

# TB175W

Hydraulic Excavator

BOOK No. **CW3E001**

## WORKSHOP MANUAL

Serial No. 17540001~

**TAKEUCHI**

## FOREWORD

This manual is intended for persons who engage in maintenance operations, and explains procedures for disassembly and reassembly of the machine, check and maintenance procedures, maintenance reference values, troubleshooting and outline specifications, etc. Please use this manual as a reference in service activities to improve maintenance techniques.

Further, please be advised that items contained in this manual are subject to change without notice due to design modifications, etc.

### MACHINE FRONT AND REAR, LEFT AND RIGHT

The side on which the blade is mounted is referred to as the rear. The left and right sides of the operator when seated in the operator's seat are the left and right sides of the machine.

### MACHINE SERIAL NUMBER

The machine serial number is stamped on the identification plate. When sending reports and inquiries, and when ordering parts, etc., be sure to include this number.

### MANUAL CONTROL

Information on those to whom this manual is distributed is recorded in the ledger in the section in charge at this company, so please decide on a person to be in charge of it and control it. When there are updates or additions, etc., we will notify the person in charge.

## SYMBOLS

 means "Please refer to the section quoted."

 Indicates the tightening torque at the specific section that requires special attention in designing.

 Indicates the mass of a part or device.



**I . GENERAL**  
**II . SPECIFICATIONS**  
**III. MACHINE CONFIGURATION**  
**IV. HYDRAULIC UNITS**  
**V . TROUBLESHOOTING**  
**VI. ENGINE**



# **I . GENERAL**

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## SAFETY PRECAUTIONS



### SAFETY ALERT SYMBOL

This symbol means Attention! Be Alert! Your Safety Is Involved.

The message that follows the symbol contains important information about safety.

Read and understand the message to avoid personal injury or death.

### ■ SIGNAL WORDS

Safety messages appearing in this manual and on machine decals are identified by the words “DANGER”, “WARNING” and “CAUTION”. These signal words mean the following:

|  <b>DANGER</b>                             |
|-----------------------------------------------------------------------------------------------------------------------------|
| The word “DANGER” indicates an imminently hazardous situation which, if not avoided, can result in serious injury or death. |

|  <b>WARNING</b>                               |
|--------------------------------------------------------------------------------------------------------------------------------|
| The word “WARNING” indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death. |

|  <b>CAUTION</b>                            |
|-------------------------------------------------------------------------------------------------------------------------------|
| The word “CAUTION” indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. |

**IMPORTANT:** The word “IMPORTANT” is used to alert against operators and maintenance personnel about situations which can result in possible damage to the machine and its components.

This manual is intended for trained and qualified personnel only. Warnings or cautions described in this manual do not necessarily cover all safety measures. For maintenance work, each person must take adequate safety precautions against possible hazards present in the respective working environment.

### Observe all safety rules

- Operation, inspection and maintenance of this machine must be performed only by a trained and qualified person.
- All rules, regulations, precautions and safety procedures must be understood and followed when performing operation, inspection and maintenance of this machine.
- Do not perform any operation, inspection and maintenance of this machine when under the adverse influence of alcohol, drugs, medication, fatigue, or insufficient sleep.



E3A040

### Wear appropriate clothing and personal protective equipment

- Do not wear loose clothing or any accessory that can catch on controls or in moving parts.
- Do not wear oily or fuel stained clothing that can catch fire.

- Wear a hard hat, safety shoes, safety glasses, filter mask, heavy gloves, ear protection and other protective equipment as required by job conditions. Wear required appropriate equipment such as safety glasses and filter mask when using grinders, hammers or compressed air, as metal fragments or other objects can fly and cause serious personal injury.
- Use hearing protection when operating the machine. Loud prolonged noise can cause hearing impairments, even the total loss of hearing.

### Provide a fire extinguisher and first aid kit



E3A080

- Know where a fire extinguisher and first aid kit are located and understand how to use them.
- Know how to contact emergency assistance and first aid help.

### Attach a “DO NOT OPERATE” tag

Severe injury could result if an unauthorized person should start the engine or touch controls during inspection or maintenance.

- Stop the engine and remove the key before performing maintenance.
- Attach a “DO NOT OPERATE” tag to the starter switch or control lever.

### Use the correct tools



E3A530

Do not use damaged or weakened tools or tools designed for other purposes. Use tools suited for the operation at hand.

### Replace important safety parts periodically

- Replace fuel hoses periodically. Fuel hoses become weaker over time, even if they appear to be in good shape.
- Replace important safety parts whenever an irregularity is found, even if it is before the normal time for replacement.

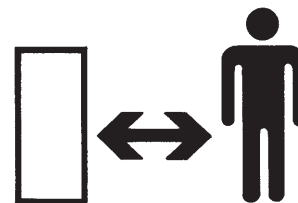
### Anti-explosive lighting



E3A550

Use anti-explosive electrical fixtures and lights when inspecting fuel, oil, coolant, battery fluid, etc. If lighting that is not anti-explosive should break, the substance could ignite, resulting in serious injury or death.

### Do not allow unauthorized personnel in the work area



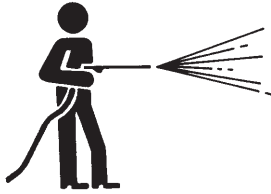
E3A140

Do not allow unauthorized personnel in the work area. Chips or other debris can fly off machine parts when grinding, welding or using a hammer.

### Prepare the work area

- Select a firm, level work area. Make sure there is adequate light and, if indoors, ventilation.
- Clear obstacles and dangerous objects. Eliminate slippery areas.

### Always clean the machine



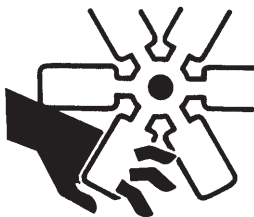
E3A580

- Clean the machine before performing maintenance.
- Cover electrical parts when washing the machine. Water on electrical parts could cause short-circuits or malfunctions.  
Do not use water or steam to wash the battery, sensors, connectors or the operator's seat area.

### Stop the engine before performing maintenance

- Avoid lubrication or mechanical adjustments with the machine in motion or with the engine running while stationary.
- If maintenance must be performed with the engine running, always work as a 2-person team with one person sitting in the operator's seat while the other works on the machine.
- When performing maintenance, be sure to keep your body and clothing away from moving parts.

### Stay clear of moving parts



E3A630

- Stay clear of all rotating and moving parts. Wrapping or entanglement may result in serious injury or death.
- Keep hands, clothing and tools away from the rotating fan and running fan belts.

### Securely block the machine or any component that may fall



E3A570

- Before performing maintenance or repairs under the machine, set all working equipment against the ground or in the lowermost position.
- Securely block the tracks.
- If you must work beneath the raised machine or equipment, always use wood blocks, jack-stands or other rigid and stable supports. Never get under the machine or working equipment if they are not sufficiently supported. This procedure is especially important when working on hydraulic cylinders.

### Securely block the working equipment

To prevent unexpected movement, securely block the working equipment when repairing or replacing the cutting edges or bucket teeth.

### Secure the engine hood or cover when opened

Be sure to secure the engine hood or cover when opening it. Do not open the engine hood or cover on slopes or in strong wind.

### Place heavy objects in a stable position



E3A560

When removing or installing the hoe attachment, place it in a stable position so that it does not tip over.

### Cautions on working on the machine



L3A005

- When performing maintenance on the machine, clean up the foot area and strictly observe the following so as not to fall:
  - Do not spill oil or grease.
  - Do not leave tools laying around.
  - When walking, watch your step.
- Never jump off the machine. Use the steps and handrails when climbing on and off the machine, and always support your body at three points with your hands and feet.
- Use protective equipment as required by job conditions.

### Use caution when fueling



E3A100

- Do not smoke or permit open flames while fueling or near fueling operations.
- Never remove the fuel cap or refuel with the engine running or hot. Never allow fuel to spill on hot machine components.
- Maintain control of the fuel filler nozzle when filling the tank.
- Do not fill the fuel tank to capacity. Allow room for expansion.
- Clean up spilled fuel immediately.
- Tighten the fuel tank cap securely. Should the fuel cap be lost, replace it only with the original manufacturer's approved cap. Use of a non-approved cap without proper venting may result in pressurization of the tank.
- Never use fuel for cleaning purposes.
- Use the correct fuel grade for the operating season.

### Handling of hoses

Fuel, oil or hydraulic fluid leaks can cause a fire.

- Do not twist, bend or hit the hoses.
- Never use twisted, bent or cracked hoses, tubes and pipes. They may burst.
- Retighten loose connections.

### Be careful with hot and pressurized components



E3A110

Stop the engine and allow the machine to cool down before performing inspection and maintenance.

- The engine, muffler, radiator, hydraulic lines, sliding parts and many other parts of the machine are hot directly after the engine is stopped. Touching these parts will cause burns.
- The engine coolant, oil and hydraulic fluid are also hot and under high pressure. Be careful when loosening caps and plugs. Working on the machine under these conditions could result in burns or injuries due to the hot oil spurt-ing out.

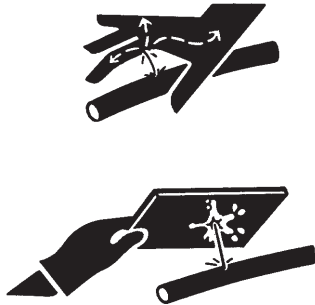
### Be careful with hot cooling systems



E3A540

Do not remove the radiator cap or drain plugs when the coolant is hot. Stop the engine, let the engine and radiator cool and loosen the radiator cap or drain plugs slowly.



**Be careful with fluids under pressure**

E3A600

Pressure can be maintained in the hydraulic circuit long after the engine has been shut down.

- Release all pressure before working on the hydraulic system.
- Hydraulic fluid under pressure can penetrate the skin or eyes and cause injury, blindness or death. Fluid escaping from a small hole can be almost invisible. Wear a safety goggles and heavy gloves and use a piece of cardboard or wood to search for suspected leaks.

If fluid is injected into the skin, it must be removed within a few hours by a doctor familiar with this type of injury.

**Release all pressure before working on the hydraulic system**

Oil may spurt out if caps or filters are removed or pipes disconnected before releasing the pressure in the hydraulic system.

- Gradually loosen the vent plug to relieve tank pressure.
- Move all the control levers and pedals several times in all directions to release the pressure from the working equipment circuitry. (For link type controls)
- When removing plugs or screws or disconnecting hoses, stand to the side and loosen slowly to gradually release the internal pressure before removing.

**Handling of the Accumulator**

N0A005

High pressure nitrogen gas is enclosed in the accumulator and incorrect handling could possibly bring about serious injury due to explosion. The following matters should be strictly observed:

- Do not disassemble.
- Do not bring close to fire or throw into a fire.
- Do not make hole, weld, or fuse.
- Do not subject to shock such as hitting or rolling.
- At time of disposal, it will be necessary to release the enclosed gas. Please contact a Takeuchi sales or service agent.

**Be careful with grease under pressure**

E3A620

The track adjuster contains highly pressurized grease. If the tension is adjusted without following the prescribed procedure, the grease discharge valve may fly off, resulting in injury.

- Loosen the grease discharge valve slowly. Do not unfasten it more than one full turn.
- Do not put your face, arms, legs or body in front of the grease discharge valve.

**Disconnect the battery**

E3A590

Disconnect the battery before working on the electrical system or doing any welding. Remove the negative (–) battery cable first. When reconnecting the battery, connect the negative (–) battery cable last.

### Avoid battery hazards

- Batteries contain sulfuric acid which will damage eyes or skin on contact.
  - If acid contacts eyes, flush immediately with clean water and get prompt medical attention.
  - If acid is accidentally swallowed, drink large quantities of water or milk and call a physician immediately.
  - If acid contacts skin or clothing, wash off immediately with clean water.
- Wear safety glasses and gloves when working with batteries.
- Batteries generate flammable and explosive gases. Keep arcs, sparks, flames and lighted tobacco away.
- Use a flashlight to check battery electrolyte level.
- Stop the engine and shut off electrical equipment while inspecting or handling the battery.
- Do not short circuit the battery posts with metal items.
- Always unfasten the negative (–) battery cable first when disconnecting the battery cable. Always connect the negative (–) battery cable last when fastening the battery cable.
- Loose battery terminals may result in sparks. Be sure to fasten terminals tightly.
- Make sure the vent caps are tightened securely.
- Do not charge a battery or jump-start the engine if the battery is frozen. Warm to 15°C (60°F) or the battery may explode.

### Have a Takeuchi service agent repair welding cracks or other damage

Ask a Takeuchi service agent to repair any welding problems which are detected. If not feasible, make sure the welding is done by a qualified person in a properly equipped workplace.

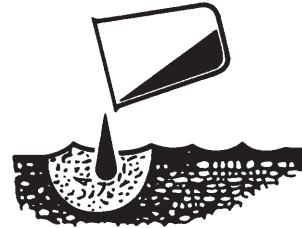
### Safety signs

- Keep all safety signs clean and legible.
- Replace all missing, illegible or damaged safety and warning signs.

### Checks after maintenance

- Gradually raise the engine speed from a low idle to maximum speed and check that no oil or air is leaking from serviced parts.
- Move the controls and check that the machine is operating properly.

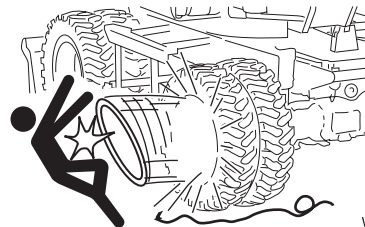
### Disposing of wastes



E3A640

- Funnel spent fluids from the machine into containers. Disposing of fluids improperly destroys the environment.
- Follow the prescribed regulations when disposing of oil, fuel, engine coolant, refrigerant, solvents, filters, batteries or other harmful substances.

### Tire Maintenance



W2A001

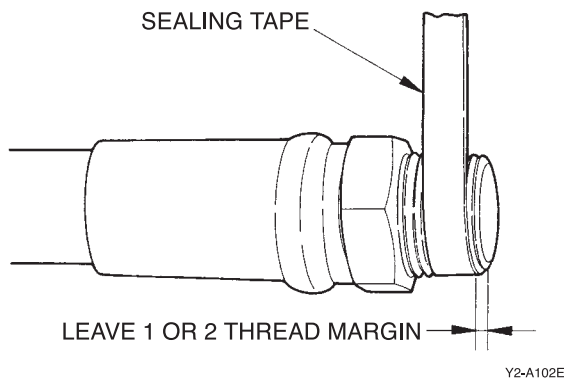
- Explosive separation of a tire and/or rim parts can cause serious injury or death. Always follow the service outlet or see your tire supplier.
- Special tools and procedures are required to change tires. To do it safely, it must be done correctly. Changing tires is a job better done by your tire service company.
- Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure.
- Inspect tires and wheels daily. Do not operate with low pressure, cuts, bubbles, damaged rims.
- A rise in tire pressure during operation is normal, and should NOT be reduced.



- When adding air to a tire, do so from a distance. Use a long hose with self-attaching chuck. Always stand behind tread when adjusting tire pressure.
- Do not inflate tires with flammable gases or from systems utilizing an alcohol injector.
- Never cut or weld on a wheel with an inflated tire mounted on it. This could cause explosive decompression.
- Tires are to be repaired only by an authorized person using the proper procedures and safety equipment. New or replacement tires and wheels should always be checked for proper size before mounting.
- Always use a safety cage or cable restraints when reinflating a repaired tire.

## CAUTIONS DURING DISASSEMBLY AND ASSEMBLY

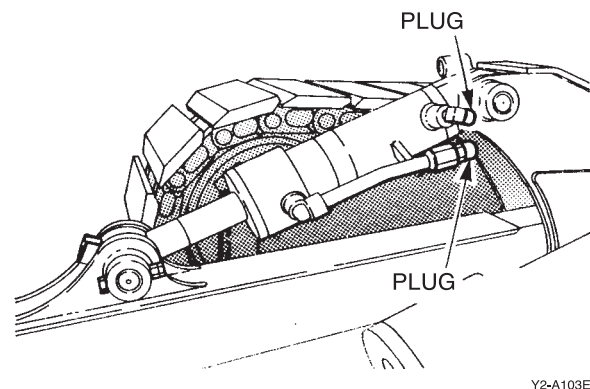
1. Clean the machine before disassembly operation.
2. Before disassembly, check the machine conditions and record them.
  - Model, Machine Serial Number, Hourmeter
  - Reason for Repairs, Repair History
  - Dirtiness of Filters
  - Fuel and Oil Conditions
  - Damage to each parts, etc.
3. To make reassembly operations easy, make matching marks at the necessary points.
4. Clean all disassembled parts and new parts, then arrange them in the proper sequence.
5. Be sure to replace all seals and cotter pins, etc., with new parts.
6. Keep parts which should not come in contact with oil and water separate from parts with oil on them.
  - Electrical Parts, Rubber, V-Belts, etc.
7. When installing bearings, bushings and oil seals, as a rule, use a press. When a hammer, etc., is used, it leaves bruises.
8. Wipe all joining surfaces clean so that there is no dirt or dust adhering to them.
9. Wrap seal tape from the front end, Wrapping it tight and leaving 1 or 2 threads bare, Overlap the tape by about 10 mm.



10. When fitting the snap rings, the bigger, rounder side of their circumferences should face the mating surfaces.

## CAUTIONS DURING REMOVAL AND INSTALLATION OF THE HYDRAULIC UNITS

1. Make sure that the temperature of the hydraulic oil has dropped.
2. To prevent a loss of flow of the hydraulic oil, the residual pressure in the piping and the internal pressure in the hydraulic tank should be released.
3. Be sure to install caps or plugs on all openings in the hydraulic unit to prevent dirt from getting into the unit through the openings.

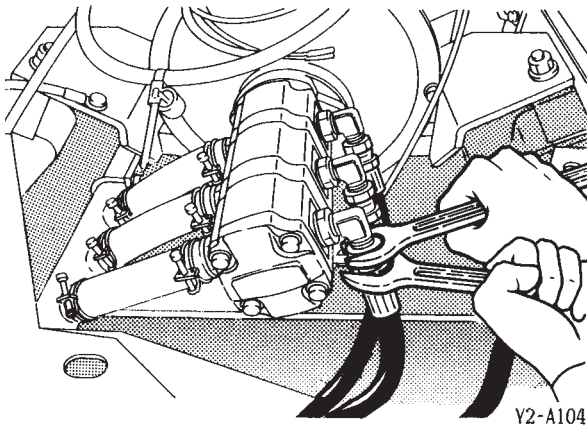


4. It is easy to mistake hydraulic oil adhering to the hydraulic unit for an oil leak, so wipe the unit off thoroughly.
5. Be sure that no damage is done to the plating on the rod in the hydraulic cylinder.
6. As a rule, removal and installation of the hydraulic cylinder should be done with the rod fully retracted.
7. Be sure to bleed the air after replacing the hydraulic oil or removing any of the hydraulic devices.

☞ “III. Machine Configuration, Hydraulic System”

## CAUTIONS DURING REMOVAL AND INSTALLATION OF PIPING

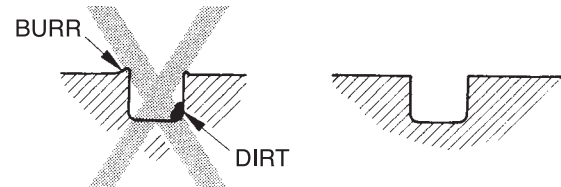
1. When hydraulic hoses are installed, tighten them once to the prescribed torque, then loosen them slightly and retighten them to the prescribed torque.
  - Tighten the fittings after the installation surfaces fit snugly together.
  - Pieces wrapped with seal tape are excluded.
2. Use 2 spanners, each on an opposite side, to remove and tighten fittings so that the hoses or steel pipes are not twisted.



3. After installation of hydraulic hoses or steel pipes, apply the maximum working pressure 5 or 6 times and confirm that there is no leakage.

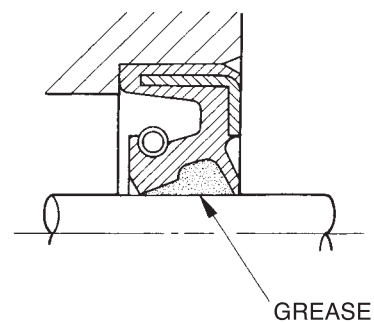
## HANDLING OF SEALS

1. Clean the grooves for O-rings and if there is any burr, etc., remove it.



Y2-A105E

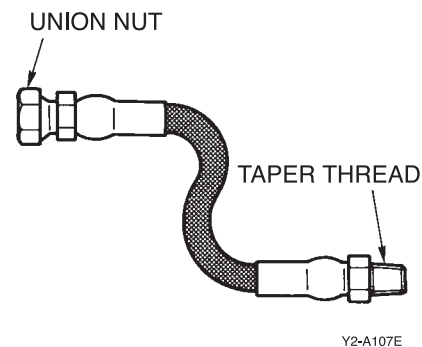
2. Be careful not to twist O-rings. If an O-ring is twisted, remove the twist with the fingertips.
3. During insertion, be careful not to damage the seal.
4. Handling of Floating Seals
  - Wipe all oil off the O-ring and housing of the floating seal.
  - When assembling, apply a thin coating of gear oil to the contact surface of the housing.
  - After assembly, turn the seal 2 or 3 times to get it to fit snugly.
5. Apply grease to the lip of the oil seal.
  - This is to prevent wear when it is first started up after assembly.



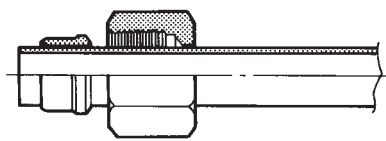
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**TIGHTENING TORQUES****Hydraulic Hoses**

| Hose Fitting Size | Torque              |                     |                  |                  |
|-------------------|---------------------|---------------------|------------------|------------------|
|                   | Union Nut (G)       |                     | Taper Thread (R) |                  |
|                   | N·m                 | ft-lb               | N·m              | ft-lb            |
| 1/8               | 9.8 $^{+4.9}_{0}$   | 7.3 $^{+3.5}_{0}$   | 11.8 $\pm 1.2$   | 8.7 $\pm 0.8$    |
| 1/4               | 24.5 $^{+4.9}_{0}$  | 18.1 $^{+3.5}_{0}$  | 29.4 $\pm 2.9$   | 21.7 $\pm 2.1$   |
| 3/8               | 49 $^{+4.9}_{0}$    | 36.2 $^{+3.5}_{0}$  | 53.9 $\pm 5.4$   | 39.8 $\pm 3.9$   |
| 1/2               | 58.8 $^{+4.9}_{0}$  | 43.4 $^{+3.5}_{0}$  | 88.3 $\pm 8.8$   | 65.1 $\pm 6.4$   |
| 3/4               | 117.7 $^{+4.9}_{0}$ | 86.8 $^{+3.5}_{0}$  | 147.1 $\pm 14.7$ | 108.5 $\pm 10.7$ |
| 1                 | 137.3 $^{+4.9}_{0}$ | 101.3 $^{+3.5}_{0}$ | 196.1 $\pm 19.6$ | 144.7 $\pm 14.3$ |

**Bite Type Pipe Fitting for Steel Pipe**

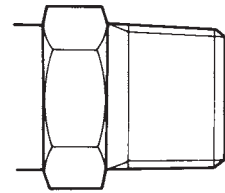
| Pipe Outer Diameter<br>(mm) | Torque           |                  |
|-----------------------------|------------------|------------------|
|                             | N·m              | ft-lb            |
| 8                           | 34.3 $\pm 4.9$   | 25.3 $\pm 3.5$   |
| 10                          | 41.7 $\pm 2.5$   | 30.7 $\pm 1.7$   |
| 12                          | 58.8 $\pm 4.9$   | 43.4 $\pm 3.5$   |
| 15                          | 88.3 $\pm 4.9$   | 65.1 $\pm 3.5$   |
| 16                          | 93.2 $\pm 4.9$   | 68.7 $\pm 3.5$   |
| 18                          | 132.4 $\pm 4.9$  | 97.6 $\pm 3.5$   |
| 22                          | 205.9 $\pm 9.8$  | 151.8 $\pm 7.2$  |
| 27.2                        | 245.2 $\pm 9.8$  | 181.0 $\pm 7.2$  |
| 28                          | 313.8 $\pm 19.6$ | 231.4 $\pm 14.3$ |
| 32                          | 313.8 $\pm 19.6$ | 231.4 $\pm 14.3$ |
| 35                          | 411.9 $\pm 19.6$ | 303.7 $\pm 14.3$ |



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### Joints for Piping

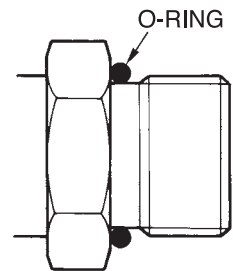
| Nominal Thread<br>Diameter<br>(R) | Torque      |             |             |             |
|-----------------------------------|-------------|-------------|-------------|-------------|
|                                   | Steel       |             | Cast Steel  |             |
|                                   | N·m         | ft-lb       | N·m         | ft-lb       |
| 1/8                               | 11.8 ±1.2   | 8.7 ±0.8    | 10.8 ±1.1   | 8.0 ±0.7    |
| 1/4                               | 29.4 ±2.9   | 21.7 ±2.1   | 24.5 ±2.5   | 18.1 ±1.7   |
| 3/8                               | 53.9 ±5.4   | 39.8 ±3.9   | 49 ±4.9     | 36.2 ±3.5   |
| 1/2                               | 88.3 ±8.8   | 65.1 ±6.4   | 73.5 ±7.4   | 54.3 ±5.3   |
| 3/4                               | 147.1 ±14.7 | 108.5 ±10.7 | 127.5 ±12.7 | 94.1 ±9.3   |
| 1                                 | 196.1 ±19.2 | 144.7 ±14.3 | 171.6 ±17.2 | 126.6 ±12.5 |



Y2-A109

### Joints for Piping (O-ring Seal Type)

| Nominal Thread<br>Diameter<br>(G) | Torque     |            |
|-----------------------------------|------------|------------|
|                                   | N·m        | ft-lb      |
| 1/8                               | 19.6 ±2.0  | 14.5 ±1.4  |
| 1/4                               | 34.3 ±4.9  | 25.3 ±3.5  |
| 3/8                               | 53.9 ±4.9  | 39.8 ±3.5  |
| 1/2                               | 63.7 ±4.9  | 47.0 ±3.5  |
| 3/4                               | 93.2 ±4.9  | 68.7 ±3.5  |
| 1                                 | 107.9 ±9.8 | 79.5 ±7.2  |
| 1-1/4                             | 117.7 ±9.8 | 86.8 ±7.2  |
| 1-1/2                             | 137.3 ±9.8 | 101.2 ±7.2 |



Y2-A110

| Nominal Thread<br>Diameter<br>(UNF) | Torque     |            |
|-------------------------------------|------------|------------|
|                                     | N·m        | ft-lb      |
| 7/16-20                             | 16.7 ±2.0  | 12.3 ±1.4  |
| 1/2-20                              | 22.6 ±2.0  | 16.6 ±1.4  |
| 9/16-18                             | 31.4 ±2.9  | 23.1 ±2.1  |
| 3/4-16                              | 59.8 ±4.9  | 44.1 ±3.5  |
| 1-1/16-12                           | 102.0 ±5.9 | 75.2 ±4.4  |
| 1-5/16-12                           | 135.3 ±7.8 | 99.8 ±5.8  |
| 1-5/8-12                            | 181.4 ±9.8 | 133.8 ±7.2 |

**Bolts and Nuts (for ISO Strength Category 10.9)**

| Thread | Size × Pitch | Torque                    |            |             |                           |            |             |
|--------|--------------|---------------------------|------------|-------------|---------------------------|------------|-------------|
|        |              | General Tightening Points |            |             | Special Tightening Points |            |             |
|        |              | N·m                       | kgf·m      | ft-lb       | N·m                       | kgf·m      | ft-lb       |
| Coarse | M 6 × 1.0    | 9.8 ±0.5                  | 1.0 ±0.05  | 7.2 ±0.4    | 11.8 ±0.6                 | 1.2 ±0.06  | 8.7 ±0.4    |
|        | M 8 × 1.25   | 22.6 ±1.1                 | 2.3 ±0.11  | 16.6 ±0.8   | 26.5 ±1.3                 | 2.7 ±0.13  | 19.5 ±0.9   |
|        | M10 × 1.5    | 47.1 ±2.4                 | 4.8 ±0.24  | 34.7 ±1.7   | 54.9 ±2.7                 | 5.6 ±0.28  | 40.5 ±2.0   |
|        | M12 × 1.75   | 83.4 ±4.1                 | 8.5 ±0.42  | 61.5 ±3.0   | 97.1 ±4.8                 | 9.9 ±0.49  | 71.6 ±3.5   |
|        | M14 × 2.0    | 134.4 ±6.7                | 13.7 ±0.68 | 99.1 ±4.9   | 155.9 ±7.7                | 15.9 ±0.79 | 115.0 ±5.7  |
|        | M16 × 2.0    | 207.9 ±10.4               | 21.2 ±1.06 | 153.3 ±7.7  | 241.2 ±12.1               | 24.6 ±1.23 | 177.9 ±8.9  |
|        | M20 × 2.5    | 410.9 ±20.5               | 41.9 ±2.09 | 303.1 ±15.1 | 475.6 ±23.7               | 48.5 ±2.42 | 350.8 ±17.5 |
| Fine   | M 8 × 1.0    | 24.5 ±1.2                 | 2.5 ±0.12  | 18.1 ±0.9   | 28.4 ±1.4                 | 2.9 ±0.14  | 21.0 ±1.0   |
|        | M10 × 1.25   | 50.0 ±2.5                 | 5.1 ±0.25  | 36.9 ±1.8   | 58.8 ±2.9                 | 6.0 ±0.30  | 43.4 ±2.2   |
|        | M12 × 1.5    | 87.3 ±4.3                 | 8.9 ±0.44  | 64.4 ±3.2   | 102.0 ±5.1                | 10.4 ±0.52 | 75.2 ±3.8   |
|        | M14 × 1.5    | 135.3 ±6.8                | 13.8 ±0.69 | 99.9 ±5.0   | 157.9 ±7.8                | 16.1 ±0.80 | 116.5 ±5.8  |
|        | M16 × 1.5    | 220.6 ±11.0               | 22.5 ±1.12 | 162.7 ±8.1  | 256.0 ±12.7               | 26.1 ±1.30 | 188.8 ±9.4  |
|        | M20 × 1.5    | 452.1 ±22.6               | 46.1 ±2.30 | 333.4 ±16.6 | 524.7 ±26.1               | 53.5 ±2.66 | 387.0 ±19.2 |

- General Tightening Points (Non-lubricated)
  - All securing points other than the special tightening points.
- Special Tightening Points (Grease with molybdenum disulfide applied.)
  - Points where particularly necessary due to function.  
Special tightening positions and associated instructions are given in the text.
- Points where thread-locking compound is used (Three Bond #1324 is applied.)  
Thread-locking compound positions and associated instructions are given in the text.
- If tightening torque values are provided in this manual, then tightening should be done according to those values.  
(This indicates that the tightening torque differs from the values given in this table.)
- In order to tighten bolts and nuts evenly, they should be tightened alternately top, bottom, left, right.



## **II . SPECIFICATIONS**

## CONTENTS

|                                          |    |
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### In regard to Standard Values and Allowable Values

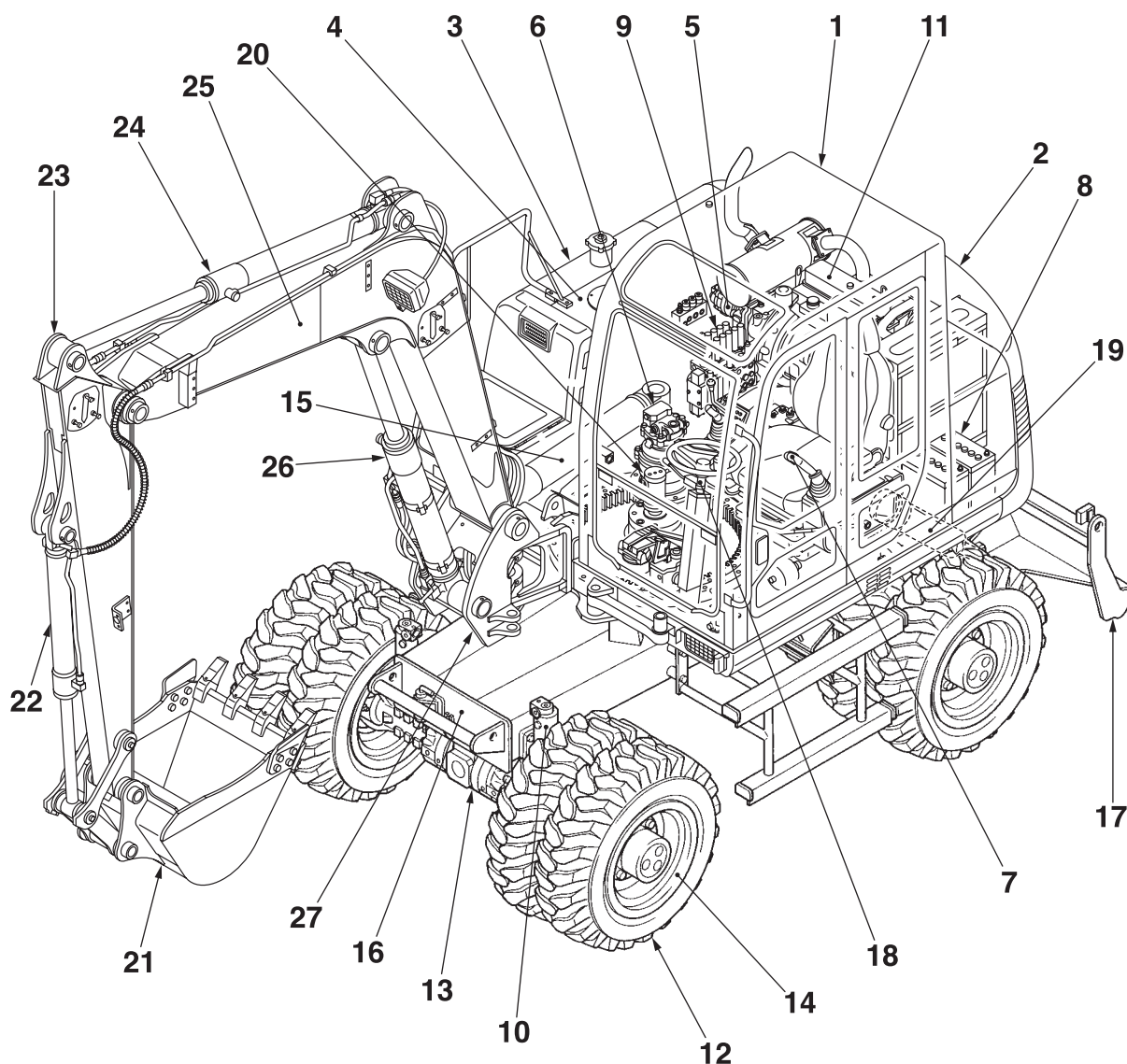
The terms used in the items “Servicing Standards” and “Standards for Judging Performance” have the following meanings.

Standard Value ..... This indicates the standard value for the new machine at the time of shipping from the factory. It should be used as the target value for maintenance work after operation.

Allowable Value ..... The dimensions of parts change during use because of wear and deformation. Also, the performance of pumps, motors, and other hydraulic equipment drops, and this is the estimated value indicating the use limit for the respective part. It is decided under reference to the standard at the time of shipping, the results of various tests, etc. As the use conditions, the degree of repairs, etc., differ for each machine, these should be combined and used as reference for servicing standards and standards for judging performance.

\* Do not use the standard values and the allowable values as standards for customer claims.

**NAMES OF COMPONENTS**



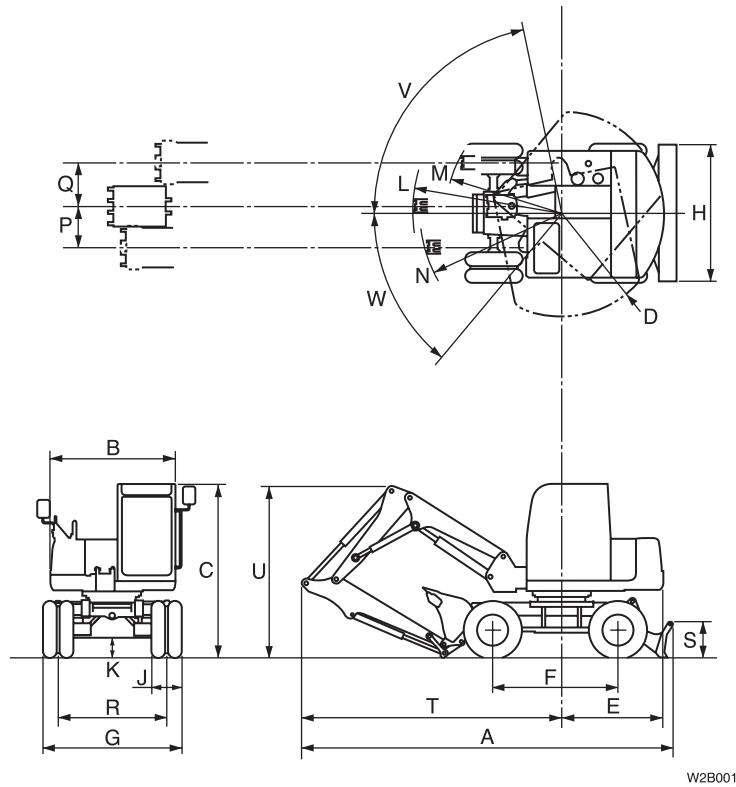
W2B000

- |                   |                        |                          |
|-------------------|------------------------|--------------------------|
| 1. Cab            | 10. Axle Lock Cylinder | 19. Dozer Blade Cylinder |
| 2. Engine Hood    | 11. Engine             | 20. Swivel Joint         |
| 3. Fuel Tank      | 12. Tire               | 21. Bucket               |
| 4. Hydraulic Tank | 13. Axle               | 22. Bucket Cylinder      |
| 5. Hydraulic Pump | 14. Hub                | 23. Arm                  |
| 6. Slew Motor     | 15. Swing Cylinder     | 24. Arm Cylinder         |
| 7. Pilot Valve    | 16. Undercarriage      | 25. Boom                 |
| 8. Battery        | 17. Dozer Blade        | 26. Boom Cylinder        |
| 9. Control Valve  | 18. Steering Wheel     | 27. Swing Bracket        |

## DIMENSIONS

## SPECIFICATIONS

### DIMENSIONS

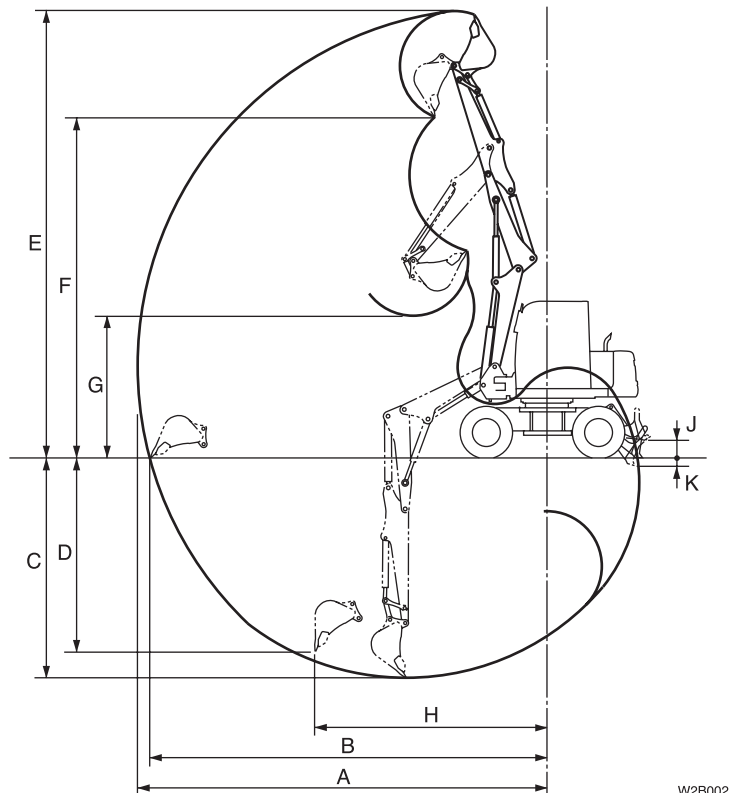


### Machine Dimensions

Unit: mm

|   | 2-Piece Boom | Mono-Boom |
|---|--------------|-----------|
| A | 6260         | 6320      |
| B | 2110         | ←         |
| C | 2925         | ←         |
| D | 1720         | ←         |
| E | 1715         | ←         |
| F | 2100         | ←         |
| G | 2330         | ←         |
| H | 2300         | ←         |
| J | 515          | ←         |
| K | 335          | ←         |
| L | 2505         | 2620      |
| M | 1955         | 2060      |
| N | 2385         | 2495      |
| P | 690          | ←         |
| Q | 730          | ←         |
| R | 1815         | ←         |
| S | 600          | ←         |
| T | 4380         | 4445      |
| U | 2895         | 2645      |
| V | 80°          | ←         |
| W | 50°          | ←         |

### 2-Piece Boom



### Operating Range

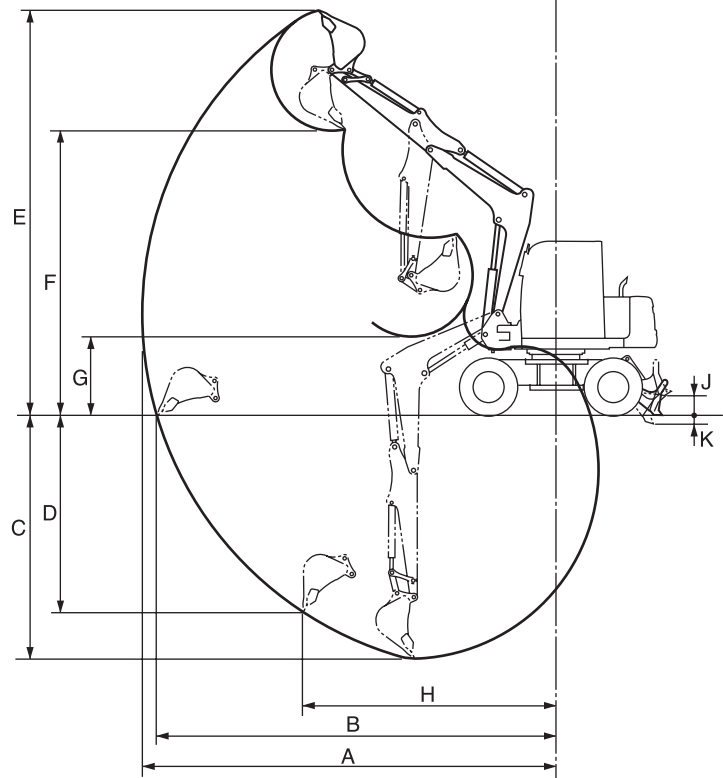
Unit: mm

|   | 2-Piece Boom |
|---|--------------|
| A | 7650         |
| B | 7430         |
| C | 4085         |
| D | 3600         |
| E | 8325         |
| F | 6355         |
| G | 2665         |
| H | 4360         |
| J | 335          |
| K | 145          |

DIMENSIONS

SPECIFICATIONS

Mono-Boom



W2B003

Operating Range

Unit: mm

|   | Mono-Boom |
|---|-----------|
| A | 6945      |
| B | 6700      |
| C | 4055      |
| D | 3220      |
| E | 6780      |
| F | 4765      |
| G | 1330      |
| H | 4270      |
| J | 335       |
| K | 145       |

# SPECIFICATIONS TABLES

# SPECIFICATIONS

## SPECIFICATIONS TABLES

## SPECIFICATIONS

| Serial Number                                              |                      | 17540095 or later |           |
|------------------------------------------------------------|----------------------|-------------------|-----------|
| Machine Type                                               |                      | 2-Pice Boom       | Mono-Boom |
| Machine Mass (not including operator)                      | kg                   | 8130              | 7905      |
| Engine Rated Output                                        | kW/min <sup>-1</sup> | 49.3/2300         | ←         |
| Bucket Capacity (Standard Bucket)                          |                      |                   |           |
| Rated Capacity                                             | m <sup>3</sup>       | 0.245             | ←         |
| Struck Capacity                                            | m <sup>3</sup>       | 0.185             | ←         |
| Performance                                                |                      |                   |           |
| Slew Speed: Slow Speed                                     | min <sup>-1</sup>    | 4.1 to 7.6        | ←         |
| Normal Speed                                               | min <sup>-1</sup>    | 10.7              | ←         |
| Travel Speed:                                              |                      |                   |           |
| Forward: Creep                                             | km/h                 | 0 to 4.5          | ←         |
| Site                                                       | km/h                 | 0 to 9.0          | ←         |
| Road                                                       | km/h                 | 0 to 20           | ←         |
| Reverse: Creep                                             | km/h                 | 0 to 4.5          | ←         |
| Site                                                       | km/h                 | 0 to 9.0          | ←         |
| Road                                                       | km/h                 | 0 to 20           | ←         |
| Gradeability                                               | % (degree)           | 70 (35)           | ←         |
| Minimum Turning Radius                                     | mm                   | 5855              | ←         |
| Minimum Turning Clearance Radius                           | mm                   | 5615              | ←         |
| Noise Level: Sound-power level                             | dB (A)               | LWA 99            | ←         |
| Sound-pressure level                                       | dB (A)               | LPA 77            | ←         |
| Auxiliary Hydraulic Flow Rate                              | 1st L/min            | 69                | ←         |
|                                                            | 2nd L/min            | 53.6              | ←         |
|                                                            | 3rd L/min            | 11.3              | ←         |
| Dimensions                                                 |                      |                   |           |
| Overall Length                                             | mm                   | 5685              | ←         |
| Overall Width                                              | mm                   | 2330              | ←         |
| Overall Height                                             | mm                   | 3990              | ←         |
| Dimensions of Base Machine                                 |                      |                   |           |
| Tail Swing Radius                                          | mm                   | 1720              | ←         |
| Distance of Rearmost Upper Structure from Axis of Rotation | mm                   | 1715              | ←         |
| Clearance Height under Upperstructure                      | mm                   | 1140              | ←         |
| Wheel Base                                                 | mm                   | 1815              | ←         |
| Rear Overhang                                              | mm                   | 765               | ←         |
| Minimum Ground Clearance                                   | mm                   | 335               | ←         |

# STANDARDS FOR JUDGING PERFORMANCE

# SPECIFICATIONS

| Serial Number                                               |        | 17540095 or later |           |
|-------------------------------------------------------------|--------|-------------------|-----------|
| Machine Type                                                |        | 2-Pice Boom       | Mono-Boom |
| Working Equipment (Hoe Attachment)                          |        |                   |           |
| Boom Swing Angle: L.H.                                      | degree | 80                | ←         |
| R.H.                                                        | degree | 50                | ←         |
| Maximum Reach                                               | mm     | 7650              | 6945      |
| Maximum Reach at GRP                                        | mm     | 7430              | 6700      |
| Minimum Level Cut Radius with Bucket Flat on GRP            | mm     | 905               | 1700      |
| Maximum Digging Depth                                       | mm     | 4085              | 4055      |
| Radius at Maximum Digging Depth                             | mm     | 2665              | 2425      |
| Vertical Digging Depth                                      | mm     | 3660              | 3220      |
| Maximum Digging Height                                      | mm     | 8325              | 6780      |
| Radius at Maximum Digging Height                            | mm     | 1335              | 3985      |
| Maximum Dumping Height                                      | mm     | 6355              | 4765      |
| Radius at Maximum Dumping Height                            | mm     | 2090              | 4345      |
| Minimum Dumping Height                                      | mm     | 2665              | 1330      |
| Minimum Front Swing Radius                                  | mm     | 2505              | 2620      |
| Minimum Front Swing Radius at Boom Offset                   | mm     | 1955              | 2060      |
| Overall Height at Minimum Front Swing Radius                | mm     | 5180              | 4975      |
| Overall Height at Minimum Front Swing Radius at Boom Offset | mm     | 5395              | 4975      |
| Maximum Bucket Offset Volume: Left                          | mm     | 690               | ←         |
| Right                                                       | mm     | 730               | ←         |
| Digging Force: Bucket                                       | kN     | 52.7              | ←         |
| Arm                                                         | kN     | 36.0              | ←         |
| Working Equipment (Dozer Blade)                             |        |                   |           |
| Dozer Blade: Width                                          | mm     | 2300              | ←         |
| Height                                                      | mm     | 600               | ←         |
| Dozer Blade: Lift Height                                    | mm     | 335               | ←         |
| Depth of Cut                                                | mm     | 145               | ←         |

SPECIFICATIONS TABLES

SPECIFICATIONS

SPECIFICATIONS OF DEVIDES

|                                     |                       |                                                                    |
|-------------------------------------|-----------------------|--------------------------------------------------------------------|
| Serial Number                       |                       | 17540095 or later                                                  |
| Engine                              |                       |                                                                    |
| Model                               |                       | Yanmar 4TNV98T-ZSTBW                                               |
| Type                                |                       | 4-cycle, vertical, water-cooled, in-line, 4-cylinder diesel engine |
| Number of Cylinders – Bore × Stroke | mm                    | 4-98 × 110                                                         |
| Total Displacement                  | mL                    | 3318                                                               |
| Compression Ratio                   |                       | 18                                                                 |
| Performance                         |                       |                                                                    |
| Maximum Torque                      | N·m/min <sup>-1</sup> | 271.3 to 295.8/1650 ±100                                           |
| Maximum No-load R.P.M.              | min <sup>-1</sup>     | 2350 ±10                                                           |
| Minimum No-load R.P.M.              | min <sup>-1</sup>     | 1100 ±10                                                           |
| Specific Fuel Consumption           | g/kW·h                | ≤249                                                               |
| Starter                             | V – kW                | 12 – 3.0                                                           |
| Generator                           | V – kW                | 12 – 0.96                                                          |
| Battery                             | V – A·h               | 12 – 90                                                            |
| Hydraulic Pump                      |                       |                                                                    |
| Model                               |                       | K3SP36C-1CFR-9002-2                                                |
| Type                                |                       | Variable displacement type double axial piston                     |
| Delivery: P1                        | L/min                 | 72.6                                                               |
| P2                                  | L/min                 | 72.6                                                               |
| Rated Pressure: P1                  | MPa                   | 27.4/31.0*                                                         |
| P2                                  | MPa                   | 27.4/31.0*                                                         |
| Hydraulic Pump (Gear)               |                       |                                                                    |
| Model                               |                       | SDYA259.5F1H1-R473                                                 |
| Type                                |                       | Double gear                                                        |
| Delivery: P3                        | L/min                 | 55.7                                                               |
| P4                                  | L/min                 | 20.9                                                               |
| Rated Pressure: P3                  | MPa                   | 24.0                                                               |
| P4                                  | MPa                   | 17.5                                                               |
| Hydraulic Pump (Gear)               |                       |                                                                    |
| Model                               |                       | GPW1-C-4A                                                          |
| Type                                |                       | Gear                                                               |
| Delivery: P5                        | L/min                 | 10.8                                                               |
| Rated Pressure: P5                  | MPa                   | 3.4                                                                |
| Control Valve (Mono-Block)          |                       |                                                                    |
| Model                               |                       | KVMM-80-TB                                                         |
| Number of Circuits                  |                       | Mono-Block                                                         |
| Main Relief Valve Pressure Setting  | MPa                   | 27.4/31.0*                                                         |
| Port Relief Valve Pressure Setting  | MPa                   | 33.3                                                               |
|                                     | MPa                   | 20.6                                                               |

\*: In Case of raise



# SPECIFICATIONS TABLES

# SPECIFICATIONS

|                                    |              |        |  |                    |
|------------------------------------|--------------|--------|--|--------------------|
| Control Valve (4-Section)          |              |        |  |                    |
| Model                              |              |        |  | KVSE31-4           |
| Number of Circuits                 |              |        |  | 4                  |
| Main Relief Valve Pressure Setting | MPa          |        |  | 24.0               |
| Port Relief Valve Pressure Setting | MPa          |        |  | 26.9               |
|                                    | MPa          |        |  | 20.6               |
| Solenoid Valve                     |              |        |  |                    |
| Model                              |              |        |  | 16521-00010        |
| Number of Solenoids                |              |        |  | 4                  |
| Solenoid Rated Voltage             | V            |        |  | 12                 |
| Relief Valve Set Pressure          | MPa          |        |  | 3.4                |
| Solenoid Valve                     |              |        |  |                    |
| Model                              |              |        |  | 16545-00000        |
| Number of Solenoids                |              |        |  | 3                  |
| Solenoid Rated Voltage             | V            |        |  | 12                 |
| Solenoid Valve (2-Piece Boom)      |              |        |  |                    |
| Model                              |              |        |  | 16522-00000        |
| Number of Solenoids                |              |        |  | 4                  |
| Solenoid Rated Voltage             | V            |        |  | 12                 |
| Proportional Control Solenoid      |              |        |  |                    |
| Model                              |              |        |  | 2KWE5A-30/G12R-269 |
| Number of Solenoids                |              |        |  | 2                  |
| Solenoid Rated Voltage             |              |        |  | 12                 |
| Pilot Valve                        |              |        |  |                    |
| Model                              |              |        |  | PV48M2             |
| Secondary Side Pressure            | (Ports 1, 3) | MPa    |  | 0.54 to 2.06       |
|                                    | (Ports 2, 4) | MPa    |  | 0.64 to 1.86       |
| Operating Angle: Single            | (Ports 1, 3) | degree |  | 19                 |
| Single                             | (Ports 2, 4) | degree |  | 25                 |
| Pilot Valve (Swing)                |              |        |  |                    |
| Model                              |              |        |  | PV6P1013A          |
| Secondary Side Pressure            |              | MPa    |  | 0.49 to 2.06       |

# SPECIFICATIONS TABLES

# SPECIFICATIONS

|                                |                      |  |              |
|--------------------------------|----------------------|--|--------------|
| Boom Cylinder                  |                      |  |              |
| Bore Diameter × Rod Diameter   | mm                   |  | 120 × 75     |
| Stroke                         | mm                   |  | 725          |
| Fully Retracted Length (Pitch) | mm                   |  | 1207         |
| Cushion Mechanism              |                      |  | Rod Side     |
| Arm Cylinder                   |                      |  |              |
| Bore Diameter × Rod Diameter   | mm                   |  | 100 × 65     |
| Stroke                         | mm                   |  | 875          |
| Fully Retracted Length (Pitch) | mm                   |  | 1327         |
| Cushion Mechanism              |                      |  | Both Ends    |
| Bucket Cylinder                |                      |  |              |
| Bore Diameter × Rod Diameter   | mm                   |  | 85 × 55      |
| Stroke                         | mm                   |  | 660          |
| Fully Retracted Length (Pitch) | mm                   |  | 1035         |
| Cushion Mechanism              |                      |  | —            |
| Boom Adjustment Cylinder       |                      |  |              |
| Bore Diameter × Rod Diameter   | mm                   |  | 90 × 55      |
| Stroke                         | mm                   |  | 580          |
| Fully Retracted Length (Pitch) | mm                   |  | 955          |
| Cushion Mechanism              |                      |  | —            |
| Slew Motor                     |                      |  |              |
| Model                          |                      |  | MSG-44P-21   |
| Type                           |                      |  | Piston Motor |
| Total Displacement             | cm <sup>3</sup> /rev |  | 702.4        |
| Motor Displacement             | cm <sup>3</sup> /rev |  | 34.1         |
| Reduction Gear Ratio           |                      |  | 1/20.615     |
| Relief Valve Pressure Setting  | MPa                  |  | 23.5         |
| Parking Brake Torque           | N·m                  |  | 177.9        |
| Parking Brake Release Pressure | MPa                  |  | 1.5          |
| Travel Motor                   |                      |  |              |
| Model                          |                      |  | A6VM80HA1TA  |
| Motor Displacement: Low        | cm <sup>3</sup> /rev |  | 80           |
| Hi                             | cm <sup>3</sup> /rev |  | 27.2         |
| Front Axle                     |                      |  |              |
| Type                           |                      |  | 212          |
| Rear Axle                      |                      |  |              |
| Type                           |                      |  | 112          |
| Drop Box Type                  |                      |  | 357          |
| Reduction Gear Ratio: Low      |                      |  | 1:3.28       |
| Hi                             |                      |  | 1:1.43       |
| Reduction Gear                 |                      |  | —            |
| Differential                   |                      |  | 11.35        |
| Hub                            |                      |  | 1:6.00       |

## SPECIFICATIONS TABLES

## SPECIFICATIONS

|                    |                                                                            |
|--------------------|----------------------------------------------------------------------------|
| Tire               |                                                                            |
| Front Tire: Qty.   | 4                                                                          |
| Size               | 8.25-20-12PR                                                               |
| Tire Pressure      | 600                                                                        |
|                    | kpa                                                                        |
| Steering System    |                                                                            |
| Type               | Front Setting System                                                       |
| Operation Type     | Hydraulically-Operated                                                     |
| Breake Device      |                                                                            |
| Travel Brake Type  | Front and rear wheel braking, direct acting hydraulic disk with brake lock |
| Parking Brake Type | Rear wheel braking disk                                                    |
| Outrigger (Option) |                                                                            |
| Type               | Hinge                                                                      |

## RECOMMENDED LUBRICANTS

## SPECIFICATIONS

## RECOMMENDED LUBRICANTS

Select the appropriate fuel, lubricant and grease according to the temperature by referring to the table below.

- Regardless of the specified time, change the oil if it becomes too dirty or degraded.
- When refilling, never mix oils of different brands. If a brand is to be changed, replace the whole fuel/oil.

| Part                   | Type                                 | Type by air temperature                                              |                                                                               |   |    |    |    |      | When to change/<br>replenish               | Capacity                                                |
|------------------------|--------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|---|----|----|----|------|--------------------------------------------|---------------------------------------------------------|
|                        |                                      | -20                                                                  | -10                                                                           | 0 | 10 | 20 | 30 | 40°C |                                            |                                                         |
| Engine oil pan         | Diesel engine oil<br>API: CF class   | <div><div>SAE 10W-30</div><div>SAE 15W-40</div></div>                |                                                                               |   |    |    |    |      | Every 250 hrs<br>after the first 50<br>hrs | Upper limit 10.2 L<br>Lower limit 5.7 L                 |
| Hydraulic oil<br>tank  | Takeuchi genuine<br>hydraulic oil 46 | <div><div>ISO VG46</div></div>                                       |                                                                               |   |    |    |    |      | Every 4000 hrs**                           | Total amount of<br>oil: 135 L<br>Tank capacity:<br>68 L |
|                        | Anti-wear hydraulic<br>oil           | <div><div>ISO VG32</div><div>ISO VG46</div><div>ISO VG68</div></div> |                                                                               |   |    |    |    |      | Every 2000 hrs**                           |                                                         |
|                        | Engine cooling<br>system             | Cooling water<br>(water + coolant)*                                  | <div><div>Mixture of 50% coolant</div><div>Mixture of 30% coolant</div></div> |   |    |    |    |      |                                            |                                                         |
| Hub                    | Gear oil<br>API: GL-4                | SAE 90                                                               |                                                                               |   |    |    |    |      | Every 1500 hrs                             | 1.0 L                                                   |
| Transmission           | Gear oil<br>API: GL-4                | SAE 90                                                               |                                                                               |   |    |    |    |      | Every 1500 hrs                             | 1.3 L                                                   |
| Differential           | Gear oil<br>API: GL-4                | SAE 90                                                               |                                                                               |   |    |    |    |      | Every 1500 hrs                             | 8.5 L                                                   |
| Undercarriage          | Lithium grease<br>EP-2<br>NLGI No.2  | —                                                                    |                                                                               |   |    |    |    |      | Every 250 hrs                              | As required                                             |
| Slew bearing           |                                      |                                                                      |                                                                               |   |    |    |    |      | Every 50 hrs                               |                                                         |
| Working equip-<br>ment |                                      |                                                                      |                                                                               |   |    |    |    |      | Daily or every<br>10 hrs                   |                                                         |
| Levers                 |                                      |                                                                      |                                                                               |   |    |    |    |      | When required                              |                                                         |

\*: For water, use tap water (soft). Do not use well or river water.

When the ambient temperature drops below 0°C, add coolant (antifreeze). Follow the coolant manufacturer's instructions to determine the mixture ratio.

\*\* : The replacement interval for hydraulic oil depends on the oil type being used. New machines are shipped from the factory with the Takeuchi genuine hydraulic oil 46. This manual describes when to replace the hydraulic oil assuming that this Takeuchi oil 46 is used. When a conventional antiwear hydraulic oil is used, replace it every 2000 hours.

## RECOMMENDED LUBRICANTS

## SPECIFICATIONS

### Diesel fuel standards

Use the diesel fuel that is compliant with any of the standards below. The table below shows the standards from the various countries.

| Diesel fuel standards          | Region |
|--------------------------------|--------|
| No. 2-D, No. 1-D, ASTM D975-94 | USA    |
| EN590:96                       | EU     |

| Part      | Type       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Capacity |
|-----------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Fuel tank | Desel fuel | <p>To keep the performance and service life of the engine, always use the clean and high-quality fuel.</p> <ul style="list-style-type: none"> <li>• To avoid freezing in cold climates, use a light oil that still functions when the temperature is at least 12°C below the lowest expected ambient temperature.</li> <li>• Use a light oil that has a cetane number of 45 or higher. When operating at a very low temperature or at a high altitude, a higher cetane number fuel will be required.</li> <li>• The sulfur content must be less than 0.5% by volume. he recommended value, however, is less than 0.05%. The electronically-controlled engine with an EGR system should use fuel containing less than 0.05% sulfur. Fuel containing a high content of sulfur may cause sulfuric acid corrosion inside the cylinder.</li> <li>• Do not mix diesel fuel with any kerosene, used engine oil or leftover fuel.</li> <li>• Poor quality fuel can degrade the engine performance. It also can damage the engine.</li> <li>• Avoid using additives to fuel. Some fuel additives can degrade the engine performance.</li> </ul> | 120 L    |

## STANDARDS FOR JUDGING PERFORMANCE

## SPECIFICATIONS

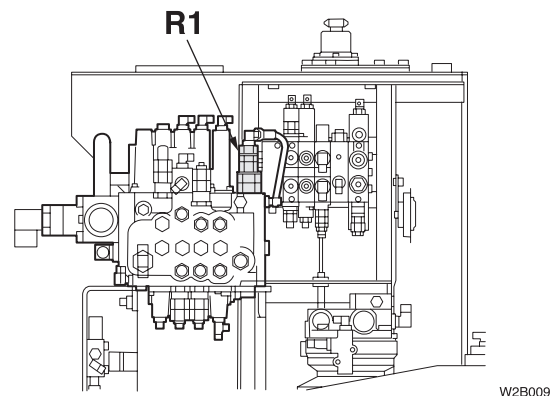
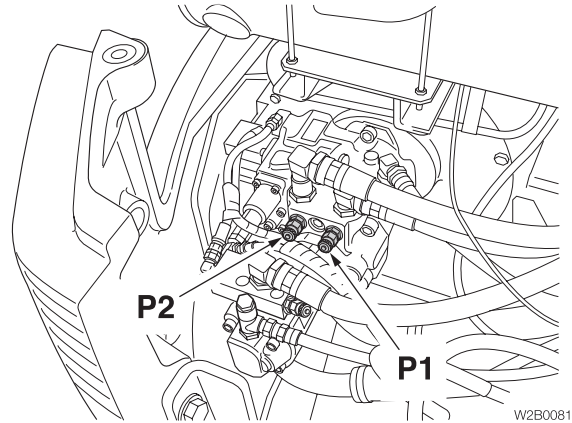
**STANDARDS FOR JUDGING PERFORMANCE**
**REFERENCE VALUE TABLE**

| Serial Number              |           | 17540095 or later |                  |                 |                  |
|----------------------------|-----------|-------------------|------------------|-----------------|------------------|
| Machine Type               |           | 2-Piece Boom      |                  | Mono-Boom       |                  |
| Item                       | Unit      | Standard Values   | Allowable Values | Standard Values | Allowable Values |
| Hydraulic Oil Pressure     |           |                   |                  |                 |                  |
| Travel                     | MPa       | 31.00             |                  | 31.00           |                  |
| Boom                       | MPa       | 27.46             |                  | 27.46           |                  |
| Arm                        | MPa       | 27.46             |                  | 27.46           |                  |
| Dozer Blade                | MPa       | 24.0              |                  | 24.0            |                  |
| Slew                       | MPa       | 23.54             |                  | 23.54           |                  |
| Pilot Pressure             | MPa       | 3.43              |                  | 3.43            |                  |
| Brake, Steering            | MPa       | 17.16             |                  | 17.16           |                  |
| Slew                       |           |                   |                  |                 |                  |
| Slew Time Normal Speed     | s         | 10.82             |                  | 10.82           |                  |
| Slow Speed                 | s         | 14.53             |                  | 14.53           |                  |
| Overrun When Slewing Stops | mm        | 498.5             |                  | 380             |                  |
| Natural Slew Drop          | mm        | 0                 |                  | 0               |                  |
| Cylinders                  |           |                   |                  |                 |                  |
| Cylinder Speed             |           |                   |                  |                 |                  |
| Boom                       | Extended  | s                 | 3.10             | 2.20            |                  |
|                            | Retracted | s                 | 3.65             | 2.65            |                  |
| Arm                        | Extended  | s                 | 3.43             | 3.43            |                  |
|                            | Retracted | s                 | 3.07             | 3.07            |                  |
| Bucket                     | Extended  | s                 | 3.36             | 3.36            |                  |
|                            | Retracted | s                 | 2.11             | 2.11            |                  |
| Dozer Blade                | Extended  | s                 | 1.91             | 1.91            |                  |
|                            | Retracted | s                 | 1.46             | 1.46            |                  |
| Swing                      | Extended  | s                 | 8.38             | 8.1             |                  |
|                            | Retracted | s                 | 8.36             | 8.24            |                  |
| Adjust                     | Extended  | s                 | 7.81             | —               |                  |
|                            | Retracted | s                 | 7.42             | —               |                  |
| Cylinders                  |           |                   |                  |                 |                  |
| Natural Cylinder Drop      |           |                   |                  |                 |                  |
| Boom                       | mm        | 3                 |                  | 2               |                  |
| Arm                        | mm        | 2                 |                  | 2               |                  |
| Bucket                     | mm        | 2                 |                  | 2               |                  |
| Dozer Blade                | mm        | 0                 |                  | 0               |                  |
| Swing                      | mm        | 5                 |                  | 5               |                  |
| Adjust                     | mm        | 6                 |                  | —               |                  |
| Bucket Tip                 | mm        | 100               |                  | 60              |                  |
| Slew Bearing               |           |                   |                  |                 |                  |
| Backlash                   | mm        | 30 ±10            |                  | 30 ±10          |                  |

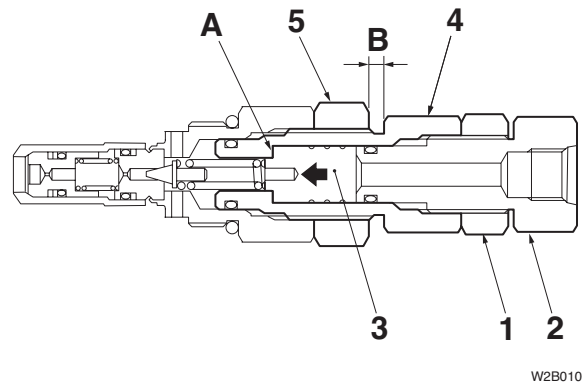
**METHODS FOR INSPECTING PERFORMANCE****Hydraulic Oil Pressure (Main Relief Valve Set Pressure)****Travel, Boom, Arm****Measuring Method**

- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Mount the pressure gauge on the pressure detection port, operate the desired hydraulic circuit and measure the relief pressure.

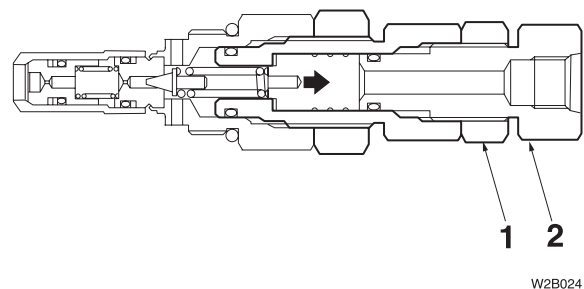
| Circuit | Pressure Detection Port |      | Relief Valve |
|---------|-------------------------|------|--------------|
|         | Port Position           | Size |              |
| Boom    | P1                      | G1/4 | R1           |
| Arm     | P2                      | G1/4 |              |
| Travel  | P1                      | G1/4 |              |

**Adjusting Method****Travel circuit (High pressure set)**

1. Loosen the lock nut (1).
2. Fasten the plug (2) until the piston (3) contacts the surface A of the plug (4).
  - Be sure that the plug (4) does not turn together with the plug (2).
  - The tightening torque of the plug (2) is 19.6N·m or less.
  - The size B is 4 mm or more.
3. Turn the plug (4) and adjust the set pressure.
  - Turn the plug slowly by referring to the pressure gauge.
  - The pressure increases by 21.3 MPa at one turn of the plug.
4. Upon completion of the pressure adjustment, hold the plug (4) to prevent it from turning and fasten it with the lock nut (5).

**Boom and Arm Circuits (Low pressure set)**

5. First, set the travel circuit (high pressure set), then loosen the plug (2) and adjust the set pressure.
  - Turn the plug slowly by referring to the pressure gauge.
  - The pressure decreases by 21.3 MPa at one turn of the plug
6. Upon completion of the pressure adjustment, hold the plug (2) to prevent it from turning and fasten it with the lock nut (1).
7. Actuate the relief valve again and confirm that the set pressure is stable.



## STANDARDS FOR JUDGING PERFORMANCE

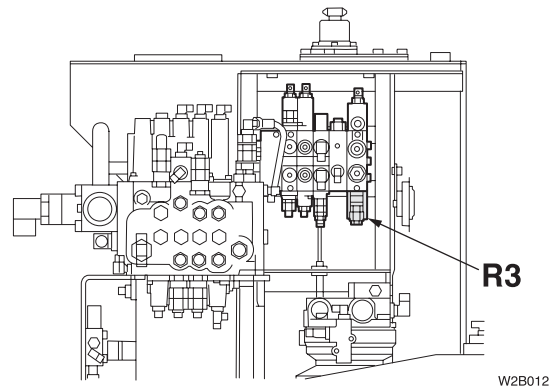
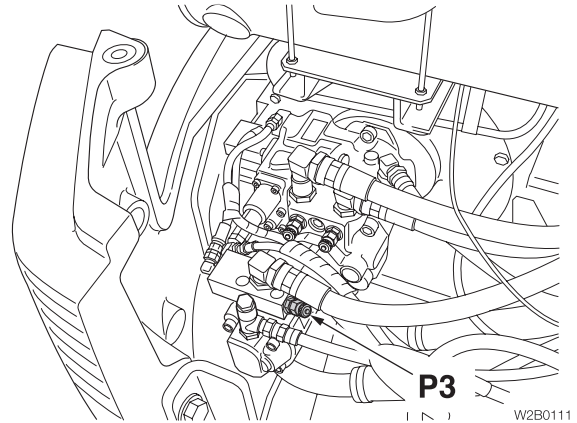
## SPECIFICATIONS

### Dozer Blade

#### Measuring Method

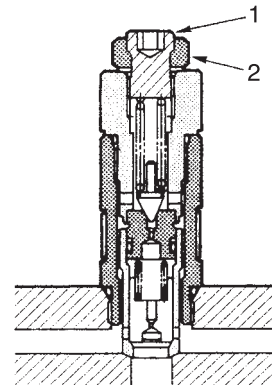
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Mount the pressure gauge on the pressure detection port, operate the desired hydraulic circuit and measure the relief pressure.

| Circuit     | Pressure Detection Port |      | Relief Valve |
|-------------|-------------------------|------|--------------|
|             | Port Position           | Size |              |
| Dozer Blade | P3                      | G1/4 | R3           |



#### Adjusting Method

1. Loosen locknut (2), then begin adjusting pressure by turning setting screw (1).  
Turning clockwise..... raises the set pressure.  
Turning counterclockwise.... lowers the set pressure.
2. In order to keep the setting screw from turning after pressure has been adjusted, tighten the locknut while at the same time holding the setting screw firmly in place.
3. Operate the relief valve once more to confirm that the pressure that has been set it stabilized.





### Hydraulic Oil Pressure (Slewing Relief Valve Set Pressure)

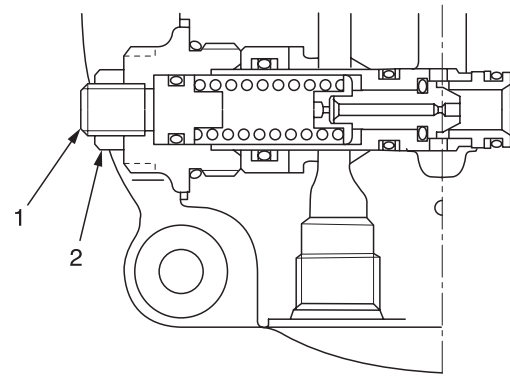
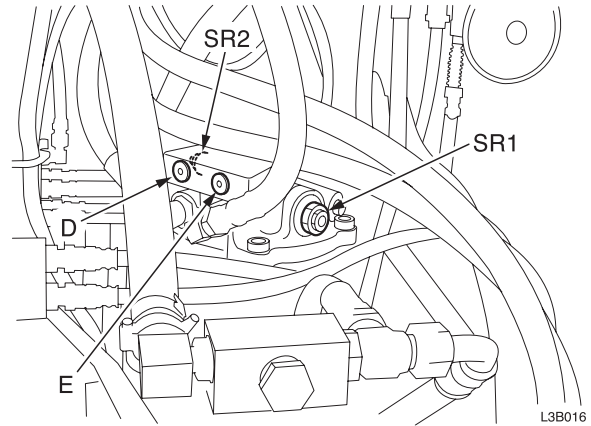
#### Measuring Method

- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Mount the pressure gauge on the pressure detection port and set a solid obstacle so that the upperstructure cannot slew in the direction to be measured. Next, operate the circuit to be measured and measure the relief pressure.

| Circuit    | Pressure Detection Port |      | Relief Valve |
|------------|-------------------------|------|--------------|
|            | Port Position           | Size |              |
| Right Slew | D                       | G1/4 | SR1          |
| Left Slew  | E                       | G1/4 | SR2          |

#### Adjusting Method

1. Loosen locknut (2), then begin adjusting pressure by turning setting screw (1).  
Turning clockwise..... raises the set pressure.  
Turning counterclockwise.... lowers the set pressure.
2. In order to keep the setting screw from turning after pressure has been adjusted, tighten the locknut while at the same time holding the setting screw firmly in place.
3. Operate the relief valve once more to confirm that the pressure that has been set it stabilized.



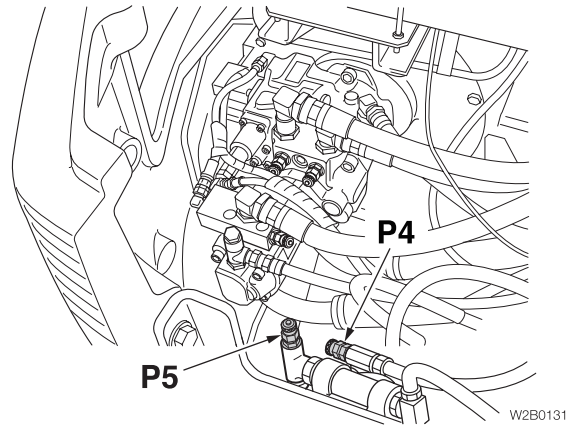
## STANDARDS FOR JUDGING PERFORMANCE

## SPECIFICATIONS

**Hydraulic Oil Pressure (Pilot Relief Valve Set Pressure)****Measuring Method**

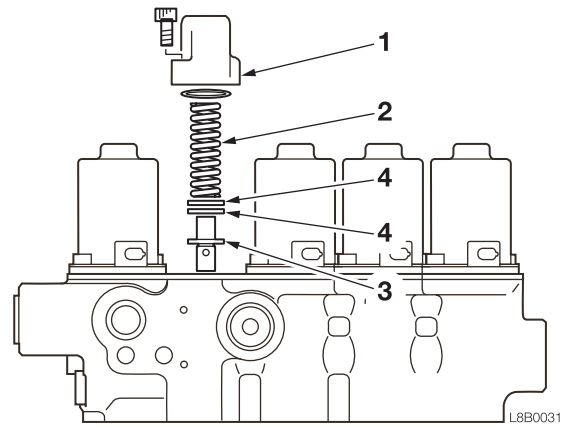
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Mount pressure gauge on the pressure detection port and measure the pilot relief pressure.

| Pressure Detection Port |      | Relief Valve |
|-------------------------|------|--------------|
| Port Position           | Size |              |
| P5                      | G1/4 | PR           |

**Pressure Adjustment**

The relief valve pressure is set at the factory. Do not adjust it unless necessary.

1. Remove the cap screws, and then remove the cover (1).
2. Remove the spring (2) and the plunger (3).
3. Adjust the pressure with the shims (4)  
Shim thickness.....0.2 mm  
Shim thickness.....0.5mm



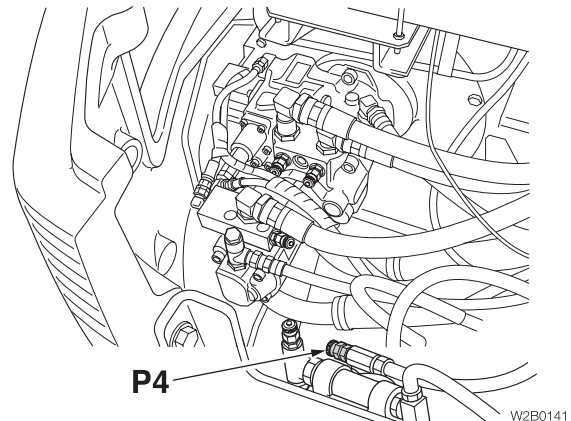
|        |        |                              |
|--------|--------|------------------------------|
| 0.2 mm | Remove | Decrease of approx. 0.13 MPa |
|        | Add    | Increase of approx. 0.13 MPa |
| 0.5 mm | Remove | Decrease of approx. 0.31 MPa |
|        | Add    | Increase of approx. 0.31 MPa |

4. Upon completion of the pressure adjustment, assemble the relief valve and confirm that the relief valve set pressure is stable.  
⌘ Cap Screw: 3.92 N·m

**Hydraulic Oil Pressure (Steering Relief Valve Set Pressure)****Measuring Method**

- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Mount pressure gauge on the pressure detection port and measure the pilot relief pressure.

| Pressure Detection Port |      | Relief Valve |
|-------------------------|------|--------------|
| Port Position           | Size |              |
| P4                      | G1/4 | —            |

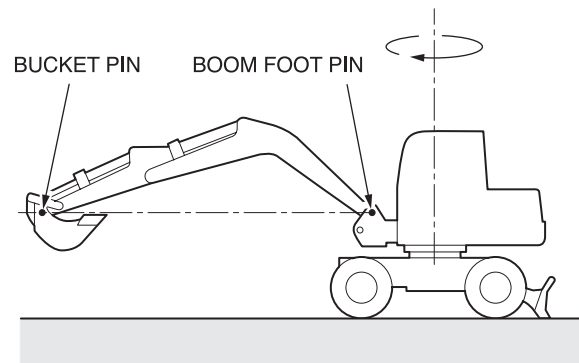


## STANDARDS FOR JUDGING PERFORMANCE

## SPECIFICATIONS

### Slew Time

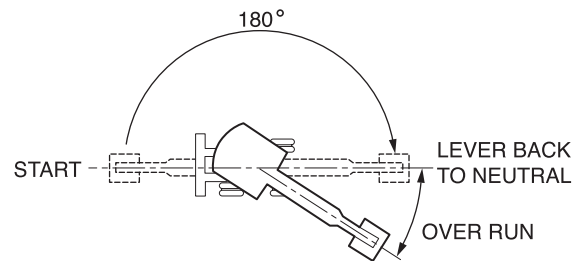
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Completely retract the arm cylinder, fully extend the bucket cylinder and adjust so that boom foot pin and bucket pin are at matching height. Rest the dozer blade on the ground.
- With the hoe attachment in a no-load state, wait 1 rotation, then measure the time required for the next 2 rotations.



W2B015E

### Overrun When Slewing Stops

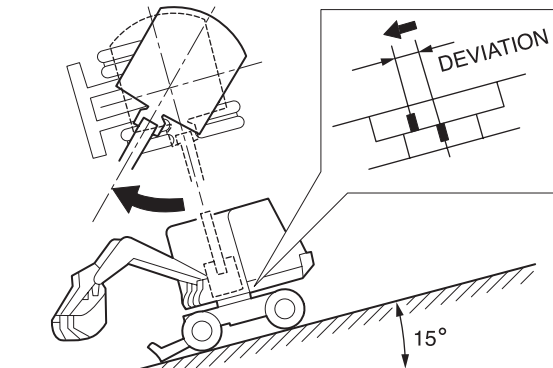
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Same as that for measuring slew time.
- Draw matching marks on the outer race of the slew bearing and lower frame at an exactly 180 degrees rotation from the starting point. With the hoe attachment in a no-load state, rotate 180 degrees at, which point return the operation lever to neutral. Measure the differential between the position marks and the point the hoe attachment stops.



W2B016E

### Natural Slew Drop

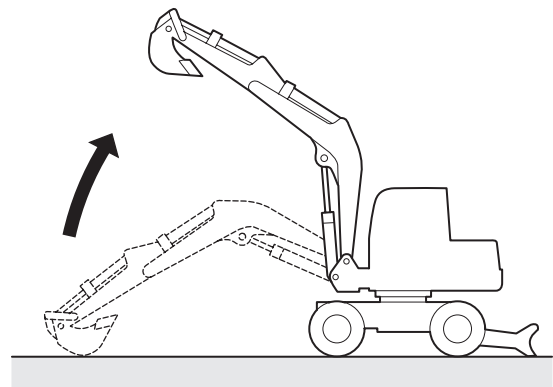
- Engine : Stopped
- Hydraulic Oil Temp. : 50~60°C
- Grade : 15°
- Measurement Posture: Same as that for measuring slew time.
- Rotate the upper machinery so that it is directly abeam of the grade, then draw positional marks on the slew bearing's outer race and the lower frame. Then measure the distance that develops between the marks after 5 minutes.



W2B017E

### Boom Cylinder Speed

- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Completely retract the arm cylinder, fully extend the bucket cylinder and rest the dozer blade on the ground.
- Then measure the time required for the bucket to reach its highest elevation point (lowest point) from its lowest point (highest point) resting on the ground. (Do not include the cushioning time.)



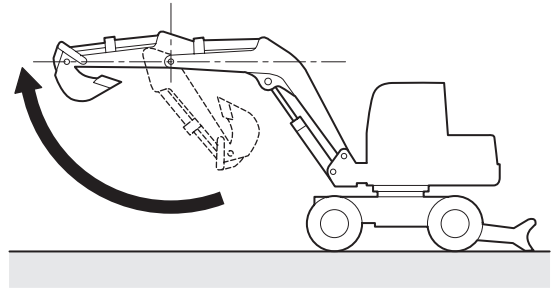
W2B018

## STANDARDS FOR JUDGING PERFORMANCE

## SPECIFICATIONS

### Arm Cylinder Speed

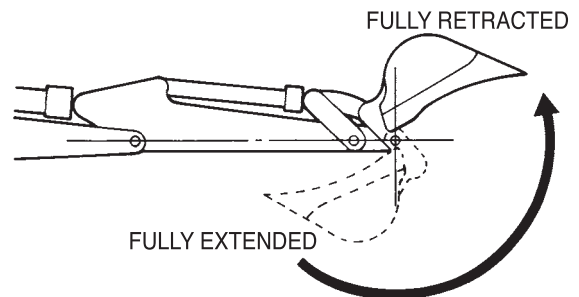
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Completely retract the arm cylinder, fully extend the bucket cylinder, position the arm horizontally and rest the dozer blade on the ground.
- Then measure the time required for the arm cylinder to completely retract (extend) from a fully extended state (retracted state).



W2B019

### Bucket Cylinder Speed

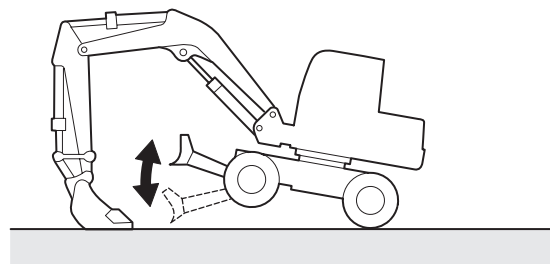
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Completely retract the arm cylinder, position the arm horizontally and rest the dozer blade on the ground.
- Then measure the time required for the bucket cylinder to completely retract (extend) from a fully extended state (retracted state).



Y2-B239E

### Dozer Blade Cylinder Speed

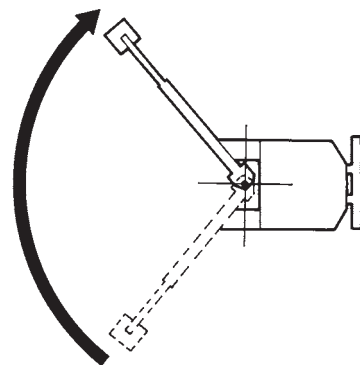
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Using the hoe attachment, lift up the dozer blade end of the excavator.
- Then, raising and lowering the dozer blade full stroke, measure the time required per stroke in each direction.



W2B020

### Swing Cylinder Speed

- Engine : Maximum r.p.m.
  - Hydraulic Oil Temp. : 50~60°C
  - Measurement Posture: Same as that for measuring slew time.
  - While swinging the boom left (right) to right (left), measure the time required for a full stroke each way.
- (Do not include the cushioning time.)



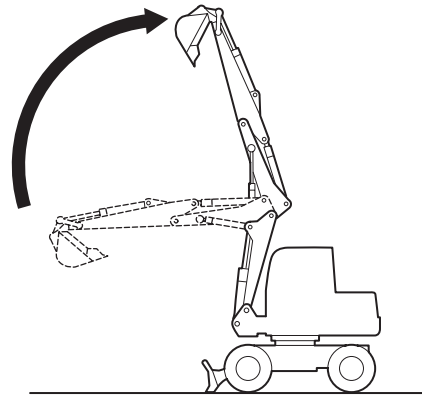
Y2-B241

## STANDARDS FOR JUDGING PERFORMANCE

## SPECIFICATIONS

### Adjust Cylinder Speed

- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Completely retract the arm cylinder, fully extend the bucket and boom cylinders, position the arm horizontally and rest the dozer blade on the ground.
- Then measure the time required for the adjust cylinder to completely retract (extend) from a fully extended state (retracted state).

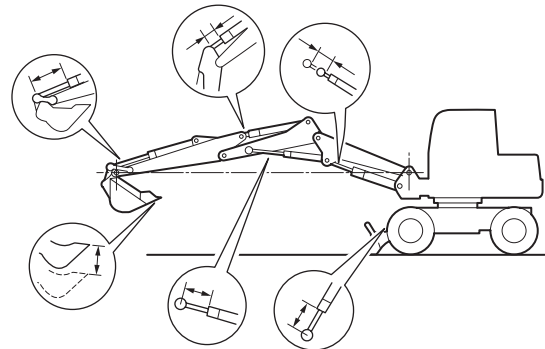


W2B021

### Natural Cylinder Drop

#### Boom, Arm, Bucket, Dozer Blade, Bucket Tip

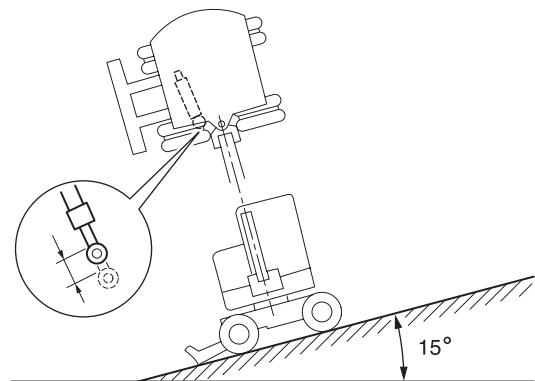
- Engine : Maximum r.p.m.
- Hydraulic Oil Temp. : 50~60°C
- Measurement Posture: Completely retract the dozer blade and arm cylinders, fully extend the bucket cylinder and adjust the bucket pin position to the same height as the boom foot pin.
- Maintain this position for 10 minutes, then measure the change in rod length and the distance the bucket tip falls.



W2B022

### Swing Cylinder

- Engine : Stopped
- Hydraulic Oil Temp. : 50~60°C
- Grade : 15°
- Measurement Posture: Same as that for measuring slew time.
- Rotate the upper machinery so that it is directly abeam of the grade, then measure the change in rod length after 5 minutes.



W2B023



## **III . MACHINE CONFIGURATION**

## MACHINE CONFIGURATION

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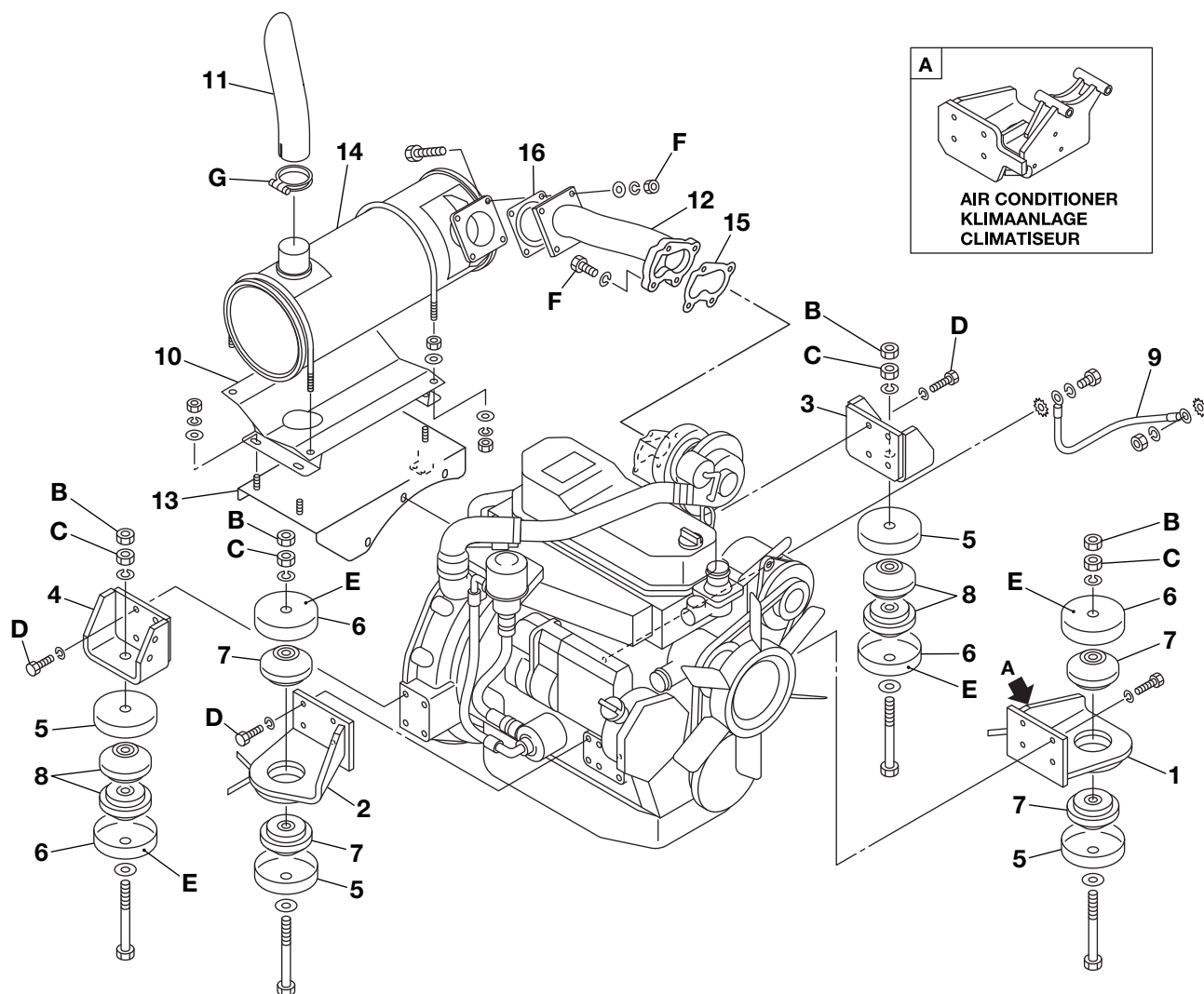
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| Travel System .....          | 11 |
| Upper Frame .....            | 13 |
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## DRIVE SYSTEM

### CONSTRUCTION

#### Engine Mount 1/2

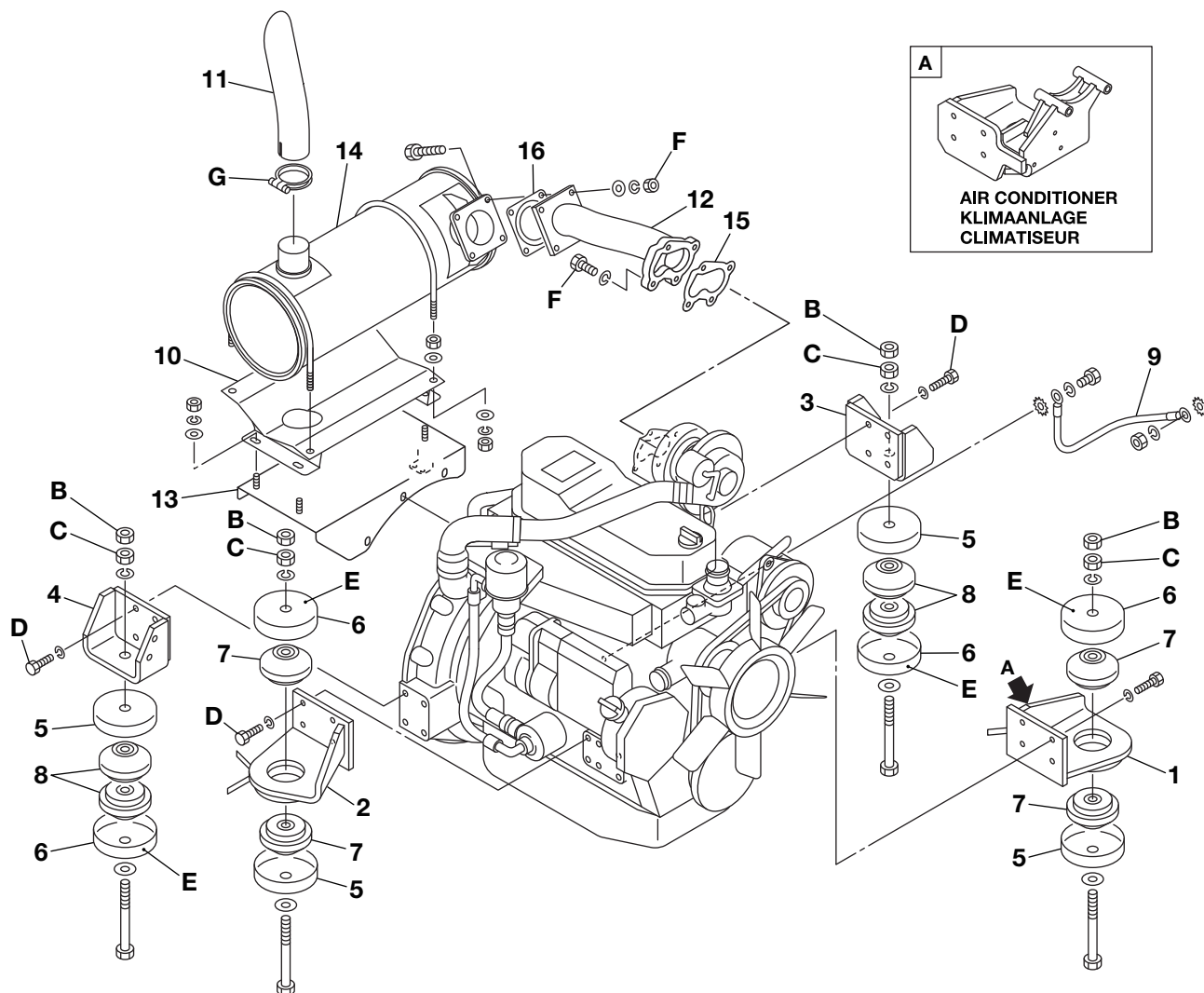


W3C101E

- B: 241 N·m  
 C: 193 N·m  
 D: 55 N·m  
 Apply thread-locking compound.  
 E: "A" Mark  
 F: 23 N·m  
 G: 3.9 N·m

1. Engine Foot FL  
 2. Engine Foot FR  
 3. Engine Foot RL  
 4. Engine Foot RR  
 5. Stopper  
 6. Stopper  
 7. Cushion Rubber  
 8. Cushion Rubber  
 9. Ground Cable  
 10. Bracket  
 11. Exhaust Pipe  
 12. Pipe  
 13. Bracket  
 14. Silencer  
 15. Gasket  
 16. Gasket

Engine Mount 2/2

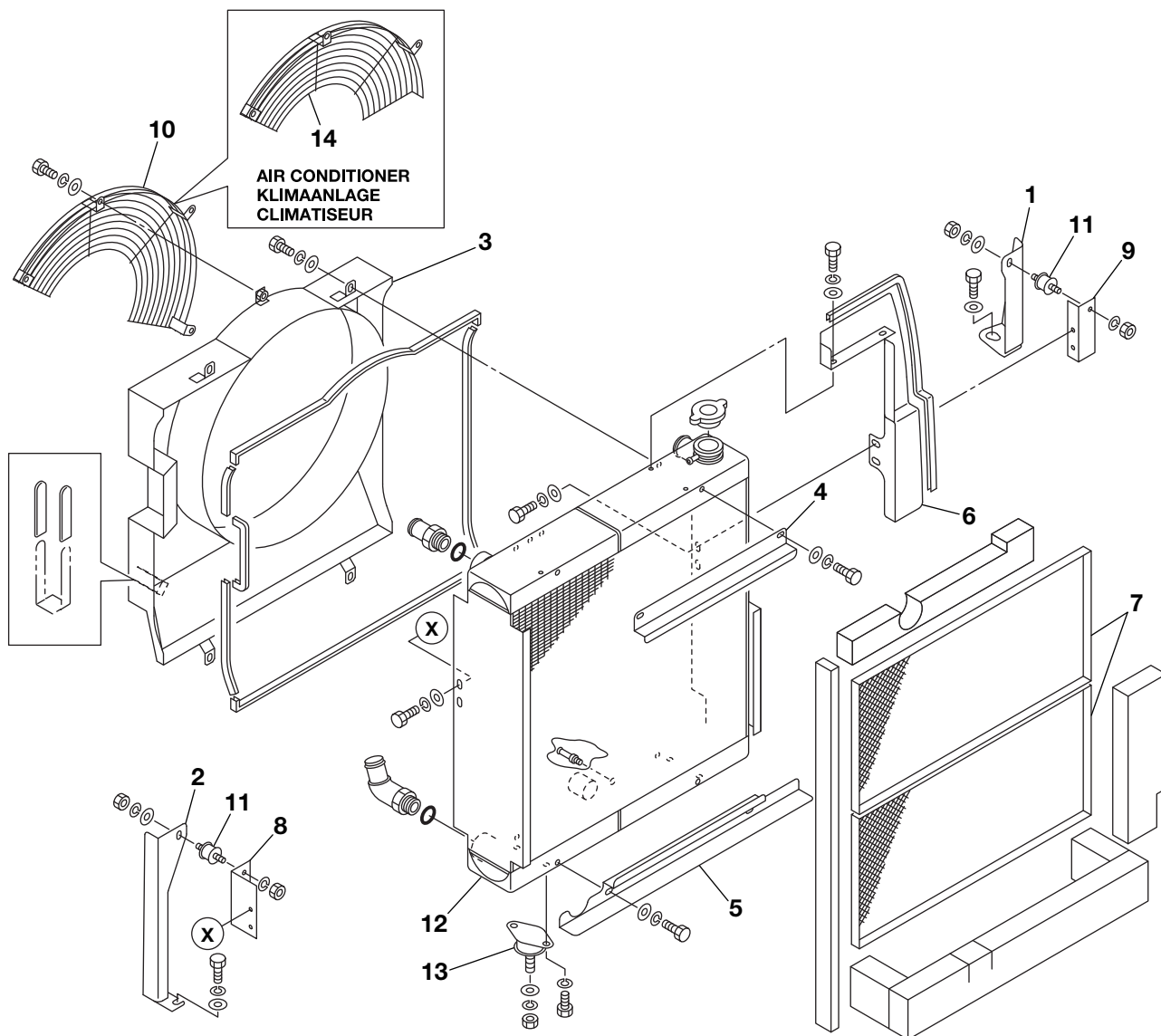


W3C101E

A: 3.9 N·m  
A: 4.9 N·m

- |                |              |
|----------------|--------------|
| 1. Bracket     | 12. Hose     |
| 2. Air Cleaner | 13. Hose     |
| 3. Hose        | 14. Hose     |
| 4. Hose        | 15. Sub Tank |
| 5. Pipe        | 16. Bracket  |
| 6. Pipe        | 17. Plate    |
| 7. Pipe        | 18. Hose     |
| 8. Pipe        | 19. Sensor   |
| 9. Hose        | 20. Joint    |
| 10. Hose       | 21. Hose     |
| 11. Drain Vave |              |

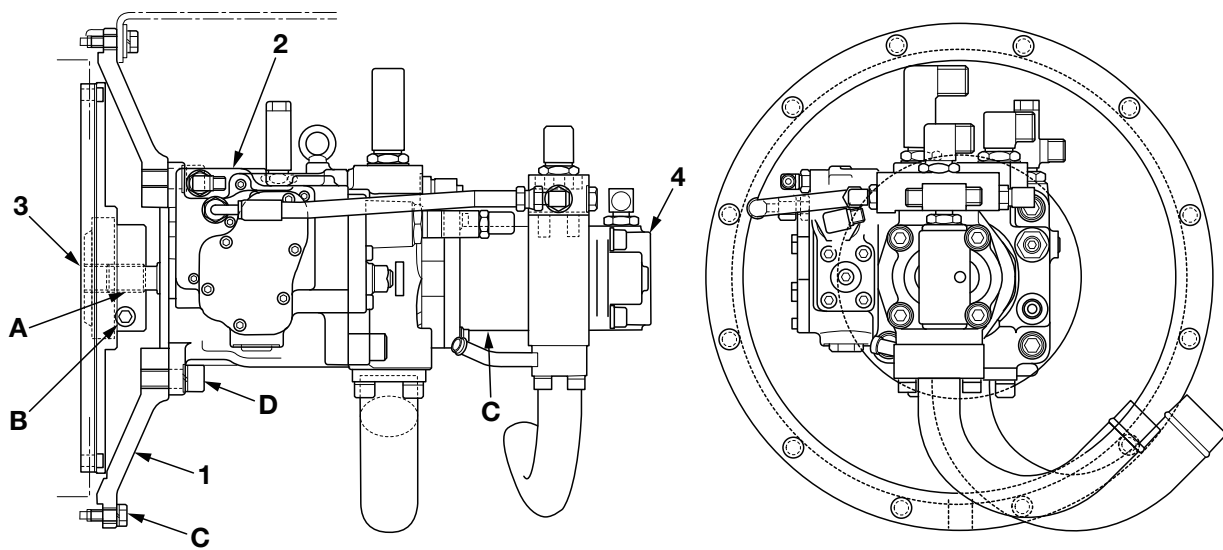
## Radiator and Oil Cooler



W3C103E

- |           |                             |
|-----------|-----------------------------|
| 1. Stay   | 8. Bracket                  |
| 2. Stay   | 9. Bracket                  |
| 3. Shroud | 10. Guard                   |
| 4. Plate  | 11. Cushion Rubber          |
| 5. Plate  | 12. Radiator and Oil Cooler |
| 6. Plate  | 13. Cushion Rubber          |
| 7. Net    | 14. Guard                   |

## Pump Coupling



W3C104

A: Supply molybdenum disulfide grease.

B:  $\Rightarrow$  86 N·m

C:  $\Rightarrow$  54.9 N·m

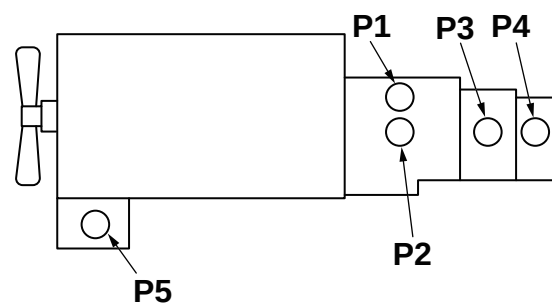
D:  $\Rightarrow$  255.8 N·m

1. Engine Housing
2. Hydraulic Pump
3. Hab
4. Gear Pump

The pump coupling connects the engine flywheel and the hydraulic pump's drive shaft. It is constructed so that it absorbs vibrations, torsions, impact and out of center of the engine and hydraulic pump.

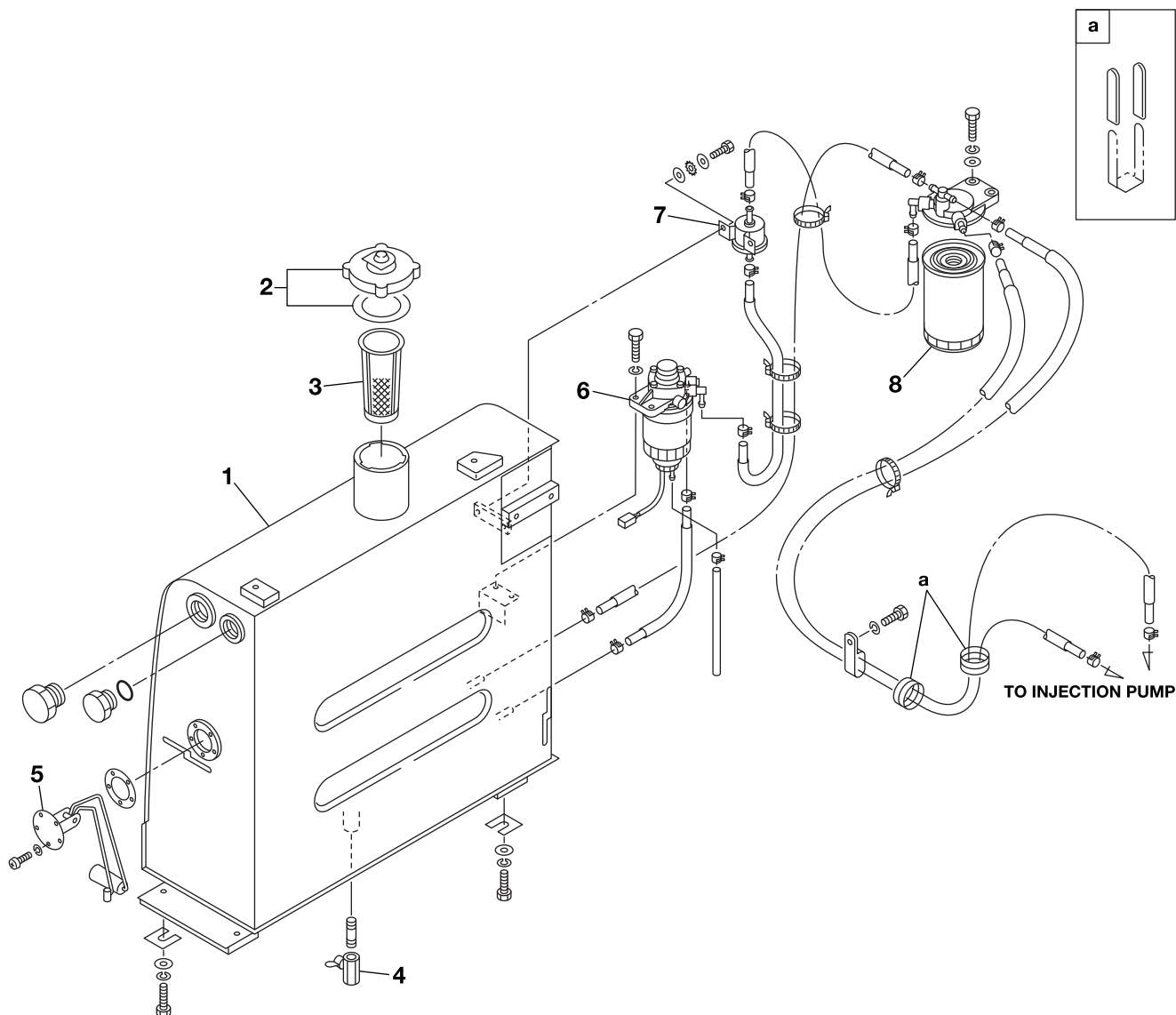
- Refer to the table concerning the responsibility of each of the pumps shown in the drawing at right.

|    |                                           |
|----|-------------------------------------------|
| P1 | Travel, Bucket, Boom[1], Arm[2]           |
| P2 | Travel, Auxiliary, Boom[2], Arm[1], Swing |
| P3 | Outrigger, Slew, Auxiliary                |
| P4 | Steering, Brake                           |
| P5 | Pilot Pressure                            |



W2C104

Fuel Tank and Lines



W3C105

1. Fuel Tank
2. Cap
3. Strainer
4. Drain Valve
5. Fuel Sender
6. Water Separator
7. Feed Pump
8. Fuel Filter

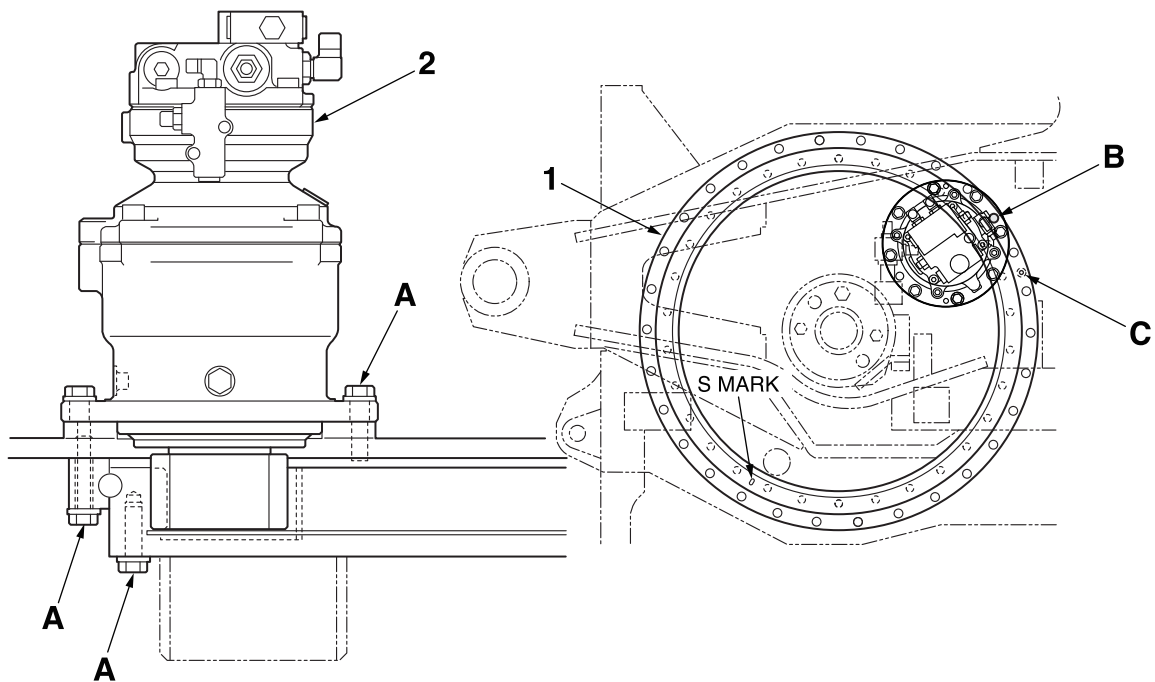
## W3C106

8. Hose
9. Plug
10. Level Switch
11. Strainer
12. Pump
13. Float

## SLEW SYSTEM

### CONSTRUCTION

#### Slew Bearing, Slew Motor



W2C200E

A: 256 N·m

Apply thread-locking compound.

B: At this place only, use a reamer bolt. No washer is needed.

C: R 1/8

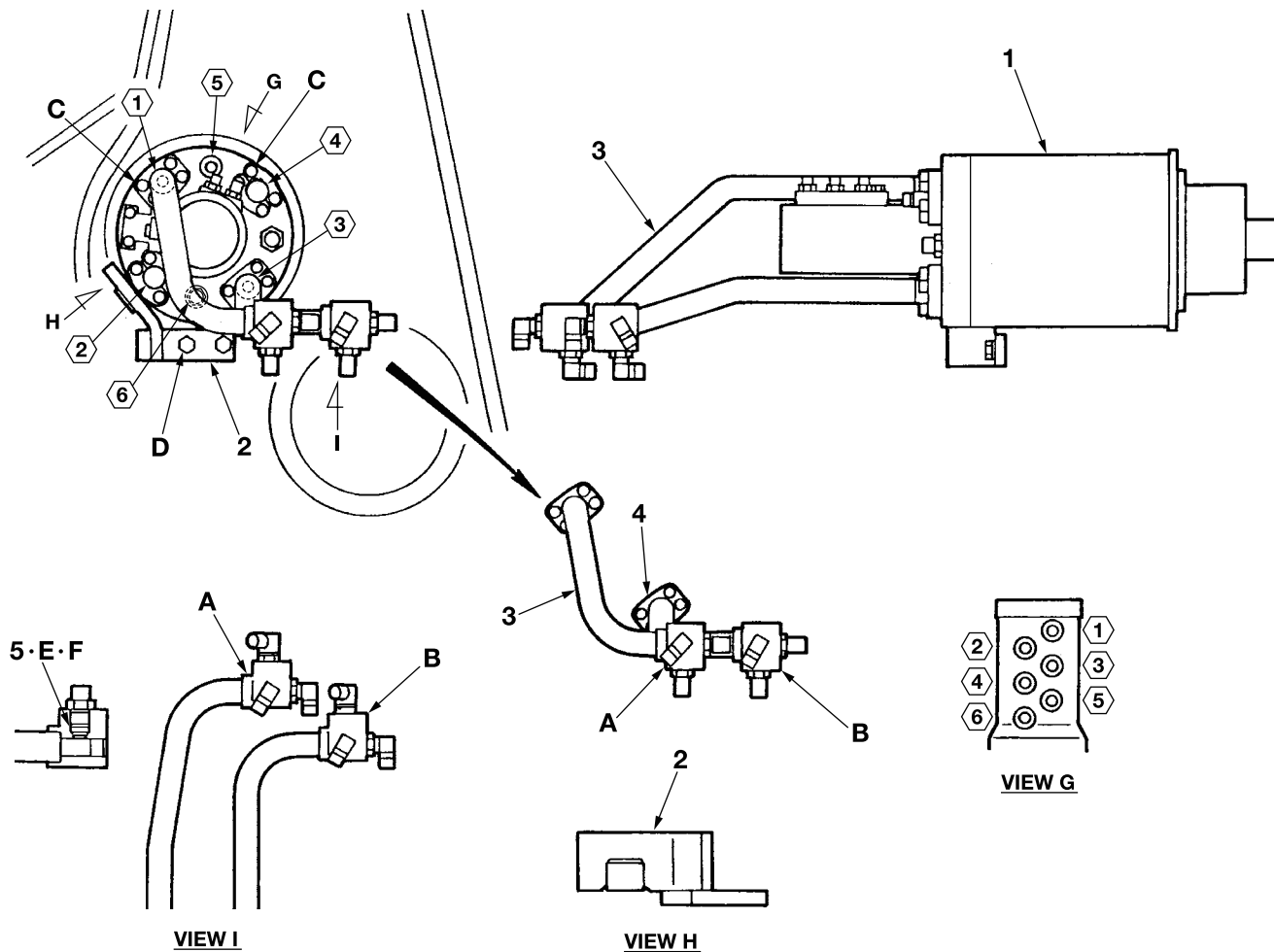
1. Slew Bearing

2. Slew Motor

# MACHINE CONFIGURATION

## SLEW SYSTEM

### Swivel Joint



W3C201E

- A: Travel Block 1 [Reverse Travel]  
 B: Travel Block 2 [Forward Travel]  
 C:  $\hookrightarrow 47 \text{ N}\cdot\text{m}$   
 D:  $\hookrightarrow 134 \text{ N}\cdot\text{m}$   
 Apply thread-locking compound.  
 E:  $\hookrightarrow 39 \text{ N}\cdot\text{m}$   
 F: Check Valve Cranking Pressure: 0.017MPa

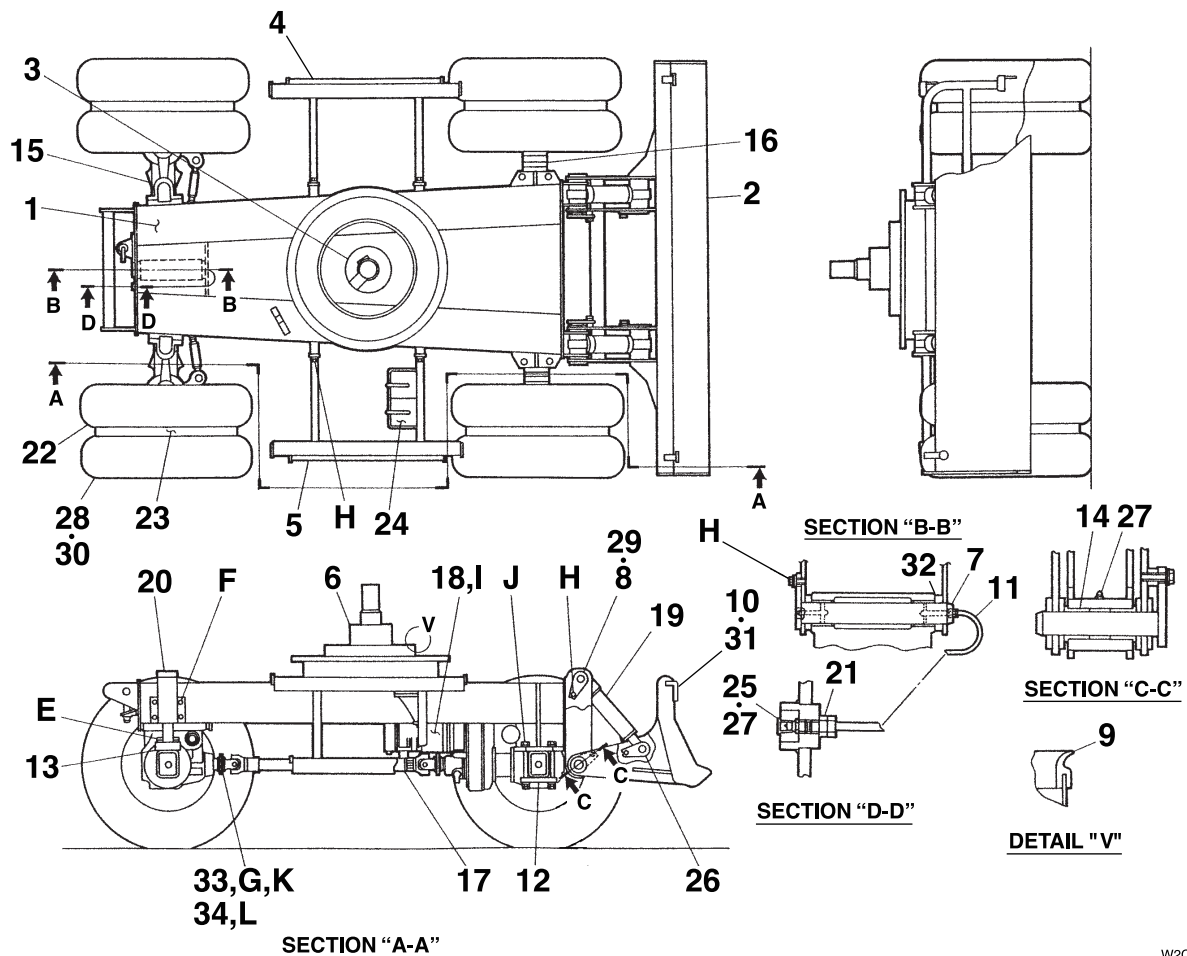
1. Swivel Joint  
 2. Turn Stopper  
 3. Pipe 1  
 4. Pipe 2  
 5. Check Valve



## TRAVEL SYSTEM

### CONSTRUCTION

#### Undercarriage



W2C300E

- |                              |                              |                       |
|------------------------------|------------------------------|-----------------------|
| E: $\hookrightarrow$ 100 N·m | H: $\hookrightarrow$ 150 N·m | K: Apply Loctite 706N |
| F: $\hookrightarrow$ 250 N·m | I: $\hookrightarrow$ 170 N·m | L: Apply Loctite 243  |
| G: $\hookrightarrow$ 50 N·m  | J: $\hookrightarrow$ 400 N·m |                       |

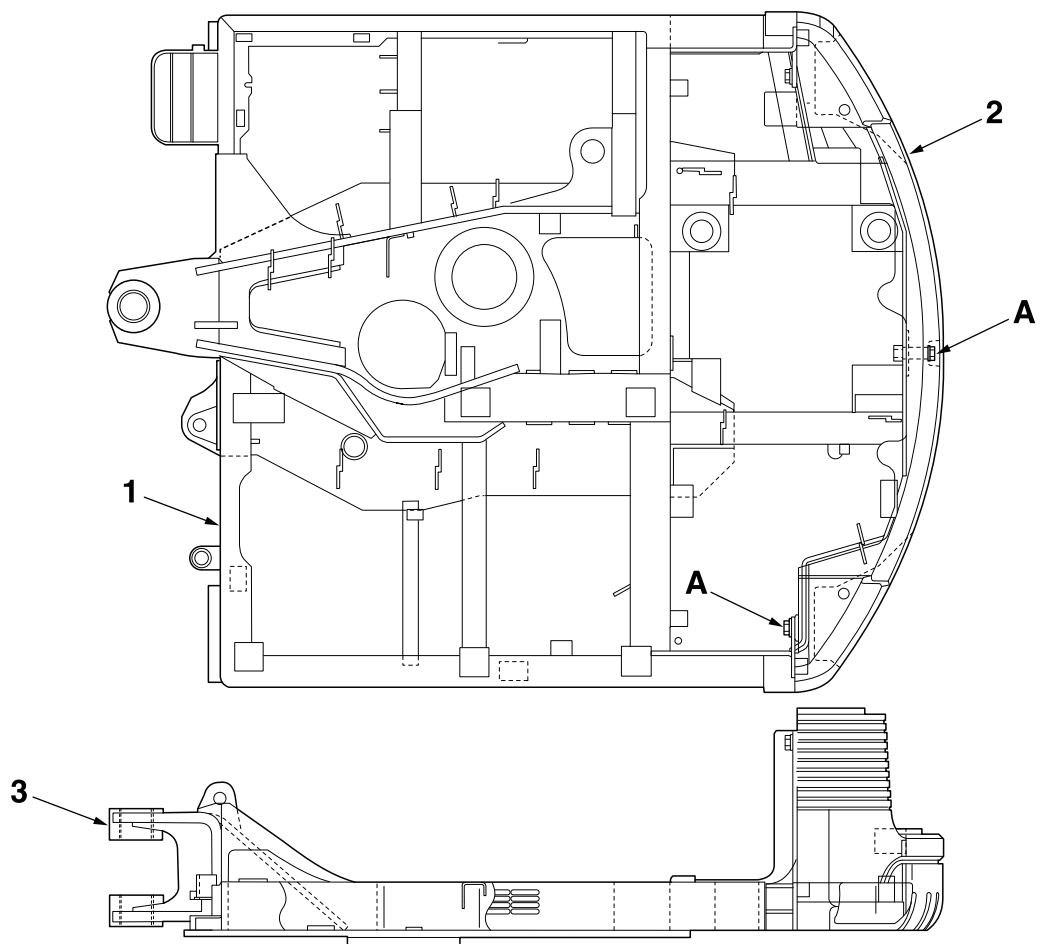
- |                    |                    |                 |
|--------------------|--------------------|-----------------|
| 1. Undercarriage   | 13. Thrust Plate   | 25. Cap         |
| 2. Dozer Blade     | 14. Bushing        | 26. Spacer Ring |
| 3. Swivel Joint    | 15. Steering Axle  | 27. Lubricator  |
| 4. Ascent          | 16. Rear Axle      | 28. Extension   |
| 5. Ascent          | 17. Cardran Shaft  | 29. Plug        |
| 6. Hydraulic Plant | 18. Variable Motor | 30. Wheel, Left |
| 7. Axle, Compl.    | 19. Cylinder       | 31. Cotter      |
| 8. Axle, Compl.    | 20. Cylinder       | 32. Shim        |
| 9. Profile         | 21. Union          | 33. Screw       |
| 10. Reflector      | 22. Wheel, Right   | 34. Nut         |
| 11. Pipe           | 23. Bracket        |                 |
| 12. Plate          | 24. Brake Shoe     |                 |



## UPPER FRAME

### CONSTRUCTION

#### Turntable



W2C400

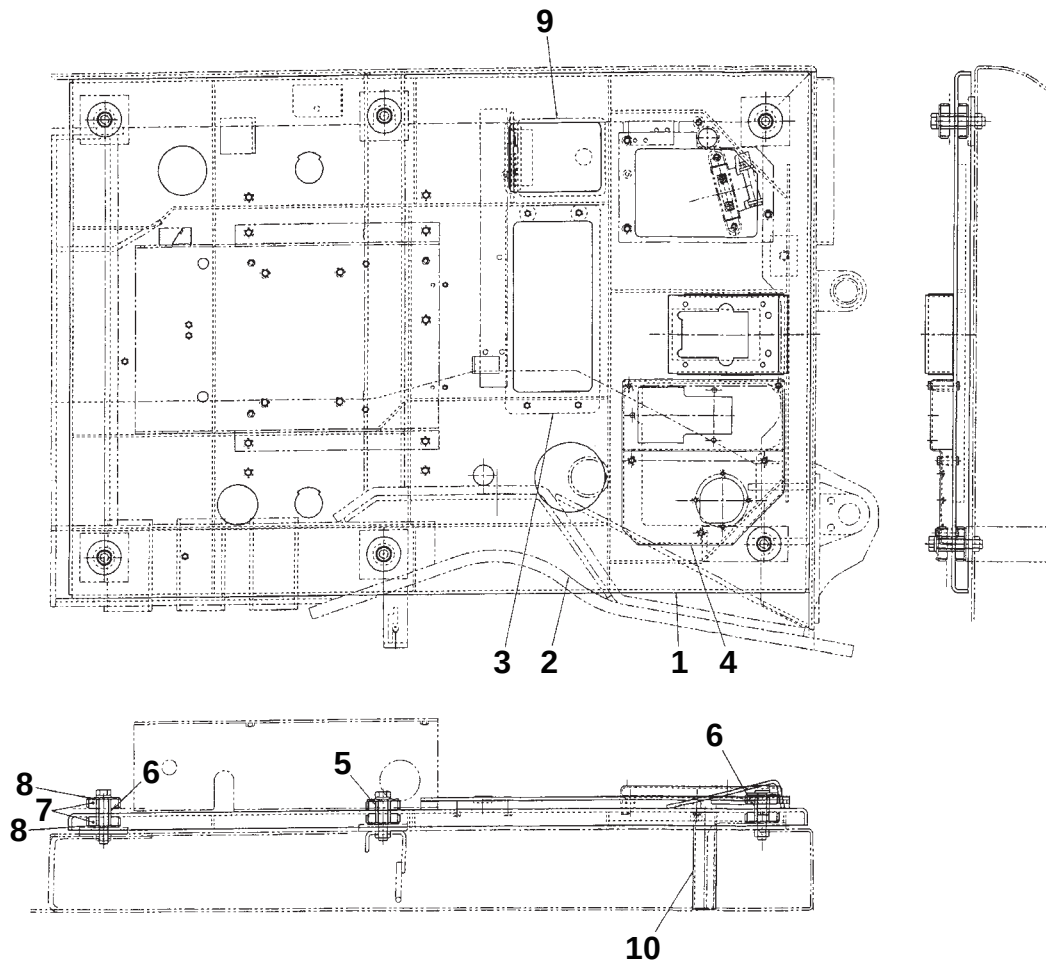
A:  840 N·m  
Apply thread-locking compound.

- 1. Turntable
- 2. Counterweight
- 3. Bushing

## MACHINE CONFIGURATION

## UPPER FRAME

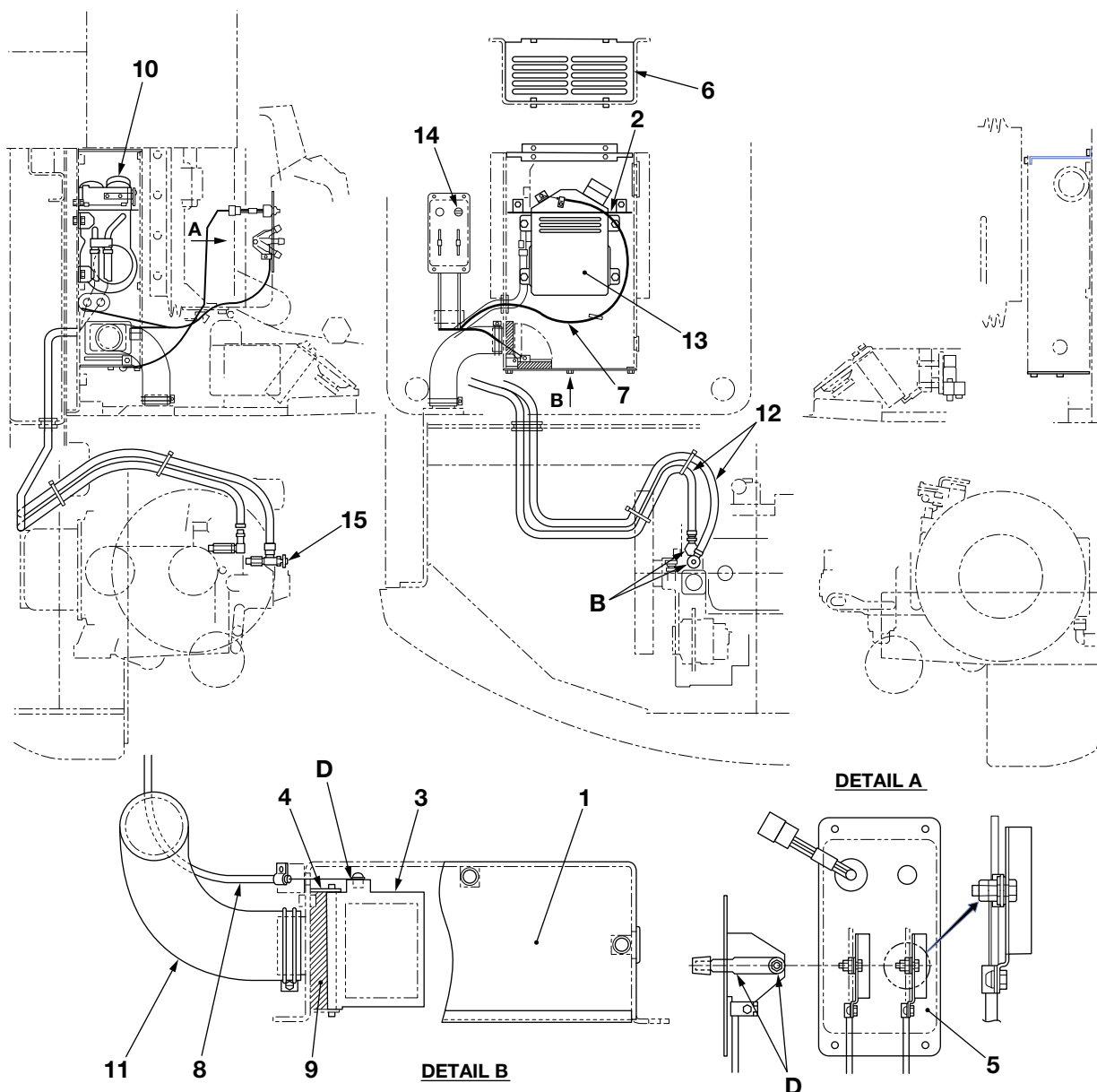
### Floor Plate



W2C401

- 1. Floor Plate
- 2. Floor Mat
- 3. Cover
- 4. Stage
- 5. Tube
- 6. Tube
- 7. Rubber
- 8. Cover
- 9. Cover
- 10. Pipe

# Heater

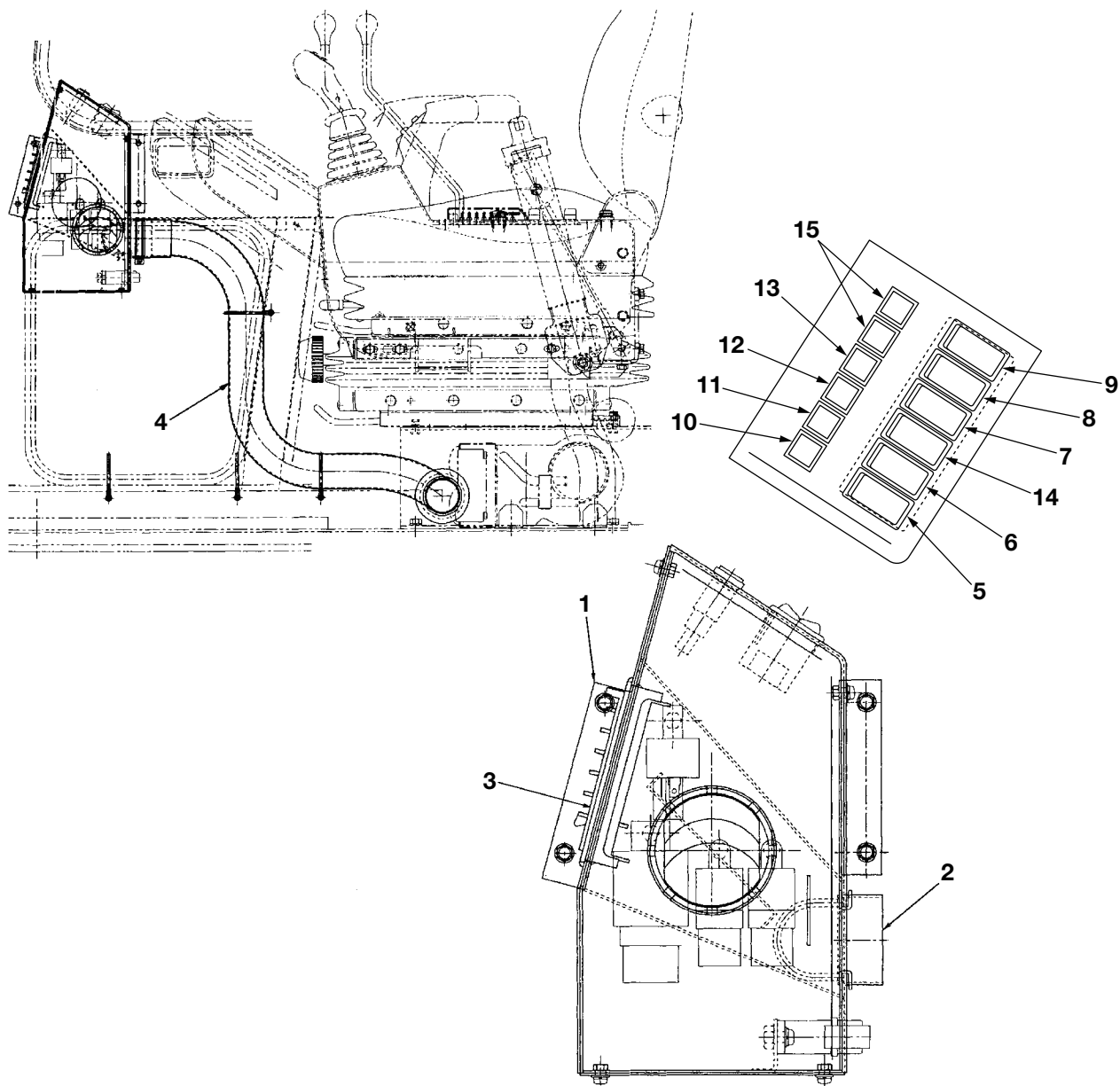


D: Grease with molybdenum disulfide applied.

B:  $\rightarrow 23.5 \text{ N}\cdot\text{m}$

W3C401E

- |                    |                     |
|--------------------|---------------------|
| 1. Cover           | 9. Filter           |
| 2. Plate           | 10. Cover           |
| 3. Selector Damper | 11. Hose            |
| 4. Bracket         | 12. Hose            |
| 5. Panel           | 13. Heater Assembly |
| 6. Cover           | 14. Switch          |
| 7. Wire            | 15. Valve           |
| 8. Wire            |                     |



W3C402

- |                         |                            |
|-------------------------|----------------------------|
| 1. Bracket              | 9. Hazard Switch           |
| 2. Box                  | 10. Pilot Lamp             |
| 3. Louver               | 11. Pilot Lamp             |
| 4. Defroster Hose       | 12. Pilot Lamp             |
| 5. Parking Brake Switch | 13. Pilot Lamp             |
| 6. Site Travel Switch   | 14. Creeping Travel Switch |
| 7. Axle Lock Switch     | 15. Ornament               |
| 8. Light Switch         |                            |

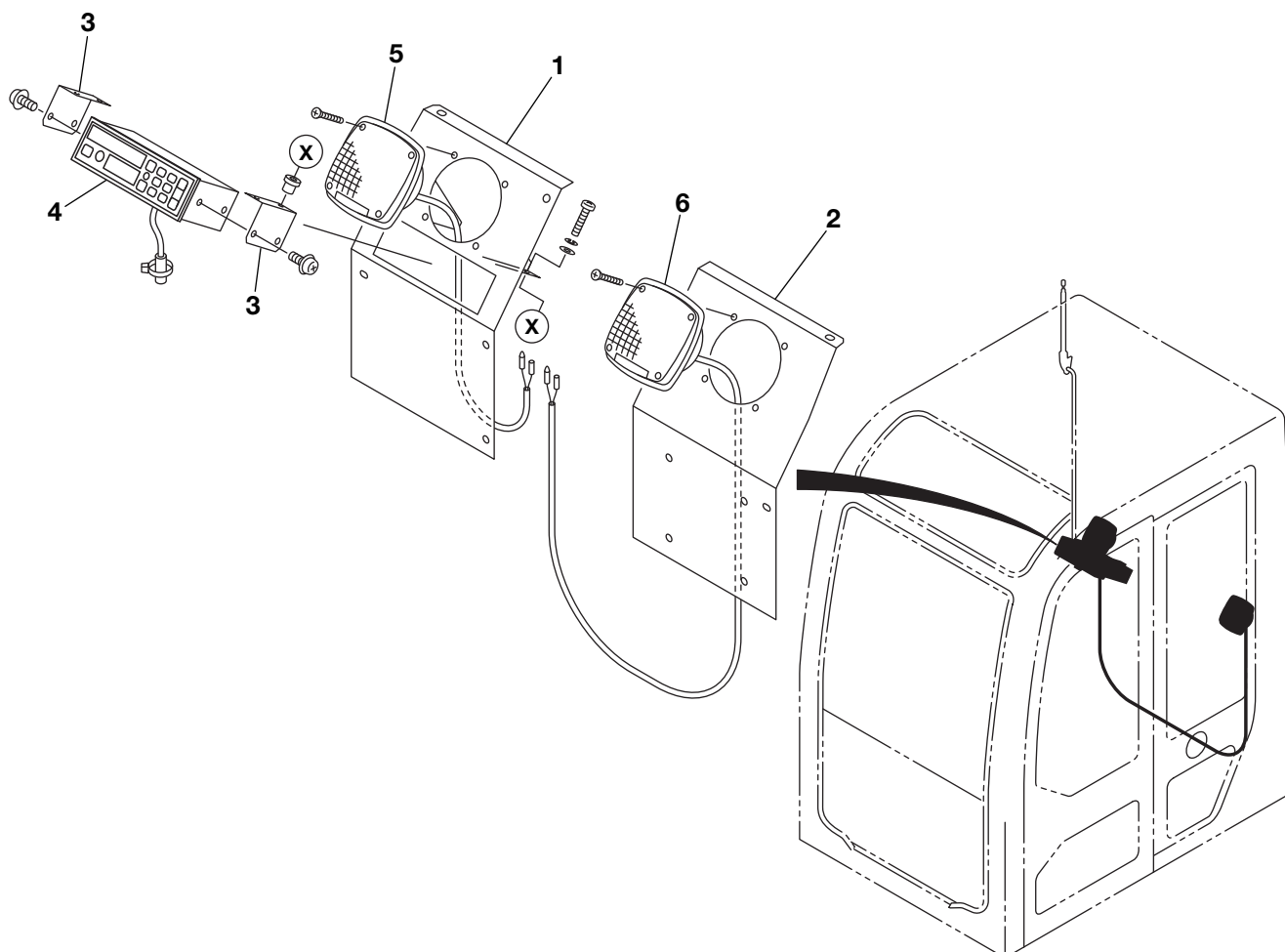


1. Clamp
2. Box
3. Plate
4. Relay
5. Relay
6. Sheet
7. Battery
8. Bracket
9. Cable
10. Battery Cable
11. Terminal
12. Clamp
13. Cover
14. Battery Switch
15. ECU
16. Ground Cable

## MACHINE CONFIGURATION

## UPPER FRAME

### Radio

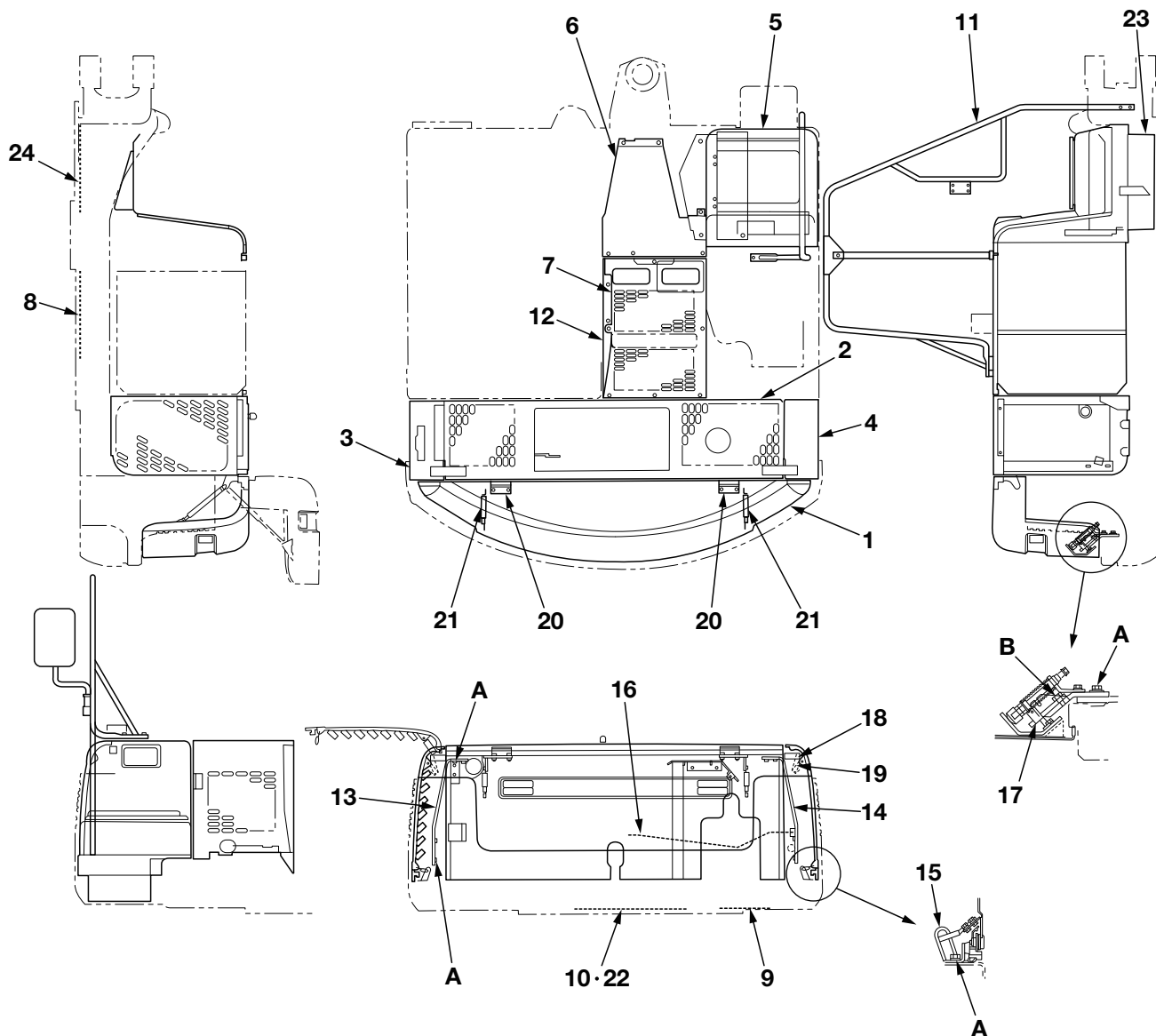


W3C404

1. Cover R
2. Cover L
3. Bracket
4. AM/FM Radio
5. Speaker R
6. Speaker L



## Covers



W3C405

- A:  $\hookrightarrow$  54.9 N·m  
Apply thread-locking compound.
- B:  $\hookrightarrow$  26.5 N·m  
Apply thread-locking compound.

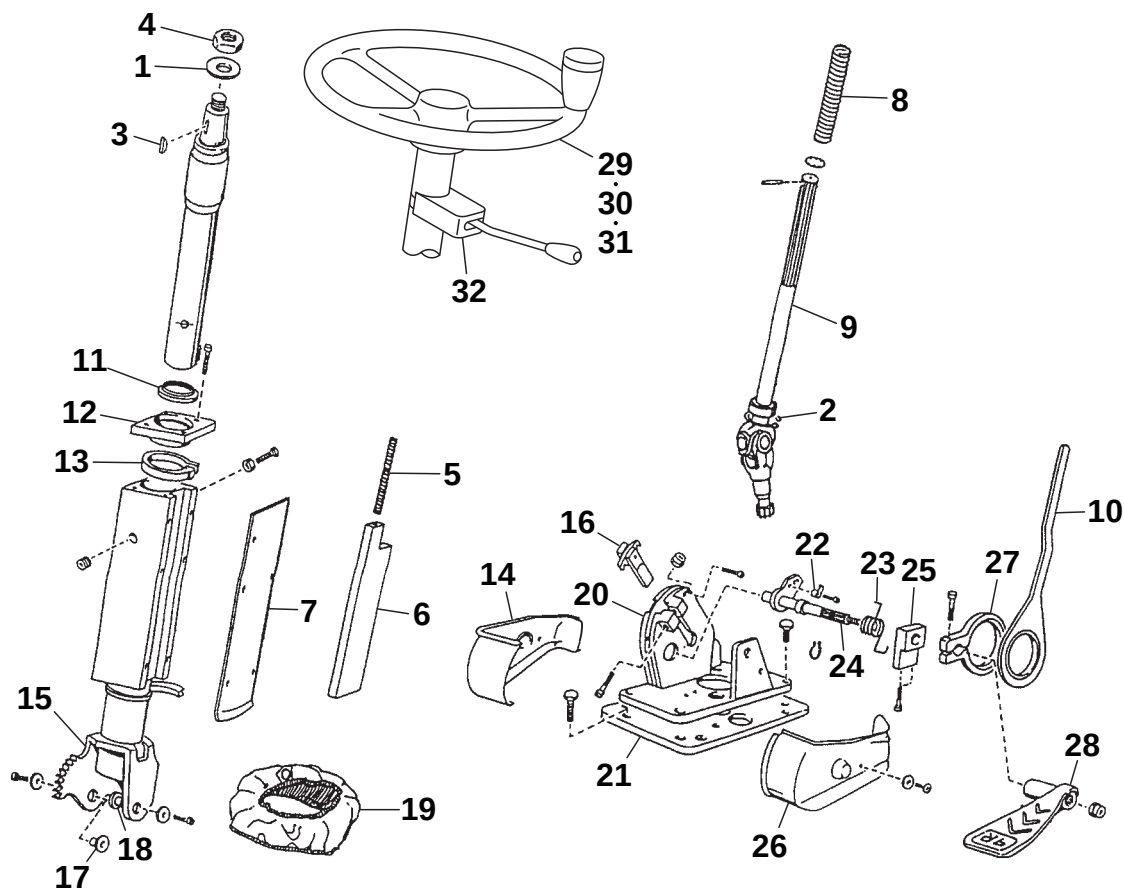
- |                         |                          |                 |
|-------------------------|--------------------------|-----------------|
| 1. Engine Food          | 9. Under Cover Assembly  | 17. Lock Plate  |
| 2. Engine Cover [Front] | 10. Under Cover Assembly | 18. Link        |
| 3. Side Cover L         | 11. Handrail             | 19. Yoke        |
| 4. Side Cover R         | 12. Plate                | 20. Hinge       |
| 5. Front Cover          | 13. Stay                 | 21. Gas Spring  |
| 6. Center Cover F       | 14. Stay                 | 22. Under Cover |
| 7. Center Cover T       | 15. Hook                 | 23. Plate       |
| 8. Under Cover          | 16. Wire                 | 24. Under Cover |



## CONTROL SYSTEM

### CONSTRUCTION

#### Steering Unit

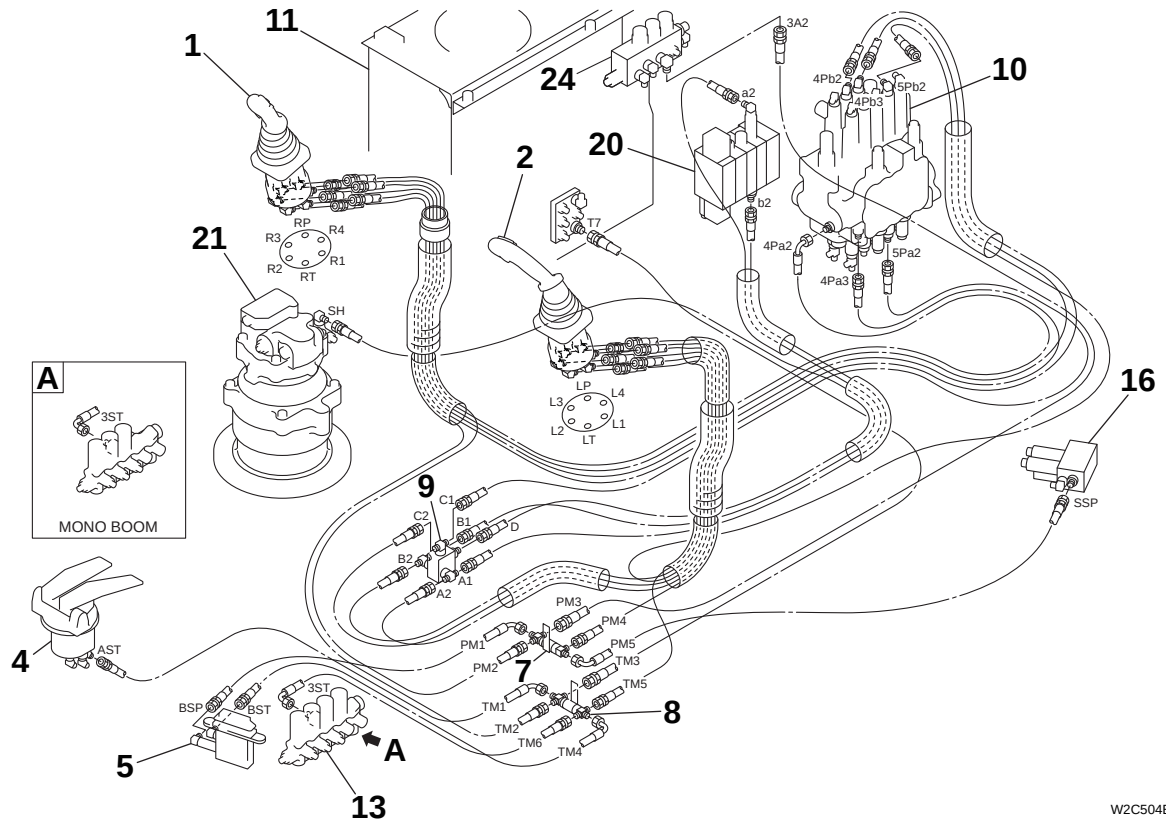


W2C500

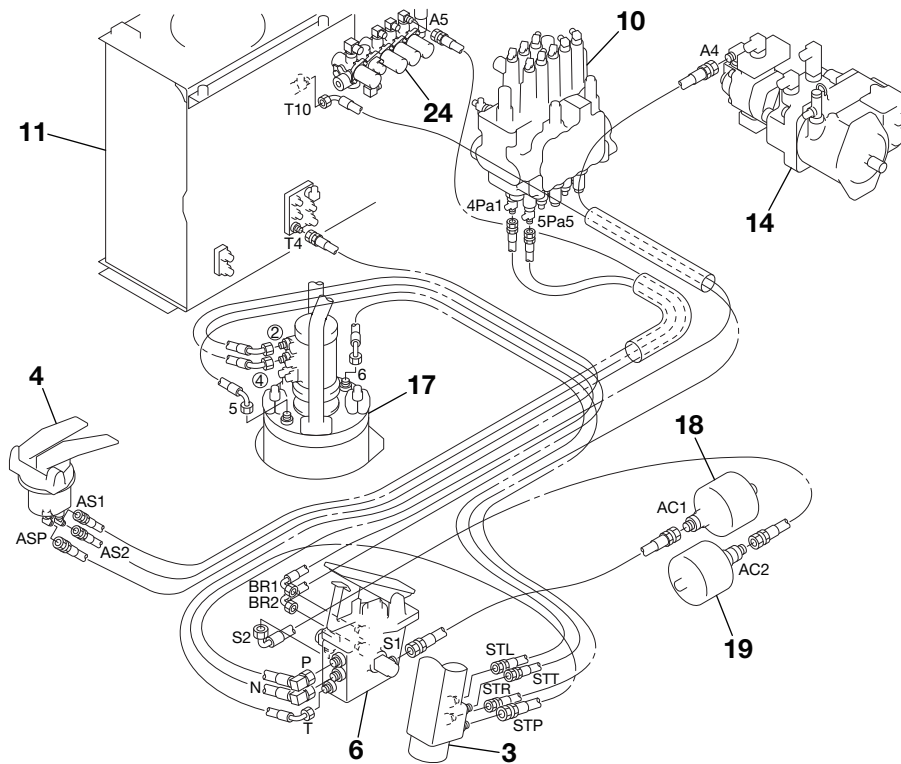
- |                      |                  |                          |                    |
|----------------------|------------------|--------------------------|--------------------|
| 1. Washer            | 9. Shaft         | 17. Pin                  | 25. Support        |
| 2. Telescopic Device | 10. Bracket      | 18. Pin                  | 26. Half Bowl      |
| 3. Woodruff Key      | 11. Ring         | 19. Collar               | 27. Clamp          |
| 4. Nut               | 12. Covering     | 20. Substructure, Compl. | 28. Pedal          |
| 5. Spring            | 13. Washer       | 21. Plate                | 29. Steering Wheel |
| 6. Shield            | 14. Half Bowl    | 22. Stop                 | 30. Turning Handle |
| 7. Covering          | 15. Substructure | 23. Spring               | 31. Cap            |
| 8. Spring            | 16. Segment      | 24. Shaft                | 32. Switch         |

# MACHINE CONFIGURATION

# CONTROL SYSTEM



W2C504E



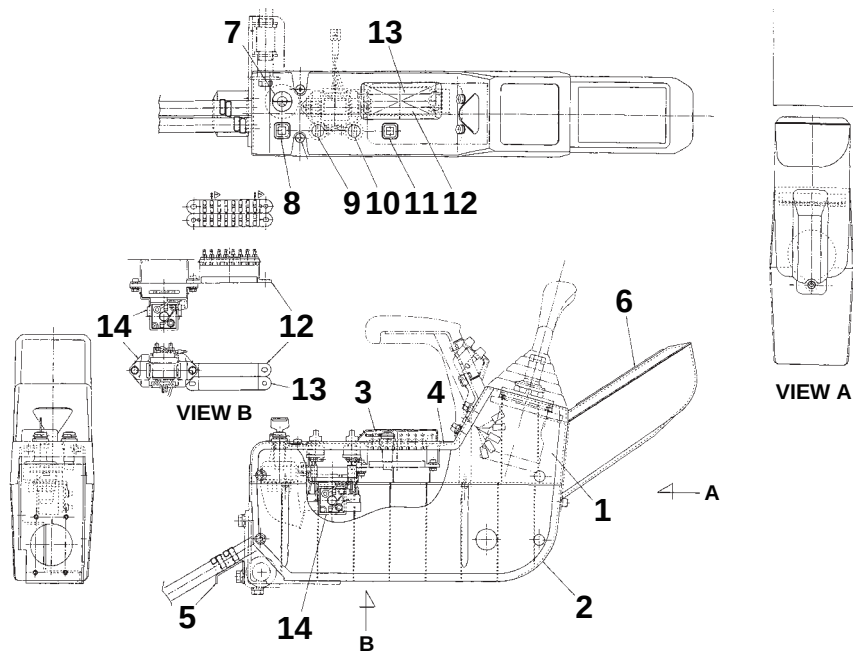
W3C501



## MACHINE CONFIGURATION

## CONTROL SYSTEM

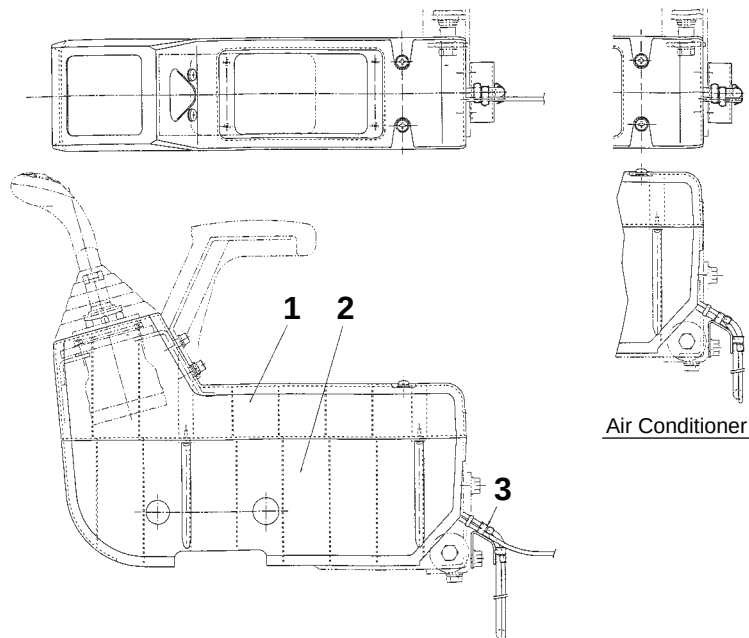
### Control Box R



W2C506E

- |                  |                      |                        |                  |
|------------------|----------------------|------------------------|------------------|
| 1. Panel Cover R | 5. Clamp             | 9. Light Switch        | 13. Fuse Box     |
| 2. Cover         | 6. Cluster Gauge     | 10. Wiper Switch       | 14. Safety Relay |
| 3. Cover         | 7. Starter Switch    | 11. Safety Lock Button |                  |
| 4. Panel Cover R | 8. Slew Speed Switch | 12. Fuse Box           |                  |

### Control Box L

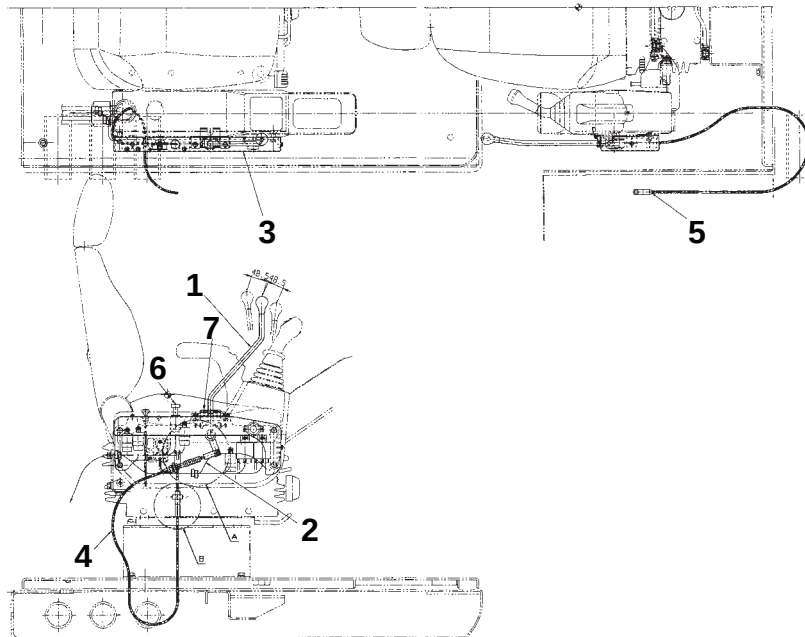


Air Conditioner

W2C507E

- |                  |
|------------------|
| 1. Panel Cover L |
| 2. Cover         |
| 3. Clamp         |

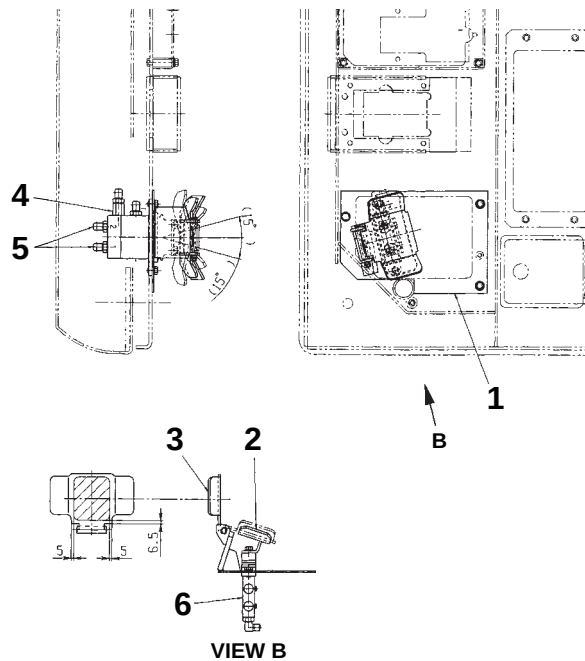
## Dozer Blade Lever



W2C508

- |                      |                      |          |
|----------------------|----------------------|----------|
| 1. Dozer Blade Lever | 4. Control Cable     | 7. Hinge |
| 2. Bracket           | 5. Yoke              |          |
| 3. Cover             | 6. Cigarette Lighter |          |

## Swing Pedal



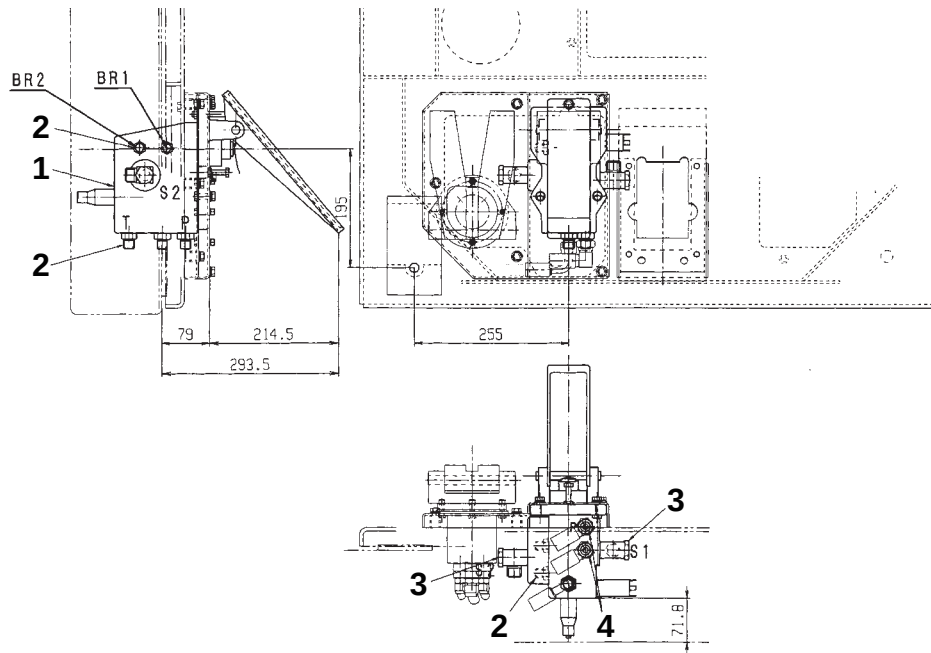
W2C509E

- |                |            |                        |
|----------------|------------|------------------------|
| 1. Bracket     | 3. Cover   | 5. Elbow               |
| 2. Swing Pedal | 4. Bushing | 6. Pilot Valve (Swing) |

## MACHINE CONFIGURATION

## CONTROL SYSTEM

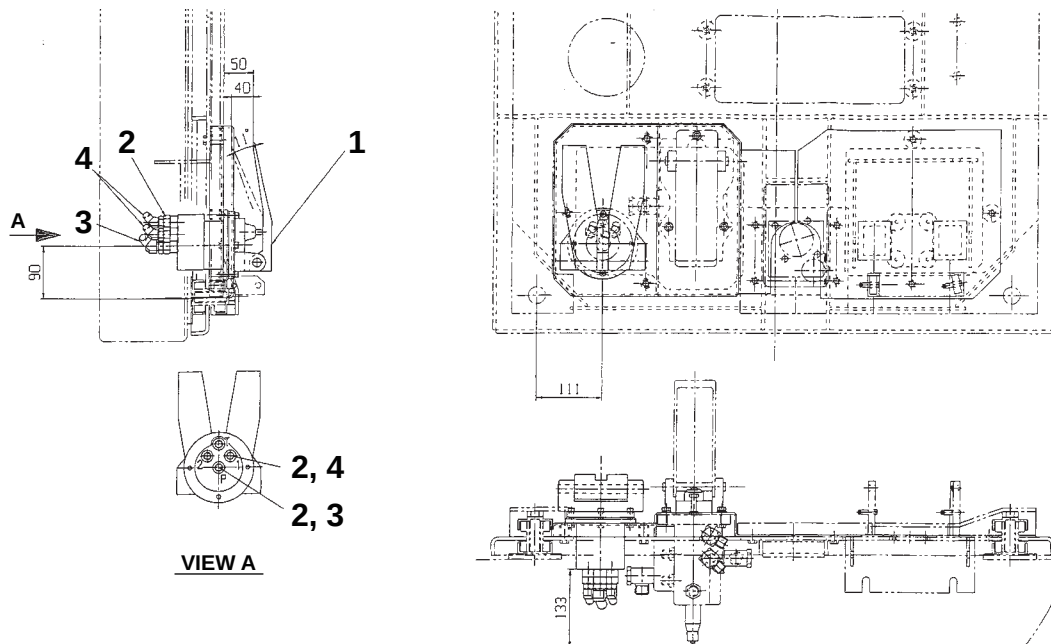
### Pilot Valve (Brake)



W2C510

- |                        |            |
|------------------------|------------|
| 1. Pilot Valve (Brake) | 3. Elbow   |
| 2. Adapter             | 4. Adapter |

### Pilot Valve (Travel)



W2C511E

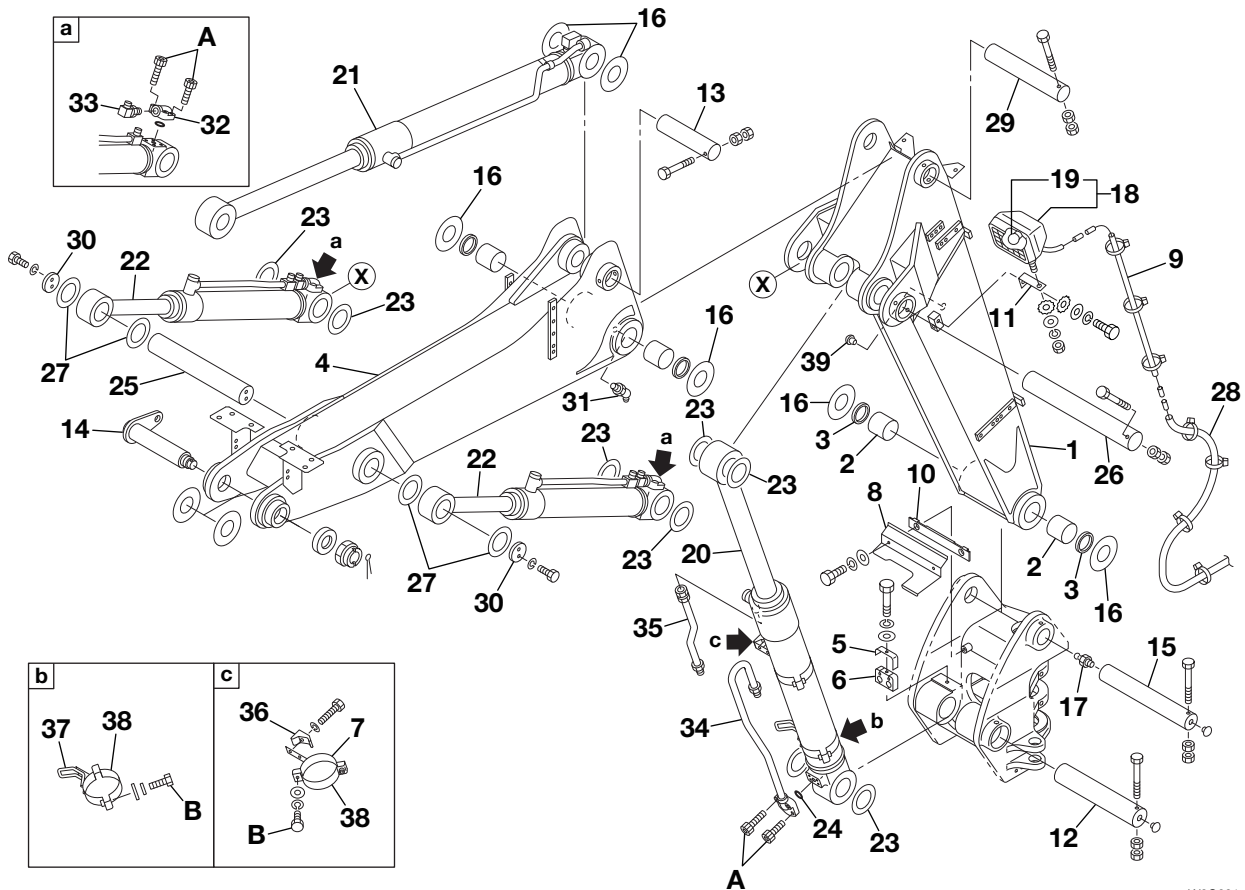
- |                         |          |
|-------------------------|----------|
| 1. Pilot Valve (Travel) | 3. Elbow |
| 2. Bushing              | 4. Elbow |



## ATTACHMENTS

## CONSTRUCTION

## 2-Piece Boom 1



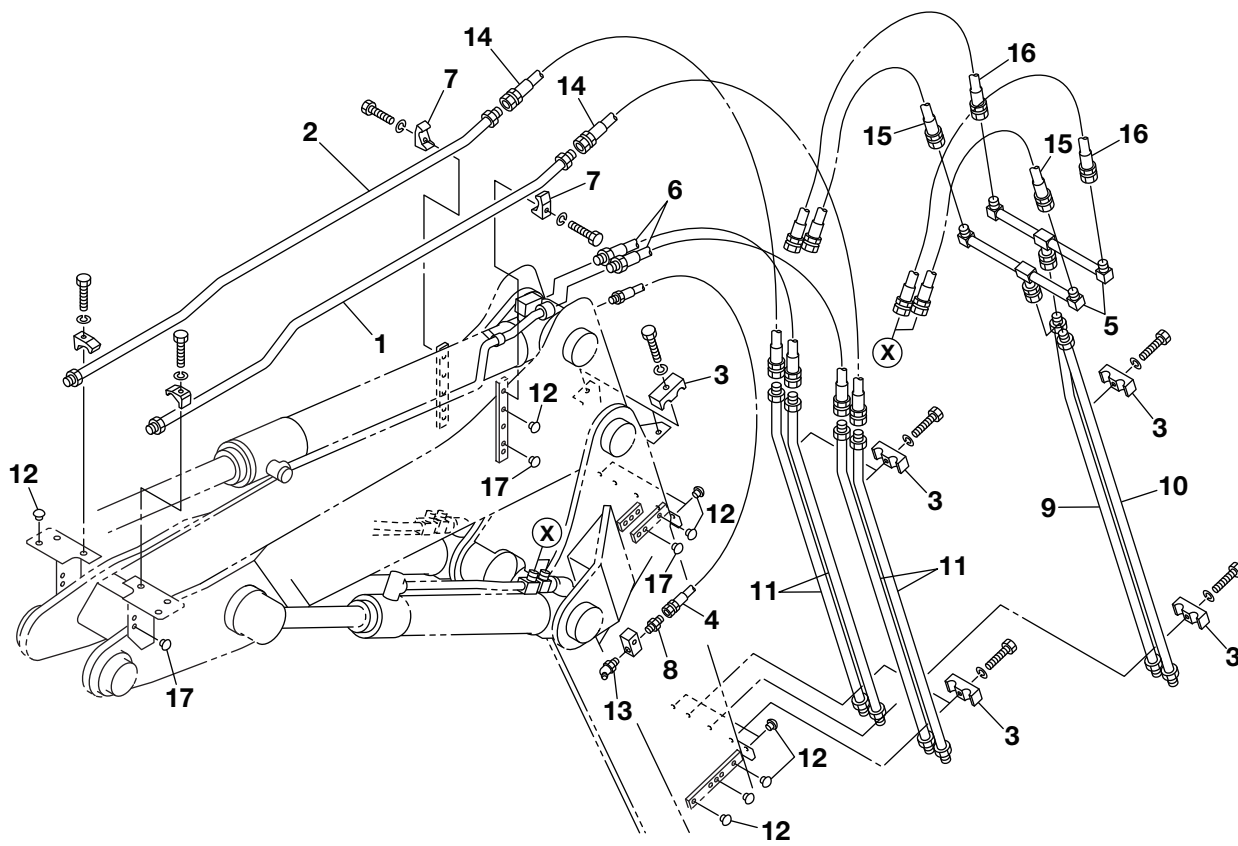
W3C601

A:  $\approx 26 \text{ N}\cdot\text{m}$ B:  $\approx 31.5 \pm 5.88 \text{ N}\cdot\text{m}$ 

- Keep the clearance at the pin connecting section (excluding the bucket connecting section) to 0.5 mm or less by using the shim.
- When fastening the lock bolt with double nuts, maintain a clearance between the nuts and the bushing of 0.5~1.0 mm when tightening the double nuts.

|                      |                              |                   |           |
|----------------------|------------------------------|-------------------|-----------|
| 1. Boom              | 12. Pin                      | 23. Shim          | 34. Tube  |
| 2. Bushing           | 13. Pin                      | 24. O-ring        | 35. Tube  |
| 3. Dust Seal         | 14. Pin                      | 25. Pin           | 36. Clamp |
| 4. Intermediate Boom | 15. Pin                      | 26. Pin           | 37. Band  |
| 5. Plate             | 16. Shim                     | 27. Shim          | 38. Band  |
| 6. Protector         | 17. Grease Nipple            | 28. Protector     | 39. Cap   |
| 7. Clamp             | 18. Boom Light               |                   |           |
| 8. Cover             | 19. Bulb                     |                   |           |
| 9. Wire Harness      | 20. Boom Cylinder            |                   |           |
| 10. Rubber           | 21. Arm Cylinder             |                   |           |
| 11. Bracket          | 22. Boom adjustment Cylinder |                   |           |
|                      |                              | 31. Grease Nipple |           |
|                      |                              | 32. Elbow         |           |
|                      |                              | 33. Elbow         |           |

2-Piece Boom 2

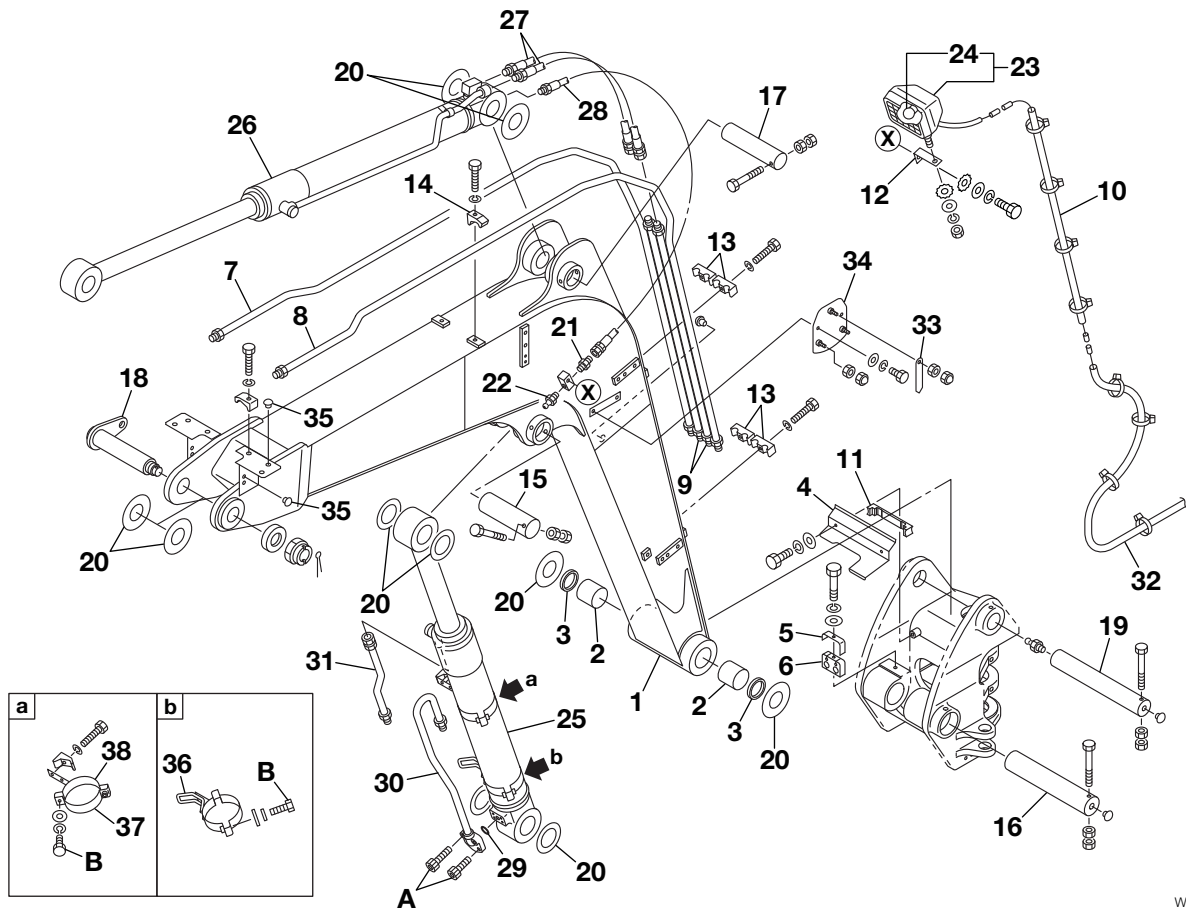


W3C602

- Keep the clearance at the pin connecting section (excluding the bucket connecting section) to 0.5 mm or less by using the shim.
- When fastening the lock bolt with double nuts, maintain a clearance between the nuts and the bushing of 0.5~1.0 mm when tightening the double nuts.

- |            |                   |
|------------|-------------------|
| 1. Pipe L  | 10. Pipe L        |
| 2. Pipe R  | 11. Pipe          |
| 3. Clamp   | 12. Cap           |
| 4. Hose    | 13. Grease Nipple |
| 5. Pipe    | 14. Hose          |
| 6. Hose    | 15. Hose          |
| 7. Clamp   | 16. Hose          |
| 8. Adapter | 17. Cap           |
| 9. Pipe R  |                   |

**Mono-Boom**



W3C603

A: 26 N·m

B: 31.5 ±5.88 N·m

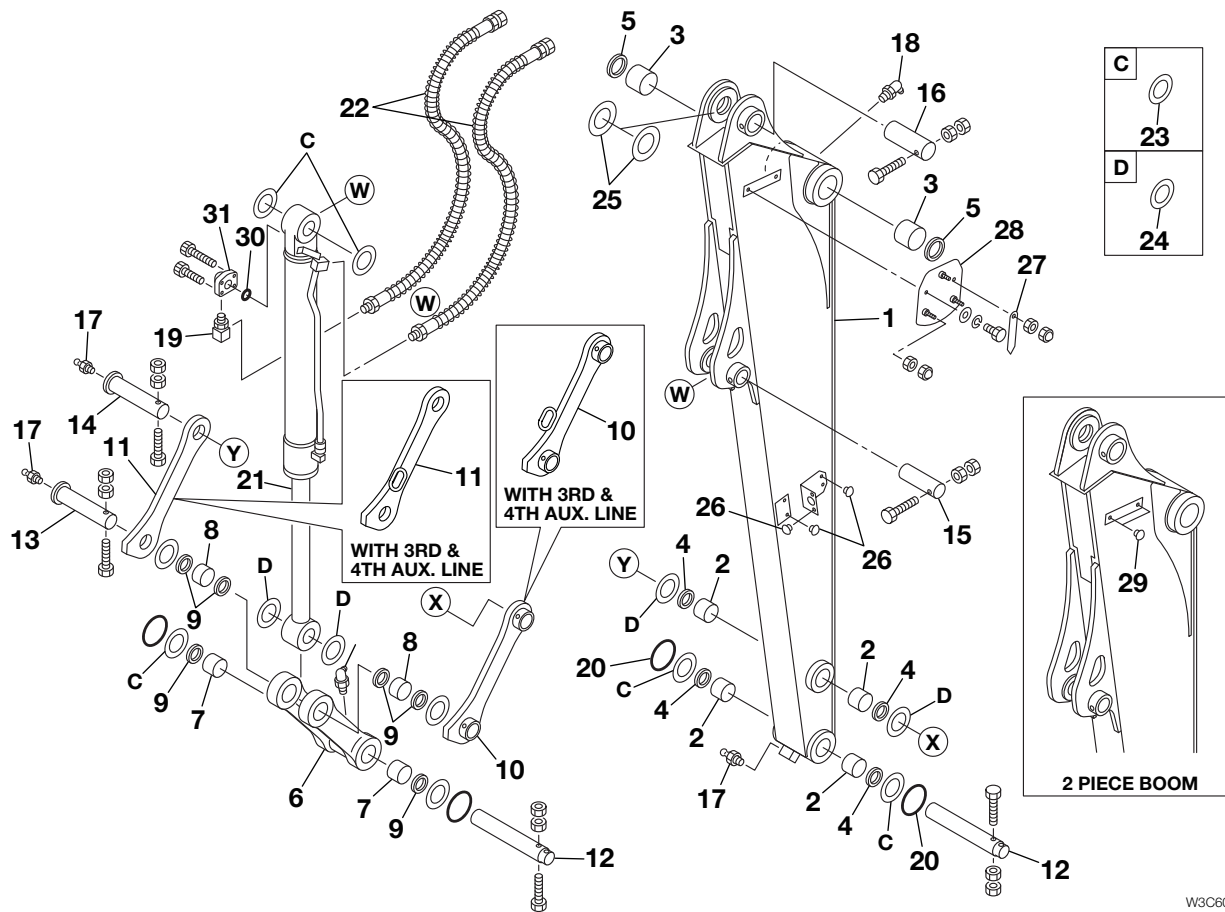
- Keep the clearance at the pin connecting section (excluding the bucket connecting section) to 0.5 mm or less by using the shim.
- When fastening the lock bolt with double nuts, maintain a clearance between the nuts and the bushing of 0.5~1.0 mm when tightening the double nuts.

|                  |             |                   |               |
|------------------|-------------|-------------------|---------------|
| 1. Boom          | 11. Rubber  | 21. Adapter       | 31. Tube      |
| 2. Bushing       | 12. Bracket | 22. Grease Nipple | 32. Protector |
| 3. Dust Seal     | 13. Clamp   | 23. Boom Light    | 33. Gauge     |
| 4. Cover         | 14. Clamp   | 24. Bulb          | 34. Plate     |
| 5. Plate         | 15. Pin     | 25. Boom Cylinder | 35. Cap       |
| 6. Protector     | 16. Pin     | 26. Arm Cylinder  | 36. Band      |
| 7. Pipe R        | 17. Pin     | 27. Hose          | 37. Band      |
| 8. Pipe L        | 18. Pin     | 28. Hose          | 38. Band      |
| 9. Pipe          | 19. Pin     | 29. O-ring        |               |
| 10. Wire Harness | 20. Shim    | 30. Tube          |               |

## MACHINE CONFIGURATION

## ATTACHMENTS

## Arm



W3C604

A: 26 N·m

- Keep the clearance at the pin connecting section (excluding the bucket connecting section) to 0.5 mm or less by using the shim.
- When fastening the lock bolt with double nuts, maintain a clearance between the nuts and the bushing of 0.5~1.0 mm when tightening the double nuts.

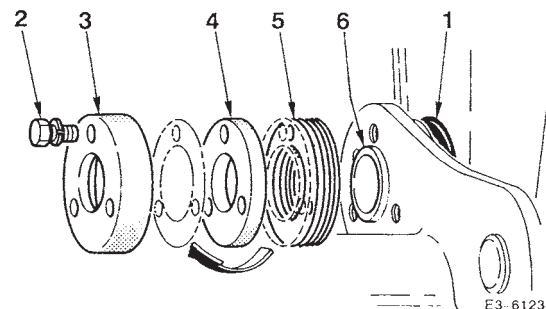
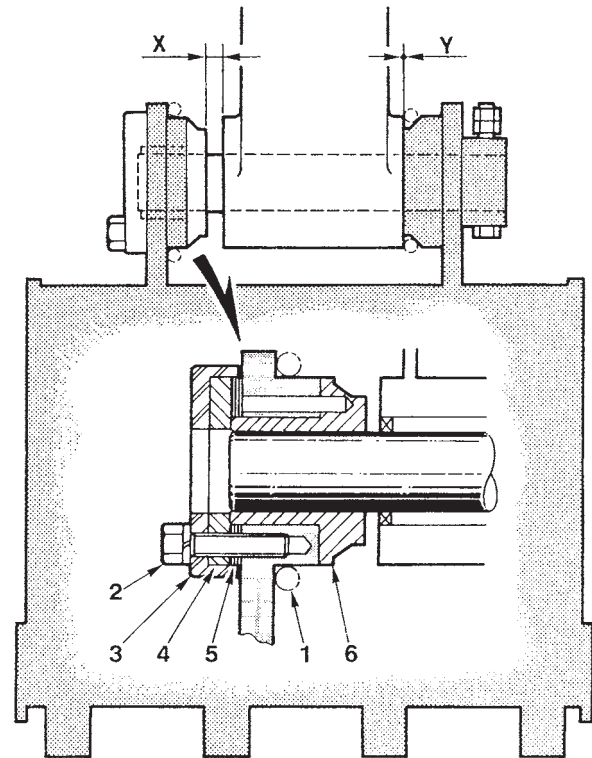
|                  |                     |            |
|------------------|---------------------|------------|
| 1. Arm           | 12. Pin             | 23. Shim   |
| 2. Bushing       | 13. Pin             | 24. Shim   |
| 3. Bushing       | 14. Pin             | 25. Shim   |
| 4. Dust Seal     | 15. Pin             | 26. Cap    |
| 5. Dust Seal     | 16. Pin             | 27. Gauge  |
| 6. Bucket Link   | 17. Grease Nipple   | 28. Plate  |
| 7. Bushing       | 18. Elbow           | 29. Cap    |
| 8. Bushing       | 19. Elbow           | 30. O-ring |
| 9. Dust Seal     | 20. O-ring          | 31. Elbow  |
| 10. Guide Link L | 21. Bucket Cylinder |            |
| 11. Guide Link R | 22. Hose            |            |

**INSPECTION AND ADJUSTMENT****Adjusting the Clearance Between the Bucket and Arm**

Adjust the clearance between the bucket and arm so that it is 0.5 mm.

1. Clean the bucket mount and the area around it thoroughly.
2. Slide the O-ring (1).
3. Measure the clearance (X).
  - The opposite side (Y) should be fitting tightly with no clearance.
4. Calculate the amount of the clearance adjustment (the number of shims which need to be moved).
  - Subtract the recommended clearance, 0.5 mm from the value calculated above [clearance (X)]. However, since the thickness of the adjustment shims is 0.5 mm, the actual clearance will be a value near 0.5.

Example: If the clearance (X) is 1.8 mm,  
 $1.8 - 0.5 = 1.3$  mm  
 Shims to be moved: 2 shims
5. Loosen the bolts (2), leave one and take out the other 2.
6. With the bolt remaining in the end plate (3), flange (4) and shim (5), remove the parts so that their assembly order is not destroyed.
7. Take out only the number of shims required for clearance adjustment from between the bushing (6) and flange.
8. Insert the shims which were just removed between the flange and the end plate, then reassemble the parts.  
 Tighten the 3 bolts uniformly.  
 ⚙ Bolt: 83 N·m
9. Return the O-ring to its proper position.





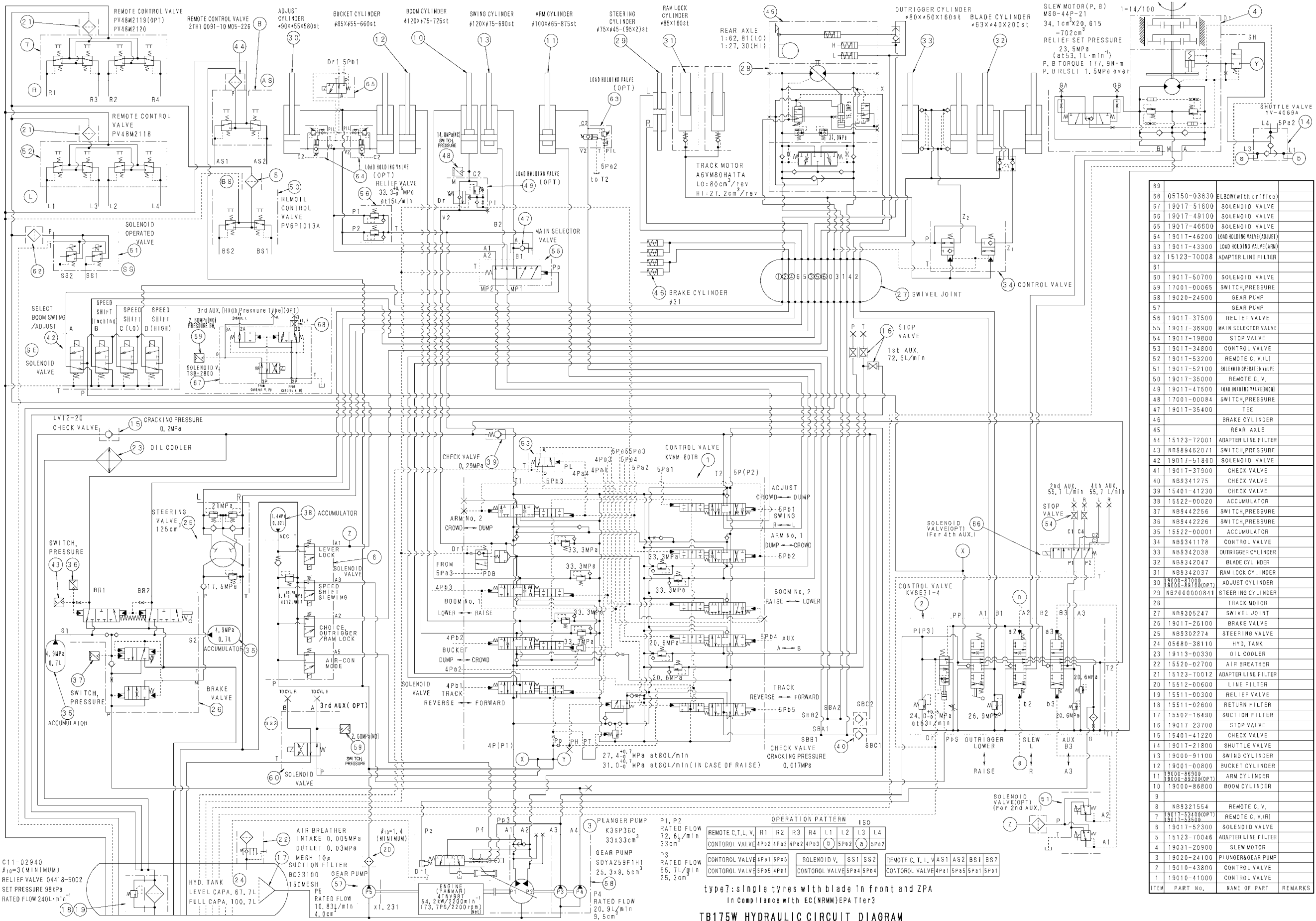
HYDRAULIC SYSTEM

MACHINE CONFIGURATION

HYDRAULIC SYSTEM

HYDRAULIC CIRCUIT DIAGRAM

2 Piece Boom

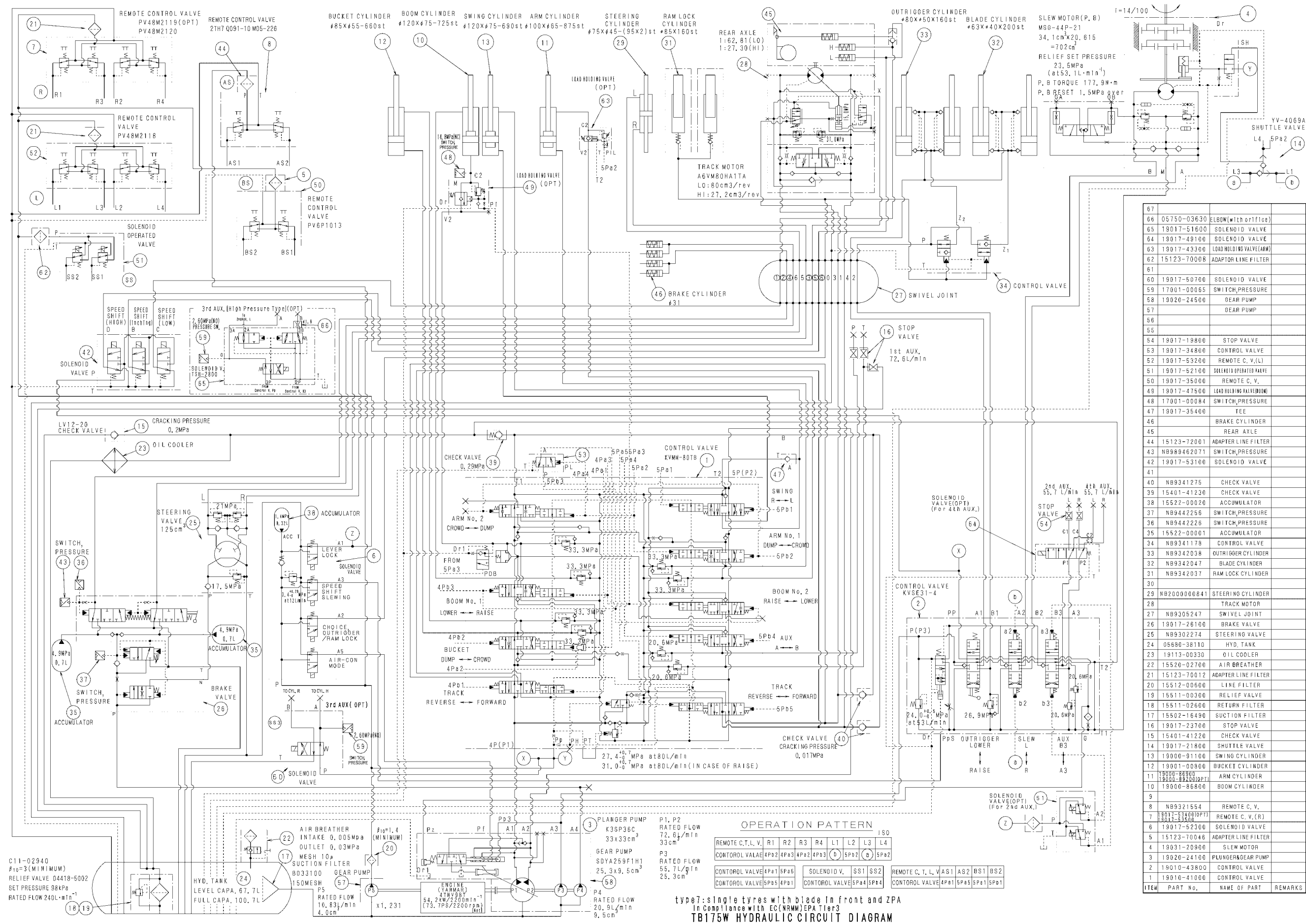




MACHINE CONFIGURATION

HYDRAULIC SYSTEM

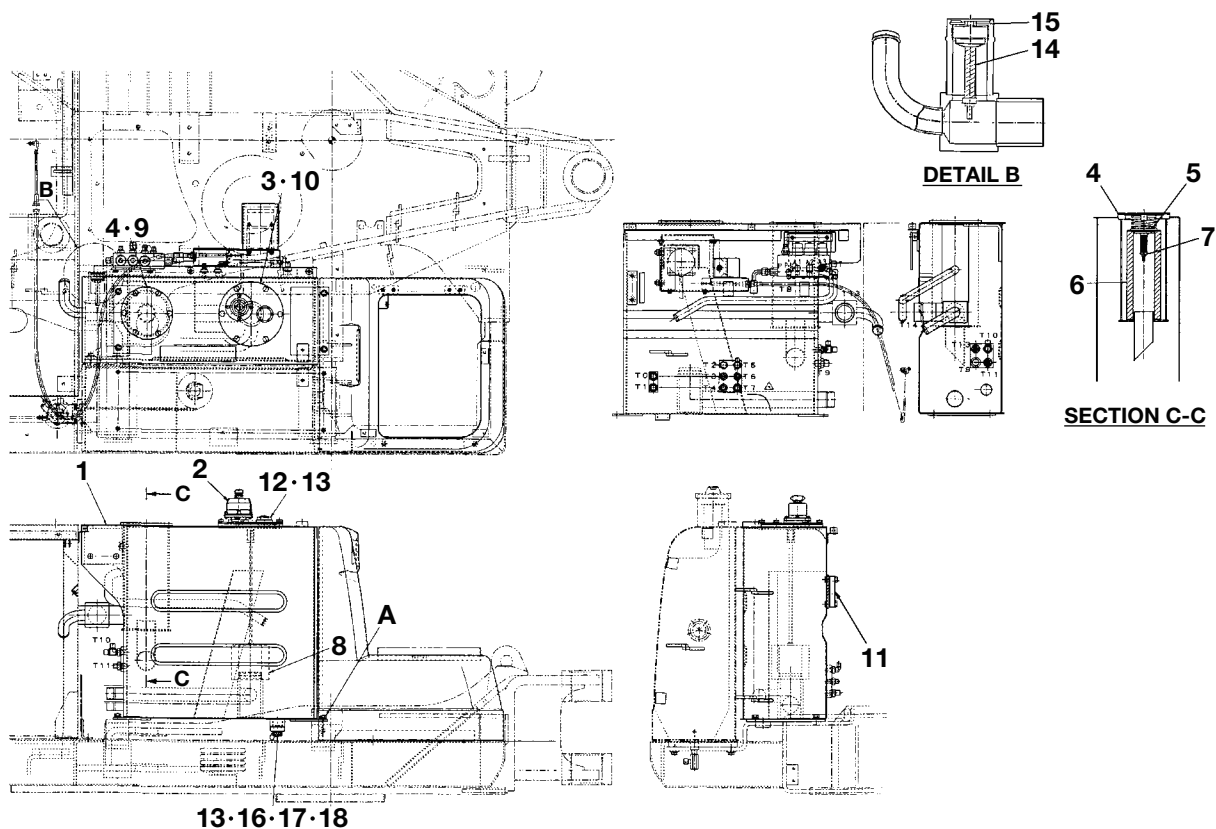
Mono-Boom





## CONSTRUCTION

### Hydraulic Tank



W3C701E

A: 54.9 N·m  
Apply thread-locking compound.

- |                   |                 |
|-------------------|-----------------|
| 1. Tank           | 10. O-ring      |
| 2. Air Breather   | 11. Sight Gauge |
| 3. Cover          | 12. Plug        |
| 4. Cover          | 13. O-ring      |
| 5. Spring         | 14. Check Valve |
| 6. Filter Element | 15. Snap Ring   |
| 7. Check Valve    | 16. Adapter     |
| 8. Suction Filter | 17. Washer      |
| 9. O-ring         | 18. Bushing     |

## MACHINE CONFIGURATION

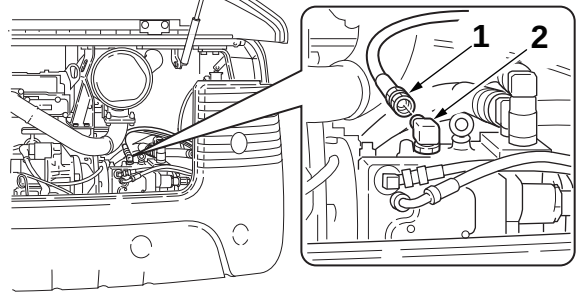
## HYDRAULIC SYSTEM

### Bleeding the air

**IMPORTANT:** After replacing the hydraulic oil, bleed the air from the hydraulic circuit and hydraulic devices. Failure to do so may damage the hydraulic devices.

### Hydraulic pump

1. Open the engine hood.
2. Disconnect the drain hose (1) from the hydraulic pump.
3. Once hydraulic oil overflows from the elbow (2), connect the drain hose (1).



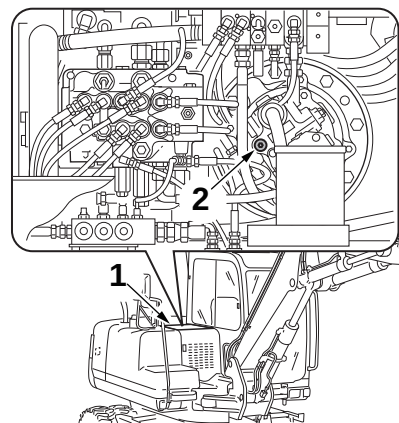
W2C705

### Slew motor

1. Loosen the bolts and remove the center cover (1).
2. Remove the plug (2).
3. Once hydraulic oil overflows from the plug hole, tighten the plug (2).
4. Install the center cover (1).

### Cylinders

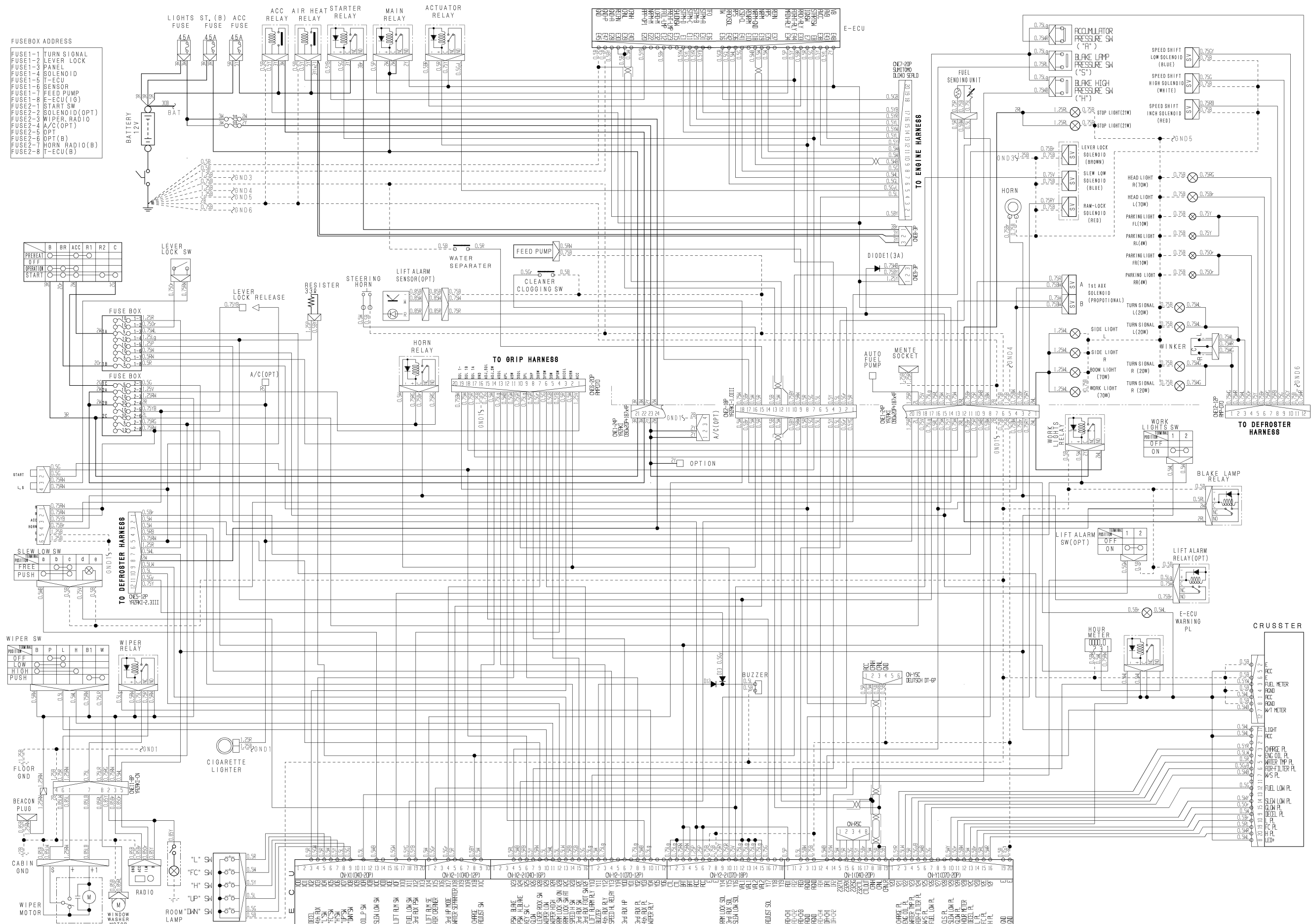
1. Start the engine and run it at low idle for 10 minutes.
2. Set the engine to a low idle, then extend and contract all the cylinders 4 or 5 times, without going to the stroke end.
3. Run the engine at high speed, then extend and contract all the cylinders 4 or 5 times, without going to the stroke end.
4. Set the engine back to a low idle, then extend and contract all the cylinders 4 or 5 times to the stroke ends.

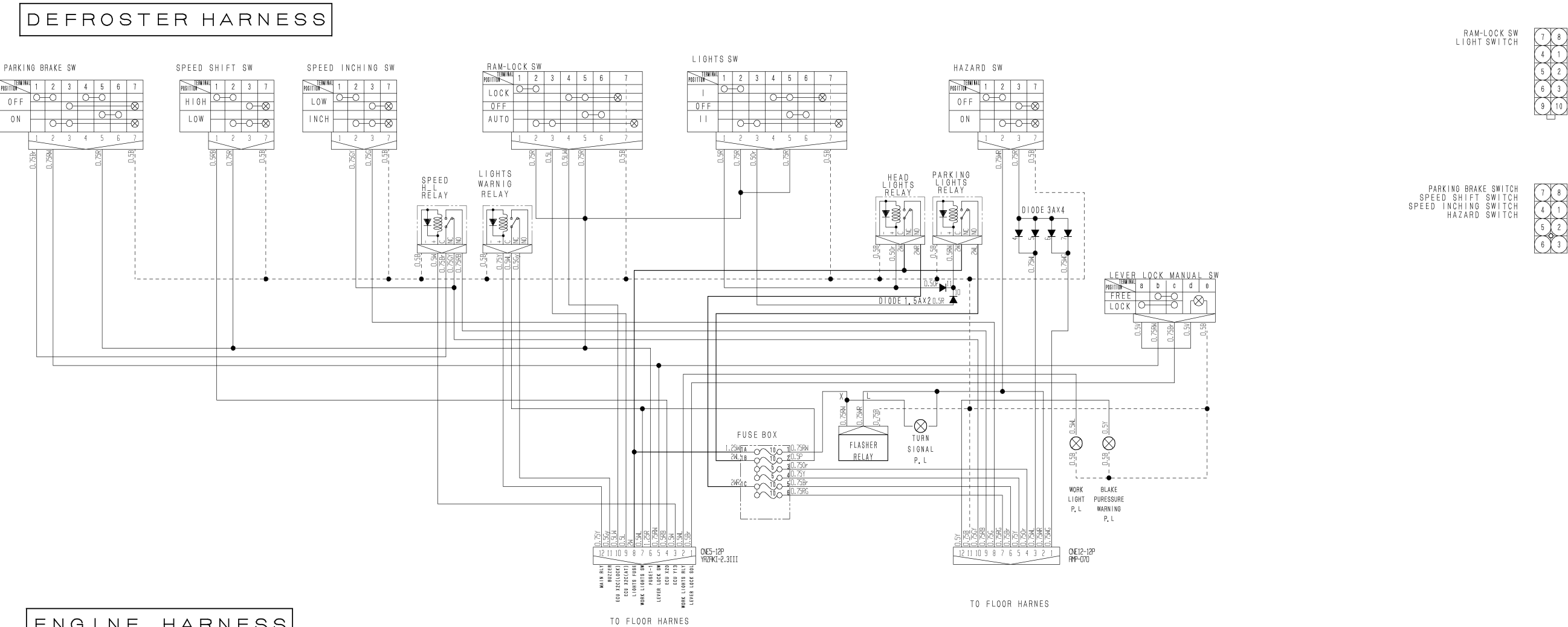


W2C706

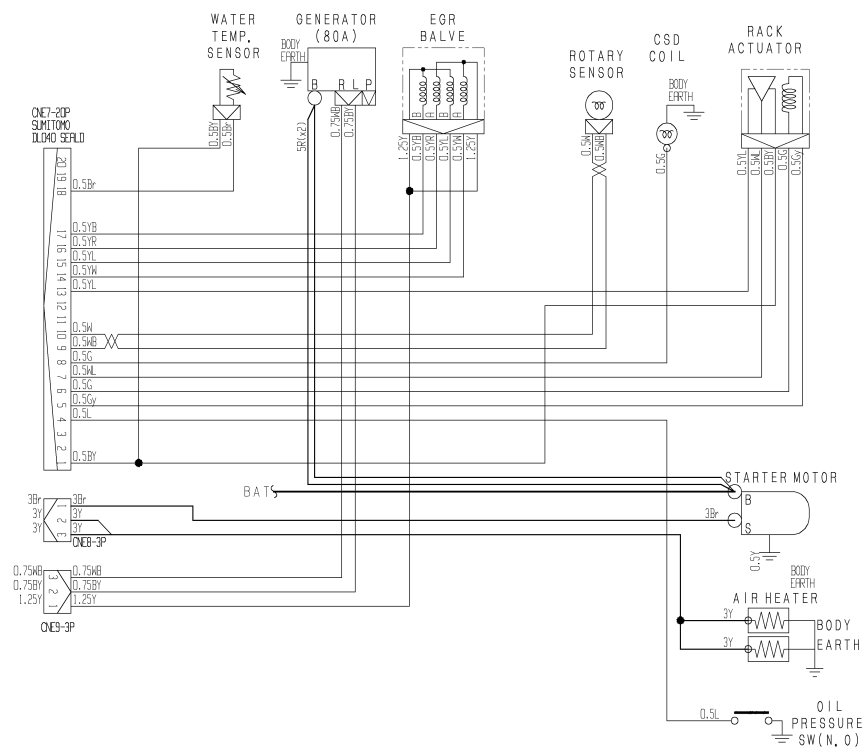
## ELECTRICAL WIRING DIAGRAM

| FUSEBOX | ADDRESS       |
|---------|---------------|
| FUSE1-1 | TURN SIGNAL   |
| FUSE1-2 | LEVER LOCK    |
| FUSE1-3 | PANEL         |
| FUSE1-4 | SOLENOID      |
| FUSE1-5 | T-ECU         |
| FUSE1-6 | SENSOR        |
| FUSE1-7 | FEED PUMP     |
| FUSE1-8 | E-ECU (1G)    |
| FUSE2-1 | START SW      |
| FUSE2-2 | SOLENOID(OPT) |
| FUSE2-3 | WIPER, RADIO  |
| FUSE2-4 | A/C(OPT)      |
| FUSE2-5 | OPT           |
| FUSE2-6 | OPT(B)        |
| FUSE2-7 | HORN RADIO(B) |
| FUSE2-8 | T-ECU(B)      |



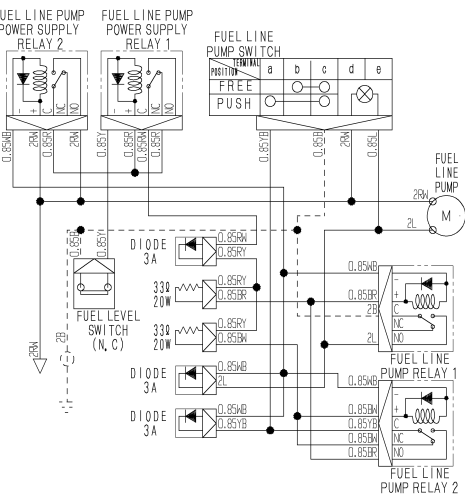


**ENGINE HARNESS**

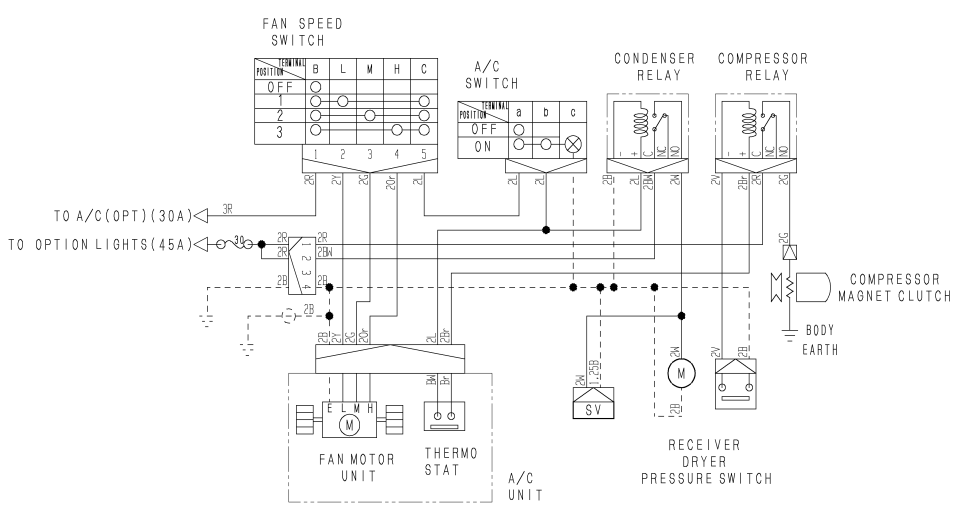


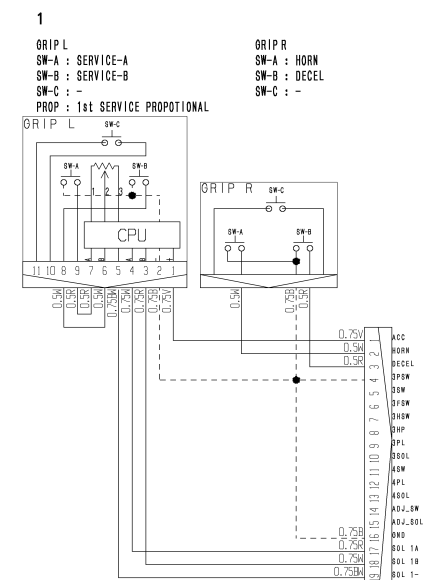
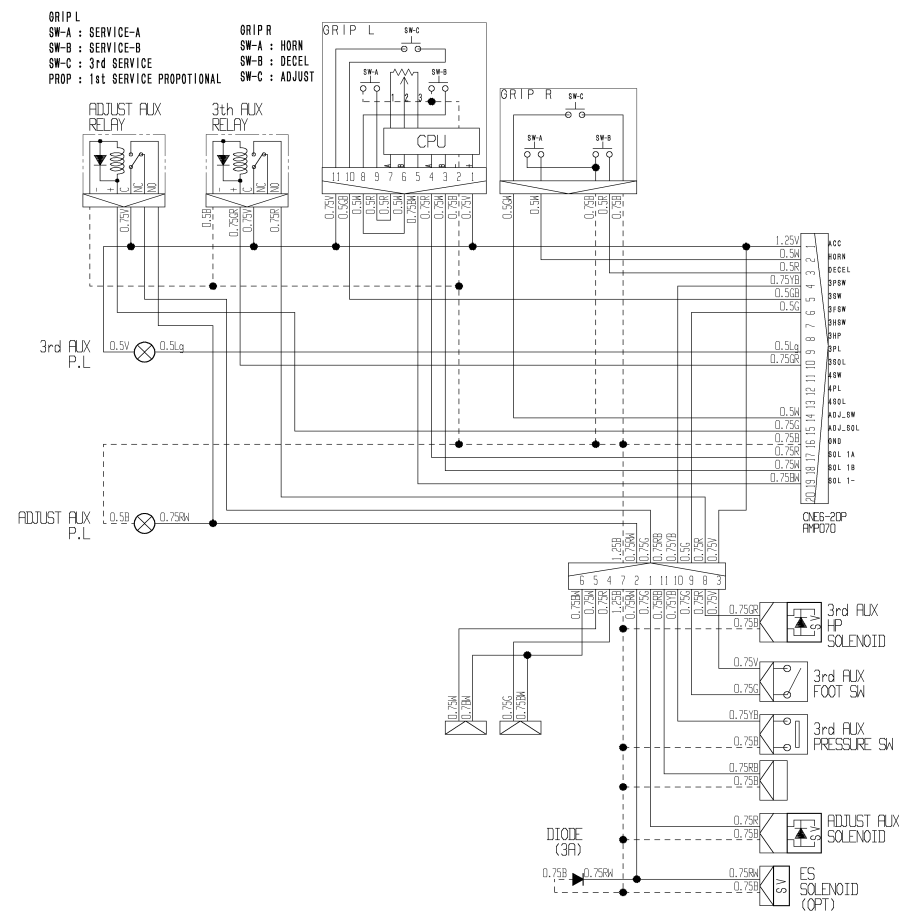
**OPTIONS**

**AUTO FUEL PUMP**



**AIR CONDITIONER**

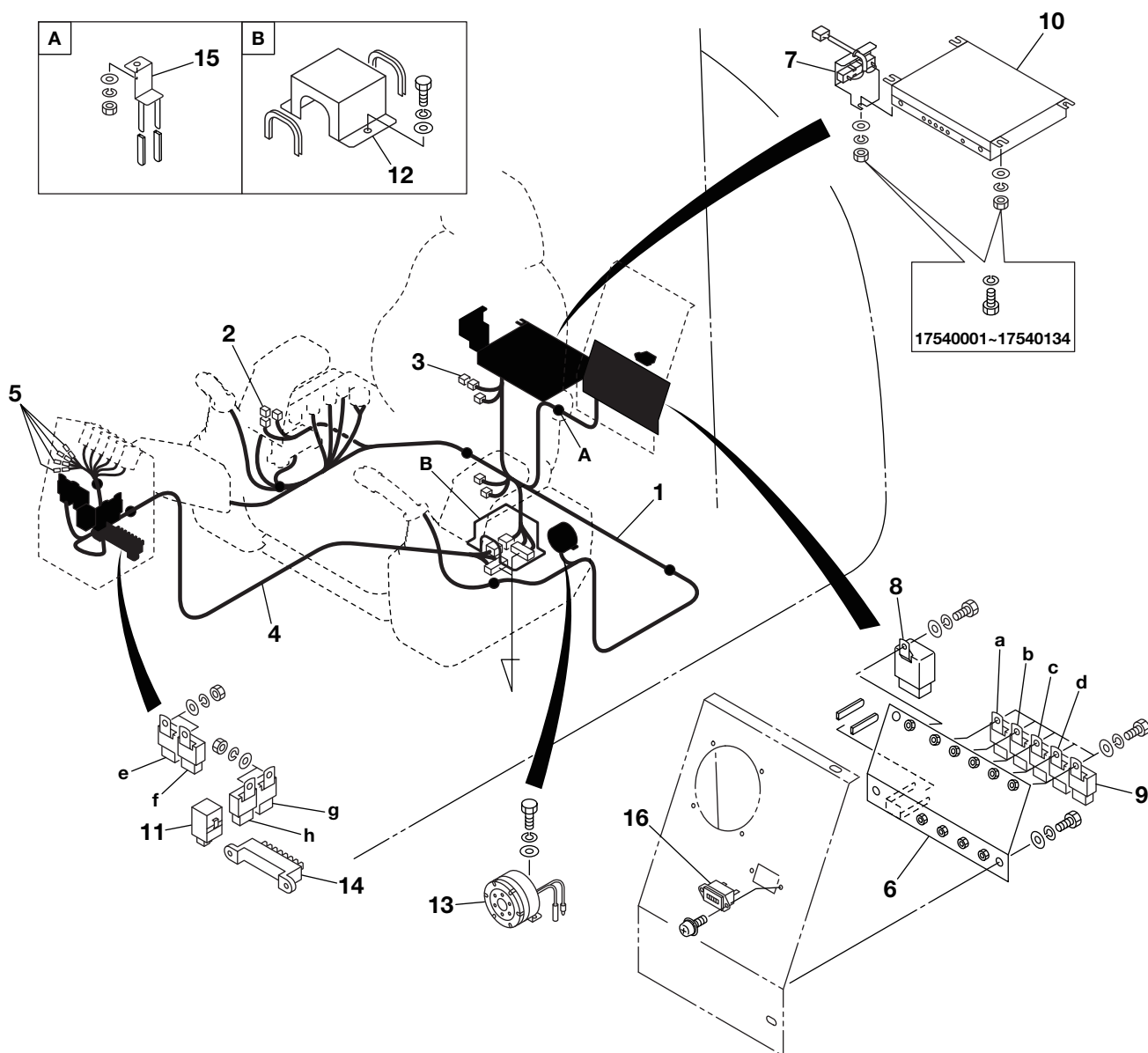






# ELECTRICAL SYSTEM

# MACHINE CONFIGURATION



W3C801

- a: Horn relay
- b: Wiper relay
- c: Light relay
- d: Lift alarm relay
- e: Parking light relay
- f: Head light relay
- g: Change speed relay
- h: Hazard relay

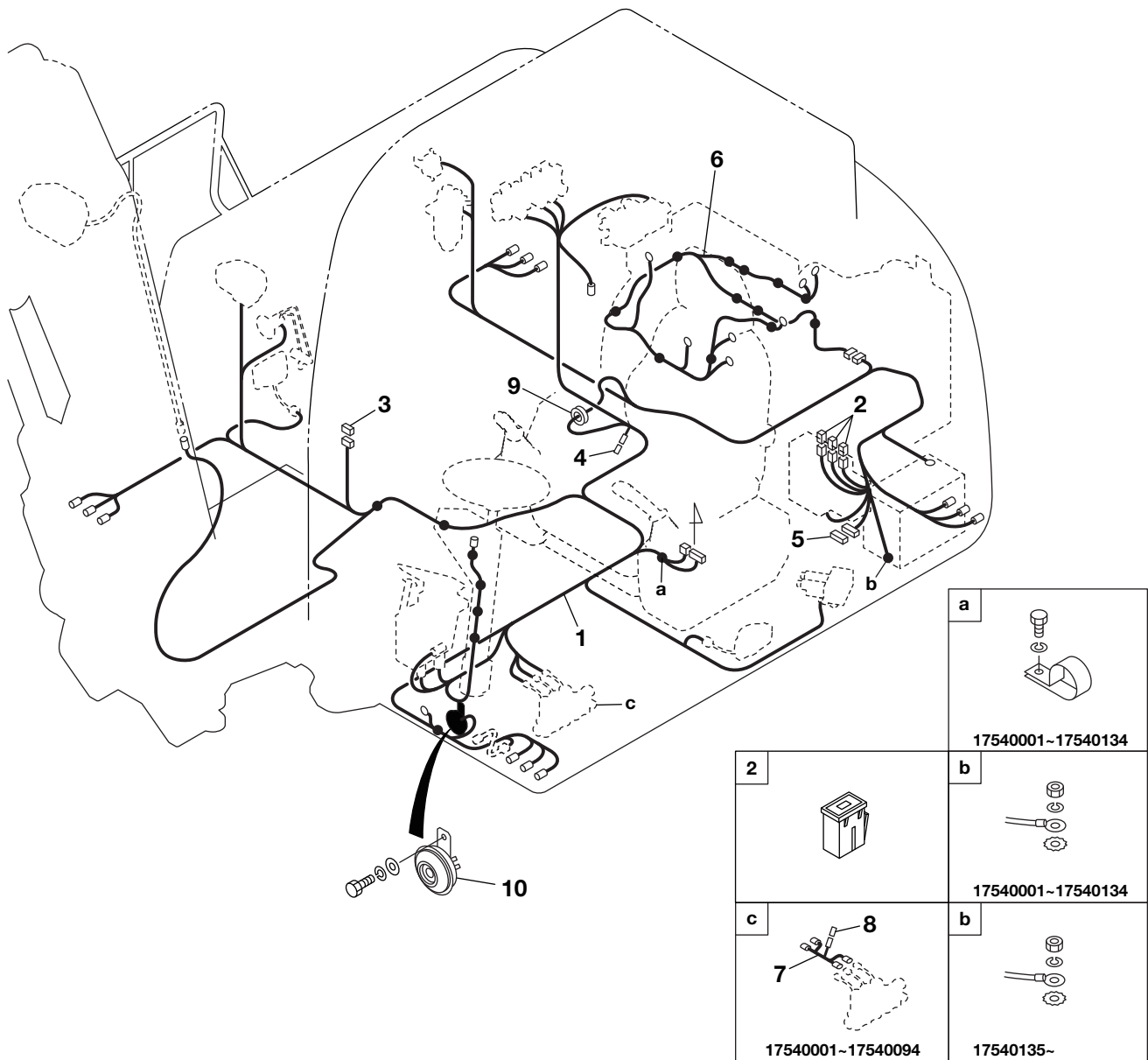
- 1. Wire Harness
- 2. Short Connector
- 3. Cap
- 4. Wire Harness
- 5. Diode (3A yellow)
- 6. Plate
- 7. Resistor
- 8. Detector

- 9. Relay
- 10. Controller
- 11. Flasher Relay
- 12. Box
- 13. Buzzer
- 14. Fuse Box
- 15. Bracket
- 16. Hour Meter



## MACHINE CONFIGURATION

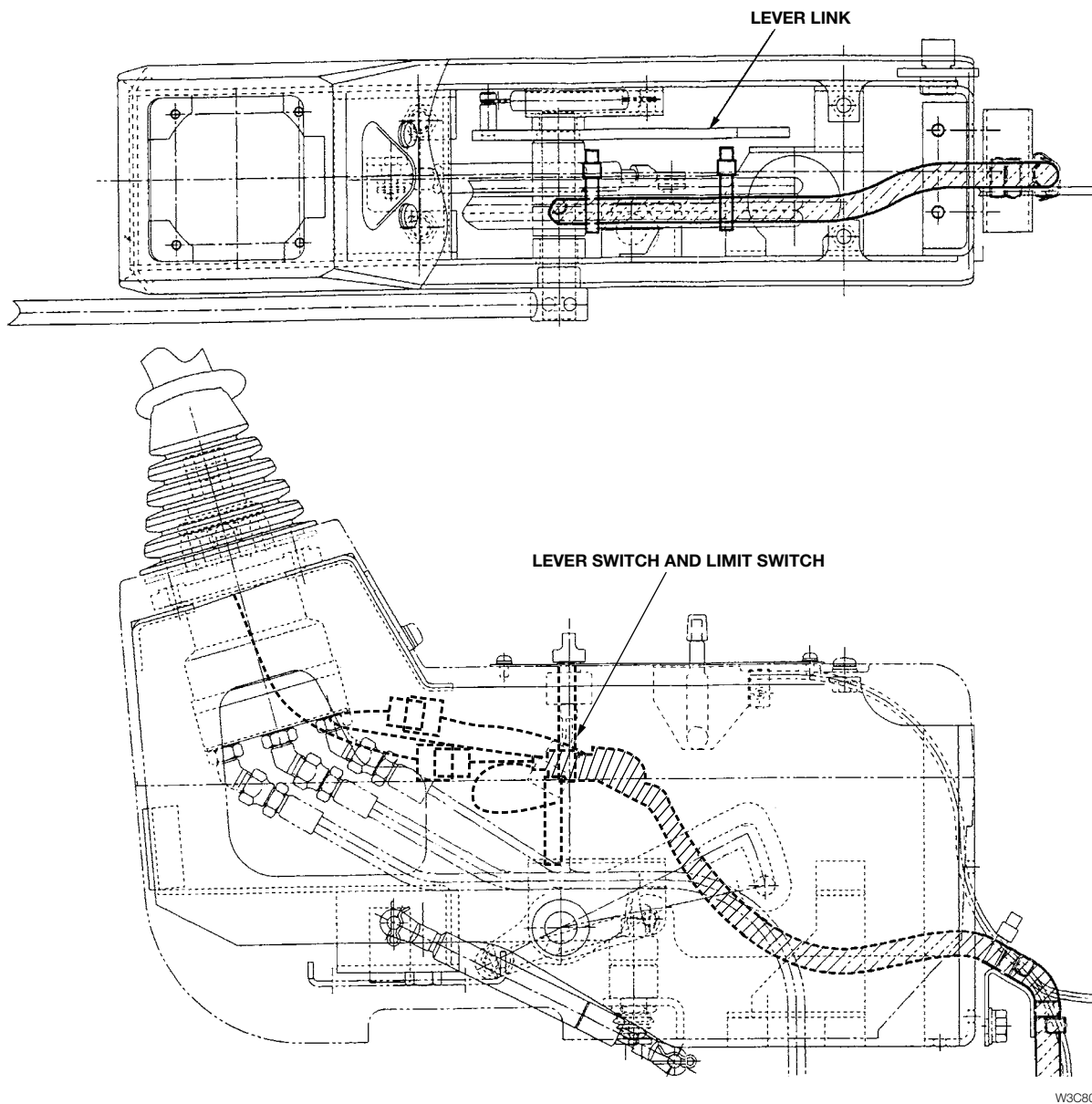
## ELECTRICAL SYSTEM



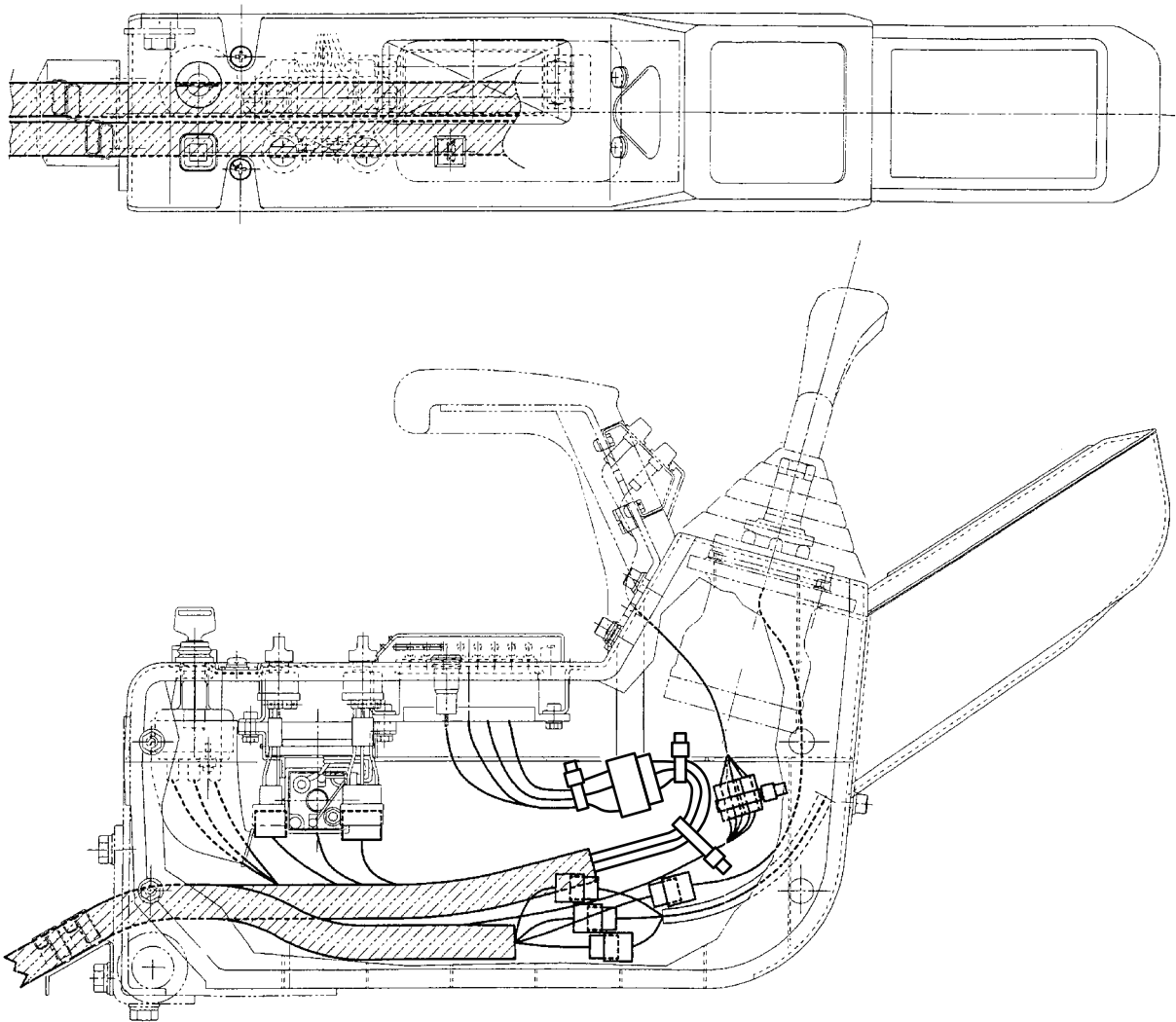
W3C802

1. Wire Harness
2. Fusible Link
3. Short Connector
4. Diode (3A yellow)
5. Short Connector
6. Wire Harness
7. Wire Harness
8. Diode (3A yellow)
9. Guard
10. Horn





W3C803

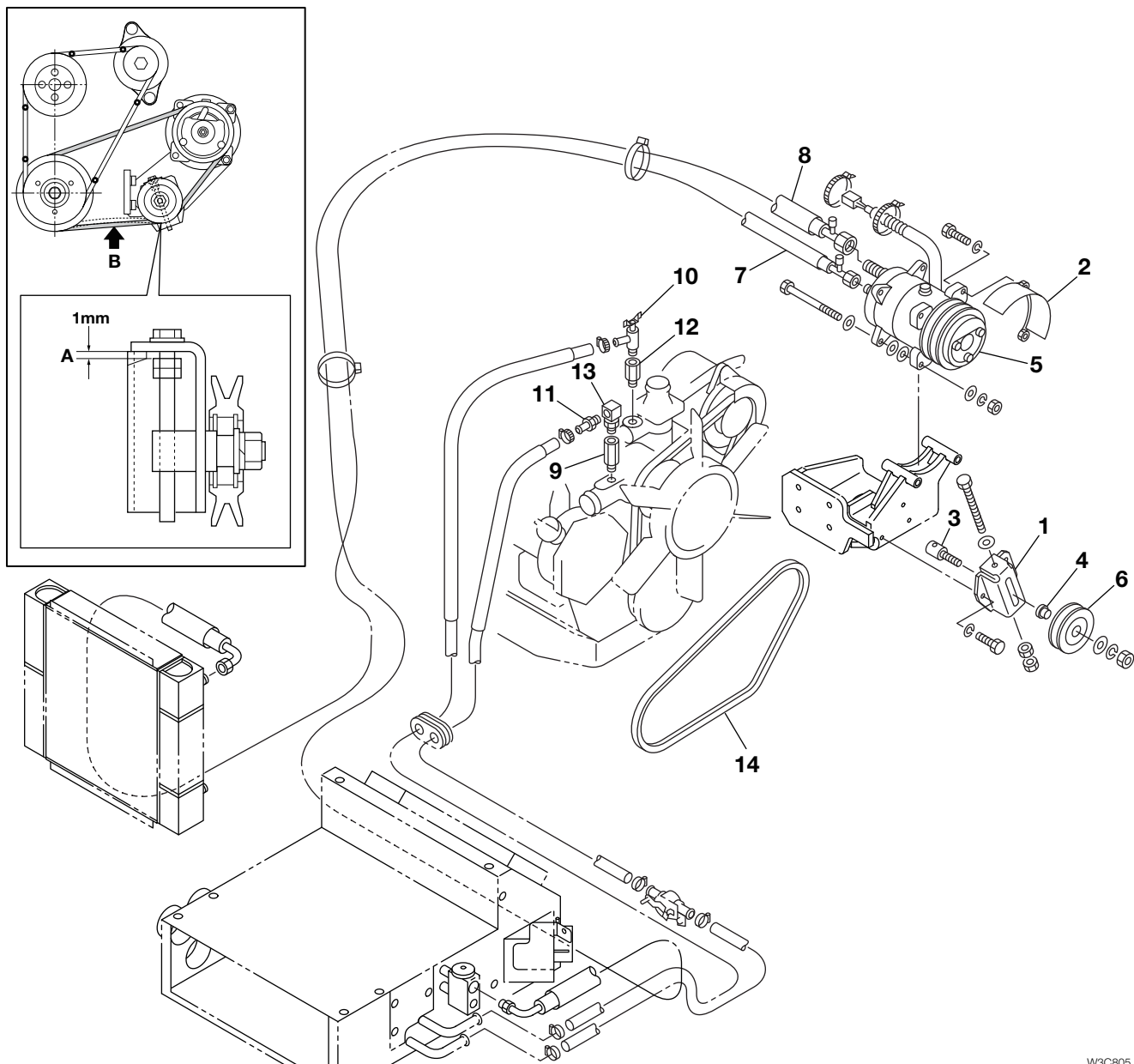


W3C804

## AIR CONDITIONER SYSTEM

### CONSTRUCTION

#### Compressor Assembly



W3C805

A: Allow a clearance.

B: Press on the center of the belt with a finger. The belt's tension is normal if it bends about 8 mm when pressed with a force of about 98N.

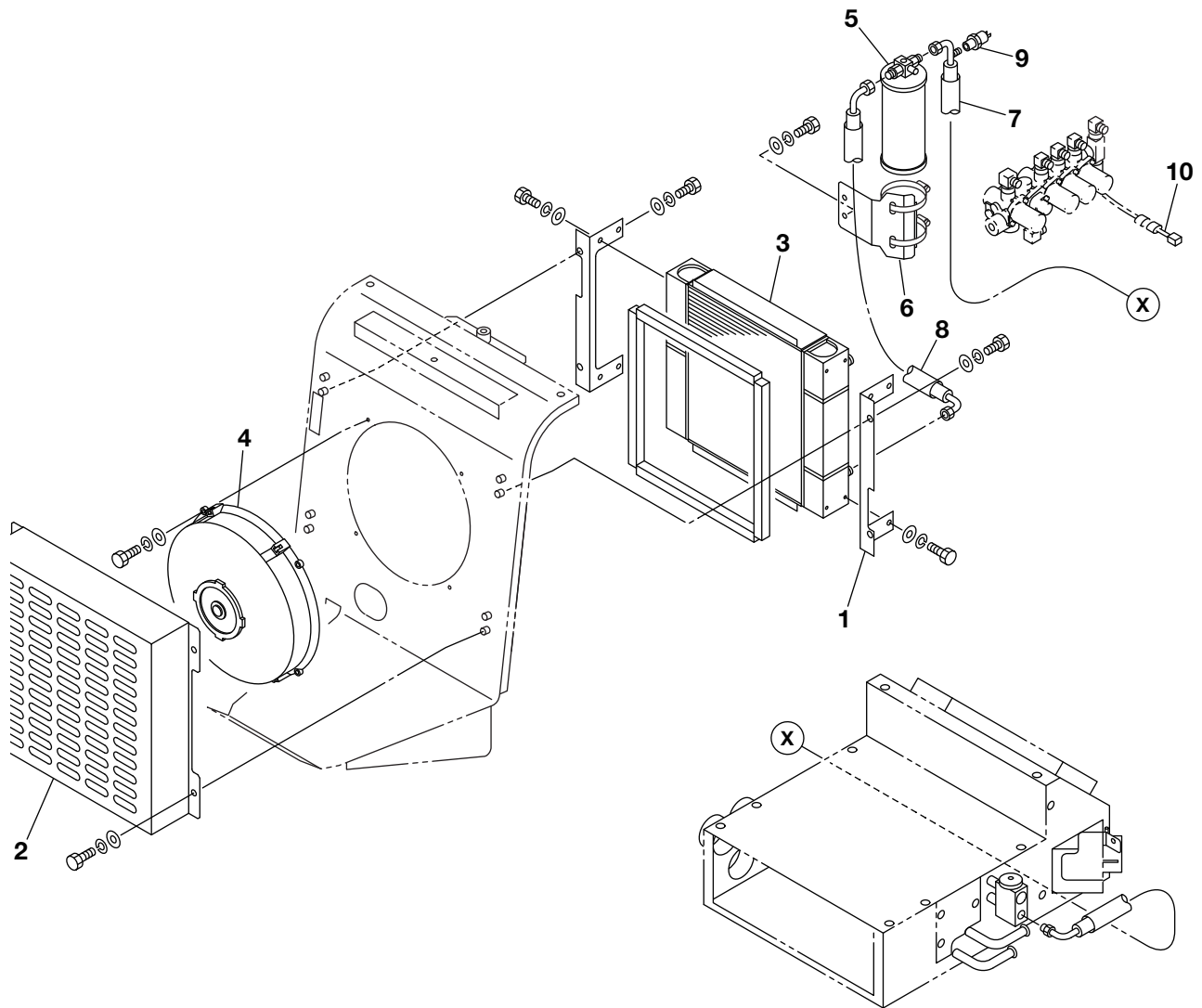
1. Bracket
2. Guard
3. Shaft
4. Collar
5. Compressor
6. Pulley
7. Hose

8. Hose
9. Bushing
10. Valve
11. Adaptor
12. Bushing
13. Elbow
14. V-Belt

## MACHINE CONFIGURATION

## AIR CONDITIONER SYSTEM

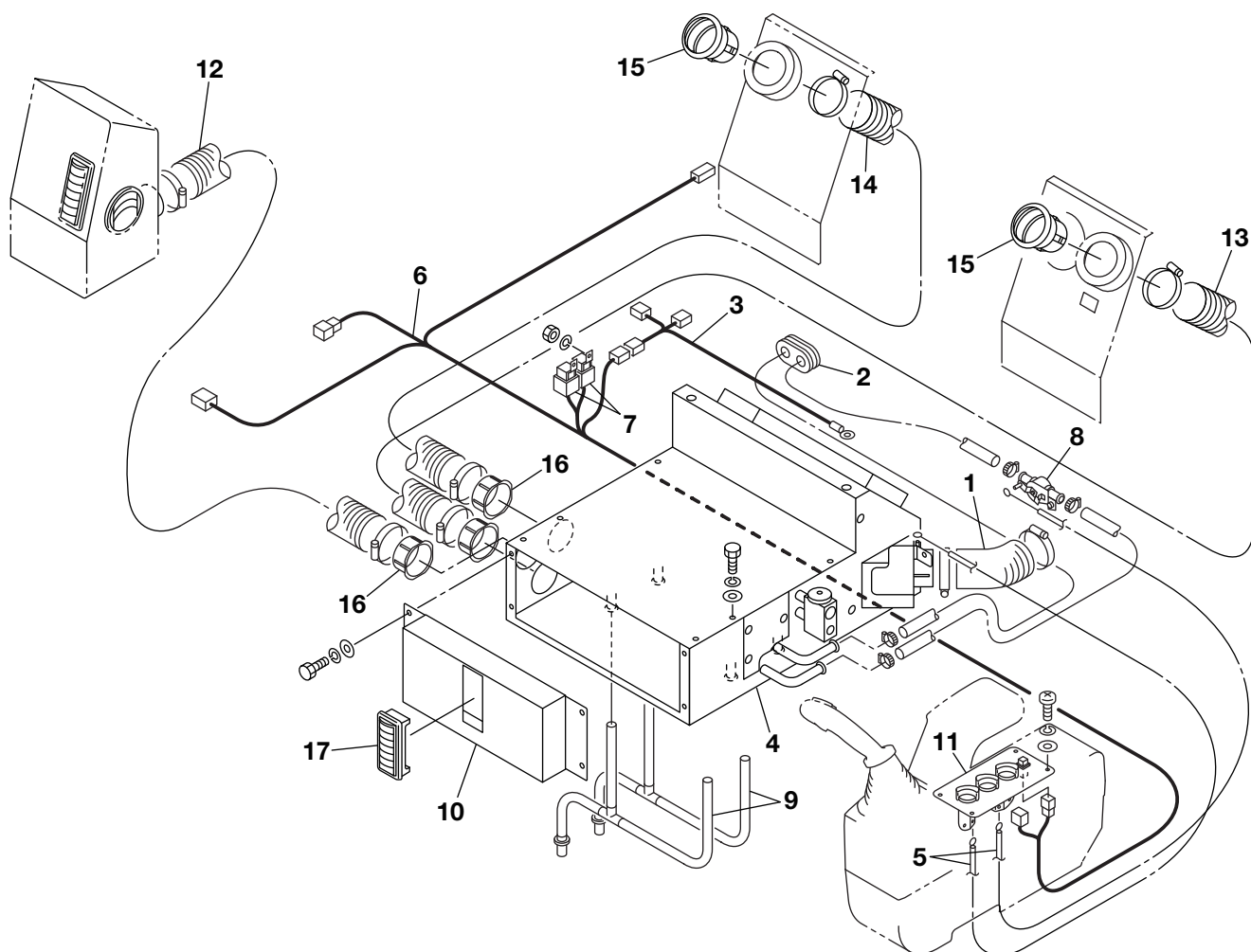
### Air Conditioner 1/2



W3C806

1. Bracket
2. Cover
3. Condenser
4. Fan
5. Dryer
6. Bracket
7. Hose
8. Hose
9. Switch
10. Connector

**Air Conditioner 2/2**



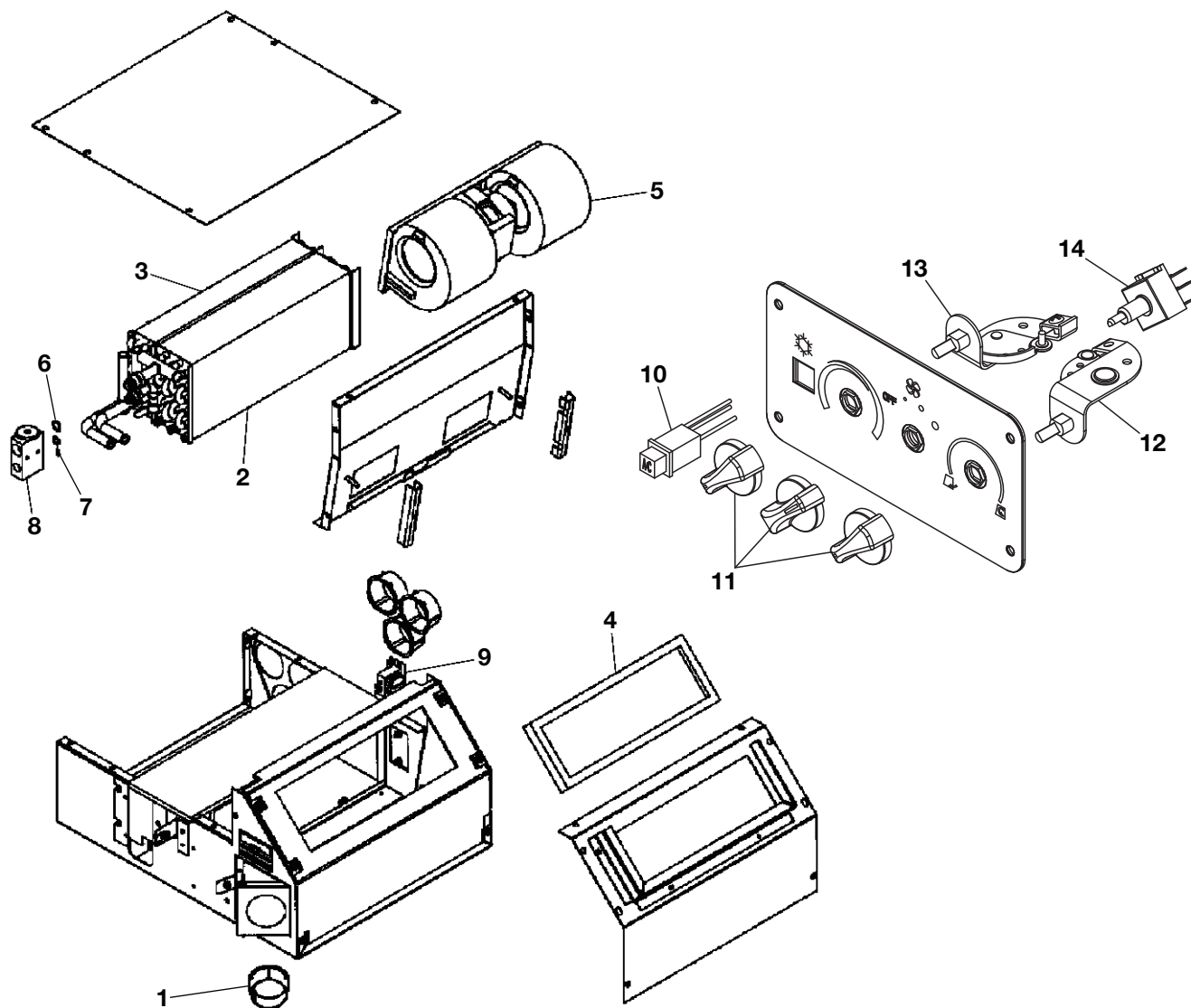
W3CB07

1. Hose
2. Guard
3. Wire Harness
4. Air Conditioner Unit
5. Wire
6. Wire Harness
7. Relay
8. Valve
9. Tube
10. Cover
11. Panel
12. Hose
13. Hose
14. Hose
15. Louver
16. Adaptor
17. Louver

## MACHINE CONFIGURATION

## AIR CONDITIONER SYSTEM

### Condenser, Air Conditioner Unit, Panel Assembly



W3C808

1. Adaptor
2. Evaporator
3. Heater Core
4. Filter
5. Blower Motor
6. O-Ring
7. O-Ring
8. Expansion Valve
9. Thermo Stat
10. Air Conditioner Switch
11. Knob
12. Cable Control Converter
13. Cable Control Converter
14. 3-Speed Rotary Switch

# Overview of System Operation

*Click on any of these  
subject headings to go  
directly to the page*

- Truck and Heavy Equipment Systems
- Air Conditioner-System Operation
- Heater System Operation
- Environmental Effects on System Operation
- Chapter Review

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## Truck and Heavy Equipment Systems

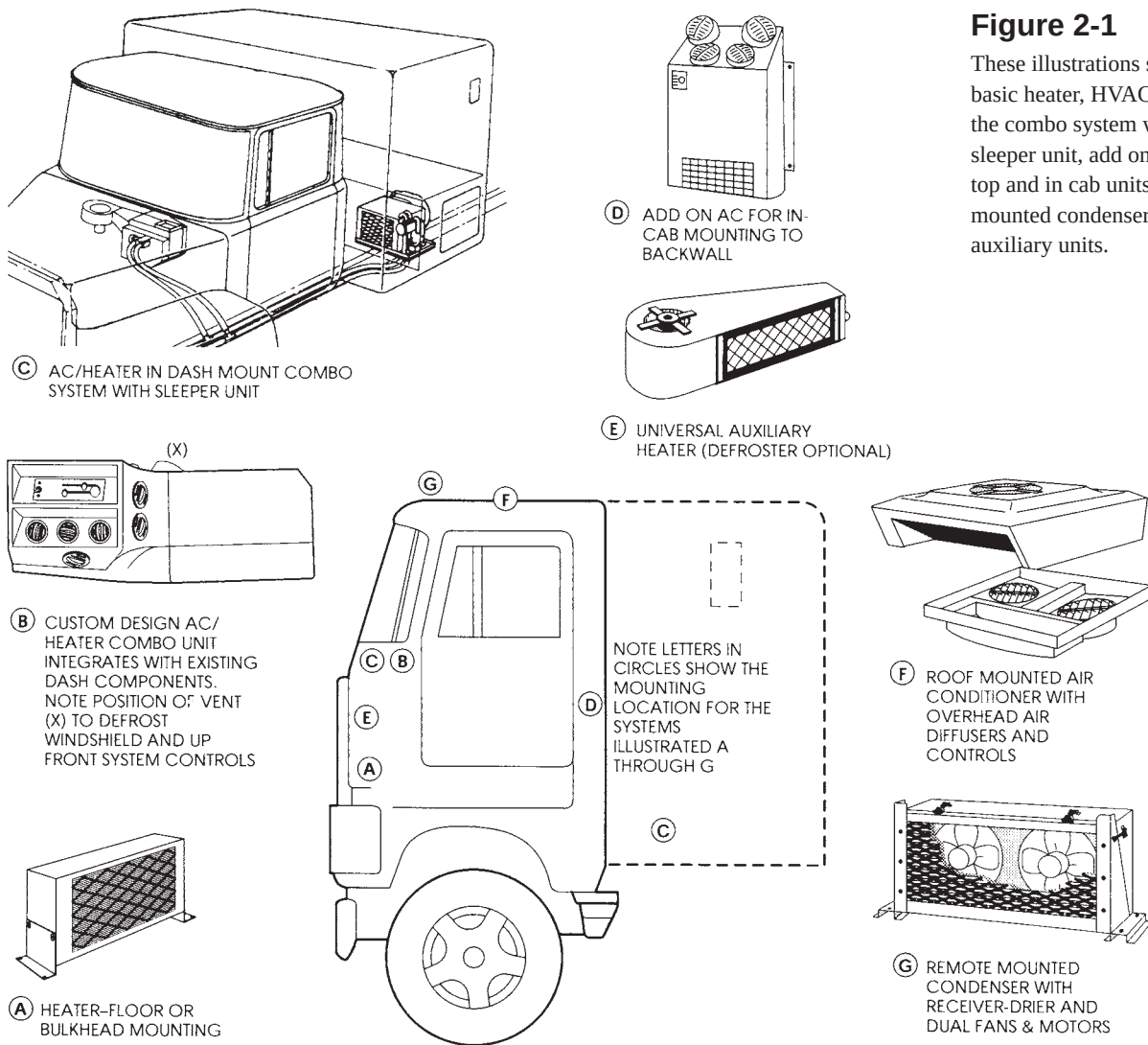
A variety of HVAC systems are in use today, some old and some new. There are:

- Vehicle manufacturer installed systems
- Owner specified systems
- Add-on systems
- Retrofit systems

The system components come in different colors, shapes, and sizes. They may be mounted in or on the cab in varied locations. Owners or fleet maintenance people can modify systems by adding controls, auxiliary units or ducts. Major components are sometimes replaced due to damage or failure. All systems were, at least originally, designed and installed to meet the needs of an operator. Figure 2-1 includes illustrations of various AC and Heater systems. They illustrate system advantages and disadvantages explained in the paragraphs that follow.

The HVAC system includes both heater and air conditioner components, usually a common control, and air ducts. The system cools the cab by removing heat energy. It removes moisture from damp air in the cab and adds fresh outside air to the cab. In this way, the operator can work comfortably in all kinds of weather.

A sleeper unit, built in or added on, increases the air volumes in the cab. The air conditioner or heater must circulate and cool or heat a larger amount of air. This is accomplished by routing ducts and controls to the sleeper compartment as part of system design. Components may be increased in size to handle the larger cab air volume. A bigger heater core, air conditioning evaporator coil, condenser, blower or fan may be included. Often, on long haul trucks, auxiliary air conditioning and heater components and controls are added. The objective remains the same, to move heat energy and maintain occupant comfort.



By law, all trucks have a heater/defroster as part of the standard equipment. When there is a reason to add air conditioning, there are options to meet different needs. The available space in the cab, operating environment, and owner preference can all play a part in the type of AC unit selected. You will probably encounter roof-mounted and in-cab add on systems, and even systems where the condenser is mounted on the roof and the evaporator is attached to the back panel or mounted under the dash. In cooler climates you may come across a cab with two heaters, the original and an auxiliary unit.

## Air Conditioner—System Operation

We have described the movement of heat energy and basic HVAC system function in Chapter 1. Now we will go into some detail on how an air conditioner operates. The system is sealed to keep out air and moisture. To operate properly, the inside of the system contains a measured amount of refrigerant and special refrigerant oil that keeps the system lubricated. Figure 2-2 is an illustration of system components without the cab outline, in-cab controls, component housing, and air ducts or vents. Please study it for a moment. Note the information printed next to each component. Remember that the components may be positioned and attached to the truck in various locations.



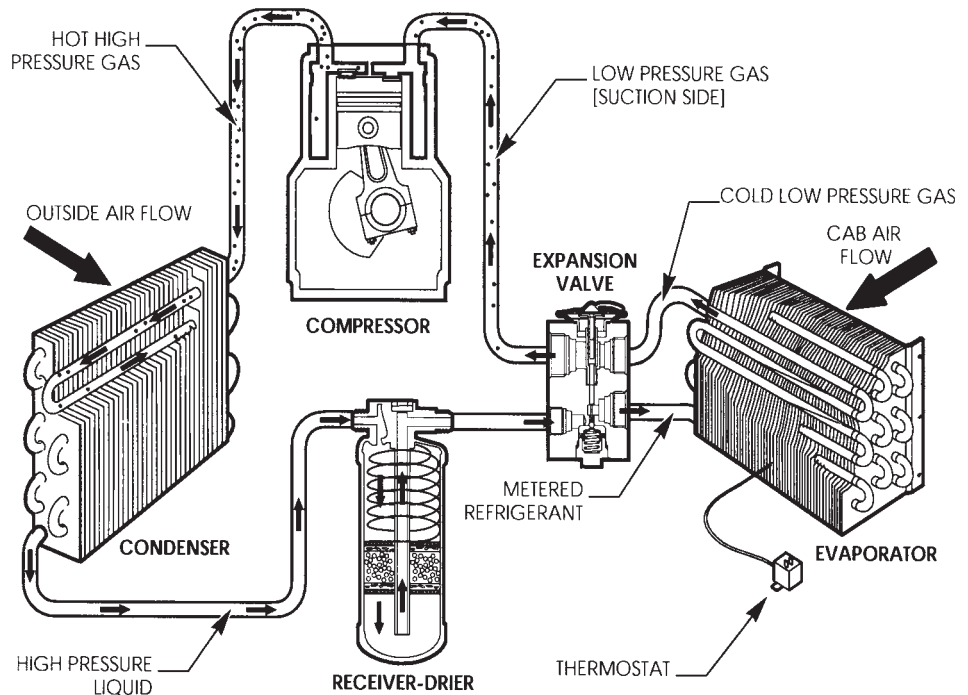
## System Operation

The following AC components are discussed in detail in this section:

1. Compressor/Clutch Assembly
2. Condenser
3. Receiver-Drier
4. Expansion Valve
5. Evaporator Coil

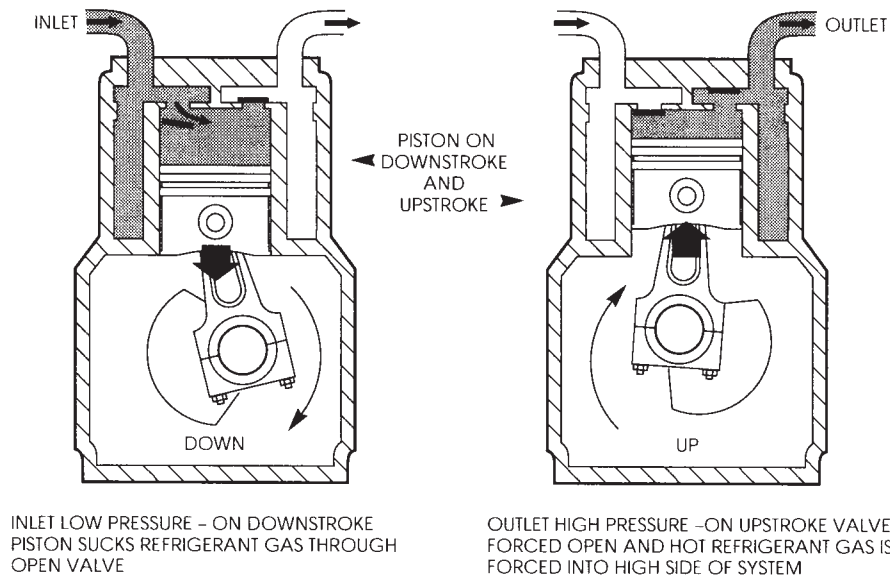
**Figure 2-2**

Air Conditioner components are connected together to illustrate system operation. The components shown are not to scale. The refrigerant and refrigerant oil are clear in color and not visible in this drawing. The small arrows inside the components and connecting hoses show the direction of refrigerant flow (refrigerant circuit).



### 1. Compressor/Clutch Assembly

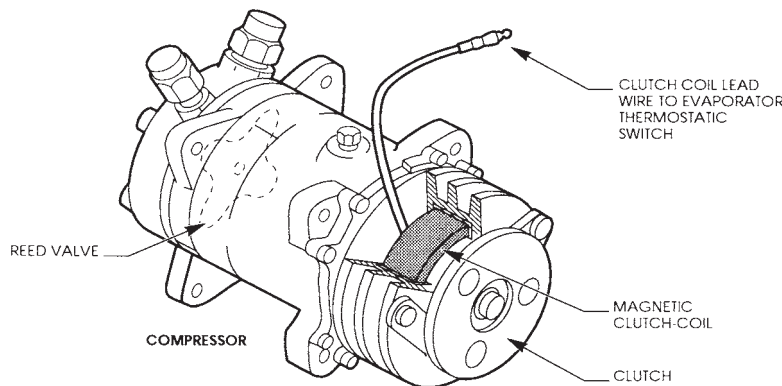
The compressor/clutch assembly is the heart of the system. When the clutch is engaged, the compressor pumps refrigerant and oil around the system. It raises the temperature and pressure of the refrigerant gas, and forces it to the condenser where it changes state and becomes a liquid. The compressor also sucks the vaporized refrigerant out of the evaporator and back inside itself in the form of gas. One way valves inside the compressor separate the compressed gas (high pressure) side of the system from the suction (low pressure) side. Figure 2-3 shows a cutaway view of a compressor with the high and low pressure sides noted.



**Figure 2-3**

The compressor inlet is low pressure and the outlet is high pressure. The reed valves are one way. They open to allow refrigerant gas to enter the compressor on the down stroke and exit on the upstroke. Note the open valves in the illustrations.

The clutch is mounted on the shaft of the compressor and is engaged by electromagnetic action. Part of the clutch assembly is an electromagnetic wire coil. The coil is energized through a thermostat that senses the temperature in the evaporator coil. If the evaporator is too warm the electrical contacts close and allows power to flow to the clutch. The compressor shaft is engaged and moves the refrigerant around inside the system. Figure 2-4 is a cutaway view of the clutch mounted on the compressor.



**Figure 2-4**

The clutch shown here has its electromagnetic coil mounted on the compressor body. When the coil is energized, magnetic force pulls the clutch drive plate into the pulley. This action locks the pulley to the compressor drive shaft and drives the compressor.

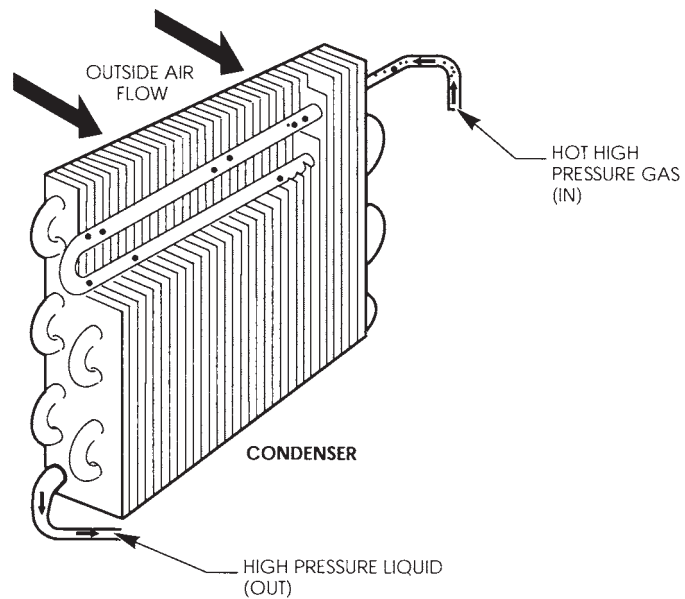
## 2. Condenser

The refrigerant gas leaves the compressor and moves through a high pressure hose to the condenser. Inside the condenser the gas “changes state” and becomes a liquid. It is still hot and under pressure. Remember in Chapter 1 when we talked about water at 212 degrees Fahrenheit? Heat energy was involved in the “change of state,” but the temperature did not change. The same kind of action happens inside the AC system. The refrigerant gas gives up a lot of heat energy to the outside air as it “changes state” in the condenser. Figure 2-5 illustrates a condenser. Air moving through the condenser absorbs heat from the refrigerant. The amount of air flow through the condenser is the major factor in how well the condenser functions.

## System Operation

**Figure 2-5**

As the refrigerant gas moves through the tubing coil from top to bottom, it condenses (changes state) into a liquid. For ease of installation, condenser fittings are often routed close together.

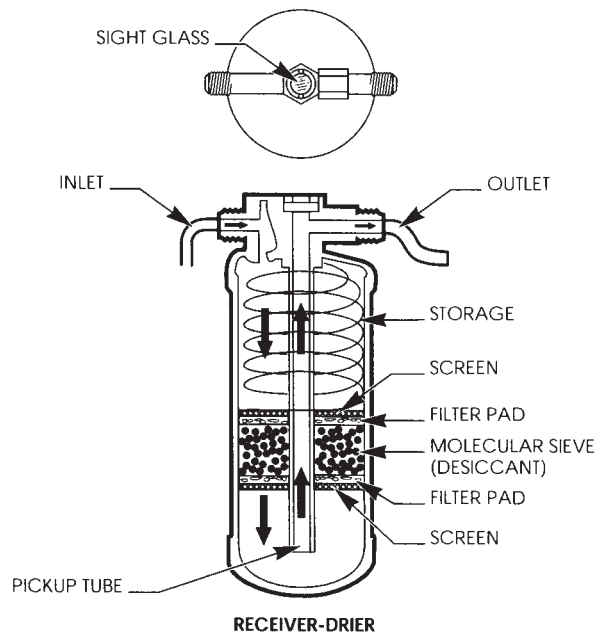


### 3. Receiver-Drier

The liquid refrigerant continues to move inside the system, out of the condenser through a tube or hose to the receiver-drier. The receiver-drier serves as a small storage tank and filter for the refrigerant. It is also a good location to mount pressure switches and often contains a sight glass (small window) used to view activity inside the system. The receiver-drier, Figure 2-6, also separates gas (bubbles) from the liquid with a pick-up tube as shown in this illustration. Some receiver-driers have a spring to preload the desiccant pack.

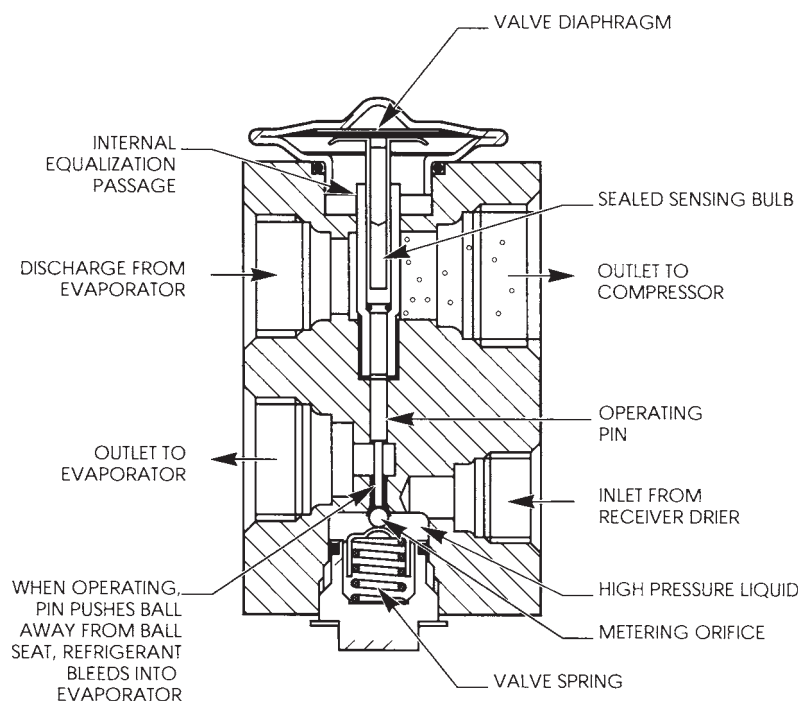
**Figure 2-6**

This cutaway view of a receiver-drier shows the filter elements, inlet, outlet and refrigerant path. The sight glass is a small window into the system used in diagnosis and when adding refrigerant (charging the system).



#### 4. Expansion Valve (Refrigerant Metering Device)

When refrigerant moves from the receiver-drier, it travels through another high pressure hose to a metering device at the inlet of the evaporator coil. The metering device can be an expansion valve, an expansion tube or a combination (multiple function) valve. Between the compressor and this point inside the system, the pressure is high and can range from 150 to 250 pounds per square inch. The expansion valve (TXV) is closely connected to the evaporator. A diaphragm opens the valve by exerting pressure on the spring. Pressure comes from gas inside the diaphragm housing on top of the valve and in the sealed sensing bulb. The sensing tube is located in the outlet of the evaporator and picks up heat from warm refrigerant leaving the evaporator. The gas in the valve diaphragm housing and sensing tube expands when it gets warmer and forces the expansion valve open at the metering orifice.



**Figure 2-7**

This block type expansion valve cutaway view will give you a better idea how these valves work. Spring pressure holds the valve closed.

#### 5. Evaporator Coil

The expansion valve or other type of metering device bleeds high pressure refrigerant into the evaporator coil, where the pressure is low. The refrigerant expands rapidly in this low pressure environment. When it expands it “changes state”. The sudden drop in pressure brings the refrigerant temperature down quickly inside the evaporator coil. Figure 2-8 shows an evaporator coil and thermostat. Refrigerant is sprayed into the evaporator by the high side pressure when the expansion valve opens. The refrigerant absorbs heat from the air when the blower forces the air through the fins. When the thermostat probe senses the upper limit of the thermostat heat setting, a circuit closes. The compressor clutch engages and the compressor operates and moves more refrigerant to the high side of the system.

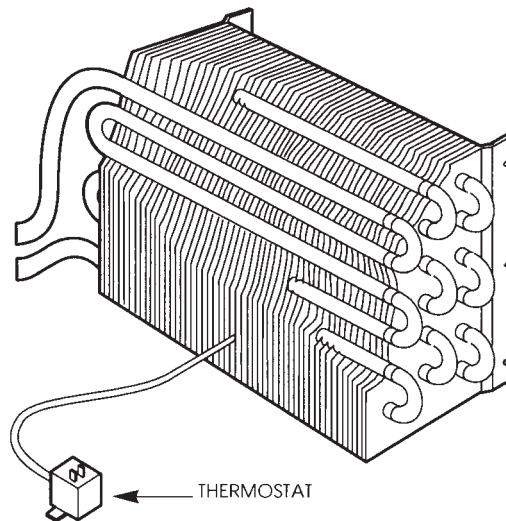
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## System Operation

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**Figure 2-8**

The evaporator coil as shown is of fin and tube construction. The thermostat probe is positioned in between the evaporator fins and senses the temperature.



**Note:** Moisture in the air (humidity) condenses on the fins of the evaporator as water droplets which drain out of the evaporator through a drain hose. This action dehumidifies the air in the cab as part of system operation, and contributes to operator comfort.

Cab air forced across the evaporator coil gives up heat energy to the cold refrigerant inside the coil. The cooled air circulates in the cab for occupant comfort. Refrigerant continues to expand and absorb heat energy in the evaporator coil. Refrigerant changes from liquid to gas before it leaves the evaporator on the way back to the compressor. The refrigerant gas moves to the compressor through a low pressure (suction) hose. When the compressor is operating, it sucks the refrigerant gas back inside, compressing and raising its temperature and pressure.

Some of AC system operation is controlled by the operator, and some is automatic. The operator can turn the system on and off, regulate the air velocity with the blower control, and in some designs adjust the thermostat control. The system and component operating range settings automatically cycle the clutch on and off. The operation of the expansion valve or other refrigerant metering device at the inlet to the evaporator is automatic.

Individual system features may differ, but the basic system function remains the same. Variations in components and controls are described in Chapters 4 and 5. The engine provides the power for both air conditioner and heater operation. It drives the AC compressor and the cooling system water pump. Engine RPM affects the efficiency of both the heater and air conditioner. The slower the engine RPM, the less capacity a heater or AC system will have.

### WARNING

When an AC system is operating, the high pressure side components, fittings and high pressure lines or hoses can be hot enough to burn your skin if you touch them. This includes the compressor, clutch, hoses, condenser, receiver-drier, and any control devices or metal tubing. The low pressure side will be cool to the touch. In operation the AC system is under load and high side pressures normally range between 150 and 250 pounds per square inch for R-12 and higher for some other refrigerants.

## System Operation

### Heater System Operation

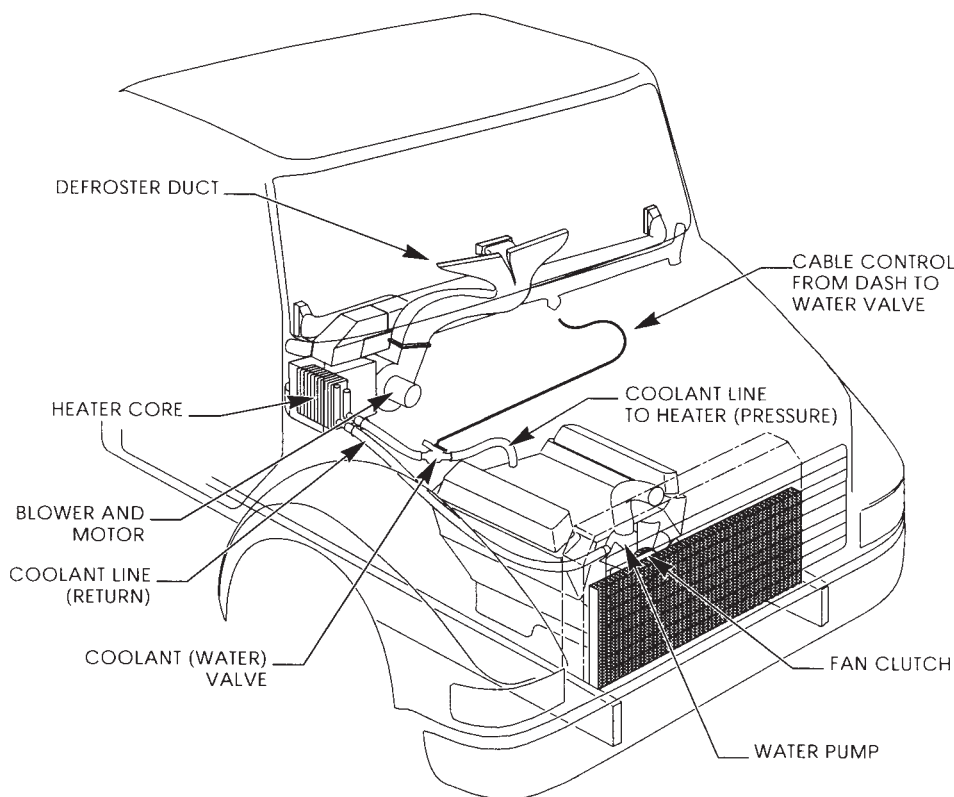
Heater and air conditioner systems both have the same basic function of moving heat. They take advantage of nature's laws where heat energy always moves from a warmer to a cooler area. In a heater system there is no "change of state" involved in system operation. The system is sealed and operates under pressure, but the pressure is low when compared to an air conditioner.

A heater system uses the engine coolant to carry excess heat energy to the cab air. The heart of the system is the water pump. The water pump forces hot coolant through a hose from the engine block and through the heater core. The coolant is returned to the engine cooling system either at the suction side of the water pump or to the radiator.

A control cable, attached to a water valve between the water pump and the heater inlet, is used to control the flow of coolant to the heater. The heater fan or blower forces cab air through the heater core where heat energy moves from the engine coolant to the air in the cab. Figure 2-9 illustrates the main heater system components. In-cab controls, component housing and air vents are not shown.

The following heater components are discussed in detail in this section:

1. Heater Core
2. Water Valves
3. Defrosters and Ducts
4. Blowers and Fans



**Figure 2-9**

This view of a heater system shows the main components and how they are connected.

Additional heater controls, ducts, air vents, blend-air doors, temperature regulating devices and auxiliary heaters may be installed as part of a heater system. These may be air, vacuum, electrical or mechanically operated.

### **1. Heater Core**

Heater cores are like small radiators. The fin and tube construction is designed to route coolant flow for the best possible heat energy transfer from coolant to cab air. Hoses from and to the engine are connected to the core with clamps. The core outlet may be larger or the same size as the inlet.

### **2. Water Valves**

Water valves may be cable, vacuum or air controlled. The valve can be either open, closed or set part way open. Some valves have a bypass design to return coolant to the engine. Most are manually controlled although electronic systems are now being installed.

### **3. Defrosters and Ducts**

Defrosting is accomplished by directing heated dry air through ducts to the windshield. The heater system serves the dual purpose of defrosting and heating. Controls are used to route the air flow to the windshield and occupant areas by opening and closing duct doors. Controls may be manual, air or vacuum.

Many vehicles use a “defrost interlock” system which utilizes the air conditioner to dry the defrost air and clear the cab windows more quickly.

### **4. Blowers and Fans**

Blowers or fans are used in the system to move cab air through the heater core and evaporator. Air can be pushed or pulled through the core depending on system design. Blower or fan speed is usually selected by the operator.

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## **Environmental Effects on System Operation**

The environment outside the cab involves more than the weather. It may be hot and humid or cold and dry. That is only part of the condition the HVAC system must handle to maintain an ideal comfort range. A truck can be at idle, in traffic or moving along for hours on the Interstate at 65 M.P.H. The load condition on a trip can include going out full, coming home empty, or driving across the Rockies or Kansas plains during the day or night. The truck color and shape, the windows and angle of the sun are all variables that can increase or decrease the “load” on the system. The following are a few examples of environmental effect:

- A black cab-over (COE) with a dark color interior will be more difficult to cool than the same vehicle with white paint and a light colored interior. The black cab picks up and holds the radiant heat from the sun more easily than the white one.
- In Florida or Houston the humidity in mid summer can be very high with the temperature in the high 90’s or low 100’s. The AC unit must remove a lot of moisture from the air in the cab as the air moves through the evaporator fins. The more moisture on the fins, the less effective the transfer of heat is to the refrigerant inside the evaporator coil.



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## System Operation

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- On a cold day the temperature can drop below zero. The engine may run cooler so the engine coolant is cooler when it circulates through the heater. The heat in the cab moves out of the cab faster (remember heat always moves to a cooler area until both are the same temperature—nature’s law). To maintain cab comfort you have to increase the flow of coolant through the heater, increase coolant temperature, and/or move more air through the heater core.
- On a hot day, an off-road vehicle experiences cooling at a slower rate than an on-road vehicle. This is a result of high sun-load, large window area and often less insulation.

It is important for you to keep environmental effects in mind when you are servicing or diagnosing heater or air conditioner systems. If you work in Denver the altitude will affect system function and pressure. In Houston the heat and humidity may lower heat transfer to the air at the condenser and increase system operating pressures.

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## Chapter Review

- HVAC systems range from simple cab heaters to multi-function combination systems. The multi-function system can heat and cool the cab and sleeper unit, and have separate auxiliary components and controls for driver and passenger comfort.
- Both heater (engine) coolant and air conditioner refrigerant circulate inside sealed, pressurized systems. The normal air conditioner operating pressure ranges from 150 to 250 pounds per square inch, sometimes higher with a different refrigerant.
- Air conditioners have a high and a low pressure side within the system. The compressor is the starting point of the high side. Pressure drops at the expansion valve opening to the evaporator.
- The basic components of an AC system are the compressor/clutch assembly, high pressure lines, condenser, receiver-drier, expansion valve, evaporator, thermostat, blower assembly, and suction lines. There may be other controls installed for more complex systems.
- The basic components of a heater system are the inlet and outlet hoses, a water valve and valve control, heater core and fan or blower assembly. There may be other controls for more complex systems.
- An air conditioner system uses the “change of state” of refrigerant inside the system to move heat from the cab air to the outside air. Refrigerant changes from a gas to a liquid in the condenser, and back to a gas in the evaporator.
- A heater system uses the heat from the engine, carried to the heater core by the action of the water pump, to warm the air in the cab. There is no change of state within the heater system.
- Environmental conditions affect how both heaters and air conditioners work. Weather, driving conditions, color of the vehicle are factors. All contribute to heat gain or loss inside a cab and how much heat energy must be moved to maintain occupant comfort.



# Inspection and Maintenance-without gauges

*Click on any of these subject headings to go directly to the page*

- Discussion of Inspection & Maintenance Survey Results
- Visual Inspection - System Off
- Electrical System Inspection
- Performance Inspection - Engine Running
- Heater System Inspection
- Preventive Maintenance Worksheet
- Chapter Review

## Discussion of Inspection & Maintenance Survey Results

There are three reasons for regular inspection and maintenance procedures:

1. They save money in the long run by reducing down time and often prevent more costly repairs.
2. They help to insure driver comfort and safety.
3. They add to your store of knowledge about these systems and maintain your level of efficiency.

About half of all heavy duty vehicles have air conditioners. Surveys of AC system owners find that over 30% of the systems are serviced every six months or less, and another 62% are serviced at least once a year.

The survey also covered how often the different components required maintenance. Figure 7.1 below shows survey finding percentages. Failure of any of the AC components listed in the survey could cause a system to malfunction or stop cooling.

**Figure 7-1**

This chart shows maintenance frequency, lists key parts and how often they require maintenance.

| INSPECTION & MAINTENANCE SURVEY                   |                          |                       |                           |                          |              |
|---------------------------------------------------|--------------------------|-----------------------|---------------------------|--------------------------|--------------|
| How often are your air conditioners serviced?     |                          |                       |                           |                          |              |
| Average                                           | 1 to 6 months<br>30%     | 7 to 12 months<br>62% | More than 12 months<br>6% | Never<br>2%              |              |
| Which AC components require frequent maintenance? |                          |                       |                           |                          |              |
| Belts<br>32%                                      | Compressor Clutch<br>26% | Condenser<br>12%      | Add Refrigerant<br>12%    | Refrigerant Lines<br>11% | Valves<br>7% |

**Note:** The above survey results may not apply to your situation. Actual operating conditions for the vehicles you service will determine or influence maintenance frequency and requirements.

The following inspection procedures should take about 15 to 20 minutes, longer if corrective steps, part replacement or adding refrigerant is necessary. There is a “Preventive Maintenance Worksheet” you may use at the end of this chapter, Figure 7-9

## Visual Inspection - System Off

Your observations and the corrective measures you take may be different depending on circumstances. The following inspection procedures are explained in more detail below:

1. Observe the System
2. Inspect Parts
3. Check Hoses and Fittings
4. Check for Refrigerant Leaks

Use the following procedures as a general rule in performing a visual inspection with the AC system off:

### 1. Observe the System

Your first inspection step is to answer the following question if you can:

- Has the vehicle just come in off the road and has the HVAC system been in use?
- Did the operator or work order explain or describe any problems about the system?
- Did someone else work on the system yesterday, 700 miles down the road? Your first inspection step is to answer these questions if you can.

#### CAUTION

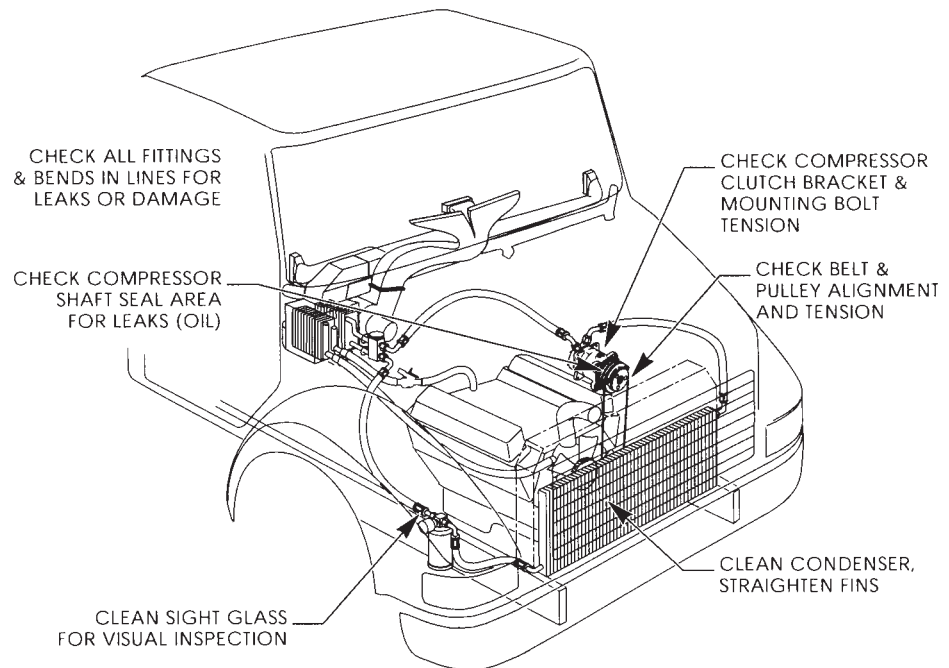
Even when someone has told you what is wrong with an HVAC system, you should perform a visual inspection. Always make a visual inspection before you hook up the manifold gauge set. Never add refrigerant to a system until you have made a complete visual and performance inspection.

### 2. Inspect Parts

Look at the system for what might come loose, leak, wear out or become dirty and not function the way it should. The main points for visual inspection of the system are emphasized in Figure 7-2.

**Figure 7-2**

This system illustration notes the main points for visual inspection.



**A. Condenser** – Is it free of leaves, bugs, bird feathers or mud? The condenser must be relatively clean to work well as a heat exchanger. How you clean the condenser depends on where it is mounted. The condenser fin comb, air hose and nozzle, or soap and water may be used. Where possible, check condenser mounting bolts or screws and tighten them if necessary.

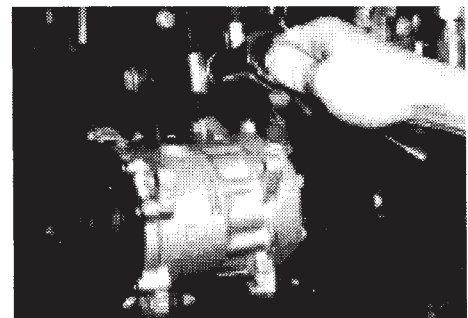
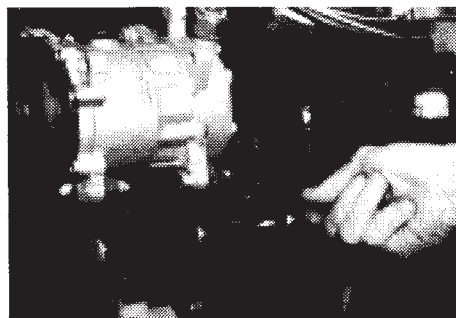
Condenser failure often results from loose hoses. Hose movement will cause fatigue failure of condenser tubing adjacent to the fittings. Make sure the hoses are securely clamped.

While inspecting the condenser check the receiver-drier sight glass and connections. Look to see if the sight glass has a moisture indicator that is showing moisture in the system.

**B. Components Under the Hood** – Tip the cab or raise the hood. Look at the compressor mounting bracket, compressor clutch assembly, drive belt and pulley alignment. The mounting bracket, compressor, clutch and drive pulley should be fastened securely, and a clutch groove (there may be two grooves) should be in line with the drive pulley. Tighten all bolts shown in Figure 7-3, as you inspect.

**Figure 7-3**

Engine and compressor vibration can work mounting bolts loose. Tighten all mounting bolts as you inspect the system. Slots in the mounting bracket are used to move the compressor clutch assembly in order to adjust belt tension or alignment.



**C. Drive Belt** – The drive belt should be tight and in good condition. Use a belt tension gauge to check tension (120 pounds maximum). With experience, you can feel belt tension by twisting the belt. Try feeling belt tension after using the gauge, when you know the tension is correct. Replace belts if they are frayed or look worn.

If the clutch pulley/belt alignment is obviously off, you need to loosen the compressor or mounting bracket, or both—and use the alignment bar to line up the clutch pulley with the drive pulley. Tighten compressor mounting bolts first, then the bolts holding the bracket. The mounting bracket should have slots or other means of adjustment to allow you to adjust the tension of the drive belt. When you use a pry bar to apply tension, be sure you do not pry against the compressor. Pry against the mounting bracket.

### 3. Check Hoses and Fittings

Check all hoses and fittings. Look for places where hoses flex when the cab is tilted. Any places the hoses or fittings are fastened, clamped, connected, bent or secured are potential wear points. This also applies to places where hoses are not clamped or supported but should be (often near the condenser). All of these spots are potential leak or damage points. Tighten, re-fasten, add, or replace as indicated by your inspection.

### 4. Check for Refrigerant Leaks

System refrigerant leaks can be anywhere but there are obvious places. You can spot some by looking for signs of refrigerant oil forced out with refrigerant leakage. One location leaks frequently occur is the compressor shaft seal. The shaft and seal are hidden behind the clutch assembly, but centrifugal force will throw the oil off the shaft and against the engine, bracket or whatever is close. Check these points when you examine the compressor clutch and mounting bracket. A solution of soap and water applied around potential leak points works well for detecting leaks. A leak in the evaporator may be indicated if you feel around the condensate drain hole and find oil present.

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**Note:** You can add inexpensive dry nitrogen gas to the system instead of R-12 if system pressures are low. Dispense the gas at no more than 200-250 PSI as this is sufficient pressure to cause or indicate a leak point in the AC system. AC service procedures for complete system recovering of refrigerant, evacuating, and recharging are covered and illustrated in *Chapter 9*.

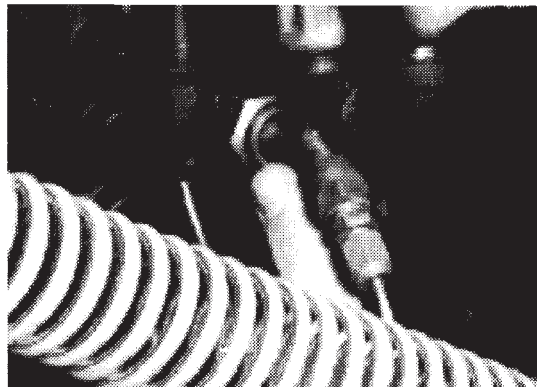
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**Note:** A leaking heater core could also result in coolant at the condensate drain.

You can feel for oil at the bottom of all connections (see Figure 7-4) if the system is not too hot. Of course, a few minutes with an electronic leak detector is the best way to check for leaks. Keep in mind that pressure is different in a system at rest, so small leaks may be hard to find. Pressure in a system at rest, will equalize at from 60 to 95 PSI, depending on outside air temperature. This means there is more pressure in the low side of the system at rest than during normal system operation. Just the opposite is true of the high side; at rest, high side pressure is lower. You may want to use the detector to check for leaks in the high side when the air conditioner is operating, if you suspect a leak and can't find it when the system is at rest.

**Figure 7-4**

This illustration shows a potential refrigerant leak point at the condenser fitting.



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## Electrical System Inspection

The two stages of an electrical inspection are explained in more detail below:

1. Inspect Electrical Connections
2. Check Electrical Current Flow and Device Functions

Use the following procedures to perform an electrical system inspection:

### 1. Inspect Electrical Connections

First, while you are making your visual inspection under the hood (cab) and/or at the roof top condenser, take a moment and check all electrical connections visually and by feel. Look for any corrosion on leads or connectors and clean them. Make sure all leads and wires are properly supported and securely connected.

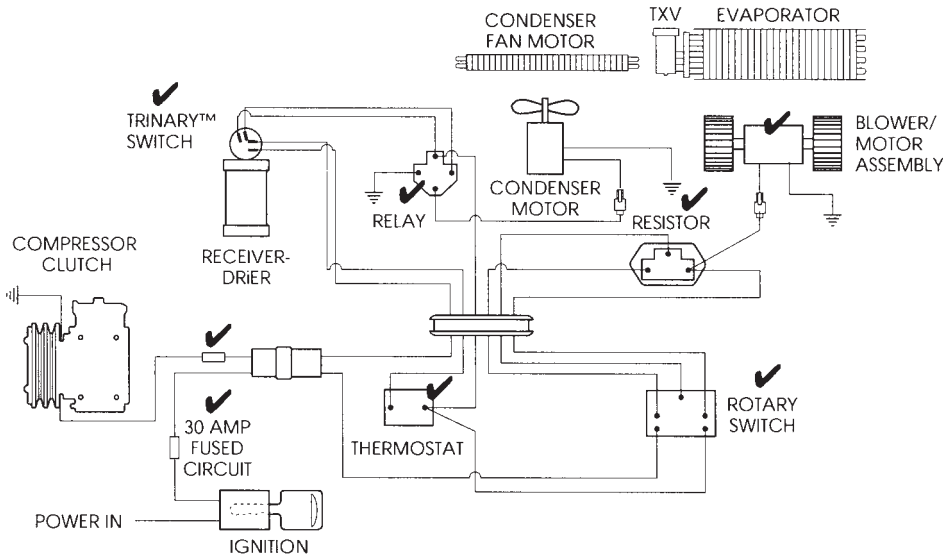
### 2. Check Electrical Current Flow and Device Functions

Perform the following steps to check current flow and electrical device functions:

**A. Turn the Ignition On** – To check current flow the ignition must be on.

## Inspection & Maintenance

**B. Turn the AC System On** – This will power the thermostat and clutch. If it does not come on, use the AC mode switch to check the leads to the switch. You should be able to hear a “click” from the thermostat and hear the clutch drive plate “snap” against the clutch pulley. You can not check thermostat cycling on and off until you do the performance inspection. Figure 7-5 illustrates a typical AC electrical system and the places you should inspect.



**Figure 7-5**

The electrical system inspection points are noted with check marks (✓) on this wiring diagram (electrical schematic).

**C. Check Fuses** – If there is a failure and you have made sure all connections are clean and tight, you need to check fuses—in-cab as well as in-line.

**D. Check Clutch Engagement** – Since you can’t see and may not hear the clutch engage, get out and look at the clutch. If it’s engaged, you will see that the drive plate is against the pulley and not slightly spaced from it. If you are not sure the clutch is engaged, look for the lead wire connector near the clutch. Break and close that connection. The clutch will disengage and engage again.

**E. Test Blower Speed Operation** – Some systems have a common switch that turns on the air conditioner and powers the blower motor. Test blower speed operation by adjusting this or the separate blower control switch. Feeling the air flow from the ducts or note blower sound (speed) changes.

**F. Inspect Roof Mounted Condensers** – Don’t forget to inspect roof mounted condensers and AC systems for dirt and debris. Be sure the condenser fan(s) are working properly and all parts and electrical connections are securely fastened. The roof mounted condenser fans may come on when the system is turned on. Like the thermostat and most clutches, the normal on-off cycling action can not be observed until the engine is running with the AC system on.

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## Performance Inspection – Engine Running

The purpose of visual and electrical inspection is to detect obvious problems and assure AC system function for an accurate performance inspection. If you do the performance inspection first, you could be misled. Problem areas discovered during the performance inspection can give you false clues or symptoms, and result in repair errors and come-backs. The following performance inspection procedures are explained in more detail below:

1. Inspect System Component Cycling and  
Cab Temperature Levels
2. Check Clutch Cycling Under Load
3. Check Sight Glass

The performance inspection does not cover pressure and temperature sensitive safety devices (cutout switches, fan control, Trinary etc.). Testing these devices requires the use of the manifold gauge set for observation of internal system pressures during tests. These are explained in *Chapter 8*.

Use the following procedures as a general rule in a performance inspection:

### 1. Inspect System Component Cycling and Cab Temperature Levels

**A. Turn On the Engine and Air Conditioner** – Inspect for system component cycling and cab temperature levels.

---

**Note:** System performance testing will be much faster if all doors and windows in the cab are closed.

The cab air must cool down to thermostat control setting levels before system components will cycle on and off, indicating correct function. This is called ‘stabilizing the system’ and takes about five minutes of operation. In very hot weather the system may not cycle.

**B. Check Thermometer Readings** – In the cab you can use your thermometer to measure air temperature at the vents. When the evaporator is easy to reach with a thermometer probe without removing some of the dash or duct work, use the probe to measure evaporator temperature. When the AC unit is on and working correctly, you can see the thermometer dial needle move down to about 32 degrees, then rise six to ten degrees and move back down again. The movement up and down indicates that the cycling clutch and thermostat, or orifice tube and accumulator pressure switch (to the clutch) are functioning correctly. In systems with a non-cycling clutch, this movement indicates correct function of the refrigerant metering device.

The needle movement is called “temperature swing.” When you can adjust the thermostat setting, the range of swing should change. For example, from full cooling (cold) to moderate (between cold and warm), the swing may change from 32-38 to 32-42 degrees.

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Inspection & Maintenance

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These readings at the vents will be higher and temperature swing slower and not as obvious. Also blower speed will cause the temperature, levels to read higher (high air speed) or lower (low air speed) at the same thermostat setting. When you measure air temperature, an electronic thermometer/pyrometer is a great tool to have. You can easily measure cab air temperature at several locations quickly.

Swing temperatures vary depending on where you measure temperature, and on outside temperature, humidity and altitude. The chart in Figure 7-6, shows some examples of typical temperature variables. Don't forget that cab and sleeper area temperatures can vary within the same vehicle. Also, electronic controls used in newer HVAC systems often keep the temperature spread within a narrower range.

|                                               |                  |                  |                  |                  |                  |                  |                  |                  |
|-----------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| AIR TEMP.<br>DEGREES F.                       | 70°              |                  | 80°              |                  | 90°              |                  | 100°             |                  |
|                                               | HUMID            | DRY              | HUMID            | DRY              | HUMID            | DRY              | HUMID            | DRY              |
| CENTER OUTLET<br>AIR TEMP.<br>DEGREES F.      | 43°<br>to<br>47° | 40°<br>to<br>44° | 44°<br>to<br>48° | 40°<br>to<br>44° | 47°<br>to<br>51° | 40°<br>to<br>44° | 52°<br>to<br>56° | 41°<br>to<br>45° |
| LEFT & RIGHT AIR OUTLET TEMPERATURE WILL VARY |                  |                  |                  |                  |                  |                  |                  |                  |
| OUTLET AIR TEMP.<br>RANGE DEGREES F.          | LEFT             | RIGHT            | LEFT             | RIGHT            | LEFT             | RIGHT            | LEFT             | RIGHT            |
|                                               | 40°<br>to<br>41° | 41°<br>to<br>44° | 41°<br>to<br>45° | 43°<br>to<br>47° | 46°<br>to<br>52° | 47°<br>to<br>54° | 48°<br>to<br>55° | 50°<br>to<br>56° |

**Figure 7-6**

The chart of AC system and cab temperature range shows you typical variables.

## 2. Check Clutch Cycling Under Load

The following operating inspections, visual and by feel, are done outside the cab while you wait for the system to stabilize.

**A. Lift hood** – With the hood up (or cab tilted) observe the clutch cycling under load.

---

**Note:** If the condenser is hood mounted you may not have adequate air flow through it.

**B. Touch suction and discharge lines** – Soon after system start up you can safely feel the suction and discharge lines and note their change in temperature. The discharge line will get hot (after a while it may be too hot to touch) and the suction line will get cooler.

## 3. Check Sight Glass

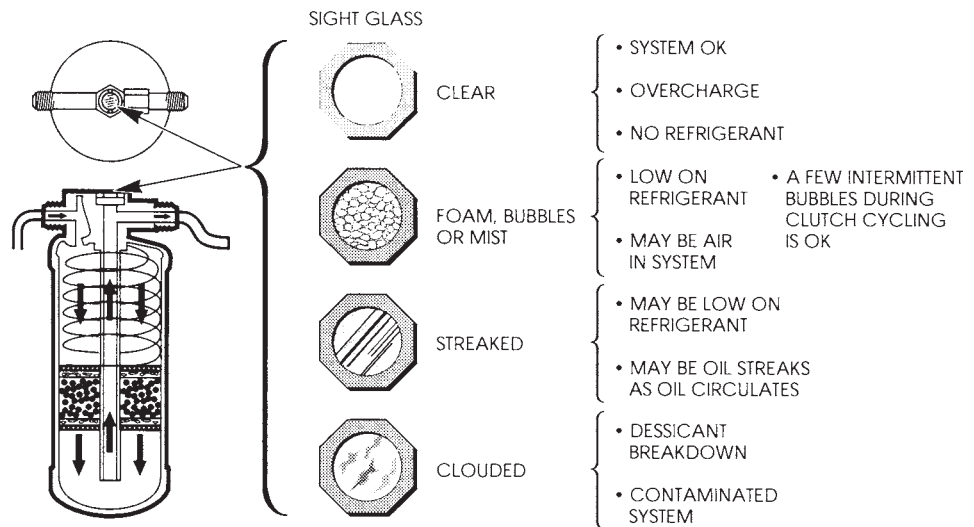
The sight glass is the only point where you can actually see inside the air conditioner during operation. Check the sight glass through the window on the top of the receiver-drier (or the separate in-line sight glass). If the system is functioning properly and cooling the cab adequately, the sight glass should be clear (you will not see anything in it). If it is not clear when the system is first turned on, wait a few minutes for the system to stabilize, then look again. Figure 7-7 illustrates and explains what you may observe in the sight glass. Roof mounted condenser fans may run continuously or cycle on and off. If you can't tell by sound you may have to climb a ladder and observe the fan blades.

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**Figure 7-7**

These drawings illustrate conditions you may observe in the sight glass window.



**Note:** A roof mounted condenser or AC unit assembly often includes a roof mounted receiver-drier (and sight glass) close to the condenser.

## Heater System Inspection

A heater system inspection is really a combination engine cooling system and heater inspection. All heater/cooling system rubber parts deteriorate due to the air (ozone), heat, coolant and oils. They should be replaced at regular intervals to prevent breakdown on the road. Metal parts and gaskets are subject to malfunction or breakdown due to fatigue and corrosion.

Coolant has a limited life and should be replaced regularly. If it is dirty, the cooling system should be drained and flushed or back flushed (using special equipment) before refilling with clean water and anti-freeze. Coolant must be hot when using the hydrometer to check protection (freeze-up) level. The following inspection procedures are explained in more detail below:

1. Check Heater Control Valve Function
2. Inspect Other Functions

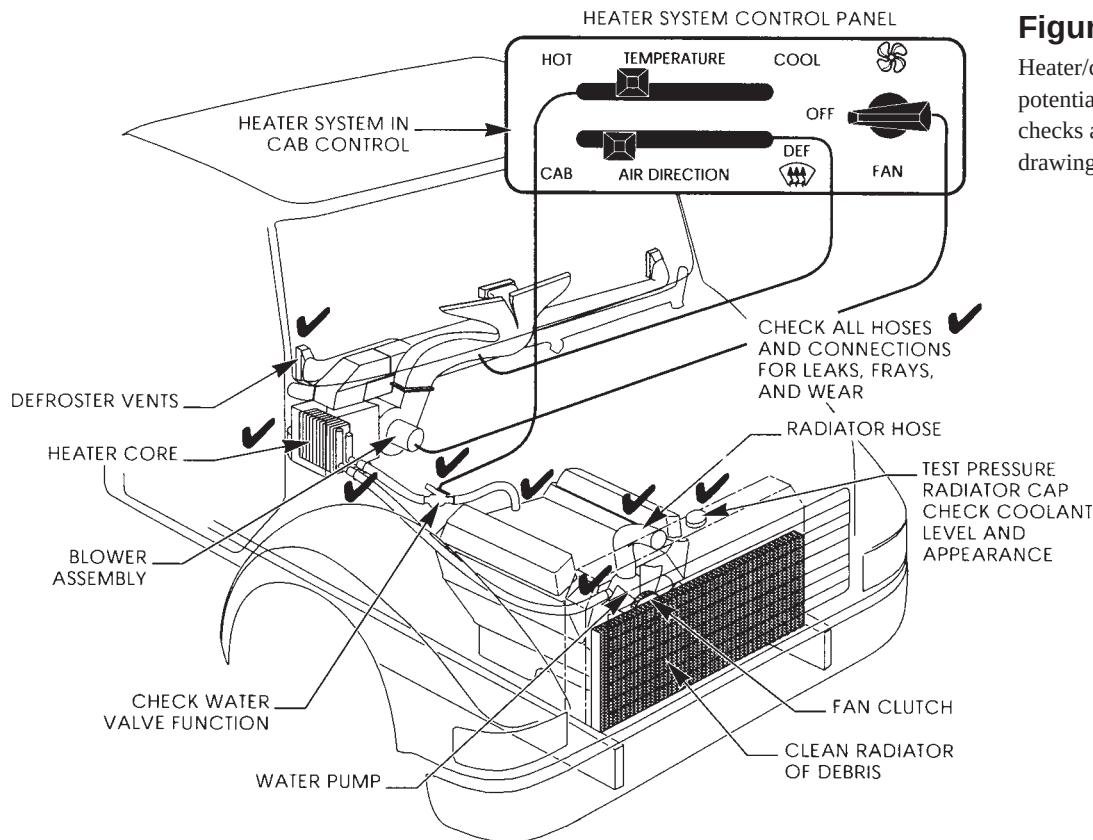
### 1. Check Heater Control Valve Function

Many air conditioner/heater systems depend on the heater control valve for temperature control and positive closure. You can easily check heater control valve function as follows.

**A. Cool engine** – Start with the engine cool, set the temperature to cold and leave the fan off. As the engine warms up, feel the heater return hose. If the hose feels warm or hot, the heater control valve is leaking internally. This type of leak can seriously reduce air conditioning performance.

## Inspection &amp; Maintenance

**B. Warm up engine** – Next, let the engine warm up to normal operating temperature and set both fan and temperature on high. Feel both heater supply and return hoses. If there is a noticeable difference in their temperature, it indicates a low flow of coolant through the heater core (a partially closed or blocked heater control valve). This could result in poor heating performance during cold weather conditions.

**Figure 7-8**

Heater/cooling system potential problem areas and checks are indicated in this drawing.

## 2. Inspect Other Functions

There are some things you can't see or feel when you inspect the thermostat, heater core, radiator pressure cap, electrical switch and control valve functions. Some of these can be checked with the pressure and thermostat testers as described in *Chapter 6*. A hand pump pressure tester can also be used to check for coolant leaks. This is done by using the pump to raise the pressure inside the system above normal operating pressure to force small suspected leaks to show up.

Heater/cooling electrical and valve component inspection is the same as air conditioner inspection. The controls are operated to see if they function correctly to maintain or vary cab temperature and air flow.

## Preventive Maintenance Worksheet

Please feel free to modify or copy the worksheet in Figure 7-9. Actual vehicle use, mileage, operating conditions and maintenance budget may influence service frequency.

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## Chapter Review

The purpose of these brief inspection procedures is for vehicle system maintenance and to determine if further, more detailed service is required. The uses of a manifold gauge set, system troubleshooting, recovery, flushing, evacuating and charging are explained in the next chapter.

High usage and operating condition variations are tough on air conditioning and heater components. You should establish and follow regular inspection and maintenance procedures to improve overall system function and component service life.

The typical inspection should not take more than 15 to 20 minutes unless component replacement and/or complete system evacuation and recharging is warranted. The survey results shown in Figure 7-1, indicate belts, compressor clutch assembly, condenser and the refrigerant lines are the most frequent problem areas. However, your own experience with service and maintenance may vary from survey results.

Inspection should first be visual and by feel. Some of your electrical system inspection will be done as you inspect other components (checking leads, connections and for loose wires). When you check the electrical circuit, begin with the engine off but ignition on. A system performance inspection with the engine running and system on really combines electrical and AC or heater system function.

**Figure 7-9** Preventive Maintenance Schedule.



## PREVENTIVE MAINTENANCE SCHEDULE FOR AIR CONDITIONING SYSTEMS

**NOTE: Typical Maintenance Schedule:** 3 months or 15,000 miles, 6 Months or 30,000 miles, 12 Months or 60,000 miles

Installation Date: \_\_\_\_\_ Mileage: \_\_\_\_\_

Last Maintenance Check: \_\_\_\_\_ Mileage: \_\_\_\_\_

Checked by \_\_\_\_\_ Mileage: \_\_\_\_\_

| COMPONENT                             | MAINTENANCE INTERVAL (months) |    |     | DONE                     | COMPONENT                     | MAINTENANCE INTERVAL (months) |    |     | DONE                     |
|---------------------------------------|-------------------------------|----|-----|--------------------------|-------------------------------|-------------------------------|----|-----|--------------------------|
|                                       | 3*                            | 6* | 12* |                          |                               | 3*                            | 6* | 12* |                          |
| <b>1. COMPRESSOR</b>                  |                               |    |     |                          | <b>4. EXPANSION VALVE</b>     |                               |    |     |                          |
| Check noise level                     | •                             |    |     | <input type="checkbox"/> | Inspect capillary tube        |                               |    | •   | <input type="checkbox"/> |
| Check clutch pulley                   | •                             |    |     | <input type="checkbox"/> | (leakage/damage/looseness)    |                               |    |     |                          |
| Check oil level                       | •                             |    |     | <input type="checkbox"/> | <b>5. EVAPORATOR</b>          |                               |    |     |                          |
| Run system 5 minutes                  | •                             |    |     | <input type="checkbox"/> | Clean dirt/bugs/leaves from   |                               |    | •   | <input type="checkbox"/> |
| Check belts for tension               | •                             |    |     | <input type="checkbox"/> | fins/tubes (w/compressed air) |                               |    |     |                          |
| (120 lb max.)                         |                               |    |     |                          | Check solder joints on        |                               |    | •   | <input type="checkbox"/> |
| Inspect shaft seal (leakage)          |                               | •  |     | <input type="checkbox"/> | inlet/outlet tubes (leakage)  |                               |    | •   | <input type="checkbox"/> |
| Check mounting bracket                |                               | •  |     | <input type="checkbox"/> | Inspect condensate drain      |                               |    |     |                          |
| (tighten bolts)                       |                               |    |     |                          | (R-12 or oil leak)            |                               |    |     |                          |
| Check alignment to clutch             |                               | •  |     | <input type="checkbox"/> | <b>6. OTHER COMPONENTS</b>    |                               |    |     |                          |
| w/crankshaft drive pulley             |                               |    |     |                          | Check discharge lines         | •                             |    |     | <input type="checkbox"/> |
| Perform manifold gauge check          |                               |    | •   | <input type="checkbox"/> | (hot to touch)                |                               |    |     |                          |
| Verify clutch is engaging             |                               |    | •   | <input type="checkbox"/> | Check suction lines           | •                             |    |     | <input type="checkbox"/> |
| <b>CONDENSER</b>                      |                               |    |     |                          | (cold to touch)               |                               |    |     |                          |
| <b>2. Clean dirt/bugs/leaves from</b> | •                             |    |     | <input type="checkbox"/> | Inspect fittings/clamps/hoses |                               | •  |     | <input type="checkbox"/> |
| coils (w/compressed air)              |                               |    |     |                          | Check thermostatic switch     |                               |    | •   | <input type="checkbox"/> |
| Check inlet/outlet for                | •                             |    |     | <input type="checkbox"/> | (proper operation)            |                               |    |     |                          |
| obstructions/damage                   |                               |    |     |                          | Outlets in cab (temperature   |                               | •  |     | <input type="checkbox"/> |
| <b>RECEIVER-DRIER</b>                 |                               |    |     |                          | check; 40 to 50°F)            |                               |    |     |                          |
| <b>3. Check inlet line from</b>       | •                             |    |     | <input type="checkbox"/> | Check fan clutch (proper      |                               | •  |     | <input type="checkbox"/> |
| condenser (hot to touch)              |                               |    |     |                          | operation)                    |                               |    |     |                          |
| Check sight glass                     | •                             |    |     | <input type="checkbox"/> | Inspect all wiring            |                               | •  |     | <input type="checkbox"/> |
| (streaks or cloudiness)               |                               |    |     |                          | connections                   |                               |    |     |                          |
| Replace if system is opened           |                               |    | •   | <input type="checkbox"/> | Operate manual controls       | •                             |    |     | <input type="checkbox"/> |
|                                       |                               |    |     |                          | through full functions        |                               |    |     |                          |

The following require monthly maintenance:

\*Compressor – run system at least 5 minutes (40 degrees Fahrenheit minimum outside temp.) in order to circulate oil and lubricate components.

Maintenance notes: \_\_\_\_\_

# Troubleshooting & Service Procedures

*Click on any of these  
subject headings to go  
directly to the page*

- Troubleshooting Overview
- Understanding System Function
- A Troubleshooting Example
- Manifold Gauge Set Installation
- Troubleshooting by Manifold Gauge Set Readings
- Review of Frequent Problem Areas
- Conclusion

**Can you fix an air conditioner or heater system without finding and correcting the cause of the problem? You bet you can!** It happens every day and it's not good for business. Here is an example. A truck pulls in off the road and the operator asks to have his rig serviced in a hurry. He tells you the air conditioner isn't cooling like it should and dashes into the restaurant for lunch.

You tip the hood, and check the sight glass on top of the receiver-drier. You see bubbles, not a lot but a fairly constant stream of them. It is obvious the system is low on refrigerant so you hook up the manifold gauge set, purge the gauge set hoses of air, and add refrigerant until the sight glass clears. Then you check evaporator temperature and it's OK. **The air conditioner is repaired right?** Wrong! What you did is add refrigerant and the problem went away. You did not find and fix the cause of the problem.

Component failure in an air conditioning system may be the result of a problem elsewhere in the system. For example, a belt or clutch failure might be caused by a dirty condenser restricting air flow and increasing head pressures. High head pressures commonly create problems with other system components. **Take time to look beyond the obvious for a potential hidden problem.**

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## Troubleshooting Overview

Troubleshooting includes collecting enough information to locate the cause of the problem, then correcting the problem and its cause by replacement, adjustment, and/or repairing. You begin by gathering information from the most to the least important sources.

Starting with the most important:

1. Your personal knowledge and experience with AC systems.
2. The vehicle operator's knowledge and experience—question him or her.
3. The work order.
4. Good test equipment and the HVAC system

The routine you follow when troubleshooting should proceed from the most to least productive way of locating the problem and fixing the cause.

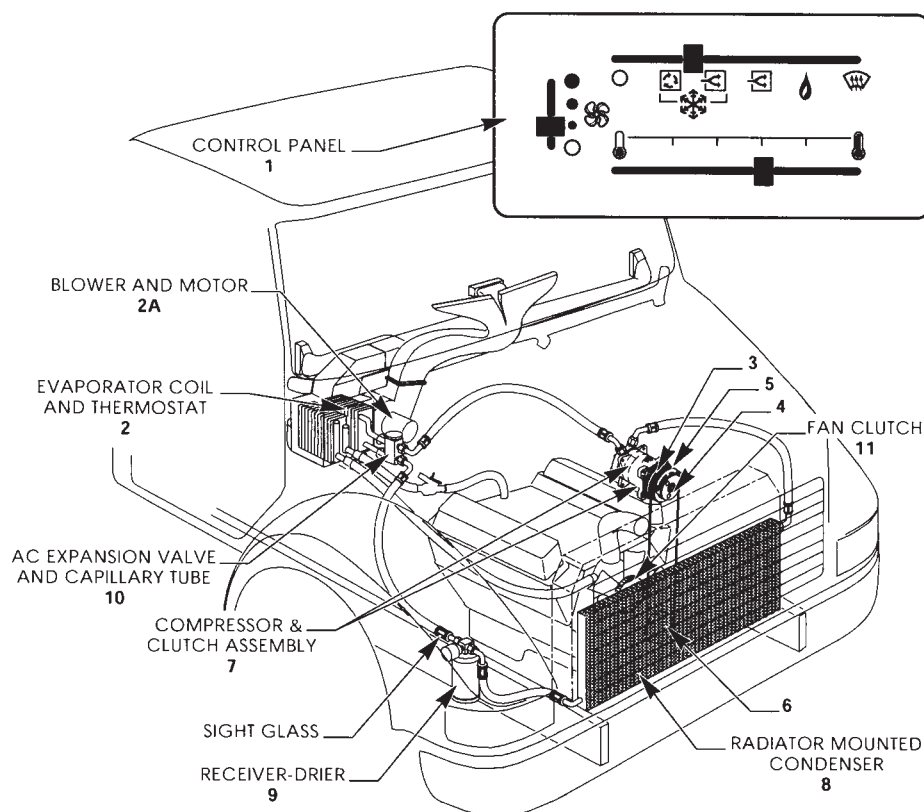
## Troubleshooting & Service Procedures

Experienced troubleshooters talk to the operator if they can, then personally verify the symptoms of the problem whenever possible. They attempt quick fixes on the basis of their knowledge of common system problems and causes when appropriate. They know where components are located, and make repairs when they have a good idea of what the problem is. They fix the cause or causes as well as the problem. They are confident of their knowledge and ability.

**Note:** The best troubleshooters all know who to call when they get stuck. They know someone who knows more than they do and are not too proud to ask for help or suggestions when needed. The key—understanding system function

### The Key—Understanding System Function

Your complete understanding of AC and heater systems and how they work, plus what can go wrong, is the key to troubleshooting and repair. We have talked about components and system function before. Now let's take a little different approach in describing what happens when the air conditioner is turned on. In Figure 8-1 we have used numbers on the illustration to track normal air conditioner function.



**Figure 8-1**

An illustration of the typical HVAC system. The numbers follow the action when the AC part of the system is working properly (moving heat out of the cab and into the outside air).

When you turn on the air conditioner at the control panel (1), the thermostat (2), is supposed to sense a warm temperature at the evaporator. A circuit in the thermostat should close, allowing current to flow through the thermostat to the compressor clutch field coil (3). When this happens, the clutch field coil becomes an electromagnet and pulls the clutch drive plate (4) tight against the clutch pulley (5).

---

**Note:** The same AC switch (1) may also turn on the fan or blower motor (2a) to circulate air in the cab. The air feels warm at first but will cool quickly.

A belt connects the clutch pulley to a drive pulley (6) on the engine. The engine provides the power to turn the clutch pulley and drive the compressor (7) when the clutch is engaged. When operating, the compressor compresses and pushes refrigerant gas to the condenser (8), through the receiver-drier (9), and to the expansion valve (10) orifice. When it does, it puts a lot of pressure on the gas. The compressor raises the temperature and pressure of the refrigerant inside the high side of the system.

At the same time, the compressor is also sucking in low pressure refrigerant gas from the expansion valve orifice, evaporator and through the low side of the system. The movement of the refrigerant inside the system transfers heat energy from the cab to the outside air for occupant comfort.

The automatic functions of the thermostat (or the pressure valve on some accumulators), and the expansion valve, help maintain pressures and temperatures inside the system at safe and efficient operating levels. Pressure and temperature are constantly changing due to compressor and expansion valve action, the amount of heat energy being moved and the environment or weather conditions.

The engine cooling system fan and clutch (11), and the evaporator blower motor (2a), move a sufficient amount of air through the condenser and evaporator. On the road, vehicle speed provides most of the (ram) air required for the condenser to work right. In a parked or slow moving vehicle the engine fan (or roof or remote mounted condenser and fans) moves sufficient air through the condenser fins.

---

**Note:** Clean refrigerant and refrigeration oil should be inside the system in the amount specified by the manufacturer. Moisture, sludge (moisture combined with refrigerant oil or desiccant), or desiccant particles will prevent the correct performance of the system and may cause component damage.

---

### A Troubleshooting Example

Remember the story at the beginning of this chapter? The vehicle operator pulled in off the road and asked you to repair the rig. He was in such a hurry he didn't tell you anything except that the air conditioner wasn't cooling. Here is the best way to handle that kind of situation.



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## Troubleshooting & Service Procedures

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Use your knowledge and experience. Ask yourself what could have caused a lack of cooling in that rig! Did the compressor drive belt break? Did a pressure switch or relief valve cutout the compressor because of high or low system pressure? Does the switch or valve in this type of system reset itself? Could there be a superheat switch and thermal limiter with a melted fuse. Did someone else service the system recently and put in too much refrigerant?

Could there be contaminants in the system blocking the expansion valve (expansion tube)? If there is a leak, why and how did refrigerant get out of the system? You know if refrigerant can get out, air and moisture may get inside as well, especially if the leak is on the suction side of the system. Could there be a restriction to refrigerant flow in one of the high pressure lines because of a kink? From your knowledge and experience, you already know about these possibilities and others when you talk to the operator (before he has the chance to leave).

The right kind of questions can speed up troubleshooting and your service work by pinpointing the problem(s) that needs fixing. Your conversation with the operator might be as follows:

- *How long ago did the AC system stop cooling?*  
**Answer:** About an hour ago.
- *What steps did you take when you noticed the lack of cooling?*  
**Answer:** I put it on maximum cool.
- *Then what did you do?*  
**Answer:** When it wouldn't cool, I opened the window and turned the air conditioner off.
- *Is this problem new or has it happened before, and when?*  
**Answer:** In the last few days I've had problems with cooling off and on—this is the first time it's happened when I was close to a place that did AC service.
- *Do you get any cooling at all?*  
**Answer:** Yes but it seems to quit after a while.
- *Do you still get air flow at the vents from the blower?*  
**Answer:** Yes.
- *When was your air conditioner checked thoroughly?*  
**Answer:** Before I bought the rig last May (a year ago).
- *Has the heater been used recently and did it work OK?*  
**Answer:** Yes.



- *Have you had other service problems in the last few months?*

**Answer:** No.

- *(If the answer was yes, you should ask—When? Where? What was fixed or replaced?).*
- *Finally, ask the operator if he or she has a wiring diagram for the system.*

Now let's look at the information you have gathered from the operator and what you know from experience. He believes the problem is that the AC system quits cooling after it has been on for a while! You know that the AC system has not been maintained since the rig was purchased a year ago. Because of that, there could be several causes for the problem (lack of cooling) and there may be other potential problems about to develop.

It is possible that some refrigerant has leaked. Moisture and other contamination may be inside the system. You have been told there are no heater problems, but that doesn't mean there are none that might affect AC system operation. The AC system has quit cooling several times in the last few days. The problem may have become more severe than when it quit cooling the first time.

If enough refrigerant or oil has leaked out, a low pressure cutout switch may have cut the circuit to the clutch, protecting the compressor. Because the system has not been maintained in a year, there may be other components that should be serviced. You could fix the probable causes, and the system might work and then break down again as the rig drives out of your place. From your knowledge and what the operator has just told you, you know this may not be a quick fix problem.

It's up to you to describe the service situation to the operator. Tell him you need to do a complete system maintenance inspection to find and correct the problem or other potential problems. He can give you the go ahead for full service and repair now, wait till you have inspected the system to determine cause and cost, or delay repair until he has some down time available.

Normally when the operator can tell you what the problem is, you would first operate the system to verify the problem. In this situation your troubleshooting (your own knowledge added to what the operator told you), indicates the next step. You need to do a complete maintenance inspection instead! Proceed as described in *Chapter 7*. Correct any obvious problems and check carefully for leaks. Leak testing should be visual, by feel and with a leak detector. Next, do your performance test with the engine running and the AC system on.

---

**Note:** Don't forget to check the heater system too! If the water valve is not closed, then hot engine coolant flowing through the heater core would warm the air at the same time the evaporator was trying to cool it. The result would be the appearance of an AC problem.

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## Troubleshooting & Service Procedures

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If your AC and heater visual, electrical and leak inspections don't turn up any problems, save time by hooking up the manifold gauge set before you make the performance test. If you find a leak and can correct it easily by tightening a connection, do so. But if too much refrigerant leaked out, you may have to add some refrigerant to the system for an effective performance test. We will get into detail on troubleshooting with gauges after we explain manifold gauge set installation and adding refrigerant.

---

### Manifold Gauge Set Installation

|                |                                                                                                                                                                                                                             |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CAUTION</b> | Never hook up the gauge set when the engine and air conditioner are running. Be sure all the valves on the manifold are closed all the way (turn them clockwise). Check the hose connections on the manifold for tightness. |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Locate the low and high side system service fittings and remove their protective caps. Position or hang the manifold gauge set in a convenient location. Figure 8-2 illustrates a good example of manifold gauge set hookup in one service situation.



**Figure 8-2**

A typical manifold gauge set hookup is shown in this illustration. The center hose on the gauge set is connected to the vacuum pump.

The manifold gauge set is a necessary tool in troubleshooting AC system problems. The following steps are performed during and after installing the manifold gauge set:

1. Purging Air from the Gauge Set Hoses
2. Adding Refrigerant to the System
3. Stabilizing the AC System.

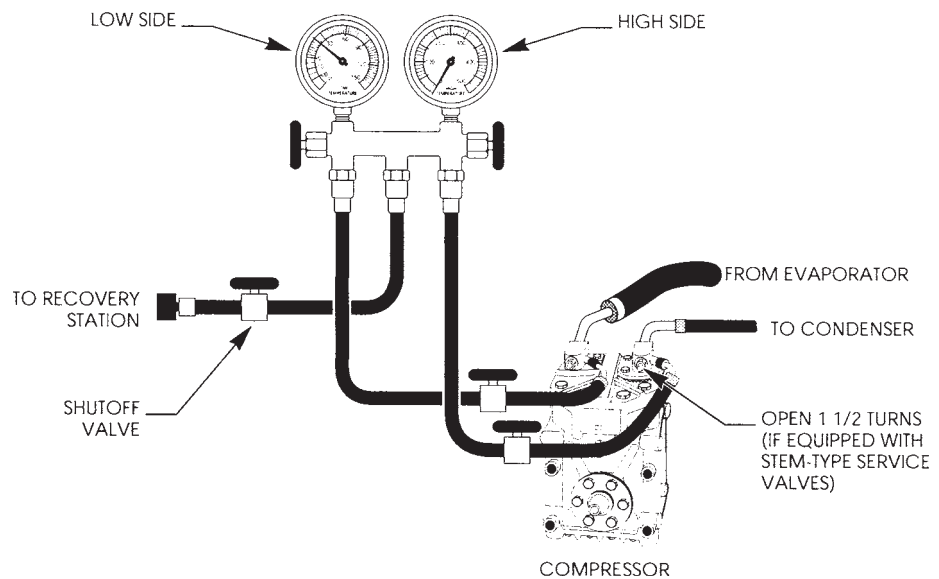
### 1. Purging Air From Gauge Set Hoses

Environmental regulations require that all service hoses have a shutoff valve within 12 inches of the service end. These valves are required to ensure only a minimal amount of refrigerant is lost to the atmosphere. R-12 gauge set hoses have a valve near the end of all three hoses. R-134a gauge sets have a combination quick disconnect and shutoff valve on the high and low sides. The utility (center) hose also requires a valve.

The initial purging is best accomplished when connected to recovery or recycle equipment. Figure 8-3 illustrates the gauge set connections for purging and refrigeration recovery.

**Figure 8-3**

The purging setup for manifold gauge set and compressor service valves are shown here.



**Note:** The manifold gauges read system pressure when the hand valves are closed if the hose end valves, and the stem type service valves (if included) are open.

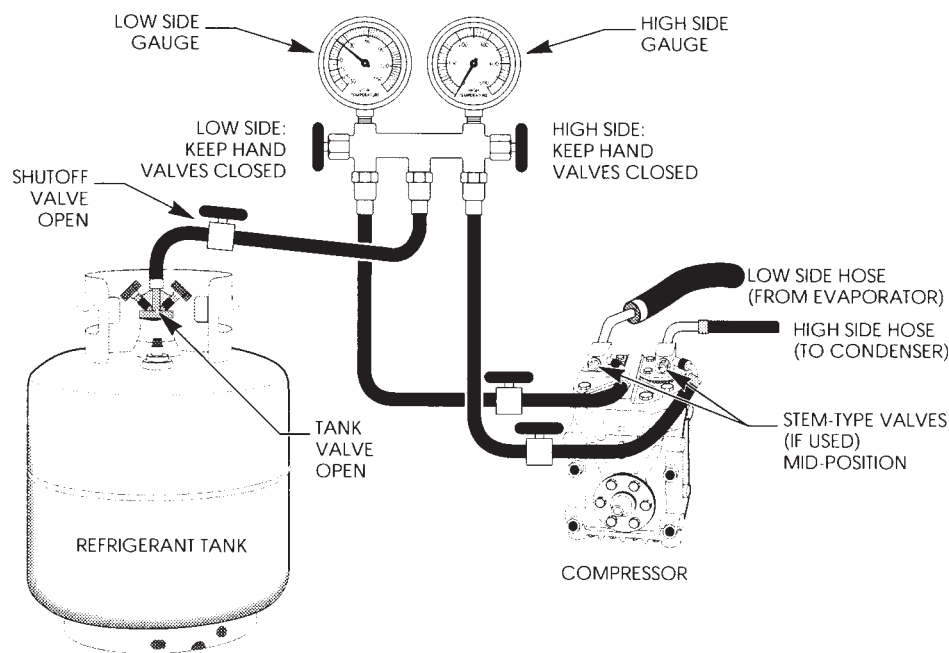
### 2. Adding Refrigerant to the System

Now that the gauges are connected, you may need to add some refrigerant to the AC system before you can do an effective performance inspection. However, if leaks are obvious they should be repaired prior to adding refrigerant.

**Note:** Loss of some refrigerant is not unusual over an extended period of time. Adding refrigerant is a typical procedure when the AC system is maintained on a regular basis.

When adding refrigerant to the system, connect the center hose from the manifold gauge set to the refrigerant dispensing valve on the container. Figure 8-4 illustrates this connection.

## Troubleshooting & Service Procedures



**Figure 8-4**

In this illustration we have noted how refrigerant is added to the air conditioner.

Before adding refrigerant to the system you should study the sight glass while the engine is running and the air conditioner is on. Even if you found a leak during the system inspection and corrected it, you have no way of knowing how much refrigerant has leaked. You will not be able to tell how much refrigerant is in there, but you can see if bubbles are present.

Then check the gauges for unusually high or low readings, or a lack of pressure. Following this procedure, and using your knowledge and experience, decide if it is safe and makes sense to add refrigerant in order to make your full performance inspection.

You are now ready to add refrigerant to the system. For your safety and to prevent system damage use the following procedure.

1. Turn on the engine and set the idle at 1200 to 1500 RPM and then turn on the air conditioner.

**CAUTION** Do not open the high pressure hand valve on the manifold gauge set. The compressor could pump refrigerant into the container and cause it to BURST. Be sure to keep the refrigerant container upright to prevent liquid refrigerant from entering the compressor.

2. Open the refrigerant dispensing valve on the container and then the low pressure hand valve on the manifold. This allows refrigerant to enter the system as a gas on the low pressure or suction side of the compressor. The compressor will pull refrigerant into the system.

3. Add refrigerant until the gauges read in the normal range and the sight glass appears clear. The sight glass may not be clear for a moment just before or after the clutch cycles on and off but should generally be clear. Gauge readings will fluctuate as the compressor cycles on and off.

---

**Note:** Pressures within the air conditioning system vary with ambient temperature. A normal pressure range is defined as follows:

|           |              |
|-----------|--------------|
| Low side  | 15–30 PSIG   |
| High side | 150–280 PSIG |

If R-134a is used in place of R-12 the high side readings will be about 20 PSI higher. For this reason many OEMs are recommending an increase in condenser capacity when retrofitting to the new refrigerant, R-134a.

---

**CAUTION**

If the gauges show any abnormally high or low pressures as you are adding refrigerant, stop and investigate for probable cause. Never add more than one pound of refrigerant. If the system is low enough on refrigerant to require more than that amount you should stop and check again for leaks. Then recover all of the refrigerant, repair, evacuate and recharge the air conditioner. (See *Chapter 9*). You may want to add dry nitrogen gas to the AC system instead of R-12 if pressures are below normal and a leak is suspected. Nitrogen gas is sold in cylinders under high pressure, 1800 to 2000 PSI. Be sure the cylinder has a pressure regulating valve to control the pressure when dispensing nitrogen gas. Dispose the gas at no more than 200-250 psi, as this is sufficient pressure to cause or indicate a leak point. See note under *Troubleshooting by Manifold Gauge Set Readings* in this chapter.

4. When the gauges show normal, close the hand valve on the manifold, the hose end shutoff valve, and the valve on the refrigerant container. You can now proceed with the performance inspection.

### 3. Stabilizing The AC System

For reliable gauge readings as an aid in troubleshooting, the AC system must be stabilized.

---

**CAUTION**

Be sure your tools and test equipment are clear of all moving parts of the engine and air conditioner.

---

## Troubleshooting & Service Procedures

---

Start the engine and set to a fast idle of 1200 to 1500 RPM. Turn on the air conditioner. After a quick in-cab performance test of control function, blower speeds and air flow, set the AC system controls to maximum cooling and blower speed on high. All windows must be closed. If cab temperature is hot (rig has been sitting in the sun with the windows closed), open the windows for a minute or so to let the hot air out. Run the engine and air conditioner about five minutes for the system to stabilize. In hot humid weather or where the AC condenser can't receive adequate air flow from the engine fan you may have to use a floor mounted fan to force sufficient air flow through condenser fins. This helps to stabilize the system by simulating ram air flow found under normal operating conditions.

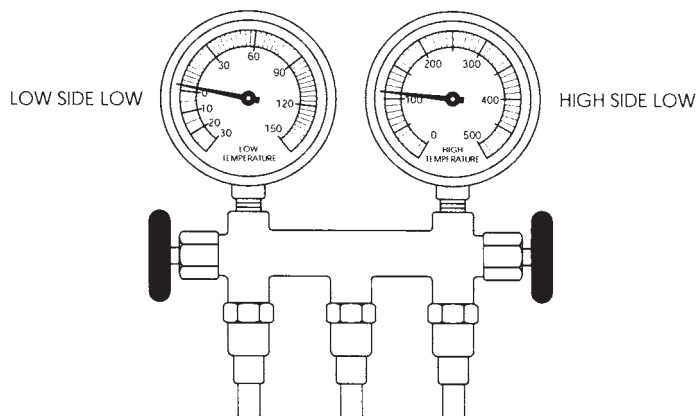
When a vehicle has a tilt cab or hood and the condenser is part of the grill, you must use the floor fan to get air to the condenser. You could tilt the cab or hood back to normal position, carefully routing the manifold gauge set and hoses away from moving parts. Then place the gauges so you can read system pressure.

---

### Troubleshooting by Manifold Gauge Set Readings

The series of figures that follow (Figures 8-6 through 8-15) show gauges with typical readings indicating AC system problems. Each figure is followed by troubleshooting tips, probable causes for the gauge readings shown, and appropriate service and repair procedures.

#### Low Refrigerant Charge in the System



**Figure 8-5**

Gauge reading, low refrigerant charge in the system.

---

**Tip:** You see bubbles in the sight glass. The air from vents in the cab is only slightly cool.

---

**Cause:** Insufficient refrigerant (charge) in the system.

---

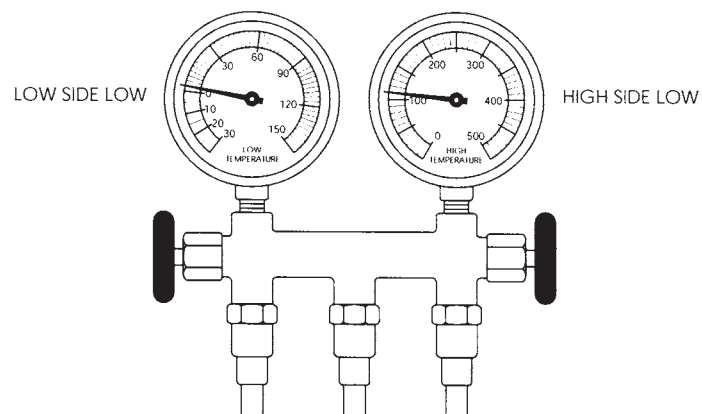
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**Repair Procedure:**

Check for leaks with your leak detector. If you find a leak at a connection, tighten it then add refrigerant as necessary. If a component or line is leaking (defective), recover all refrigerant from the system. Replace the defective part and then check the compressor oil level and replace missing oil. Evacuate and recharge with refrigerant, then check AC operation and performance.

**Figure 8-6**

Gauge reading, extremely low refrigerant charge in system.

**Extremely Low Refrigerant Charge in the System**

---

**Tip:**

The sight glass is clear or shows oil streaks. The air from vents in the cab seems warm. If there is a low pressure or Trinary™ switch in the system it may have shut off the compressor (clutch).

---

**Cause:**

Extremely low or no refrigerant in the system. There is a leak in the system.

---

**Repair Procedure:**

Add refrigerant to the system, at least half of the normal full charge amount. Then perform your leak test. As an alternative to a refrigerant, add dry nitrogen gas to the system and then test for leaks.

---

**Note:**

It may be necessary to use a jumper wire to bypass some types of low pressure cutout switches to operate the compressor (clutch) when you add refrigerant to the system.

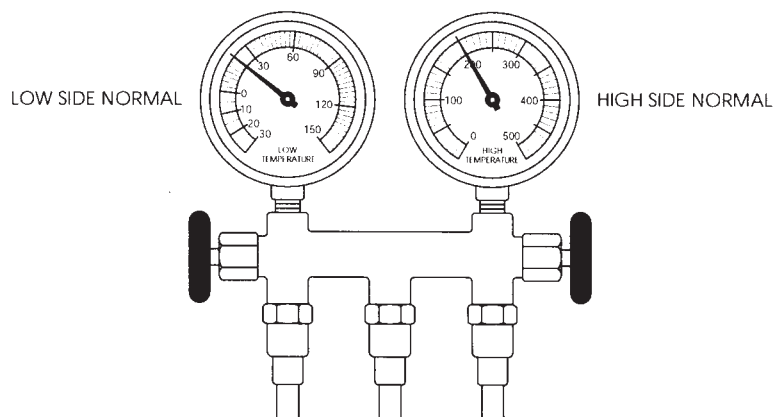
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## Troubleshooting & Service Procedures

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After finding a leak, recover all refrigerant from the system and repair the leak. Check the compressor and replace any refrigeration oil lost due to leakage. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

### Air and/or Moisture in the System



**Figure 8-7**

Gauge reading, air and/or moisture in the system.

---

**Tip:** The sight glass may be clear or show some bubbles. The air from vents in the cab is only slightly cool. In a cycling clutch type system with a thermostatic switch, the switch may not cycle the clutch on and off, so the low pressure gauge will not fluctuate.

---

**Cause:** Air and/or moisture in the system.

---

### Repair Procedure:

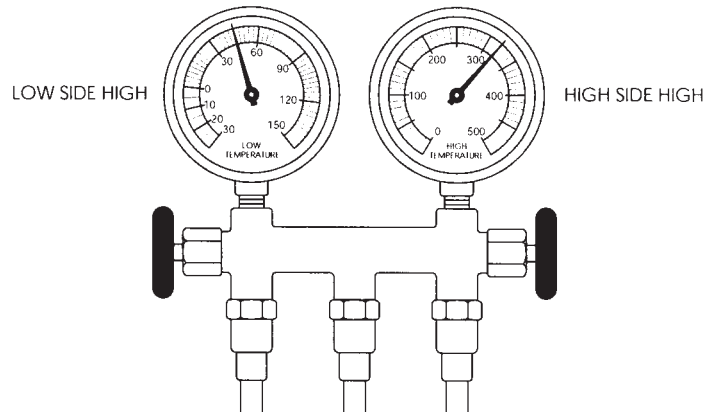
Test for leaks, especially around the compressor shaft seal area. When the leak is found, recover refrigerant from the system and repair the leak. Replace the receiver-drier or accumulator because the desiccant may be saturated with moisture (there is no way to tell). Check the compressor and replace any refrigeration oil lost due to leakage. Evacuate and recharge the system with refrigerant, then check AC operation and performance.



**Figure 8-8**

Gauge reading, excessive air and/or moisture in the system.

**Excessive Air and/or Moisture in the System**



**Tip:** There may be occasional bubbles in the sight glass. Air from vents in the cab is only slightly cool.

**Cause:** System contains excessive air and/or moisture.

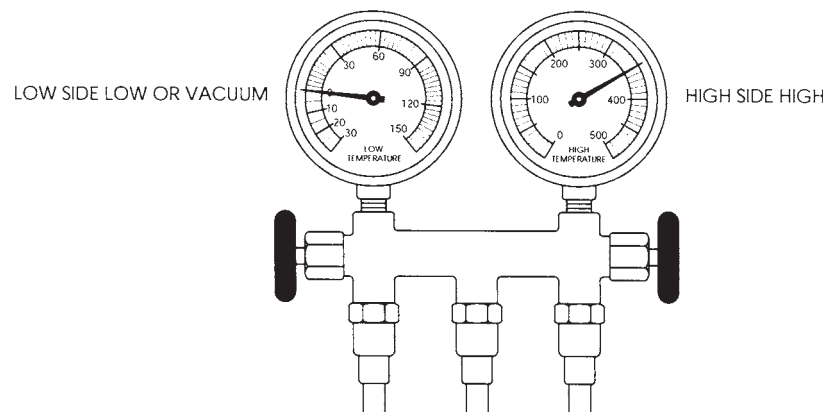
**Repair Procedure:**

Test for leaks, recover refrigerant from the system and repair the leak. Depending on the type of system, replace the receiver-drier or accumulator. The desiccant is saturated with moisture. Check and replace any compressor oil lost due to leakage. Evacuate and recharge the system, then check AC operation and performance.

**Figure 8-9**

Gauge reading, expansion valve (TXV) stuck closed.

**Expansion Valve (TXV) Stuck Closed or Plugged**



**Tip:** Air from vents in the cab is only slightly cool. The expansion valve body is frosted or sweating.

---

## Troubleshooting & Service Procedures

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---

**Cause:** An expansion valve malfunction could mean the valve is stuck in the closed position, the filter screen is clogged (block type expansion valves do not have filter screens), moisture in the system has frozen at the expansion valve orifice, or the sensing bulb is not operating. In vehicles where the TXV and sensing bulb are accessible, perform the following test. If not accessible, then proceed to *Repair Procedure*.

---

**Test:**

1. Warm diaphragm and valve body in your hand or carefully with a heat gun. Activate system and watch to see if the low pressure gauge rises.
2. Next, carefully spray a little nitrogen, or any substance below 32 degrees Fahrenheit, on the capillary coil (bulb) or valve diaphragm. The low side gauge needle should drop and read at a lower (suction) pressure on the gauge. This indicates the valve was part way open and that your action closed it. Repeat the test, but first warm the valve diaphragm or capillary with your hand. If the low side gauge drops again, the valve is not stuck.
3. Clean the surfaces of the evaporator outlet and the capillary coil or bulb. Make sure the coil or bulb is securely clamped to the evaporator outlet tube and the insulation is in place. Next proceed with recovering refrigerant from the system.

---

### Repair Procedure:

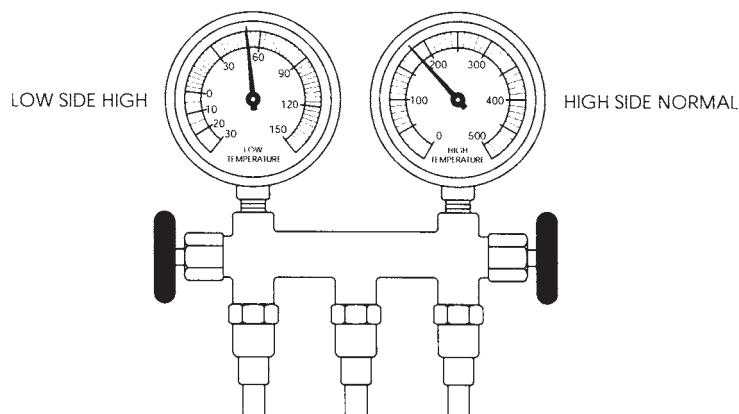
Inspect the expansion valve screen (except block type valves). To do this you must recover all refrigerant from the system. Disconnect the inlet hose fitting from the expansion valve. Remove, clean and replace the screen, then reconnect the hose. Any signs of contamination will **require** flushing the system. Next, replace the receiverdrier. Then evacuate and recharge the system with refrigerant, and check AC operation and performance.

**Note:** If the expansion valve tests did not cause the low pressure gauge needle to rise and drop, and if the other procedures described did not correct the problem, the expansion valve is defective. You must recover all refrigerant from the system again, and replace the expansion valve and receiver-drier. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

### Figure 8-10

Gauge reading, expansion valve (TXV) stuck open.

### Expansion Valve (TXV) Stuck Open



**Tip:** Air from vents in the cab is warm or only slightly cool.

**Cause:** The expansion valve is stuck open and/or the capillary tube (bulb) is not making proper contact with the evaporator outlet tube. Liquid refrigerant may be flooding the evaporator making it impossible for the refrigerant to vaporize and absorb heat normally. In vehicles where the TXV and sensing bulb are accessible, check the capillary tube for proper mounting and contact with the evaporator outlet tube. Then perform the following test. If the TXV is not accessible, then proceed to *Repair Procedure*.

**Test:**

1. Operate the AC system on it's coldest setting for a few minutes. Carefully spray a little nitrogen or other cold substance, on to the capillary tube coil (bulb) or head of the valve.
2. The low pressure (suction) side gauge needle should now drop on the gauge. This indicates the valve has closed and is not stuck open. Repeat the test, but first warm the valve diaphragm with your hand.

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## Troubleshooting & Service Procedures

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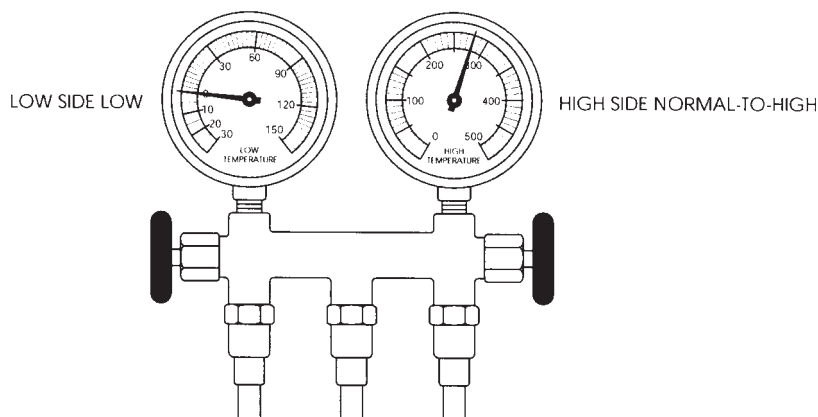
3. If the low side gauge shows a drop again, the valve is not stuck. Clean the surfaces of the evaporator outlet and the capillary coil or bulb. Make sure the coil or bulb is securely fastened to the evaporator outlet and covered with insulation material. Operate the system and check performance.

---

### Repair Procedure:

If the test did not result in proper operation of the expansion valve, the valve is defective and must be replaced. Recover all refrigerant from the system and replace the expansion valve and the receiver-drier. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

### System High Pressure Side Restriction



**Figure 8-11**

Gauge reading, system high pressure side restriction.

---

**Tip:** Air from vents in the cab is only slightly cool. Look for sweat or frost on high side hoses and tubing, and frost appearing right after the point of restriction. The hose or line may be cool to the touch near the restriction.

---

**Cause:** There could be a kink in a line, or other restriction in the high side of the system.

---

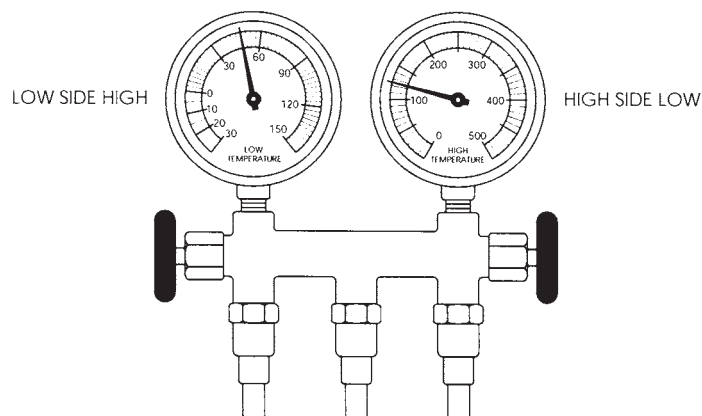
**Repair Procedure:**

After you locate the defective component containing the restriction, recover all of the refrigerant. Replace the defective component and the receiver-drier. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

**Figure 8-12**

Gauge reading, compressor malfunction.

**Compressor Malfunction**



---

**Tip:** The compressor may be noisy when it operates.

---

**Cause:** Defective reed valves or other compressor components. If the compressor is not noisy, there may be a worn or loose compressor clutch drive belt.

---

**Repair Procedure:**

If you find the belt worn or loose, replace or tighten it and recheck system performance and gauge readings. To inspect and service the compressor, you must isolate (front seat the stem type compressor service valves) and recover refrigerant, or fully recover R-12 from systems containing Schrader valves. Remove the compressor cylinder head and check the appearance of the reed valve plate assembly. If defective, replace the valve plate and install with new gaskets, or replace the compressor assembly.

---

## Troubleshooting & Service Procedures

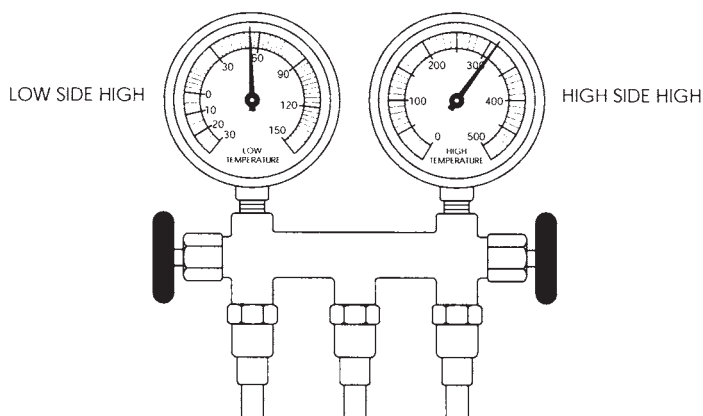
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If you find particles of desiccant in the compressor, remove and replace it and the receiver-drier. Before doing so, back flush other system components (except the expansion valve) using a flushing kit. If there are stem type valves and you isolate the compressor, the rest of the system must be purged of refrigerant before you can disconnect and flush system components (*Chapter 9* describes the flushing procedure). After flushing, reassemble the components. Always check the oil level in the compressor, even if you install a new or rebuilt unit. Tighten all connections and evacuate the system. Recharge the air conditioner with refrigerant and check system operation and performance.

---

**Note:** Rotary compressors have a limited oil reservoir. Extra oil must be added for all truck installations

### Condenser Malfunction or System Overcharge



**Figure 8-13**

Gauge reading, condenser malfunction or system overcharge.

---

**Tip:** The air from vents in the cab may be warm. In R-12 systems there can be bubbles in the sight glass. The high pressure hoses and lines will be very hot. Don't forget to check the engine cooling system components—fan and drive belt, fan clutch operation, and the radiator shutter.

---

**Cause:** The condenser is not functioning correctly or there may be an overcharge of refrigerant inside the system. Another possibility is lack of (ram) air flow through the condenser fins during testing. Engine cooling system component malfunction can cause high pressure by blocking air flow (radiator shutter) or not providing air flow (fan clutch) in sufficient quantity.

---

**Repair Procedure:**

Inspect the condenser for dirt, bugs or other debris and clean if necessary. Be sure the condenser is securely mounted and there is adequate clearance (about 1-1/2 inches) between it and the radiator. Check the radiator pressure cap and cooling system, including the fan, fan clutch, drive belts and radiator shutter assembly. Replace any defective parts and then recheck AC system operation, gauge readings and performance.

If the problem continues, the system may be overcharged (have too much refrigerant inside). Recover the system slowly until low and high pressure gauges read below normal, and bubbles appear in the sight glass. Then add refrigerant (charge the system) until pressures are normal and the bubbles disappear. Add another quarter to half pound of refrigerant and recheck AC system operation, gauge readings and performance.

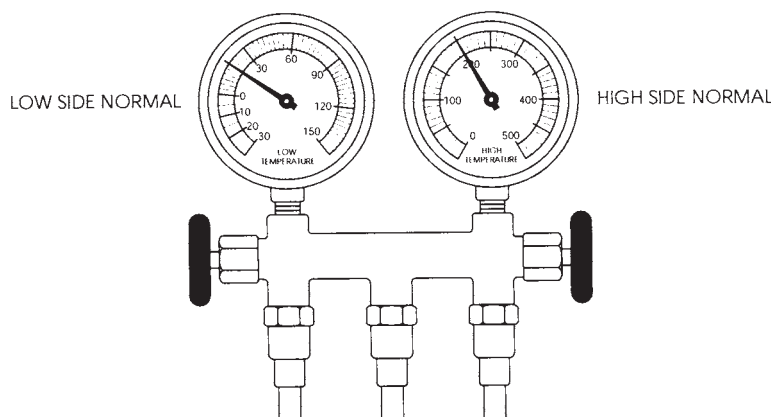
If the high gauge readings do not change, you should recover all of the refrigerant and flush (it may be partially plugged) or replace the condenser. Also replace the receiver-drier or accumulator. Then connect the components and evacuate the system. Recharge the air conditioner with refrigerant and check system operation and performance.

---

## Troubleshooting & Service Procedures

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### Thermostatic Switch Malfunction



**Figure 8-14**

Gauge reading, thermostatic switch malfunction.

---

**Tip:** The low side gauge needle may fluctuate in a very narrow range compared to a normal range. The compressor clutch may be cycling on and off more frequently than it should.

The low side gauge needle may fluctuate in an above normal range as the clutch cycles. This may be an indication that the thermostat is set too high (someone may have attempted to adjust the factory setting). A new thermostat may have been installed incorrectly (capillary tube not inserted between the evaporator fins in the proper position).

---

**Cause:** The thermostatic switch is not functioning properly or at all.

---

#### Repair Procedure:

Replace the thermostatic switch. When you remove the old thermostat, replace it with one of the same type. (They operate in a factory preset temperature range.) Take care in removing and handling the thermostat and thin capillary tube attached to it. Don't kink or break the tube.

Position the new thermostat capillary tube at or close to the same location and seating depth between the evaporator coil fins as the old one. Connect the electrical leads.



---

**Note:** See the *Thermostat* section in *Chapter 10*. Fan clutch, radiator shutter, condenser, compressor, and the newer air and water valve control systems are covered in *Chapter 10*.

---

## Review of Frequent Problem Areas

In HVAC systems a limited number of things can go wrong. Moving parts of the compressor, clutch, and expansion valve or refrigerant metering device can malfunction or break down from metal fatigue, contamination, abnormal pressure or lack of lubrication. Electrical connections may corrode, become disconnected or break. Fuses blow from shorts or overload. Belts slip or break.

Vibration from the engine or road surface can work bolts and air or vacuum lines loose, or rub and break or wear parts out. Motors may burn out. The inside of the system can become contaminated from moisture, air or desiccant material breakdown. Refrigerant may leak out of the system quickly or very slowly. Moisture in the system can combine with refrigerant to form acid and attack (corrode) metal parts from the inside. Moisture and refrigeration oil can combine to form sludge that may block refrigerant flow.

The following problems are discussed in more detail in this section:

1. Belts and Compressor Clutch
2. Condenser
3. Refrigerant Lines, Hoses, and Fittings
4. Refrigerant Metering Valves
5. Other Problems

### 1. Belts and Compressor Clutch

Let's review problem areas listed at the beginning of *Chapter 7*. The most frequent repairs are replacing belts and servicing or replacing the compressor or clutch. Heavy duty vehicle operation puts a lot of stress on these parts. There are several main reasons.

There is often continuous operation for long periods of time. There may be frequent sudden RPM variations when shifting gears up or down. For this reason the AC clutches used in heavy duty systems usually have double row ball bearings. Vibration and road shock contribute to loose or broken mounting brackets, electrical connections and fittings. Belts, bearings and compressor reed valves wear out.

Various compressor clutch cutout switches are used because the AC designers know about compressor operating conditions. System leaks, high operating pressures, malfunctioning engine cooling system components—all cause compressor problems and failures. When refrigerant and refrigeration oil leaks out of a system or there is contamination blocking oil flow, the compressor will be starved for oil and seize.

## **2. Condenser**

Condensers get dirty and the dirt reduces heat movement by insulating the condenser. The fittings come loose or break from stress if the condenser or connecting hoses are not secured properly to keep the effects of vibration at a minimum.

Heat transfer efficiency and pressure in the condenser are affected by the amount of outside air flowing through condenser fins. A lack of air flow can mean the refrigerant doesn't give up enough heat energy to the outside air (it doesn't change state). The refrigerant arrives at the evaporator as a gas and can't pick up any heat energy from cab air. In the cab, air from the vents is only slightly cool or warm.

One possible cause of condenser malfunction could be the engine cooling system. This is why fan clutches and radiator shutters are often controlled or overridden by AC switch function. In fact, we can add fan clutch, radiator shutters and also fan motors to condenser problems. If they don't function to allow sufficient air through the condenser, pressure inside the system may become dangerously high. A lack of air through the condenser fins can raise high side pressure and blow out the weakest point in a system, or damage the compressor.

## **3. Refrigerant Lines, Hoses and Fittings**

Problems with these parts may be caused by normal deterioration, vibration damage, lack of maintenance or human error (improper installation or replacement). All rubber parts are attacked by ozone (oxygen) in the air. Rubber parts break down slowly and become more vulnerable to the effects of vibration with the passage of time.

Heavy duty vehicle vibration causes stress on all lines, fittings and connections. Regular maintenance includes checking and tightening any suspect line, or hose retainers, or grommet position where the grommet is protecting a line or hose from abrasion. Any insulating material wrapped around hoses must be in place and securely fastened.

## **4. Refrigerant Metering Valves**

When you consider valve problems there are obvious differences in valve construction and what can go wrong. If a valve is clogged with sludge or other obstruction, the result is a valve problem but the cause is contamination in the system. Valves get stuck open or closed, although most often closed when the gas charge is lost from the diaphragm housing in a traditional TXV. The capillary tube can vibrate loose from the evaporator outlet tube. The capillary can break and the small quantity of temperature sensitive gas can escape. The diagnosis of a valve as defective calls for replacement.

## **5. Other Problems—Leaks, Moisture, and Adding Refrigerant**

Before any refrigerant was put inside the AC system, someone used a vacuum pump to evacuate any air and moisture. Vacuum is really a force pulling against all hoses, fittings and components from the inside. When the system is charged with refrigerant, the pressure goes from minus (a vacuum) to plus pressure inside the hoses and all components. The refrigerant and refrigeration oil are trying to escape from the system at all times.

Technicians frequently add refrigerant to a system, replacing refrigerant seepage through system connections or fittings. If the system has been maintained regularly (every three to six months), adding a small amount of refrigerant may result in normal system function. However, the best procedure is to check all connections and look for, find and repair any leaks before adding refrigerant.

When your leak detector indicates the presence of a leak, you can't tell how long the system has been leaking. Finding one leak doesn't mean there are not others. Until you have some AC system work experience, it will be hard to guess how much refrigerant may have leaked. If you have to top a system off with a half pound of refrigerant or more, adding refrigerant is not the answer.

Find the leak. Recover all of the refrigerant and repair the system. The moisture absorbing capacity of any desiccant material is limited and cannot be measured. For that reason, replace the receiver-drier or accumulator. Then evacuate the system for an hour and recharge with refrigerant.

When a compressor shaft seal has leaked oil and the refrigerant charge is a little low, the shaft seal may have leaked because the air conditioner was not used. The seal can get a little out of round from the weight of the crankshaft and leak above the shaft. Running the compressor may cause the seal to swell and close up the leak. The shaft rotation exerts force all around the seal and puts life back into it. To prevent this from happening, manufacturers recommend regular AC system operation a minimum of every couple of weeks even in cool weather.

Keep in mind that the compressor can cause a vacuum inside the system if there is a restriction in the system. That means it can suck air and moisture inside under some conditions. It will pull these contaminants in through the same space where refrigerant and refrigerant oil has leaked out.

---

## Conclusion

What could the air conditioning problem and its cause have been at the beginning of this chapter? The operator was in a hurry, but you were able to start your troubleshooting with the answers he gave you. Problems your inspection may have turned up are a very low refrigerant charge, a contaminated system or defective compressor. Those are not quick fix jobs.

On the other hand, you might have found enough debris on the condenser fin surface to boost high side pressures to an abnormal level during the hottest part of the day. So the Trinary™ or high pressure switch would cut out from high pressure—but reset itself. You cleaned the condenser, added a half pound of refrigerant and AC system pressures and function returned to normal. Service and repair took a half hour. But there was no way to tell without using your knowledge and experience. By now you are pretty familiar with AC system problems, the reasons for some of them, troubleshooting and repair. In *Chapter 9* we will describe complete system purging, evacuation, flushing and recharging.

## MACHINE CONFIGURATION

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## **IV . HYDRAULIC UNITS**

## HYDRAULIC UNITS

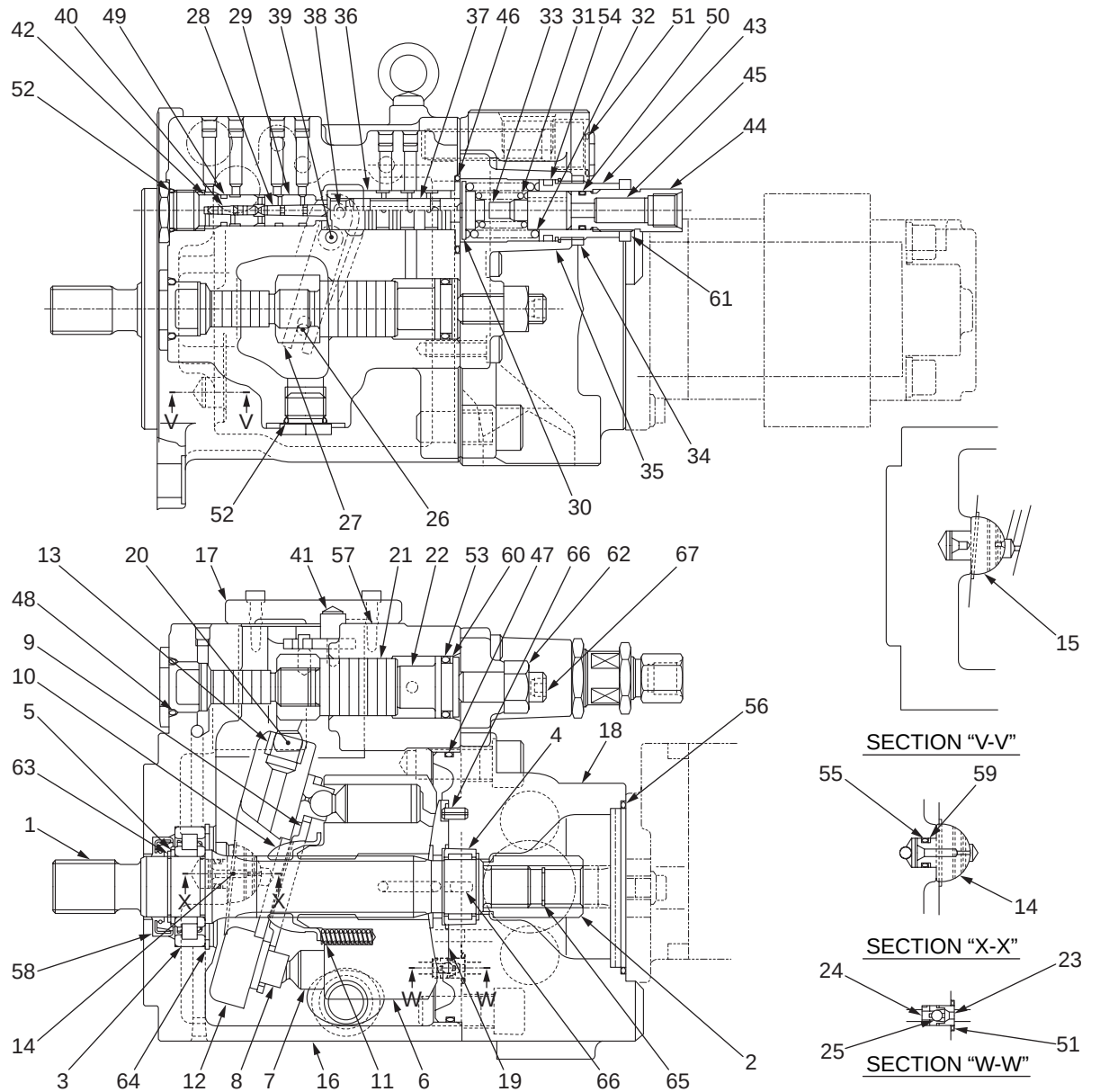
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| Swivel Joint Type: 532                     |      |

## HYDRAULIC PUMP (PISTON)

### CONSTRUCTION



L3D100E

- |                   |                 |                 |                     |                     |
|-------------------|-----------------|-----------------|---------------------|---------------------|
| 1. Shaft          | 15. Pin         | 29. Case        | 43. Adjusting Screw | 57. Packing         |
| 2. Coupling       | 16. Housing     | 30. Spring Seat | 44. Adjusting Screw | 58. Oil Seal        |
| 3. Collar Bearing | 17. Cover       | 31. Spring      | 45. Piston          | 59. Backup Ring     |
| 4. Needle Bearing | 18. Cover       | 32. Spring      | 46. O-ring          | 60. Backup Ring     |
| 5. Spacer         | 19. Valve Plate | 33. Stem        | 47. O-ring          | 61. Nut             |
| 6. Cylinder Block | 20. Pin         | 34. Nut         | 48. O-ring          | 62. Nut             |
| 7. Piston         | 21. Piston      | 35. Cover       | 49. O-ring          | 63. Ring            |
| 8. Shoe           | 22. Stopper     | 36. Sleeve      | 50. O-ring          | 64. Ring            |
| 9. Shoe Holder    | 23. Seat        | 37. Spool       | 51. O-ring          | 65. Ring            |
| 10. Guide         | 24. Stopper     | 38. Pin         | 52. O-ring          | 66. Spring Pin      |
| 11. Spring        | 25. Ball        | 39. Pin         | 53. O-ring          | 67. Adjusting Screw |
| 12. Swash Plate   | 26. Pin         | 40. Piston      | 54. O-ring          |                     |
| 13. Bushing       | 27. Lever       | 41. Pin         | 55. O-ring          |                     |
| 14. Pin           | 28. Piston      | 42. Case        | 56. O-ring          |                     |

## HYDRAULIC UNITS

## HYDRAULIC PUMP

## OPERATION

**Piston Pump**

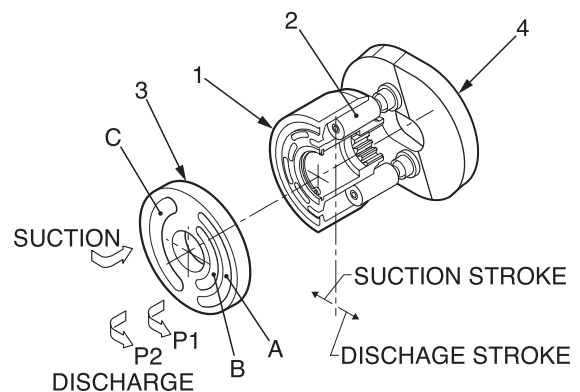
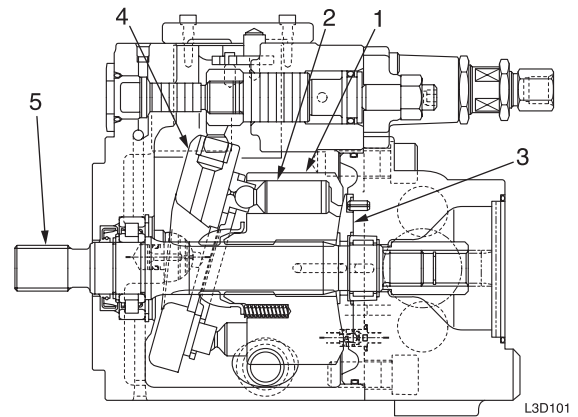
This pump is a variable displacement piston pump with a single cylinder block, which discharges two equal volumes.

Ten pistons (2) are installed in the cylinder block (1), and the end surface is in contact with the valve plate (3). The suction port C and the discharge port A of the pump P1 and the discharge port B of the pump P2 are arranged in the valve plate (3). On the other hand, the swash plate (4) is fastened to the housing at a given inclination, and the pistons (2) rotate along this swash plate (4).

When the shaft (5) is rotated, the cylinder block (1) rotates, the pistons (2) in the cylinder block execute reciprocating movement along the swash plate (4), and the pump executes suction and discharge. At this time, the pistons in contact with the discharge port A of the valve plate (3) operate as the pump P1, while the pistons in contact with the discharge port B operate as the pump P2.

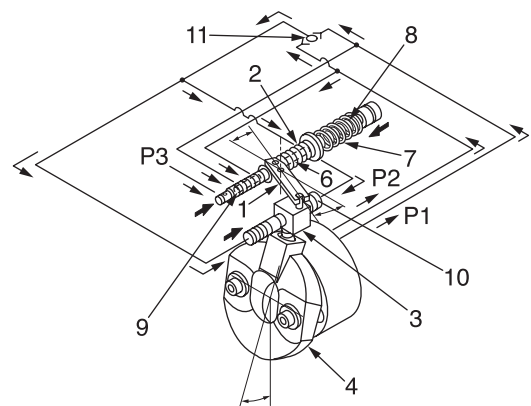
In this way, the ten pistons (2) execute one suction and discharge stroke with each revolution of the cylinder block (1), so that suction and discharge are executed continuously when the shaft (5) is rotated continuously.

As the piston stroke displacement depends on the inclination of the swash plate (4), the discharge flow quantity can be changed by changing the inclination of the swash plate (4).

**Discharge volume control**

The lever (1) can pivot on the pin and is linked with the sleeve (2) and pin (3). The pin (3) is linked with the swash plate (4) to change the inclination of the swash plate.

The force exerted by the springs (7) and (8) acts on the spool (6) while the average discharge pressure from pumps P1 and P2 and discharge pressure from pump P3 act on the piston (9). Also, the discharge pressure selected by the shuttle valve (11) and transmitted through the sleeve (2) and spool (6) acts on the servo piston (10).





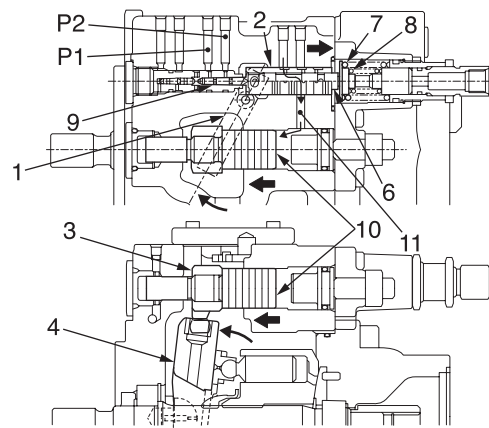
## HYDRAULIC PUMP

## HYDRAULIC UNITS

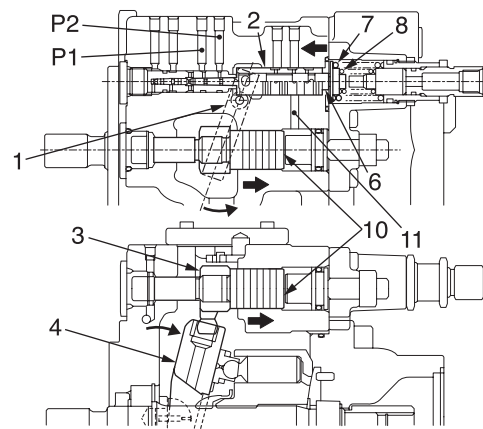
When the discharge pressure from pump P1 or P2 exceeds the setting value, the average pressure of the discharges from pumps P1 and P2,  $(P_1 + P_2)/2$ , acts on the piston (9). Then, the spool (6) is pushed and moved to the right until this operating pressure balances the force exerted by the springs (7) and (8).

When the spool (6) moves, the hydraulic oil passes through the sleeve (2), spool (6), and hydraulic passage (11), and is supplied to the large bore of the servo piston (10). This pushes the servo piston (10) to the left, decreasing the inclination of the swash plate (4). The movement of the servo piston (10) is conveyed via the piston (3) to the lever (1). The lever (1) pivots on the pin fixed on the housing and moves the sleeve (2) to the right. The sleeve (2) continues to move until the hydraulic oil passage (11) connected to the large bore is closed.

When the discharge pressure from pumps P1 and P2 is reduced, the spool (6) is pushed back to the left by the force exerted by the springs (7) and (8), and the hydraulic oil passage (11) connected to the large bore is connected to the tank passage. Then the servo piston (10) moves to the right by pressure from the small bore on its own, increasing the inclination of the swash plate (4). The lever (1) pivots on the pin and moves the sleeve (2) to the left. This operation continues until the openings of the sleeve (2) and spool (6) are closed.

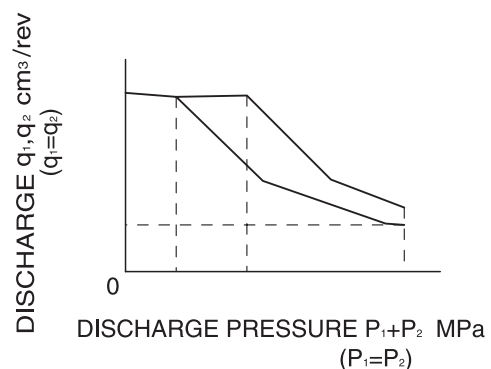


L3D104



L3D105

Thus, by changing the inclination of the swash plate (4) the discharge is controlled and only minimum pressure and flow required for the load are supplied from the pump. This minimizes the pressure loss of the pump. The inclination of the swash plate (4) varies depending on the operating pressures not only by the pumps P1 and P2 but also by the pump P3. Thus, the P-Q curve for the piston pumps shows that the engine's power is fully utilized (full horse power control).



L3D124E

## HYDRAULIC UNITS

## HYDRAULIC PUMP

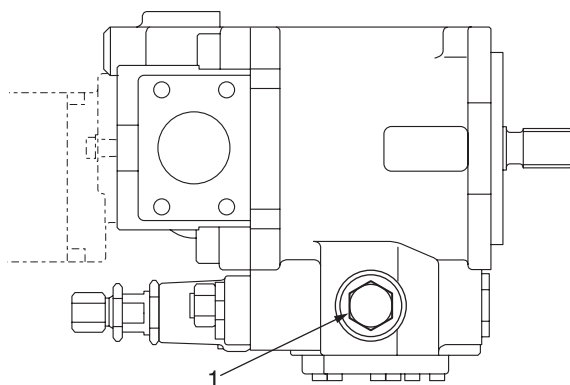
### DISASSEMBLY AND ASSEMBLY

#### General Cautions

- Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
- Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
- Clean all disassembled parts in cleaning solvent. Use a lint free cloth, or air dry the parts.
- Make match marks on each part so that they will be assembled in the same positions when assembled.
- Replace all seals with new ones each time the hydraulic units is disassembled.
- Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.
- Do not turn adjusting screws if not required.
- Apply hydraulic oil to sliding surfaces and apply a thin coating of grease to seals when assembling them.

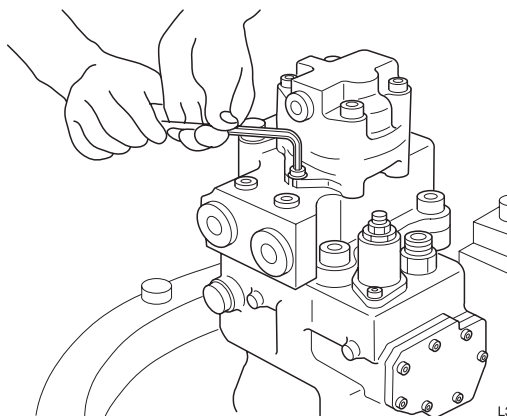
#### Disassembly

1. Loosen the drain plug (1) and drain out the oil.



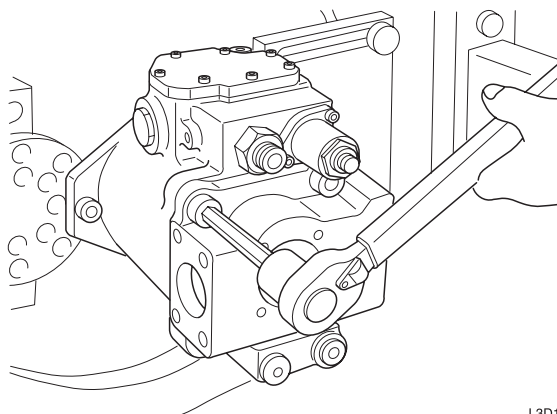
L3D106

2. Remove the cap screws and remove the gear pump.
3. Remove the coupling.



L3D107

4. Remove the cap screws and remove the cover.
  - Remove the cover in horizontal condition.

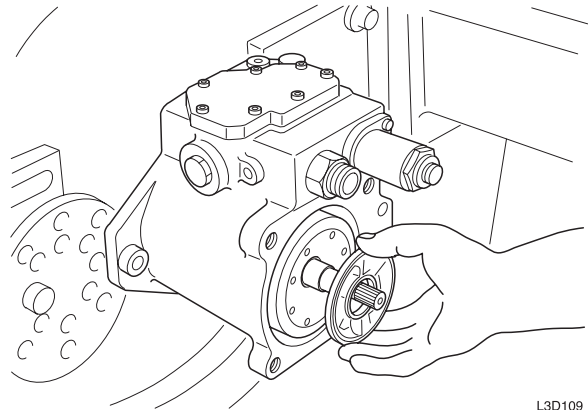


L3D108

## HYDRAULIC PUMP

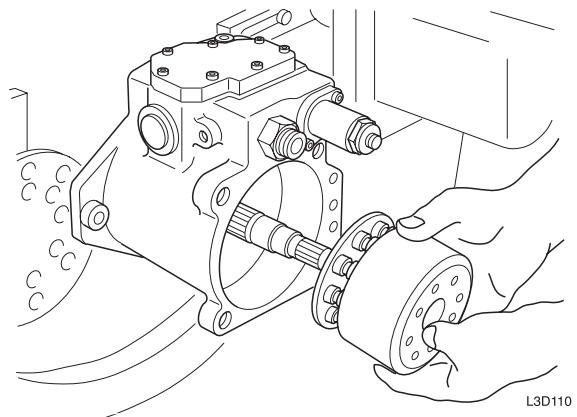
## HYDRAULIC UNITS

5. Remove the valve plate.



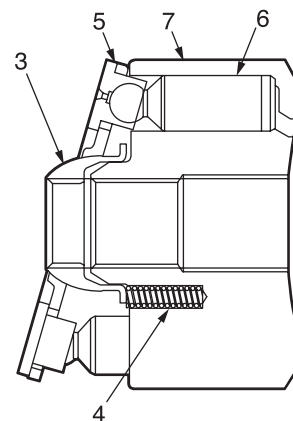
L3D109

6. Disassemble the cylinder block.
  - a. Remove the cylinder block from the shaft.



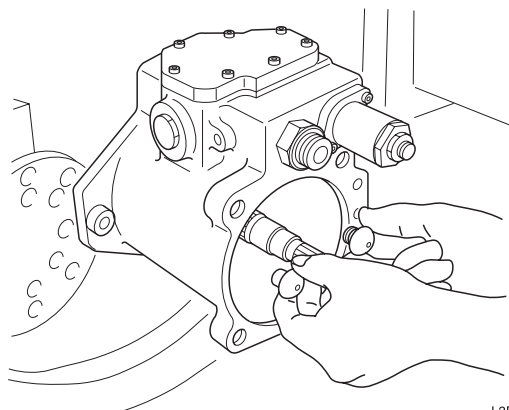
L3D110

- b. Remove the guide (3), the springs (4), the holder (5), and the pistons (6) from the cylinder block (7).
    - Disassemble the inside of the cylinder block (7) only when required.



L3D111

7. Remove the swash plate.
8. Remove the pin R and pin L.

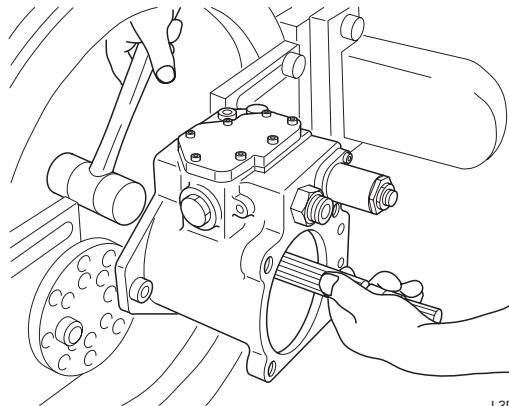


L3D112

## HYDRAULIC UNITS

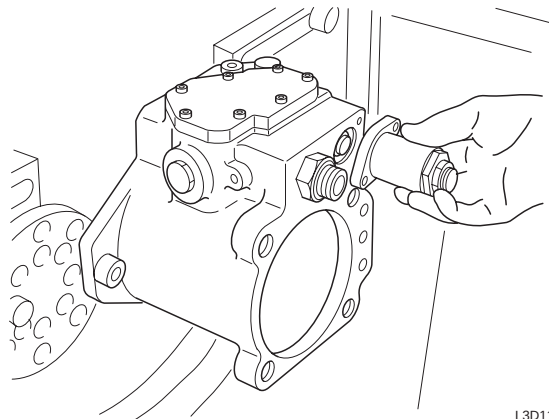
## HYDRAULIC PUMP

9. Remove the shaft while tapping its rear end with a plastic hammer.



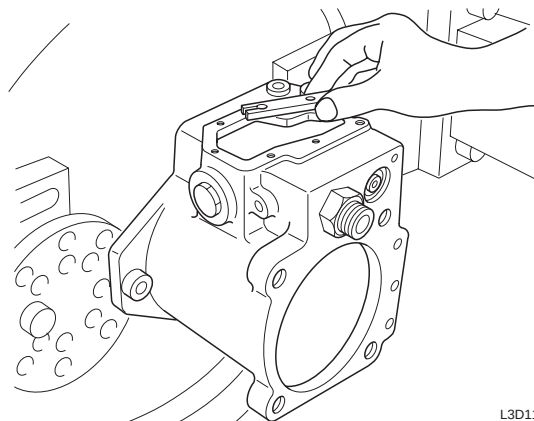
L3D113

10. Remove the cap screws and remove the cover.
11. Remove the two springs [inside, outside].
12. Remove the spring seat.



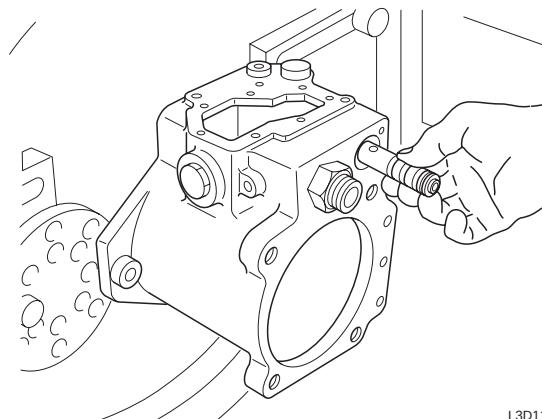
L3D114

13. Remove the cap screws and remove the cover.
14. Remove the lever.



L3D115

15. Remove the sleeve, the spool and piston.

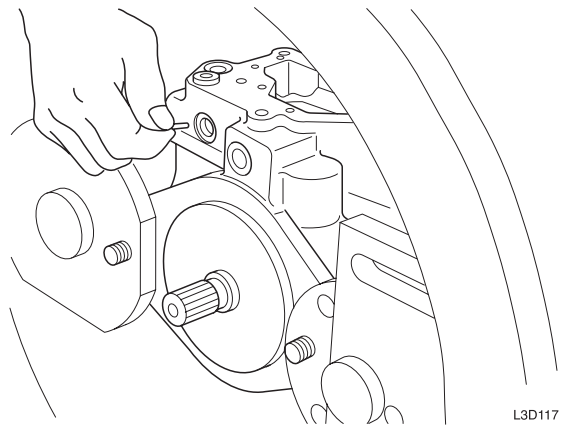


L3D116

## HYDRAULIC PUMP

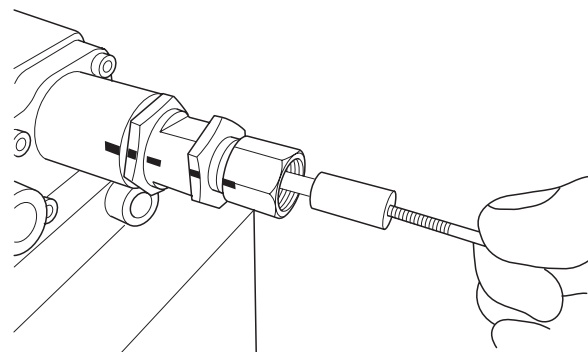
## HYDRAULIC UNITS

16. Remove the plug and the pin.



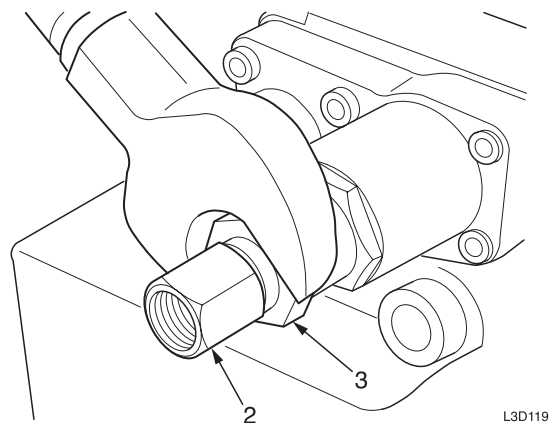
17. Remove the piston.

- Screw the bolt into the screw hole (M4) at the end face of the piston, and grab the bolt to pull out the piston.



18. Loosen the lock nut (3) and remove the adjusting screw (2).

- Record the length of the adjusting screw protrusion before starting the disassembly.



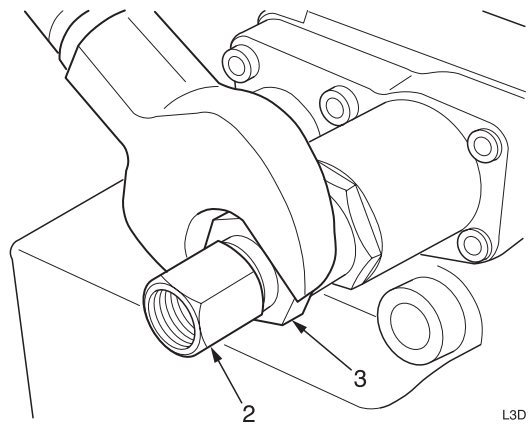
## HYDRAULIC UNITS

## HYDRAULIC PUMP

### Assembly

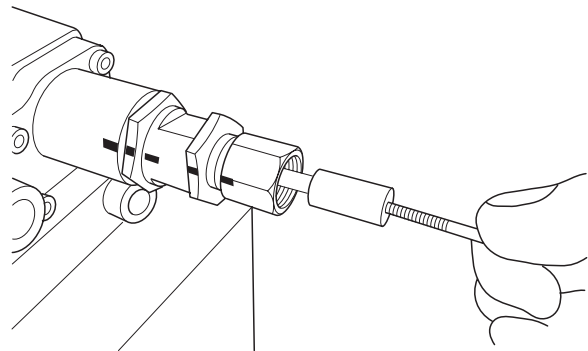
1. Install the adjusting screw (2).
  - Fix the adjusting screw (2) to the same length as previously assembled using the lock nut (3).

🔑 Lock nut: 98 N·m



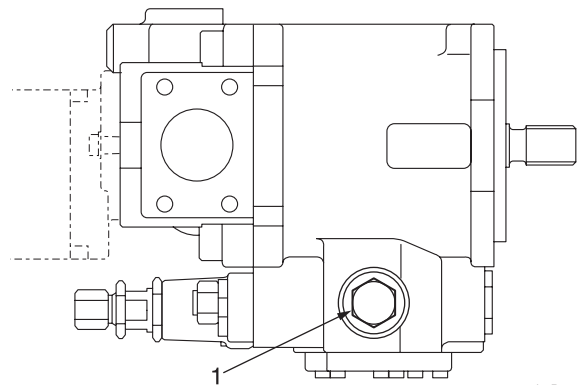
L3D119

2. Install the piston.



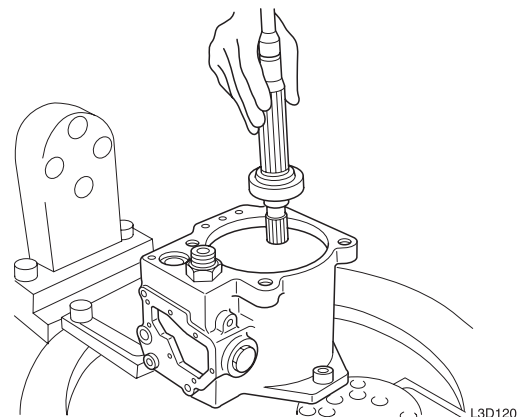
L3D118

3. Install the drain plug (1).



L3D106

4. Install the oil seal.
5. Install the shaft in the housing.
  - Tap the spline end with a plastic hammer to positively install the outer race of the bearing in the housing hole.

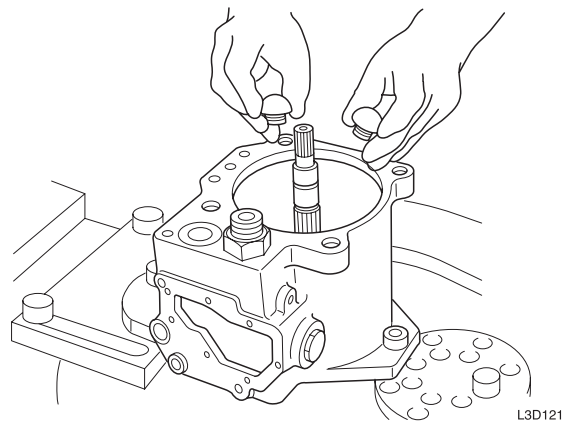


L3D120

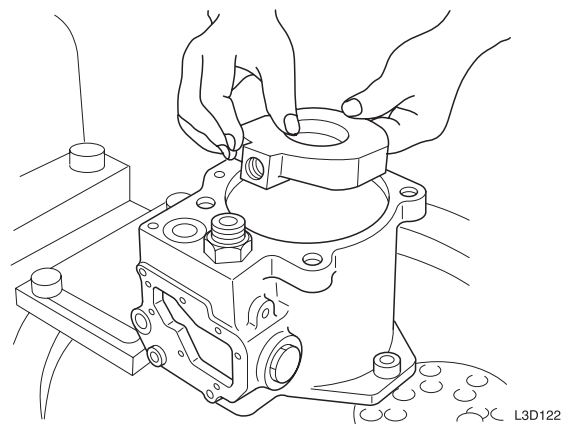
## HYDRAULIC PUMP

## HYDRAULIC UNITS

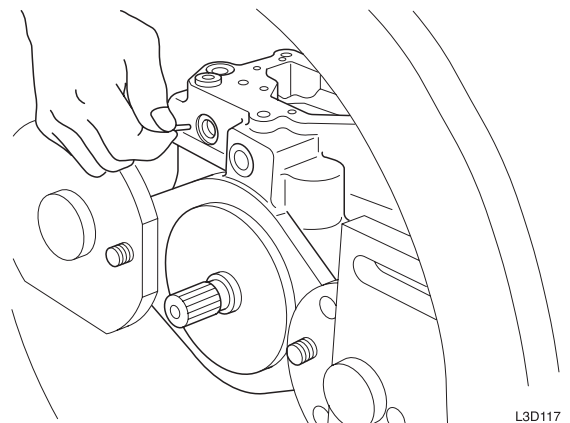
6. Fit the pin R and L on the swash plate.



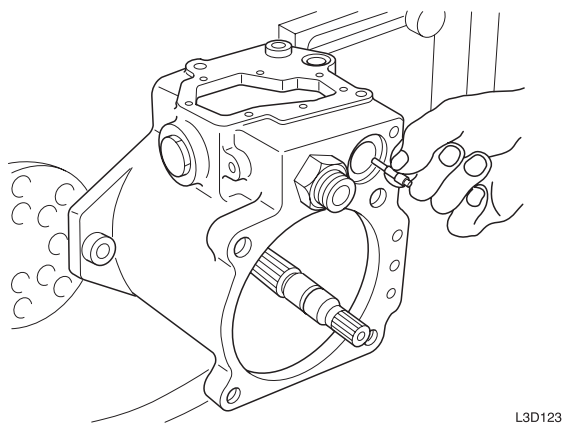
7. Install the swash plate in the housing.
- Insert the bushing into the swash plate.
  - Apply grease on the sliding surfaces of the swash plate, pin R and pin L.



8. Mount the pin and tighten the plug.
- 🔑 Plug: 29.4 N·m



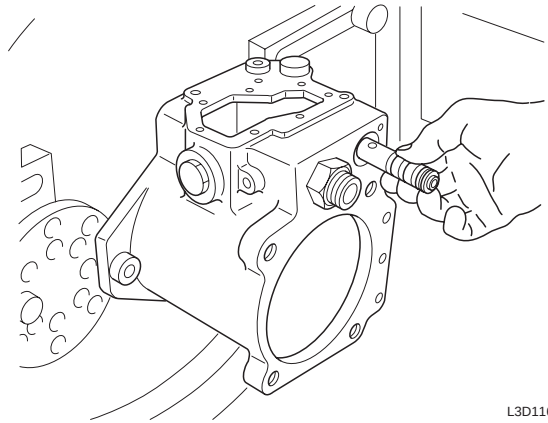
9. Mount the piston in the housing.



## HYDRAULIC UNITS

## HYDRAULIC PUMP

10. Mount the sleeve and spool.

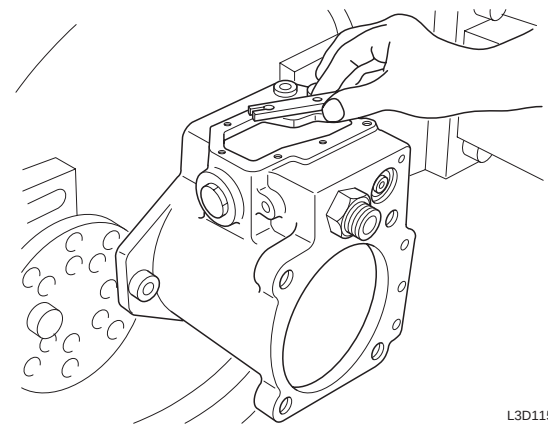


L3D116

11. Install the lever on the housing.

12. Install the cover and install the cap screws.

⌘ Cap screw: 29.4 N·m

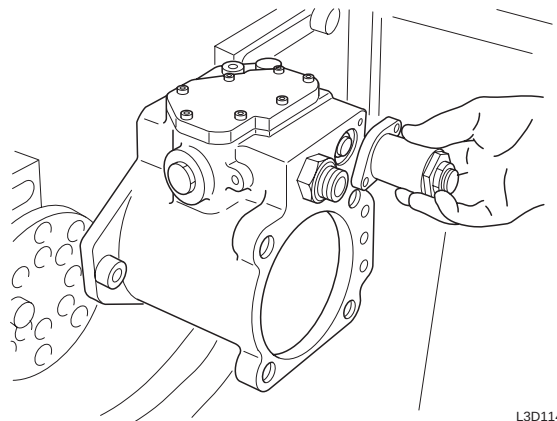


L3D115

13. Install the spring seat.

- Apply grease to the spherical part of the spring seat.

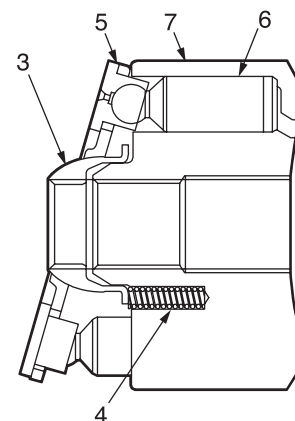
14. Install the two springs [inside, outside].



L3D114

15. Assemble the cylinder block.

- Install the springs in the cylinder block.
- Install the guide (3) in the cylinder block.
  - Apply grease to the spherical part of the guide.
- Attach the pistons (6) to the shoe holder (5), and install the shoe holder (5) in the cylinder block.



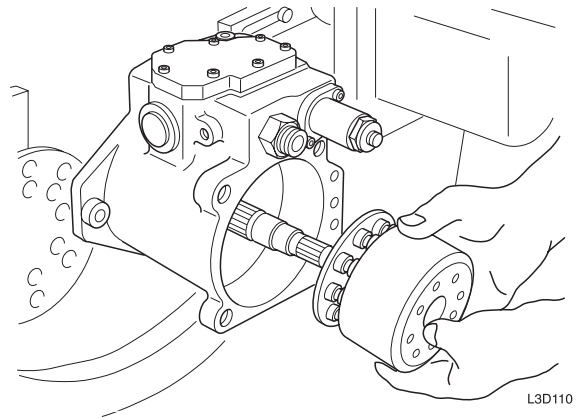
L3D111



## HYDRAULIC PUMP

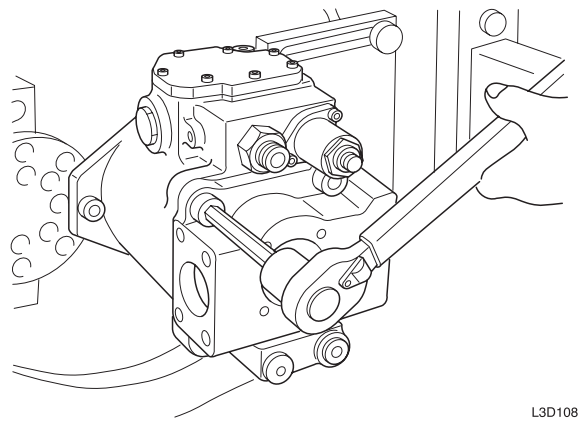
## HYDRAULIC UNITS

16. Install the cylinder block matching the spline of the shaft.
  - Apply grease to the sliding surfaces of the piston shoes and the plate.



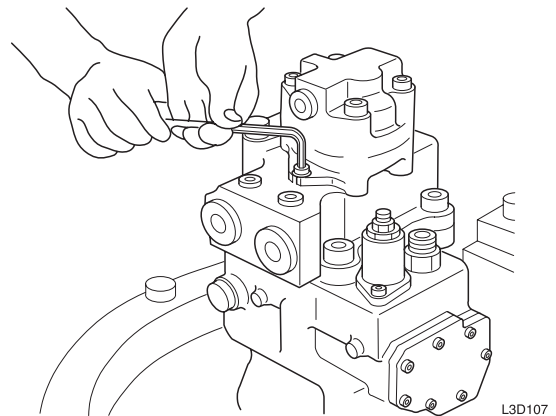
17. Apply grease to the rear of the valve plate and install it to the cover, matching the knock hole.
18. Install a large and a small O-ring in the cover.
19. Install the cover and install the cap screws.
  - Install the cover parallel to the housing installation surface.

🔧 Cap screw: 235 N·m



20. Install the coupling on the end of the main pump shaft.
21. Unite the main pump and gear pump and fix them with the cap screws.

🔧 Cap screw: 56.9 N·m

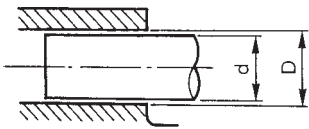
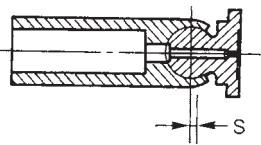
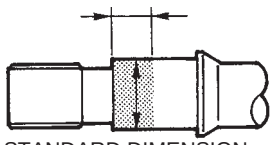


## HYDRAULIC UNITS

## HYDRAULIC PUMP

### INSPECTION AND ADJUSTMENT

#### Checking the Parts

|                                      | Parts                                                                                                                                       | Judgment Criteria                                                                                                                                                                                            | Treatment                                                                              |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Piston and cylinder block assembly   |  <p><math>S = D - d</math> Y3-D230</p>                     | <ul style="list-style-type: none"> <li>A clearance S of 0.05 mm or more between the piston and the cylinder block</li> <li>Occurrence of scratches, scoring, abnormal wear, etc. on sliding parts</li> </ul> | <ul style="list-style-type: none"> <li>Exchange</li> <li>Exchange.</li> </ul>          |
| Slack of the piston shoe             |  <p>Y3-D231</p>                                            | <ul style="list-style-type: none"> <li>A slack S of 0.2 mm or more for the piston shoe</li> </ul>                                                                                                            | <ul style="list-style-type: none"> <li>Exchange</li> </ul>                             |
| Shaft and oil seal installation part |  <p>OIL SEAL MOUNT<br/>STANDARD DIMENSION<br/>Y3-D232</p> | <ul style="list-style-type: none"> <li>A wear amount of 0.025 mm at the installation part of shaft and oil seal</li> </ul>                                                                                   | <ul style="list-style-type: none"> <li>Exchange</li> </ul>                             |
| Valve plate                          |                                                                                                                                             | <ul style="list-style-type: none"> <li>No abnormal scratches (0.02 mm or more), wear, or sticking for the sliding surfaces</li> </ul>                                                                        | <ul style="list-style-type: none"> <li>Correct by lapping or exchange.</li> </ul>      |
| Bushing                              |                                                                                                                                             | <ul style="list-style-type: none"> <li>No abnormal wear or harmful scratches of the sliding surfaces</li> </ul>                                                                                              | <ul style="list-style-type: none"> <li>Exchange</li> </ul>                             |
| Seals and O-rings                    |                                                                                                                                             | <ul style="list-style-type: none"> <li>At the time of reassembly after disassembly</li> </ul>                                                                                                                | <ul style="list-style-type: none"> <li>Exchange</li> </ul>                             |
| Drive gear and driven gear           |                                                                                                                                             | <ul style="list-style-type: none"> <li>No abnormal scratches, wear, or flaking of the tooth surfaces</li> </ul>                                                                                              | <ul style="list-style-type: none"> <li>Exchange</li> </ul>                             |
| Ball bearings and needle bearings    |                                                                                                                                             | <ul style="list-style-type: none"> <li>No abnormal scratches, wear, or flaking of the rolling surfaces</li> </ul>                                                                                            | <ul style="list-style-type: none"> <li>Exchange the shaft and the assembly.</li> </ul> |

## HYDRAULIC PUMP

## HYDRAULIC UNITS

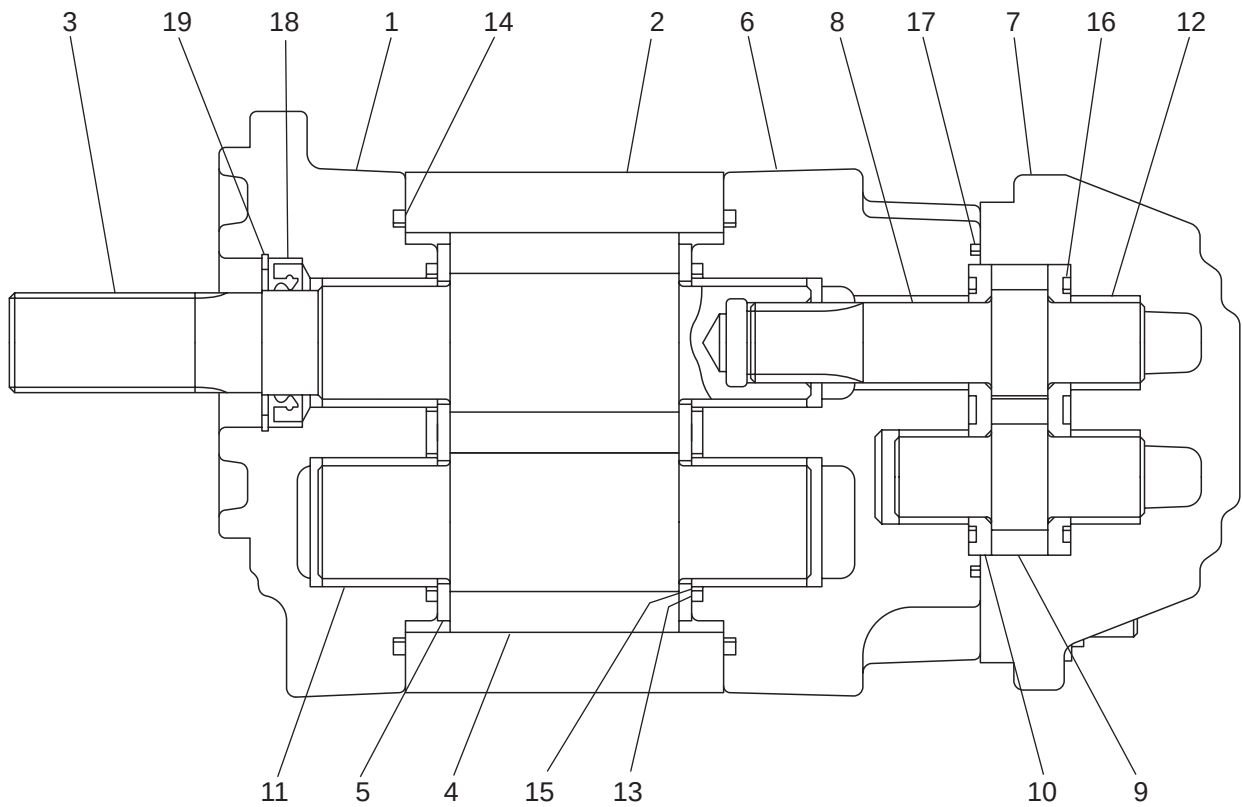
## TROUBLESHOOTING

| Symptom                                                  | Probable Causes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Remedy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Noise is loud. Abnormal noise is generated.              | <ul style="list-style-type: none"> <li>The suction hose is pinched or the suction filter is clogged.</li> <li>The suction side joint is loose and air is being sucked in.</li> <li>The hydraulic oil's viscosity is too high and cavitation is occurring.</li> <li>The pump is off center with respect to the engine.</li> <li>There are bubbles in the hydraulic oil.</li> <li>The engine's speed is higher than the specified speed.</li> <li>The drain back pressure is higher than the specified pressure.</li> <li>The bearing, etc. is mechanically damaged.</li> </ul> | <ul style="list-style-type: none"> <li>Remove the dirt or eliminate the pinched condition of the hose.</li> <li>Retighten each joint.</li> <li>Replace the hydraulic oil with oil of the proper viscosity.</li> <li>Center the pump with respect to the engine.</li> <li>Investigate the cause of the bubbles and repair it.</li> <li>Operate the engine at the specified speed.</li> <li>Check and replace the drain piping.</li> <li>Replace the damaged parts or replace the pump.</li> </ul> |
| Discharge is insufficient.                               | <ul style="list-style-type: none"> <li>The engine's speed is too low.</li> <li>The oil temperature is abnormally high.</li> <li>The hydraulic oil's viscosity is too high.</li> <li>The pump's volumetric efficiency has dropped.</li> <li>The horsepower setting adjustment screw is loose.</li> <li>The oil level in the tank is low.</li> <li>The suction side pipe or the suction filter is clogged.</li> <li>The amount of leakage from hydraulic devices other than the pump is increasing.</li> </ul>                                                                  | <ul style="list-style-type: none"> <li>Operate the engine at the specified speed.</li> <li>Stop the machine and let the oil cool off, then check again.</li> <li>Replace the hydraulic oil with oil of the proper viscosity.</li> <li>Replace the pump.</li> <li>Reset the screw and lock it.</li> <li>Replenish the tank with hydraulic oil to the specified level.</li> <li>Clean the piping.</li> <li>Repair the hydraulic device or replace it.</li> </ul>                                   |
| Pressure doesn't rise.                                   | <ul style="list-style-type: none"> <li>The relief valve setting has dropped.</li> <li>The amount of leakage from hydraulic devices other than the pump is increasing.</li> <li>The pump's volumetric efficiency has dropped.</li> </ul>                                                                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>Reset the relief valve setting.</li> <li>Repair the hydraulic device or replace it.</li> <li>Replace the pump.</li> </ul>                                                                                                                                                                                                                                                                                                                                 |
| The rotational speed drops when there is a dynamic load. | <ul style="list-style-type: none"> <li>The peak pressure is generated due to a drop in the relief valve's response.</li> <li>There is foreign matter trapped in the pilot line or foreign matter is caught in the sliding parts of the control equipment.</li> </ul>                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>Repair the relief valve or replace it.</li> <li>Remove the foreign matter and repair or replace the scratched parts.</li> </ul>                                                                                                                                                                                                                                                                                                                           |
| Abnormal heat is generated.                              | <ul style="list-style-type: none"> <li>Leakage from the pump is increasing.</li> <li>The bearings, etc. are mechanically damaged.</li> <li>There is seizing of sliding parts.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Replace the pump.</li> <li>Replace the damaged parts or replace the pump.</li> <li>Replace the damaged parts or replace the pump.</li> </ul>                                                                                                                                                                                                                                                                                                              |
| Hydraulic oil is leaking.                                | <ul style="list-style-type: none"> <li>Seals are damaged.</li> <li>The shaft surface which slides against the oil seal is worn.</li> <li>The plug or bolts are loose.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Replace the seals.</li> <li>Replace the shaft or replace the pump.</li> <li>Tighten them or replace the seals.</li> </ul>                                                                                                                                                                                                                                                                                                                                 |



## HYDRAULIC PUMP (GEAR)

### CONSTRUCTION

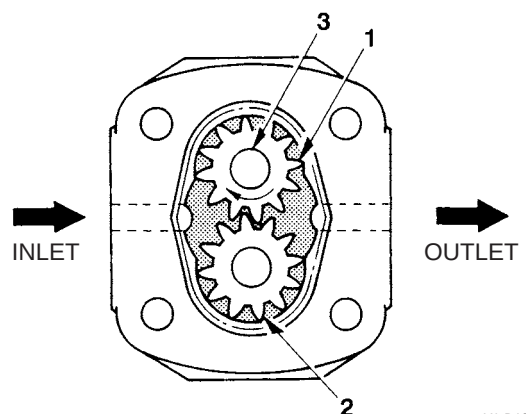


L4D150

- |                |                  |                 |               |
|----------------|------------------|-----------------|---------------|
| 1. Flange      | 6. Adapter Plate | 11. Bushing     | 16. Gasket    |
| 2. Housing     | 7. Rear Cover    | 12. Bushing     | 17. Gasket    |
| 3. Drive Gear  | 8. Drive Gear    | 13. Gasket      | 18. Oil Seal  |
| 4. Driven Gear | 9. Driven Gear   | 14. Gasket      | 19. Snap Ring |
| 5. Bushing     | 10. Bushing      | 15. Backup Ring |               |

### Gear Pump

The gear pump consists of a single gear case, inside of which is a drive gear (1) and a driven gear (2) engaged with each other. By turning the drive shaft (3), the space between the case and the gears is filled with oil. This oil is thus sent through the pump from the inlet to the outlet.



Y1-D101E

## HYDRAULIC UNITS

## HYDRAULIC PUMP

## DISASSEMBLY AND ASSEMBLY

## General Cautions

- Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
- Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
- Clean each of the disassembled parts with a cleaning oil such as diesel fuel.
- Make match marks on each part so that they will be assembled in the same positions when assembled.

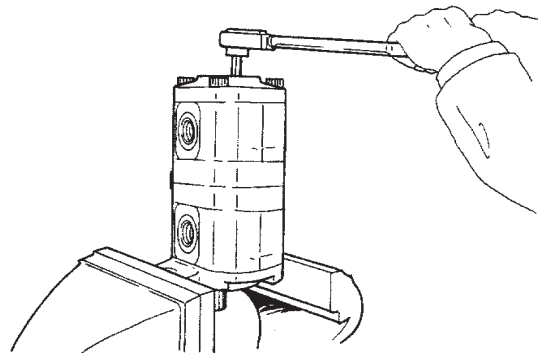
- Replace all seals with new ones each time the pump is disassembled, coating them lightly with grease.
- Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.
- Adjust adjustment screws only when required.

Following is an explanation of the gear pump disassembly procedure.

Follow the procedure used to disassemble the gear pump in reverse order when reassembling it.

1. Remove the cap screws.

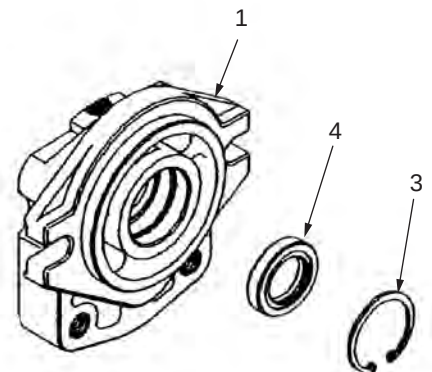
🔧 Screw: 98~108 N·m



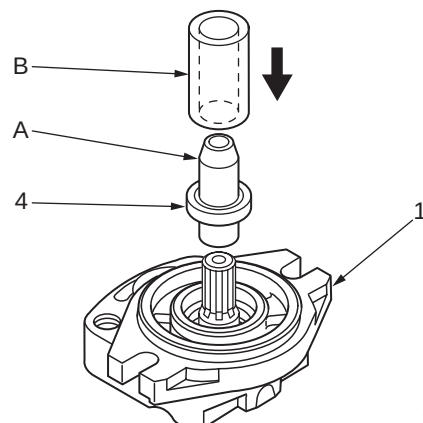
T5-D162

2. Remove the flange (1).

3. Remove the snap ring (3) and the oil seal (4) from the flange (1).
  - Be careful not to scratch or otherwise damage the flange.
  - When re-assembling, install the oil seal using the jigs A and B.



L4D151

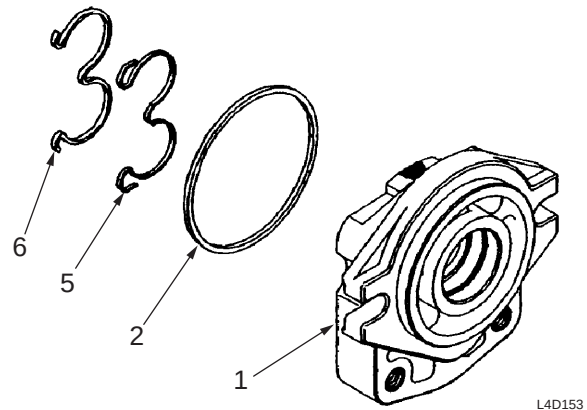


T7D152

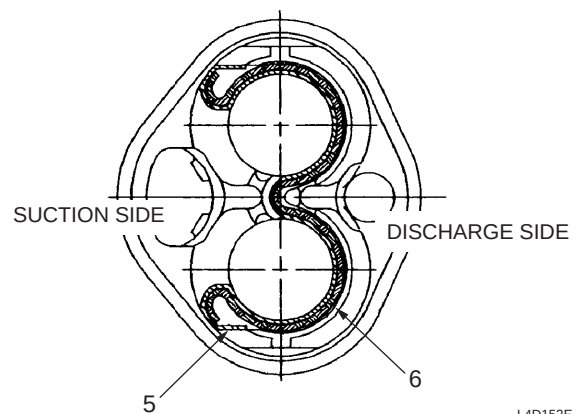
## HYDRAULIC PUMP

## HYDRAULIC UNITS

4. Remove the gasket (2) from the flange (1).
5. Remove the backup ring (5) and gasket (6) from the flange (1).

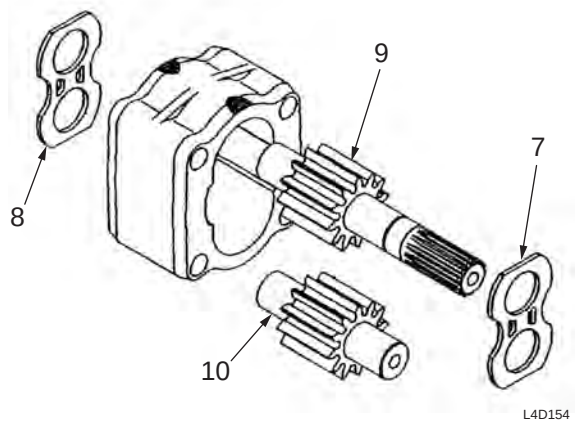


L4D153



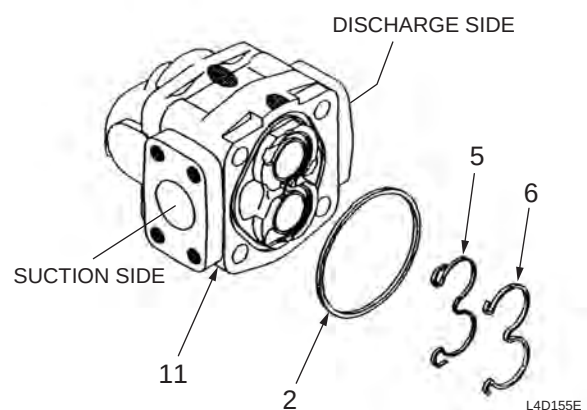
L4D152E

6. Remove the bushing (7), the bushing (8), the drive gear (9), and the driven gear (10) from the housing.
  - Be careful to keep the bushings separated and in their original places.
  - Be careful not to scratch or otherwise damage the inside of the housing.



L4D154

7. Remove the gasket (2) from the adapter plate (11).
8. Remove the backup ring (5) and gasket (6) from the adapter plate (11).

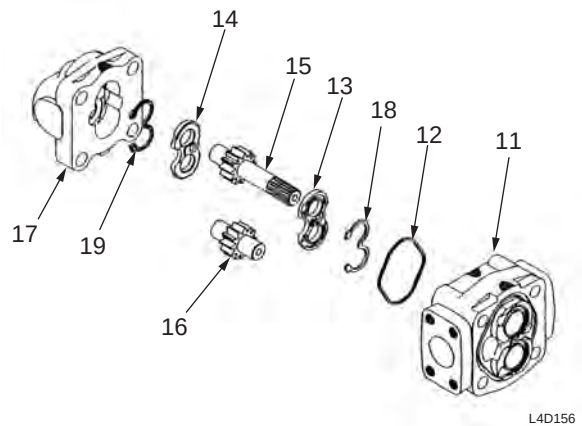


L4D155E

## HYDRAULIC UNITS

## HYDRAULIC PUMP

9. Remove the rear cover (17).
10. Remove the gasket (12) from the adapter plate (11).
11. Remove the bushing (13), bushing (14), the drive gear (15), and the driven gear (16).
  - Be careful to keep the bushings separated and in their original places.
  - Be careful not to scratch or otherwise damage the inside of the rear cover.
12. Remove the gasket (18), (19) from the bushing (13) and the bushing (14).
  - Be careful to keep the bushings separated and in their original places.



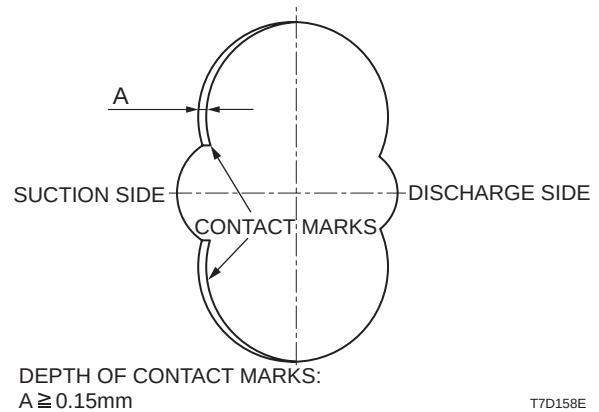
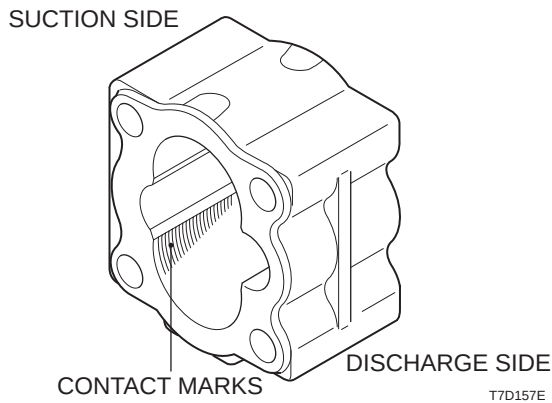


## INSPECTION AND ADJUSTMENT

### Checking Parts

After checking the disassembled parts for dirt or discoloration, clean them with diesel fuel. However, do not let diesel fuel get on rubber parts. Check each part for the following points and if there is any trouble, repair or replace the part.

#### Housing



The gear pump is made so that the crests of the gear teeth make light contact with the housing walls as a means of increasing its efficiency. Therefore, contact marks can be seen near the suction port in any pump that has been operated.

It is normal if the depth of the contact marks is within 0.1 mm. If the depth exceeds the use limit in the above figure, replace the pump assembly.

#### Bushing

The ideal situation is for the sliding surfaces to have no roughness and for the suction side half to be lustrous. Also, it is satisfactory if strong contact marks can be seen on the side surface on the suction side and minute contact marks can be seen on the discharge side.

- Contact marks can be seen on the sliding surface of the entire bearing inner diameter and it is so rough that it looks like it has been clawed.
- There is a large number of scratches around the circumference of the side surface and it is so rough that it looks like it has been clawed.
- There are marks from foreign matter biting into the sliding surface of the bearing inner diameter and the side surface.

Dirty hydraulic oil is one likely cause of such wear. In such a case, replace the hydraulic oil and flush out affected hydraulic circuit completely.

Other likely causes are as follows.

- Excessive load due to damage to the relief valve.
- Cavitation or aeration.
- Hydraulic oil temperature is too high.
- Hydraulic oil is deteriorated.
- Hydraulic oil's viscosity is low.

If it is necessary to replace the bushings, this means that the gear shaft and gear side surfaces are also rough or worn severely, so replace the gears at the same time as the bushings are replaced.

### Gear

Replace a gear if it is in the following condition.

1. The shaft or the gear side surfaces are so rough that they look like they have been clawed.
2. There are cracks in the tooth roots and there is extreme abnormal wear in the tooth surfaces.
3. None of the points coming into contact with the oil seal should be abraded to a depth in excess of 0.1 mm.

### Seals

- Check oil seals for scratches in the seal surface, wear, deformation or deterioration of the rubber's elasticity. If a seal is abnormal, replace it.
- Replace seals when the hydraulic pump is disassembled.
- Check the backup ring for scaling and cutting. If it is abnormal, replace it.

### Test Operation

The best method for testing the pump's operation is to mount it in a test stand. However, if that cannot be done, test it under the conditions it would be subjected to if it were installed in the machine.

Also, if any abnormal wear is discovered during disassembly, be sure to replace the hydraulic oil and return filter.

1. Install a pressure gauge in the high pressure piping near the pump.
2. Run the engine at 500~1,000 rpm and set the control valve in the neutral position.
3. Run the pump for 10 minutes under the conditions in (2), then increase the engine's speed to 1,500~2,000 rpm and run it for another 10 minutes.

4. Next, run the pump so that it reaches the rated pressure (☞ "II. Specifications, Specification Tables") for 5 minutes at a time for each additional 1.96~2.94 kPa of pressure.

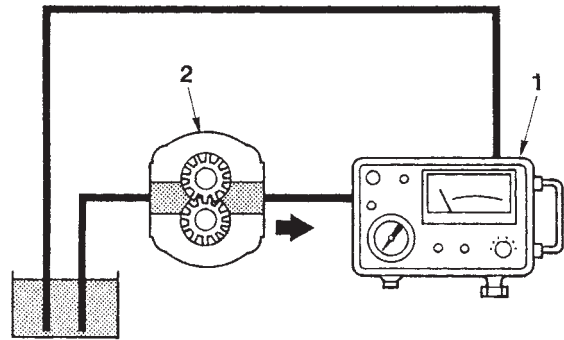
Afterward, after operating each circuit for about 5 minutes, replace the return filter or clean it.

In addition, during the process of raising the pressure, pay careful attention to the oil temperature, the pump's surface temperature and the operating noise. If the oil temperature or the pump's surface temperature become abnormally high, eliminate the load from the pump and let the temperature drop before resuming the test.

### Measuring the Discharge Volume

After completing the test operation, measure the discharge volume.

1. Connect a tester (1) to the discharge side of the pump (2).
  - There should be no mistakes made in the tester's pipe installation.
2. Open the tester's loading valve and start the engine.
3. Run the engine at the rated speed.
4. Gradually close the loading valve and apply the rated pressure to the pump (2).
5. Measure the discharge volume and the pump's speed (engine speed).



Y2-D126

## HYDRAULIC UNITS

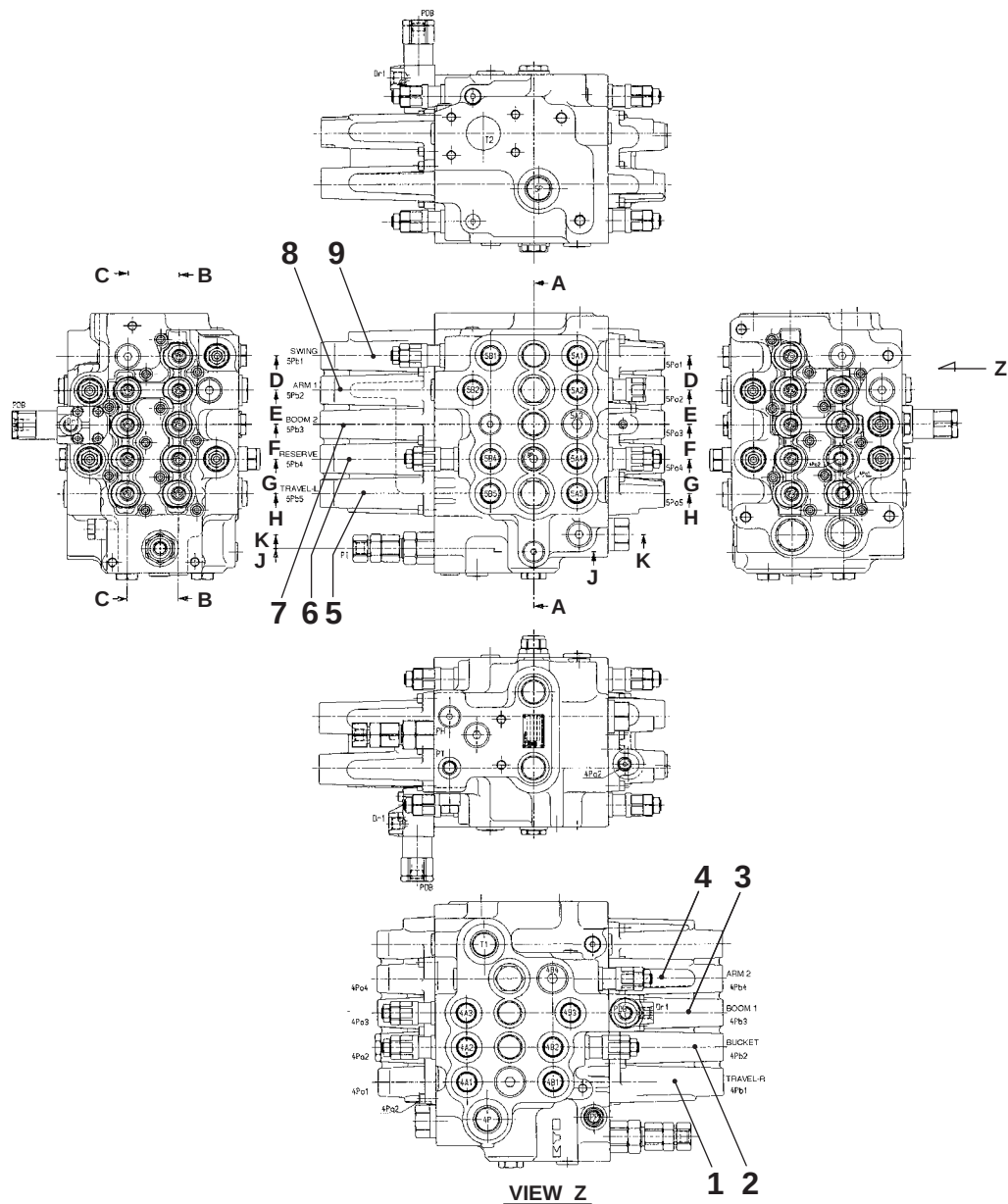
## HYDRAULIC PUMP

### TROUBLESHOOTING

| Symptom                                                                                  | Probable Causes                                                                                                                                                                                                                                                                                                                                                                                                           | Remedy                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pump won't discharge.                                                                    | <ul style="list-style-type: none"> <li>• Direction of rotation is reversed.</li> <li>• Oil level in the tank is low.</li> <li>• Suction side pipe or suction filter is clogged.</li> <li>• Hydraulic oil's viscosity is too high.</li> <li>• Speed is low.</li> </ul>                                                                                                                                                     | <ul style="list-style-type: none"> <li>• Run the pump in the specified direction.</li> <li>• Replenish the oil to the specified level.</li> <li>• Clean the pipes.</li> <li>• Replace the hydraulic oil with oil of the proper viscosity.</li> <li>• Run the pump at the specified speed.</li> </ul>                                                       |
| Noise level is high.<br>Abnormal noise is generated.                                     | <ul style="list-style-type: none"> <li>• Suction side hose is crushed, the suction filter is clogged or cavitation is occurring.</li> <li>• Suction side joint is loose and air is being sucked in.</li> <li>• Hydraulic oil's viscosity is too high, and cavitation is occurring.</li> <li>• Pump and engine are out of center with respect to each other.</li> <li>• There are bubbles in the hydraulic oil.</li> </ul> | <ul style="list-style-type: none"> <li>• Remove the dirt or eliminate the crushed condition of the hose.</li> <li>• Tighten all the joint.</li> <li>• Replace the hydraulic oil with oil of the proper viscosity.</li> <li>• Correct the centering between the pump and engine.</li> <li>• Investigate the cause of the bubbles and correct it.</li> </ul> |
| Oil leaks from oil seals.                                                                | <ul style="list-style-type: none"> <li>• Oil seal is worn, damaged or deformed.</li> </ul>                                                                                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>• Replace the oil seal.</li> </ul>                                                                                                                                                                                                                                                                                  |
| Oil leaks from mating surfaces between housing and flange and between housing and cover. | <ul style="list-style-type: none"> <li>• Body seal is damaged or worn by rubbing.</li> </ul>                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>• Replace with a new part.</li> </ul>                                                                                                                                                                                                                                                                               |
| Discharge volume is low.                                                                 | <ul style="list-style-type: none"> <li>• Bushing seal is damaged.</li> <li>• Cavitation is occurring.</li> <li>• Aeration is occurring.</li> <li>• Viscosity of the hydraulic oil is too low.</li> </ul>                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>• Replace the bushing.</li> <li>• Clean the suction filter and suction side piping.</li> <li>• Check for insufficient tightening of pipes, etc. and repair.</li> <li>• Replace the hydraulic oil with oil of the proper viscosity.</li> </ul>                                                                       |

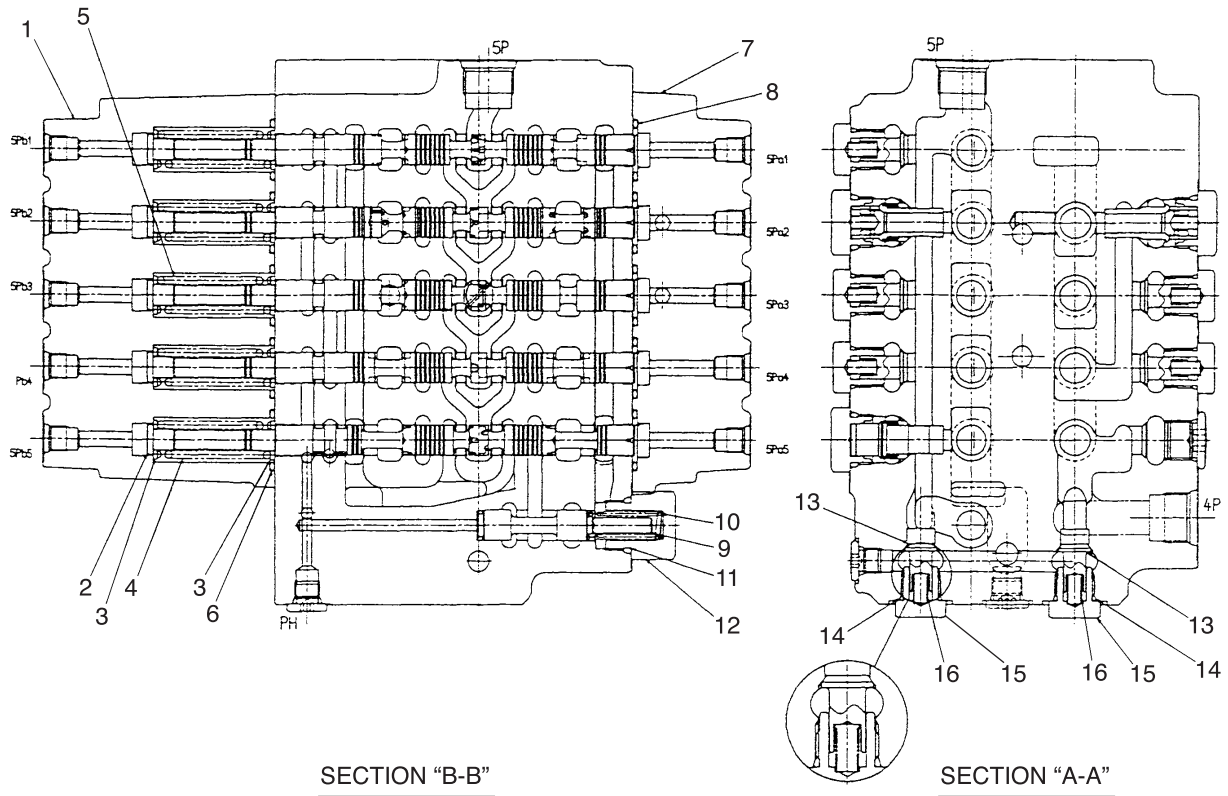
## CONTROL VALVE (MONO-BLOCK)

## CONSTRUCTION



W2D200E

1. Right Travel Section
2. Bucket Section
3. Boom [1] Section
4. Arm [2] Section
5. Left Travel Section
6. Auxiliary Section
7. Boom [2] Section
8. Arm [1] Section
9. Swing Section



L3D201E

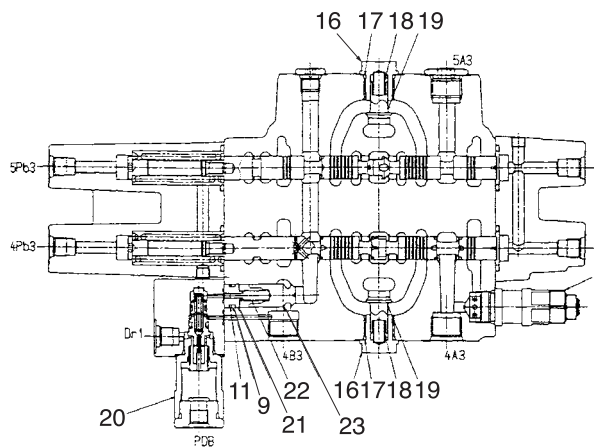
- |              |            |            |
|--------------|------------|------------|
| 1. Cover     | 7. Cover   | 13. Poppet |
| 2. Spool End | 8. O-ring  | 14. O-ring |
| 3. Holder    | 9. Shuttle | 15. Plug   |
| 4. Spring    | 10. Spring | 16. Spring |
| 5. Spring    | 11. O-ring |            |
| 6. O-ring    | 12. Plug   |            |



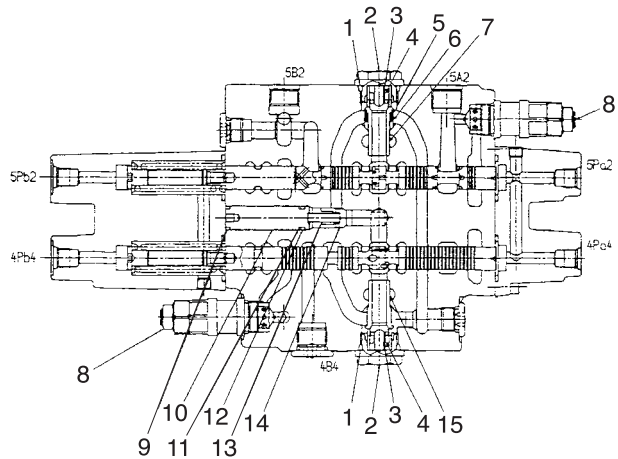
1. Housing
2. O-ring
3. Spring Holder
4. Spring
5. Spool End
6. Port Relief Valve
7. O-ring
8. Plug
9. Spring
10. Poppet

## HYDRAULIC UNITS

## CONTROL VALVE



SECTION "F-F"

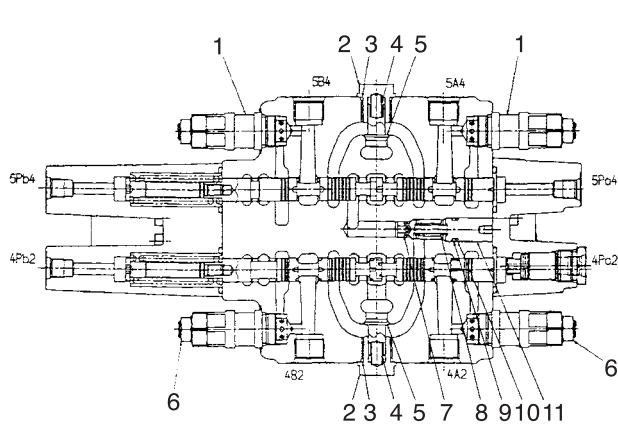


SECTION "E-E"

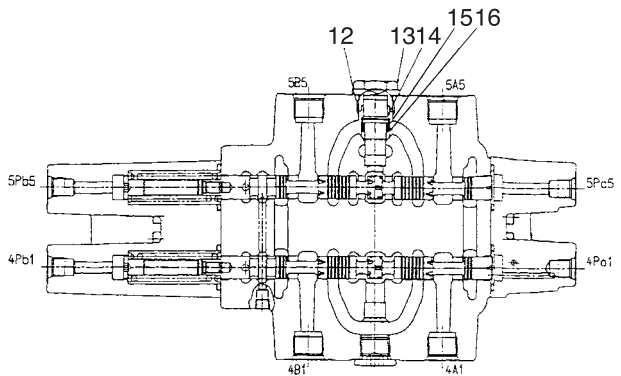
L3D203E

- |                      |                 |                      |
|----------------------|-----------------|----------------------|
| 1. O-ring            | 9. O-ring       | 17. O-ring           |
| 2. Plug              | 10. Plug        | 18. Spring           |
| 3. Spring            | 11. Backup Ring | 19. Poppet           |
| 4. Poppet            | 12. O-ring      | 20. Anti-Drift Valve |
| 5. Spring            | 13. Spring      | 21. Spacer           |
| 6. Poppet            | 14. Poppet      | 22. Spring           |
| 7. Sleeve            | 15. Sleeve      | 23. Poppet           |
| 8. Port Relief Valve | 16. Plug        |                      |





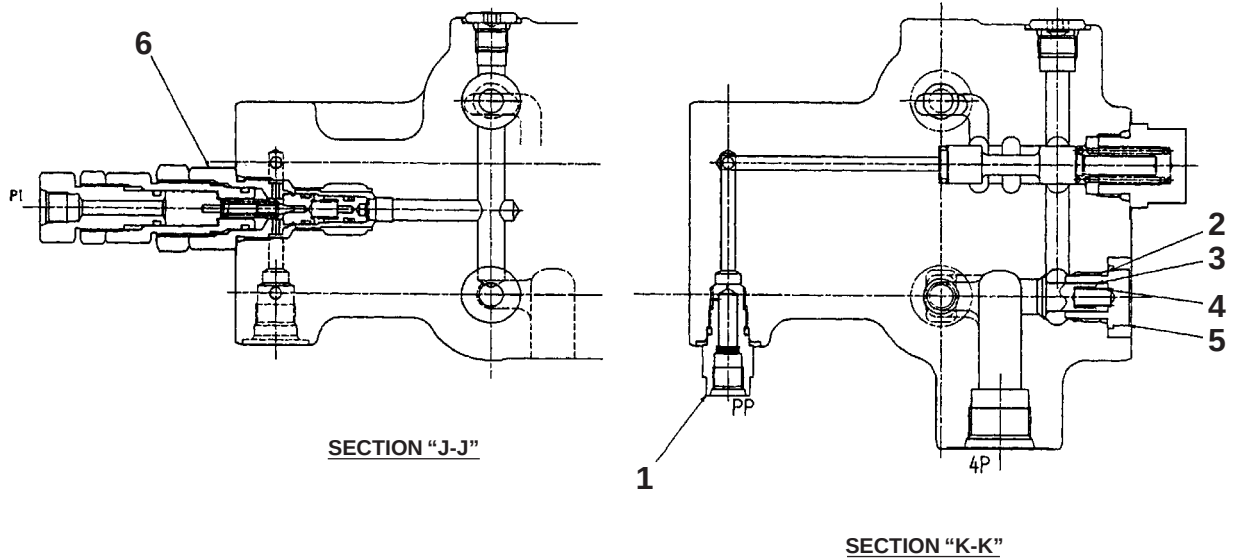
SECTION "G-G"



SECTION "H-H"

L3D204E

- |                      |                 |
|----------------------|-----------------|
| 1. Port Relief Valve | 9. O-ring       |
| 2. Plug              | 10. Backup Ring |
| 3. O-ring            | 11. Plug        |
| 4. Spring            | 12. O-ring      |
| 5. Poppet            | 13. Plug        |
| 6. Port Relief Valve | 14. Sleeve      |
| 7. Poppet            | 15. Spring      |
| 8. Spring            | 16. Poppet      |



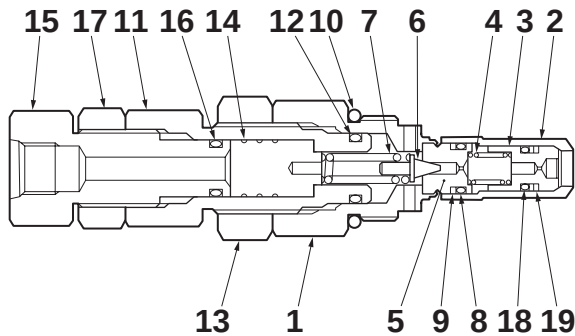
W2D205E

1. Plug
2. O-ring
3. Poppet
4. Spring
5. Plug
6. Main Relief Valve

## CONTROL VALVE

## HYDRAULIC UNITS

### Main Relief Valve

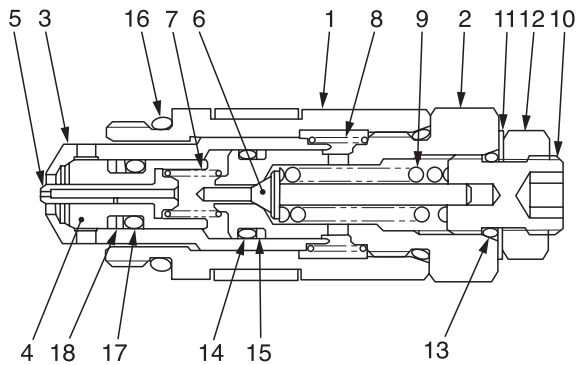


W2D206

1. Plug
2. Sleeve
3. Main Poppet
4. Spring
5. Seat
6. Needle Valve
7. Spring
8. O-ring
9. Backup Ring
10. O-ring

11. Plug
12. O-ring
13. Nut
14. Piston
15. Plug
16. O-ring
17. Nut
18. O-ring
19. Backup Ring

### Port Relief Valve

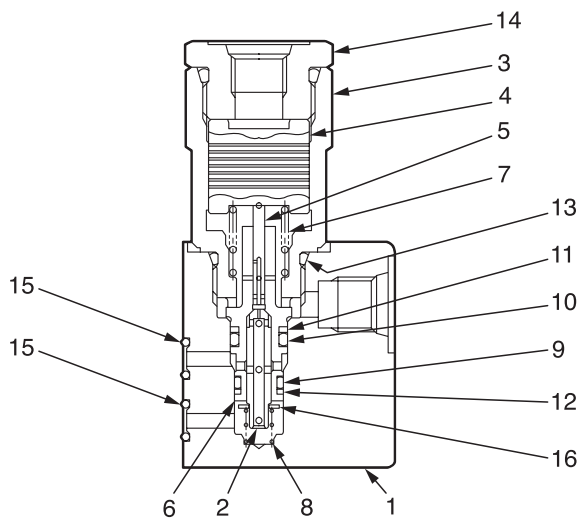


L2D207

1. Housing
2. Plug
3. Poppet
4. Poppet
5. Piston
6. Needle Valve
7. Spring
8. Spring
9. Spring

10. Adjusting Screw
11. Washer
12. Nut
13. O-ring
14. O-ring
15. Backup Ring
16. O-ring
17. O-ring
18. Backup Ring

### Anti-Drift Valve



L2D208

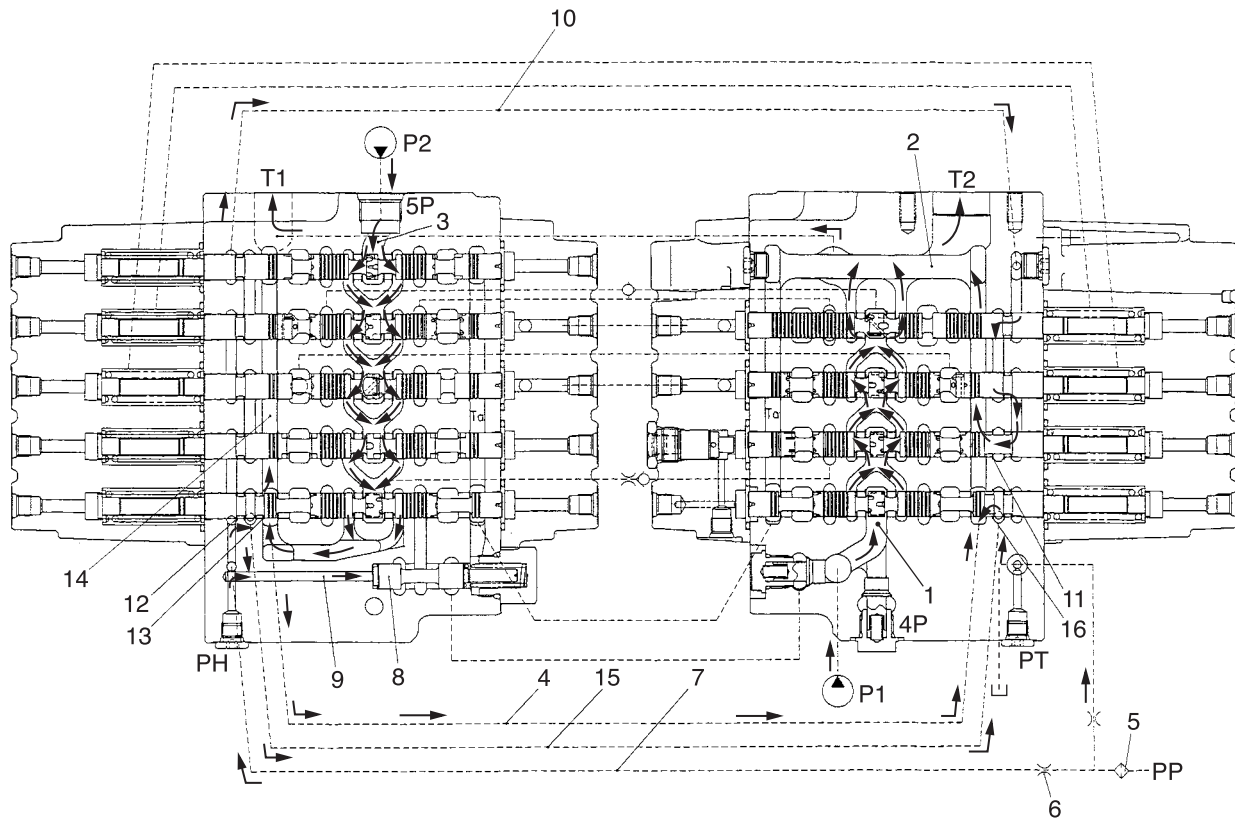
1. Body
2. Poppet
3. Plug
4. Piston
5. Spool
6. Sleeve
7. Spring
8. Spring
9. O-ring
10. O-ring
11. Backup Ring
12. Backup Ring
13. O-ring
14. Plug
15. O-ring
16. Spring Holder

## HYDRAULIC UNITS

## CONTROL VALVE

## OPERATION

This control valve has a structure incorporating a 4-section and a 5-section part.



L3D209

### When All Spools are in the Neutral Positions

#### Center bypass passage

The oil supplied from the pump P1 flows through the center bypass passage (1) and the tank passage (2) of the 4-section part, and through the ports T1 and T2, and then back to the tank.

The oil supplied from the pump P2 flows through the center bypass passage (3) and the passage (4) of the 5-section part, the tank passage (2) of the 4-section part, the ports T1 and T2, and then back to the tank.

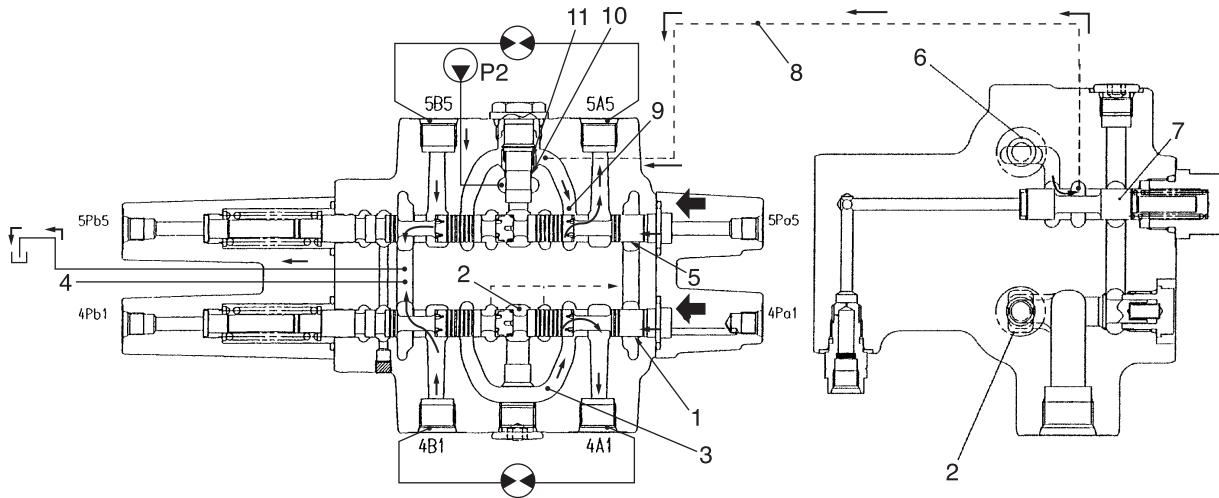
#### Signal passage

The oil supplied from the port PP of the signal passage passes through the filter (5), orifice (6), passage (7), and flows into the pilot chamber (9) of the straight travel spool (8). At the same time, the oil from the signal land of individual spools of the 5-section part passes through the passage (10), signal lands of individual spools of the 4-section part, signal land (11) of the bucket spool, and then flows into the tank passage

(2).

Concurrently, the oil that passed through the signal land (12) passes through the signal land (13) and flows into the tank passage (14).

On the other hand, the oil that passed through the passage (15) and entered the signal passage of the travel spool of the 4-section part flows through the signal land (16) to the tank passage (2).

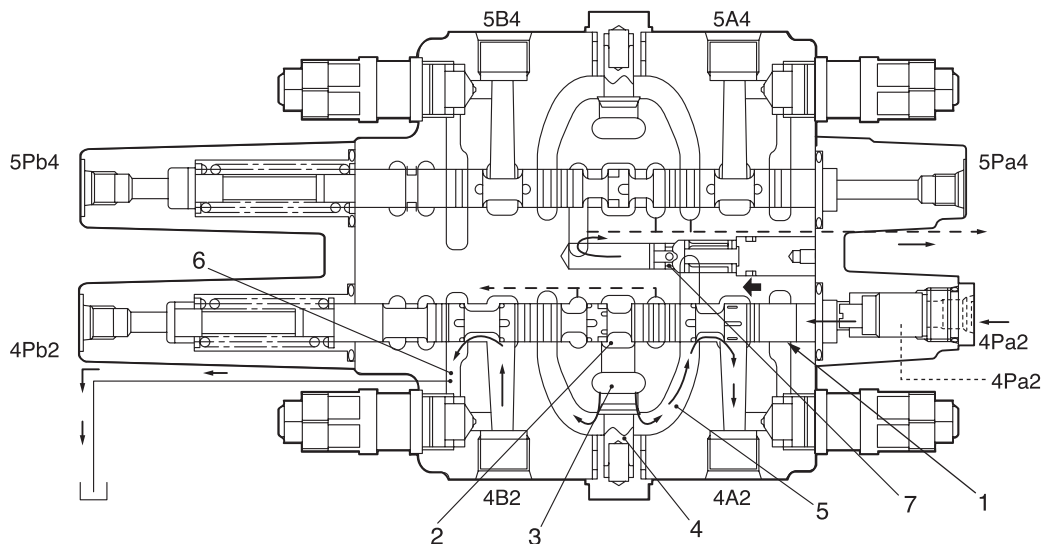
**Independent Operation****Travel spool switching**

L3D210

Switching the spool (1) on the right travel lever closes the center bypass passage (2), and the oil supplied from the pump P1 passes through the center bypass passage (2) and bridge passage (3), and flows into the port 4A1. The return oil flows from the port 4B1 through the head of the spool (1) and back to the tank passage (4).

Switching the spool (5) on the left travel lever allows

the oil supplied from the pump P2 to pass through the parallel passages (6), the head of straight travel spool (7), the passages (8) and (9), and to flow into the port 5A5. The return oil flows from the port 5B5 to the tank passage (4). Part of the oil from the pump P2 passes through the orifice (10), raises the poppet (11), passes through the passage (3), and flows into the port 5A5.

**Bucket spool switching**

L3D211

Switching the spool (1) by pressurizing the port 4Pa2 closes the center bypass passage (2). The oil supplied from the pump P1 raises the parallel passages (3) and the load check valve (4). Then the oil flows through the passage (5) and the head of the spool (1), and enters the port 4A2. The return oil flows from the port 4B2 through the head of the spool (1), and back to the

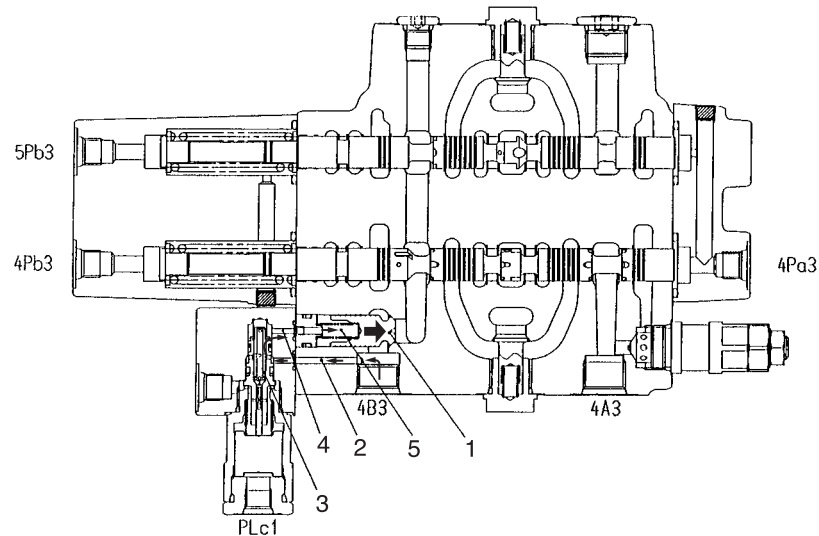
tank passage (6). Also, part of the oil is supplied from the orifice (7) to the left travel section, enabling concurrent operations of the buckets during right and left travel operations.

## HYDRAULIC UNITS

## CONTROL VALVE

## Boom spool switching

## 1. When the spool is in the neutral position

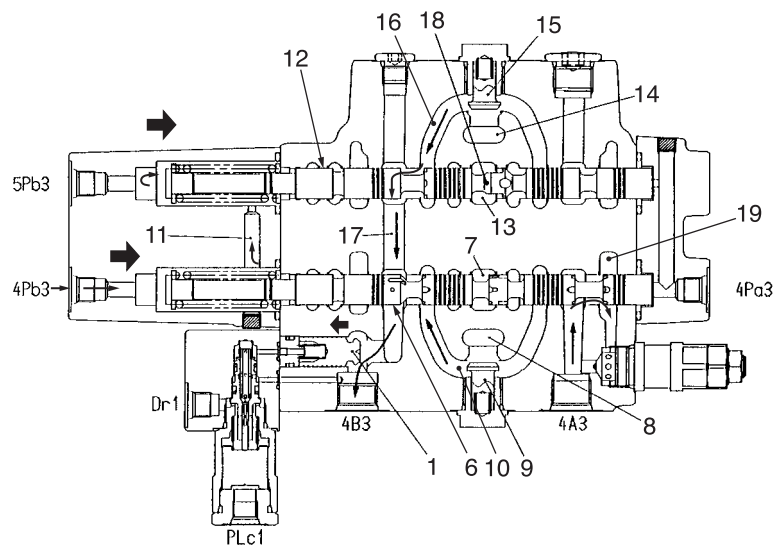


L2D212

The poppet (1) of the anti-drift valve mounted on the cylinder head of the boom [1] is seated by the pressure from the port 4B3. This pressure is applied through

the passage (2), spool (3), passage (4), and spring chamber (5).

## 2. Raise



L2D213

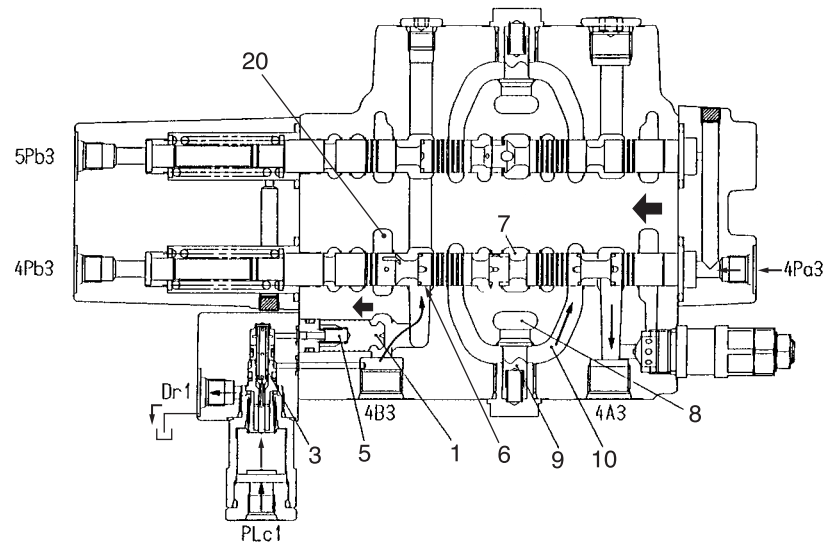
Switching the spool (6) of the boom [1] by pressurizing the port 4Pb3 closes the center bypass passage (7). The oil supplied from the pump P1 passes through the parallel passages (8), load check valve (9), passage (10), and the head of the spool (6). Then the oil raises the poppet (1) of the anti-drift valve and flows into the port 4B3.

Concurrently, the spool (12) of the boom [2] is switched by the passage (11) to close the center bypass valve (13). The oil supplied from the pump P2 passes through the parallel passages (14), load check valve (15), passage (16), the head of the spool (12), and the

passage (17), and then joins into the port 4B3. Part of the oil through the orifice (18) of the spool (12) returns to the tank.

The return oil flows from the port 4A3 through the head of the spool (6) of the boom [1], and back to the tank passage (19).

### 3. Lower

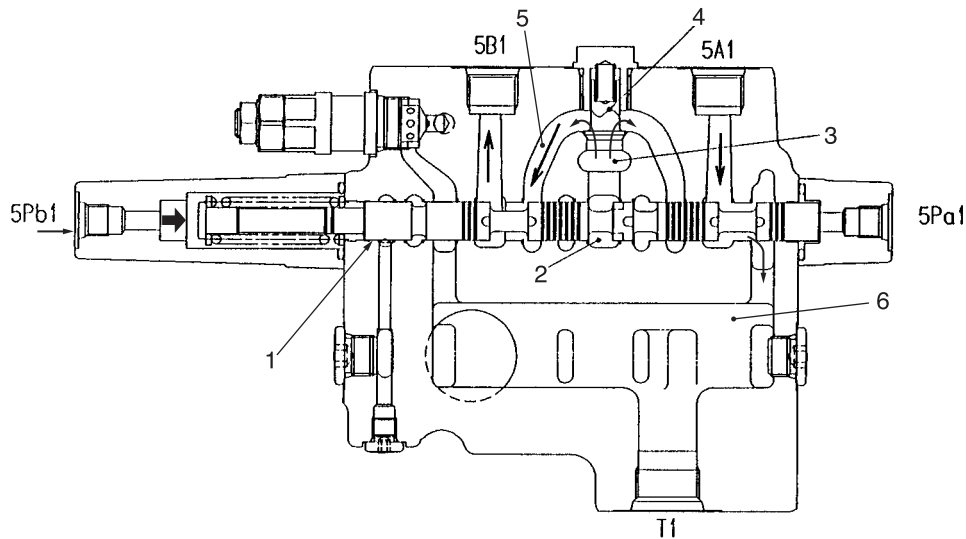


L2D214

Switching the spool (6) of the boom [1] by pressurizing the port 4Pa3 closes the center bypass passage (7). The oil supplied from the pump P1 passes through the parallel passages (8), load check valve (9), passage (10), and the head of the spool (6), and then flows into the port 4A3.

Pressurizing the ports 4Pa3 and PLC1 at the same time switches the spool (3) of the anti-drift valve. This reduces the pressure in the spring chamber (5) through the drain port Dr1 to open the poppet (1). The return oil flows through the head of the spool (6) of the boom [1], orifice, notch, and back to the tank passage (20).

### Swing spool switching



L2D215

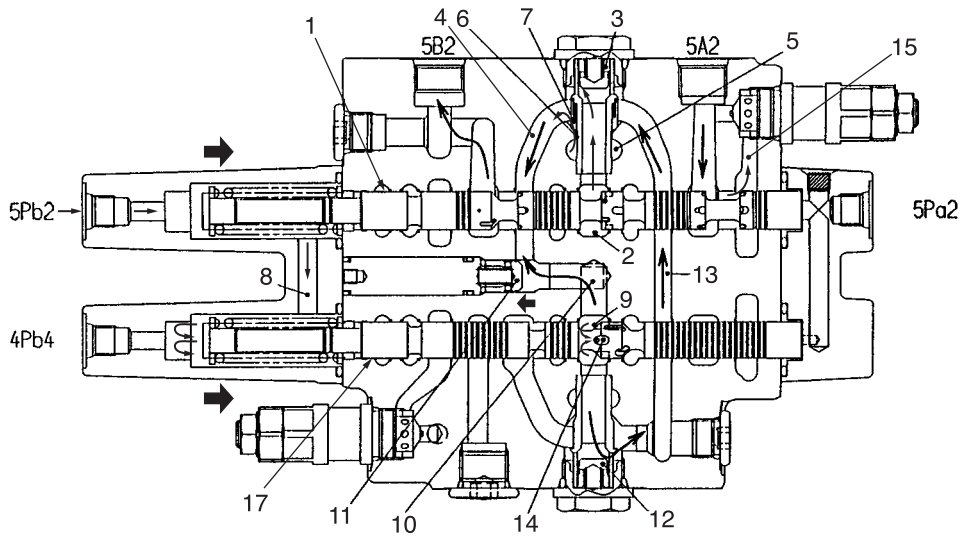
Switching the spool (1) by pressurizing the port 5Pb1 closes the center bypass passage (2). The oil supplied from the pump P2 passes through the parallel passages (3), load check valve (4), passage (5), and the head of the spool (1), and then flows into the port 5B1. The return oil flows from the port 5A1 through the head of the spool (1), and back to the tank passage (6).

## HYDRAULIC UNITS

## CONTROL VALVE

## Arm spool switching

## 1. Dump



L2D216

Switching the spool (1) of the arm [1] by pressurizing the port 5Pb2 closes the center bypass passage (2). The oil supplied from the pump P2 passes through the center bypass passage (2), tandem check valve (3), passage (4), and the head of the spool (1), and then flows into the port 5B2.

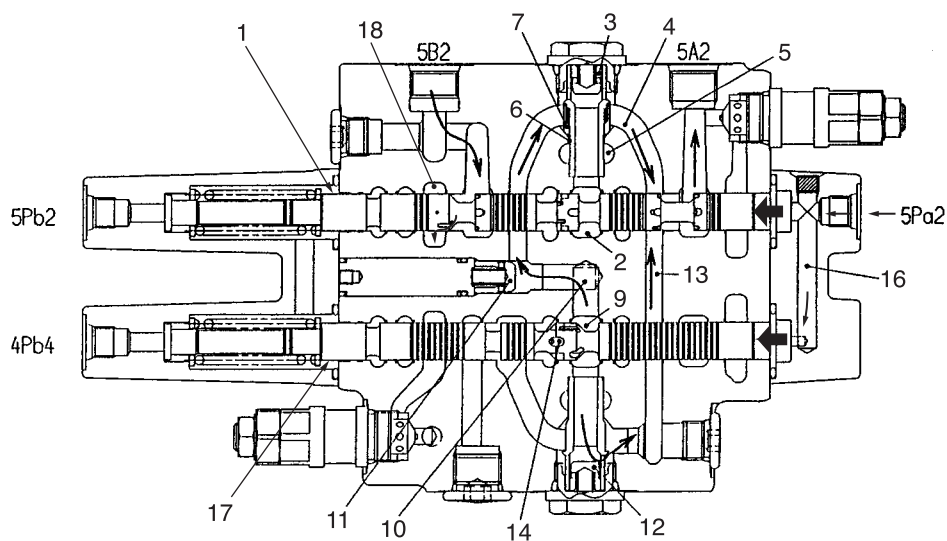
Concurrently, part of the oil from the pump P2 flows through the parallel passages (5), orifice (6), load check valve (7), and the passage (4), and then enters the port 5B2.

Switching the spool (1) of the arm [1] causes the spool (17) of the arm [2] to be switched by the passage (8)

to close the center bypass passage (9). The oil supplied from the pump P1 flows through the center bypass passage (9), passage (10), and check valve (11), and joins into the port 5B2. Part of the oil from the pump P1 also, flows through the tandem check valve (12), the passages (13) and (4), and the head of the spool of the arm [1], and then joins into the port 5B2. Part of the oil from the orifice (14) of the spool flows into the tank.

The return oil flows from the port 5A2 through the head of the spool (1) of the arm [1], and back to the tank passage (15).

## 2. Load



L2D217



## CONTROL VALVE

## HYDRAULIC UNITS

Switching the spool (1) of the arm [1] by pressurizing the port 5Pa2 closes the center bypass passage (2). The oil supplied from the pump P2 passes through the center bypass passage (2), tandem check valve (3), passage (4), and the head of the spool (1) of the arm [1], and then flows into the port 5A2.

Also, part of the oil from the pump P2 flows through the parallel passages (5), orifice (6), load check valve (7), and passage (4), and then enters the port 5A2. The orifice (6) is provided as a priority throttle for the concurrent operation with the boom offset operation. Switching the spool (1) of the arm [1] causes the spool (17) of the arm [2] to be switched by the passage (16)

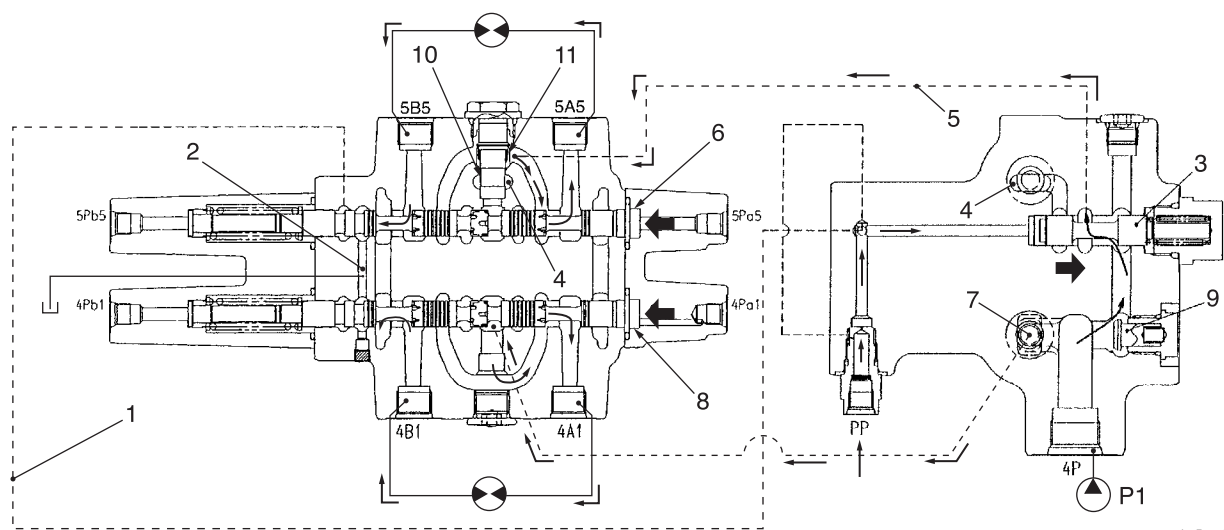
to close the center bypass passage (9). The oil supplied from the pump P1 flows through the center bypass passage (9), passage (10), check valve (11), passage (4), and the head of the spool (1) of the arm [1], and then joins into the port 5A2.

The oil from the pump P1 raises the tandem check valve (12) and from the passage (13) joins into the port 5A2.

Part of the oil from the orifice (14) of the spool returns to the tank.

The return oil flows from the port 5B2 through the orifice and notch of the head of the spool (1) of the arm [1], and back to the tank passage (18).

## Compound Operations during Traveling



When the attachment is operated while traveling, the passages (1) and (2) are closed, causing the pressure of the port PP to switch the straight travel spool (3) to block the flow from the parallel passages (4) of the 5-section part to the passage (5). This stops the oil supply from the pump P2 to the left travel spool (6), and the hydraulic oil from the pump P2 is supplied to the sections for the attachment. Concurrently, the hydraulic oil from the pump P1 is separated into two flows: one flow is from the center bypass (7) of the 4-section part to the right travel spool (8); and the other flow raises the poppet (9), passes through the head of the straight travel spool (3) and passage (5), and reaches the left travel spool. This keeps the travel straight.

Part of the oil from the pump P2 flows through the parallel passages (4), orifice (10), and load check valve (11), and is supplied to the travel section to relieve the deceleration shock at the time of switching of the straight travel spool (3).

## HYDRAULIC UNITS

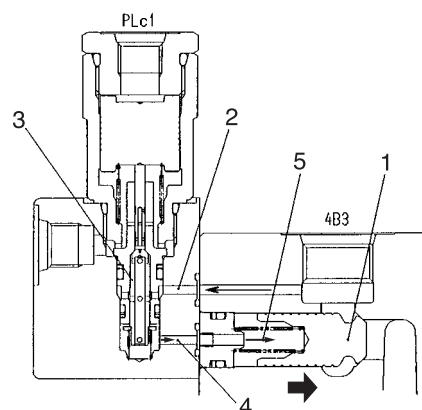
## CONTROL VALVE

### Anti-Drift Valve

This valve is installed in the boom cylinder head line to prevent the oil from leaking at the boom cylinder head line so that the boom will not fall down spontaneously when the boom spool is in the neutral position.

#### 1. Neutral

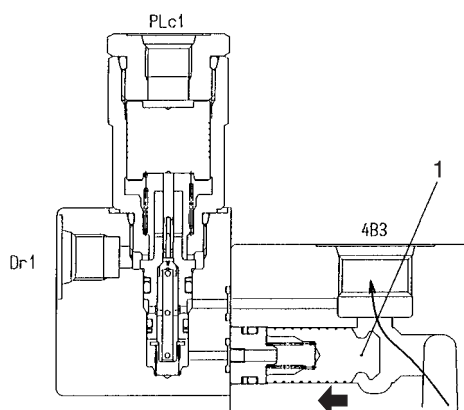
The pressure from the cylinder port is applied through the passage (2), hollow in the spool (3), passage (4), and to the spring chamber (5). Due to the spring force and the force produced by the difference in the poppet areas, the poppet (1) is firmly seated.



L2D219

#### 2. Raise

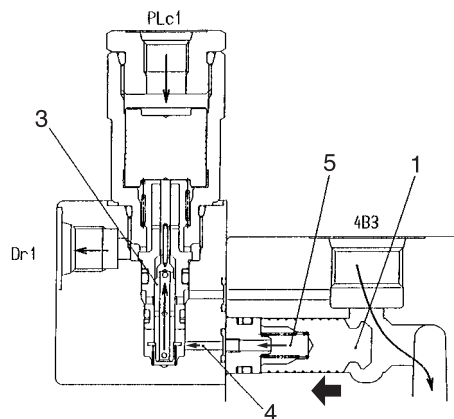
The oil supplied from the pump opens the poppet (1) and flows into the cylinder port.



L2D220

#### 3. Lower

Switching the spool (3) by pressurizing the port PLc1 causes the oil from the spring chamber (5) to flow through the passage (4) into the tank port Dr1. This opens the poppet (1), and the return oil from the cylinder port 4B3 flows through the spool of the boom [1] and back to the tank.



L2D221

## Main Relief Valve

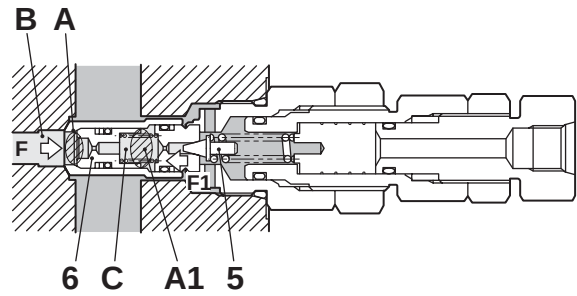
### Relieving Operation

When the pressure in the circuit is low with respect to the set value, the relief valve is maintained at equilibrium. Hydraulic oil from the pump passes through the orifice from chamber B and arrives at the spring chamber C and the needle valve (5). On the other hand, forces F and F1 are acting in the arrow directions on both sides of the main poppet (6).

$$F = P \times A \quad F1 = P \times A1$$

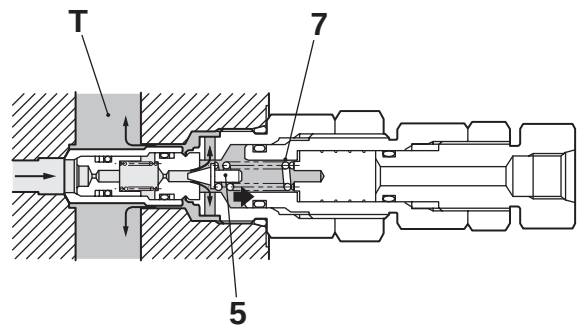
P: Pressure A, A1: Sectional Area

Since the sectional area of A is less than that of A1, the main poppet (6) is pushed by the force "F1-F" to the seat surface on the left side.



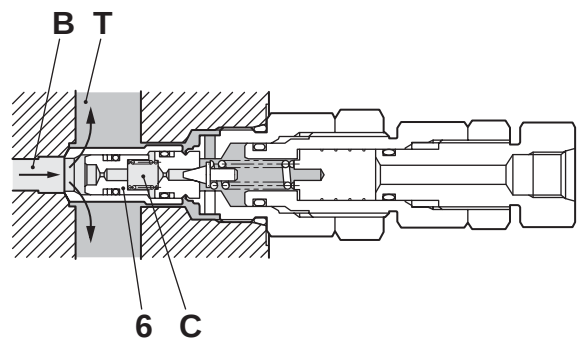
W2D207

If the pressure in the circuit becomes higher than the force of the spring (7), the needle valve (5) is pushed to the right by hydraulic pressure, opening. Oil then flows around the circumference of the needle valve (5) and passes through the slits, flowing into the tank passage (T).



W2D208

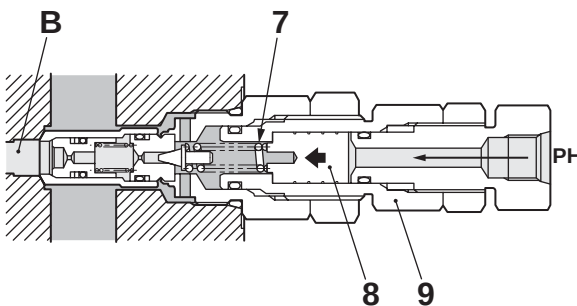
Compared to the chamber B side, the pressure in chamber C is low and there is no equilibrium in pressure. For this reason, the main poppet (6) opens and pressurized oil flows to the tank passage (T).



W2D209

### Pressure Increase Operation

When the pressure is applied to the pilot port PH, the piston (8) is pushed to the left to hit the plug (9). Then, the spring force of the spring (7) becomes larger, increasing the pressure in chamber B.



W2D210

## HYDRAULIC UNITS

## CONTROL VALVE

### Port Relief Valve

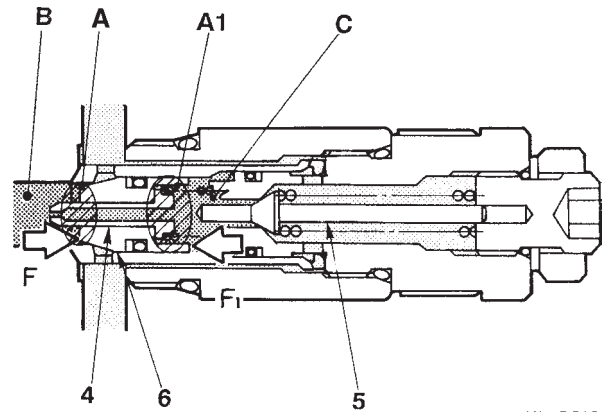
#### Relieving Operation

When the pressure in the circuit is low with respect to the set value, the relief valve is maintained at equilibrium. Pressure from the pump passes from chamber B to the orifice in piston (4), then reaches chamber C and the needle valve (5). On the other hand, forces F and F1 are acting in the arrow directions on both sides of the main poppet (6).

$$F = P \times A \quad F1 = P \times A1$$

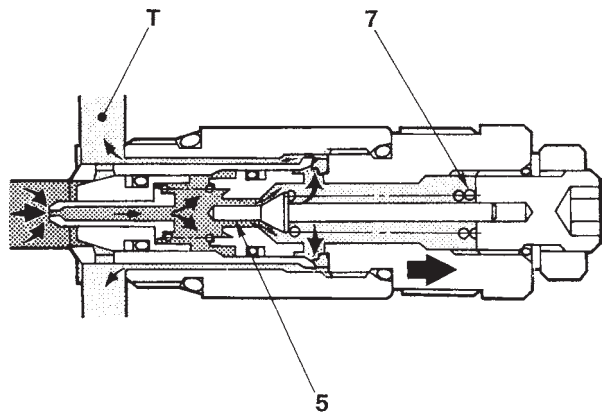
P: Pressure A, A1: Sectional Area

Since the sectional area of A is less than that of A1, the main poppet (6) is pushed by the force "F1-F" to the seat surface on the left side.



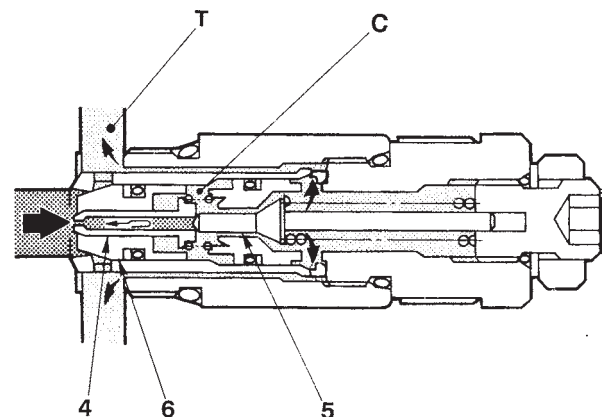
YI-D219

If the pressure in the circuit becomes higher than the force of the spring (7), the needle valve (5) is pushed to the right by hydraulic pressure, opening. Oil then flows around the circumference of the needle valve (5) and passes through the slits, flowing into the tank passage (T).



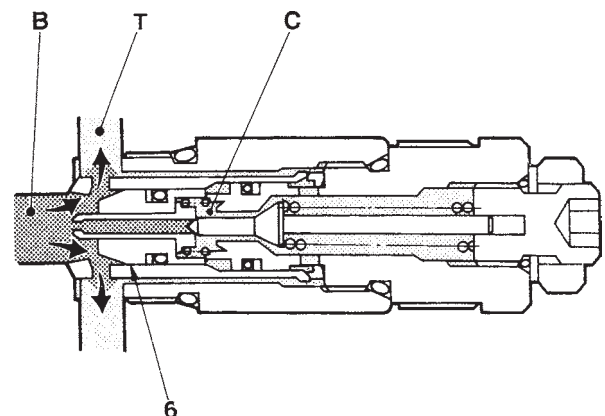
YI-D220

When the needle valve (5) opens, the pressure drops on the back side of the piston (4), pushing the piston (4) to be pushed to the right, seating with the needle valve (5). This shuts off the flow of hydraulic oil to the rear of the main poppet (6). As a result, the pressure in chamber C on the inside drops.



YI-D221

Compared to the chamber B side, the pressure in chamber C is low and there is no equilibrium in pressure. For this reason, the main poppet (6) opens and pressurized oil flows to the tank passage (T).



YI-D222

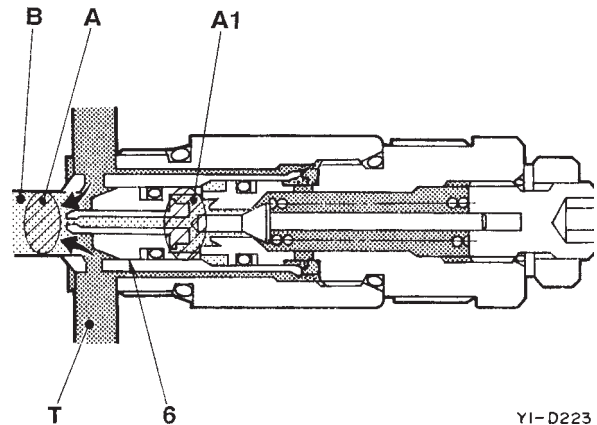
## CONTROL VALVE

## HYDRAULIC UNITS

## Suction Operation

When the cylinder is operated at high speed, and the supply of oil cannot keep up with it, creating a vacuum in chamber B, oil is supplied from the tank side, preventing the occurrence of cavitation.

When the pressure in chamber B is lower than the pressure in the tank passage (T), the differences in the sectional areas A and A1 cause the main poppet (6) to open. Thus, sufficient oil from the tank passage (T) enters chamber B, filling the empty space.



## DISASSEMBLY AND ASSEMBLY

### General Cautions

- Since all parts in control valves are precision machined, carry out disassembly and assembly operations in a clean place.
- Before disassembly, clean the outside surfaces around the valves.
- Clean all disassembled parts in cleaning solvent. Use a lint free cloth, or air dry the parts.
- Apply hydraulic oil to sliding surfaces and apply a thin coating of grease to seals when assembling them.

- Replace all seals with new ones each time the valves are disassembled.
- Spools and section bodies are specially selected for a precise fit. Therefore, if any damage is found in either of these parts, replace the section assembly as a unit.
- Be sure to number each section and spool to avoid mistakes during assembly.
- Do not turn adjusting screws if not required.

Following is an explanation of the control valve disassembly procedure.

Follow the procedure used to disassemble the control valve in reverse order when reassembling it.

- Before disassembly, number each section and spool.

### Disassembly

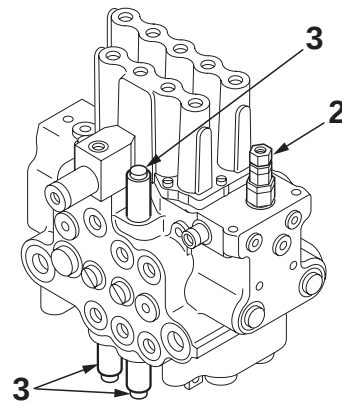
1. Remove the main relief valve (2), then remove the O-ring from the valve.

⌚ Valve: 49~54 N·m

2. Remove the port relief valve (3), then remove the O-ring from the valve.

- Do not disassemble the port relief valve, as the pressure cannot be adjusted after it is reassembled.
- Install the valve in the same position as it was in before disassembly.

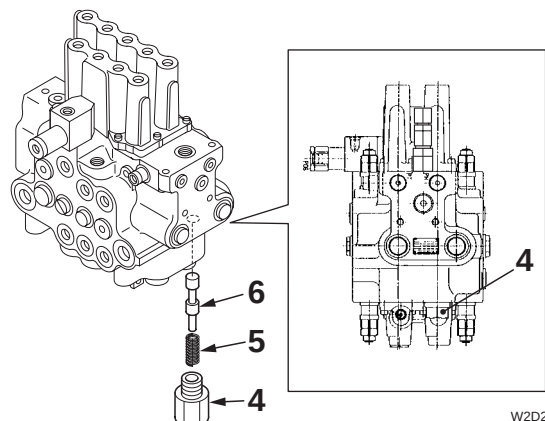
⌚ Valve: 59~69 N·m



W2D211

3. Remove the plug (4), then remove spring (5) and spool (6). Next, remove the O-ring from the plug.

⌚ Plug: 78~88 N·m

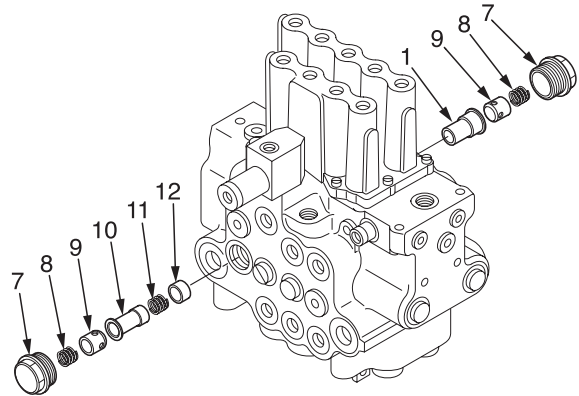


W2D212

## CONTROL VALVE

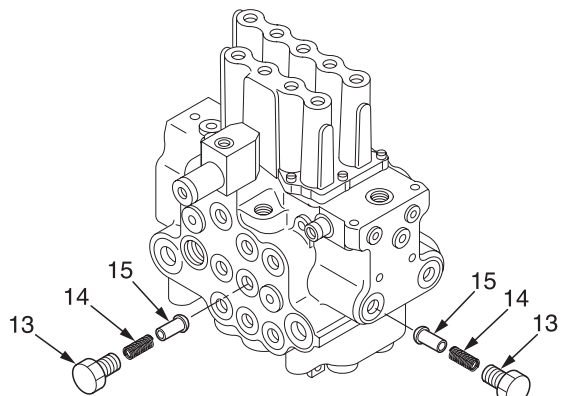
## HYDRAULIC UNITS

4. Disassemble the arm [1] and [2] and load check valve.
  - a. Remove the plug (7), then remove the O-ring from the plug.  
 Plug: 167~196 N·m
  - b. Remove the spring (8) and poppet (9).
  - c. <Arm [1]> Remove the sleeve (10), spring (11) and poppet (12).  
 <Arm [2]> Remove the sleeve (1).



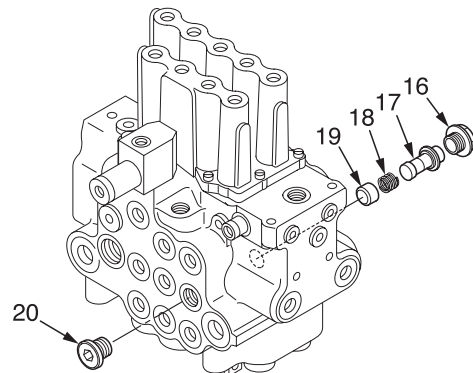
L3D226

5. Disassemble the booms [1] and [2], auxiliary, bucket, offset and the load check valves at the three common check valves.
  - a. Remove the plug (13), then remove the O-ring from the plug.  
 Plug: 88~98 N·m
  - b. Remove the spring (14) and poppet (15).



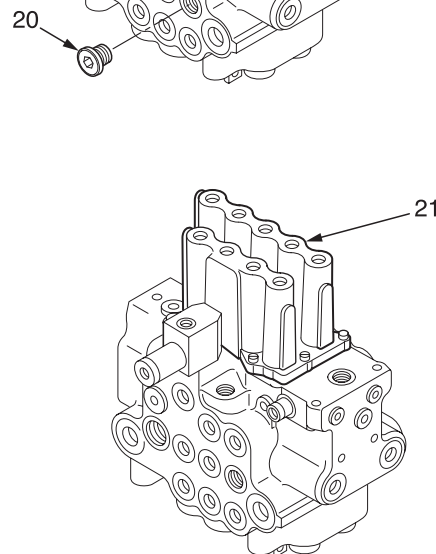
L3D227

6. Disassemble the left travel load check valve.
  - a. Remove the plug (16), then remove the O-ring from the plug.  
 Plug: 167~196 N·m
  - b. Remove the sleeve (17), spring (18) and poppet (19).



L3D228

7. Disassemble the right travel plug (20). Next, remove the O-ring from the plug.  
 Plug: 105.9~141.2 N·m



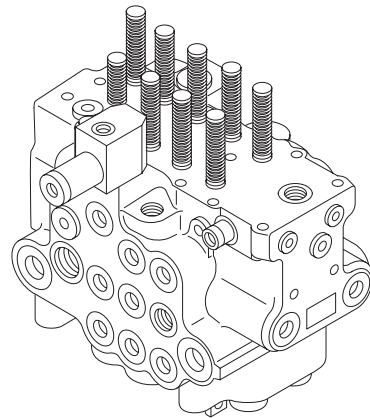
L3D229

8. Remove the cap screws, then remove cover (21). Next, remove the O-ring from the cover.  
 Cap screw: 8.8~10.8 N·m

## HYDRAULIC UNITS

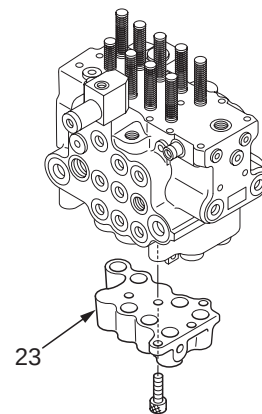
## CONTROL VALVE

9. Remove the individual spool assemblies from the valve housing.
  - Pull out the spool straight so that the spool surface will not be damaged.



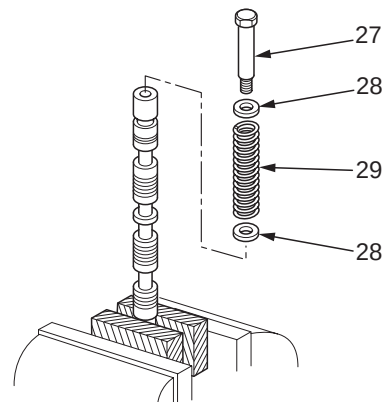
L3D230

10. Remove the cap screws, then remove cover (23).  
Next, remove the O-ring from the cover.
  - ☞ Cap screw: 8.8~10.8 N·m



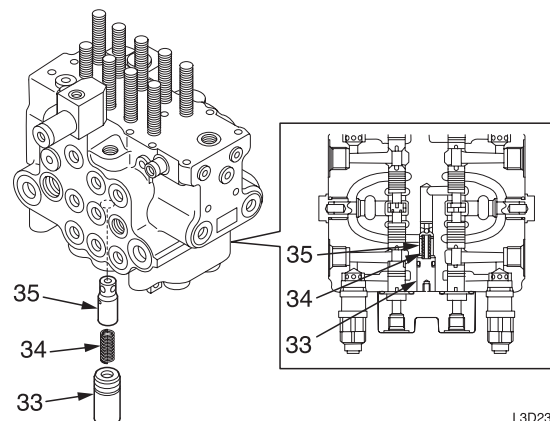
L3D231

11. Disassemble the spool.
  - Hold the spool with two pieces of wood so that the spool will not be damaged.
  - Loctite is applied to the thread, so heat the section around the thread to approximately 200°C.
  - a. Remove the screw (27), then remove the spools.
    - ☞ Cap screw: 19~22 N·m
  - b. Remove the spring holder (28), spring (29) and spring holder (28).



L2D232

12. Pull out the plug (33) and remove the spring (34) and poppet (35). Then remove the O-ring and backup ring from the plug (33).
  - Screw the bolt into the screw hole (M6 × 1.0) at the end face of the plug, and grab the bolt to pull out the plug.



L3D236

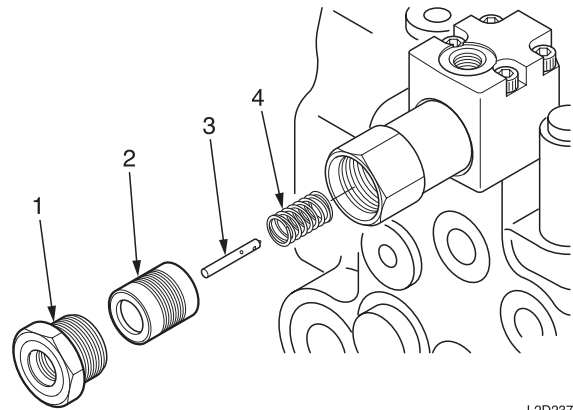


## CONTROL VALVE

## HYDRAULIC UNITS

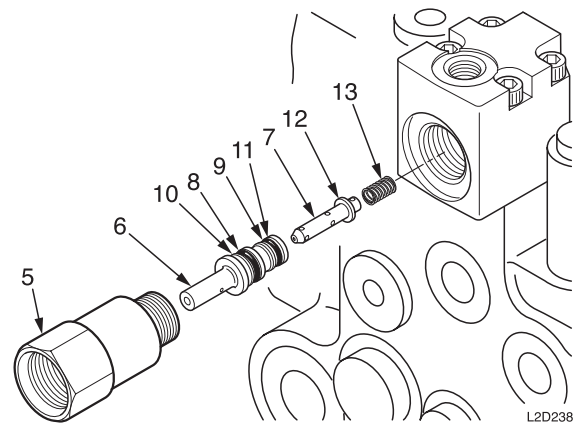
### Anti-Drift Valve

1. Remove the plug (1), then remove the O-ring from the plug.  
 ⇐ Plug: 69~78 N·m
2. Remove the piston (2), spool (3) and spring (4).

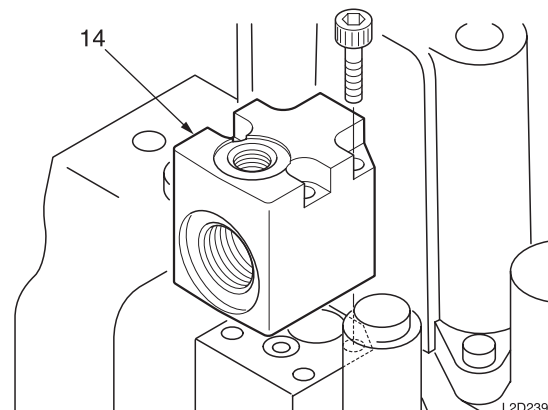


L2D237

3. Remove the plug (5), then remove the O-ring from the plug.  
 ⇐ Plug: 69~78 N·m
4. Remove the sleeve (6). Then remove the O-rings (8) and (9), and the backup rings (10) and (11) from the sleeve (6).
  - When reassembling, be sure to put the O-rings and the backup rings in place. Otherwise the boom can fall spontaneously.
5. Remove the poppet (7), spring seat (12), and spring (13).
  - When reassembling, be sure to apply grease to the edge of the poppet (7) to prevent the spring seat and the spring from being displaced.
6. Remove the cap screws, then remove the body (14) from the housing.  
 ⇐ Cap screw: 8.8~10.8 N·m
7. Remove the O-ring from the body (14).

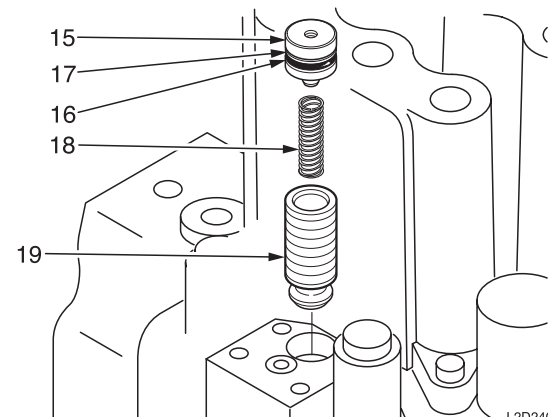


L2D238



L2D239

8. Remove the spacer (15).
  - Screw the bolt into the screw hole (M4 × 0.7) at the end face of the spacer, and grab the bolt to pull out the spacer.
9. Remove the O-ring (16) and backup ring (17) from the spacer (15).
10. Remove the spring (18) and poppet (19) from the body (14).



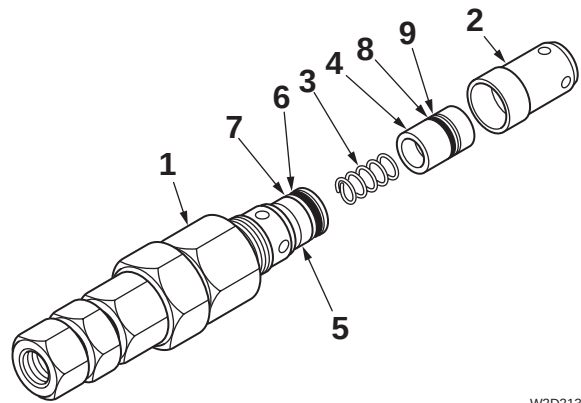
L2D240

## HYDRAULIC UNITS

## CONTROL VALVE

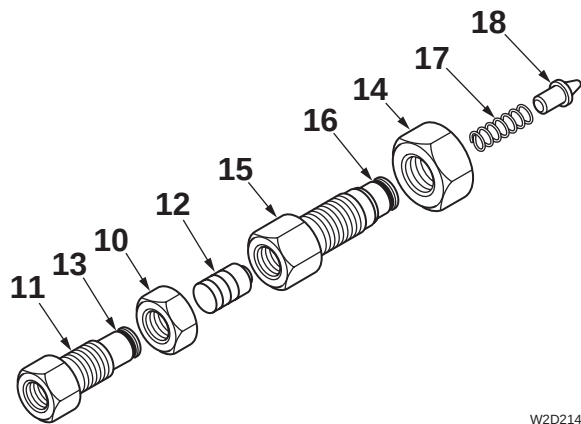
### Main Relief Valve

1. Remove the sleeve (2), spring (3) and main poppet (4) from the plug assembly (1).
  - The pilot seat (5) is caulked by the tip of the plug and cannot be disassembled.
2. Remove the O-ring (6) and backup ring (7) from the pilot seat (5).
3. Remove the O-ring (8) and backup rings (9) from the main poppet (4).



W2D213

4. Loosen the lock nut (10) and remove the plug (11) and piston (12).
  - When assembling, after installing the plug, first partially tighten the lock nut, then fully tighten it after adjusting the pressure.
5. Remove the O-ring (13) from the plug (11).
6. Loosen the lock nut (14) and remove the plug (15).
7. Remove the O-ring (16) from the plug (15).
8. Remove the spring (17) and needle valve (18).



W2D214

**INSPECTION AND ADJUSTMENT****Checking the Parts**

| Parts                                                        | Judgment Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Treatment                                                                                                                                                      |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Housing                                                      | <ul style="list-style-type: none"> <li>Scratches, rust, corrosion of the portion which slides against the spool.</li> <li>Scratches, rust, corrosion of the seal pocket portion of the part that enters the spool.</li> <li>Scratches, rust, corrosion of the port seal portion which is in contact with the O-ring.</li> <li>Scratches, rust, corrosion of the seal portion of the relief valve, etc.</li> <li>Other damage which could be a hindrance to correct function.</li> </ul> | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ul>                                  |
| Spool                                                        | <ul style="list-style-type: none"> <li>Scratch marks like being clawed around the outer circumference sliding portion.</li> <li>Scratches on the portion that slides against the seals on both ends.</li> <li>Spool not operating smoothly.</li> </ul>                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Repair or replace.</li> </ul>                                                         |
| Load Check Valve                                             | <ul style="list-style-type: none"> <li>Imperfect sealing due to damage to the valve or spring.</li> <li>Does not catch, but operates lightly when inserted in the section body and operated.</li> </ul>                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Repair or replace.</li> <li>Normal</li> </ul>                                                                           |
| Around Springs                                               | <ul style="list-style-type: none"> <li>Rust, corrosion, deformation, breakage or other marked damage to the spring, holder or cover.</li> </ul>                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Replace</li> </ul>                                                                                                      |
| Around Spool Seal                                            | <ul style="list-style-type: none"> <li>Oil leaking to the outside.</li> <li>Rust, corrosion or deformation of the seal holder.</li> </ul>                                                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Repair or replace.</li> <li>Repair or replace.</li> </ul>                                                               |
| Main Relief Valve,<br>Port Relief Valve,<br>Anti-Drift Valve | <ul style="list-style-type: none"> <li>External rust, damage.</li> <li>Damage to valve seat contact surface.</li> <li>Damage to poppet contact surface.</li> <li>Abnormality in the spring.</li> <li>O-rings, backup rings, seals</li> </ul>                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>As a rule, all these should be replaced.</li> </ul> |

**Adjusting the Main Relief Valve Pressure**

 “II. Specifications, Standards for Judging Performance”

## HYDRAULIC UNITS

## CONTROL VALVE

## TROUBLESHOOTING

The following items are a list of all the problems that might occur individually, but in actual practice, 2 or 3 of these problems might occur simultaneously to

compound the trouble. It is therefore desirable to proceed so that the causes can be eliminated one at a time.

| Symptom                                            | Probable Causes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Remedy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Oil leaks from spool seal.                         | <ul style="list-style-type: none"> <li>Seal is scratched or the seal lip is worn due to long use.</li> <li>Spool's seal sliding portion was damaged by some external cause (bruise, scratch, etc.).</li> <li>Seal bulged out and the cover was installed in a warped state.</li> <li>Paint adhered to the sliding portion of the spool's seal portion during painting.</li> <li>Tank circuit's pressure became high and exceeded the pressure level that the seal was capable of withstanding.</li> </ul>                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>Replace with a new part.</li> <li>Repair or replace the spool.</li> <li>Return to the correct shape and check for eccentric wear of the seal lip.</li> <li>Remove paint with paint thinner or remove it mechanically. However, at this time, be careful not to damage the spool surface or the seal lip.</li> <li>Eliminate the factors causing excessive flow resistance.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Spool's sliding is not smooth.                     | <ul style="list-style-type: none"> <li>Foreign matter is biting into the spool's sliding surface.</li> <li>Oil film between the spool and body disappears due to abnormally high oil temperature.</li> <li>Lubrication is improper due to deteriorating oil.</li> <li>Spool is worn from long use or due to pressure bearing on one side only.</li> <li>Spool is bent from externally applied pressure.</li> <li>Entire valve is strained due to strain in the installation face.</li> <li>Valve was used at a pressure or a flow volume which was out of specification.</li> <li>Bolts used to assemble the valve were tightened excessively.</li> <li>Oil is accumulating in the cover (the side with a spring or a detent) opposite the side where the spool operates.</li> </ul> | <ul style="list-style-type: none"> <li>Overhaul and repair or replace.</li> <li>Use some method to lower the oil temperature or if the relief valve is operating frequently, investigate the cause and reduce the frequency.</li> <li>This could be alleviated by simply replacing the hydraulic oil, or it could require an overhaul of the circuit.</li> <li>Check the spool's diameter and consider the necessity of replacement.</li> <li>Check the spool's straightness and other factors, then repair or replace.</li> <li>Loosen the installation bolts, then cut the installation face and edge and check.</li> <li>In the case of pressure, check with a pressure gauge. In the case of flow volume, check by the actuator's speed of movement and the capacity.</li> <li>Check if the assembly bolts are tightened to the specified torque. If the torque deviates markedly from the specified torque, tighten them again.</li> <li>The spool is leaking oil, so when the spool moves, oil leaks from the cover. After confirming this, replace the seal.</li> </ul> |
| Cylinder drops while shifting to a lift operation. | <ul style="list-style-type: none"> <li>Foreign matter is biting into the load check valve seat or large scratches were made by foreign matter biting into the valve's seat previously.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Disassemble and check, then overhaul or replace.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## CONTROL VALVE

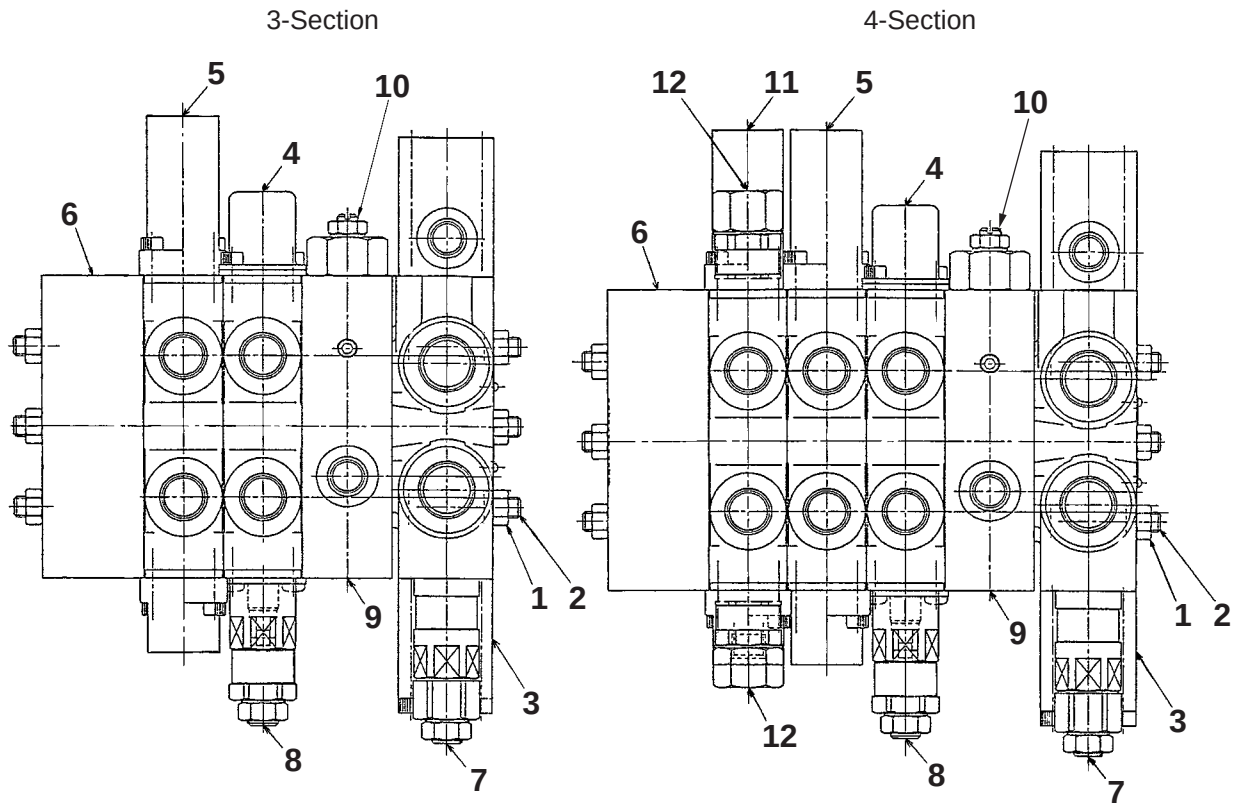
## HYDRAULIC UNITS

| Symptom                                                       | Probable Causes                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Remedy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Can't be held in the spool neutral position (cylinder drops). | <ul style="list-style-type: none"> <li>• Could be mistaken for a great amount of leakage in the cylinder.</li> <li>• The gap between the spool and body is large, so the amount of oil leaking from the spool is great.</li> <li>• Spool won't return completely to the neutral position.</li> <li>• Foreign matter is biting into the port relief valve seat or the anti-cavitation valve seat and oil is bypassing. Or a seat is damaged.</li> </ul>                | <ul style="list-style-type: none"> <li>• Check if it isn't just the cylinder's natural drop when the cylinder is held. If the problem is in the cylinder, disassemble and repair it.</li> <li>• Replace the spool or replace the valve block assembly.</li> <li>• Manually Operated :<br/>Check if there is something interfering with the link mechanism.</li> <li>• Pilot Operated:<br/>Check the pilot pressure.</li> <li>• Disassemble and check, then overhaul or replace.</li> </ul>                                                                                                                                                                                                                                  |
| The load won't move. (Pressure won't increase.)               | <ul style="list-style-type: none"> <li>• Foreign matter is biting into the relief valve seat and oil is bypassing. Or the seat is damaged.</li> <li>• The relief valve's adjustment screw is loose.</li> <li>• Foreign matter is biting into the port relief valve seat or the anti-drift valve seat and oil is bypassing. Or a seat is damaged.</li> <li>• Spool stroke is not the specified stroke.</li> <li>• Pump is damaged and no oil is discharged.</li> </ul> | <ul style="list-style-type: none"> <li>• Disassemble and check, then overhaul or replace.</li> <li>• Try tightening the adjustment screw. If it is loose, correct the setting and tighten the lock nut securely.</li> <li>• Disassemble and check, then overhaul or replace.</li> <li>• Manually Operated:<br/>Check if there is something interfering with the link mechanism. Check if a pin or a pin hole in the link connection is worn.</li> <li>• Pilot Operated:<br/>Check the pilot pressure.</li> <li>• Check if the pump is abnormal or not. If the pump is bad, replace it. Check if the cause of the abnormality is air being sucked in, deterioration of hydraulic oil or shafts not centered, etc.</li> </ul> |
| Load doesn't move. (Pressure rises.)                          | <ul style="list-style-type: none"> <li>• The load is too heavy.</li> <li>• Mechanical resistance of connecting parts is great regardless of the hydraulic pressure in the operating unit.</li> <li>• A large piece of foreign matter is trapped in the circuit or a pipe is bent, causing great resistance.</li> <li>• Spool stroke is not the specified stroke.</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li>• Compare with an object of the specified weight.</li> <li>• Check and replenish hydraulic oil, etc., modify or repair.</li> <li>• Find the affected place and repair it.</li> <li>• Check if there is something interfering with the link mechanism. Check if a pin or a pin hole in the link connection is worn or not.</li> </ul>                                                                                                                                                                                                                                                                                                                                                 |



## CONTROL VALVES (3-SECTION/4-SECTION)

### CONSTRUCTION



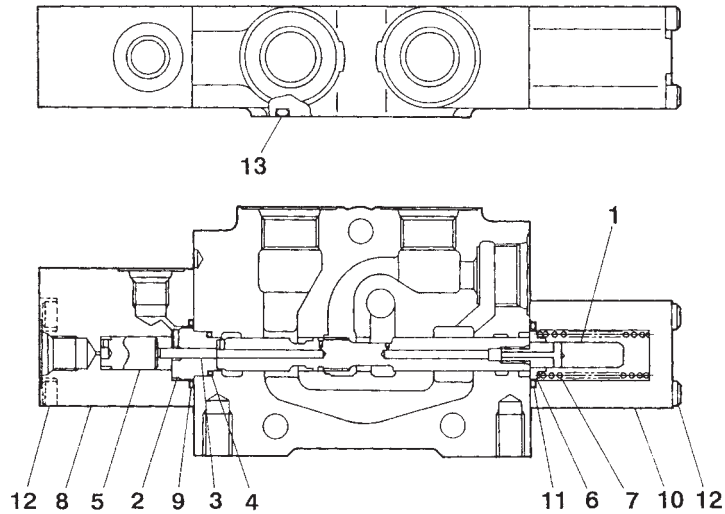
W2D215E

1. Nut
2. Tie Rod
3. Slew Flow Control Section Assembly
4. Dozer Blade Section Assembly
5. Slew Section Assembly
6. Outlet Housing
7. Main Relief Valve
8. Port Relief Valve
9. Spacer Section
10. Slow Slew Speed Adjusting Valve
11. Auxiliary Section Assembly
12. Port Relief Valve

## HYDRAULIC UNITS

## CONTROL VALVES

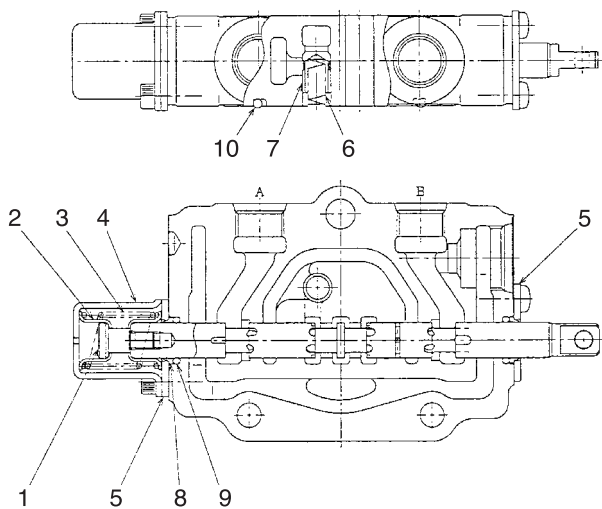
### Slew Flow Control Section



1. Screw
2. Sleeve
3. Pin
4. O-ring
5. Piston
6. Spring Holder
7. Spring
8. Cover
9. O-ring
10. Cover
11. O-ring
12. Cap Screw
13. O-ring

L1-D241

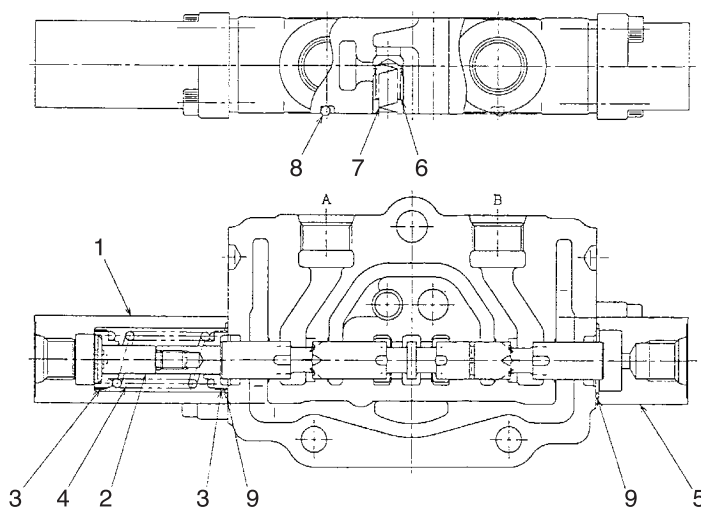
### Dozer Blade Section



1. Screw
2. Spring Holder
3. Spring
4. Cover
5. Seal Holder
6. Load Check Valve
7. Spring
8. Wiper
9. O-ring
10. O-ring

L3D251

### Slew Section



1. Cover
2. Screw
3. Spring Holder
4. Spring
5. Cover
6. Load Check Valve
7. Spring
8. O-ring
9. O-ring

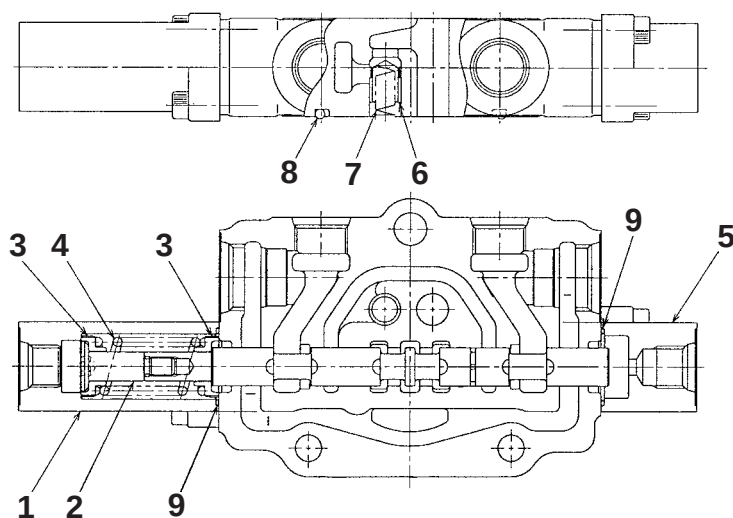
L3D252



## CONTROL VALVES

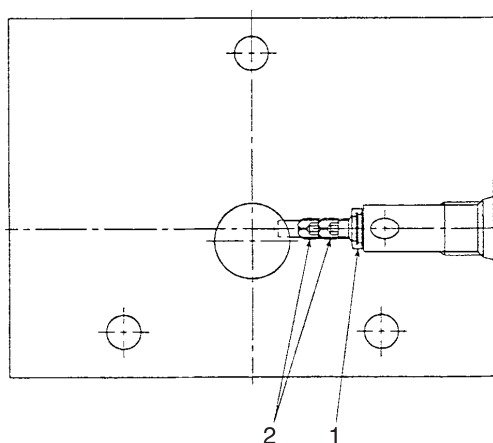
## HYDRAULIC UNITS

### Auxiliary Section



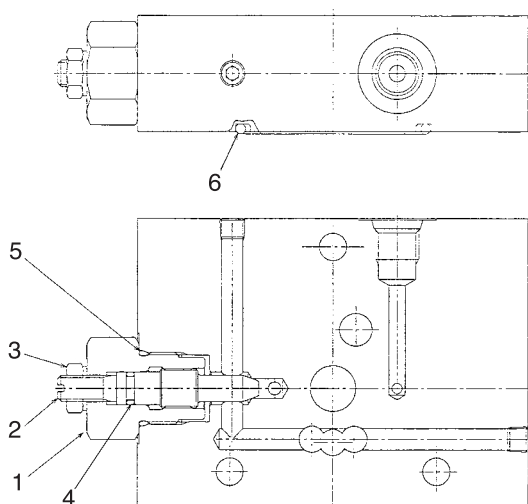
W2D217

### Outlet Housing



L3D253

### Spacer Section

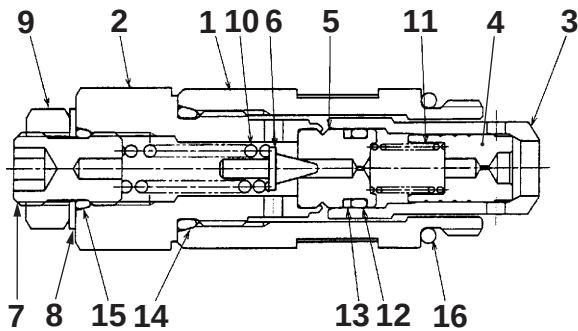


L3D254

## HYDRAULIC UNITS

## CONTROL VALVES

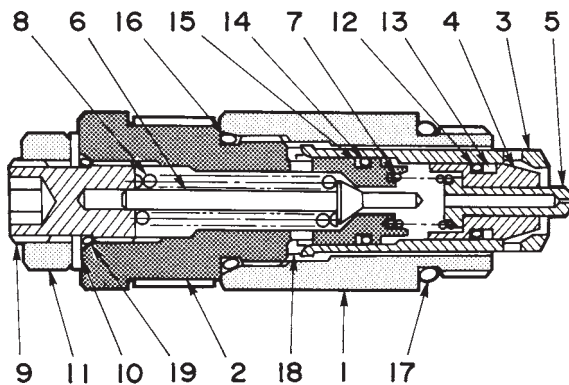
### Main Relief Valve



W2D216

- |                    |                 |
|--------------------|-----------------|
| 1. Housing         | 9. Lock Nut     |
| 2. Plug            | 10. Spring      |
| 3. Sleeve          | 11. Spring      |
| 4. Main Poppet     | 12. O-ring      |
| 5. Seat            | 13. Backup Ring |
| 6. Needle Valve    | 14. O-ring      |
| 7. Adjusting Screw | 15. O-ring      |
| 8. Washer          | 16. O-ring      |

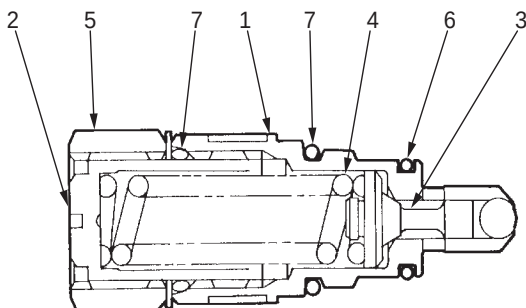
### Port Relief Valve



YI-D212

- |                    |                 |
|--------------------|-----------------|
| 1. Housing         | 11. Lock Nut    |
| 2. Plug            | 12. O-ring      |
| 3. Sleeve          | 13. Backup Ring |
| 4. Main Poppet     | 14. O-ring      |
| 5. Piston          | 15. Backup Ring |
| 6. Needle Valve    | 16. O-ring      |
| 7. Spring          | 17. O-ring      |
| 8. Spring          | 18. Wave Washer |
| 9. Adjusting Screw | 19. O-ring      |
| 10. Washer         |                 |

### Port Relief Valve



C4D205

- |                    |
|--------------------|
| 1. Housing         |
| 2. Adjusting Screw |
| 3. Poppet          |
| 4. Spring          |
| 5. Lock Nut        |
| 6. O-ring          |
| 7. O-ring          |

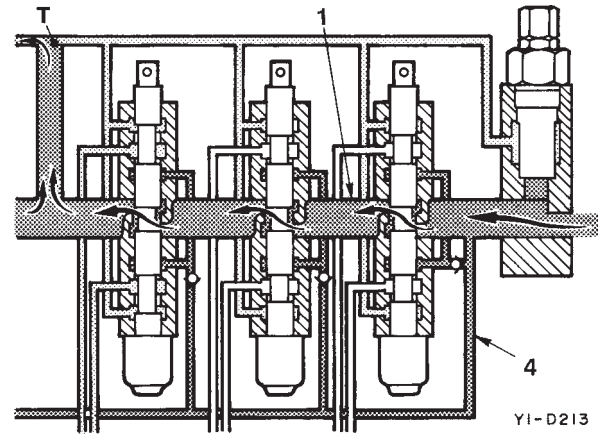
## CONTROL VALVES

## HYDRAULIC UNITS

### OPERATION

#### When the Spool is in the Neutral Position

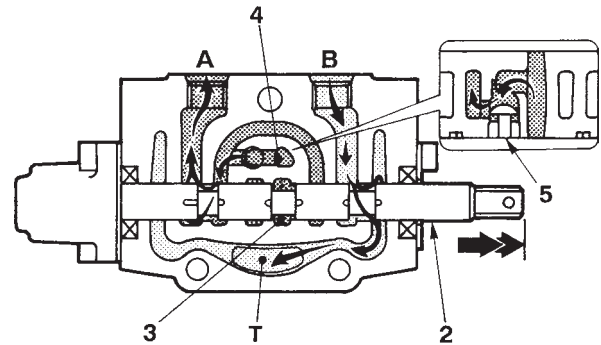
When the control valve spool is not moving, hydraulic oil flows through the center bypass passage (1) and then through the tank passage (T) in the arrow direction, returning to the tank.



#### When the Spool is Actuated

Explanation is given for the case where the spool is moved to the right.

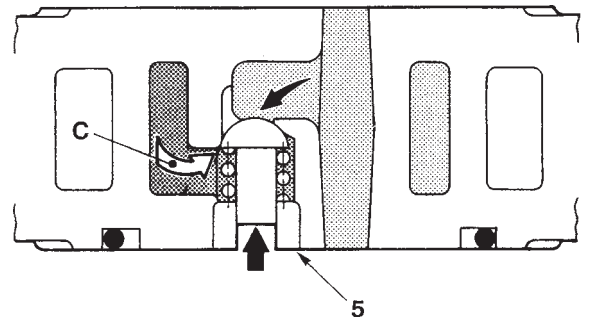
When the spool (2) is moved to the right, the center bypass passage (3) is closed and hydraulic oil entering from the pump passes through the load check valve (5) from the parallel passage (4), flowing from the A port to the actuator. On the other hand, oil returning from the B port flows through the tank circuit (T) and returns to the tank.



#### Load Check Valve

A load check valve (5) is included in each section except the travel (right, left) sections.

This valve prevents oil from flowing backward due to the load pressure (C) from the actuator port during switching of the spool.



## HYDRAULIC UNITS

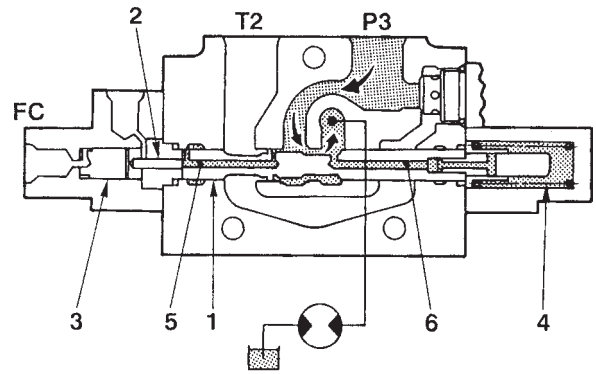
## CONTROL VALVES

### Slew Flow Control Function

This function switches the quantity of hydraulic oil flowing to the slew motor to change the slewing speed between normal and slow. It also keeps the flow to the motor steady even when the supply pressure changes during slow speed slewing.

#### Normal speed mode

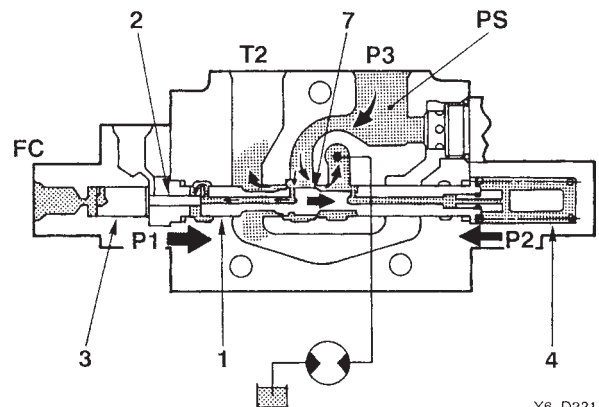
When there is no pilot pressure at port FC, spool (1), push rod (2) and piston (3) are positioned at the left side by spring (4). In addition, pre-choke pressure P1 is led to the left side of spool (1) through pilot hole (5) and post-choke pressure P2 is led to the right side of spool (1) through pilot hole (6). At this time, all the oil supplied from port P3 flows to the slew motor.



Y6-D220

#### Slow speed mode

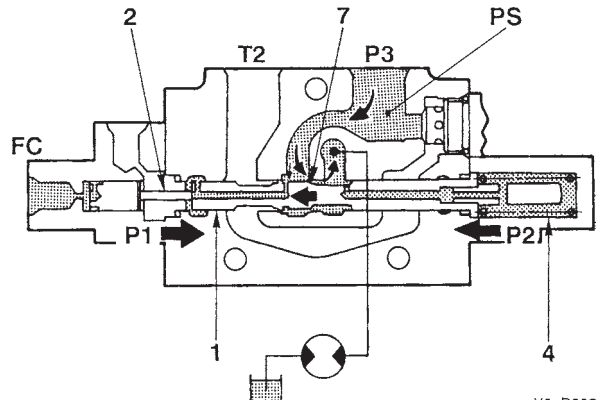
When the pilot pressure reaches port FC, piston (3) moves to the right side, push rod (2) and spool (1) also move, and the difference between pre-choke pressure P1 and post-choke pressure P2 at spool (1) works to maintain a constant pressure (PC). Part of the hydraulic oil supplied from port P3 passes through the control orifice (7) and flows to the slew motor, and the remaining oil flows to tank port T2. The pressure at port P3 (PS) at this time increases, and when the flow increases, the difference in pressure between P1 and P2 increases, so spool (1) moves to the right side, the control orifice (7) is choked, the pressure difference [P1 - P2] is kept at PC, and the flow to the slew motor does not increase.



Y6-D221

Inversely, when the pressure (PS) at port P3 decreases, the difference in pressure between P1 and P2 decreases, so spool (1) is moved to the left side by spring (4) until the pressure difference reaches PC and orifice (7) opens, so the flow to the slew motor does not decrease.

In this way, only a specific quantity of the oil supplied flows to the slew motor even when the supply pressure changes, the remaining being released to tank port T2. This makes it possible to slew in the slow speed mode with a slow flow.



Y6-D222

### Main Relief Valve

A main relief valve is mounted between the pump circuit and tank circuit of each inlet housing and serves to maintain the circuit pressure at the set value.

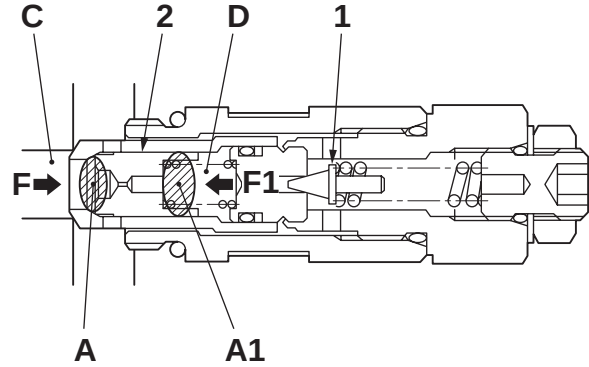
#### When the Relief Valve is NOT Operating

When the pressure in the circuit is low with respect to the set value, the relief valve maintains equilibrium. Hydraulic oil from the pump passes through the orifice from chamber (C) and arrives at the spring chamber (D) and the needle valve (1). On the other hand, forces F and F1 are acting in the respective arrow directions on both sides of the main poppet (2).

$$F = P \times A \quad F1 = P \times A1$$

P: Pressure A, A1: Cross Sectional Area

Since the cross sectional area of A is less than that of A1, the main poppet (2) is pushed by the force "F1 - F" to the seat surface on the left side.

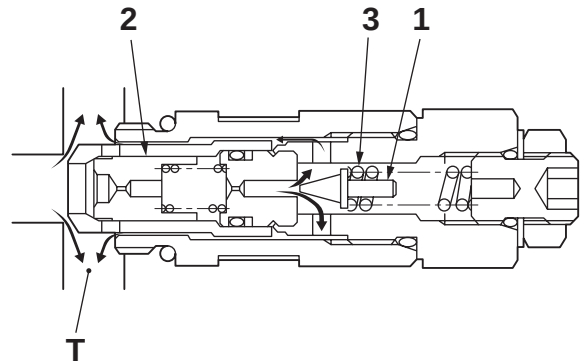


S3F611

#### When the Relief Valve is Operating

If the circuit's pressure becomes greater than the set value of the spring (3), the needle valve (1) is pushed to the right by hydraulic pressure and oil flows to the tank passage (T). When this happens, a pressure differential is generated between the two ends of orifice of the main poppet (2), and this hydraulic pressure pushes the main poppet toward the right. As a result, the pressurized oil in the circuit flows to the tank passage.

This operation maintains the pressure in the circuit at the set value.



S3F612

## HYDRAULIC UNITS

## CONTROL VALVES

### Port Relief Valve

A port relief valve is located between the actuator port and the tank circuit and when abnormal pressure due to shock pressure or external pressure generated when the actuator port is suddenly blocked by the spool or when there is an overload occurs, these valves act to protect the actuator.

#### Relieving Operation

When the pressure in the circuit is low with respect to the set value, the relief valve is maintained at equilibrium. Pressure from the pump passes from chamber B to the orifice in piston (4), then reaches chamber C and the needle valve (5). On the other hand, forces F and F1 are acting in the arrow directions on both sides of the main poppet (6).

$$F = P \times A \quad F1 = P \times A1$$

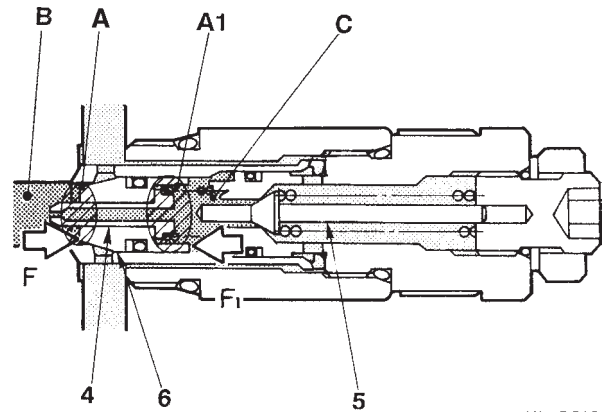
P: Pressure A, A1: Sectional Area

Since the sectional area of A is less than that of A1, the main poppet (6) is pushed by the force "F1-F" to the seat surface on the left side.

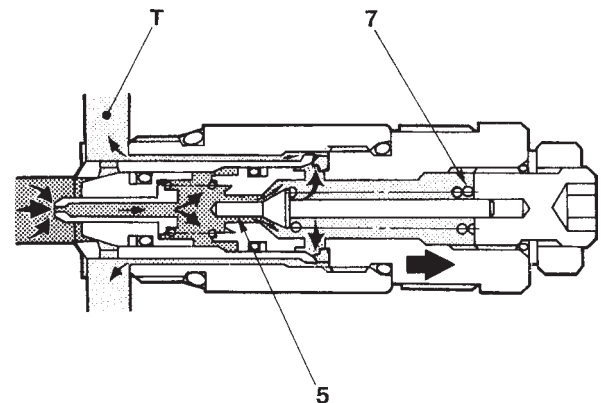
If the pressure in the circuit becomes higher than the force of the spring (7), the needle valve (5) is pushed to the right by hydraulic pressure, opening. Oil then flows around the circumference of the needle valve (5) and passes through the slits, flowing into the tank passage (T).

When the needle valve (5) opens, the pressure drops on the back side of the piston (4), pushing the piston (4) to be pushed to the right, seating with the needle valve (5). This shuts off the flow of hydraulic oil to the rear of the main poppet (6). As a result, the pressure in chamber C on the inside drops.

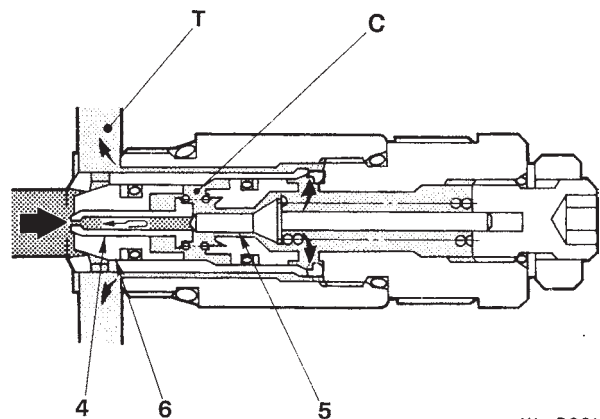
Compared to the chamber B side, the pressure in chamber C is low and there is no equilibrium in pressure. For this reason, the main poppet (6) opens and pressurized oil flows to the tank passage (T).



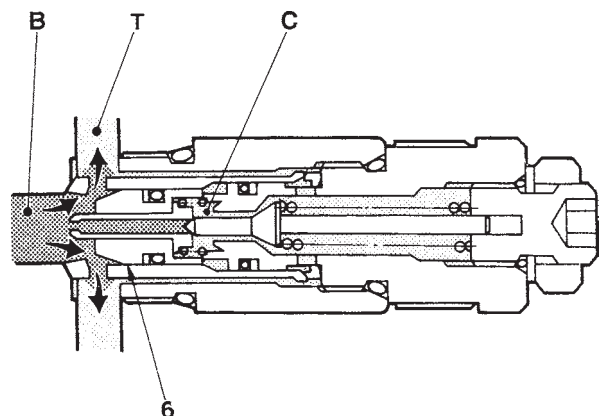
YI-D219



YI-D220



YI-D221



YI-D222

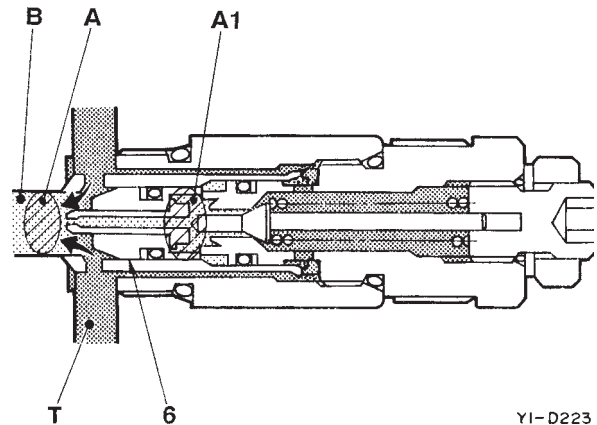
## CONTROL VALVES

## HYDRAULIC UNITS

## Suction Operation

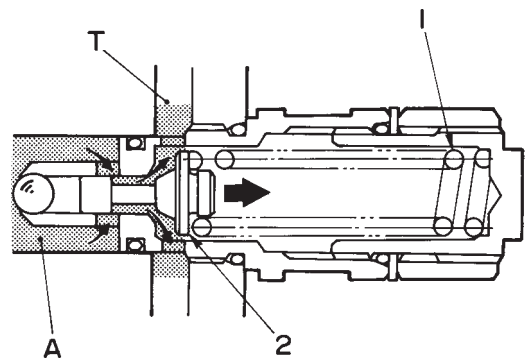
When the cylinder is operated at high speed, and the supply of oil cannot keep up with it, creating a vacuum in chamber B, oil is supplied from the tank side, preventing the occurrence of cavitation.

When the pressure in chamber B is lower than the pressure in the tank passage (T), the differences in the sectional areas A and A1 cause the main poppet (6) to open. Thus, sufficient oil from the tank passage (T) enters chamber B, filling the empty space.



## For Auxiliary

The figure at right shows when hydraulic pressure arrives at chamber A from the actuator port. If this pressure becomes stronger than the set value of the spring (1), it pushes the poppet (2) to the right side and pressurized fluid from the actuator port flows to the tank passage.



## HYDRAULIC UNITS

## CONTROL VALVES

## DISASSEMBLY AND ASSEMBLY

## General Cautions

- Since all parts in control valves are precision machined, carry out disassembly and assembly operations in a clean place.
- Before disassembly, clean the outside surfaces around the valves.
- Clean all disassembled parts in cleaning solvent. Use a lint free cloth, or air dry the parts.
- Apply hydraulic oil to sliding surfaces and apply a thin coating of grease to seals when assembling them.

Following is an explanation of the control valve disassembly procedure.

Follow the procedure used to disassemble the control valve in reverse order when reassembling it.

- Before disassembly, number each section and spool.

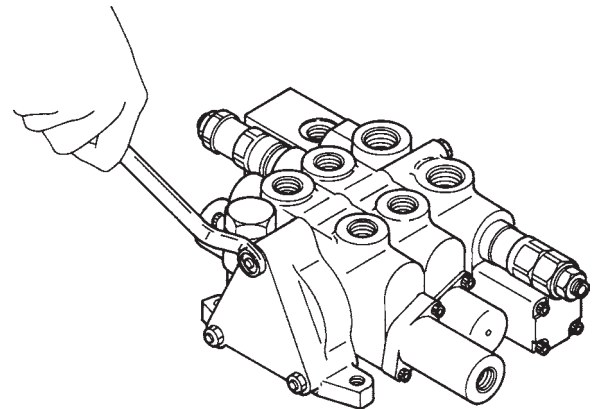
## Disassembly

## Valve Assembly

1. Loosen the nuts and remove the tie rods, then remove the sections.

⌚ Nut: 19.0 N·m

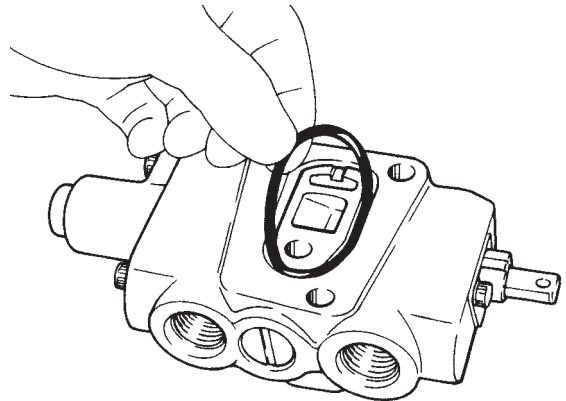
- Replace all seals with new ones each time the valves are disassembled.
- Spools and section bodies are specially selected for a precise fit. Therefore, if any damage is found in either of these parts, replace the section assembly as a unit.
- Be sure to number each section and spool to avoid mistakes during assembly.
- Do not turn adjusting screws if not required.



L1-D244

2. Remove the O-ring.

- The mating surfaces are metal seals, so be careful not to scratch, bruise or otherwise damage them.

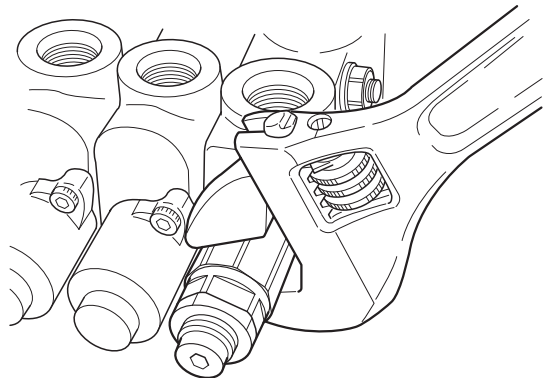


Y1-D226

3. Remove the main relief valves and the port relief valves, then remove the O-rings from the relief valves.

- Do not disassemble the relief valves unless it is necessary.
- When using a spanner or adjustable wrench, be sure to attach it in the place shown in the figure at right.

⌚ Relief valve: 68~78.5 N·m



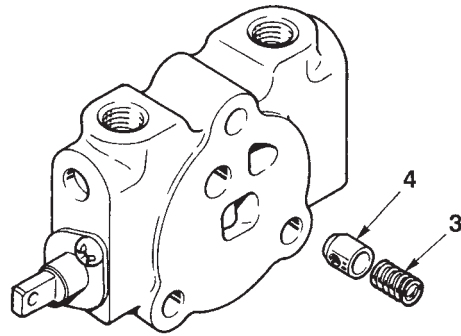
G4D223



## CONTROL VALVES

## HYDRAULIC UNITS

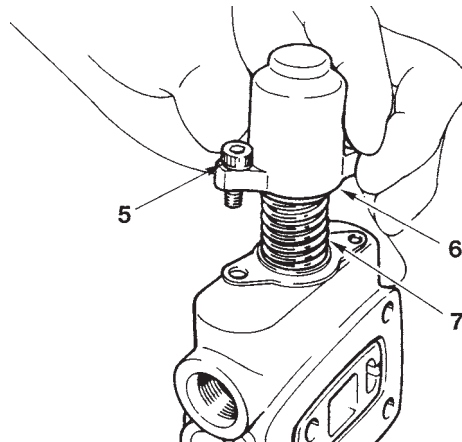
4. Remove the load check valve.
  - Remove the spring (3), then remove the poppet (4).



YI-D229

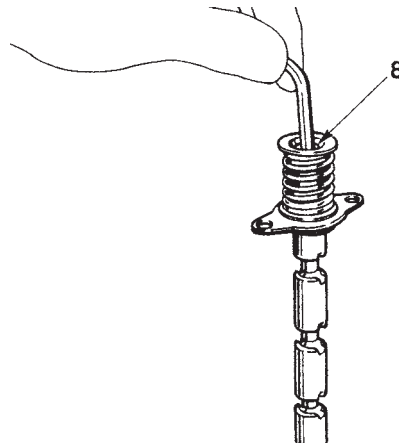
### Manually Operated Section

1. Remove the cap screws (5), the cover (6) and the spool assembly (7).
  - ⌘ Cap screw: 7.3 N·m



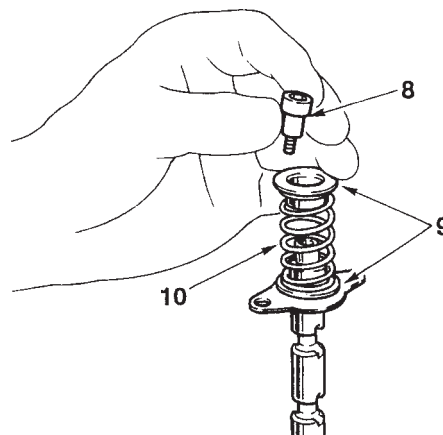
YI-D230

2. Loosen the screw (8) from the spool assembly (7).
  - ⌘ Screw: 5.2 N·m



YI-D231

3. Remove the spring holder (9), spring (10), and spring holder (9).

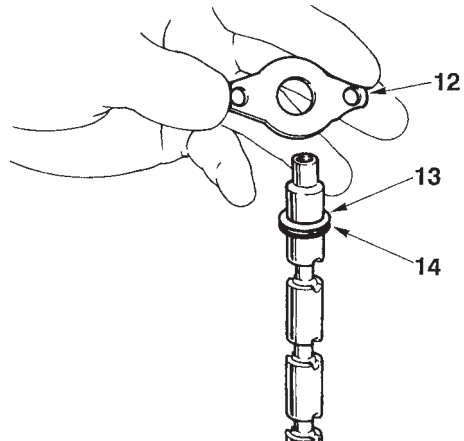


YI-D232

## HYDRAULIC UNITS

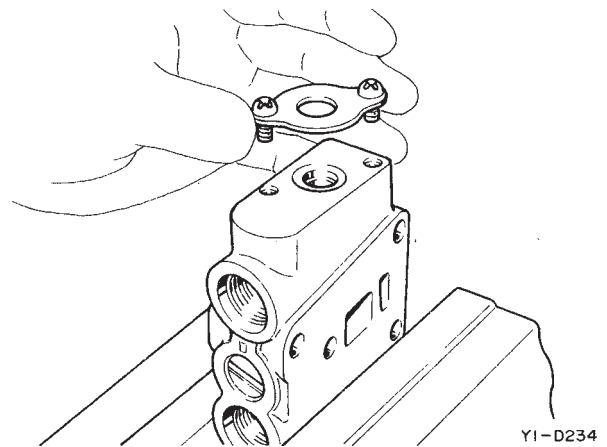
## CONTROL VALVES

4. Remove the seal holder (12), then remove the backup ring (13) and O-ring (14).



5. Remove the screws on the spool yoke end side of the section, then remove the seal holder, backup ring and O-ring.

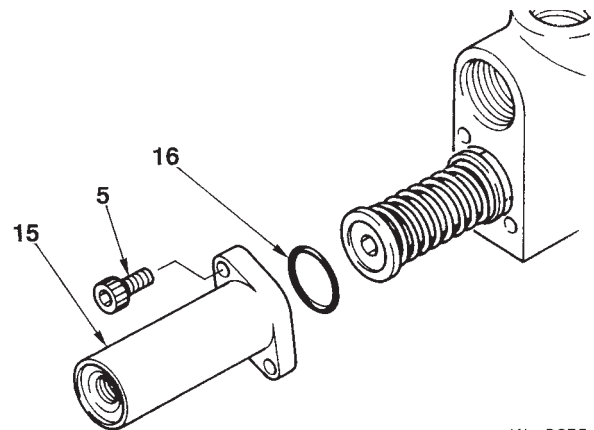
⌘ Screw: 2.5 N·m



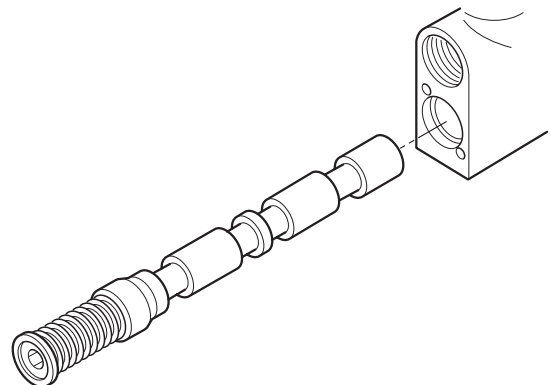
### Pilot Operated Section

1. Take out the cap screw (5) and remove the cover (15), then remove the O-ring (16) from the cover (15).

⌘ Cap screw: 7.3 N·m



2. Remove the spool from the section.

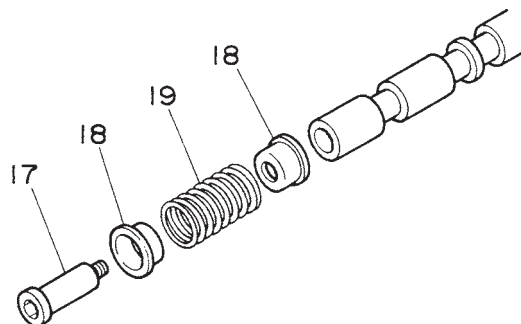


## CONTROL VALVES

## HYDRAULIC UNITS

3. Take out the screw (17) and remove the spring holder (18), spring (19) and spring holder (18).

🔧 Screw: 4.9 N·m

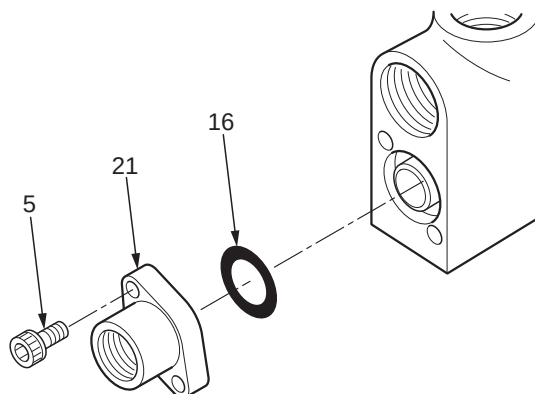


Y1-D237

4. Take out the cap screws (5) and remove the cover (21).

5. Remove the O-ring (16) from the cover (21).

🔧 Cap screw: 7.3 N·m



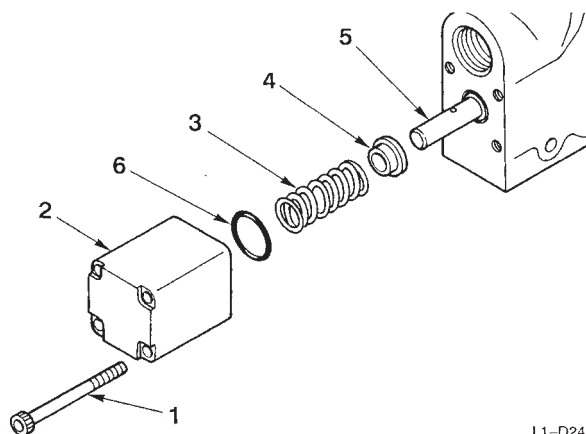
K3D219

### Disassembling the Slew Flow Control Block

1. Remove cap screws (1), then remove cover (2), spring (3), spring holder (4) and spool (5).

🔧 Cap screw: 9.8 N·m

2. Remove O-ring (6) from cover (2).



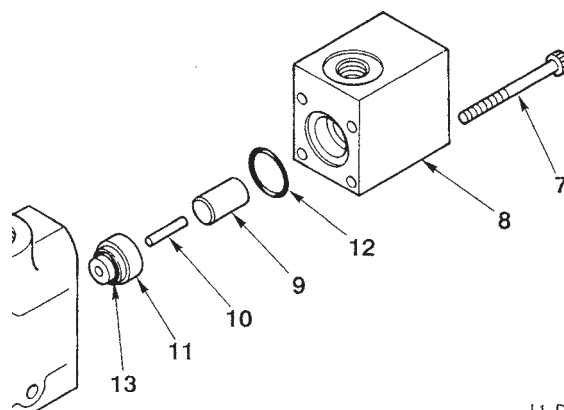
L1-D245

3. From the opposite side of the block, remove cap screws (7), then remove cover (8), piston (9), pin (10) and sleeve (11).

🔧 Cap screw: 9.8 N·m

4. Remove O-ring (12) from cover (8).

5. Remove O-ring (13) from sleeve (11).



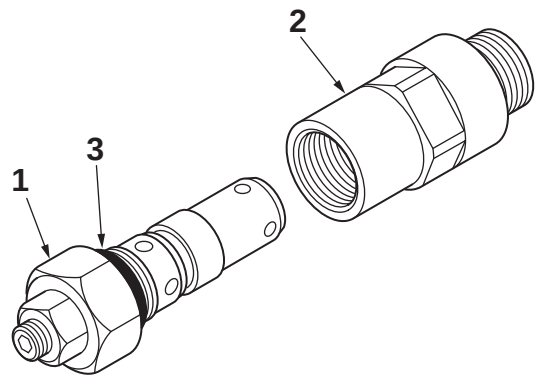
L1-D246

## HYDRAULIC UNITS

## CONTROL VALVES

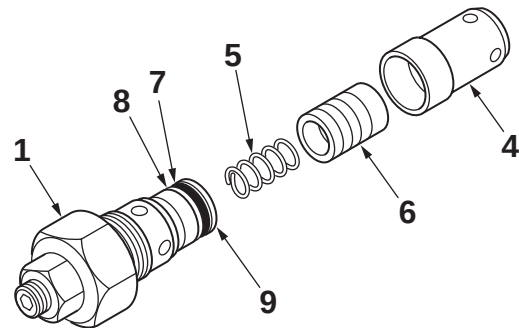
### Main Relief Valve

1. Remove the plug (1) from the housing (2).  
⚙️ Plug: 49~54 N·m
2. Remove the O-ring (3) from the plug (1).



W2D218

3. Remove the sleeve (4) from the plug (1) and remove the spring (5) and main poppet (6) from the sleeve (4).
4. Remove the O-ring (7) and backup ring (8) from the seat (9).

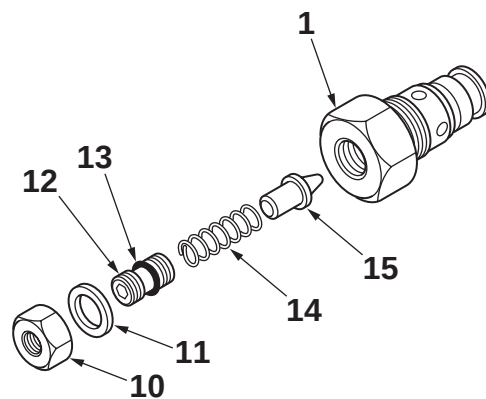


W2D219

5. Remove the lock nut (10), washer (11) and adjusting screw (12) from the plug (1), then remove the O-ring (13) from the adjusting screw (12).
  - During assembly, after installing the adjusting screw (12), lock the lock nut (10) temporarily, then tighten it after adjusting the pressure.

⚙️ Lock nut: 27~31 N·m

6. Remove the spring (14) and needle valve (15).



W2D220

**INSPECTION AND ADJUSTMENT****Checking the Parts**

| Parts                                   | Judgment Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Treatment                                                                                                                                                      |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Housing,<br>Section Body                | <ul style="list-style-type: none"> <li>Scratches, rust, corrosion of the portion which slides against the spool.</li> <li>Scratches, rust, corrosion of the seal pocket portion of the part that enters the spool.</li> <li>Scratches, rust, corrosion of the port seal portion which is in contact with the O-ring.</li> <li>Scratches, rust, corrosion of the seal portion of the relief valve, etc.</li> <li>Other damage which could be a hindrance to correct function.</li> </ul> | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ul>                                  |
| Spool                                   | <ul style="list-style-type: none"> <li>Scratch marks like being clawed around the outer circumference sliding portion.</li> <li>Scratches on the portion that slides against the seals on both ends.</li> <li>Spool not operating smoothly.</li> </ul>                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Repair or replace.</li> </ul>                                                         |
| Load Check Valve                        | <ul style="list-style-type: none"> <li>Imperfect sealing due to damage to the valve or spring.</li> <li>Does not catch, but operates lightly when inserted in the section body and operated.</li> </ul>                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Repair or replace.</li> <li>Normal</li> </ul>                                                                           |
| Around Springs                          | <ul style="list-style-type: none"> <li>Rust, corrosion, deformation, breakage or other marked damage to the spring, holder or cover.</li> </ul>                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Replace</li> </ul>                                                                                                      |
| Around Spool Seal                       | <ul style="list-style-type: none"> <li>Oil leaking to the outside.</li> <li>Rust, corrosion or deformation of the seal holder.</li> </ul>                                                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Repair or replace.</li> <li>Repair or replace.</li> </ul>                                                               |
| Main Relief Valve,<br>Port Relief Valve | <ul style="list-style-type: none"> <li>External rust, damage.</li> <li>Damage to valve seat contact surface.</li> <li>Damage to poppet contact surface.</li> <li>Abnormality in the spring.</li> <li>O-rings, backup rings, seals</li> </ul>                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>As a rule, all these should be replaced.</li> </ul> |

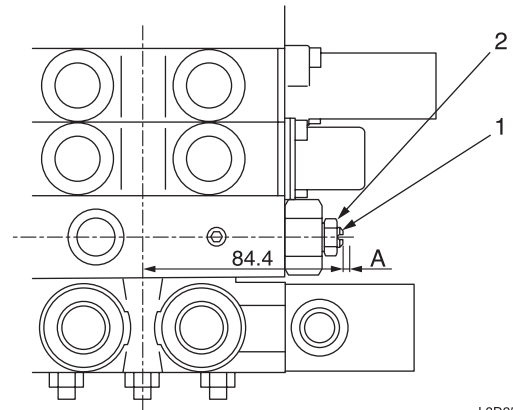
**Adjusting the Main Relief Valve Pressure**

☞ “II. Specifications, Standards for Judging Performance”

### Adjusting The Slow Slew Speed Adjusting Valve

The slow slew speed can be adjusted in the range of 38% to 71%. The slow slew speed has been set to 71% at the factory. (The right figure shows the setting at the factory.)

- Adjustable distance A: 3 mm
- Loosen the lock nut (2) and turn the set screw (1) to fine adjust the slew speed.  
Turning to the left will reduce the speed.  
Turning to the right will increase the speed.
  - Upon completion of the adjustment, tighten the lock nut while holding down the set screw to prevent it from turning.
  - Operate the valve again to confirm that the set screw is stable.



L3D255

### TROUBLESHOOTING

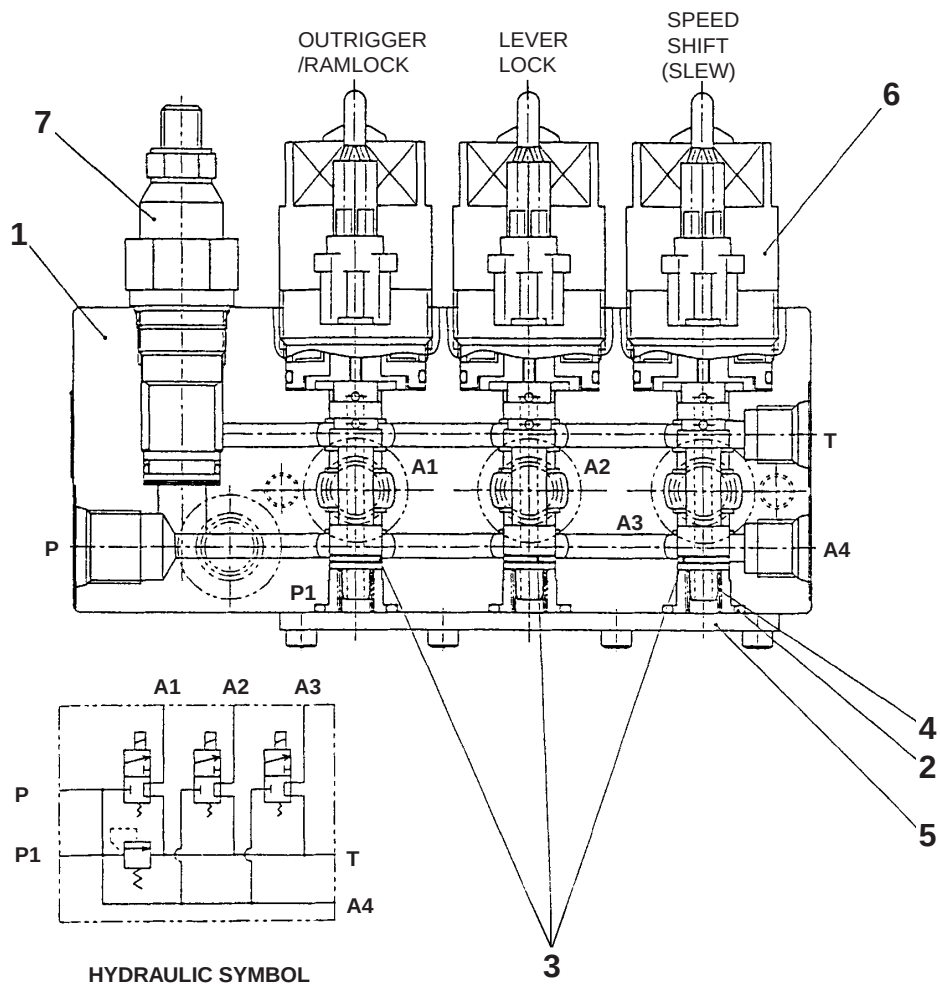
☞ “IV-48~49”

## SOLENOID VALVES

### CONSTRUCTION

#### Solenoid Valve (3-Section)

Ram Lock, Lever Lock and Speed Shift



W2H100E

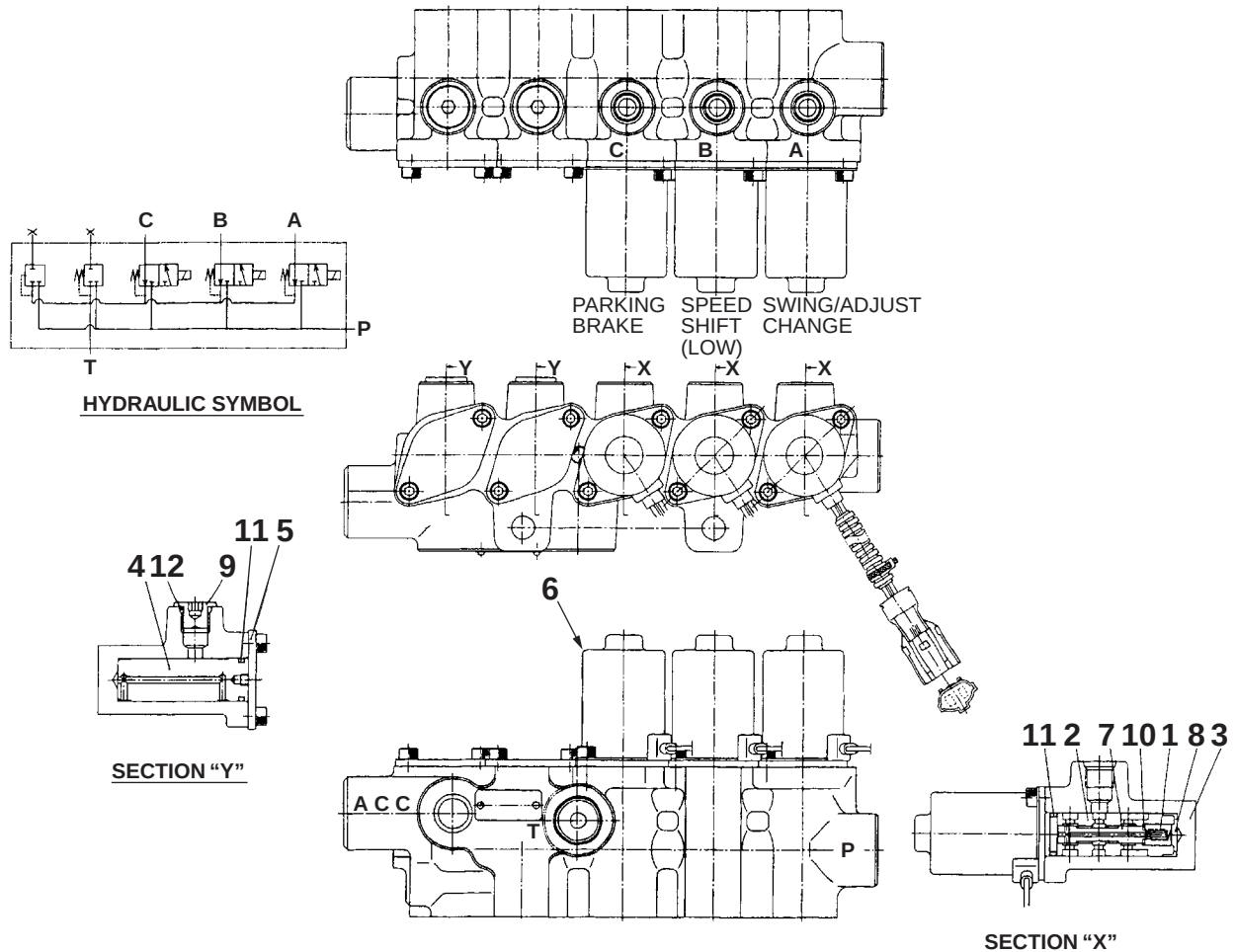
1. Body
2. O-ring
3. Spool
4. Spring
5. Cover
6. Solenoid Valve
7. Relief Valve

## HYDRAULIC UNITS

## SOLENOID VALVES

### Solenoid Valve (3-Section)

Change, Speed Shift and Parking Brake

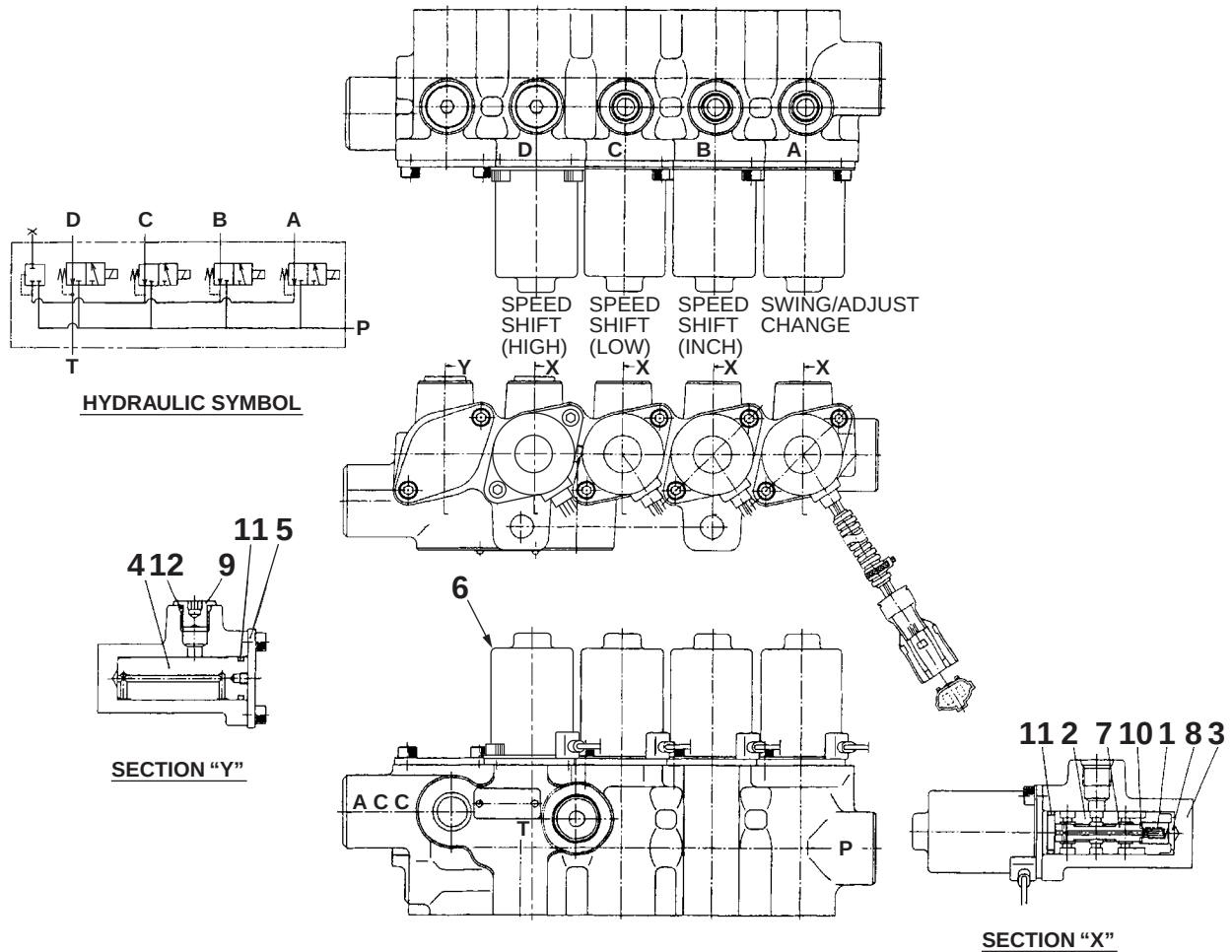


W2H101E



### Solenoid Valve (4-Section)

Change and Speed Shift



W2H102E

- |                   |            |
|-------------------|------------|
| 1. Spring         | 7. Spool   |
| 2. Sleeve         | 8. Stopper |
| 3. Body           | 9. Plug    |
| 4. Rod            | 10. Washer |
| 5. Plate          | 11. O-ring |
| 6. Solenoid Valve | 12. O-ring |

## HYDRAULIC UNITS

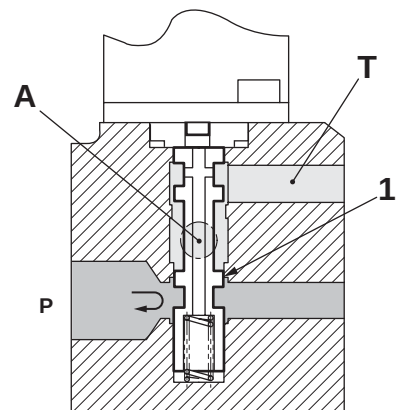
## SOLENOID VALVES

### OPERATION

#### Solenoid Valve

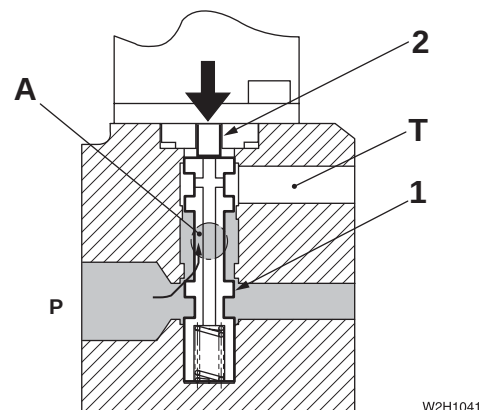
When current is not flowing

Oil at port P is blocked by the spool (1). Also, since port A and port T are connected, the pressure in the pilot circuit downstream becomes the same as the tank pressure.



When current is flowing

A magnetic field is generated around the coil and the plunger (2) is pulled down. This pushes the spool (1) down. As a result, oil at port P flows into port A and pressure is transmitted to the pilot circuit at the bottom.



**DISASSEMBLY AND ASSEMBLY****General Cautions**

- Carry out disassembly and assembly operations in a clean place and place disassembled parts in clean containers.
- Before disassembly, clean thoroughly around the ports and remove paint or thread lock, etc. from all joints with a wire brush.
- Clean all disassembled parts in cleaning solvent. Use a lint free cloth, or air dry the parts.

- The spool and body are selectively fitted, so if one is found to be damaged, replace the valve assembly.
- Apply a thin coating of hydraulic oil to sliding surfaces and a thin coating of grease to seals when assembling them.
- Replace seals with new parts each time disassembly is done.
- Do not turn adjusting screws if not required.

Following is a description of the solenoid valve block disassembly procedure. Reassemble the solenoid valve block by following this procedure in reverse order.

**Solenoid Valve (3-Section)**

Ram Lock, Lever Lock and Slew Shift

1. Fix the housing and remove the solenoid valve (1).

☞ Solenoid valve:  $44 \pm 5 \text{ N}\cdot\text{m}$

2. Remove the socket bolt, and then remove the cover (2).

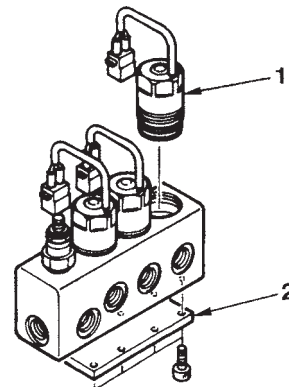
☞ Cap screw:  $3.4 \pm 0.5 \text{ N}\cdot\text{m}$

3. Remove the spring (3) and the spool (4).

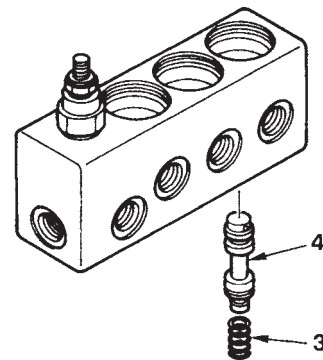
- Pull out the spool slowly, and take care not to scratch or dent the circumference.
- At the time of reassembly, the spool must be installed in the same housing hole.

4. Remove the relief valve.

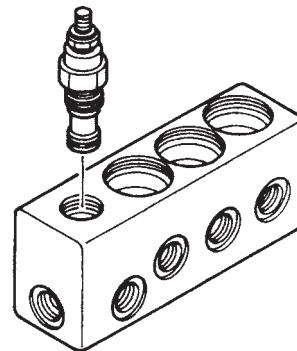
☞ Relief valve:  $44 \pm 5 \text{ N}\cdot\text{m}$



Y3-D803



Y3-D804



Y3-D805

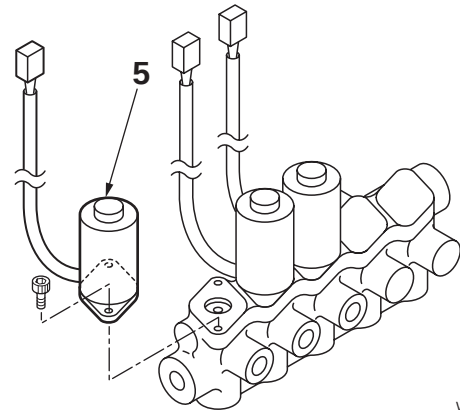
## HYDRAULIC UNITS

## SOLENOID VALVES

### Solenoid Valve (3-Section)

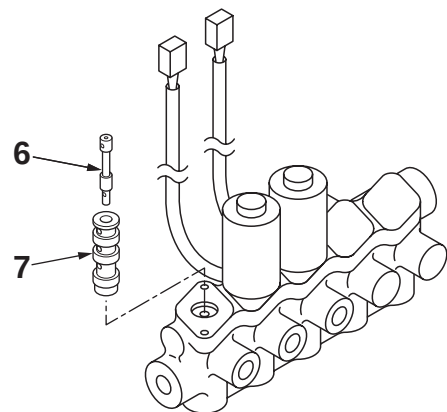
#### Change, Speed Shift and Parking Brake

1. Loosen the cap screws and remove the solenoid coil (5).
  - Put matching marks on the solenoid and the body so that they can be aligned when assembling.
  - Take care not to miss the push rod.
2. Remove the O-ring from the solenoid coil (5).



W2H105

3. Remove the spool (6) and sleeve (7) from the body.
  - Record the positions of the spool, sleeve and the body hole so that they can be aligned when assembling.
  - To take out the spool, hook the small orifice at the end of the spool using a tool such as a scriber.
  - To remove the sleeve, turn the body upside down and lightly tap it.

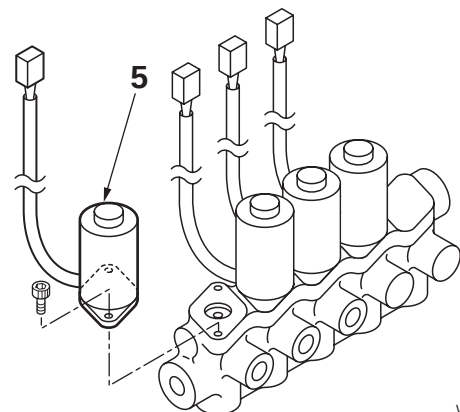


W2H106

### Solenoid Valve (4-Section)

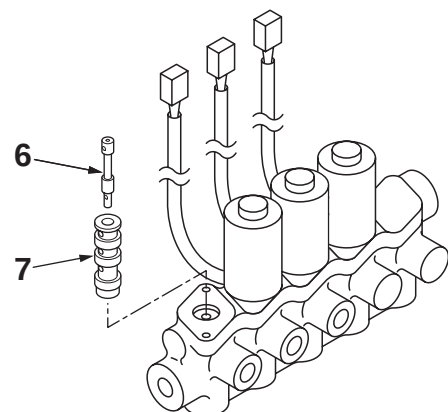
#### Change and Speed Shift

1. Loosen the cap screws and remove the solenoid coil (5).
  - Put matching marks on the solenoid and the body so that they can be aligned when assembling.
  - Take care not to miss the push rod.
2. Remove the O-ring from the solenoid coil (5).



W2H107

3. Remove the spool (6) and sleeve (7) from the body.
  - Record the positions of the spool, sleeve and the body hole so that they can be aligned when assembling.
  - To take out the spool, hook the small orifice at the end of the spool using a tool such as a scriber.
  - To remove the sleeve, turn the body upside down and lightly tap it.



W2H108

## SOLENOID VALVES

## HYDRAULIC UNITS

## INSPECTION AND ADJUSTMENT

## Checking the Parts

| Parts          | Judgment Criteria                                                                                                                                                                                                                                                      | Treatment                                                                                   |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Solenoid coil  | <ul style="list-style-type: none"> <li>When the solenoid is burned, short-circuited, or has a wire break</li> <li>Wiring short-circuit or wire break</li> </ul>                                                                                                        | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> </ul>                  |
| Body           | <ul style="list-style-type: none"> <li>Scratches, rust, or corrosion at the sliding parts with the spool</li> <li>Scratches, rust, or corrosion of the seal part in contact with the O-ring</li> <li>Other damage considered to impair the normal functions</li> </ul> | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ul> |
| Spool, plunger | <ul style="list-style-type: none"> <li>Damage on the outer circumference which catches a fingernail</li> <li>No smooth movement</li> </ul>                                                                                                                             | <ul style="list-style-type: none"> <li>Replace</li> <li>Adjust or replace</li> </ul>        |
| Spring         | <ul style="list-style-type: none"> <li>Rust, corrosion, deformation, breakage, or other notable damage</li> </ul>                                                                                                                                                      | <ul style="list-style-type: none"> <li>Replace</li> </ul>                                   |
| O-Ring         | —                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Replace</li> </ul>                                   |

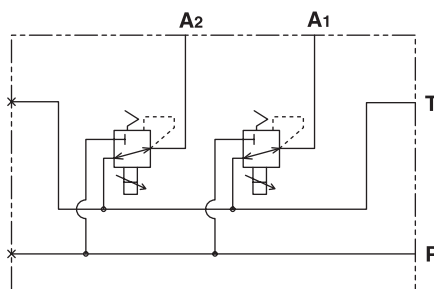
## TROUBLESHOOTING

| Symptom                                                                 | Probable Causes                                                                                                                                                                                                                                                                                                                                               | Remedy                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Solenoid valve does not operate.                                        | <ul style="list-style-type: none"> <li>Wiring short-circuit or wire break</li> <li>Solenoid coil short-circuit or wire break</li> <li>Catching of foreign matter by the spool</li> <li>Damage on the outer circumference of the spool</li> <li>Catching of foreign matter by the plunger</li> <li>Damage on the outer circumference of the plunger</li> </ul> | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Overhaul and repair or replace.</li> <li>Overhaul and repair or replace.</li> <li>Overhaul and repair or replace.</li> <li>Overhaul and repair or replace.</li> </ul> |
| Oil leakage from solenoid valve, cover, or relief valve to the outside. | <ul style="list-style-type: none"> <li>Damaged O-ring</li> <li>Damaged O-ring at the emergency manual button of the solenoid valve</li> </ul>                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> </ul>                                                                                                                                                                     |
| Pressure does not rise.                                                 | <ul style="list-style-type: none"> <li>Catching of foreign matter by the relief valve</li> </ul>                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Clean or replace.</li> </ul>                                                                                                                                                                            |

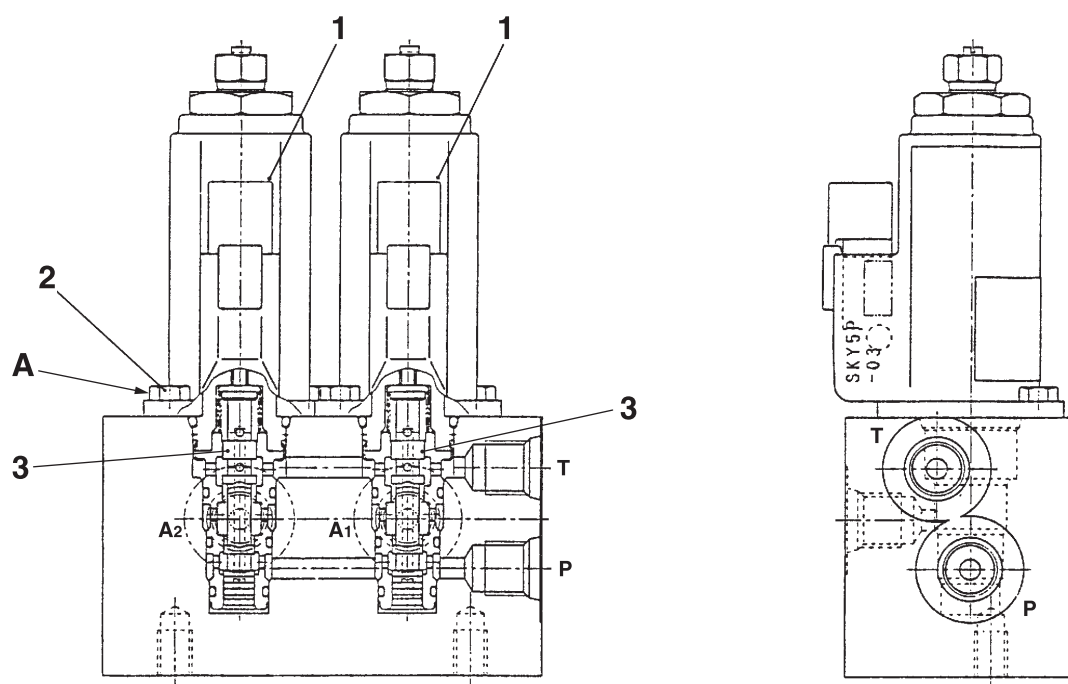


## PROPORTIONAL CONTROL SOLENOID VALVE

### CONSTRUCTION



HYDRAULIC SYMBOL



T9H200E

A:  $\Rightarrow 7 \pm 0.5 \text{ N}\cdot\text{m}$

1. Proportional Control Solenoid
2. Bolt
3. Spool

## HYDRAULIC UNITS

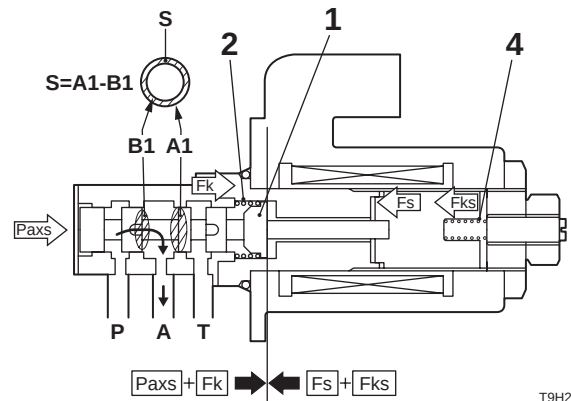
## PROPORTIONAL CONTROL SOLENOID VALVE

### OPERATION PRINCIPLE

This valve controls the secondary pressure by using the built-in proportional pressure reducing valve. The secondary pressure of this valve is proportional to the magnitude of electric current flowing in the valve, because the force to generate the secondary pressure is applied by the solenoid based on the current passing through the coil.

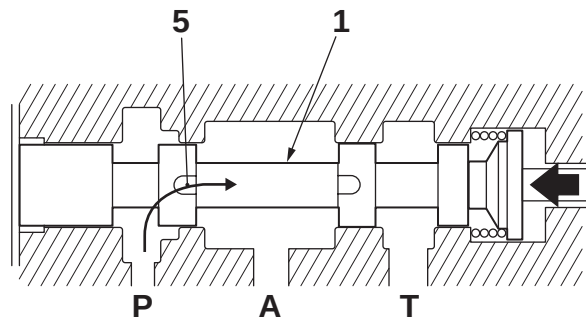
When a current flows in the solenoid, a thrust force proportional to the current is generated and moves the spool (1) so that the oil supplied from Port P is led to the secondary pressure side Port A, thus increasing pressure  $P_a$  of Port A.

Pressure  $P_a$  is a function of the differential area  $S$  between the cross sections  $A1$  and  $B1$  of the spool (1), and the spool (1) is pushed to the solenoid side by the oil pressure  $P_a \times S$ . The spool (1) stops at a position where the sum of the oil pressure  $P_a \times S$  and the force  $F_k$  exerted by the springs (2) is balanced with the thrust force  $F_s$  generated by the solenoid. The weight  $F_{ks}$  of the spring (4) for fine adjustment of the secondary pressure acts in the direction (left) to help the thrust force from the solenoid.



T9H201

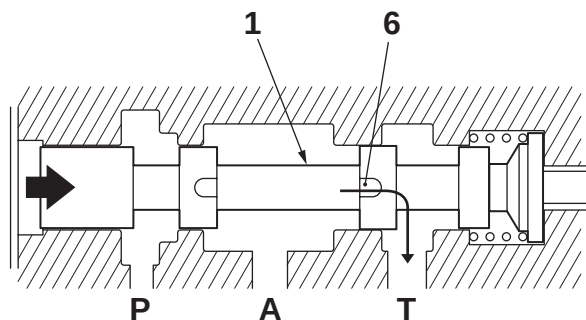
When the thrust force is larger than the set value, the spool (1) is moved to the left, connecting Port P (primary, supply side) and Port A (secondary, discharge side) through the notch (5).



T9H202

When the thrust force is smaller than the set value, the spool (1) is moved to the right, connecting Port A (secondary, discharge side) and Port T (outlet to tank) through the notch (6).

Therefore, the opening areas of the supply side notch (5) and discharge side notch (6) are controlled by the movement of the spool (1), and secondary (pilot) pressure created by the thrust force generated by the solenoid can be provided.



T9H203



## DISASSEMBLY AND ASSEMBLY

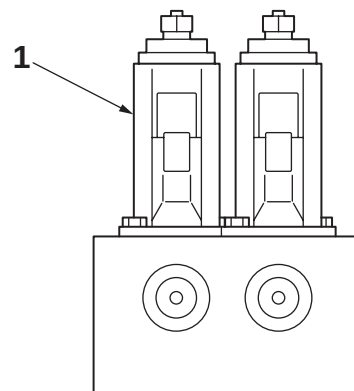
### General Cautions

- Carry out disassembly and assembly operations in a clean place and place disassembled parts in clean containers.
- Before disassembly, clean thoroughly around the ports and remove paint or thread lock, etc. from all joints with a wire brush.
- Clean disassembled parts with light oil or other cleaning oil.
- The spool and body are selectively fitted, so if one is found to be damaged, replace the valve assembly.
- Apply a thin coating of hydraulic oil to sliding surfaces and a thin coating of grease to seals when assembling them.
- Replace seals with new parts each time disassembly is done.

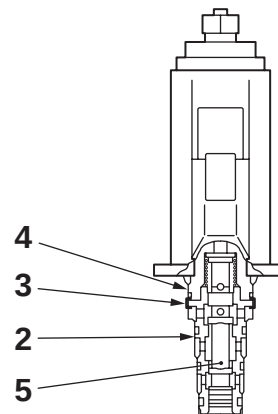
The following describes the disassembly procedure. For assembly, follow the disassembly procedure in the reverse order.

### Disassembly

1. Remove the bolts, and then remove the proportional control solenoid (1).  
 Bolt:  $6.9 \pm 1 \text{ N}\cdot\text{m}$
2. Remove the O-rings from the proportional control solenoid (1).
  - Do not disassemble the sleeve (2) that is swaged onto the solenoid (4) with the retaining ring (3).
  - Make sure that the spool (5) moves a little if pushed from the sleeve (2) end.



T9H204



T9H205

**HYDRAULIC UNITS****PROPORTIONAL CONTROL SOLENOID VALVE****INSPECTION AND ADJUSTMENT****Checking the Parts**

| Part          | Judgment Criteria                                                                                                                                                                                                                                                            | Treatment                                                                                         |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Coil assembly | <ul style="list-style-type: none"> <li>• When the solenoid is burned, short-circuited, or has a wire break</li> <li>• Wiring short-circuit or wire break</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> </ul>                    |
| Housing       | <ul style="list-style-type: none"> <li>• Scratches, rust, or corrosion at the sliding parts with the spool</li> <li>• Scratches, rust, or corrosion of the seal part in contact with the O-ring</li> <li>• Other damage considered to impair the normal functions</li> </ul> | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> <li>• Replace</li> </ul> |
| Spool         | <ul style="list-style-type: none"> <li>• Damage on the outer circumference which catches a finger-nail</li> <li>• No smooth movement</li> </ul>                                                                                                                              | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Adjust or replace</li> </ul>          |
| Spring        | <ul style="list-style-type: none"> <li>• Rust, corrosion, deformation, breakage, or other notable damage</li> </ul>                                                                                                                                                          | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |
| O-ring        | —                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |

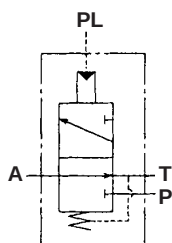
**TROUBLESHOOTING**

| Symptom                         | Main Causes                                                                                                                                                                                                                                                                                                                                           | Remedy                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Solenoid valve does not operate | <ul style="list-style-type: none"> <li>• Wiring short-circuit or wire break</li> <li>• Coil assembly short-circuit or wire break</li> <li>• Catching of foreign matter by the spool</li> <li>• Damage on the outer circumference of the spool</li> <li>• Defective the proportional controller</li> <li>• Primary pressure is insufficient</li> </ul> | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> <li>• Overhaul and repair or replace</li> <li>• Overhaul and repair or replace</li> <li>• Repair or replace</li> <li>• Keep the primary pressure</li> </ul> |
| Oil leakage from solenoid valve | <ul style="list-style-type: none"> <li>• Damaged O-ring</li> <li>• Damaged seal nut</li> </ul>                                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> </ul>                                                                                                                                                       |

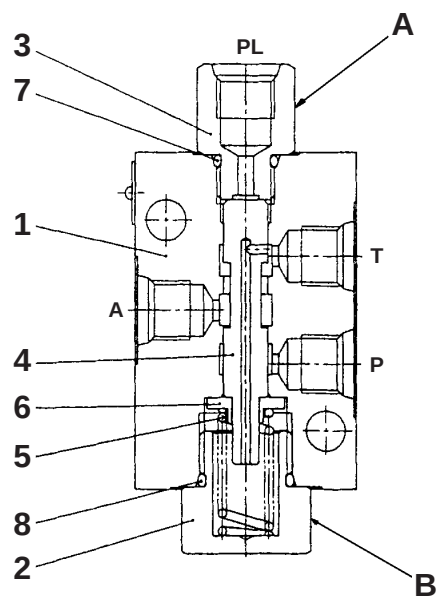
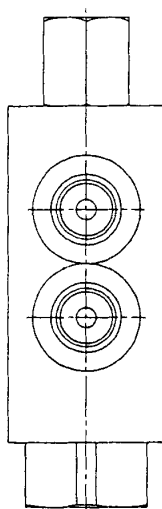
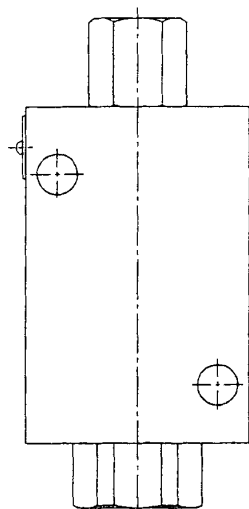
## SELECTOR VALVE

### CONSTRUCTION

#### Pilot Change



HYDRAULIC SYMBOL



A:  $\Rightarrow$  26.5 N·m  
B:  $\Rightarrow$  70.6 N·m

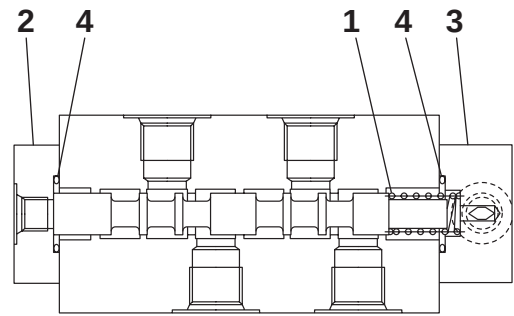
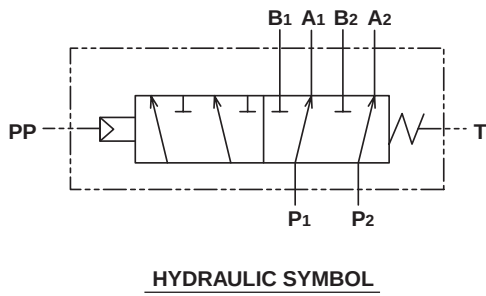
W2H300

- |              |             |
|--------------|-------------|
| 1. Body      | 5. Spring   |
| 2. Plug      | 6. Retainer |
| 3. Connector | 7. O-ring   |
| 4. Spool     | 8. O-ring   |

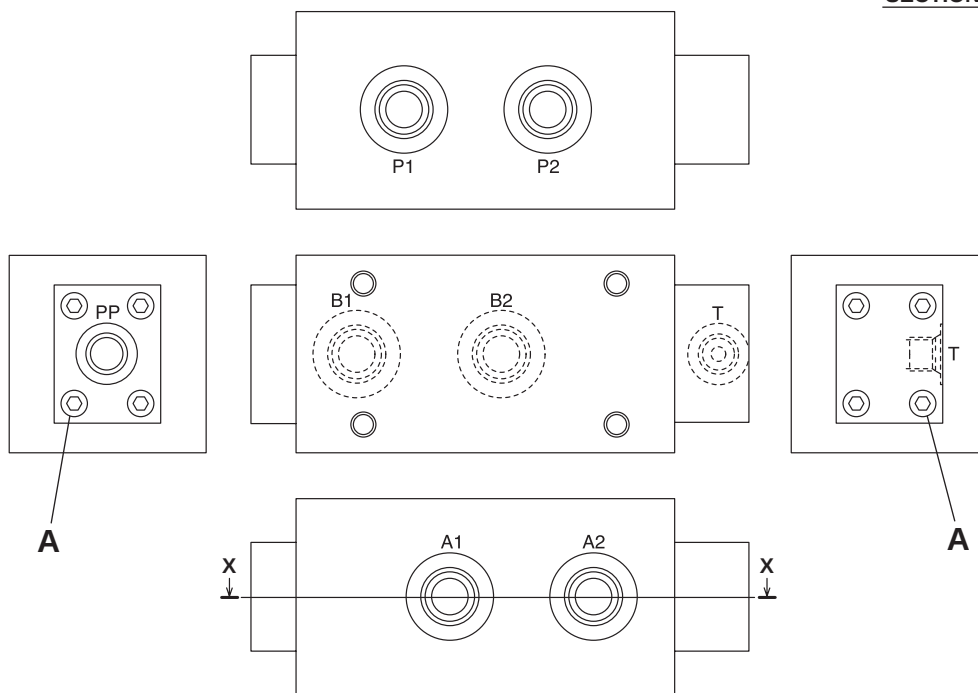
## HYDRAULIC UNITS

## SELECTOR VALVE

### Swing/Adjust Change



**SECTION "X-X"**



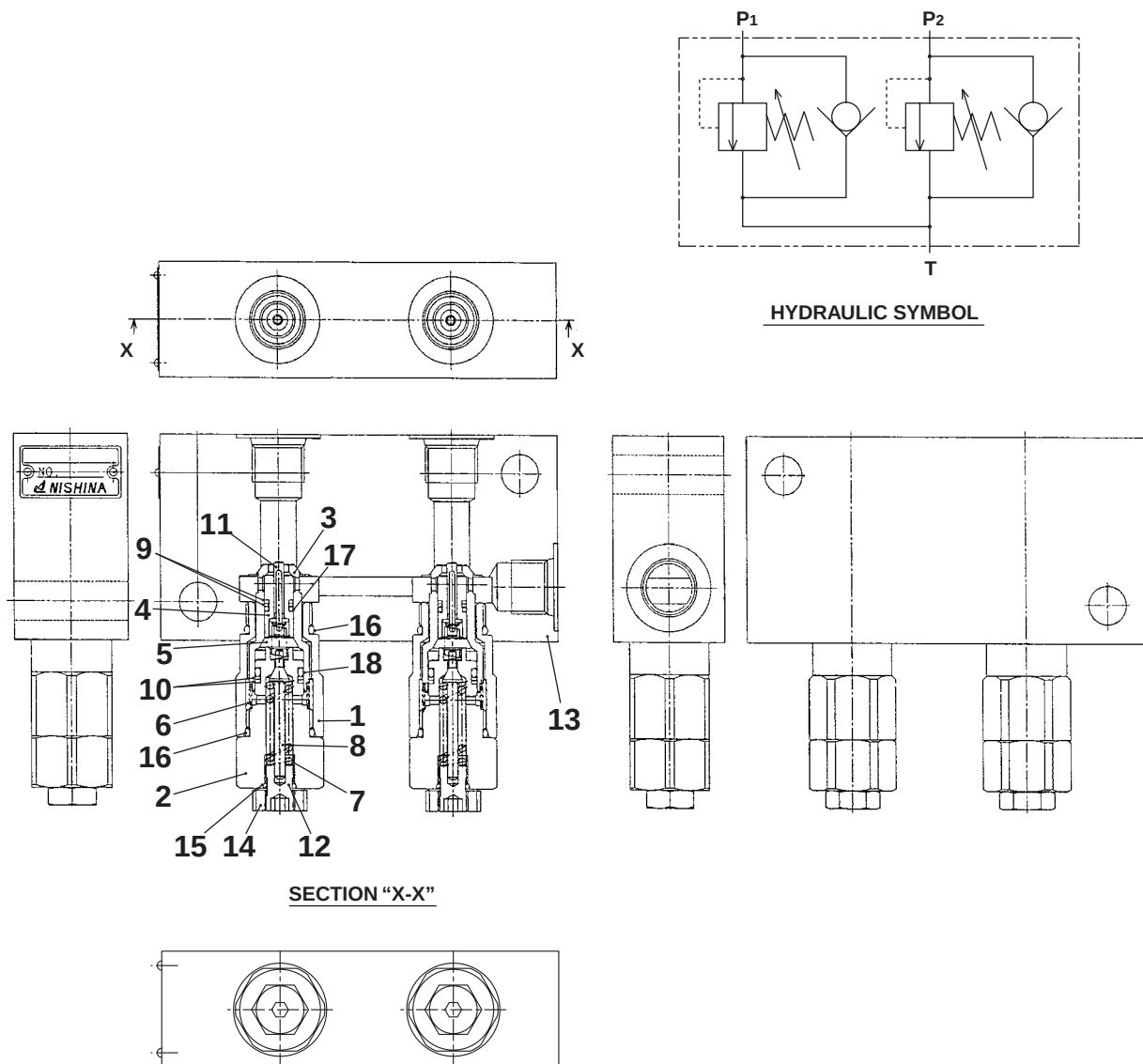
A: 9.8 N·m

W2H301E

1. Spring
2. Cover
3. Cover
4. O-ring

## PORT RELIEF VALVE

### CONSTRUCTION



W2H400E

- |                 |                     |
|-----------------|---------------------|
| 1. Housing      | 10. Backup Ring     |
| 2. Plug         | 11. Pin             |
| 3. Sleeve       | 12. Adjusting Screw |
| 4. Main Poppet  | 13. Body            |
| 5. Spring       | 14. Lock Nut        |
| 6. Spring       | 15. O-ring          |
| 7. Spring       | 16. O-ring          |
| 8. Needle Valve | 17. O-ring          |
| 9. Backup Ring  | 18. O-ring          |

## OPERATION

☞ “IV-58~59”

## DISASSEMBLY AND ASSEMBLY

### General Cautions

☞ “IV-60”

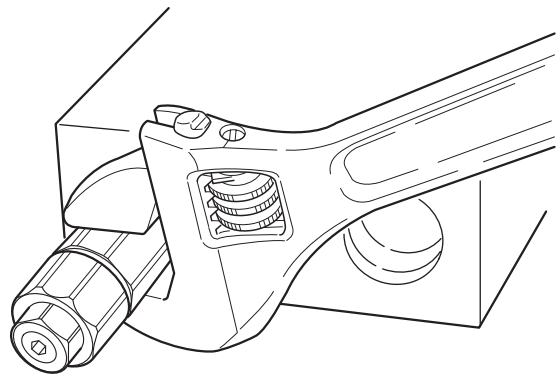
Following is an explanation of the relief valve disassembly procedure.

Follow the procedure used to disassemble the relief valve in reverse order when reassembling it.

### Disassembly

1. Remove the port relief valves, then remove the O-rings from the relief valves.
  - Do not disassemble the relief valves unless it is necessary.
  - When using a spanner or adjustable wrench, be sure to attach it in the place shown in the figure at right.

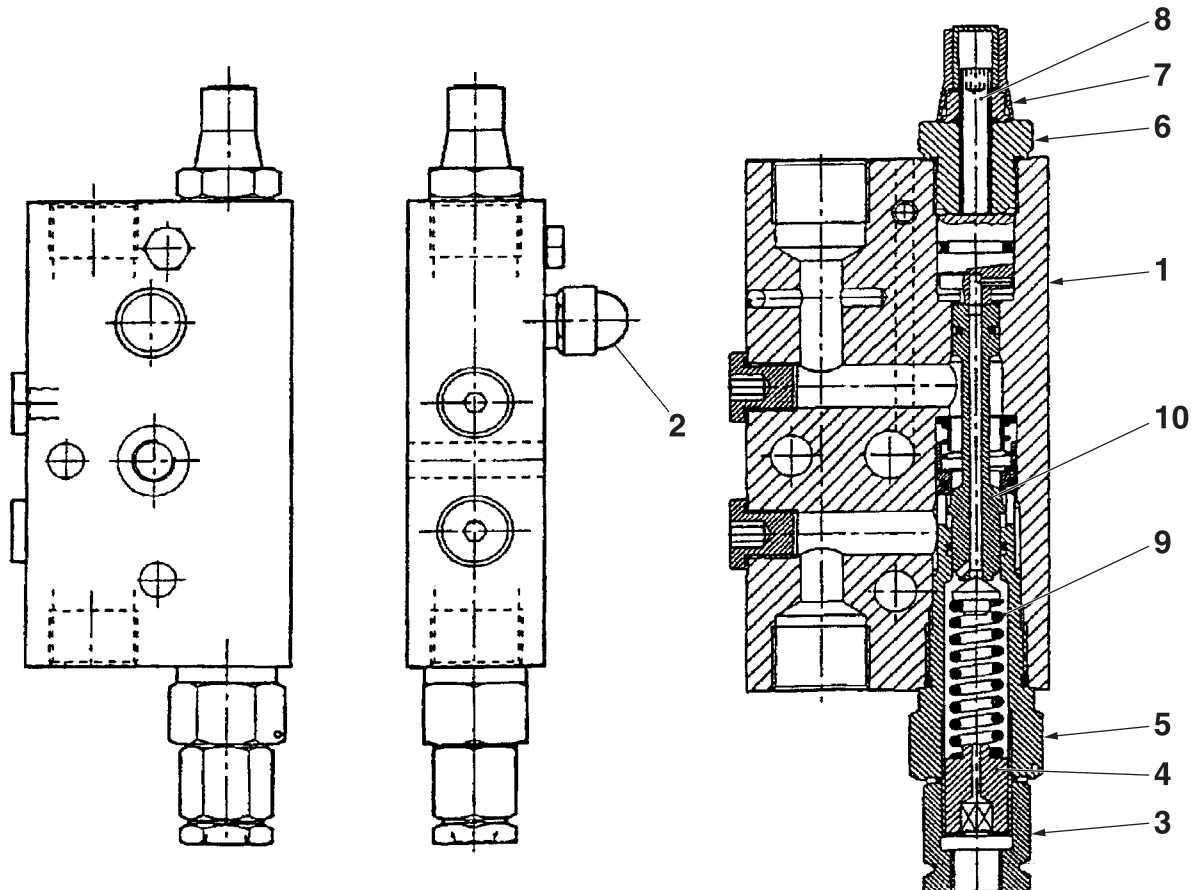
☞ Relief valve: 58.84 N·m



W2H401

## SHUT-OFF VALVES

### CONSTRUCTION



W2H6001

- |                 |                    |
|-----------------|--------------------|
| 1. Body         | 6. Plug            |
| 2. Relief Valve | 7. Lock Nut        |
| 3. Plug         | 8. Adjusting Screw |
| 4. Screw        | 9. Spring          |
| 5. Plug         | 10. Spool          |

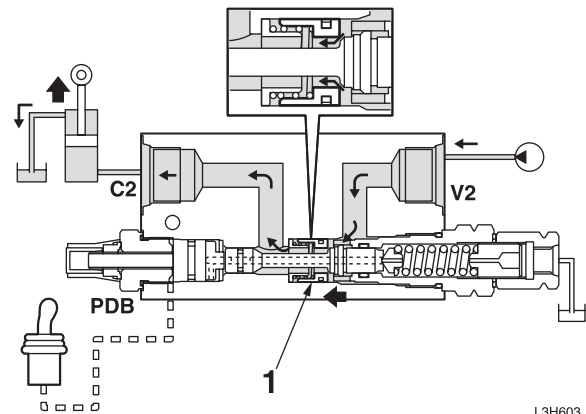
## HYDRAULIC UNITS

## SHUT-OFF VALVES

### OPERATION

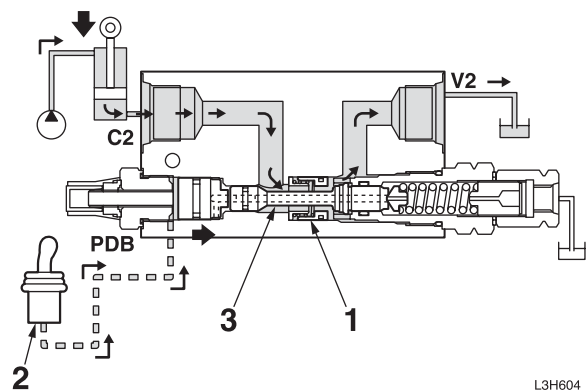
The isolation valve prevents the boom or arm being raised from falling. If the hydraulic hose breaks, the valve blocks and isolates the hydraulic oil flowing to the cylinder head.

When the boom or arm is raised, the pressure oil from the hydraulic pump flows through the port V2 to push up the check valve (1) and then through the port C2 into the boom or arm cylinder.



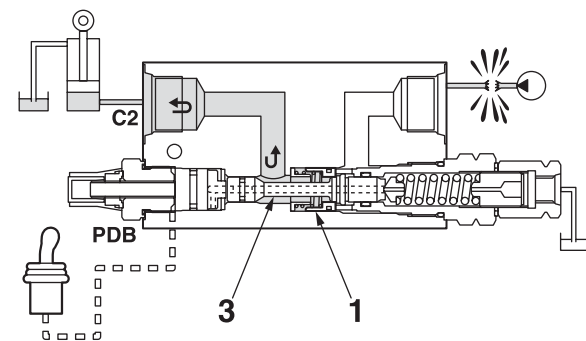
L3H603

When the boom or arm is lowered, the pilot pressure from the pilot valve (2) is led to the port PDB. The pilot pressure in the port PDB moves the spool (3) to the left. The return oil from the cylinder flows from the port C2 to the passage through the spool (3) and the check valve (1), the port V2 and into the tank passage.



L3H604

The boom or arm does not fall in case of hydraulic hose breakage, because the oil flow leading to the boom or arm is blocked and isolated in the passage through the check valve (1) and the spool (3) if a hose breaks.



L3H605



**INSPECTION AND ADJUSTMENT**

Never adjust the adjuster screws on the isolation valve. Otherwise, the valve may not work properly, or the boom or arm may fall.

## TROUBLE SHOOTING

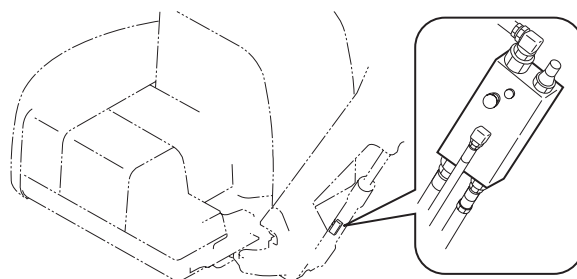
When the hose of the boom or arm cylinders are ruptured and the boom or arm falls, the emergency shut-off valve is activated and stops the boom or arm part way through the fall.

### **⚠ WARNING**

If the boom or arm drops and the emergency shut-off valves are activated, immediately move away from the suspended object.

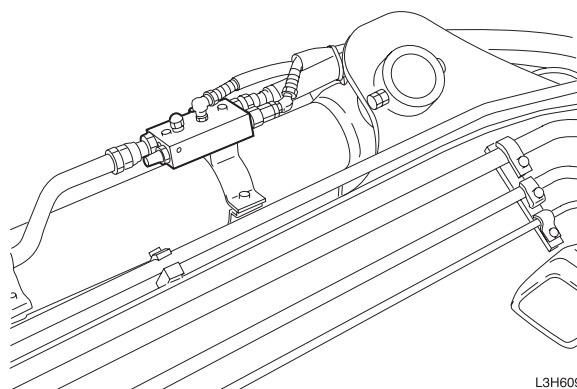
If the engine can be started, the boom or arm can be lowered with the operating lever. Check for safety, then slowly lower the boom or arm.

If the engine cannot be started, the boom or arm can be lowered using the procedure described below.

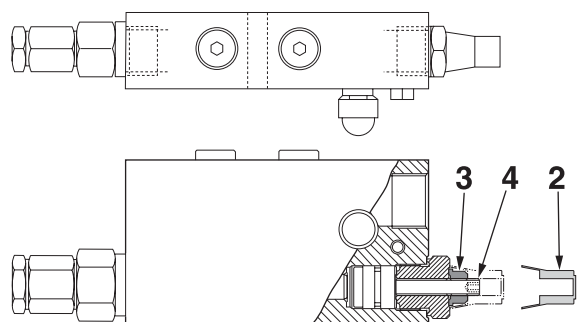


L3H608

1. Check for safety in the working area and for stability of the machine and lifted load.
2. Remove the cap (2).
3. Loosen the lock nut (3).
4. Tighten the stem (4) to lower the boom or arm.
5. Check for stability of the hoe attachment and load.
6. Loosen the stem (4) secure it with the lock nut (3).



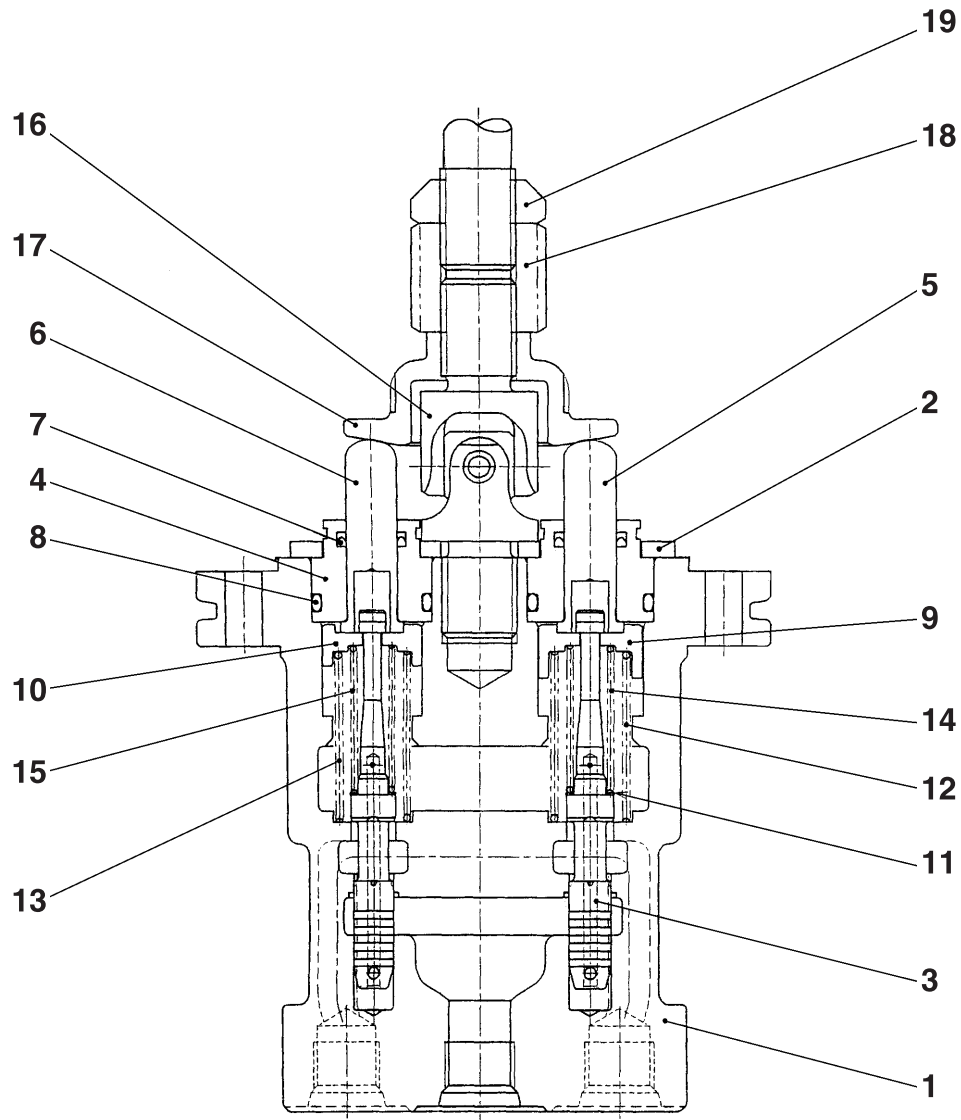
L3H609



L3H610

## PILOT VALVE

### CONSTRUCTION



L3D354

- |                 |                   |
|-----------------|-------------------|
| 1. Casing       | 11. Washer 2      |
| 2. Plate        | 12. Spring        |
| 3. Spool        | 13. Spring        |
| 4. Plug         | 14. Spring        |
| 5. Push Rod     | 15. Spring        |
| 6. Push Rod     | 16. Joint         |
| 7. Seal         | 17. Disc          |
| 8. O-ring       | 18. Adjusting Nut |
| 9. Spring Seat  | 19. Lock Nut      |
| 10. Spring Seat |                   |

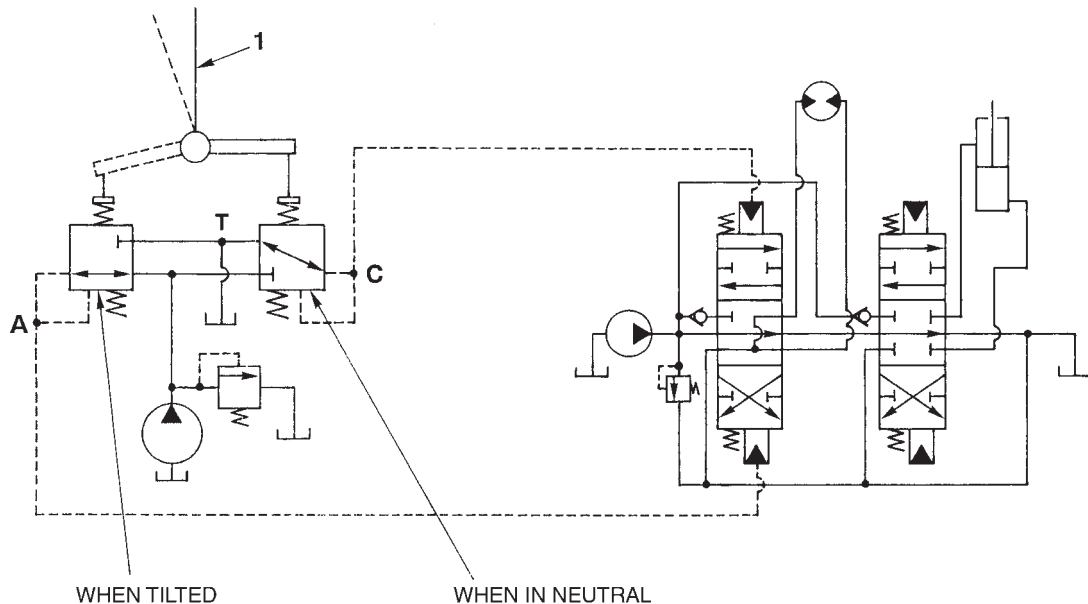
## PILOT VALVE

## HYDRAULIC UNITS

## OPERATION

The pilot valve casing contains a vertical shaft hole with a reducing valve incorporated into it. When the handle is tilted, the push rod and spring seat are pushed down changing the secondary pressure spring's pressure.

The casing also contains an inlet port for hydraulic oil port P (primary pressure) and an outlet port, port T (tank) and secondary pressure is taken from 4 ports, port 1, port 2, port 3 and port 4, on the bottom of the vertical shaft hole.



Y1-D301E

## When the Handle is in Neutral

In this case, the force of the secondary pressure setting spring, which determines the pilot valve's output pressure (secondary pressure), is not transmitted to the spool. Therefore, the spool is pushed up by the return spring and is in the output port C position shown above, with oil not flowing between port P and the output port C but flowing between the T port and output port C.

## When the Handle is Tilted

When the handle (1) is tilted and the push rod is pushed, the spool moves downward and port P and port A are joined. The oil in the pilot valve pump flows out to port A, generating pressure.

- When the pressure in port A is the same as the set force of the spring (set pressure), there is a balance between the hydraulic pressure and the spring force.
- When the pressure in port A is greater than the set pressure, port A and port P close and port A and port T open.
- When the pressure at port A is lower than the set pressure, port A and port P open and port A and port T close.

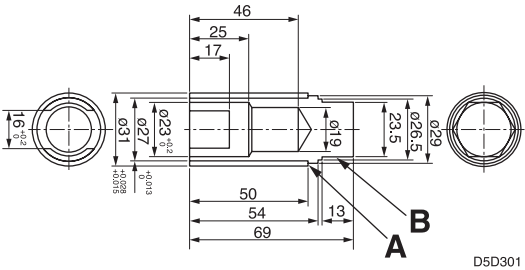
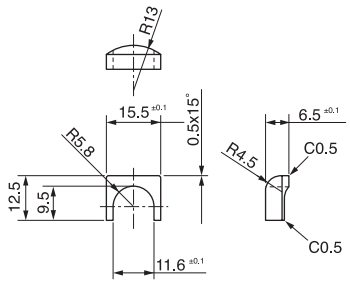
In this way, the secondary pressure is kept constant.

## HYDRAULIC UNITS

## PILOT VALVE

## DISASSEMBLY AND ASSEMBLY

Table of Special Tools

| NAME, DIMENSION                                                                                                                                                                        | Q'ty | NAME, DIMENSION                                                                                                                                                     | Q'ty |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>INSTALLATION JIG (A)</b><br><br>MATERIAL A; S45C<br>MATERIAL B; SCM415N WITH CEMENTATION HARDENING | 1    | <b>INSTALLATION JIG (B)</b><br><br>MATERIAL B; SCM415N WITH CEMENTATION HARDENING | 2    |

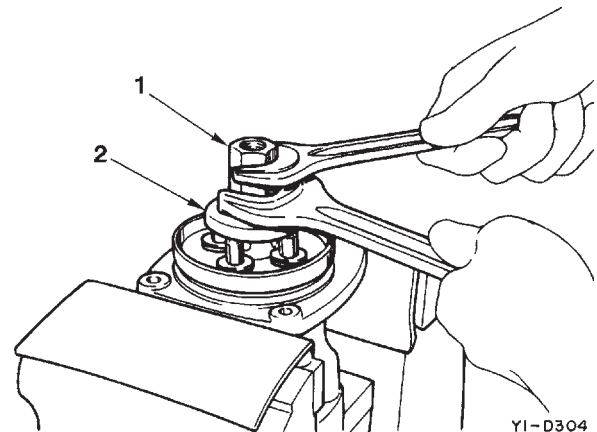
## General Cautions

- Since all parts in the pilot valve are precision machined, carry out disassembly and reassembly operations in a clean place and take special care not to scratch the parts.
- Before disassembly, clean the outside surfaces of the pilot valve.
- Clean each of the disassembled parts and apply clean hydraulic oil to them.

- Replace all seals with new ones each time the pilot valve is disassembled.
- During assembly, remove all the foreign matter from each part and check them to make sure there are no burrs, bruises using or other marks on them. Remove all burrs and bruises using an oil stone.
- Apply thin coating of grease to seals when assembling them.

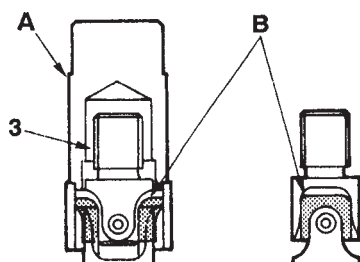
## Disassembly

1. Remove the lock nut and the adjust nut (1), then remove the disc (2).
  - Using copper or lead plates, fasten the valve in a vise.

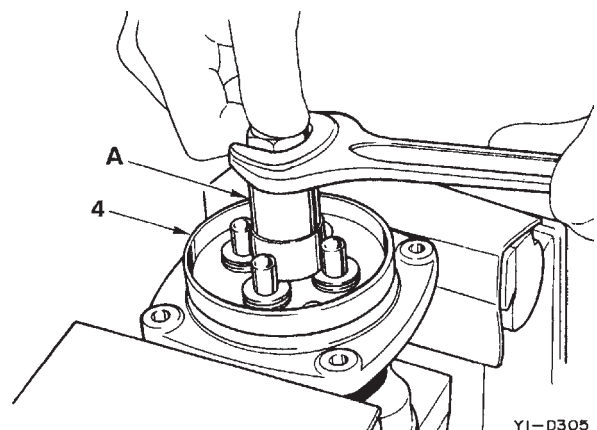


YI-D304

2. Remove the joint (3), then remove the plate (4).
  - Use installation jigs (A) and (B).



Y2-D306

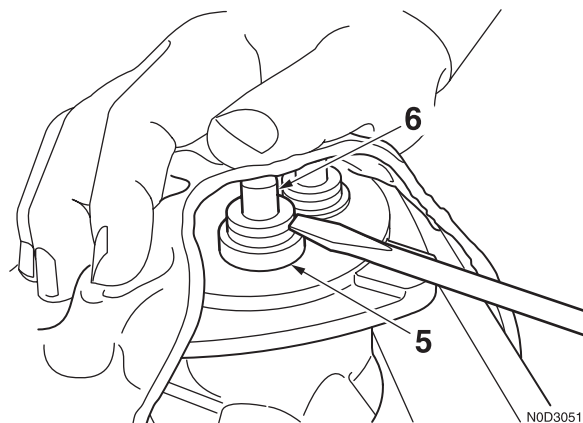


YI-D305

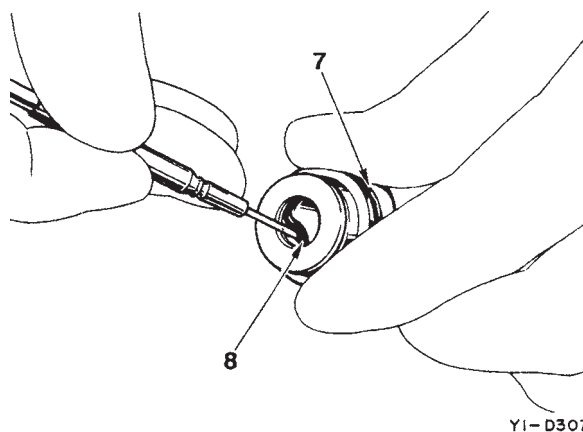
## PILOT VALVE

## HYDRAULIC UNITS

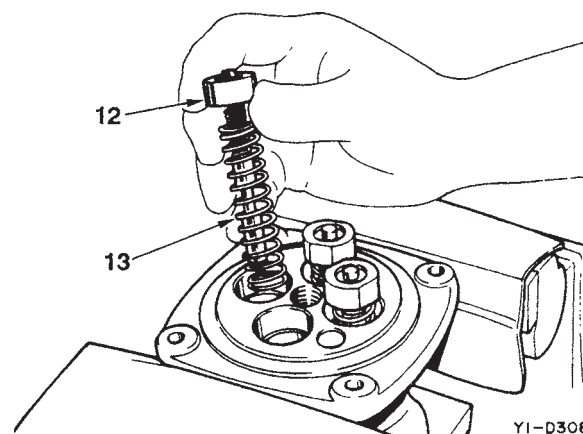
3. Take out the plug (5) then remove the push rod (6) from the plug (5).
  - If the plug is difficult to remove, use (–) screw driver to remove it.
  - Be careful not to let the plug fly out from the spring's force.



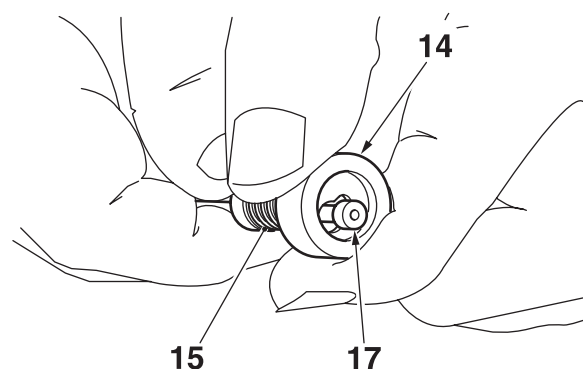
4. Remove the O-ring (7) and seal (8) from the plug.



5. Remove the reducing valve (12) and spring (13).
  - Make match marks on the reducing valve and casing hole so they can be placed in the same position when they are reassembled.



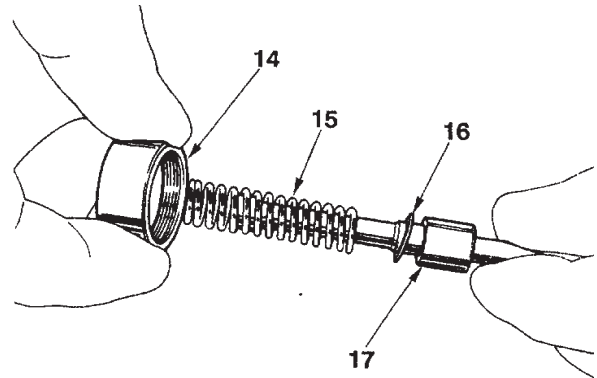
6. Disassemble the reducing valve.
  - a. Push in the spring sheet (14) to contract the spring (15), and move the spool (17) from the small hole to the large hole of the spring sheet (14).
    - Do not push in the spring sheet too far (at most 6 mm).



## HYDRAULIC UNITS

## PILOT VALVE

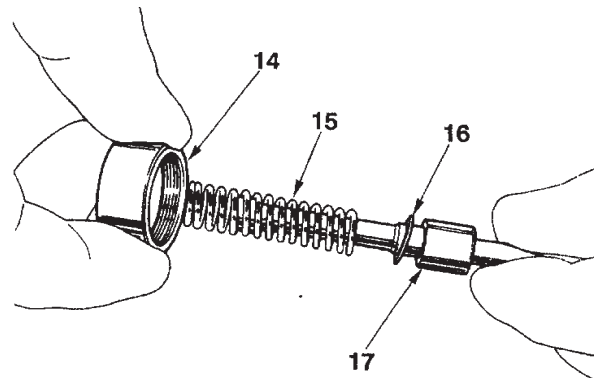
- b. Remove the spring seat (14), spring (15) and washer 2 (16) from the spool (17).



Y1-D310

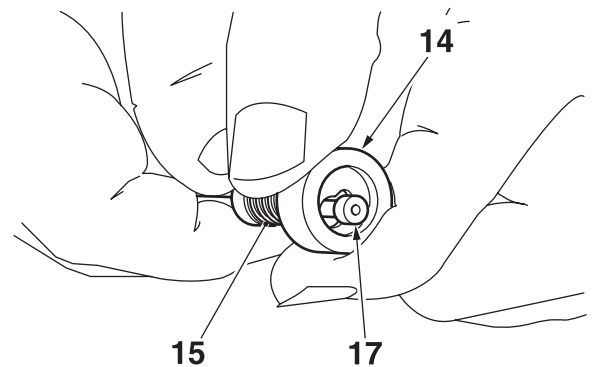
### Assembly

1. Assemble the reducing valve (12).
- a. Install the washer 2 (16), spring (15) and spring seat (14) on the spool (17).



Y1-D310

- b. Push in the spring sheet (14) to contract the spring (15), and move the spool (17) from the large hole to the small hole of the spring sheet (14).
- Do not push in the spring sheet too far (at most 6 mm).

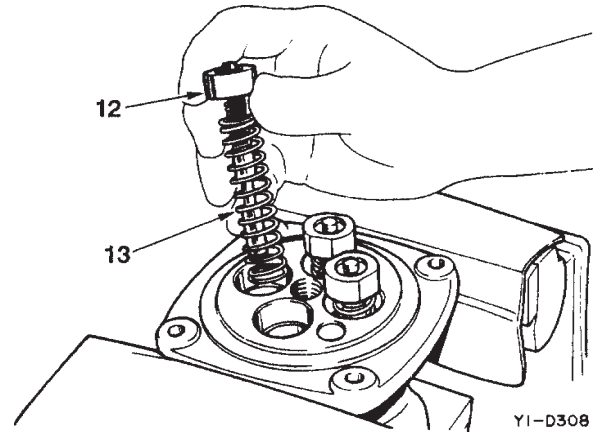


N0D3061

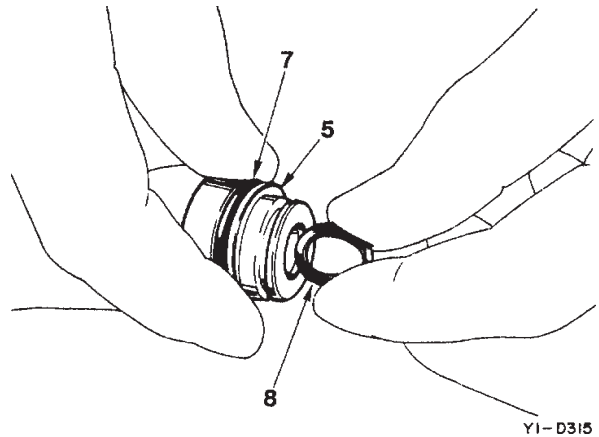
## PILOT VALVE

## HYDRAULIC UNITS

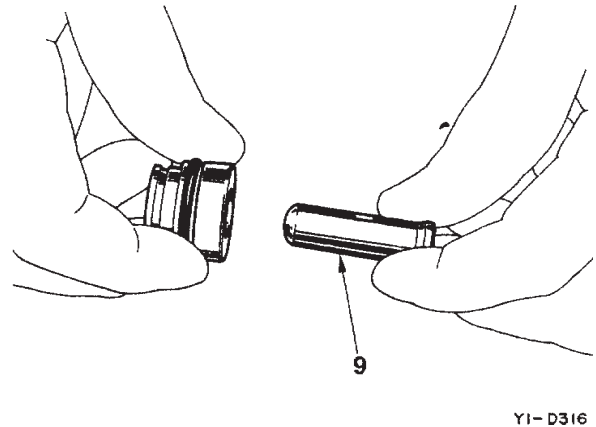
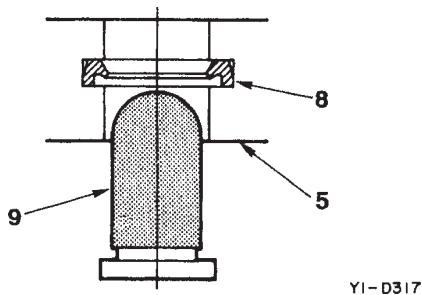
2. Install the spring (13) and reducing valve (12).
  - Install them in the positions they were in before disassembly.



3. Install the O-ring (7) and seal (8) in the plug (5).

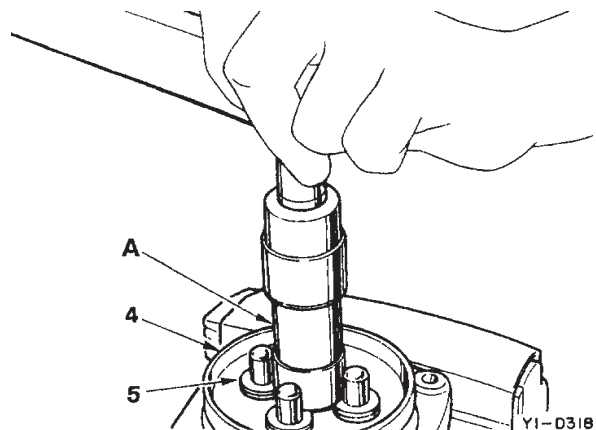


4. Install the push rod (9) in the plug (5).
  - Apply hydraulic oil to the push rod.



5. Install the plug (5) and plate (4), then install the joint.
  - Use installation jigs (A) and (B) to install the joint.

⌚ Joint:  $47.1 \pm 2.9 \text{ N}\cdot\text{m}$





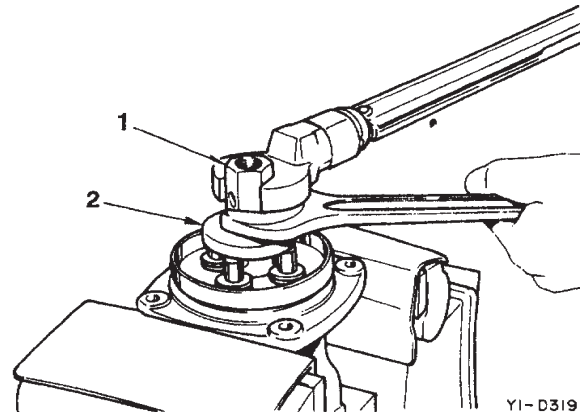
## HYDRAULIC UNITS

## PILOT VALVE

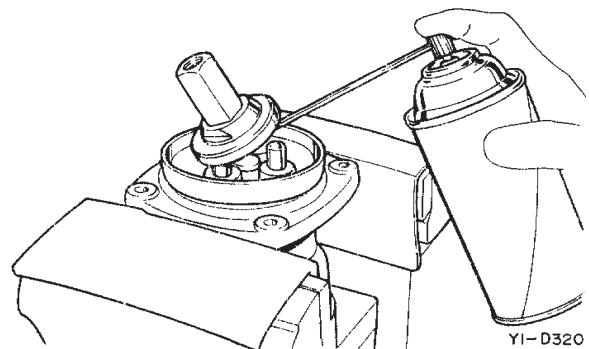
6. Install the disc (2), the adjust nut (1) and the lock nut.

- Tighten the adjust nut to the point where all 4 push rods are uniformly making contact.
- During tightening, the disc should not be moved.

🔧 Adjust Nut:  $68.6 \pm 4.9 \text{ N}\cdot\text{m}$



7. Apply grease to the contact surfaces of the joint rotating portion, the disc and the push rod.

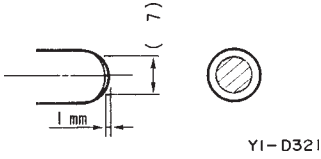


## HYDRAULIC UNITS

## PILOT VALVE

## INSPECTION AND ADJUSTMENT

## Checking the Parts

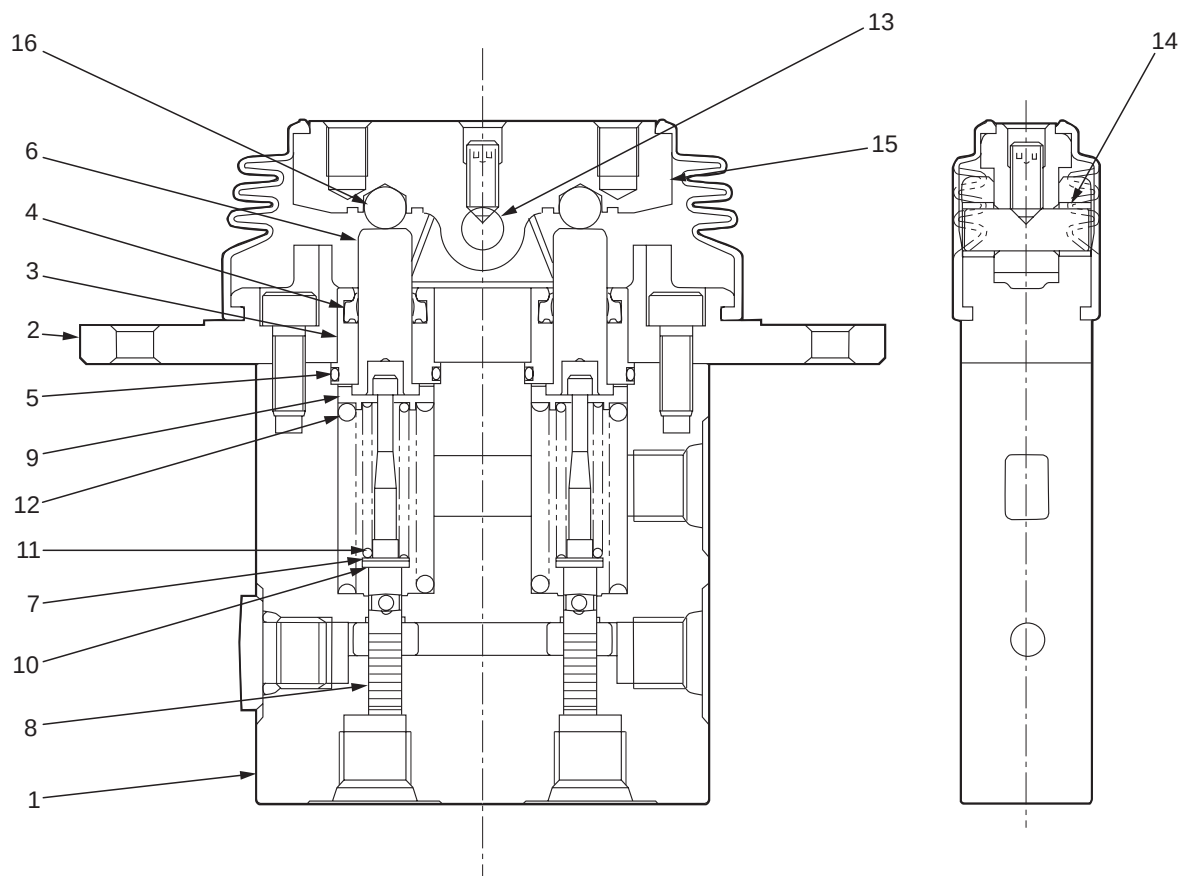
| Parts              | Judgment Criteria                                                                                                                                                                                                                                                                                      | Treatment                                                                                              |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| O-ring             | —                                                                                                                                                                                                                                                                                                      | • Replace                                                                                              |
| Seal               | —                                                                                                                                                                                                                                                                                                      | • Replace                                                                                              |
| Seal Washer        | —                                                                                                                                                                                                                                                                                                      | • Replace                                                                                              |
| Spool              | <ul style="list-style-type: none"> <li>• Wear on sliding portions is 10 <math>\mu</math>m or greater compared to non-sliding portions</li> <li>• Scratches on sliding portions</li> <li>• Spool doesn't move smoothly</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Repair or replace</li> </ul>               |
| Push Rod           | <ul style="list-style-type: none"> <li>• Front end is worn 1 mm or more</li> </ul>                                                                                                                                    | • Replace                                                                                              |
|                    | <ul style="list-style-type: none"> <li>• Scratches in the sliding portion</li> </ul>                                                                                                                                                                                                                   | • Replace                                                                                              |
| Plug               | • Seal is imperfect due to damage                                                                                                                                                                                                                                                                      | • Repair or replace                                                                                    |
| Operating Portion  | <ul style="list-style-type: none"> <li>• Tightening is loose at the pin, shaft or joint of the operating portion, with looseness of 2 mm or greater</li> <li>• Due to wear, etc. tightening is loose at the pin, shaft or joint of the operating portion, with looseness of 2 mm or greater</li> </ul> | <ul style="list-style-type: none"> <li>• Tighten to the specified torque</li> <li>• Replace</li> </ul> |
| Casing, Port Plate | <ul style="list-style-type: none"> <li>• Scratches, rust or corrosion on the spool and sliding portion</li> <li>• Scratches, rust or corrosion on seal portions which come in contact with the O-ring</li> </ul>                                                                                       | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Repair or replace</li> </ul>               |

## TROUBLESHOOTING

| Symptom                              | Probable Causes                                                                                                                                                                                                                                                 | Remedy                                                                                                                                                                                                                    |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Secondary pressure doesn't rise      | <ul style="list-style-type: none"> <li>• Primary pressure is insufficient</li> <li>• Spring is damaged or permanently deformed</li> <li>• The clearance between the spool and casing is abnormally large</li> <li>• There is looseness in the handle</li> </ul> | <ul style="list-style-type: none"> <li>• Keep the primary pressure</li> <li>• Replace the spring</li> <li>• Replace the spool and casing assembly</li> <li>• Disassemble and reassemble, or replace the handle</li> </ul> |
| Secondary pressure doesn't stabilize | <ul style="list-style-type: none"> <li>• Sliding parts are catching</li> <li>• Tank line pressure fluctuates</li> <li>• Air gets mixed into the piping</li> </ul>                                                                                               | <ul style="list-style-type: none"> <li>• Repair or replace</li> <li>• Remove the abnormal portions of the tank line</li> <li>• Operate the machine several times and bleed out the air</li> </ul>                         |
| Secondary pressure is high           | <ul style="list-style-type: none"> <li>• Tank line pressure is high</li> <li>• Sliding parts are catching</li> </ul>                                                                                                                                            | <ul style="list-style-type: none"> <li>• Remove the abnormal portions of the tank line</li> <li>• Repair or replace</li> </ul>                                                                                            |

## PILOT VALVE (SWING)

### CONSTRUCTION



L3D350

- |             |                |
|-------------|----------------|
| 1. Casing   | 9. Spring Seat |
| 2. Cover    | 10. Washer     |
| 3. Plug     | 11. Spring     |
| 4. Seal     | 12. Spring     |
| 5. O-ring   | 13. Shaft      |
| 6. Push Rod | 14. Bushing    |
| 7. Shim     | 15. Cam        |
| 8. Spool    | 16. Ball       |

OPERATION

👉 “IV-86”

DISASSEMBLY AND ASSEMBLY

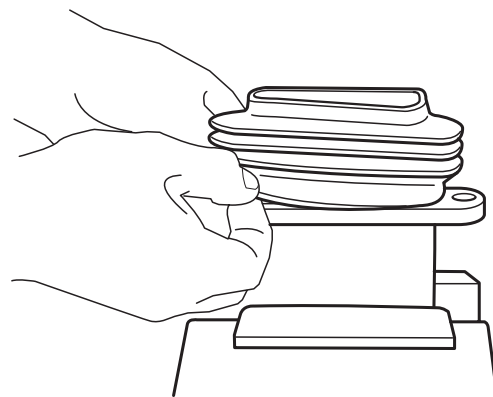
General Cautions

👉 “IV-87”

The following describes the disassembly procedure. For assembly, refer to the construction diagram and follow the disassembly procedure in the reverse order.

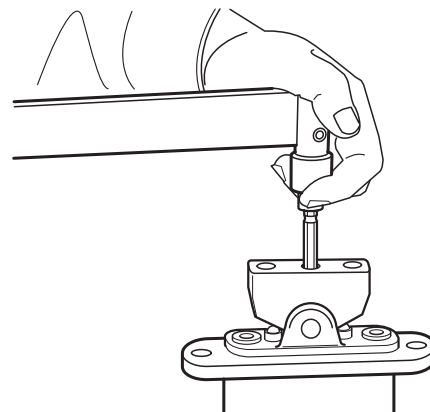
Disassembly

1. Remove the boot from the cover.
  - Use a copper or iron sheet to fasten the valve to the vice.
  - Apply grease to the cam and push rods.



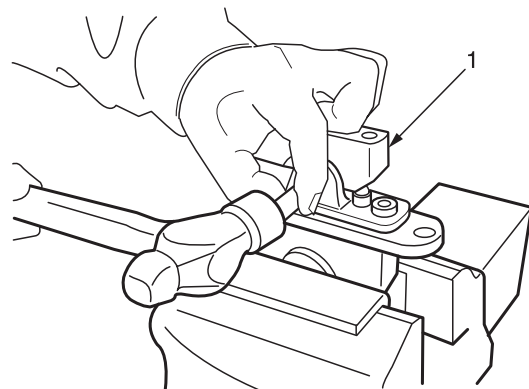
L2D301

2. Remove the set screw.
  - 🔧 Set screw: 6.9 N·m
  - Apply Loctite #241 to the set screw.



L2D302

3. Remove the cam pin, then remove the cam (1).



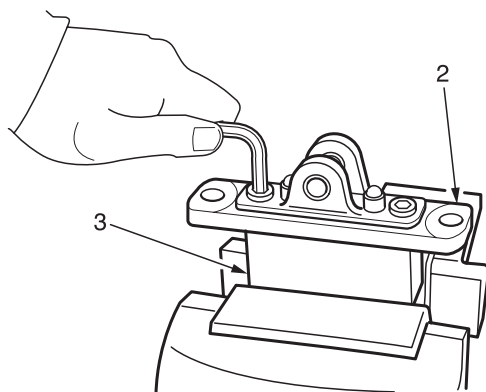
L2D303

## PILOT VALVE

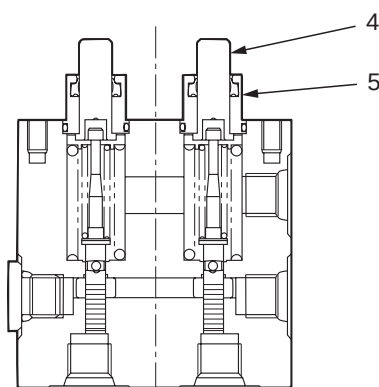
## HYDRAULIC UNITS

4. Loosen the cap screws and remove the cover (2).
  - The cover and plug will rise from the surface if the rebound spring is too strong, so loosen the cap screws alternately so that the cover is flat.
  - Mark the cover and casing so that they can be reassembled in the same positions.

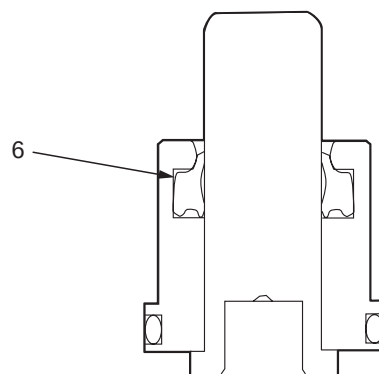
🔧 Cap screw: 8.8 N·m



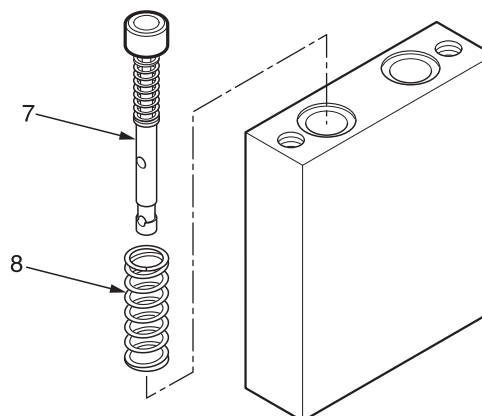
5. Remove the push rods (4) together with the plug (5).



6. Remove the O-rings and seal (6) from the plug.



7. Remove the spool assembly (7) and spring (8) from the casing.
  - Never disassemble the spool assembly as the pressure has been adjusted by the shim.

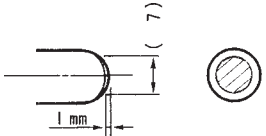


## HYDRAULIC UNITS

## PILOT VALVE

## INSPECTION AND ADJUSTMENT

## Checking the Parts

| Parts              | Judgment Criteria                                                                                                                                                                                                                                                                                      | Treatment                                                                                                   |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| O-ring             | —                                                                                                                                                                                                                                                                                                      | • Replace                                                                                                   |
| Seal               | —                                                                                                                                                                                                                                                                                                      | • Replace                                                                                                   |
| Seal Washer        | —                                                                                                                                                                                                                                                                                                      | • Replace                                                                                                   |
| Spool              | <ul style="list-style-type: none"> <li>• Wear on sliding portions is 10 <math>\mu\text{m}</math> or greater compared to non-sliding portions</li> <li>• Scratches on sliding portions</li> <li>• Spool doesn't move smoothly</li> </ul>                                                                | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> <li>• Repair or replace</li> </ul> |
| Push Rod           | <ul style="list-style-type: none"> <li>• Front end is worn 1 mm or more</li> </ul>  <p style="text-align: center;">Y1-D321</p>                                                                                        | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                                 |
| Plug               | <ul style="list-style-type: none"> <li>• Scratches in the sliding portion</li> </ul>                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                                 |
| Plug               | <ul style="list-style-type: none"> <li>• Seal is imperfect due to damage</li> </ul>                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Repair or replace</li> </ul>                                       |
| Operating Portion  | <ul style="list-style-type: none"> <li>• Tightening is loose at the pin, shaft or joint of the operating portion, with looseness of 2 mm or greater</li> <li>• Due to wear, etc. tightening is loose at the pin, shaft or joint of the operating portion, with looseness of 2 mm or greater</li> </ul> | <ul style="list-style-type: none"> <li>• Tighten to the specified torque</li> <li>• Replace</li> </ul>      |
| Casing, Port Plate | <ul style="list-style-type: none"> <li>• Scratches, rust or corrosion on the spool and sliding portion</li> <li>• Scratches, rust or corrosion on seal portions which come in contact with the O-ring</li> </ul>                                                                                       | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Repair or replace</li> </ul>                    |

**TROUBLESHOOTING**

| Symptom                              | Probable Causes                                                                                                                                                                                                                                            | Remedy                                                                                                                                                                                                               |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Secondary pressure doesn't rise      | <ul style="list-style-type: none"><li>• Primary pressure is insufficient</li><li>• Spring is damaged or permanently deformed</li><li>• The clearance between the spool and casing is abnormally large</li><li>• There is looseness in the handle</li></ul> | <ul style="list-style-type: none"><li>• Keep the primary pressure</li><li>• Replace the spring</li><li>• Replace the spool and casing assembly</li><li>• Disassemble and reassemble, or replace the handle</li></ul> |
| Secondary pressure doesn't stabilize | <ul style="list-style-type: none"><li>• Sliding parts are catching</li><li>• Tank line pressure fluctuates</li><li>• Air gets mixed into the piping</li></ul>                                                                                              | <ul style="list-style-type: none"><li>• Repair or replace</li><li>• Remove the abnormal portions of the tank line</li><li>• Operate the machine several times and bleed out the air</li></ul>                        |
| Secondary pressure is high           | <ul style="list-style-type: none"><li>• Tank line pressure is high</li><li>• Sliding parts are catching</li></ul>                                                                                                                                          | <ul style="list-style-type: none"><li>• Remove the abnormal portions of the tank line</li><li>• Repair or replace</li></ul>                                                                                          |





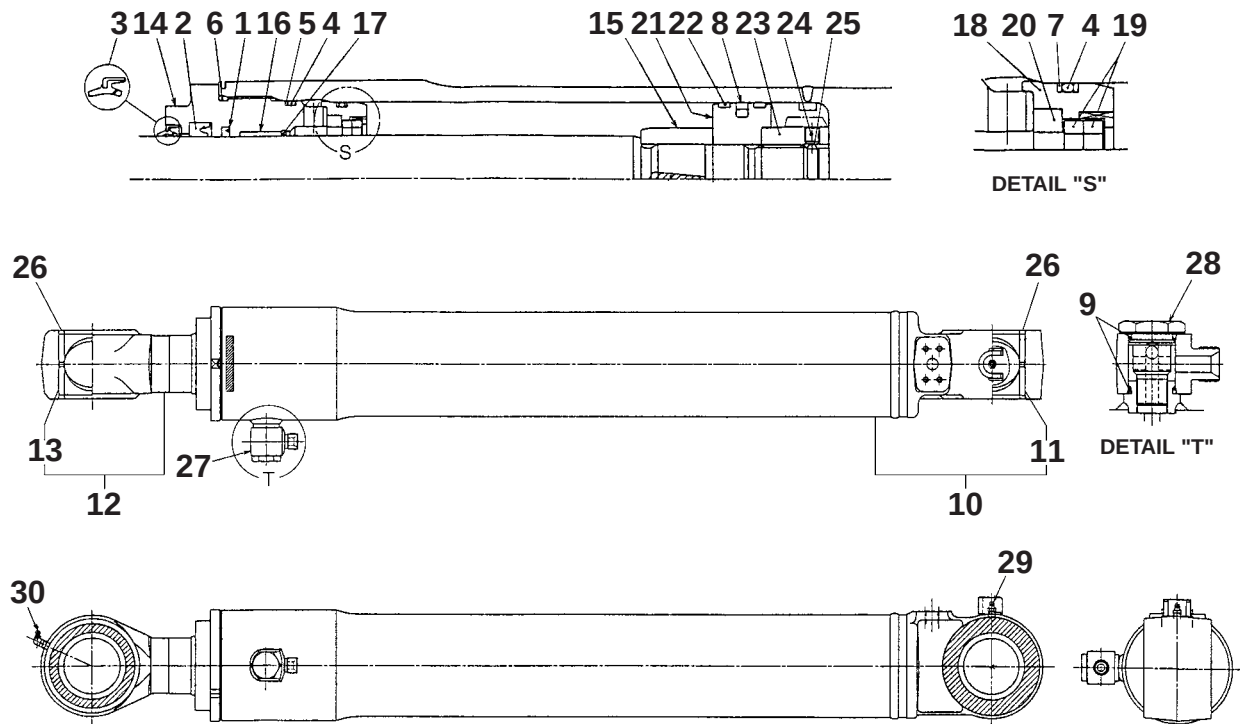
## CYLINDERS

## HYDRAULIC UNITS

### CYLINDERS

#### CONSTRUCTION

##### Boom Cylinder



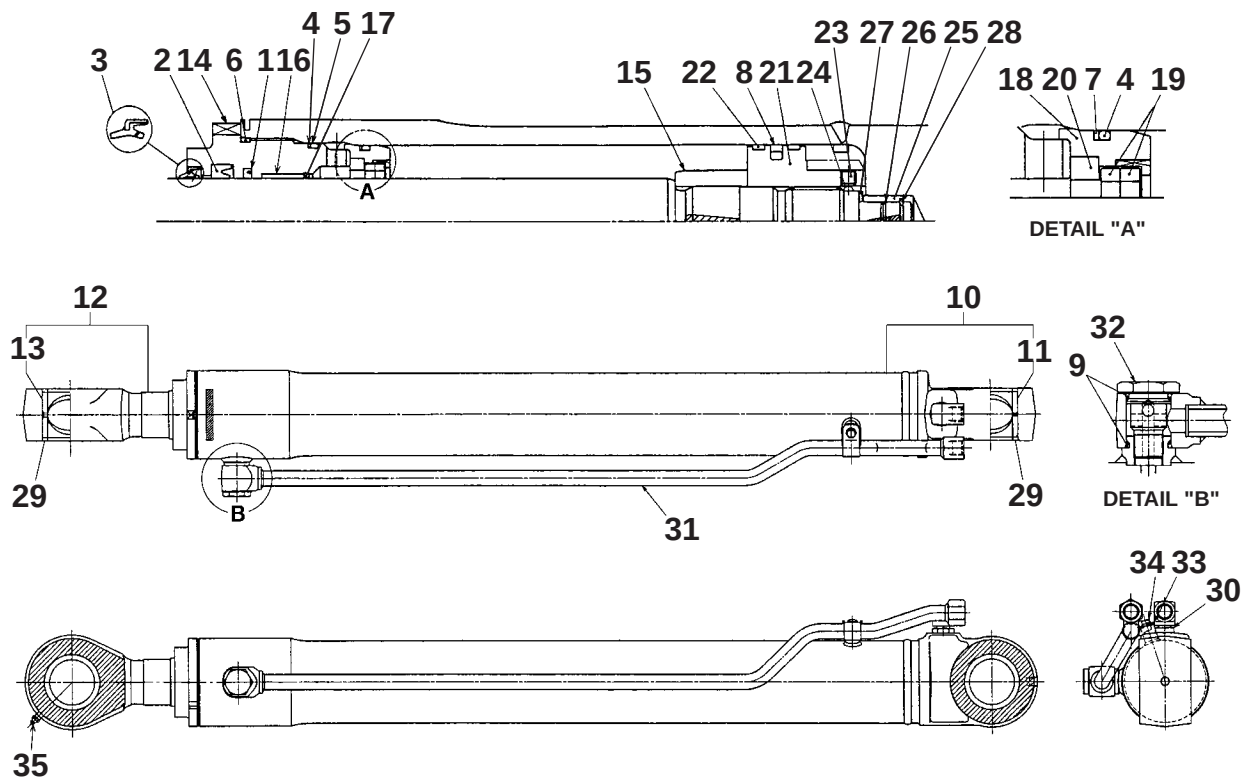
W2D400E

- |                   |                     |                  |                   |
|-------------------|---------------------|------------------|-------------------|
| 1. Buffer Ring    | 9. O-ring           | 17. Snap Ring    | 25. Ball          |
| 2. Rod Packing    | 10. Tube            | 18. Holder       | 26. Dust Seal     |
| 3. Dust Seal      | 11. Bushing         | 19. Cushion Seal | 27. Nipple        |
| 4. O-ring         | 12. Piston Rod      | 20. Collar       | 28. Plug          |
| 5. Backup Ring    | 13. Bushing         | 21. Piston       | 29. Grease Nipple |
| 6. O-ring         | 14. Rod Cover       | 22. Wear Ring    | 30. Grease Nipple |
| 7. Backup Ring    | 15. Cushion Bearing | 23. Nut          |                   |
| 8. Piston Packing | 16. Bushing         | 24. Set Screw    |                   |

## HYDRAULIC UNITS

## CYLINDERS

### Arm Cylinder



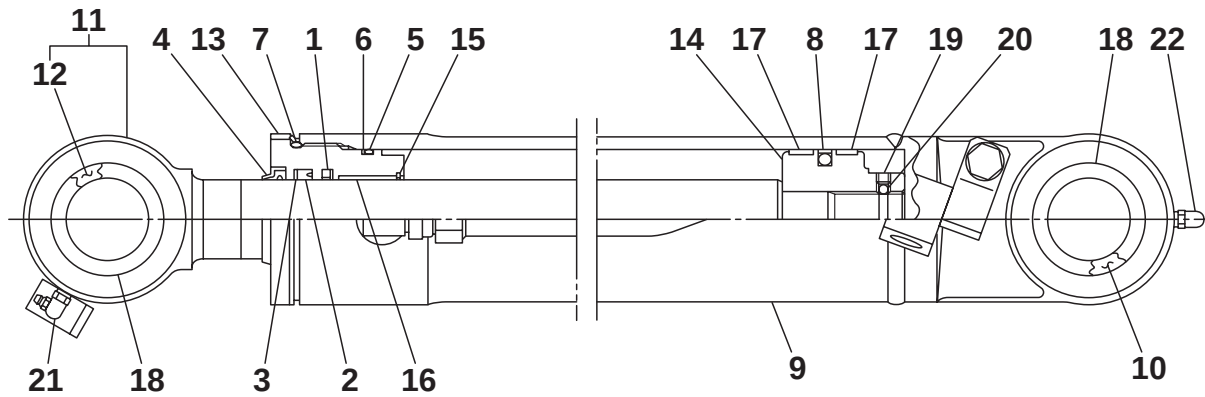
W2D401E

- |                   |                     |                     |                   |
|-------------------|---------------------|---------------------|-------------------|
| 1. Buffer Ring    | 10. Tube            | 19. Cushion Seal    | 28. Stopper       |
| 2. Rod Packing    | 11. Bushing         | 20. Collar          | 29. Dust Seal     |
| 3. Dust Seal      | 12. Piston Rod      | 21. Piston          | 30. Nipple        |
| 4. Backup Ring    | 13. Bushing         | 22. Wear Ring       | 31. Pipe          |
| 5. O-ring         | 14. Rod Cover       | 23. Set Screw       | 32. Plug          |
| 6. O-ring         | 15. Cushion Bearing | 24. Ball            | 33. Holder        |
| 7. Backup Ring    | 16. Bushing         | 25. Cushion Bearing | 34. Bolt          |
| 8. Piston Packing | 17. Snap Ring       | 26. Cushion Seal    | 35. Grease Nipple |
| 9. O-ring         | 18. Holder          | 27. Snap Ring       |                   |

## CYLINDERS

## HYDRAULIC UNITS

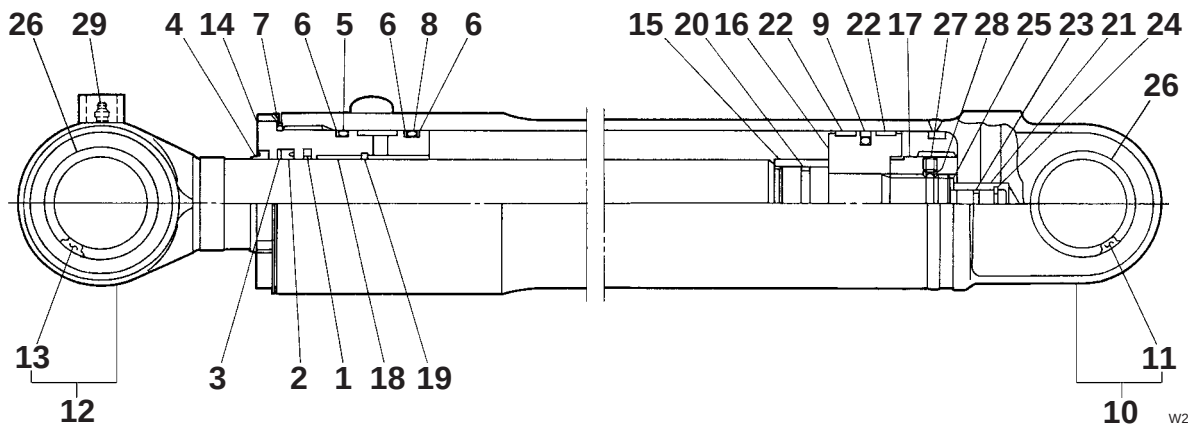
### Bucket Cylinder



W2D402

- |                |                   |               |                   |
|----------------|-------------------|---------------|-------------------|
| 1. Buffer Ring | 7. O-ring         | 13. Rod Cover | 19. Set Screw     |
| 2. Rod Packing | 8. Piston Packing | 14. Piston    | 20. Ball          |
| 3. Backup Ring | 9. Tube           | 15. Snap Ring | 21. Grease Nipple |
| 4. Dust Seal   | 10. Bushing       | 16. Bushing   | 22. Grease Nipple |
| 5. O-ring      | 11. Piston Rod    | 17. Wear Ring |                   |
| 6. Backup Ring | 12. Bushing       | 18. Dust Seal |                   |

### Swing Cylinder



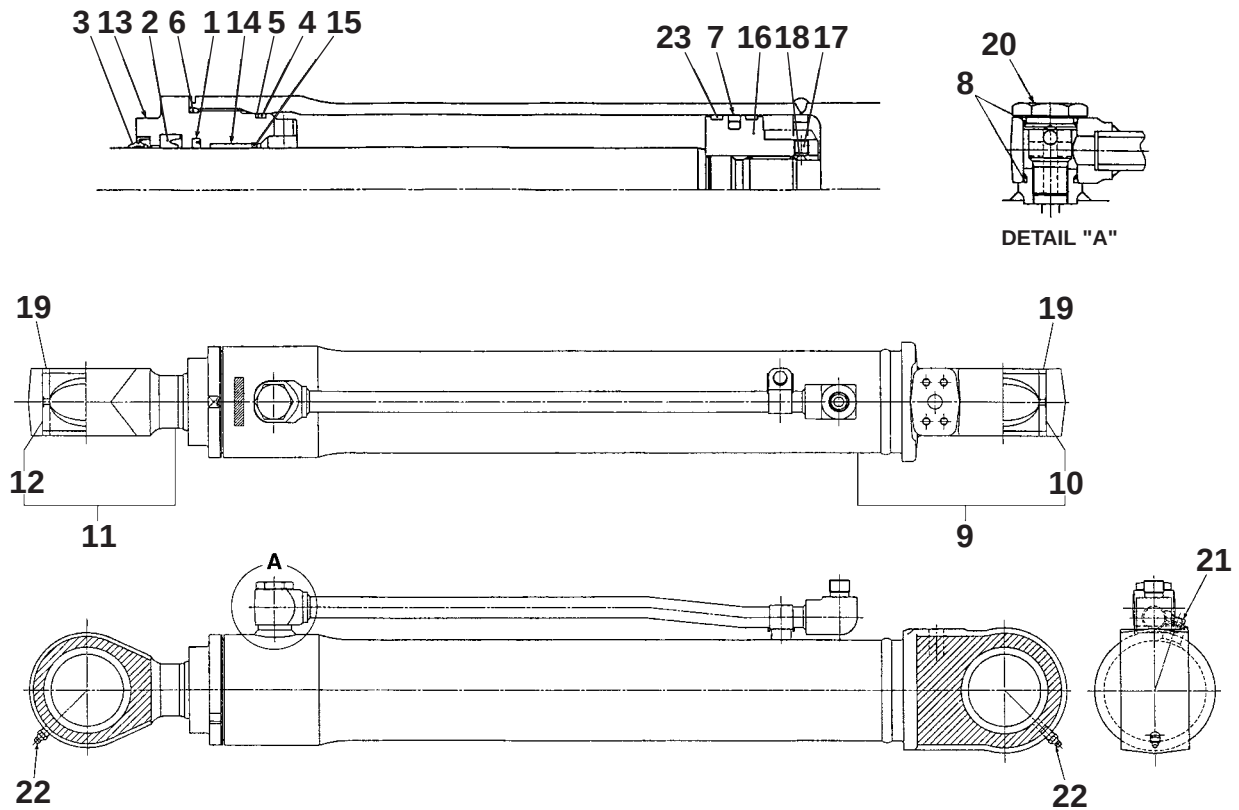
W2D403

- |                |                     |                     |                   |
|----------------|---------------------|---------------------|-------------------|
| 1. Buffer Ring | 9. Piston Packing   | 17. Nut             | 25. Snap Ring     |
| 2. Rod Packing | 10. Tube            | 18. Bushing         | 26. Dust Seal     |
| 3. Backup Ring | 11. Bushing         | 19. Snap Ring       | 27. Set Screw     |
| 4. Dust Seal   | 12. Piston Rod      | 20. Cushion Seal    | 28. Ball          |
| 5. O-ring      | 13. Bushing         | 21. Cushion Bearing | 29. Grease Nipple |
| 6. Backup Ring | 14. Rod Cover       | 22. Wear Ring       |                   |
| 7. O-ring      | 15. Cushion Bearing | 23. Cushion Seal    |                   |
| 8. O-ring      | 16. Piston          | 24. Stopper         |                   |

## HYDRAULIC UNITS

## CYLINDERS

### Boom Adjustment Cylinder



W2D404

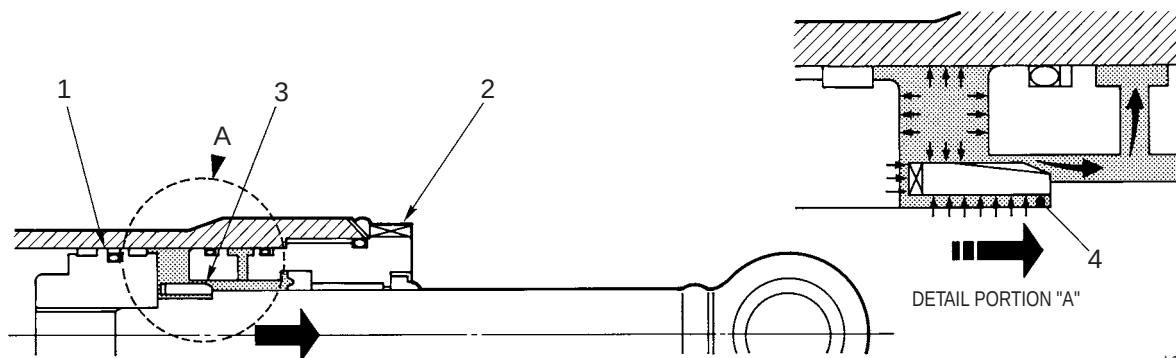
- |                |                   |               |                   |
|----------------|-------------------|---------------|-------------------|
| 1. Buffer Ring | 7. Piston Packing | 13. Rod Cover | 19. Dust Seal     |
| 2. Rod Packing | 8. O-ring         | 14. Bushing   | 20. Plug          |
| 3. Dust Seal   | 9. Tube           | 15. Snap Ring | 21. Holder        |
| 4. O-ring      | 10. Bushing       | 16. Piston    | 22. Grease Nipple |
| 5. Backup Ring | 11. Piston Rod    | 17. Set Screw | 23. Wear Ring     |
| 6. O-ring      | 12. Bushing       | 18. Ball      |                   |

## OPERATION

Hydraulic oil flowing alternately in and out of the oil outlet and inlet on both sides (head and rod sides) of the piston acts on the piston and its force causes the piston to move back and forth.

In cylinders equipped with a cushion mechanism, the shock resulting from the piston colliding with the cover at the stroke end acts on that mechanism and is dampened by it.

## Cushion Mechanism



L1-D406E

When the piston (1) nears the stroke end, just before it collides with the cover (2), if the cushion bearing (3) that precedes it enters the inner diameter portion of the cover, the oil in the back of the piston is restricted by the cushion bearing (3) and the clearance (4) of the cover inner diameter portion. This causes the piston's (1) back pressure to rise and slows the piston's speed.

## HYDRAULIC UNITS

## CYLINDERS

### DISASSEMBLY AND ASSEMBLY

#### Special Tools

See the table of special tools at the back of this section for the jigs and tools used for disassembly and assembly.

#### General Cautions

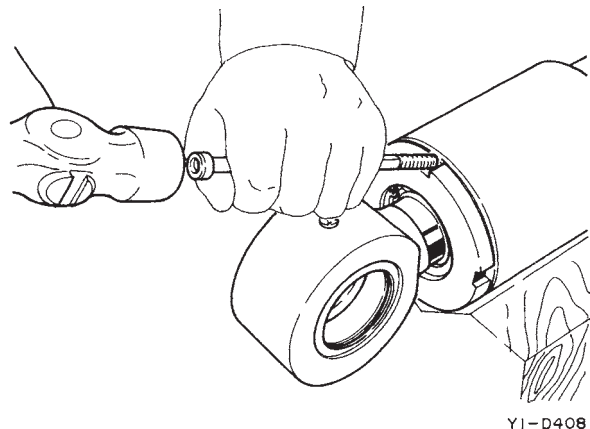
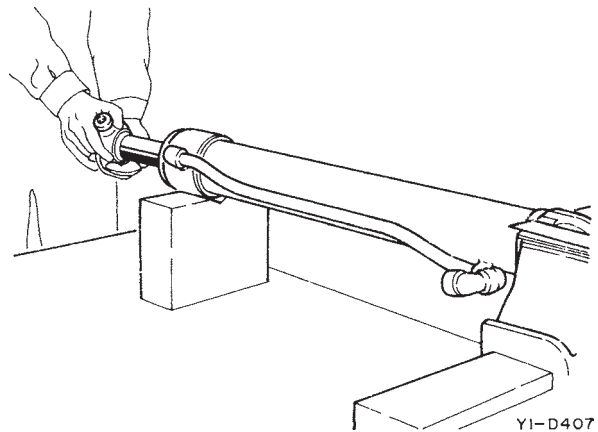
- Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
- Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
- Clean all disassembled parts in cleaning solvent. Use a lint free cloth, or air dry the parts.
- Make match marks on each part so that they will be assembled in the same positions when assembled.
- Replace all seals with new ones each time the hydraulic units is disassembled.
- Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.
- Do not turn adjusting screws if not required.
- Apply hydraulic oil to sliding surfaces and apply a thin coating of grease to seals when assembling them.

In this manual, the procedure for the arm cylinder is described. When necessary, the points which are different in other cylinders are mentioned.

#### Disassembly

##### Cylinder Assembly

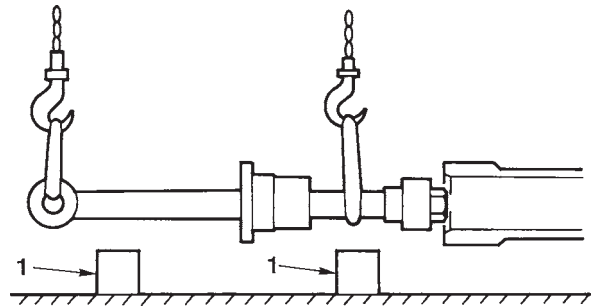
1. Fasten the clevis of the tube in a vice and place the other end on a support block made of wood to fasten the cylinder in a horizontal condition.
2. Drain out hydraulic oil remaining in the cylinder.
  - Move the piston rod gently to prevent the hydraulic oil from spraying out and scattering all over.
3. Free the locked portion of the rod cover.
  - Since the lock is integrated with the cylinder tube, be careful not to bend it or to scratch it when the lock is being freed.
4. Loosen the rod cover.
  - The piston rod should be pulled out approximately 200 mm beforehand.
  - Measures should be taken to prevent the piston rod from being hit.



## CYLINDERS

## HYDRAULIC UNITS

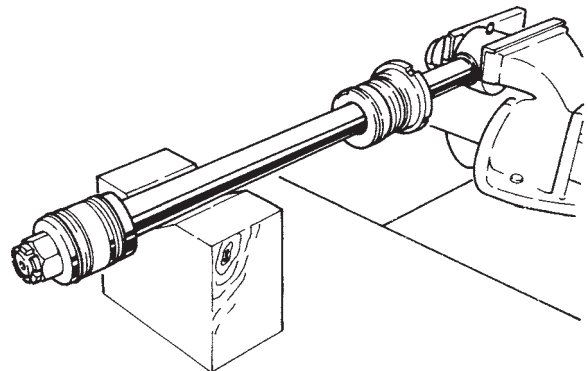
5. Pull the piston rod assembly out of the tube.
  - Use a wooden block (1) so as not to scratch the sliding surface, and pull the assembly straight out.



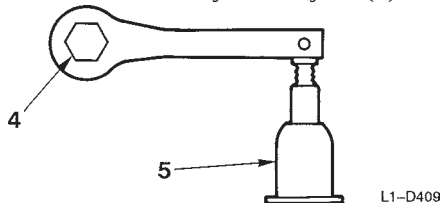
L1-D407

### Piston Rod Assembly

1. Fasten the piston rod assembly securely in a level position.
2. Remove the piston.
  - a. Take out the set screw (2) and remove the steel ball (3).
    - The set screw is staked at 2 places with a punch, so grind off the staked portions using a hand drill.
  - b. Loosen the piston nut (4) and remove it.
    - Use a wrench with a hydraulic jack (5).

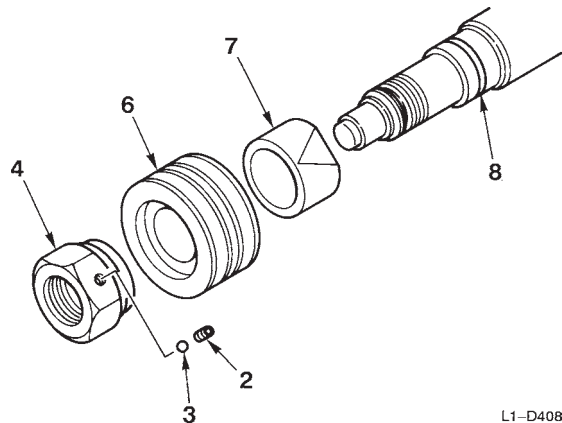


Y1-D410

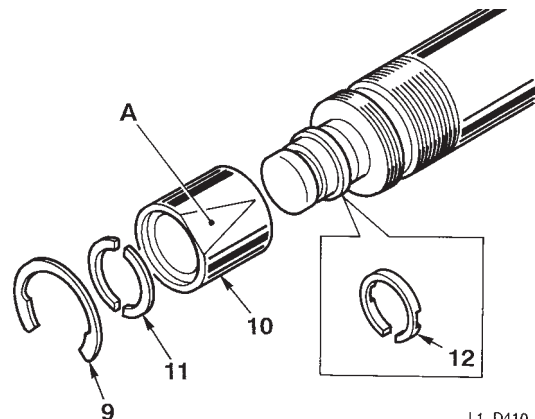


L1-D409

- c. Remove the piston (6).
3. Remove the cushion bearing (7) and cushion seal (8).
4. Remove the cushion bearing.
  - a. Remove the snap ring (9).
  - b. Move the cushion bearing (10) and remove the stopper (11).
  - c. Pull out the cushion bearing (10).
  - d. Remove the cushion seal (12).
5. Remove the rod cover from the piston rod.



L1-D408



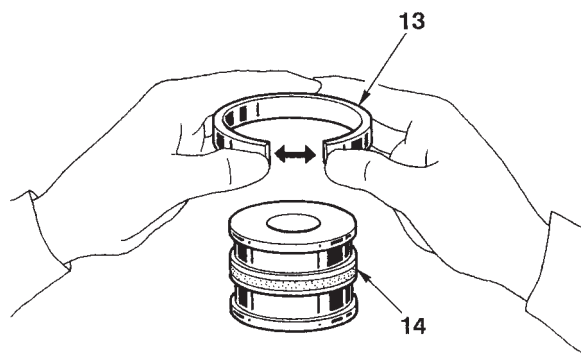
L1-D410

## HYDRAULIC UNITS

## CYLINDERS

### Piston

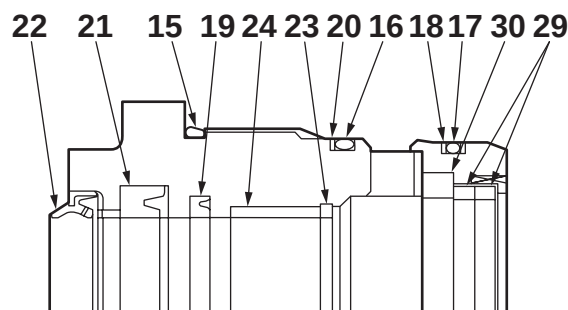
1. Remove the wear ring (13) from the piston.
  - Spread the wear ring the minimum amount necessary and remove it in the axial direction.
2. Remove the piston packing (14).
  - Remove the piston packing by cutting it or using a screwdriver.



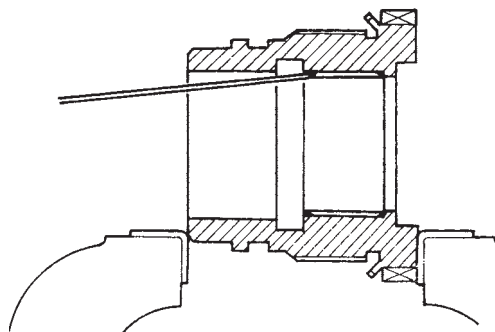
L1-D411

### Rod Cover

1. Remove the O-ring (17) and the backup rings (18) from holder.
2. Remove the collar (30) and cushion seals (29).
3. Remove the O-rings (15), (16) and the backup rings (20).
4. Remove the buffer ring (19) and rod packing (21).
  - Extract using a eyeleteer with a pointed tip.
5. Remove the dust seal (22).
  - Extract by raising the rubber part with a screwdriver, etc., and striking.
6. Remove the snap ring (23).
7. Remove the bushing
  - Since the bushing has been pressure fitted tightly in the rod cover, it is impossible to take it out. First use a lathe to grind down the inside portion until only a thin piece remains, then insert a copper spatula strongly and pry it out to removed it.



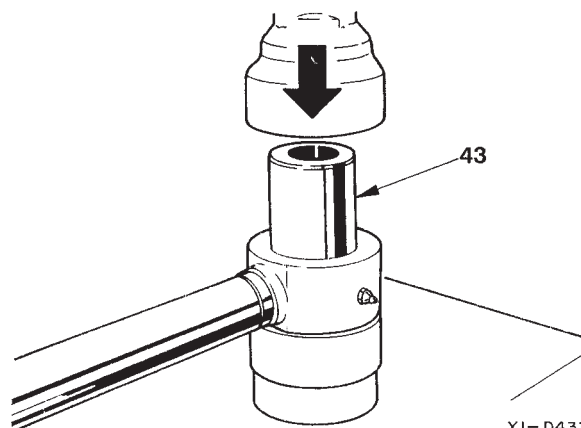
W2D405



Y1-D43

### Clevis

1. Remove the dust seal from the tube and piston rod.
2. Remove the bushing using a setting tool (43).



Y1-D433



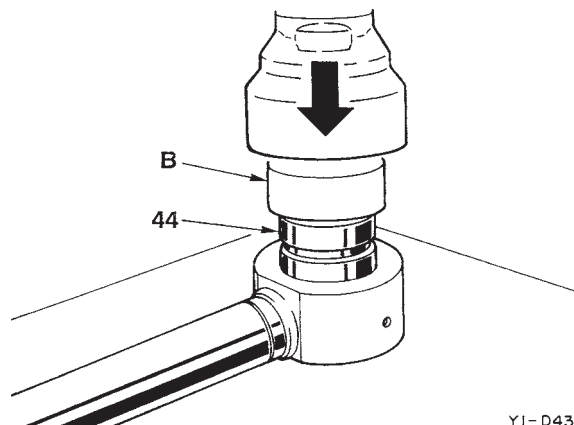
## CYLINDERS

## HYDRAULIC UNITS

### Assembly

#### Clevis

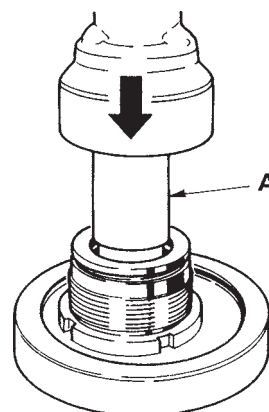
1. Using installation jig (B), pressure fit the bushing (44) in the piston rod and tube.
2. Using a setting tool, install the dust seal.



YI-D434

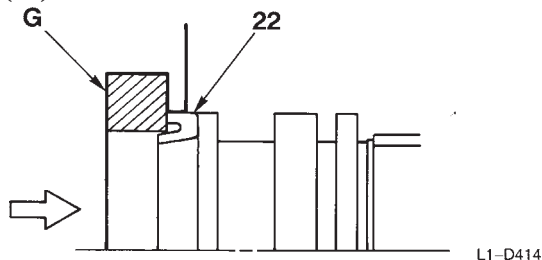
#### Rod Cover

1. Using an installation jig (A), pressure fit the bushing.
  - Hydraulic oil should be applied to the inside surface of the rod cover before assembly.
  - After installation, make sure there are no level differences with the bushing.

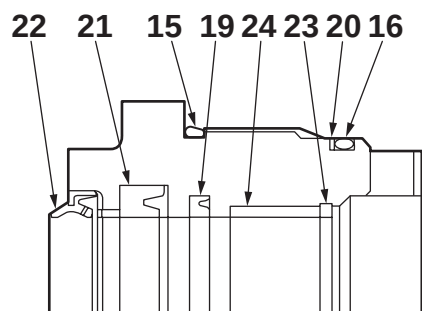


YI-D436

2. Install the O-rings (15), (16) and the backup rings (20).
3. Using setting tool (G), pressure fit the dust seal (22).



L1-D414



W2D406

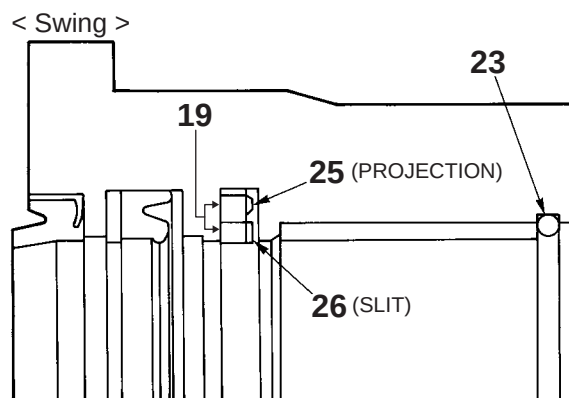
4. Install the rod packing (21).

5. Install the buffer ring (19).

<Swing>

- Attach the seal ring (25), bend the buffer ring (26) into a U shape with your fingers, then set it in the groove. Make sure it is bent with a radius of 6mm or greater to prevent wrinkles.
- Be sure to install it in the proper direction.

6. Install the snap ring (23).

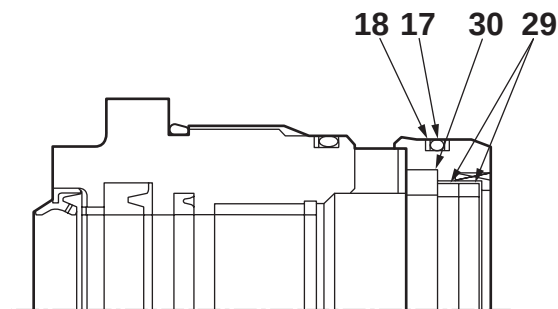


W2D407E

## HYDRAULIC UNITS

## CYLINDERS

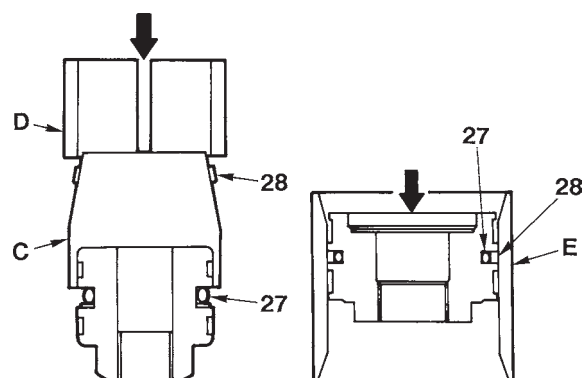
7. Install the collar (30) and the cushion seals (29).
8. Install the O-ring (17) and the backup rings (18).



W2D408

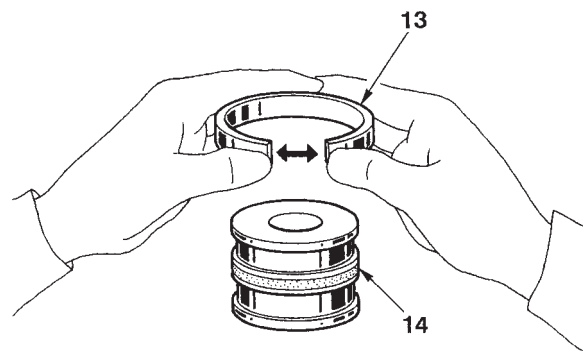
### Piston

1. Install the O-ring (27) on the piston.
2. Cover the piston with the sliding jig (C), then, using the fitting jig (D), insert the slipper ring (28) rapidly.
3. Since the slipper ring (28) is extended when it is installed, correct it using the corrective jig (E).



L1-D416

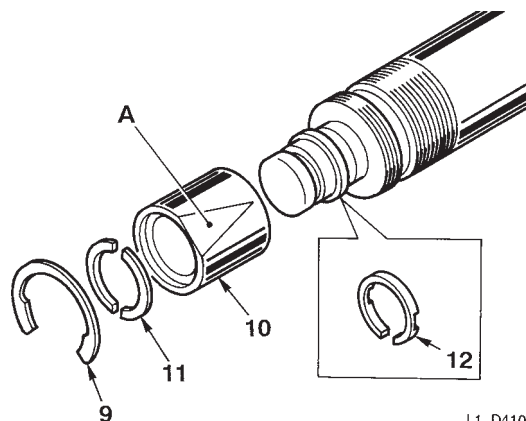
4. Install the wear ring (13).
  - Spread the wear ring at the cut portion the minimum amount necessary, installing it on the piston from the shaft direction.



L1-D411

### Piston Rod Assembly

1. Fasten the piston rod so that it is flat and install the rod cover.
  - Cover the piston rod thread with tape, etc., to protect the seals from being scratched.
2. Install the cushion bearing (10).
  - a. Install the cushion seal (12).
    - Set the side with the slits facing the screw side.
  - b. Install the cushion bearing (10).
    - Be sure to set with the flat side (A) in the proper direction.
  - c. Install the stopper (11) on the piston rod, and move the cushion bearing (10).
  - d. Install the snap ring (9).



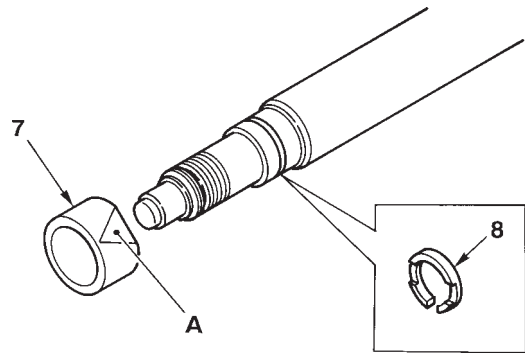
L1-D410

## CYLINDERS

## HYDRAULIC UNITS

3. Install the cushion seal (8) and cushion bearing (7).

- Set the side of the cushion seal with the slits facing the screw side.
- Be sure to set with the flat side (A) of the cushion seal in the proper direction.

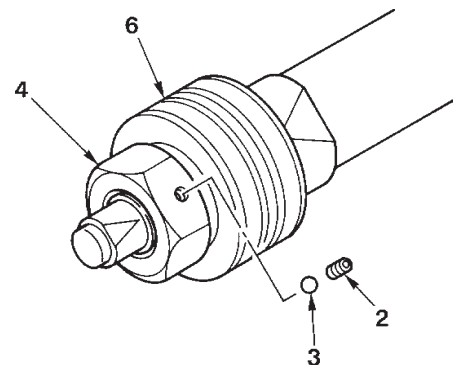


L1-D417

4. Install the piston.
  - a. Install the piston (6).
  - b. Install the piston nut (4) and tighten it.  
 Piston nut: Refer to the table below.
  - c. Insert the steel ball (3).
  - d. Tighten the set screw (2) and caulk it at two places with a punch.  
 Set screw: Refer to the table below.

 Piston Nut, Set Screw Unit: N·m

| Place           | Piston Nut | Set Screw |
|-----------------|------------|-----------|
| Boom            | 3500       | 56.9      |
| Arm             | 3100       | 31.5      |
| Bucket          | 1540       | 31.5      |
| Boom Adjustment | 1470       | 31.5      |
| Swing           | 4410       | 56.9      |



L1-D418

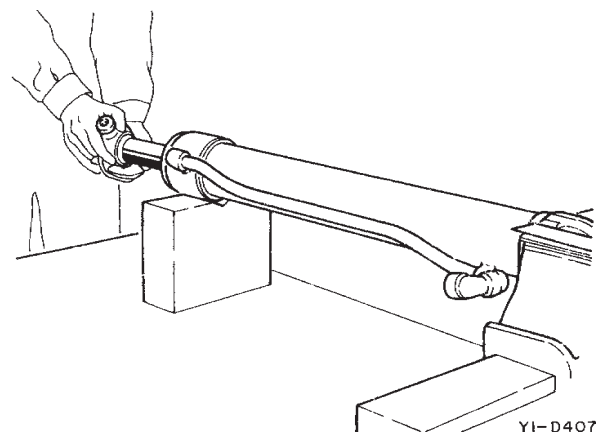
## Cylinder Assembly

1. Fasten the tube in a horizontal position, then insert the piston rod assembly in the tube.
  - During insertion, align the center of the piston rod with the center of the tube, inserting it straight so the seals will not be scratched.
2. Tighten the rod cover.
  - Apply Three Bond #1901 or the equivalent to the rod cover tread.

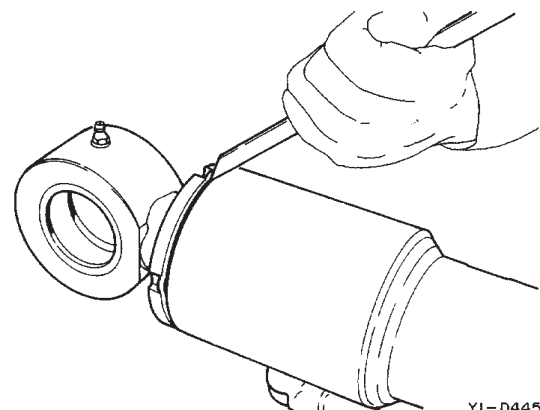
 Rod cover Unit: N·m

|                 |      |
|-----------------|------|
| Boom            | 1060 |
| Arm             | 647  |
| Bucket          | 490  |
| Boom Adjustment | 530  |
| Swing           | 1060 |

3. Bend the lock rib on the tube down in a notch of the rod cover to lock it.



YI-D407



YI-D445

## HYDRAULIC UNITS

## CYLINDERS

## INSPECTION AND ADJUSTMENT

**Inspection after Disassembly**

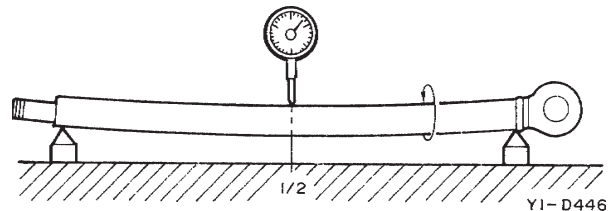
Clean each part thoroughly with cleaning oil, then carry out the following checks. When a cylinder has been disassembled, replace all the seals with new ones.

**Piston Rod**

- Replace the rod if there are cracks.
- If the threads are damaged, repair them or replace it.
- If the plating layer of the plated portion is broken, rusted or scratched, replace it.
- If the rod is bent more than the limit of 1 mm in 1 m, replace it. (Measure by the method shown in the figure at right.

If the bending of the rod is within the above limit, yet is bent a lot in a small distance so that it won't move smoothly, replace the rod if it makes a squeaking sound in the operation test after reassembly or if it catches during movement.

- If the inner diameter of the clevis bushing is worn, replace the bushing.

**Measuring the Bend**

- Support the portion of the rod with the same diameter at both ends on V-blocks.
- Set a dial gauge at the center between the two blocks.
- Rotate the rod and take a reading of the maximum and minimum runout indicated by the dial gauge.

**Tube**

- If there are cracks in the welded portion, replace it.
- Replace the tube if the inside surface is scratched or if it leaks hydraulic oil.
- If the inner diameter of the clevis bushing is worn, replace the bushing.

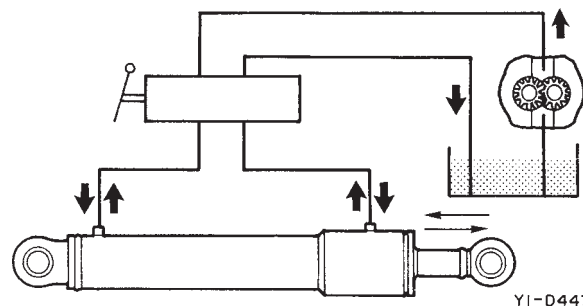
**Rod Cover**

- If the bushing inner diameter is worn and the clearance with the piston rod is greater than 0.25 mm, replace the bushing.
- If the inside surface of the bushing is scratched, and the scratches are deeper than the depth of the coating layer, replace the bushing.

### Inspection after Assembly

#### No Load Operation Test

1. Place the cylinder in a horizontal position with no load.
2. Apply gentle pressure alternately to the ports at both ends, operating the piston rod 5 or 6 times.
3. Make sure there is no abnormality in the operating condition.



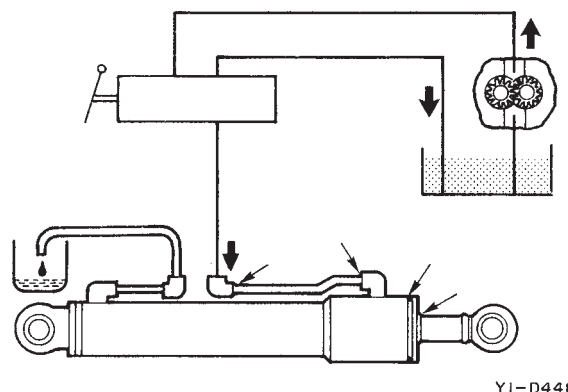
#### Leak Test

##### External Leakage

1. Apply test pressure for 3 minutes each to the retraction side and the extension side.
2. Make sure there are no abnormalities such as external leakage or permanent deformation, etc. in the rod seal, the rod cover mount, or in any welded portion.

##### Internal Leakage

1. Disconnect the extension side hose.
2. Apply test pressure to the retraction side for 3 minutes.
3. Measure the amount of oil that has leaked from the extension side.
  - The amount of leakage should be 1 cm<sup>3</sup> / 3min or less.



### Bleeding Air from the Hydraulic Cylinder

Bleed the air out of the cylinder when the cylinder is removed or when the hydraulic piping, etc. is disconnected.

1. Start the engine and let it idle for approximately 5 minutes.
2. With the engine running at slow speed, extend and retract the cylinder 4 or 5 times.
  - Move the piston rod to a position 100 mm before the end of the stroke, being careful not to apply any relief at all.
3. With the engine at top speed, repeat the operation in (2), then with the engine running at slow speed, move the piston rod to the stroke end and apply relief.

## HYDRAULIC UNITS

## CYLINDERS

### TROUBLESHOOTING

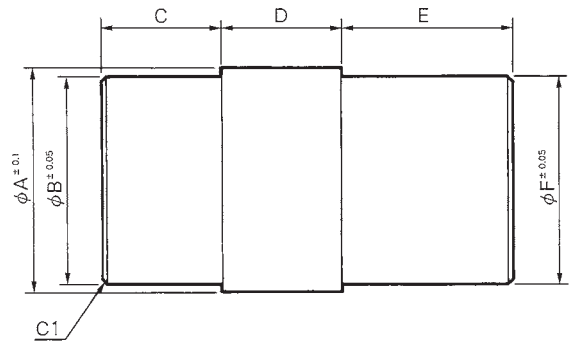
| Symptom                                                                                                                                                                                                                   | Probable Causes                                                                                                                                                                                                                                                                | Remedy                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Oil leaks from piston rod sliding surface (an oil ring forms on the piston and this enlarges and drips off).                                                                                                              | <ul style="list-style-type: none"> <li>Foreign matter is caught in the inner diameter portion of the rod packing, backup ring or dust seal.</li> <li>The inner diameter lip of the rod packing, backup ring or dust seal is damaged or abnormal.</li> </ul>                    | <ul style="list-style-type: none"> <li>Remove the foreign matter.</li> <li>Replace the affected parts.</li> </ul>                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Piston rod sliding surface is scratched.</li> <li>The hardened chrome plating is separating from the piston rod.</li> </ul>                                                                                                             | <ul style="list-style-type: none"> <li>Smooth the sliding surface with an oil stone (1.6 S or lower)</li> <li>If it leaks after the sliding surface has been smoothed, replace the rod packing and other seals.</li> <li>If it leaks after the seals have been replaced, replace the piston rod.</li> <li>Repair the hardened chrome plating.</li> </ul> |
| Oil leaks from the outer circumference of the rod cover.                                                                                                                                                                  | <ul style="list-style-type: none"> <li>O-ring is damaged.</li> <li>Backup ring is damaged.</li> </ul>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>Replace the affected parts.</li> <li>Replace the affected parts.</li> </ul>                                                                                                                                                                                                                                       |
| Oil leaks from welded portion.                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>The tube's welds are damaged.</li> </ul>                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Replace the affected parts.</li> </ul>                                                                                                                                                                                                                                                                            |
| Cylinder natural drop (this is the maximum amount of movement of the piston in 10 minutes when a static weight corresponding to the maximum use pressure multiplied by the cylinder's surface area) is 0.5 mm or greater. | <ul style="list-style-type: none"> <li>Foreign matter is caught in the wear ring sliding surface.</li> <li>The sliding surface of the wear ring is scratched or abnormal.</li> <li>The piston packing sliding surface is scratched.</li> <li>The O-ring is damaged.</li> </ul> | <ul style="list-style-type: none"> <li>Remove the foreign matter.</li> <li>Replace the affected parts.</li> <li>Replace the affected parts.</li> <li>Replace the affected parts.</li> </ul>                                                                                                                                                              |

CYLINDERS

HYDRAULIC UNITS

TABLE OF SPECIAL TOOLS

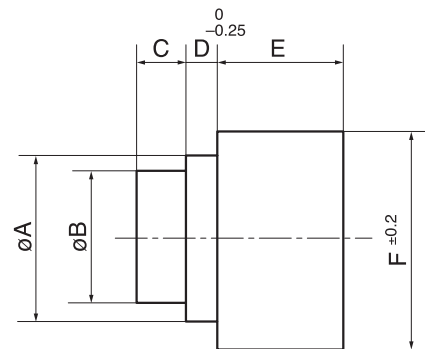
Installation Jig (A)



MATERIAL: SS41

L1-D419

Installation Jig (B)



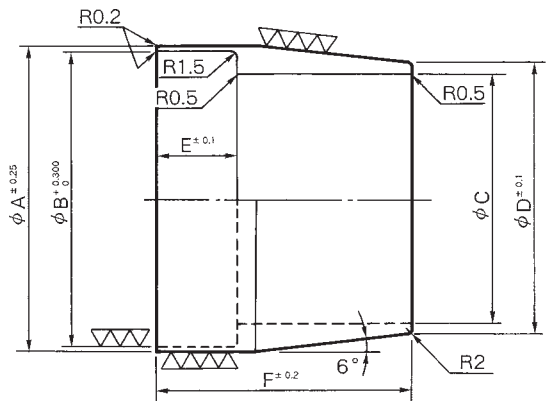
MATERIAL: SS41

E5D436

Unit: mm

|                 | Installation Jig (A) |    |    |    |    |    | Installation Jig (B) |      |    |   |    |    |
|-----------------|----------------------|----|----|----|----|----|----------------------|------|----|---|----|----|
|                 | A                    | B  | C  | D  | E  | F  | A                    | B    | C  | D | E  | F  |
| Boom            | 79                   | 75 | 43 | 12 | 75 | 75 | 89                   | 74.5 | 10 | 5 | 30 | 95 |
| Arm             | 69                   | 65 | 43 | 12 | 75 | 65 | 79                   | 64.5 | 10 | 5 | 30 | 90 |
| Bucket          | 59                   | 55 | 32 | 12 | 46 | 55 | 59                   | 49.5 | 10 | 5 | 30 | 70 |
| Boom Adjustment | 59                   | 55 | 32 | 12 | 46 | 55 | 89                   | 74.5 | 10 | 5 | 30 | 95 |
| Swing           | 79                   | 75 | 43 | 12 | 75 | 75 | 89                   | 74.5 | 10 | 5 | 30 | 95 |

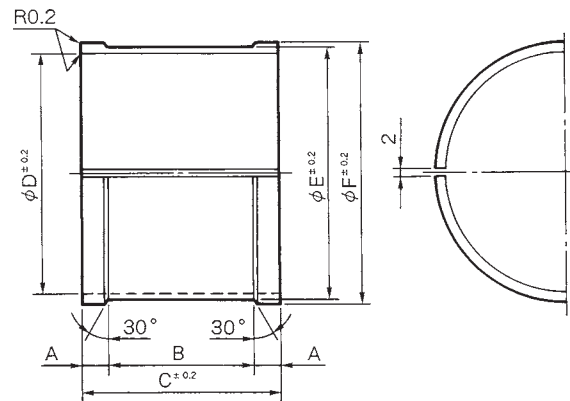
Sliding Jig (C)



MATERIAL: STKM13C

L1-D420

Fitting Jig (D)



MATERIAL: NYLON

L1-D421

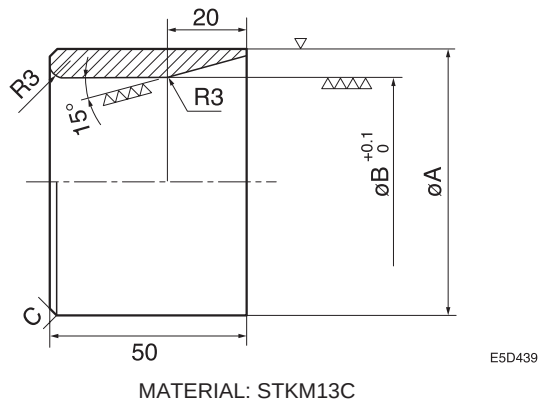
Unit: mm

|                 | Sliding Jig (C) |       |     |       |      |    | Fitting Jig (D) |    |    |     |     |     |
|-----------------|-----------------|-------|-----|-------|------|----|-----------------|----|----|-----|-----|-----|
|                 | A               | B     | C   | D     | E    | F  | A               | B  | C  | D   | E   | F   |
| Boom            | 121.0           | 119.7 | 101 | 107.3 | 23.5 | 97 | 13              | 71 | 97 | 110 | 117 | 120 |
| Arm             | 101.0           | 99.7  | 84  | 90.7  | 22.5 | 77 | 10              | 57 | 77 | 95  | 99  | 102 |
| Bucket          | 85.7            | 84.7  | 70  | 75.7  | 19.5 | 75 | 10              | 55 | 75 | 80  | 84  | 87  |
| Boom Adjustment | 90.7            | 89.7  | 75  | 80.7  | 19.5 | 75 | 10              | 55 | 75 | 85  | 89  | 92  |
| Swing           | 121.0           | 119.7 | 101 | 107.3 | 23.5 | 97 | 13              | 71 | 97 | 110 | 117 | 120 |

## HYDRAULIC UNITS

## CYLINDERS

## Corrective Jig (E)



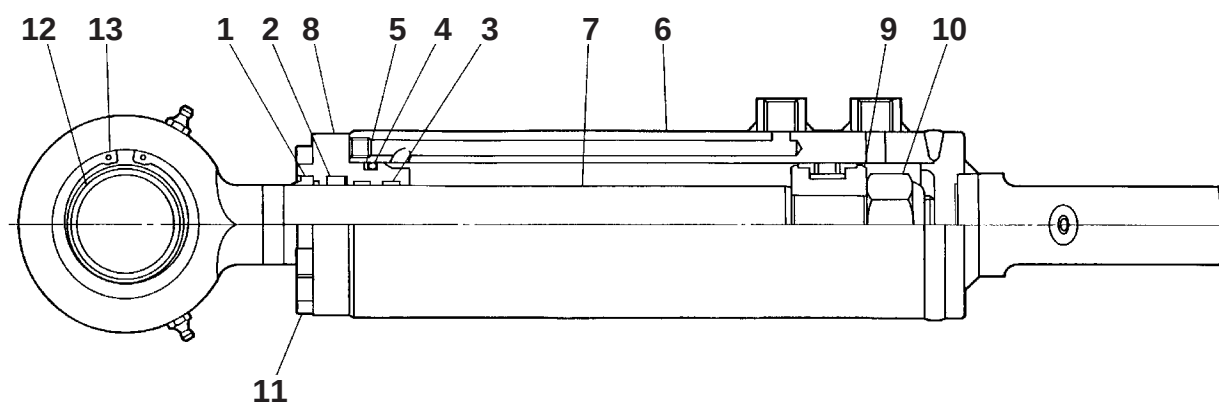
Unit: mm

|                 | A   | B   |
|-----------------|-----|-----|
| Boom            | 133 | 120 |
| Arm             | 113 | 100 |
| Bucket          | 98  | 85  |
| Boom Adjustment | 103 | 90  |
| Swing           | 133 | 120 |



## DOZER BLADE CYLINDER

### CONSTRUCTION



W2D409

- |                |              |
|----------------|--------------|
| 1. Dust Seal   | 8. Rod Cover |
| 2. Joint       | 9. Piston    |
| 3. Guide Band  | 10. Nut      |
| 4. O-ring      | 11. Screw    |
| 5. Backup Ring | 12. Bearing  |
| 6. Pipe        | 13. Ring     |
| 7. Piston Rod  |              |



## RAM LOCK CYLINDER

### Contents

1. Functional description
2. Hydraulic connection plan
3. Start-up and bleeding
4. Fault-finding
5. Repair instructions

### 1. Functional description

Designed as plunger cylinder with integrated non-return valve.

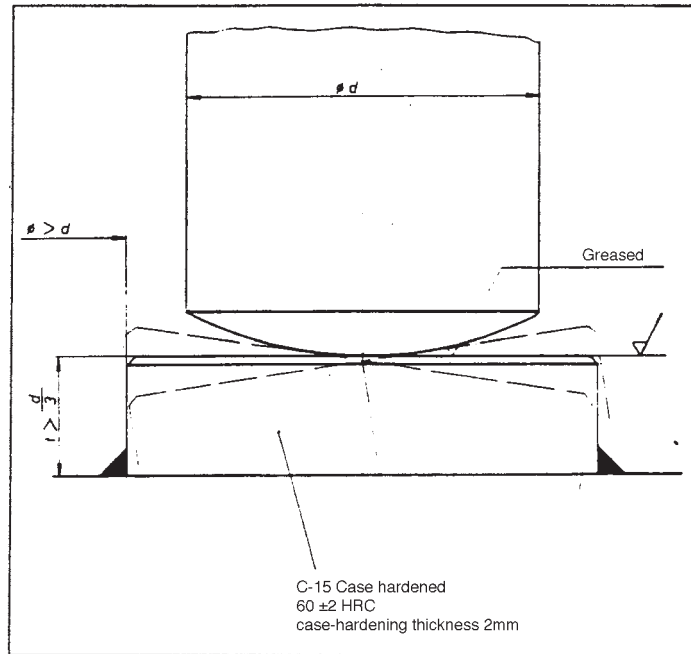
The non-return valve is designed as an oil-tight round-seat valve which can be opened via a control piston.

|                                         |                                                                   |
|-----------------------------------------|-------------------------------------------------------------------|
| Surface ratio                           | $\psi = 16:1$                                                     |
| Control volume                          | $1.4 \text{ cm}^3$                                                |
| Control pressure                        | $P_{st} = 30\text{-}50 \text{ bars}$                              |
| Blockable internal cylinder pressure    | $P_i = (P_{st} - 4.5) \times \psi$                                |
| <b>Example: 30 bar control pressure</b> | <b><math>P_i = (30 - 4.5) \times 16 = 408 \text{ bars}</math></b> |

The control line is attached to the connecting line of both cylinders, i.e. the control pressure which can be applied to the non-return valve in the cylinder head is also the initial pressure for the cylinder during reciprocating motion, i.e., only one line is needed to the cylinder.

#### Note:

- The pressure in the tank line must be less than 2 bars when blockage occurs.
- The axle mounting should be level, hardened and greased (see Fig. 1).
- Larger stroke differences in the axle design should be avoided.
- Pay particular attention to the central position of the axle's point of rotation in relation to the cylinders.
- The securing surfaces of the cylinder to the sub-assembly must be flat in order to avoid distorting the cylinder housing when bolting together.



Figs 1-6

## 2. Hydraulic switching diagram

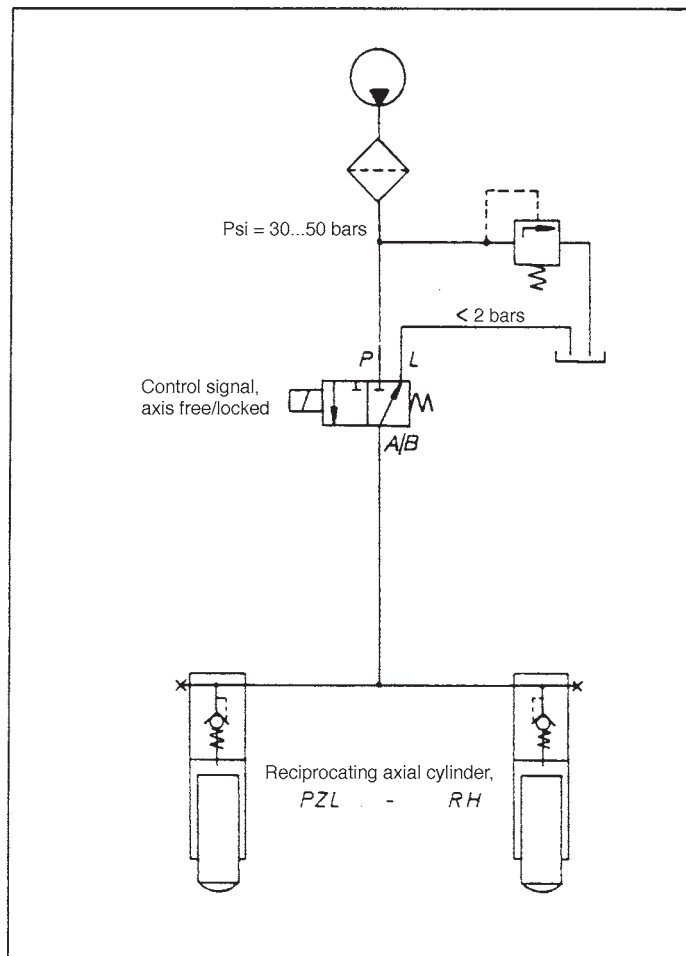


Fig. 2

### 3. Start-up and bleeding

At start-up, all components must be filled with oil and bled of air.

This is done as follows:

- Remove lock bolts from cylinder (pos. 10).
- Press rod down as far as bearing.

**WARNING! Regardless of cylinder type, the check valve case projects fairly far into the oil filler bore. Be careful not to damage the valve case when pressing down on the rod.**

- The rod can also be pressed down hydraulically.
- Fill the cylinder area with oil and re-insert the lock bolts.
- To bleed both cylinders, undo the bleed screws at Pos. 11 and fill with oil until no more air comes out.
- Do up bleed screws but do not tighten. The screws should be easy to loosen.
- Apply control pressure to cylinder and tighten bleed screws until oil comes out without air bubbles. Bleeding is now complete.

**The entire bleeding operation should be carried out under clean conditions.**

### 4. Fault-finding

- a) If the rigid axle fails to support a cylinder, the rod seal, Pos. 7, and the tightness of the check valve case, Pos. 3, should be checked and the parts replaced if necessary.
- b) If the axle cannot be brought to a variable position after switching off and on several times, the following should be checked:
  - At very high cylinder loads the internal cylinder pressure cannot be released (see Functional Description)
  - The unit needs bleeding (see Start-up)
  - If the operation of the axle is not rectified by bleeding, check whether there is adequate control pressure (see Functional Description)
  - If the previous points do not reveal any fault, the smooth operation of the control piston, Pos. 5, of the non-return valve must also be checked (see Repair Instructions).

### 5. Repair Instructions

- a) Changing the rod seal

- Remove lock bolt, Pos. 10.
- Push down and remove rod, Pos. 2.  
**WARNING! Do not damage rod surface.**
- Remove grooved ring using a round-edged tool.  
**WARNING! Do not damage the recess surface.**
- Check scraper, Pos. 6, for damage and replace if necessary.
- Grease seals.
- Re-insert rod.

## HYDRAULIC UNITS

## RAM LOCK CYLINDER

### b) Demounting the non-return valve

- Remove cylinder bolts, Pos. 9.
- Remove cylinder, Pos. 4.
- Remove piston, Pos. 5. The piston should move freely in the non-return valve and in the cylinder.
- Remove non-return valve, Pos. 3, from the inside via the filler bore, Pos. 10.
- Check seals, Pos. 8, 14, 15, 16 and 17 for damage and replace if necessary.
- The non-return valve case cannot be dismounted any further.
- Reassemble components in reverse order above. Grease seals before assembly.
- Torque cylinder bolts, Pos. 9, to 16 Nm.

**WARNING! Use only 12.9 Nm cylinder bolts.**

Before start-up, bleed again as per Point 3 above.

**WARNING! All checking and repair work should be carried out under clean conditions.**

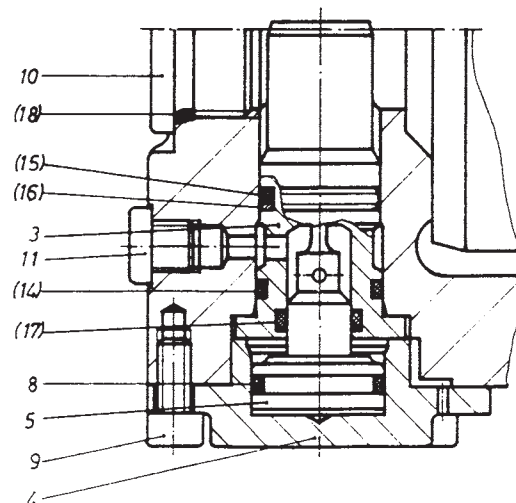
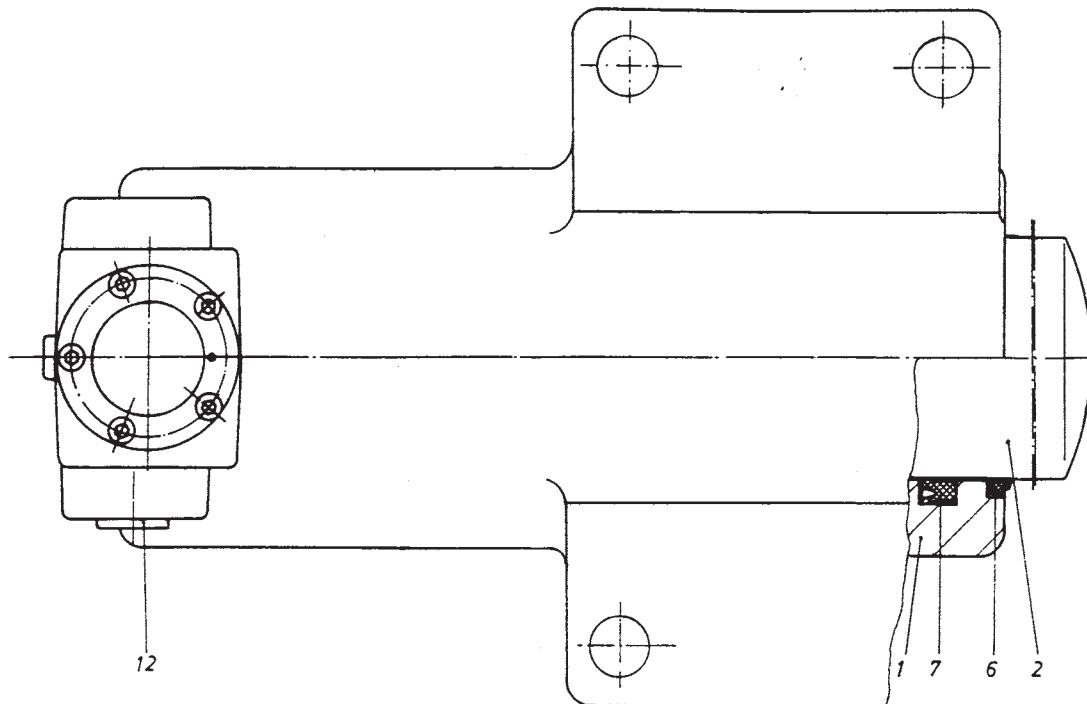
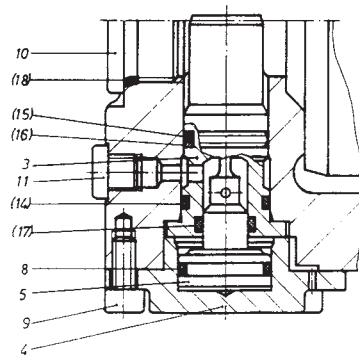
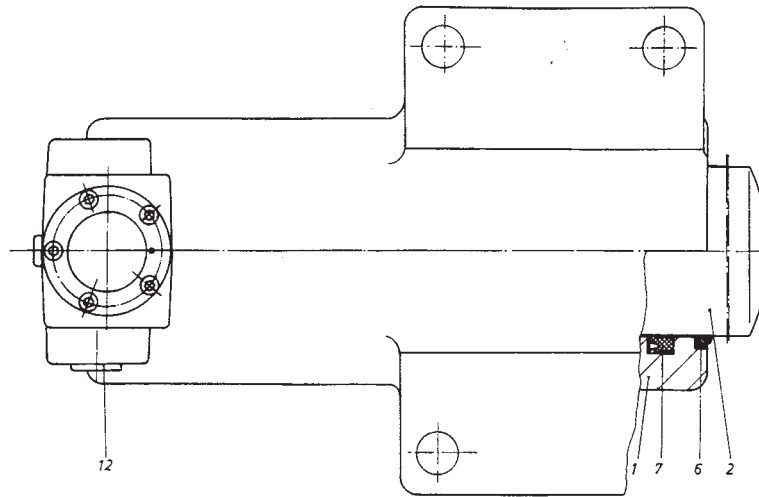


Fig. 3

## RAM LOCK CYLINDER

## HYDRAULIC UNITS



| Torque: |         |
|---------|---------|
| Pos.    | MA (Nm) |
| 9       | 16      |
| 10      | 180     |
| 11      | 10      |
| 12      | 40      |

D = be longing to seal set

|     |                                 |      |                                     |  |
|-----|---------------------------------|------|-------------------------------------|--|
| 1   | Seal set                        |      | D 0640.00.000                       |  |
|     |                                 |      |                                     |  |
| **  | If part in Pos.                 | 10   | Supply separately only for seal set |  |
| 1   | O-ring ** D                     | 18   | 410236                              |  |
|     |                                 |      |                                     |  |
| *   | If part in Pos.                 | 3    | Supply separately only for seal set |  |
| 1   | O-ring * D                      | 17   | 410019                              |  |
| 1   | Back-up ring * D                | 16   | 410391                              |  |
| 1   | O-ring * D                      | 15   | 410027                              |  |
| 1   | O-ring * D                      | 14   | 410401                              |  |
|     |                                 |      |                                     |  |
| 1   | Lock bolt                       | 12   | 310182                              |  |
| 1   | Lock bolt                       | 11   | 310180                              |  |
| 1   | Lock bolt                       | 10   | 310154                              |  |
| 5   | Cylinder bolt                   | 9    | 310200                              |  |
| 1   | O-ring D                        | 8    | 410403                              |  |
| 1   | Grooved ring D                  | 7    | 430079                              |  |
| 1   | Scraper ring D                  | 6    | 440029                              |  |
|     |                                 |      |                                     |  |
| 1   | Piston                          | 5    | 0620.00.003                         |  |
| 1   | Cylinder                        | 4    | 0620.00.002                         |  |
| 1   | Non-return valve case, complete | 3    | 0620.01.000                         |  |
| 1   | Rod                             | 2    | 0640.00.002                         |  |
| 1   | Cylinder housing                | 1    | 0640.00.001                         |  |
| No. | Name                            | Part | Dwg no.                             |  |

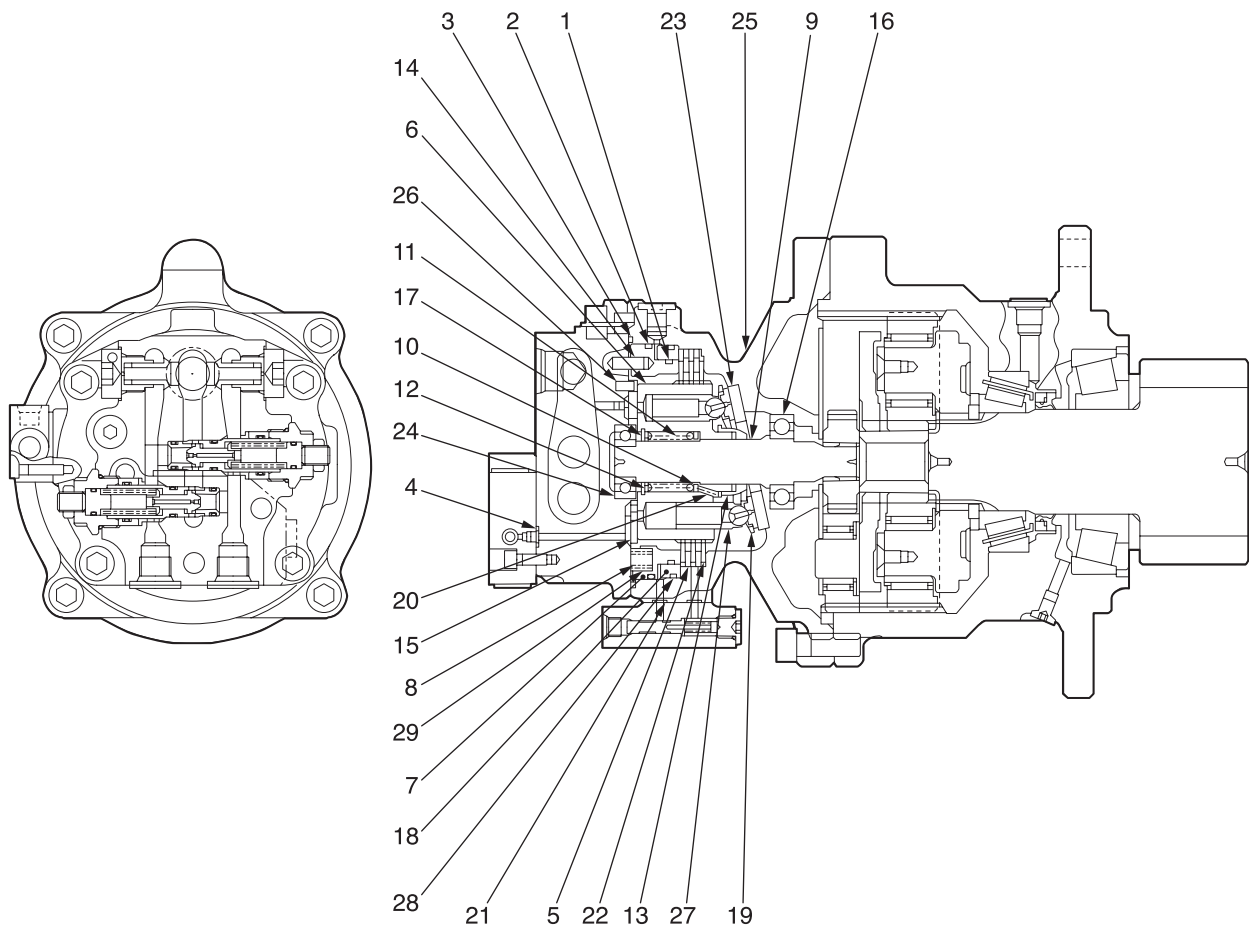




## SLEW MOTOR

### CONSTRUCTION

#### Hydraulic Motor



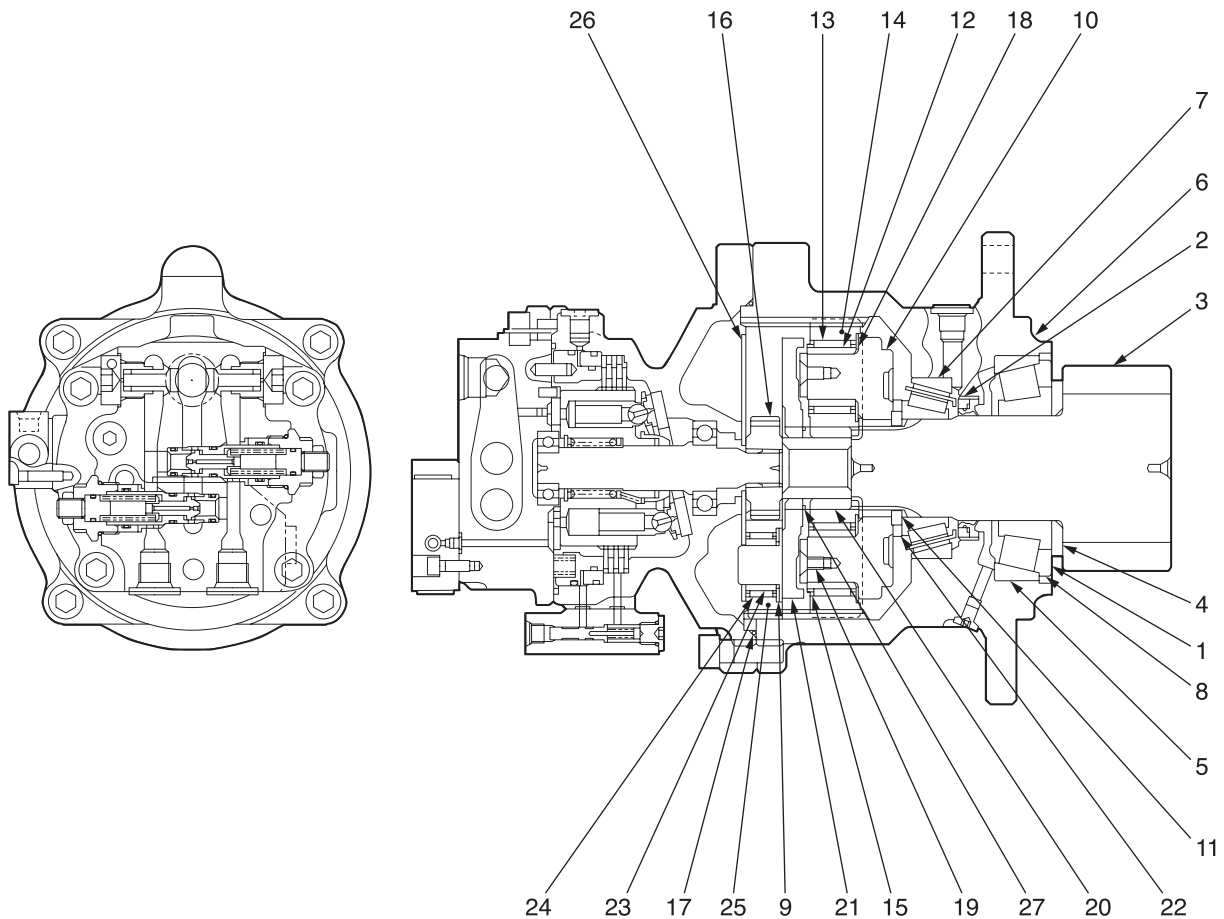
L3D600

- |                   |                 |                 |
|-------------------|-----------------|-----------------|
| 1. O-ring         | 11. Spring      | 21. O-ring      |
| 2. O-ring         | 12. Retainer    | 22. Center Disc |
| 3. O-ring         | 13. Guide       | 23. Swash Plate |
| 4. O-ring         | 14. Pin         | 24. Bearing     |
| 5. Friction Disc  | 15. Valve Plate | 25. Case        |
| 6. Cylinder Block | 16. Bearing     | 26. Pin         |
| 7. Brake Piston   | 17. Snap Ring   | 27. Piston      |
| 8. Spring         | 18. Collar      | 28. O-ring      |
| 9. Shaft          | 19. Shoe Holder | 29. Spring      |
| 10. Retainer      | 20. Pin         |                 |

## HYDRAULIC UNITS

## SLEW MOTOR

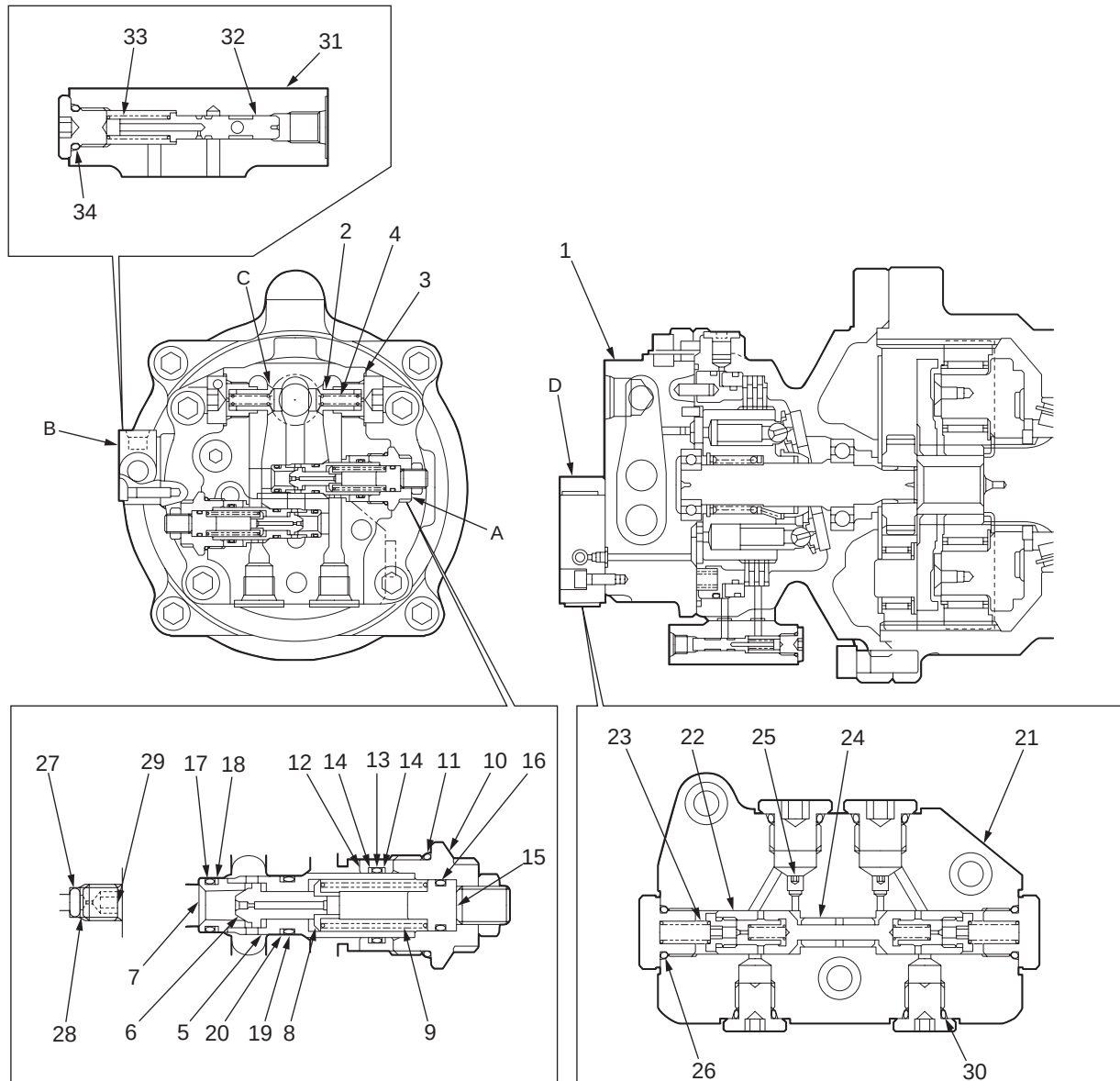
### Reduction Gears



L3D601

- |                  |                    |                      |
|------------------|--------------------|----------------------|
| 1. Plate         | 10. Carrier 2      | 19. Screw            |
| 2. Oil Seal      | 11. Plate          | 20. Sun Gear         |
| 3. Shaft         | 12. Race           | 21. Carrier 1        |
| 4. Collar        | 13. Needle         | 22. Collar           |
| 5. Bearing       | 14. Planetary Gear | 23. Race             |
| 6. Case          | 15. Thrust Plate   | 24. Needle           |
| 7. Bearing       | 16. Drive Gear     | 25. Planetary Gear A |
| 8. Plate         | 17. O-ring         | 26. Thrust Plate     |
| 9. Thrust Washer | 18. Thrust Washer  | 27. Snap Ring        |

# Brake Valve



L3D602

A: Relief Valve  
B: Timer Valve  
C: Check Valve  
D: Anti-rebound Valve

- |            |                 |                          |             |
|------------|-----------------|--------------------------|-------------|
| 1. Cover   | 10. Plug        | 19. O-ring               | 28. Washer  |
| 2. Poppet  | 11. O-ring      | 20. Backup ring          | 29. Orifice |
| 3. O-ring  | 12. Piston      | 21. Body                 | 30. O-ring  |
| 4. Spring  | 13. O-ring      | 22. Check Valve Assembly | 31. Body    |
| 5. Housing | 14. Backup ring | 23. Spring               | 32. Spool   |
| 6. Poppet  | 15. Guide       | 24. Sleeve               | 33. Spring  |
| 7. Seat    | 16. O-ring      | 25. Orifice              | 34. O-ring  |
| 8. Seat    | 17. O-ring      | 26. O-ring               |             |
| 9. Spring  | 18. Backup ring | 27. Filter               |             |

## HYDRAULIC UNITS

## SLEW MOTOR

### OPERATION

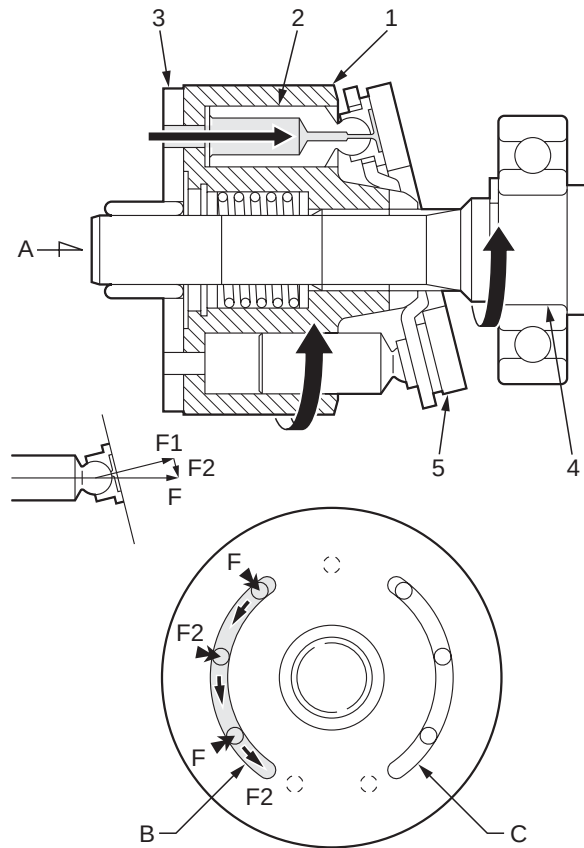
#### Hydraulic Motor

9 pistons (2) are fitted in the cylinder block (1) and there is a valve plate (3) with two half moon ports, B and C in the end. Also, the cylinder block (1) rotates freely and is joined to the shaft (4) via the spline. On the other band, the swash plate (5) is fastened to the housing.

When high pressure oil is introduced into port B, one piston (2) makes contact and force F bears on the swash plate (5).

$F = P \times A$  P: Pressure A: Piston Sectional Area

The force F which the piston (2) applies to the swash plate (5) is divided into force F1, which pushes the plate, and force F2, which rotates the cylinder block (1). The total sum of the components in the direction of rotation of the high pressure side piston generates a rotational force in the cylinder block (1) and via the spline, torque is transmitted to the shaft (4), turning it. Conversely, if high pressure oil is introduced to port C, rotation is the reverse of the above.



E5D603

#### Relief Valve

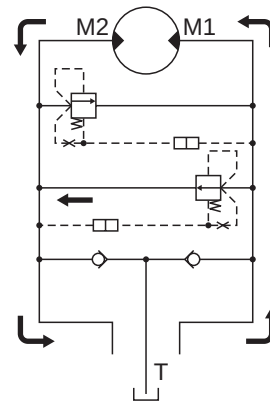
##### Operation 1

When the Motor is Started

When the motor is started, since the inertial load is great, the pressure of the oil required to accelerate it rises. If this pressure reaches the relief valve set pressure, the relief valve operates and oil returns to port M2.

In this way, the motor begins to turn as it relieves the relief valve, and as the rotational speed increases, the amount of relief decreases until it stops.

In this way, the shock during starting is absorbed.

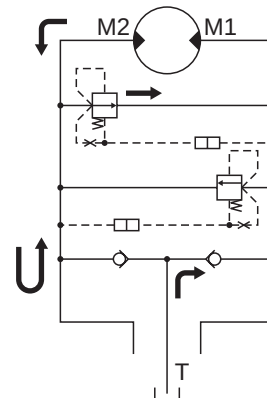


E5D605

##### When the Motor is Stopped

When the motor is stopped, the return circuit is closed off.

However, since the motor tends to want to continue rotating due to inertial energy, the pressure in port M2 rises. When this pressure reaches the relief valve's set pressure, the relief valve operates and oil flows to port M1. In this way, the flow of oil to port M1 prevents cavitation from occurring as it absorbs the shock during stopping.



E5D606

## SLEW MOTOR

## HYDRAULIC UNITS

### Operation 2

Since this relief valve has a shockless mechanism, it operates in 2 steps.

#### 1st Step

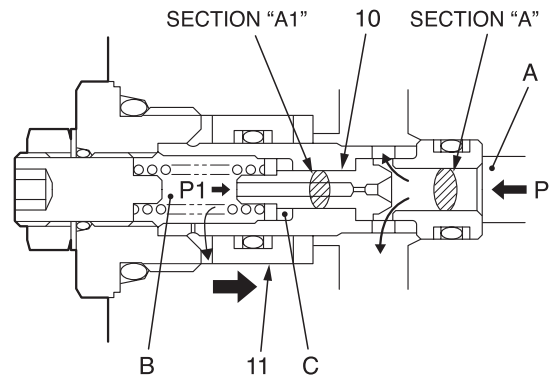
When relief valve operation starts, the pressure in chamber B (P1) is kept at a pressure which is lower than that in chamber C while the pressure in chamber A (P) becomes higher than the pressure of the oil flowing in.

At this time, there are two forces acting on the poppet (10), force (F), which attempts to move the poppet (10) to the left and force (F1) which pushes against the seat on the right side. Since  $F = P \times A$ ,  $F1 = P1 \times A1$ ,  $P > P1$  and  $A > A1$ , the poppet (10) is moved to the left by this force " $F - F1$ ".

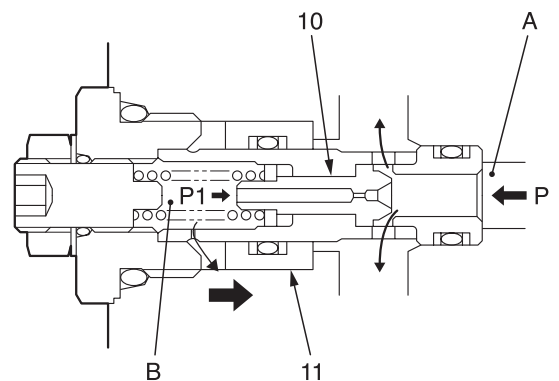
This opens a supply side circuit from chamber A and lets the pressure escape. That is, during the time piston (11) is moving to its stroke end, the relief valve operates at low pressure (about 1/3 the set pressure).

#### 2nd Step

When the piston (11) reaches the stroke end, the pressure in chamber B rises and the pressures in chamber A and chamber B equalize. At this time, the force moving the poppet (10) to the left side becomes " $P = P1$ ", so this becomes " $A - A1$ " and the relief valve operates at the specified set pressure.



L3D603E



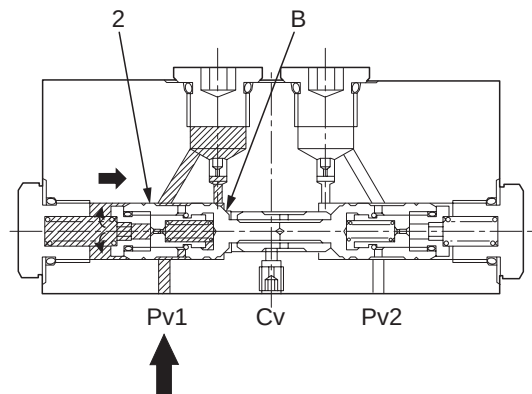
L3D604

### Anti-rebound Valve

When the motor stops, this valve will connect the motor main circuit to the makeup circuit for a prescribed time to prevent motor rebound due to the pressure in the main circuit.

#### When the Brake is Actuated

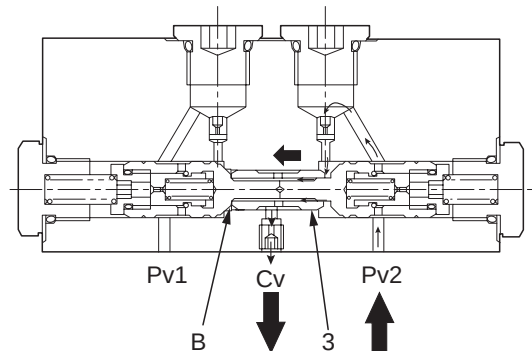
The braking pressure generated at the port Pv1 will move the check valve (2) to the right until it is seated at section B.



G4D604

#### When the Motor Rebounds

When the motor is stopped by braking operation of the brake valve, it starts to rebound due to the pressure in the main circuit. This rebound pressure generated at the port Pv2 will move the sleeve (3) to the left to open the passage. This then releases the rebound pressure to the port Cv.

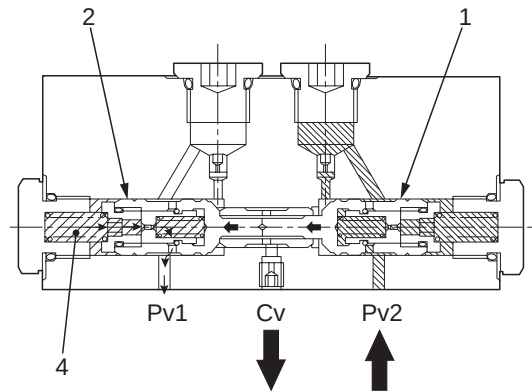


G4D605

## HYDRAULIC UNITS

## SLEW MOTOR

The rebound pressure also pushes the check valve (1) to the left, which is the opposite direction of pushing at the time of braking. The flux control valve built in the check valve (2) (that is now on the lower pressure side) releases the oil in the damper chamber (4) at a constant flux. Therefore, the check valve (1) moves at a constant speed. When the check valve reaches its stroke end, the passage from the port Pv2 to the port Cv is closed.



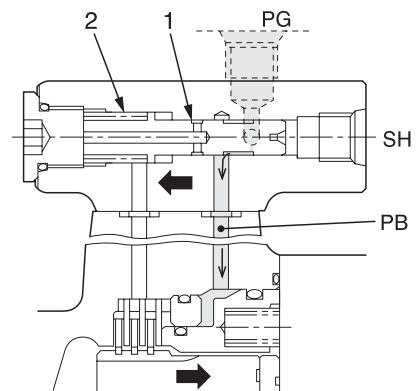
G4D606

### Timer Valve

This function is used to prevent sudden operation of the parking brake when the motor is stopped.

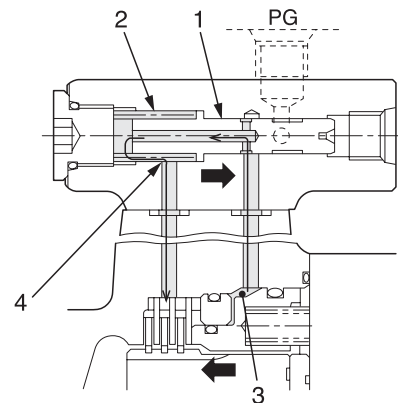
At the time of parking brake operation, pressure oil from the port P4 is supplied at all times to the port PG, the valve spool (1) is pushed to the right by the force of the spring (2), and the port PG is closed.

When turning pilot pressure or arm pilot pressure is led to the port SH, the spool (1) is moved to the left against the force of the spring (2), and the port PG is opened. The pressure oil from the port PG passes through the hole at the center of the spool (1) and is led to the parking brake release port (PB), so that the parking brake is released.



L3D605

When the pilot pressure at the port SH disappears, the spool (1) is moved by the force of the spring (2) to the right, the port PG is closed, and the oil in the brake piston chamber (3) is prevented from escaping. The oil in the chamber flows gradually through the orifice (4) at the outer circumference of the spool (1) to the drain port dr, so that the parking brake is not applied rapidly, but after a certain time, just as if a timer were used.

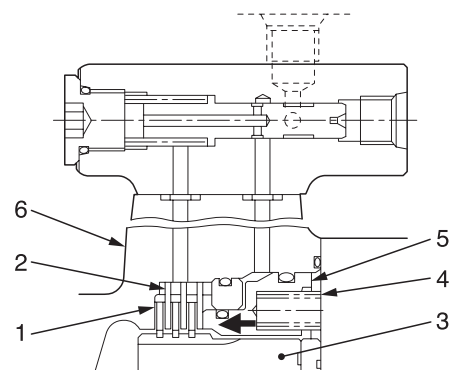


L3D606

### Parking Brake

The center discs (1) are connected to the housing and the friction discs (2) are connected to the cylinder block (3) via the spline, respectively. The center discs (1) and friction discs (2) are pressed against the housing (6) by the springs (4) via the brake piston (5). The friction force between these discs generates the brake torque to prevent the cylinder block (3) from rotating.

When the pressure oil is introduced into the motor, the oil flows from the parking brake release port (7) into the brake piston chamber (8). The oil pressure over-

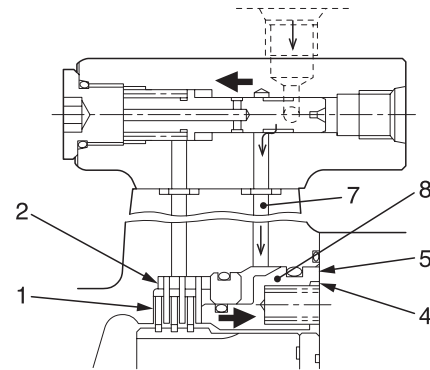


L3D607

## SLEW MOTOR

## HYDRAULIC UNITS

powers the spring force and moves the brake piston (5) to the right. This generates a clearance between the center discs (1) and friction discs (2) to release the parking brake. When the motor stops, the spool returns to the neutral position to close the parking brake release port (7). The pressure oil in the brake piston chamber (8) is introduced into the motor case and the spring (4) operates the parking brake.

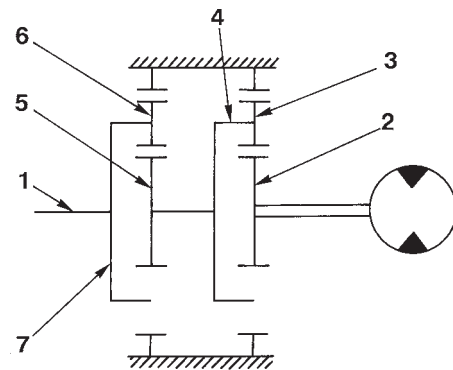


L3D608

### Reduction Gears

The reduction gear is composed of a 2-stage planetary gear mechanism, and it converts the high-speed operation of the motor to low speed torque for operation of the pinion shaft (1).

In the figure on the right, the drive force transmitted from the motor output shaft is transmitted to the second stage sun gear (5) via the first stage drive gear (2), the planetary gear (3) and the carrier 1 (4). Drive force is transmitted in the same way to the pinion shaft (1) via the second stage sun gear (5), the planetary gear (6), and the carrier 2 (7), and this becomes the slewing drive force.



Y3-D603

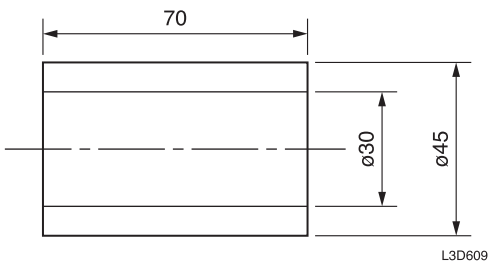
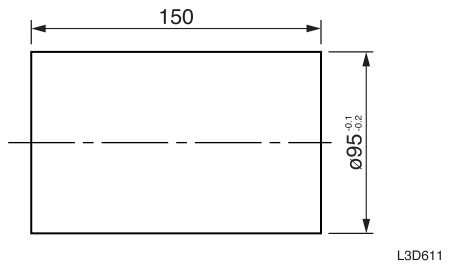
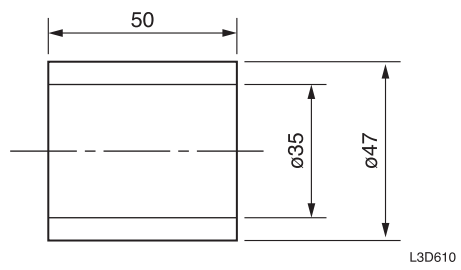
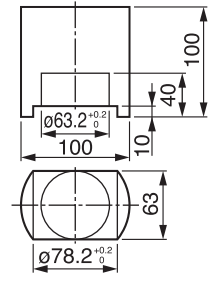
## HYDRAULIC UNITS

## SLEW MOTOR

## DISASSEMBLY AND ASSEMBLY

## Table of Special Tools

Unit: mm

|   | NAME, DIMENSIONS                                                                                                |   | NAME, DIMENSIONS                                                                                                  |
|---|-----------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------|
| 1 | <p>JIG (A)</p>  <p>L3D609</p>  | 3 | <p>JIG (C)</p>  <p>L3D611</p>   |
| 2 | <p>JIG (B)</p>  <p>L3D610</p> | 4 | <p>JIG (D)</p>  <p>L3D612</p> |

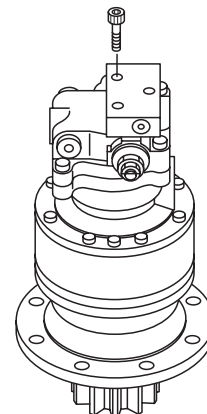
## General Cautions

- Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
- Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
- Wash the disassembled parts and dry them with compressed air. Do not use a rag, as this could cause clogging of dirt.
- Make match marks on each part so that they will be assembled in the same positions when reassembled.
- Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
- Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.

## Disassembly

## Slew Motor

1. Remove the cap screws and then the anti-rebound valve.



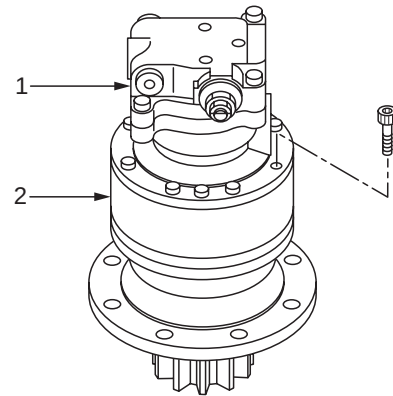
K3D626



## SLEW MOTOR

## HYDRAULIC UNITS

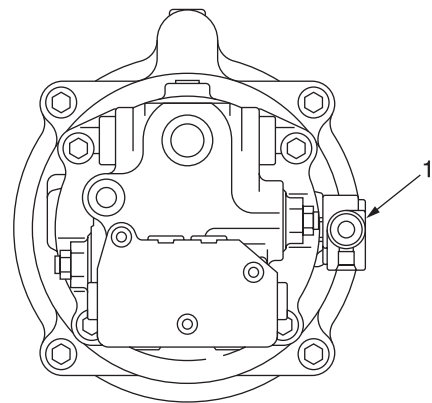
2. Remove the cap screws to disassemble the motor into the hydraulic motor (1) and the reduction gear (2).
  - Mark the mating position on both the hydraulic motor and the reduction gear so that they can be mated correctly when reassembling.
  - Fix the hydraulic motor with a vise.



K3D627

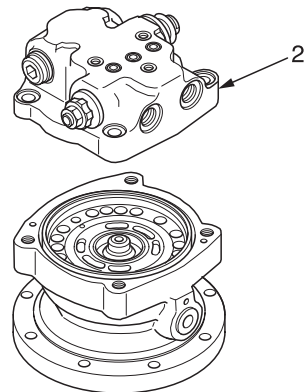
### Brake Valve and Hydraulic Motor

1. Remove the cap screws and then the timer valve (1).
  - Be careful not to miss the O-ring.



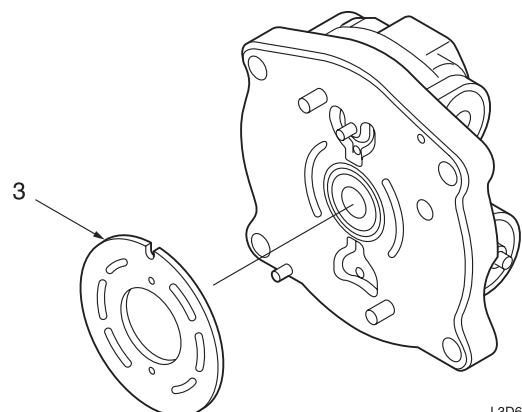
L3D613

2. Remove the cap screws and then the cover (2).
  - Fix the hydraulic motor with a vise.
  - Be careful not to let the valve plate drop off.



K3D629

3. Remove the valve plate (3) from the cover.

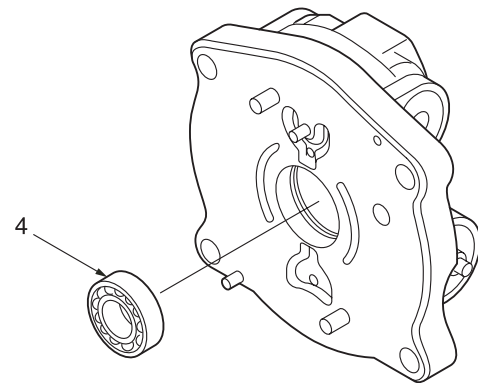


L3D614

## HYDRAULIC UNITS

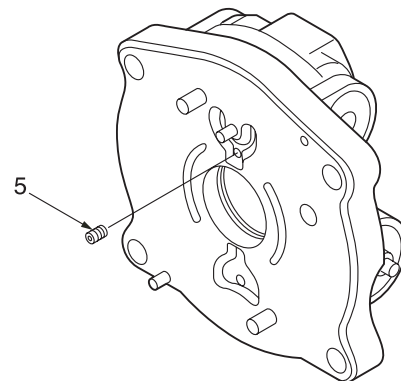
## SLEW MOTOR

4. Remove the bearing (4).



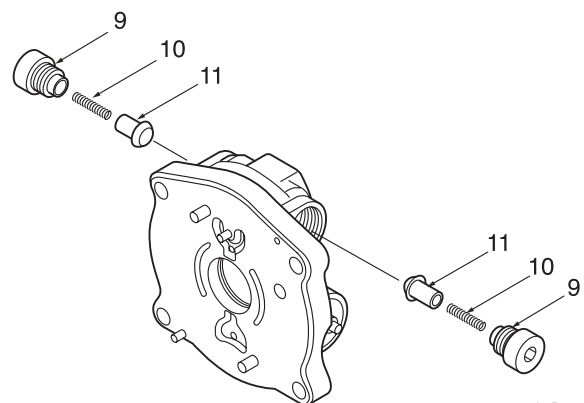
L3D615

5. Remove the orifice (5).
- The orifice is caulked. Do not remove it unless necessary.



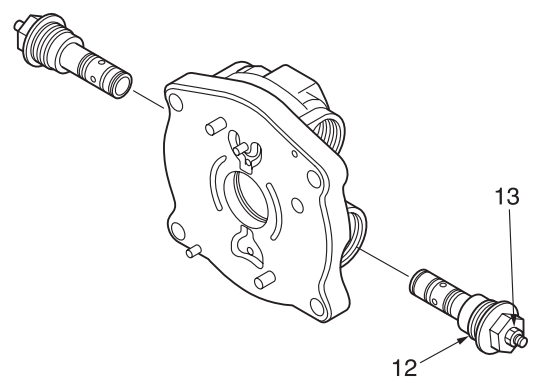
L3D616

6. Remove the check valve.
- a. Remove the plug (9).
  - b. Remove the spring (10) and check valve (11).



L3D617

7. Remove the relief valve (12).
- Do not loosen the set screw nut (13).
  - Do not disassemble the relief valve.

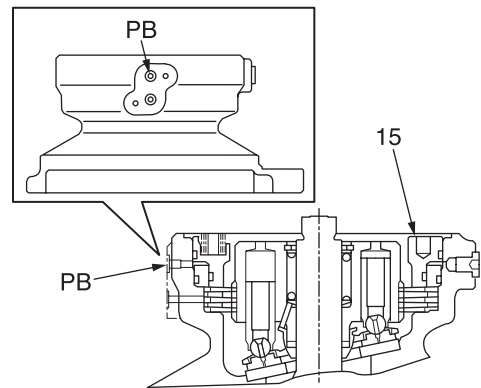


L3D618

## SLEW MOTOR

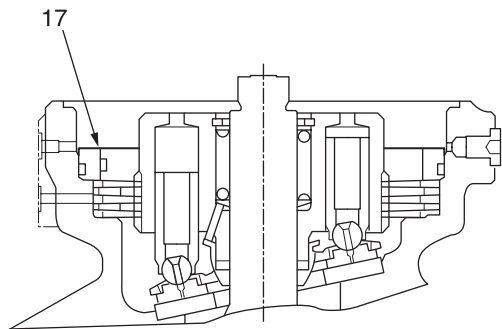
## HYDRAULIC UNITS

8. Remove the brake piston (15).
  - Blow the air from the brake release port PB with care such that the brake piston does not protrude.



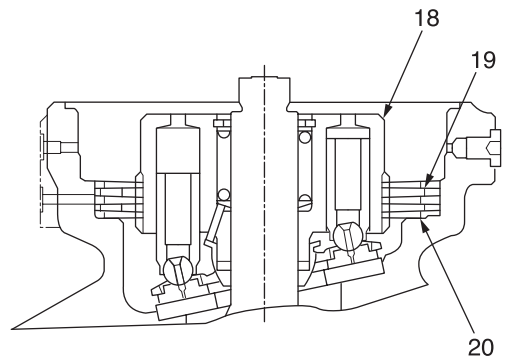
L3D619

9. Remove the collar (17).



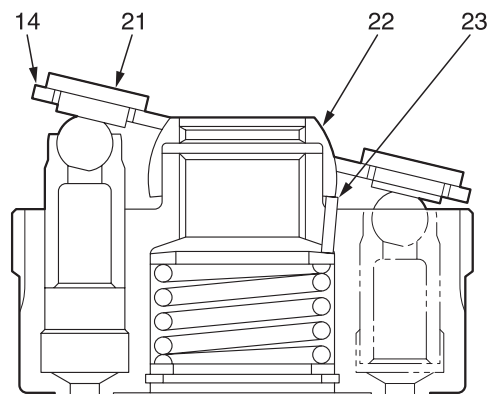
L3D620

10. Remove the cylinder block (18), friction discs (19) and center discs (20).



L3D621

11. Remove the shoe holder (14) and piston assembly (21) from the cylinder block.
12. Remove the guide (22) and pins (23) from the cylinder block.



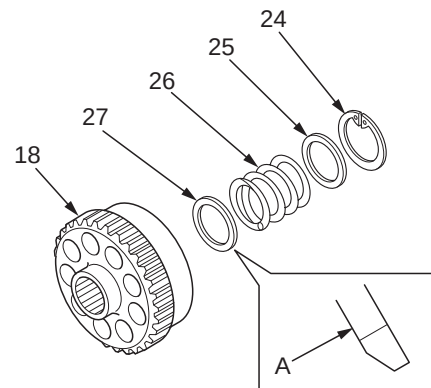
L3D622

## HYDRAULIC UNITS

## SLEW MOTOR

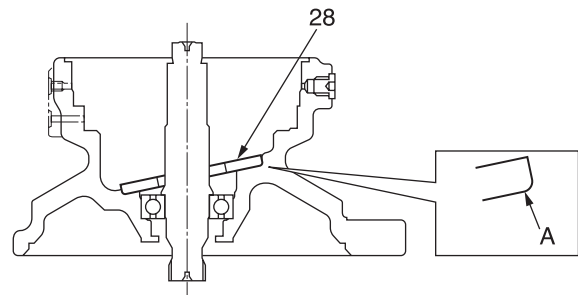
13. Remove the snap ring (24), retainer (25), spring (26) and retainer (27) from the cylinder block (18).

- Do not disassemble these parts unless necessary. These parts should be replaced as one assembly.



E5D622

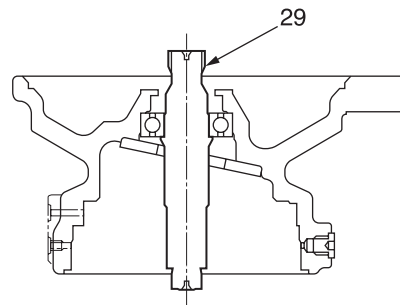
14. Remove the swash plate (28).



L3D623

15. Remove the shaft (29).

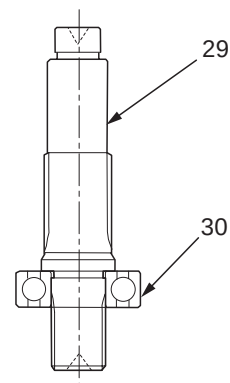
- Lightly tap the end face with a plastic hammer.



L3D624

16. Remove the bearing (30) from the shaft (29).

- Do not disassemble these parts unless necessary. The removed bearing cannot be used again.



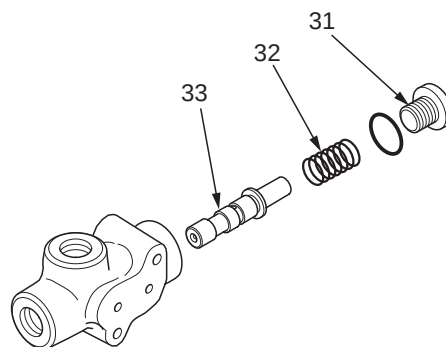
K3D643

## SLEW MOTOR

## HYDRAULIC UNITS

### 17. Disassemble the timer valve.

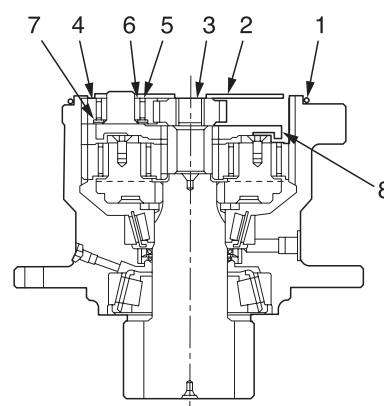
- Be careful not to damage or deform the contact surface.
- a. Remove the plug (31).
- b. Remove the spring (32) and spool (33).
- Use a pair of tweezers.



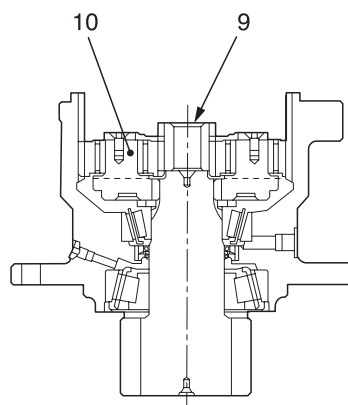
K3D644

### Reduction Gears

1. Remove the O-ring (1).
2. Remove the thrust plate (2).
3. Remove the drive gear (3).
4. Remove the planetary gear A (4), needles (5) and inner race (6).
5. Remove the thrust washer (7).
6. Remove the carrier 1 (8).
7. Remove the sun gear (9).
8. Remove the carrier 2 assembly (10).

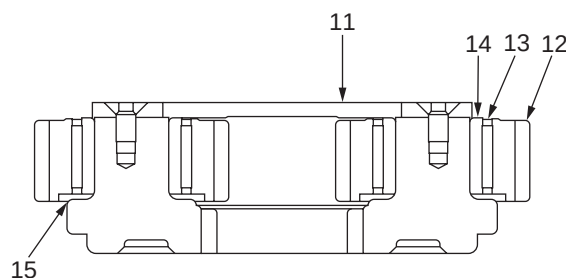


L3D625



L3D626

9. Loosen the screw and remove the thrust plate (11).
- Loctite has been applied to the screw. Warming the screw screws (for example, using a portable drier) will make its removal much easier.
10. Remove the planetary gear B (12), needle (13), inner race (14) and the thrust washer (15).

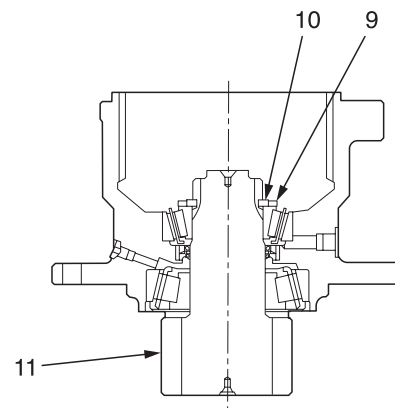


L3D627

## HYDRAULIC UNITS

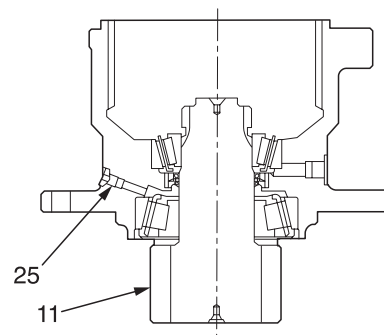
## SLEW MOTOR

11. Remove the collar (9) and plate (10).
- Do not disassemble these parts unless necessary. These parts should be replaced as one assembly.



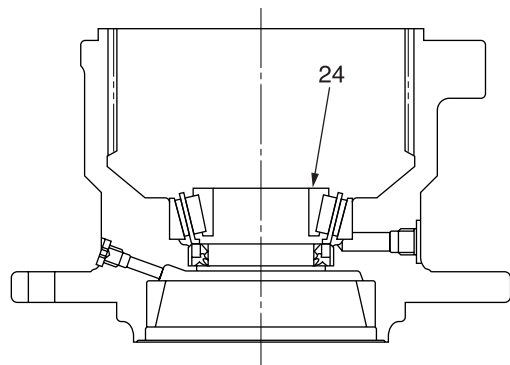
L3D628

12. Remove the shaft (11) from the case.
- Be careful not to miss the shaft.
  - If the shaft will not come out easily, lightly tap it with a plastic hammer.
  - To replace the taper roller bearing or collar, the case assembly should be replaced.



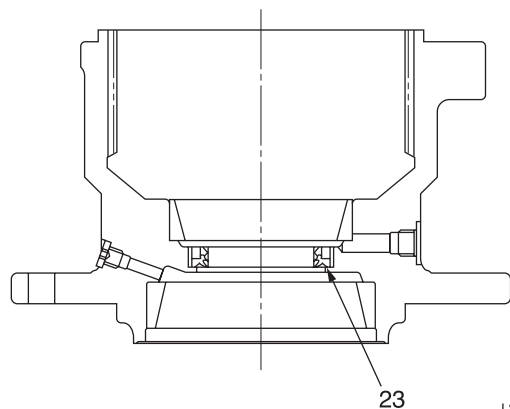
L3D629

13. Remove the inner race (24) of the taper roller bearing.



L3D630

14. Remove the oil seal (23).
- Use a flat blade screwdriver.
  - The oil seal should be replaced with a new one every time it is disassembled.
  - Be careful not to damage the outer race of the taper roller bearing.

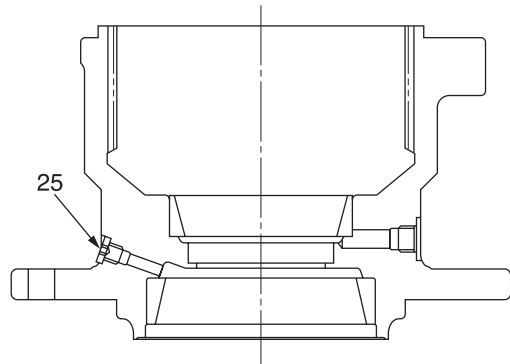


L3D631

## SLEW MOTOR

## HYDRAULIC UNITS

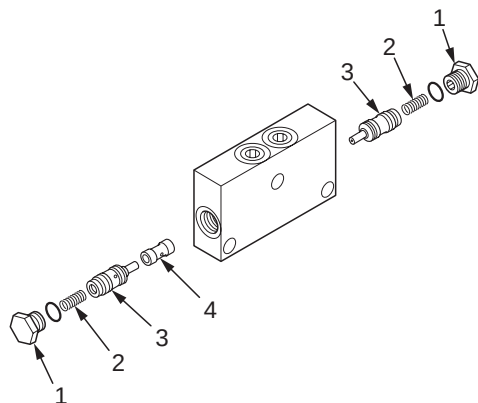
15. Remove the plug (25) from the case.



L3D632

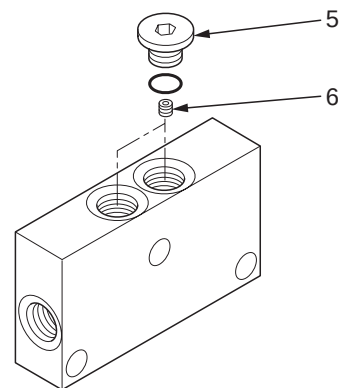
### Anti-rebound Valve

1. Remove the plug (1) and then the spring (2).
2. Remove the check valve assembly (3).
3. Remove the sleeve (4).



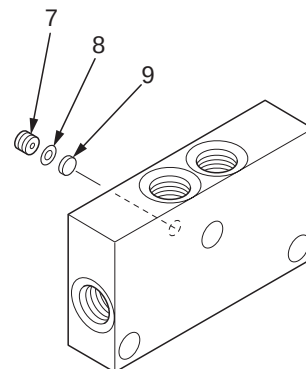
G4D613

4. Remove the plug (5) and then the orifice (6).



G4D614

5. Remove the orifice (7), washer (8) and filter (9).
  - The filter should be replaced with a new one every time the anti-rebound valve is disassembled.



G4D615

## HYDRAULIC UNITS

## SLEW MOTOR

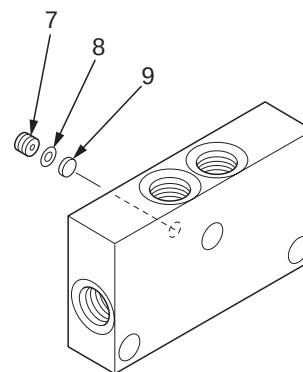
### Assembly

#### Anti-rebound Valve

1. Mount the filter (9), washer (8) and orifice (7) on the body.

- Use a new filter.

⌘ Orifice: 4.9 N·m



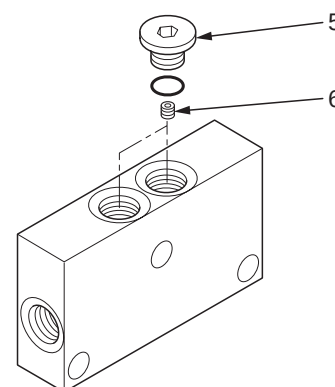
G4D615

2. Mount the orifice (6) on the body.

⌘ Orifice: 2.45 N·m

3. Fit the O-ring to the plug (5), and mount them on the body.

⌘ Plug: 61.8 N·m



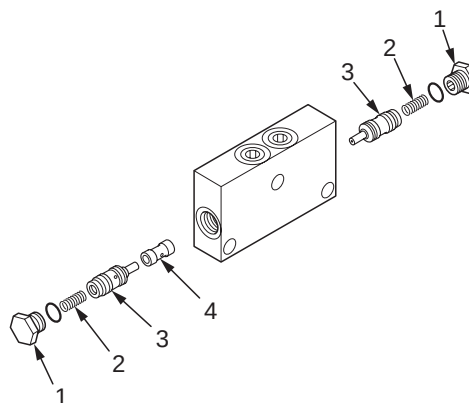
G4D614

4. Mount the sleeve (4) on the body.

5. Mount the check valve assembly (3) and the spring (2) on the body.

6. Fit the O-ring to the plug (1), and mount them on the body.

⌘ Plug: 61.8 N·m



G4D613

#### Brake Valve and Hydraulic Motor

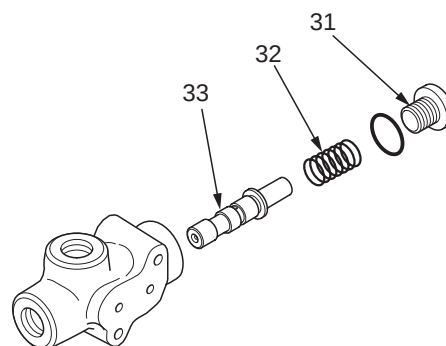
1. Assemble the timer valve.

- Be careful not to damage the rotation section of the valve.

- a. Mount the spool (33) and spring (32) on the body.

- b. Fit the O-ring to the plug (31) and mount them on the body.

⌘ Plug: 39.2 ±2.0 N·m



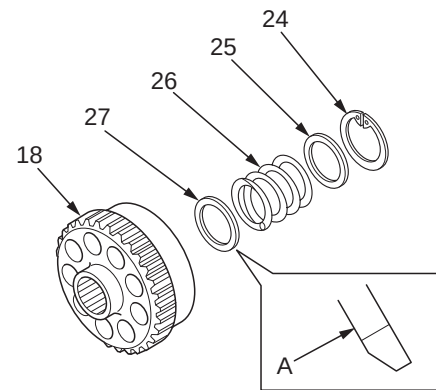
K3D644



## SLEW MOTOR

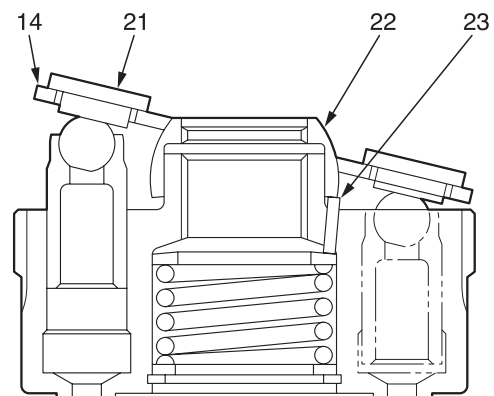
## HYDRAULIC UNITS

2. Mount the retainer (27), spring (26), retainer (25) and snap ring (24) on the cylinder block (18).
  - To mount the snap ring, push the retainer (25) by using the press and jig (C).
  - Position the retainer (27) so that its tapered side (A) faces the cylinder block.



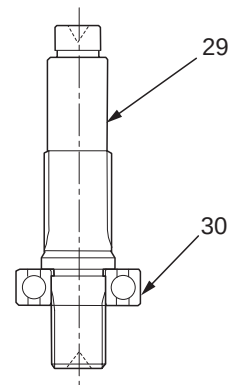
E5D622

3. Fit the pins (23) to the cylinder block.
  - Apply grease to the pins.
4. Mount the guide (22).
5. Fit the shoe holder (14) to the piston assembly (21) and mount them on the cylinder block.
  - Apply the hydraulic oil to the rotation section.



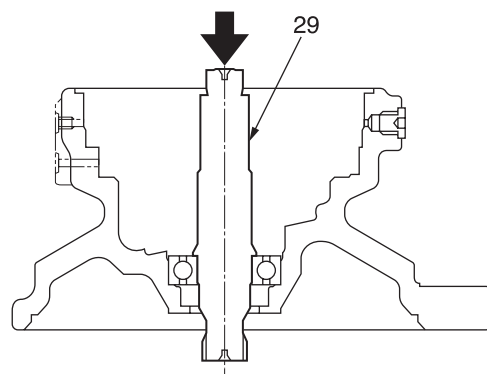
L3D622

6. Insert the bearing (30) into the shaft (29).
  - Insert the bearing by using the press and jig (A).



K3D643

7. Install the shaft (29) in the housing.
  - Lightly tap with a plastic hammer to install.

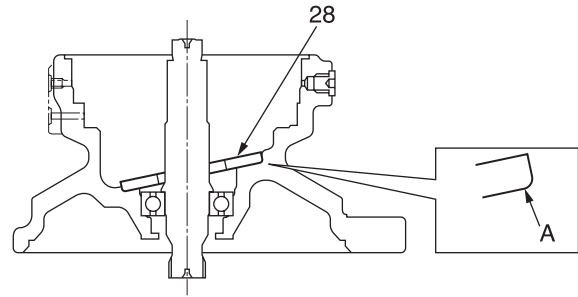


L3D633

## HYDRAULIC UNITS

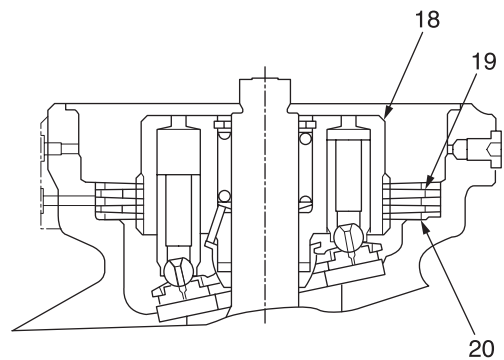
## SLEW MOTOR

8. Install the switch plate (28) in the housing.
  - Apply grease to the side (A) of the swash plate.



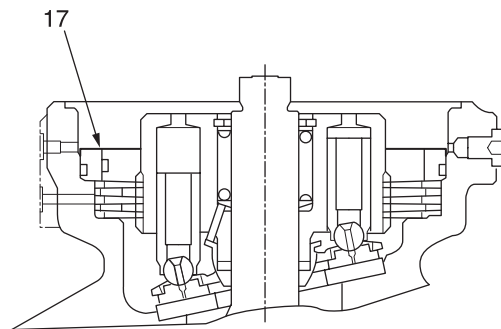
L3D623

9. Install the cylinder block (18) in the housing.
  - Be careful not to let the shoe holder or other parts drop off.
  - Use the press to insert.
10. Mount the center discs (20) and the friction discs (19).
  - Total number of friction discs: 2
  - Total number of center discs: 3
  - Be careful of the mounting order.



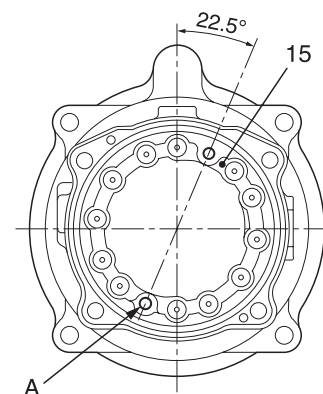
L3D621

11. Fit the O-ring to the collar (17) and insert them in the housing.



L3D620

12. Fit the O-ring to the brake piston (15) and insert them in the housing.
  - Use the press to insert.
  - Make sure that the pin hole (A) of 8.5 mm in diameter is positioned as shown in this figure.

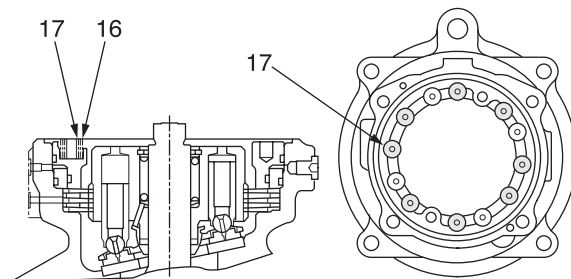


L3D634

## SLEW MOTOR

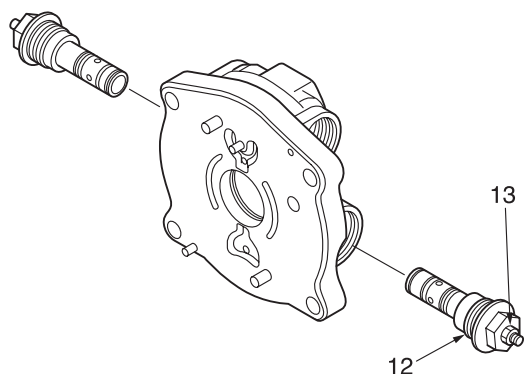
## HYDRAULIC UNITS

13. Install twelve large springs (16), eight small springs (17), and the O-ring.
  - Make sure that the eight small springs (17) are positioned as shown in this figure.



L3D635

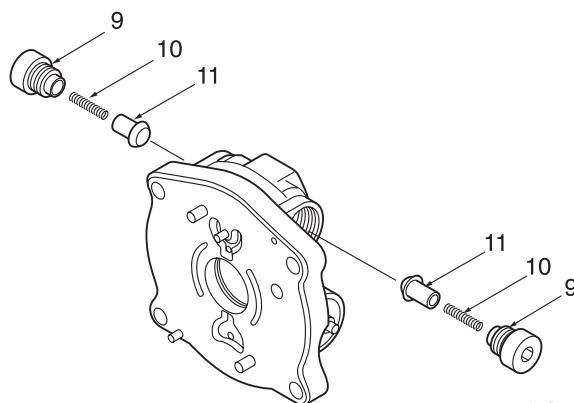
14. Fit the O-rings and backup rings to the relief valve (12).
15. Mount the relief valve assembly on the cover.
  - Be careful not to let the spring jump out.
  - ⌘ Plug:  $37 \pm 20 \text{ N}\cdot\text{m}$
  - Do not loosen the lock nut (13).



L3D618

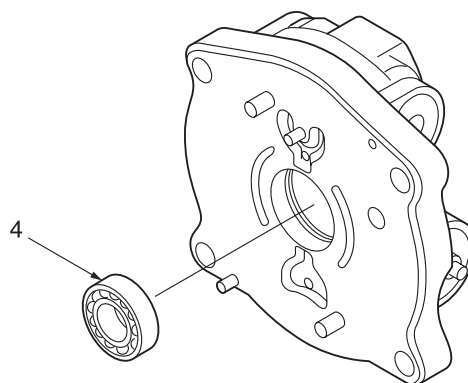
16. Mount the check valve.
  - a. Mount the spring (10) and poppet (11) on the cover.
  - b. Fit the O-ring to the plug (9) and mount them on the cover.

⌘ Plug:  $157 \pm 10 \text{ N}\cdot\text{m}$



L3D617

17. Insert the bearing (4) into the cover.
  - Use the jig (B) and the press to insert.



L3D615

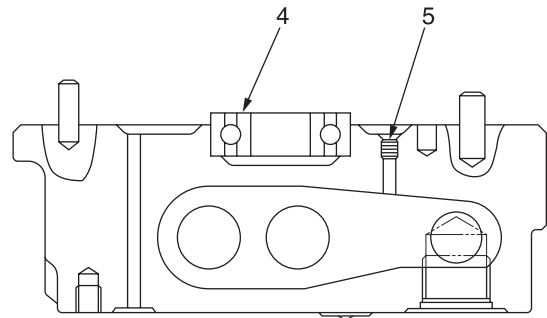
## HYDRAULIC UNITS

## SLEW MOTOR

18. Fit the pin to the cover.

19. Mount the orifice (5) on the cover.

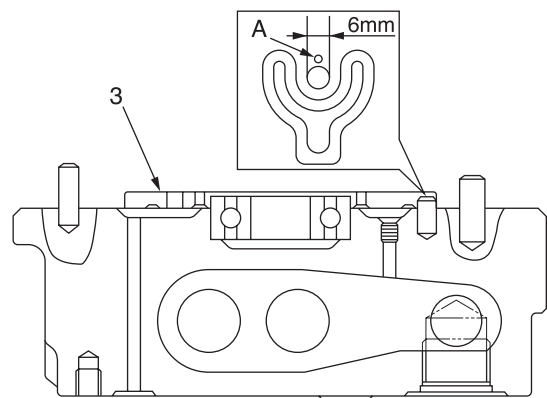
- Caulk the circumference of the orifice female screw by using a punch.



L3D636

20. Mount the pin and valve plate (3) on the cover.

- Apply grease on the back of the valve plate (the side facing the cover) in advance to prevent the plate from dropping off.
- Upon mounting the pin, caulk the position (A) using the punch as shown in this figure.

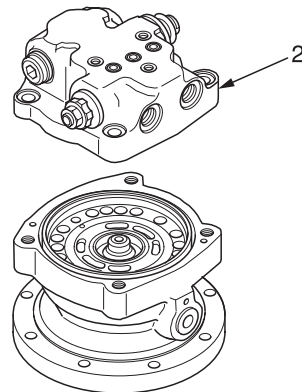


L3D637

21. Mount the cover (2) on the case and fix them with the cap screws.

- Be careful not to let the valve plate drop off.

⌘ Cap screw:  $127 \pm 10$  N·m

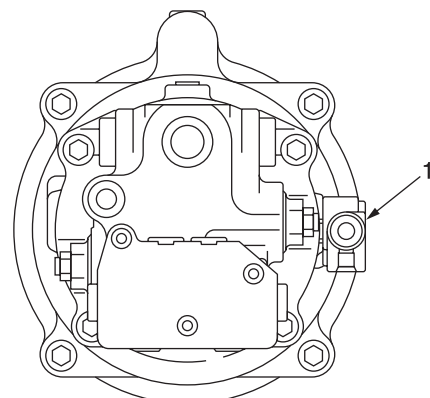


K3D629

22. Mount the timer valve (1).

- Fit the O-ring to the case.
- Mount the timer valve and fix it with the screw.

⌘ Screw:  $39.2 \pm 2.0$  N·m



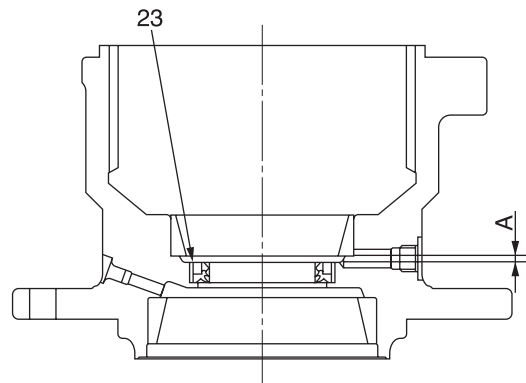
L3D613

## SLEW MOTOR

## HYDRAULIC UNITS

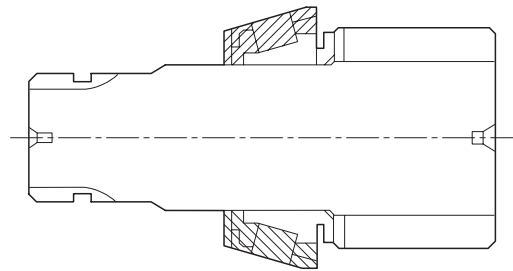
### Reduction Gears

1. Insert the oil seal (23) into the case.
  - Use the jig (C) and the press to insert.
  - The oil seal diameter (A) after insertion should be 4.25 mm.



L3D638

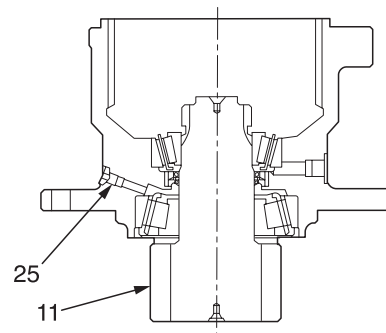
2. Put grease into the inner race of the taper roller bearing.
  - Grease type: Shell ALVANIA Grease
  - Grease volume: 80~90 mL



E5D629

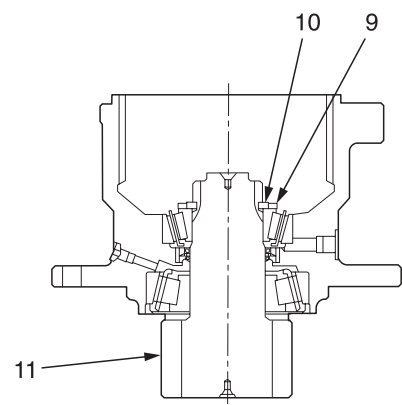
3. Mount the shaft (11) and plug (25) on the case.
  - The shaft (11) should be mounted before mounting the plug (25).

⚙️ Plug:  $15.7 \pm 0.8 \text{ N}\cdot\text{m}$



L3D629

4. Mount the plate (10) and collar (9).
  - Mount the collar while loading the 11770 N on the inner race using the jig (D).

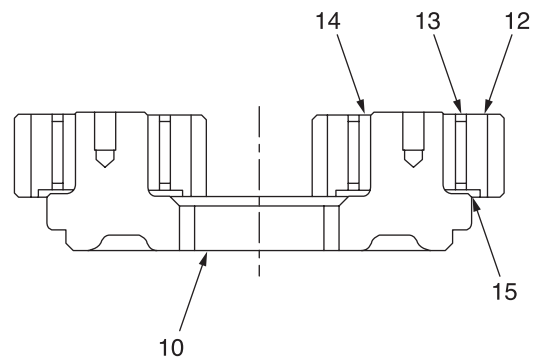


L3D628

## HYDRAULIC UNITS

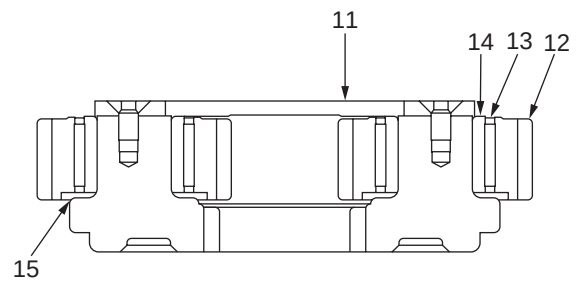
## SLEW MOTOR

5. Mount the thrust washer (15), inner race (14), needles (13) and planetary gear B (12) on the carrier 2 (10).



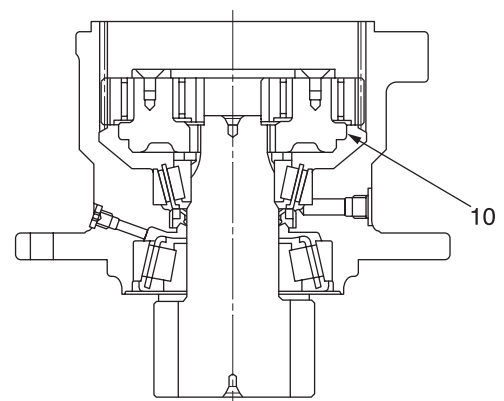
L3D639

6. Mount the thrust plate (11) on the carrier 2 (10) and fix them with the cap screws.
- Apply Loctite #242 to the cap screws.
- ⌘ Cap screw:  $24.5 \pm 4.9 \text{ N}\cdot\text{m}$



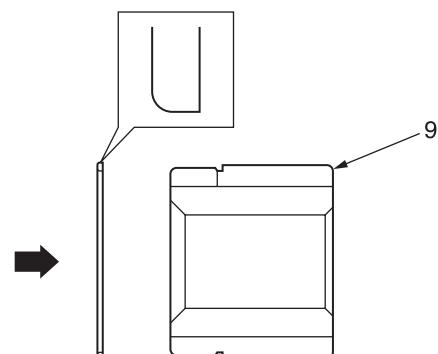
L3D627

7. Mount the carrier 2 (10) on the case.



L3D640

8. Fit the snap ring on the sun gear (9).

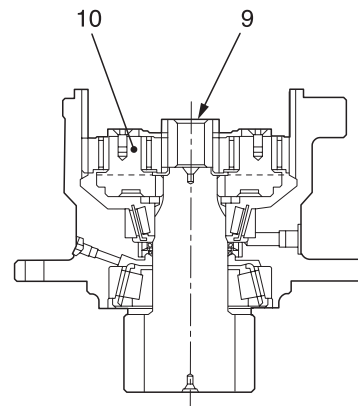


L3D641

## SLEW MOTOR

## HYDRAULIC UNITS

9. Mount the sun gear (9).

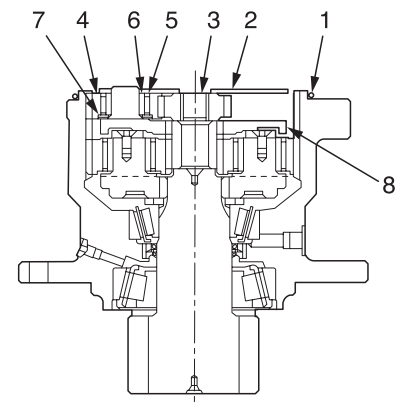


L3D626

10. Mount the carrier 1 (8).

11. Mount the thrust washer (7), inner race (6), needles (5), planetary gear A (4), drive gear (3) and thrust plate (2) on the carrier 1 (8).

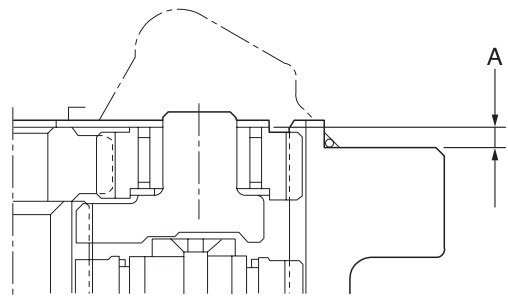
- Measure the depth (A) from the case end to the carrier 1 and select a proper thickness for the thrust plate by referring to the table.
- The largely-rounded side of the thrust plate circumference should face the planetary gear.



L3D625

| Depth (A)              | From 5.3 to less than 5.8 mm | From 5.8 to less than 6.5 mm | From 6.5 to 7.0   |
|------------------------|------------------------------|------------------------------|-------------------|
| Thrust plate thickness | $2.8 \pm 0.14$ mm            | $2.3 \pm 0.12$ mm            | $1.8 \pm 0.10$ mm |

12. Fit the O-ring (1) to the case.

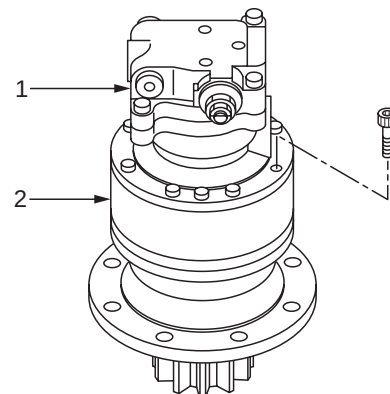


L3D642

### Slew Motor

1. Unite the hydraulic motor (1) and the reduction gear (2) and fix them with the cap screws.

⌘ Cap screw:  $177 \pm 10$  N·m

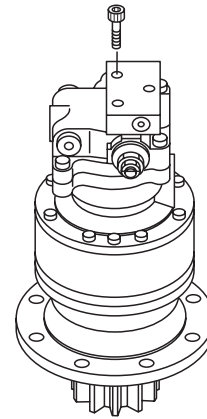


K3D627

## HYDRAULIC UNITS

## SLEW MOTOR

2. Fit the O-ring to the cover.
3. Fit the anti-rebound valve to the cover and mount the washer, seal and screws.  
🔧 Screw:  $32.4 \pm 2.0 \text{ N}\cdot\text{m}$



K3D626



## SLEW MOTOR

## HYDRAULIC UNITS

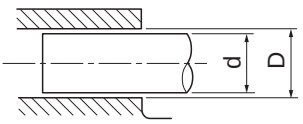
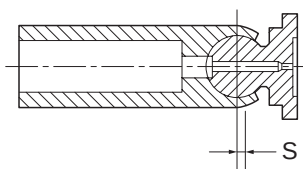
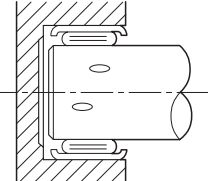
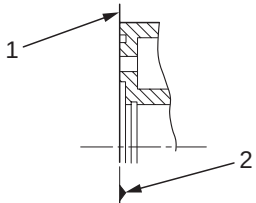
### INSPECTION AND ADJUSTMENT

#### Checking the Parts

##### Brake Valve

| Parts                 | Judgement Criteria                                                                                                                                                                                                                    | Treatment                                                                                   |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Check Valve, Piston   | <ul style="list-style-type: none"> <li>Scratches in sliding portions are deep or roughness is severe.</li> <li>The clearance with the body is large.</li> <li>Scratches in sliding portions are deep or seating is uneven.</li> </ul> | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ul> |
| Housing               | <ul style="list-style-type: none"> <li>Scratches in sliding portions are deep or roughness is severe.</li> <li>There are scratches where oil leakage occurs.</li> </ul>                                                               | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> </ul>                  |
| Relief Valve Assembly | <ul style="list-style-type: none"> <li>The set pressure drops abnormally low.</li> <li>The set pressure is unstable and vibration occurs.</li> <li>There is a lot of leakage due to faulty seating, etc.</li> </ul>                   | <ul style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ul> |
| Spring                | <ul style="list-style-type: none"> <li>Damaged or severely deformed.</li> </ul>                                                                                                                                                       | <ul style="list-style-type: none"> <li>Replace</li> </ul>                                   |

##### Hydraulic Motor

| Parts                                          |                                                                                                                            | Standard Dimension | Recommended Replacement Value              | Treatment                                        |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------|--------------------------------------------------|
| Clearance (S) between piston and cylinder bore |  <p><math>S=D-d</math></p> <p>E5D632</p> | 0.02 mm            | 0.04 mm                                    | Replace cylinder block, swash plate assembly.    |
| Clearance (S) between piston and shoe          |  <p>E5D633</p>                          | 0.15 mm            | 0.4 mm                                     | Replace cylinder block, swash plate assembly.    |
| Shaft and needle bearing rolling surface       |  <p>E5D634</p>                          |                    | Flaking or pitting in the rolling surface. | Replace shaft, port block assembly.              |
| Cylinder block sliding surface (1)             |  <p>E5D635</p>                          |                    | Sliding surface is rough.                  | Carry out lap repairs (#1000 Powder) or replace. |
| Valve plate sliding surface (2)                |                                                                                                                            |                    |                                            | Replace                                          |

## HYDRAULIC UNITS

## SLEW MOTOR

## Reduction Gears

| Parts                           | Judgement Criteria                                                                                                                                                                                                                                                              | Treatment                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Drive Gear                      | <ul style="list-style-type: none"> <li>• Gear tooth surfaces are pitted or separating, etc.</li> <li>• Clearance with motor joint is large due to spline wear.</li> </ul>                                                                                                       | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> </ul>                    |
| Housing, Internal Gear          | <ul style="list-style-type: none"> <li>• Gear tooth surfaces are pitted or separating, etc.</li> </ul>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |
| Planetary Gear                  | <ul style="list-style-type: none"> <li>• Gear tooth surfaces are pitted or separating, etc.</li> <li>• Needle rolling surfaces are pitted or separating, etc.</li> </ul>                                                                                                        | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> </ul>                    |
| Needle Bearing, Planetary Shaft | <ul style="list-style-type: none"> <li>• Needle and shaft rolling surfaces are pitted or separating, etc.</li> <li>• Pressure marks, etc. on needle and shaft rolling surfaces.</li> <li>• Bearing rotation is abnormal (abnormal noise, rotation not smooth, etc.).</li> </ul> | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> <li>• Replace</li> </ul> |
| Carrier, Shaft                  | <ul style="list-style-type: none"> <li>• Clearance with planetary shaft is large.</li> </ul>                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |
| Shaft                           | <ul style="list-style-type: none"> <li>• Clearance with pinion is large due to spline wear.</li> </ul>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |
| Thrust Wasyer                   | <ul style="list-style-type: none"> <li>• Amount of wear is great.</li> </ul>                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |
| Ball Bearing, Roller Bearing    | <ul style="list-style-type: none"> <li>• Rotation is abnormal (abnormal noise, rotation not smooth, etc.).</li> <li>• Flaking, separation, etc. on rolling surfaces.</li> <li>• Pressure marks, etc. on rolling surfaces.</li> </ul>                                            | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> <li>• Replace</li> </ul> |
| Collar, Oil Seal, O-ring        | <ul style="list-style-type: none"> <li>• Scratches, etc. exist which cause leaks.</li> </ul>                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |

## Anti-rebound Valve

| Parts          | Judgement Criteria                                                                                                                                                                                                                          | Treatment                                                                                         |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Check Valve    | <ul style="list-style-type: none"> <li>• Scratches in sliding portions are deep or roughness is severe.</li> <li>• The clearance with the body is large.</li> <li>• Scratches in sliding portions are deep or seating is uneven.</li> </ul> | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> <li>• Replace</li> </ul> |
| Body           | <ul style="list-style-type: none"> <li>• Scratches in sliding portions are deep or roughness is severe.</li> <li>• There are scratches where oil leakage occurs.</li> </ul>                                                                 | <ul style="list-style-type: none"> <li>• Replace</li> <li>• Replace</li> </ul>                    |
| Spring, Sleeve | <ul style="list-style-type: none"> <li>• Damaged or severely deformed.</li> </ul>                                                                                                                                                           | <ul style="list-style-type: none"> <li>• Replace</li> </ul>                                       |

## SLEW MOTOR

## HYDRAULIC UNITS

## TROUBLESHOOTING

If there is an abnormal increase in noise or heat, this is an indication that trouble has occurred. When this type of condition is manifested, stop the machine immediately and search out the source of the trouble.

The following table shows a number of causes of general breakdowns that can be seen in the hydraulic circuits and indicates countermeasures to take in each case.

| Symptom                                                             | How/Where?                                                                                                                           | Probable Causes                                                                                                                                             | Remedy                                                                                                                                                                      |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Motor does not start.                                               | Pressure doesn't rise at the motor's inlet port.                                                                                     | <ul style="list-style-type: none"> <li>Relief valve's set pressure is low.</li> <li>Pump is broken down.</li> <li>Control valve is broken down.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the pressure at the correct level.</li> <li>Repair or replace the pump.</li> <li>Repair or replace the control valve.</li> </ul> |
|                                                                     | Pressure rises at the motor's inlet port.                                                                                            | <ul style="list-style-type: none"> <li>The load is excessive.</li> <li>Hydraulic motor is broken down.</li> <li>Reduction gears are broken down.</li> </ul> | <ul style="list-style-type: none"> <li>Lighten the load.</li> <li>Repair or replace the hydraulic motor.</li> <li>Repair or replace the reduction gears.</li> </ul>         |
| Motor's speed won't increase.                                       | <ul style="list-style-type: none"> <li>Pump's discharge volume is insufficient.</li> <li>Depends on the motor's function.</li> </ul> | <ul style="list-style-type: none"> <li>Pump's drain amount is large.</li> <li>The motor's volumetric capacity is dropping.</li> </ul>                       | <ul style="list-style-type: none"> <li>Repair or replace the pump.</li> <li>Replace the motor.</li> </ul>                                                                   |
| Oil is leaking.                                                     | Oil is leaking from oil seals.                                                                                                       | <ul style="list-style-type: none"> <li>Lip is cut or damaged.</li> </ul>                                                                                    | <ul style="list-style-type: none"> <li>Replace the oil seal.</li> </ul>                                                                                                     |
|                                                                     | Oil is leaking from mating surfaces.                                                                                                 | <ul style="list-style-type: none"> <li>Bolts are loose.</li> <li>O-ring is cut or damaged.</li> <li>Mating surface is scratched.</li> </ul>                 | <ul style="list-style-type: none"> <li>Tighten the bolts.</li> <li>Replace the O-ring.</li> <li>Repair the surface with a grind stone or sand paper.</li> </ul>             |
| Motor makes abnormal noise.                                         | Noise in piping.                                                                                                                     | <ul style="list-style-type: none"> <li>Piping support is faulty.</li> </ul>                                                                                 | <ul style="list-style-type: none"> <li>Clamp the piping.</li> </ul>                                                                                                         |
| (The surface temperature of the reduction gears case becomes high.) | Lubricating oil                                                                                                                      | <ul style="list-style-type: none"> <li>Oil level is low.</li> <li>Hydraulic oil is getting in.</li> </ul>                                                   | <ul style="list-style-type: none"> <li>Replenish the oil.</li> <li>Replace the reduction gears.</li> </ul>                                                                  |
|                                                                     | Gear unit                                                                                                                            | <ul style="list-style-type: none"> <li>Bearings are damaged.</li> <li>Gear surfaces are damaged.</li> </ul>                                                 | <ul style="list-style-type: none"> <li>Replace the reduction gears.</li> <li>Replace the reduction gears.</li> </ul>                                                        |

## HYDRAULIC UNITS

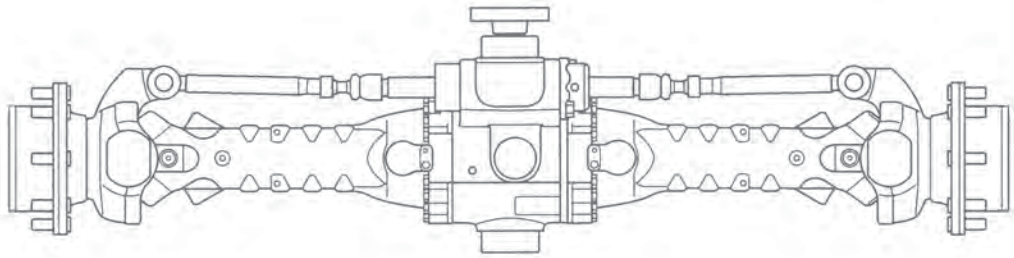
## SLEW MOTOR

### Anit-rebound Valve

| Symptom                                                  | Probable Causes                                                                                                                                                                                                                    | Remedy                                                                                                                                                          |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The motor does not rotate or its rotation speed is slow. | Something other than the piston motor, valve unit or anti-rebound valve is malfunctioning.                                                                                                                                         | Inspect the pressure at the entrance of the valve. Or, inspect individual units and service as necessary.                                                       |
|                                                          | The check valve assembly is not seated properly. <ul style="list-style-type: none"> <li>Foreign matter is trapped.</li> <li>The tightening torque of the anti-rebound valve mounting bolt exceeds the prescribed value.</li> </ul> | <ul style="list-style-type: none"> <li>Remove the foreign matter. Repair or replace the faulty parts.</li> <li>Use the prescribed tightening torque.</li> </ul> |
|                                                          | The sleeve is malfunctioning. <ul style="list-style-type: none"> <li>Foreign matter is trapped.</li> </ul>                                                                                                                         | <ul style="list-style-type: none"> <li>Remove the foreign matter. Repair or replace the faulty parts.</li> </ul>                                                |
| The motor does not stop or its stopping speed is slow.   | The check valve assembly is not seated properly. <ul style="list-style-type: none"> <li>Foreign matter is trapped.</li> <li>The tightening torque of the anti-rebound valve mounting bolt exceeds the prescribed value.</li> </ul> | <ul style="list-style-type: none"> <li>Remove the foreign matter. Repair or replace the faulty parts.</li> <li>Use the prescribed tightening torque.</li> </ul> |
|                                                          | The valve within the check valve assembly is malfunctioning. <ul style="list-style-type: none"> <li>Foreign matter is trapped.</li> <li>Foreign matter is in the orifice of the valve.</li> </ul>                                  | <ul style="list-style-type: none"> <li>Remove the foreign matter. Repair or replace the faulty parts.</li> <li>Remove the foreign matter.</li> </ul>            |
|                                                          | The sleeve is malfunctioning. <ul style="list-style-type: none"> <li>Foreign matter is trapped.</li> </ul>                                                                                                                         | <ul style="list-style-type: none"> <li>Remove the foreign matter. Repair or replace the faulty parts.</li> </ul>                                                |
| Slewing stops with a great shock.                        | The valve within the check valve assembly is malfunctioning. <ul style="list-style-type: none"> <li>Foreign matter is trapped.</li> <li>Foreign matter is in the orifice of the valve.</li> </ul>                                  | <ul style="list-style-type: none"> <li>Remove the foreign matter. Repair or replace the faulty parts.</li> <li>Remove the foreign matter.</li> </ul>            |
|                                                          | The orifice is choked. <ul style="list-style-type: none"> <li>Foreign matter is in the orifice of the anti-rebound valve body.</li> <li>Foreign matter is in the orifice of the valve unit.</li> </ul>                             | <ul style="list-style-type: none"> <li>Remove the foreign matter.</li> <li>Remove the foreign matter.</li> </ul>                                                |

## **AXLE TYPE: 212 (FRONT)**





# **maintenance and repair INSTRUCTION MANUAL**

**MANUALE D'ISTRUZIONE E RIPARAZIONE  
WARTUNG UND REPARATURANLEITUNG  
MANUAL DE MANUTENCION Y REPARACION  
MANUAL ENTRETIEN ET REPARATION**

## **DRIVE AXLE TYPE 212**

PRINTED IN ITALY

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GB

The efficiency and continued operation of mechanical units depend on constant, correct maintenance and also on efficient repair work, should there be a break-down or malfunction. The instructions contained in this manual have been based on a complete overhaul of the unit. However, it is up to the mechanic to decide whether or not it is necessary to assemble only individual components, when partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to be performed.

All the information needed for correct disassembly, checks and assembly of each individual component is set out below. In order to remove the differential unit from the vehicle, the manuals provided by the vehicle manufacturer should be consulted. In describing the following operations it is presumed that the unit has already been removed from the vehicle.

**IMPORTANT:** In order to facilitate work and protect both working surfaces and operators, it is advisable to use proper equipment such as: trestles or supporting benches, plastic or copper hammers, appropriate levers, pullers and specific spanners or wrenches.

Before going on to disassemble the parts and drain the oil, it is best to thoroughly clean the unit, removing any encrusted or accumulated grease.

**INTRODUCTORY REMARKS:** All the disassembled mechanical units should be thoroughly cleaned with appropriate products and restored or replaced if damage, wear, cracking or seizing have occurred.

In particular, thoroughly check the condition of all moving parts (bearings, gears, crown wheel and pinion, shafts) and sealing parts (O-rings, oil shields) which are subject to major stress and wear. In any case, it is advisable to replace the seals every time a component is overhauled or repaired. During assembly, the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly, the prescribed pre-loading, backlash and torque of parts must be maintained.

**CLASSIFICATION:** This manual classifies units according to part numbers. For a correct interpretation, classification is indicated as follows:

→ → [ ] = up to the part number

[ ] → → = from the part number on

When no classification is given, disassembly and assembly operations are the same for all versions.

**SPECIFIC EQUIPMENT AND SPARE PARTS:** The drawings of all specific tools required for maintenance and repair work can be found at the end of this manual; spare parts may be ordered either from the vehicle manufacturer or directly from the Service Centers or Authorised Distributors of SPICER CLARK-HURTH.

ITA

Il rendimento e la continuità degli organi meccanici dipendono oltre che da una costante e corretta manutenzione, anche dal tempestivo intervento, nell'eventualità di guasti o anomalie.

Nel proporre questo manuale si è considerata l'ipotesi di una revisione generale del gruppo ma è il meccanico a valutare la necessità di montare solo i singoli componenti nel caso di riparazione. Il manuale è una guida rapida e sicura che consente interventi precisi, tramite le fotografie ed i disegni prospettici che illustrano le varie fasi delle operazioni. Di seguito sono riportate tutte quelle informazioni ed avvertenze necessarie al corretto disassemblaggio, alle relative verifiche ed all'assemblaggio dei singoli componenti. Per la rimozione del ponte differenziale dal veicolo, è necessario consultare i manuali forniti dal costruttore del veicolo. Nel descrivere le operazioni seguenti, si presuppone che il ponte sia già stato rimosso dal veicolo.

**IMPORTANTE:** In tutte le operazioni, è consigliabile usare attrezzature idonee quali cavalletti o banchi di sostegno,

martelli in plastica o rame, leve appropriate estrattori e chiavi specifiche, al fine di facilitare il lavoro salvaguardando nel contempo le superfici lavorate e la sicurezza degli operatori. Prima di procedere al disassemblaggio delle parti e scaricare l'olio, è opportuno eseguire un'accurata pulizia del ponte, asportando incrostazioni ed accumuli di grasso.

**PREMESSA:** Tutti gli organi meccanici smontati, devono essere accuratamente puliti con prodotti appropriati, quindi ripristinati o sostituiti nel caso presentino danni, usura, incrinature, grippaggi, ecc. In particolare, verificare l'integrità di tutte quelle parti in movimento (cuscinetti, ingranaggi, coppia conica, alberi) e di tenuta (anelli OR, paraolio), soggette a maggiori sollecitazioni ed usura. È consigliabile, comunque, la sostituzione degli organi di tenuta ogni qualvolta si proceda alla revisione o riparazione dei componenti. Al momento del montaggio, gli anelli di tenuta devono essere lubrificati sui bordi di tenuta. Nel caso della coppia conica, la sostituzione di uno dei suoi ingranaggi comporta anche la sostituzione dell'altro. In fase di montaggio sono da rispettare scrupolosamente i giochi, i precarichi e le coppie prescritte.

**VALIDITÀ:** Il manuale fornisce le validità dei gruppi sotto forma di matricola. Al fine di una corretta interpretazione, le validità sono indicate come:

→ → [ ] = fino alla matricola

[ ] → → = dalla matricola

Se non sono indicate validità, le operazioni di smontaggio ed assemblaggio sono comuni a tutte le versioni.

**MANUTENZIONE E RIPARAZIONE:** Al fine di facilitare interventi sui gruppi ponte differenziali e cambi di velocità la SPICER CLARK-HURTH, ha ritenuto opportuno compilare queste istruzioni di manutenzione e riparazione. I disegni delle attrezzature specifiche eventualmente necessarie per l'esecuzione di interventi di manutenzione e riparazione possono essere acquistati direttamente presso il costruttore; i ricambi possono essere ordinati tramite il costruttore della macchina o direttamente presso la SPICER CLARK-HURTH.

D

Die Leistung und Lebensdauer der mechanischen Teile hängt nicht nur von einer ständigen und richtig durchgeführten Wartung sondern auch von einem sofortigen Eingriff im Störfall ab. Um dieses Handbuch zu erstellen sind wir von einer allgemeinen Überprüfung der Einheit ausgegangen, doch entscheidet der Mechaniker ob die einzelnen Teile bei Reparaturen montiert werden müssen oder nicht. Das Handbuch ist schnell und einfach nachzuschlagen und ermöglicht es anhand der Abbildungen und der Zeichnungen, die die verschiedenen Vorgänge darstellen, gezielt einzugreifen. Nachstehend sind alle Informationen und Hinweise aufgeführt, die zur Zerlegung, Prüfung und Montage der Einzelteile nötig sind. Um die Differentialachse des Fahrzeugs abzumontieren, lesen Sie bitte die Anweisungen in den Handbüchern des Fahrzeugherstellers. Die nachstehenden Beschreibungen gehen davon aus, daß die Fahrzeugachse schon abmontiert worden ist.

**WICHTIG:** Um die Arbeit zu erleichtern und gleichzeitig die verarbeiteten Flächen zu schützen und die Sicherheit der Arbeiter zu gewährleisten, empfehlen wir geeignete Werkzeuge wie Böcke, Tisch, Gummi- oder Kupferhammer, geeignete Abzieher und Schlüssel zu verwenden. Bevor mit der Zerlegung der Teile begonnen und das Öl abgelassen wird, muß die Achse sorgfältig gereinigt und Verkrustungen und Fettablagerungen abgetragen werden.

**VORAUSSSETZUNG:** Alle abmontierten mechanischen Teile müssen sorgfältig mit geeigneten Reinigungsmitteln gereinigt oder, wenn beschädigt, verschleißt, gerissen, festgefressen usw. ausgewechselt werden. Insbesondere muß der einwandfreie Zustand aller beweglichen Teile (Lager, Zahnräder, Kegelradpaare, Wellen) und der Dichtungen (O-Ringe, Oel-dichtungen), die am meisten beansprucht werden und verschleßen, kontrolliert werden. Wir empfehlen auf jeden Fall die Abdichtungselemente immer auszuwechseln, wenn eine Überholung oder eine Reparatur der Teile vorgenommen wird. Bei





der Montage müssen die Ränder der Dichtringe geschmiert werden. Wenn beim Kegelradpaar ein Zahnrad ausgewechselt werden muß, muß auch das andere Zahnrad ausgewechselt werden. Bei der Montage müssen die vorgeschriebenen Spiele, Vorspannungen und Drehmomente strengstens eingehalten werden.

**GÜLTIGKEIT:** Das Handbuch gibt an zu welchen Kennnummern die Einheiten gehören. Der Einfachheit halber sind die Angehörigkeiten folgendermaßen aufgeführt:

➡ ➡  = bis Kennnummer

➡ ➡ = ab Kennnummer

Wenn keine Angehörigkeit angegeben ist, verstehen sich die Arbeiten zur Zerlegung und Montage für alle Ausführungen gültig.

**SPEZIFISCHE WERKZEUGE UND ERSATZTEILE:** die Zeichnungen der für Wartungsarbeiten erforderlichen spezifischen Werkzeuge, sind am Ende des Handbuchs aufgeführt; Ersatzteile können beim Fahrzeughersteller oder direkt bei der Kundendienststelle oder bei einem zugelassenen Händler der SPICER CLARK-HURTH bezogen werden.

### ESP

El rendimiento y la duración de los órganos mecánicos depende, además que del constante y correcto mantenimiento, también de la intervención inmediata en caso de averías o anomalías.

Al proponer este manual, ha sido considerada la suposición de una revisión general del grupo, pero es el mecánico quien tiene que valorar la necesidad de montar cada uno de los componentes en caso de reparación. El manual es una guía rápida y segura que permite intervenciones precisas por medio de fotografías y de planos que muestran las distintas fases de las operaciones. A continuación figuran todas las informaciones y advertencias necesarias para ejecutar un montaje correcto, para las comprobaciones y el montaje de cada uno de los componentes. Para remover el puente diferencial del vehículo hay que consultar los manuales de los fabricantes del vehículo. En la descripción de las operaciones siguientes se supone que el puente ya ha sido sacado del vehículo.

**IMPORTANTE:** Para facilitar el trabajo salvaguardando al mismo tiempo las superficies mecanizadas y la seguridad de los operadores, se aconseja que se usen equipos y herramientas adecuados como cabalotes y bancos de soporte, martillos de plástico o de cobre, palancas adecuadas, extractores y llaves específicas.

Antes de desmontar las partes y descargar el aceite, es conveniente que se haga una limpieza minuciosa del puente sacando las incrustaciones y acumulaciones de grasa.

**INTRODUCCION:** Todos los órganos mecánicos desmontados tienen que ser limpiados minuciosamente con productos adecuados y restaurados o sustituidos en el caso de que presenten daños, desgaste, rajaduras, agrietamientos, etc. En particular, comprobar la integridad de todas las partes en movimiento (cojinetes, engranajes, par cónico, ejes) y de estanqueidad (anillos OR, retenedor de aceite) sujetas a mayores sollicitaciones y desgaste.

Se aconseja, de todas formas, que se sustituyan los órganos de estanqueidad cada vez que se ejecute la revisión o reparación de los componentes.

Al volver a montar, los segmentos de compresión tienen que estar lubricados en los bordes de estanqueidad. En el caso del par cónico, la sustitución de uno de sus engranajes comporta también la sustitución del otro. Al montar hay que tener en cuenta escrupulosamente los juegos, las precargas y los pares descriptos.

**VALIDEZ:** El manual suministra la validez de los grupos en forma de matrícula. Para poder tener una interpretación correcta, la validez está indicada:

➡ ➡  = hasta la matrícula

➡ ➡ = desde la matrícula en adelante

Si no ha sido indicada validez, las operación de desmontaje y montaje son comunes a todas las versiones.

**HERRAMIENTAS ESPECIFICAS Y RECAMBIOS:** Los planos de las herramientas específicas necesarias para la ejecución de las intervenciones de mantenimiento figuran al final del manual; los recambios se pueden pedir al fabricante de la máquina o directamente al Service Center o a Distribuidores autorizados de SPICER CLARK-HURTH.

### F

Le rendement et la continuité des organes mécaniques dépendent, non seulement d'une maintenance correcte et constante, mais également de la rapidité d'intervention en cas de pannes ou d'anomalies. En vous proposant ce manuel, on envisage l'hypothèse d'une révision générale du groupe, mais c'est au mécanicien d'évaluer la nécessité de monter ou non chacun des composants en cas de réparation. Le manuel est un guide rapide et sûr consentant des interventions précises, au travers de photographies et de dessins prospectifs qui illustrent les différentes phases des opérations. Ensuite, sont reportées toutes les informations et précautions nécessaires pour un démontage correct et les vérifications et assemblage de chaque composant. En ce qui concerne le déplacement du pont d'étai du véhicule, il est nécessaire consulter les manuels fournis par le constructeur du véhicule. En décrivant les opérations suivantes, on présume que le pont ait déjà été enlevé du véhicule.

**IMPORTANT:** Pour faciliter le travail en sauvegardant en même temps les surfaces usinées et la sécurité des opérateurs, il est préconisé d'utiliser des installations appropriées telles que des étais ou banc de support, maillets en plastique ou cuivre, leviers appropriés, extracteurs et clés spécifiques. Avant de procéder au démontage des parties et vidanger l'huile, il vaut mieux nettoyer soigneusement le pont, en enlevant incrustations et blocs de gras.

**PRELIMINAIRE:** Tous les organes mécaniques démontés doivent être soigneusement nettoyés à l'aide de produits appropriés et réparés ou remplacés dans le cas où ils seraient abîmés, usés, fêlés, grippés, etc. Vérifier, l'intégrité, en particulier, de toutes les parties en mouvement (paliers, engrenages, couple conique, arbres) et l'étanchéité des bagues (bagues OR, parahuile), qui sont sujettes à plus de sollicitations et à l'usure. Il est préconisé, de toute façon, de substituer les organes d'étanchéité, chaque fois que l'on effectue une révision ou une réparation des composants. Au moment du montage, les bagues d'étanchéité doivent être lubrifiées sur les bords étanches. Dans le cas du couple conique, la substitution de l'un de ses engrenages comporte également la substitution de l'autre. En phase de montage, il faut respecter scrupuleusement les jeux, les précharges et les couples prescrits.

**VALIDITE:** Le manuel fournit la validité des groupes sous forme de matricule. Pour une meilleure interprétation, les validités sont indiquées comme:

➡ ➡  = jusqu'à l'immatriculation

➡ ➡ = à partir de l'immatriculation et après

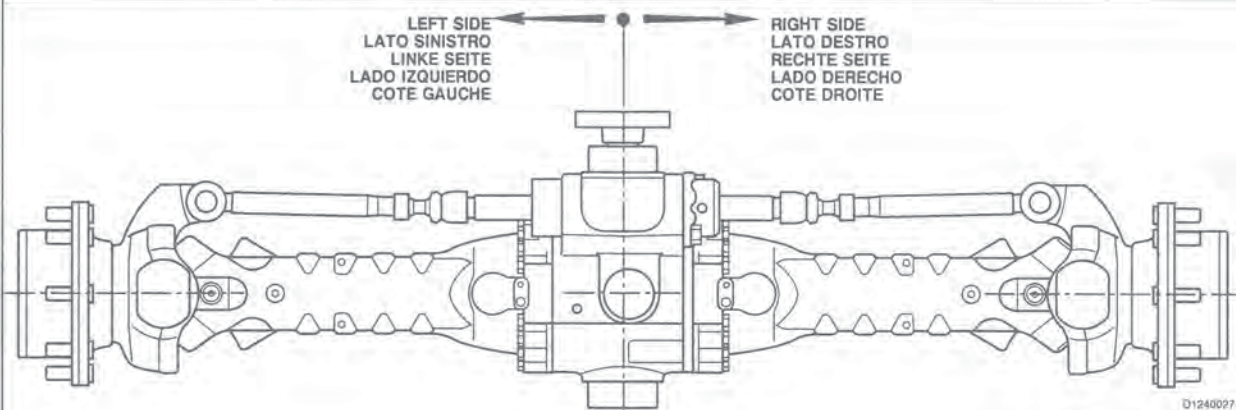
Si les validités ne sont pas indiquées, les opérations de démontage et d'assemblage sont pareilles dans toutes les versions.

**INSTALLATIONS SPECIFIQUES ET PIECES DETACHEES:** Les dessins des installations spécifiques nécessaires pour effectuer des interventions d'entretien sont reportées à la fin du manuel, les pièces détachées peuvent être commandées au constructeur de la machine ou directement aux Centres de Services, ou Distributeurs agréés de la Société SPICER CLARK-HURTH.



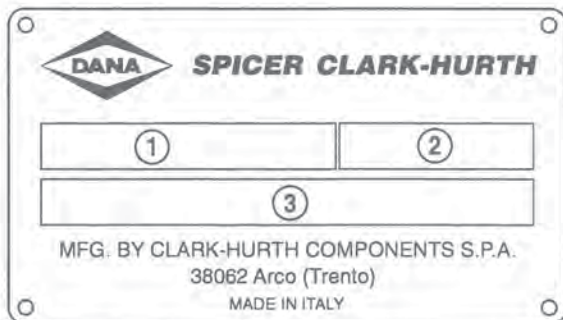


DEFINITION OF VIEWPOINTS - DEFINIZIONE VISTE - DEFINITION DER ANSICHTEN - DEFINICION VISTAS - DÉFINITION VUES



D1240027

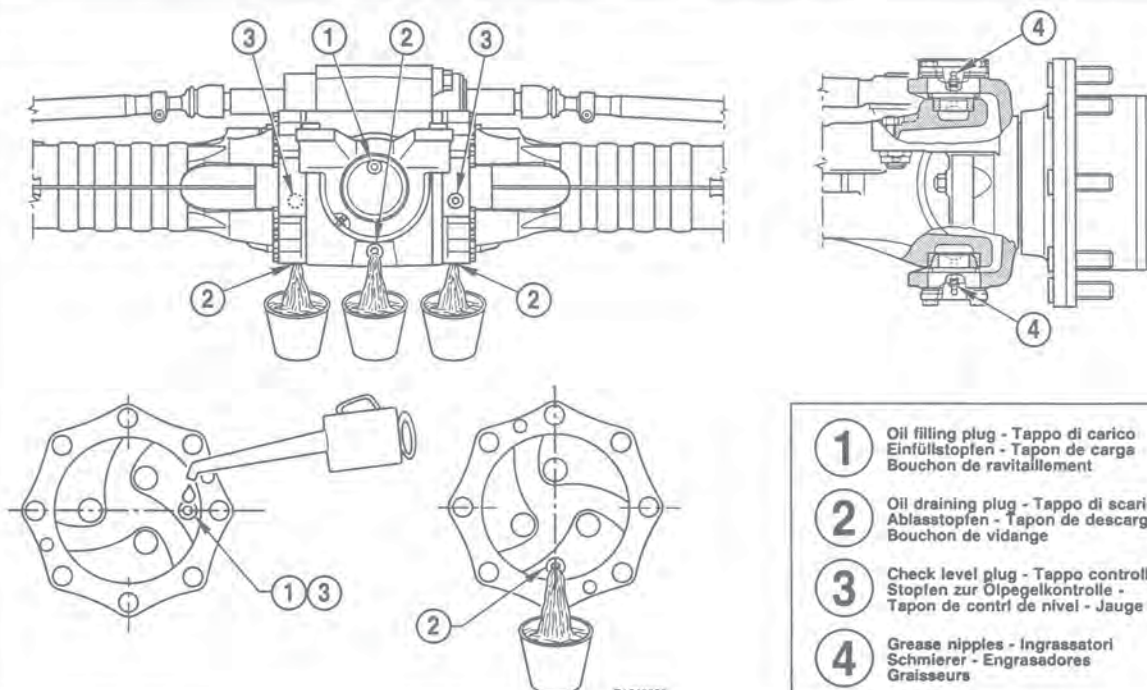
DATA PLATE - TARGA MATRICOLA - KENNUMMERNSCHILD - MATRICULA - PLAQUE D'IMMATRICULATION



D1240011

- 1 Type and model unit - modification index  
Tipo e modello gruppo - indice di modifica  
Typ und Modelleles Antriebes - Änderungsverzeichnis  
Tipo y modelo grupo - índice de modificación  
Type et modèle de ensemble - tableau des modifications
- 2 Serial number  
Numero di serie  
Seriennummer  
Número de serie  
Numero de serie
- 3 Lubricant  
Lubrificante  
Schmieröl  
Lubrifiant  
Lubrifiant

MAINTENANCE POINTS - PUNTI DI MANUTENZIONE - WARTUNGSSTELLEN - PUNTOS DE MANUTENCION - POINTS D'ENTRETIEN



D1240028

- 1 Oil filling plug - Tappo di carico  
Einfüllstopfen - Tapon de carga  
Bouchon de ravitaillement
- 2 Oil draining plug - Tappo di scarico  
Ablassstopfen - Tapon de descarga  
Bouchon de vidange
- 3 Check level plug - Tappo controllo livello  
Stopfen zur Ölpegelkontrolle -  
Tapon de contrl de nivel - Jauge de niveau
- 4 Grease nipples - Ingrassatori  
Schmierer - Engrasadores  
Graisseurs




**MAINTENANCE INTERVALS - INTERVALLI DI MANUTENZIONE - WARTUNGSINTERVALLE - INTERVALOS DE MANUTENCIÓN - INTERVALLE DE SERVICE**

| OPERATION - OPERAZIONE - ARBEITSVORGANG - OPERACION - OPERATION                                                                                                             |                                                                                                                                                     | FREQUENCY - PERIODICITÀ - ZEITABSTAND - FRECUENCIA - PERIODICITE                                   | LUBRICANTS - LUBRIFICANTI - SCHMIERSTOFFE - LUBRICANTES - LUBRIFIANTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Check levels:</li> <li>Controllo livelli:</li> <li>Ölstandkontrolle:</li> <li>Control niveles:</li> <li>Contrôle niveaux:</li> </ul> | Differential<br>Differenziale<br>Im differential<br>Diferencial<br>Différentiel                                                                     | monthly<br>mensile<br>monatlich<br>cada mes<br>mensuel                                             | <ul style="list-style-type: none"> <li><b>SAE85W90 (API GL4 - MIL L-2105)</b><br/>With additives for oil-bath brakes<br/>Con additivi per freni a bagno d'olio<br/>Mit Zusatzmittel für Bremsen in Ölbad<br/>Con aditivos para frenos de baño de aceite<br/>Avec adjuvants pour freins en bain d'huile</li> <li><b>SAE85W90 (API GL5 - MIL 2105-B)</b><br/>With additives for oil-bath brakes, for units presenting hypoid crown wheel and pinion and /or self-locking differential gear<br/>Per esecuzioni con coppia conica ipoide e/o con differenziale autobloccante, con additivi per freni a bagno d'olio<br/>Bei Ausführungen mit Kegel- und Telleradpaar und/oder Selbstsperrdifferential, mit Zusatzmitteln für Bremsen in Ölbad<br/>Para ejecuciones con par cónico hipoide y/o con diferencial autobloqueante con aditivos para frenos de baño de aceite.<br/>Pour exécutions avec couple conique hypoïde et/ou différentiel autobloquant, avec adjuvants pour freins en bain d'huile</li> </ul> |
|                                                                                                                                                                             | Planetary reduction<br>Riduzione epicicloidale<br>Planetengetrieb<br>Reducción epicicloidial<br>Reduction epicycloïdale                             | every 200 hours<br>ogni 200 ore<br>alle 200 Std.<br>cada 200 horas<br>toutes les 200 heures        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>Oil change:</li> <li>Cambio olio:</li> <li>Ölwechsel:</li> <li>Cambio aceite:</li> <li>Vidange huile:</li> </ul>                     | Differential<br>Differenziale<br>Im differential<br>Diferencial<br>Différentiel                                                                     | every 800 hours *<br>ogni 800 ore<br>alle 800 Std.<br>cada 800 horas<br>toutes les 800 heures      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                             | Planetary reduction<br>Riduzione epicicloidale<br>Planetengetrieb<br>Reducción epicicloidial<br>Reduction epicycloïdale                             | every 1000 hours *<br>ogni 1000 ore<br>alle 1000 Std.<br>cada 1000 horas<br>toutes les 1000 heures |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                             | Self-locking differential gear<br>Differenziale autobloccante<br>Selbstsperrdifferential<br>Diferencial autobloqueante<br>Différentiel autobloquant | every 700 hours * □<br>ogni 700 ore<br>alle 700 Std.<br>cada 700 horas<br>toutes les 700 heures    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

\* Initially after 100 working hours - Inizialmente dopo 100 ore di lavoro - Erstmals nach 100 Betriebsstunden - Al principio, después de 100 horas de trabajo - Initialement après 100 heures de travail

□ When it starts sounding noisy - Anche ai primi cenni di rumorosità - Auch falls ungewöhnliche Geräusche zu bemerken sind - También al primer indicio de ruido - Même aux premiers signaux de bruit

| OPERATION - OPERAZIONE - ARBEITSVORGANG - OPERACION - OPERATION | MEMBER - ORGANO - ELEMENT - ORGANO - ORGANE                 | CONDITIONS - CONDIZIONI - BEDINGUNG - CONDICIONES - CONDITIONS                                 | FREQUENCY - PERIODICITÀ - ZEITABSTAND - FRECUENCIA - PERIODICITE | LUBRICANTS - LUBRIFICANTI - SCHMIERSTOFFE - LUBRICANTES - LUBRIFIANTS |
|-----------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------|
| Greasing<br>Ingrassaggio<br>Schmieren<br>Engrase<br>Graissage   | Articulations<br>Snodi<br>Gelenk<br>Rótula<br>Articulations | Normal work<br>Lavori normali<br>Normale Arbeit<br>Trabajos normales<br>Tâches ordinaires      | monthly<br>mensile<br>monatlich<br>cada mes<br>mensuel           | MOLIKOTE                                                              |
|                                                                 |                                                             | Awkward work<br>Lavori gravosi<br>Schwere Arbeit<br>Trabajos pesados<br>Tâches extraordinaires | Weekly<br>Settimanale<br>Wöchentlich<br>Semanal<br>Hebdomadaire  |                                                                       |

**ADJUSTMENT AND CHECKS - REGISTRAZIONE E CONTROLLI - EINSTELLUNGEN UND KONTROLLEN - AJUSTE Y CONTROLÉS - REGLAGES ET CONTROLES**

| UNIT - GRUPPO - AGGREGAT - GRUPO - GROUPE                                                     | OPERATION - OPERAZIONE - ARBEITSVORGANG - OPERACION - OPERATION | FREQUENCY - PERIODICITÀ - ZEITABSTAND - FRECUENCIA - PERIODICITE                                  | SERVICE BRAKE CIRCUIT - CIRCUITO COMANDO FRENI - BREMSKREISLAUF - CIRCUITO MANDOS FRENOS - CIRCUIT DE COMMANDE DES FREINS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Negative brake<br>Freno negativo<br>Federspeicherbremse<br>Freno negativo<br>Frein négatif    | Adjustment<br>Registrazione<br>Einstellen<br>Ajuste<br>Réglage  | every 1000 hours *<br>ogni 1000 ore<br>alle 1000 Std.<br>cada 1000 horas<br>toutes les 1000 hours | Only for mineral oil use e.g. ATF Dexron II. Make sure that master cylinder seals are suitable for mineral oil.<br>Usare esclusivamente olio minerale ATF Dexron II. Accertarsi che le guarnizioni del cilindro master siano adatte a questo olio.<br>Nur mineralisches Öl verwenden, z.B.: ATF Dexron II.<br>Achtung: Dichtringe des Hauptbremszylinders müssen für dieses Öl geeignet sein.<br>Usar exclusivamente aceite mineral ATF Dexron II.<br>Asegurarse de que las juntas del cilindro principal son adecuadas para este aceite.<br>Utiliser exclusivement huile minérale ATF Dexron II.<br>Vérifier que les joints du maître-cylindre, soient compatibles avec cette huile. |
| Service brake<br>Freni di servizio<br>Hilfsbremse<br>Frenos de ejercicio<br>Freins de service | Adjustment<br>Registrazione<br>Einstellen<br>Ajuste<br>Réglage  | every 500 hours<br>ogni 500 ore<br>alle 500 Std.<br>cada 500 horas<br>toutes les 500 hours        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Wheel nuts<br>Dadi ruota<br>Radmuttern<br>Tuercas rueda<br>Ecrous de roue                     | Tightening<br>Serraggio - Festziehen<br>Apriete<br>Serrage      | every 200 hours<br>ogni 200 ore<br>alle 200 Std.<br>cada 200 horas<br>toutes les 200 hours        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

\* Initially after 100 working hours - Inizialmente dopo 100 ore di lavoro - Erstmals nach 100 Betriebsstunden - Al principio, después de 100 horas de trabajo - Initialement après 100 heures de travail





**CONVERSION TABLES - TABELLE DI CONVERSIONE - UMRECHNUNGSTABELLEN  
TABLAS DE CONVERSION - TABLEUX DE CONVERSION**

Units of pressure - Unità di pressione - Druckeinheiten  
Unidad de presión - Unités de pression:

$$1 \text{ Atm} \cong 1 \text{ bar} \cong 10^5 \text{ Pa} \cong 14.4 \text{ Psi}$$

Units of weight - Unità di peso - Gewichtseinheiten  
Unidad de peso - Unités de poids

|      | N    | daN   | kN      | kg    | lbs   |
|------|------|-------|---------|-------|-------|
| 1N   | 1    | 0,1   | 0,001   | 0,102 | 0,225 |
| 1daN | 10   | 1     | 0,01    | 1,02  | 2,25  |
| 1kN  | 1000 | 100   | 1       | 102   | 225   |
| 1kg  | 9,81 | 0,981 | 0,00981 | 1     | 2,205 |
|      |      |       |         |       |       |

Units of torque - Unità di coppia - Drehmomenteinheiten  
Unidad de par - Unités de couple

|        | Nm     | daNm    | kNm       | kgm     | lb-in |
|--------|--------|---------|-----------|---------|-------|
| 1Nm    | 1      | 0,1     | 0,001     | 0,102   | 8,854 |
| 1daNm  | 10     | 1       | 0,01      | 1,02    | 88,54 |
| 1kNm   | 1000   | 100     | 1         | 102     | 8854  |
| 1kgm   | 9,81   | 0,981   | 0,00981   | 1       | 86,8  |
| 1lb-in | 0,1129 | 0,01129 | 0,0001129 | 0,01152 | 1     |

**TIGHTENING TORQUES - COPPIE DI SERRAGGIO - ANZIEHDREHMOMENTE  
PARES DE TORSION - COUPLES DE SERRAGE**

Unit - Unità di misura - Maßeinheiten - Unidad de medida - Unités de mesure: Nm

| SIZE OF BOLT<br>MISURA VITE<br>SCHRAUBENMASS<br>TAMANO TORNILLO<br>MESURE VIS |            | TYPE OF BOLT - TIPO VITE - GEWINDE - TIPO DE TORNILLO - TYPE DE VIS |                          |                          |                          |                          |                          |
|-------------------------------------------------------------------------------|------------|---------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                                                               |            | 8.8                                                                 |                          | 10.9                     |                          | 12.9                     |                          |
|                                                                               |            | + Normali<br>Loctite 242                                            | + Normali<br>Loctite 270 | + Normali<br>Loctite 242 | + Normali<br>Loctite 270 | + Normali<br>Loctite 242 | + Normali<br>Loctite 270 |
| COARSE PITCH - PASSO GROSSO - GROBER<br>SCHRITT - PASO GRUESO - GROS PAS      | M6 x 1     | 9,5-10,5                                                            | 10,5-11,5                | 14,3-15,7                | 15,2-16,8                | 16,2-17,8                | 18,1-20,0                |
|                                                                               | M8 x 1,25  | 23,8-26,2                                                           | 25,6-28,4                | 34,2-37,8                | 36,7-40,5                | 39,0-43,0                | 43,7-48,3                |
|                                                                               | M10 x 1,5  | 48-53                                                               | 52-58                    | 68-75                    | 73-81                    | 80-88                    | 88-97                    |
|                                                                               | M12 x 1,75 | 82-91                                                               | 90-100                   | 116-128                  | 126-139                  | 139-153                  | 152-168                  |
|                                                                               | M14 x 2    | 129-143                                                             | 143-158                  | 182-202                  | 200-221                  | 221-244                  | 238-263                  |
|                                                                               | M16 x 2    | 200-221                                                             | 219-242                  | 283-312                  | 309-341                  | 337-373                  | 371-410                  |
|                                                                               | M18 x 2,5  | 276-305                                                             | 299-331                  | 390-431                  | 428-473                  | 466-515                  | 509-562                  |
|                                                                               | M20 x 2,5  | 390-431                                                             | 428-473                  | 553-611                  | 603-667                  | 660-730                  | 722-798                  |
|                                                                               | M22 x 2,5  | 523-578                                                             | 575-635                  | 746-824                  | 817-903                  | 893-987                  | 974-1076                 |
|                                                                               | M24 x 3    | 675-746                                                             | 732-809                  | 950-1050                 | 1040-1150                | 1140-1260                | 1240-1370                |
|                                                                               | M27 x 3    | 998-1103                                                            | 1088-1202                | 1411-1559                | 1539-1701                | 1710-1890                | 1838-2032                |
|                                                                               | M30 x 3,5  | 1378-1523                                                           | 1473-1628                | 1914-2115                | 2085-2305                | 2280-2520                | 2494-2757                |
| FINE PITCH - PASSO FINE - KLEINER SCHRITT<br>PASO FINO - PAS FIN              | M8 x 1     | 25,7-28,3                                                           | 27,5-30,5                | 36,2-39,8                | 40,0-44,0                | 42,8-47,2                | 47,5-52,5                |
|                                                                               | M10 x 1,25 | 49,4-54,6                                                           | 55,2-61,0                | 71,5-78,5                | 78,0-86,0                | 86,0-94,0                | 93,0-103,0               |
|                                                                               | M12 x 1,25 | 90-100                                                              | 98-109                   | 128-142                  | 139-154                  | 152-168                  | 166-184                  |
|                                                                               | M12 x 1,5  | 86-95                                                               | 94-104                   | 120-132                  | 133-147                  | 143-158                  | 159-175                  |
|                                                                               | M14 x 1,5  | 143-158                                                             | 157-173                  | 200-222                  | 219-242                  | 238-263                  | 261-289                  |
|                                                                               | M16 x 1,5  | 214-236                                                             | 233-257                  | 302-334                  | 333-368                  | 361-399                  | 394-436                  |
|                                                                               | M18 x 1,5  | 312-345                                                             | 342-378                  | 442-489                  | 485-536                  | 527-583                  | 580-641                  |
|                                                                               | M20 x 1,5  | 437-483                                                             | 475-525                  | 613-677                  | 674-745                  | 736-814                  | 808-893                  |
|                                                                               | M22 x 1,5  | 581-642                                                             | 637-704                  | 822-908                  | 903-998                  | 998-1103                 | 1078-1191                |
|                                                                               | M24 x 2    | 741-819                                                             | 808-893                  | 1045-1155                | 1140-1260                | 1235-1365                | 1363-1507                |
|                                                                               | M27 x 2    | 1083-1197                                                           | 1178-1302                | 1520-1680                | 1672-1848                | 1834-2027                | 2000-2210                |
|                                                                               | M30 x 2    | 1511-1670                                                           | 1648-1822                | 2138-2363                | 2332-2577                | 2565-2835                | 2788-3082                |





**SCREW-LOCKING, SEALING AND LUBRICATING MATERIALS - MATERIALI PER BLOCCAGGIO VITI, TENUTA E LUBRIFICAZIONE - MATERIAL ZUR BLOCKIERUNG VON SCHRAUBEN UND FÜR DICHTUNGEN UND SCHMIERMITTEL - MATERIALES PARA EL BLOQUEO, ESTANQUEIDAD Y LUBRICACION - MATERIAUX POUR LE BLOCAGE VIS, ÉTANCHÉITÉ ET LUBRIFICATION**



1 - Locking, sealing and lubricating materials referred to in this manual are the same used in the shop-floor.

*I materiali per il bloccaggio, tenuta e lubrificazione specifica indicati nel manuale, sono quelli usati in fabbrica.*

Die Materialien zur Blockierung von Schrauben, für Dichtungen und Schmiermittel, die im Handbuch aufgeführt sind, sind dieselben die auch vom Hersteller verwendet werden.

*Los materiales para el bloqueo, estanqueidad y lubricación específica indicados en el manual, son los que se usan en la fábrica.*

*Les matériaux de blocage, d'étanchéité et de lubrification spécifiés indiqués dans ce manuel sont ceux employés à l'usine.*

2 - The table below gives an account of the typical applications of each single material, in order to facilitate replacement with similar products marketed by different brand names with different trade marks.

*Di questi materiali, vengono riportate le applicazioni tipiche che li distinguono, in modo da poterli sostituire con prodotti simili commercializzati da altre marche e quindi con altre sigle.*

Von diesen Materialien werden die typischen Anwendungen genannt, um sie mit ähnlichen Materialien zu ersetzen, die unter anderen Namen und Kennzeichnungen im Handel erhältlich sind.

*De estos materiales damos las aplicaciones típicas que los distinguen, de manera que se puedan sustituir con productos similares comercializados por otras marcas y por tanto con otras siglas.*

*De ces matériaux ne sont reportées que les applications typiques qui les distinguent de telle sorte qu'ils puissent être substitués par des produits semblables se trouvant dans le commerce sous d'autres marques et par conséquent sous d'autres sigles.*

| DENOMINATION<br>DENOMINAZIONE<br>BEZEICHNUNG<br>DENOMINACION<br>DENOMINATION | APPLICATION - APPLICAZIONE - ANWENDUNG - APLICACION - APPLICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Loctite 242                                                                  | <ul style="list-style-type: none"> <li>Anaerobic product apt to prevent the loosening of screws, nuts and plugs. Used for medium-strength locking. Before using it, completely remove any lubricant by using the specific activator.</li> <li><i>Prodotto anaerobico adatto a prevenire l'allentamento di viti, dadi e tappi. Usato per la frenatura a media resistenza. Deve essere usato dopo aver asportato ogni traccia di lubrificante con l'attivatore specifico.</i></li> <li>Anaerobes Produkt, um das Lockern von Schrauben, Muttern und Stopfen zu verhindern. Für mittlere Widerstandskräfte geeignet. Darf erst aufgetragen werden, wenn die Flächen von Schmiermittel richtig sauber sind. Dazu das entsprechende Produkt verwenden.</li> <li><i>Producto anaeróbico apto para prevenir el aflojamiento de tornillos, tuercas y tapones. Usado para el frenado de media resistencia. Tiene que ser usado sólo después de haber quitado todo residuo de lubricante con el activador específico.</i></li> <li>Produit anaérobie servant à prévenir le relâchement des vis, écrous et bouchons. Utilisé pour le freinage demi résistant. Il doit être utilisé après avoir enlevé toute trace de lubrifiant à l'aide d'un activateur spécial.</li> </ul>                                                                                                                                                                |
| Loctite 243                                                                  | <ul style="list-style-type: none"> <li>The oleocompatible alternative to 242. Does not require the activation of lubricated surfaces.</li> <li><i>Prodotto alternativo al 242 che, essendo oleocompatibile, non richiede l'attivazione di superfici lubrificate.</i></li> <li>Alternatives Produkt zu Loctite 242. Da es ölkompabil ist müssen die geschmierten Flächen nicht aktiviert werden.</li> <li><i>Producto alternativo al 242 que, siendo oleocompatible, no requiere la activación de superficies lubricadas.</i></li> <li>Produit en alternance avec le 242 lequel étant oléocompatible ne requiert aucune activation des surfaces lubrifiées.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Loctite 270                                                                  | <ul style="list-style-type: none"> <li>Anaerobic product for very-high strength locking of screws and nuts. Before using it, completely remove any lubricant by using the specific activator. To remove parts, it may be necessary to heat them at 80°C approx.</li> <li><i>Prodotto anaerobico adatto per la frenatura ad altissima resistenza di viti e dadi. Deve essere usato dopo aver asportato ogni traccia di lubrificante con l'attivatore specifico. La rimozione delle parti, può richiedere un riscaldamento a circa 80°C.</i></li> <li>Anaerobes Produkt für hohe Widerstandskräfte für Schrauben und Muttern geeignet. Zuerst die Fläche sorgfältig aktivieren. Um die Flächen zu säubern, diese auf ca. 80°C erwärmen.</li> <li><i>Producto anaeróbico apto para el frenado de alta resistencia de tornillos y tuercas. tiene que ser usado después de haber quitado todo residuo de lubricante con el activador específico. La remoción de las partes, puede requerir un calentamiento a unos 80°C.</i></li> <li>Produit anaérobie apte au freinage à très haute résistance des vis et des écrous. Il doit être utilisé après avoir enlevé toute trace de lubrifiant à l'aide d'un activateur spécial.</li> </ul>                                                                                                                                                                                                |
| Loctite 275                                                                  | <ul style="list-style-type: none"> <li>Anaerobic product suitable for high-strength locking and sealing of large threaded parts, bolts and stud bolts, for pipe sealing and for protecting parts against tampering; suitable for sealing coupling surfaces with a max. diametrical clearance of 0.25 mm.</li> <li><i>Prodotto anaerobico adatto per la frenatura e sigillatura ad alta resistenza di parti filettate, bulloni e prigionieri di grandi dimensioni, protezione antimanomissione e sigillatura di tubazioni; può sigillare accoppiamenti con gioco diametrale massimo di 0,25 mm.</i></li> <li>Anaerobes Produkt zum Bremsen und Siegeln von großen Gewinden, Muttern und Stiftschrauben, sehr widerstandsfähig, verschleierungsbeständig, und zum Siegeln von Rohrleitungen geeignet; kann Kupplungen mit einer maximalen Lagerluft von 0,25 mm siegeln.</li> <li><i>Producto anaeróbico apto para el frenado y selladura a alta resistencia de tornillos, tuercas y prisioneros de grandes dimensiones, protección anti manomisión y selladura de tubaciones; puede sellar encolcados con juego diametral.</i></li> <li>Produit anaérobie adapté au freinage et au scellage à haute résistance des parties filetées, boulons et prisonniers de grandes dimensions, protection anti-altération et scellage de tuyauteries; il peut sceller des accouplements ayant un jeu diamétral maximal de 0,25 mm.</li> </ul> |





**SCREW-LOCKING, SEALING AND LUBRICATING MATERIALS - MATERIALI PER BLOCCAGGIO VITI, TENUTA E LUBRIFICAZIONE - MATERIAL ZUR BLOCKIERUNG VON SCHRAUBEN UND FÜR DICHTUNGEN UND SCHMIERMITTEL - MATERIALES PARA EL BLOQUEO, ESTANQUEIDAD Y LUBRICACION - MATERIAUX POUR LE BLOCAGE VIS, ÉTANCHEITÉ ET LUBRIFICATION**

| DENOMINATION<br>DENOMINAZIONE<br>BEZEICHNUNG<br>DENOMINACION<br>DENOMINATION                                                                                                                                                  | APPLICATION - APPLICAZIONE - ANWENDUNG - APLICACION - APPLICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Loctite 510                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Anaerobic product for the hermetic sealing of flanged units and screw holes communicating with fluids. Can seal clearances between flanges up to 0.2 mm.</li> <li><i>Prodotto anaerobico adatto alla tenuta ermetica di fluidi tra assiemi flangiati e di viti a foro comunicante con i fluidi. Può sigillare giochi tra le flange fino a 0,2 mm.</i></li> <li>Anaerobes Produkt zur Abdichtung von Flüssigkeiten an Flanschen und Schrauben mit Löchern, die mit Flüssigkeiten in Kontakt stehen. Kann ein Spiel zwischen Flanschen bis 0,2 mm abdichten.</li> <li><i>Producto anaeróbico apto para la estanqueidad de fluidos entre grupos bridados y de tornillos de orificio comunicante con los fluidos. Puede sellar juegos entre las bridas hasta 0,2 mm.</i></li> <li><i>Produit anaérobie apte à la tenue étanche des fluides entre les pièces à brides et des vis à trou en contact avec les fluides. Il peut sceller un jeu parmi les flasques jusqu'à 0,2 mm.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Loctite 577                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Quick anaerobic sealant for sealing threaded portions of conical or cylindrical unions up to M80. Before using it, remove any lubricant with the specific activator. After polymerisation, disassembly may result rather difficult, so heating may be necessary for larger diameters.</li> <li><i>Prodotto anaerobico sigillante rapido per la tenuta di filettature di raccordi conici o cilindrici fino a M80. Deve essere usato dopo aver asportato ogni traccia di lubrificante con l'attivatore specifico. Dopo la polimerizzazione presenta una moderata difficoltà di smontaggio per cui può richiedere, per i diametri maggiori, un riscaldamento.</i></li> <li>Anaerobes Produkt zum schnellen Siegeln und Abdichten von Kegel- oder Zylinderkupplungen bis M80. Darf erst aufgetragen werden, nachdem mit einem spezifischen Wirkstoff jede Spur von Schmiermittel abgetragen worden ist. Nach der Polymerisation könnte das Abmontieren etwas schwierig sein weshalb größere Durchmesser zuerst erhitzt werden müssen.</li> <li><i>Producto anaeróbico sellante rapido para el estanqueido de tornillos de empalme conico o cilindrico hasta M80. Debe de ser utilizado despues de haber quitado cada mancha de lubricante con activador especifico. Despues de la polimeracion presenta una moderada dificultad de desmontaje por lo tanto puede necesitar, para los diametros mayores, un calentamiento.</i></li> <li><i>Produit anaérobie collage rapide assurant l'étanchéité des filetages des raccords coniques ou cylindriques jusqu'à M80. Il doit être utilisé après qu'on ait enlevé toute trace de lubrifiant à l'aide d'un activateur spécial. Une certaine difficulté de démontage se présente après la polymérisation, on peut donc avoir la nécessité de devoir chauffer préalablement pour de plus amples diamètres.</i></li> </ul> |
| Loctite 638                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Anaerobic adhesive for fast and high-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with clearance ranging between 0.1 and 0.25 mm.</li> <li><i>Adesivo anaerobico per l'incollaggio rapido ad alta resistenza di giunti cilindrici in metallo (mozzo su albero). Può incollare particolari con gioco tra 0,1 e 0,25 mm.</i></li> <li>Anaerobes Klebstoff für große Widerstandskräfte für Zylinderkupplungen aus Metall geeignet (Wellennaben). Kann Einzelteil mit einem Radialspiel zwischen 0,1 mm und 0,25 mm zusammenkleben.</li> <li><i>Adhesivo anaeróbico para el encolado rápido de alta resistencia de juntas cilíndricas de metal (cubo en el eje). Puede encolar piezas con juego entre 0,1 mm y 0,25 mm.</i></li> <li><i>Adhésif anaérobie servant à un collage rapide et hautement résistant des joints cylindriques en métal (moyeu sur l'arbre). Il peut servir à coller des pièces avec un jeu allant de 0,1 à 0,25 mm.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Loctite 648                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Anaerobic adhesive for fast and medium-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with radial clearance below 0.1 mm.</li> <li><i>Adesivo anaerobico per l'incollaggio rapido a media resistenza di giunti cilindrici in metallo (mozzo su albero). Può incollare particolari con gioco radiale inferiore a 0,1 mm.</i></li> <li>Anaerobes Klebstoff für mittlere Widerstandskräfte für Zylinderkupplungen aus Metall geeignet (Wellennaben). Kann Einzelteil mit einem Radialspiel von weniger als 0,1 mm zusammenkleben.</li> <li><i>Adhesivo anaeróbico para encolado rápido de media resistencia juntas cilíndricas de metal (cubo en el eje). Puede encolar piezas con juego radial inferior a 0,1 mm.</i></li> <li><i>Adhésif anaérobie servant à un collage rapide moyennement résistant des joints cylindriques en métal (moyeu sur l'arbre). Il peut servir à coller des pièces avec un jeu radial inférieur à 0,1 mm.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| (AREXONS)<br>Repositionable jointing compound for seals<br>Mastice per guarnizioni riposizionabile<br>Klebstoff für verstellbare Dichtungen<br>Pasta para juntas reposicionable<br>Mastic pour garnitures à remettre en place | <ul style="list-style-type: none"> <li>Solvent-based sealing compound for elastic seals, drying through evaporation. Used for sealing the outer diameter of sealing rings for rotating shafts with outer metal reinforcement.</li> <li><i>Mastice sigillante per guarnizioni elastiche a base di solvente, essicante per evaporazione. Viene utilizzato per la tenuta sul diametro esterno di anelli di tenuta per alberi rotanti con armatura metallica esterna.</i></li> <li>Klebstoff für Gummidichtung auf Lösemittelbasis, trocknet durch Verdampfung. Wird am äußeren Durchmesser von Dichtungsringe bei rotierenden Wellen mit Metallmantel verwendet.</li> <li><i>Pasta para juntas de sellado para juntas elásticas a base de disolvente, deshidratante por evaporación. Se utiliza para la estanqueidad en el diámetro externo de segmentos de compresión, para ejes giratorios con armadura metálica exterior.</i></li> <li><i>Mastic adhésif à base de solvants pour garnitures élastiques, séchant par évaporation. Il sert garder étanche le diamètre extérieur des bagues d'étanchéité des arbres rotatifs ayant une armature métallique externe.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |





**SCREW-LOCKING, SEALING AND LUBRICATING MATERIALS - MATERIALI PER BLOCCAGGIO VITI, TENUTA E LUBRIFICAZIONE - MATERIAL ZUR BLOCKIERUNG VON SCHRAUBEN UND FÜR DICHTUNGEN UND SCHMIERMITTEL - MATERIALES PARA EL BLOQUEO, ESTANQUEIDAD Y LUBRICACION - MATERIAUX POUR LE BLOCAGE VIS, ETANCHEITÉ ET LUBRIFICATION**

| DENOMINATION<br>DENOMINAZIONE<br>BEZEICHNUNG<br>DENOMINACION<br>DENOMINATION                                                                                           | APPLICATION - APPLICAZIONE - ANWENDUNG - APLICACION - APPLICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Silicone</b><br><b>Silicone</b><br><b>Silikon</b><br><b>Silicona</b><br><b>Silicone</b>                                                                             | <ul style="list-style-type: none"> <li>• Semi-fluid adhesive material used for sealing and filling and to protect components from environmental and physical elements. Polymerises with non-corrosive dampness.</li> <li>• <i>Materiale adesivo semifluido usato per sigillatura, riempimenti e per la protezione di componenti dagli elementi ambientali e fisici. Polimerizza con umidità non corrosiva.</i></li> <li>• Halbflüssiger Klebstoff zum Befestigen, Füllen und zum Schutz von Bestandteilen vor äußeren Einwirkungen. Polymerisiert durch nicht korrosive Feuchtigkeit</li> <li>• <i>Material adhesivo semifluido usado para el sellado, llenado y para la protección de componentes de elementos ambientales y físicos. Polimeriza con humedad no corrosiva.</i></li> <li>• Produit adhésif semi-fluide utilisé pour le scellage, remplissage et protection des éléments ambiants et physiques. Polymérise à une humidité non corrosive.</li> </ul>                                                                                                                                                                                                                                                                                                       |
| <b>(TECNO LUPE/101)</b><br><b>Silicone-based grease</b><br><b>Grasso al silicone</b><br><b>Silikonfett</b><br><b>Grasa a la silicona</b><br><b>Graisse au silicone</b> | <ul style="list-style-type: none"> <li>• Highly adhesive synthetic grease, with silicone compounds added. Applied to adjustment screws with hole communicating with oil-type fluids. Used when frequent adjusting is required.</li> <li>• <i>Grasso sintetico con elevato grado di adesività, additivato con composti silconici. Applicato su viti di registrazione a foro comunicante con fluidi di tipo oleoso. Usato quando si richiedono frequenti interventi di registrazione.</i></li> <li>• Synthetisches Fett mit hoher Haftfestigkeit, mit silikonhaltigen Stoffen legiert. Wird auf Stellschrauben mit Loch, die mit ölhaltigen Flüssigkeiten in Kontakt stehen, angebracht. Wird verwendet, wenn die Schraub öfters eingestellt werden muß.</li> <li>• <i>Grasa sintética con elevado grado de adhesión, aditivada con componentes silicónicos. Aplicada en tornillos de ajuste de orificio comunicante con fluidos de tipo oleoso. Se usa cuando se requieren frecuentes intervenciones de ajuste.</i></li> <li>• Graisse synthétique ayant un degré d'adhésivité élevé, adjuvé de composés au silicone. Appliqué sur les vis de réglage à trou communiquant avec des fluides du type huileux. Utilisé quand il y a besoin de réglages fréquents.</li> </ul> |
| <b>Molikote</b><br><b>(DOW CORNING)</b>                                                                                                                                | <ul style="list-style-type: none"> <li>• Lubricating compound containing molybdenum disulphide, used to lubricate articulation pins and to prevent sticking and oxidation of parts that are not lubricated on a regular basis.</li> <li>• <i>Composto lubrificante contenente bisolfuro di molibdeno, usato per la lubrificazione di perni snodo e per prevenire incollamenti ed ossidazioni di particolari non lubrificati in modo continuo.</i></li> <li>• Schmierstoff mit Molybidädisulfid; wird zum Schmieren von Gelenkstiften und gegen Ankleben und Oxydation von nicht dauergeschmierten Einzelteilen verwendet.</li> <li>• <i>Compuesto lubricante que contiene bisulfuro de molibdeno, usado para la lubricación de rótulas y para prevenir encoladuras y oxidaciones de piezas no lubricadas de manera continua.</i></li> <li>• Composé lubrifiant contenant du bisulfure de molybdène, utilisé pour lubrifier les axes d'articulation et prévenir collages et oxydations des pièces qui ne sont pas continuellement lubrifiées.</li> </ul>                                                                                                                                                                                                                  |
| <b>(Lithium-based) Grease</b><br><b>Grasso (al Litio)</b><br><b>(Lithium) Fett</b><br><b>Grasa (al Litio)</b><br><b>Graisse (au Lithium)</b>                           | <ul style="list-style-type: none"> <li>• Applied to bearings, sliding parts and used to lubricate seals or parts during assembly</li> <li>• <i>Applicato a cuscinetti, parti scorrevoli e per lubrificare guarnizioni o pezzi in fase di montaggio.</i></li> <li>• Wird auf Lager, Gleitteilen aufgetragen und zum Schmieren von Dichtungen oder von Teilen bei der Montage verwendet.</li> <li>• <i>Aplicada a cojinetes, partes deslizables o para lubricar juntas o piezas en fase de montaje.</i></li> <li>• Appliqué sur les paliers, parties coulissantes et pour lubrifier les garnitures ou pièces pendant la phase de montage.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



## NOTES ON SAFETY PRECAUTIONS - NOTE RIGUARDANTI LA SICUREZZA - BEMERKUNGEN ZUR SICHERHEIT - NORMAS CONCERNIENTES A LA SEGURIDAD - NOTES EN MATIERE DE SECURITE

### GB

- 1 - During all operations described in this manual, the axle should be fastened onto a trestle, while the other parts mentioned should rest on supporting benches.
- 2 - When removing one of the arms, an anti-tilting safety trestle should be placed under the other arm.
- 3 - When working on an arm that is fitted on the machine, make sure that the supporting trestles are correctly positioned and that the machine is locked lengthways.
- 4 - Do not admit any other person inside the work area; mark off the area, hang warning signs and remove the ignition key from the machine.
- 5 - Use only clean, quality tools; discard all worn, damaged, low-quality or improvised wrenches and tools. Ensure that all dynamometric wrenches have been checked and calibrated.
- 6 - Always wear gloves and non-slip rubber shoes when performing repair work.
- 7 - Should you stain a surface with oil, remove marks straight away.
- 8 - Dispose of all lubricants, seals, rags and solvents once work has been completed. Treat them as special waste and dispose of them according to the relative law provisions obtaining in the country where the axles are being overhauled.
- 9 - Make sure that only weak solvents are used for cleaning purposes; avoid using turpentine, dilutants and toluol-, xylol-based or similar solvents; use light solvents such as Kerosene, mineral spirits or water-based, environment friendly solvents.
- 10 - For the sake of clarity, the parts that do not normally need to be removed have not been reproduced in some of the diagrams.
- 11 - The terms RIGHT and LEFT in this manual refer to the position of the operator facing the axle from the side opposite the drive.
- 12 - After repair work has been completed, accurately touch up any coated part that may have been damaged.

### ITA

- 1 - Le operazioni descritte sono riferite all'assale bloccato su cavalletto ed alcuni particolari appoggiati su un banco di lavoro.
- 2 - Quando si asporta un braccio dell'assale, sistemare sotto l'altro braccio un cavalletto di sicurezza antiribaltamento.
- 3 - Se si opera su un'assale montato sulla macchina, assicurarsi di aver sistemato dei cavalletti di sostentamento e di aver immobilizzato longitudinalmente la macchina.
- 4 - Non permettere che persone estranee entrino nella zona di lavoro; delimitare questa zona, appendere dei cartelli di avviso di lavori in corso ed asportare le chiavi di avviamento della macchina.
- 5 - Usare solo ed esclusivamente attrezzi puliti e di buona qualità; scartare chiavi od attrezzi usurati o danneggiati, di bassa qualità od improvvisati. Assicurarsi che le chiavi dinamometriche siano state controllate e tarate.
- 6 - Durante le operazioni di riparazione, indossare sempre guanti e scarpe antiscivolo.
- 7 - Pulire immediatamente le zone eventualmente imbrattate d'olio.
- 8 - I lubrificanti, le guarnizioni, gli eventuali stracci di pulizia ed i solventi usati devono essere smaltiti come rifiuti speciali e comunque secondo le normative vigenti nel Paese ove vengono revisionati gli assali.
- 9 - Per la pulizia, usare solo solventi deboli escludendo categoricamente trielina, diluenti e solventi a base di toluolo, xilolo, ecc.; usare solo solventi leggeri quali cherosene, ragie minerali o solventi ecologici a base d'acqua.
- 10 - Per chiarezza di illustrazione ed esposizione, sulle figure di alcuni gruppi mancano dei particolari che, normalmente, possono essere lasciati montati. Rimuovere solo i particolari descritti.
- 11 - I termini DESTRA e SINISTRA usati nel manuale sono riferiti alla persona che guarda l'assale dal lato opposto alla presa di moto.
- 12 - Al termine delle riparazioni, per evitare dannose ossidazioni, ritoccare con cura le parti verniciate eventualmente danneggiate.

### D

- 1 - Die beschriebenen Vorgänge werden an der Achse vorgenommen, wenn diese auf einem Bock blockiert ist. Zur Bearbeitung der Einzelteile, werden diese auf die Werkbank gelegt.
- 2 - Wenn eine Achse abgenommen wird, einen Sicherheitsbock unter den zweiten Arm legen.
- 3 - Werden Arbeiten an der Achse vorgenommen, wenn diese noch an der Maschine montiert ist, Böcke zur Halterung unter die Achse stellen und die Maschine der Länge nach blockieren.
- 4 - Es dürfen sich keine fremde Personen in der Nähe der Maschine während der Arbeiten aufhalten; diesen Bereich absperren und mit Schilder kennzeichnen, die auf die laufenden Arbeiten hinweisen. Zündschlüssel von der Maschine abnehmen.
- 5 - Nur saubere Werkzeuge guter Qualität verwenden; alte, beschädigte oder improvisierte Hilfsmittel nicht verwenden. Sicherstellen, daß die Dynamometer geprüft und geeicht worden sind.
- 6 - Bei Reparaturen, stets Handschuhe und rutschfeste Schuhe tragen.
- 7 - Mit Öl beschmutzte Stellen, sofort reinigen.
- 8 - Gebrauchte Schmiermittel, Dichtungen, Reinigungslappen und

Lösemittel müssen als Sondermüll und auf jeden Fall laut den örtlich geltenden Vorschriften entsorgt werden.

- 9 - Zur Reinigung ausschließlich schwache Lösemittel wie Petroleum, Terpentin oder wasserhaltige Lösemittel verwenden. Auf keinen Fall Trichloräthylen, tuolol- oder xylolhaltige Lösemittel usw. verwenden.
- 10 - Um die Arbeitsvorgänge verständlich abzubilden, werden in einigen Fotos die Aggregate ohne Einzelteile gezeigt, die sonst bei der Arbeit nicht abmontiert werden müssen. Nur die beschriebenen Teile abmontieren.
- 11 - Unter RECHTS und LINKS versteht man in diesem Handbuch die Seite einer Person, die zur Achse schaut und zwar dem Antrieb entgegengesetzt.
- 12 - Nach beendeten Arbeiten und um Rostbildungen zu vermeiden, die Teile an denen der Lack ggf. beschädigt worden ist, anstreichen.

### ESP

- 1 - Las operaciones descritas se refieren al eje bloqueado en un caballete y a algunas partes apoyadas en el banco de trabajo.
- 2 - Cuando se saca un brazo del eje, colocar debajo del otro un caballete de seguridad antivuelco.
- 3 - Si se trabaja con un eje montado en la máquina, asegurarse de haber colocado caballetes soporte y de haber inmovilizado longitudinalmente la máquina.
- 4 - No permitir que personas extrañas entren en la zona de trabajo; delimitar esta zona, colgar carteles de aviso de hombres trabajando y sacar las llaves de arranque de la máquina.
- 5 - Usar sólo y exclusivamente herramientas limpias y de buena calidad; descartar llaves o herramientas gastadas o dañadas, de calidad mediocre o improvisadas. Asegurarse de que las llaves dinamométricas han sido controladas y calibradas.
- 6 - Durante las operaciones de reparación, llevar siempre guantes y calzado antideslizamiento.
- 7 - Limpiar inmediatamente las zonas que pudieran estar sucias de aceite.
- 8 - Los lubricantes, las juntas, los trapos para la limpieza y los disolventes usados hay que eliminarlos como desechos especiales y, de todas formas, de acuerdo con las normativas vigentes en el país en el que se revisan los ejes.
- 9 - Para limpiar, utilizar sólo disolventes débiles excluyendo en absoluto tricloroetileno, diluyentes y disolventes a base de toluol, silol, etc.; usar sólo disolventes ligeros como queroseno, aguarrás minerales o disolventes ecológicos a base de agua.
- 10 - Para que resulte clara la exposición y la ilustración, en las figuras de algunos grupos faltan algunas piezas que por lo general se pueden dejar montadas. Sacar sólo las partes descritas.
- 11 - Las palabras DERECHA e IZQUIERDA usadas en el manual se refieren a la persona que mira el eje del lado opuesto a la toma de movimiento.
- 12 - Al final de las reparaciones, para evitar oxidaciones, retocar cuidadosamente las partes pintadas que estuvieran dañadas.

### F

- 1 - Les opérations décrites se rapportent à l'essieu bloqué sur chevalet et de quelques pièces posées sur un établi de travail.
- 2 - Quand on enlève un essieu monté sur la machine, ajuster sous l'autre bras un chevalet de sécurité contre tout basculement.
- 3 - Si on œuvre sur un essieu monté sur la machine, s'assurer d'avoir aménagé des chevalets de soutien et d'avoir bloqué la machine en longueur.
- 4 - Ne jamais permettre à des étrangers de pénétrer dans la zone de travail; délimiter cette zone, mettre des pancartes de signalisation de travaux en cours et enlever les clés de contact de la machine.
- 5 - N'utiliser que des outils propres et de bonne qualité; éliminer clé ou autres outils usés, abîmés, de mauvaise qualité ou improvisés. Veiller à ce que les clés dynamométriques aient été contrôlées et calibrées.
- 6 - Pendant les opérations de réparation, endosser toujours gants et chaussures antidérapantes.
- 7 - Nettoyer tout de suite les éventuelles zones souillées d'huile.
- 8 - Les lubrifiants, les garnitures, les éventuels chiffons servant au nettoyage et les solvants utilisés devront être récoltés et traités comme rebut spécial conformément aux lois en vigueur dans le pays où les essieux sont en révision.
- 9 - Pour le nettoyage, n'utiliser que des solvants à base de toluol, xylol, etc.; n'utiliser que des solvants légers tels que kérosène, essences minérales, ou solvants écologiques à base d'eau.
- 10 - En ce qui concerne la clarté en matière d'illustration et exposition, sur les figures de certains groupes, il y a des pièces manquantes qui normalement peuvent rester montées. Enlever uniquement les pièces décrites.
- 11 - Les termes DROITE et GAUCHE utilisés dans ce manuel se rapportent à la personne regardant l'essieu du côté opposé à celui de la prise de mouvement.
- 12 - A la fin des opérations, afin d'éviter un risque d'oxydation nuisible, retoucher soigneusement les parties vernies éventuellement abîmées.

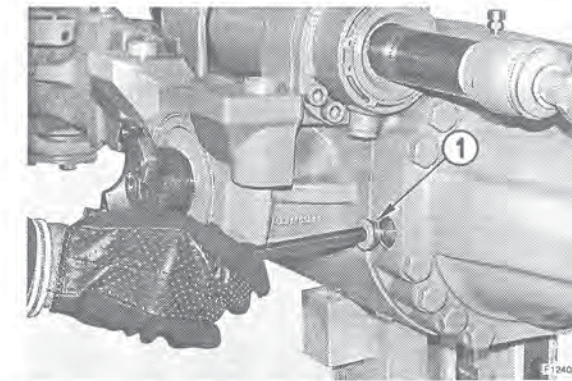


SYMBOLS - SIMBOLI - SYMBOLS  
SIMBOLOS - SYMBOLES

|  |                                                                                                                                                                                                                                                                                                           |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Disassembly of assembly groups<br>Smontaggio di sottogruppi<br>Zerlegen von Baugruppen<br>Desmontaje de subgrupos<br>Démontage des sous-groupes                                                                                                                                                           |
|  | Reassemble to from assembly groups<br>Montaggio di sottogruppi<br>Zusammenbauen von Baugruppen<br>Ensamblaje de subgrupos<br>Montage des sous-groupes                                                                                                                                                     |
|  | Remove obstruction parts<br>Smontaggio di particolari ingombri<br>Abbauen-Ausbauen<br>Desmontaje de componentes abultados<br>Démontage des pièces encombrantes                                                                                                                                            |
|  | Reinstall-remount parts which had obstructed disassembly<br>Montaggio di particolari ingombri<br>Einbauen-Ausbauen<br>Montaje de componentes abultados<br>Montage des pièces encombrantes                                                                                                                 |
|  | Attention! Important notice<br>Attenzione, indicazione importante<br>Achtung, wichtiger Hinweis<br>¡Cuidado! Indicación importante<br>Attention, indication importante                                                                                                                                    |
|  | Check - adjust e.g. torque, dimensions, pressures, etc.<br>Controllare - regolare p.e. coppie, misure, pressioni ecc.<br>Prüfen - Einstellen z.B. Momente, Maße, Drucke u.s.ä.<br>Controlar y ajustar, por ej. pares, medidas, presiones, etc.<br>Controler, régler p.e. couples, mesures, pressions etc. |
|  | T = Special tool<br>T = Spezialwerkzeug<br>T = Herramientas especiales<br>T = Outils<br>P = page<br>P = Pagina<br>P = Seite<br>P = Page                                                                                                                                                                   |
|  | Note direction of installation<br>Rispettare direzione di montaggio<br>Einbaurichtung beachten<br>Respetar la dirección de ensamblaje<br>Respecter direction de montage                                                                                                                                   |
|  | Visual inspection<br>Esaminare con controllo visuale<br>Kontrollieren - Prüfen<br>Examinar mediante inspección visual<br>Controler, examiner, contrôle visuel                                                                                                                                             |
|  | Possibly still serviceable, renew if necessary<br>Eventualmente riutilizzare (sostituire se necessario)<br>Bedingt weidervendbar<br>Puede volver a utilizarse (reemplazar, si es preciso)<br>Eventuellement a utiliser a nouveau (remplacer si nécessaire)                                                |
|  | Renew at each reassembly<br>Sostituire ad ogni montaggio<br>Beim Zusammenbau immer erneuern<br>Puede reemplazarse a cada ensamblaje<br>Remplacer avec chaque montage                                                                                                                                      |
|  | Unlock - lock e.g. split pin, locking plate, etc.<br>Togliere-mettere la sicura<br>Entsichern-Sichern<br>Quitar-colocar el seguro<br>Enlever-mettre la securite                                                                                                                                           |
|  | Lock-adhere (liquid sealant)<br>Mettere la sicura, incollare (mastice liquido)<br>Sichern-Kleben (flüssige Dichtung)<br>Colocar el seguro, pegar (mastique liquido)<br>Mettre la securite, coller (mastic liquide)                                                                                        |
|  | Guard against material damage, damage to parts<br>Evitare danni materiali, danni a pezzi<br>Materialschaden verhüten<br>Evitar dañar los materiales o las piezas<br>Eviter dommages au matériaux, dommages au pièces                                                                                      |
|  | Mark before disassembly, observe marks when reassembly<br>Marchiare prima dello smontaggio (per il montaggio)<br>Vor dem Ausbau markieren (für den Zusammenbau)<br>Marcar antes de desmontar (para facilitar el ensamblaje)<br>Marquer avant le démontage (pour le montage)                               |
|  | Filling - topping up - refilling e.g. oil, cooling water, etc.<br>Caricare - riempire (olio - lubrificante)<br>Einfüllen - Auffüllen - Nachfüllen (Öl-Schmiermittel)<br>Cargar - llenar (aceite lubricante)<br>Charger - remplir (huile - lubrifiant)                                                     |
|  | Drain off oil, lubricant<br>Scaricare olio, lubrificante<br>Öl, bzw. Schmiermittel Ablassen<br>Descargar aceite lubricante<br>Vidanger, lubrifiant                                                                                                                                                        |
|  | Tighten<br>Tendere<br>Spannen<br>Tenser<br>Tendre                                                                                                                                                                                                                                                         |
|  | Apply pressure into hydraulic circuit<br>Inserire pressione nel circuito idraulico<br>Leitung unter Druck setzen<br>Introducir presión en el circuito hidráulico<br>Insérer pression dans le circuit hydraulique                                                                                          |
|  | To clean<br>Pulire<br>Reinigen<br>Limpiar<br>Nettoyer                                                                                                                                                                                                                                                     |
|  | Lubricate - grease<br>Lubrificare - ingrassare<br>Schmieren - einfetten<br>Lubrificar - engrasar<br>Lubrifier - Graisser                                                                                                                                                                                  |



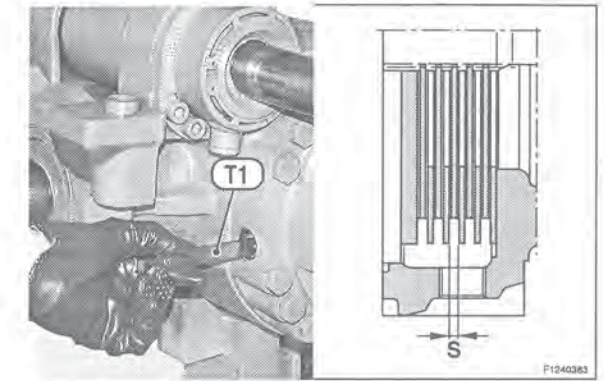
CHECKING WEAR AND REPLACING THE BRAKING DISKS - CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO - VERSCHLEISS  
KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN - CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO -  
CONTROLE D'USURE ET SUBSTITUTION DES DISQUES DE FREINAGE



GB

a

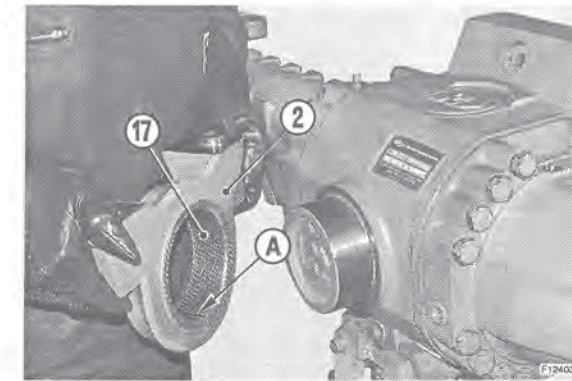
**CAUTION!** Perform all operations on both arms.  
Remove the oil-level plug (1).



GB

b

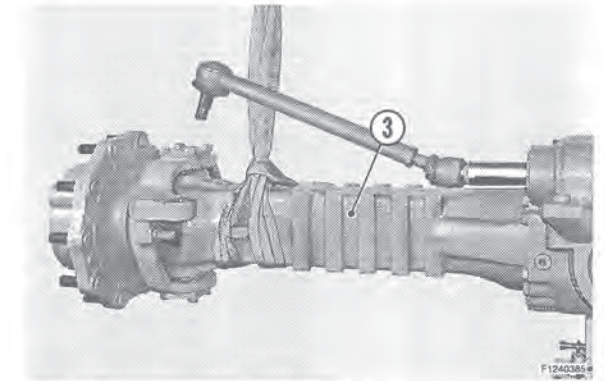
Apply the brakes and, keeping them under pressure, check the linings "S" between the disks using tool T1.  
Minimum "S": 4.5 mm.  
**CAUTION!** Replace the braking disks and the intermediate disks on both sides if necessary.



GB

c

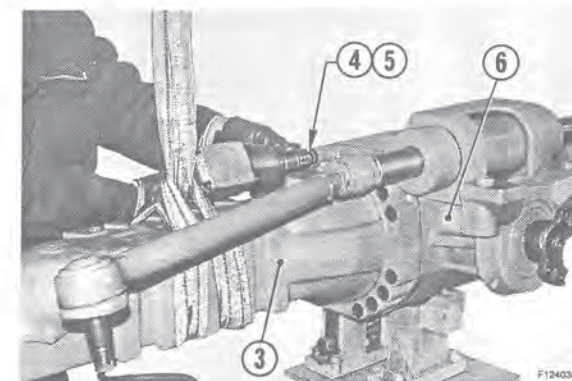
Remove the swinging support (2) on the side opposite the drive.  
**NOTE.** If the bushing (17) is worn and needs replacing, note down the assembly side of the connection notch "A".



GB

d

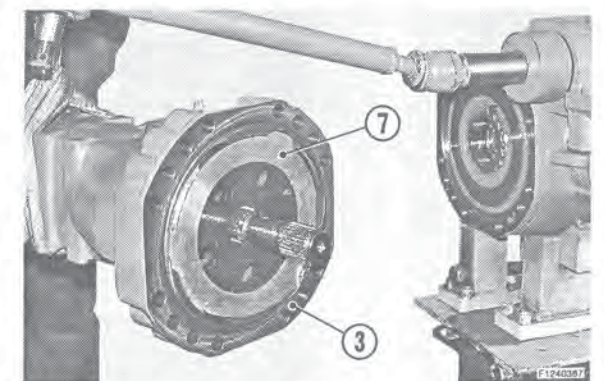
Disconnect the pins of the steering bars from the steering case (See «HOW TO REMOVE THE STEERING CYLINDER».)  
Sling the arm (3) to be removed and put the rod under slight tension.



GB

e

Unloose and remove the screws (4) and the washers (5) that fix the arm (3) to the central body (6).



GB

f

Remove the arm (3) together with the pack of the braking disks (7).  
Place the arm on a bench.



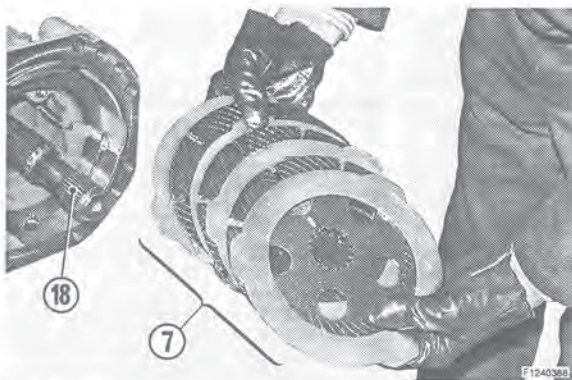


|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> <b>ATTENZIONE!</b> Eseguire tutte le operazioni per i due bracci.<br/>Asportare il tappo (1) di livello olio.</p> <p><b>D</b> <b>ACHTUNG!</b> Alle Vorgänge für beide Arme durchführen.<br/>Ölpegelstopfen (1) abnehmen.</p> <p><b>ESP</b> <b>CUIDADO!</b> Ejecutar todas las operaciones para los dos brazos.<br/>Sacar el tapón (1) de carga de nivel aceite.</p> <p><b>F</b> <b>ATTENTION!</b> Effectuer toutes les opérations sur les 2 bras.<br/>Enlever le bouchon de la jauge d'huile (1).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p><b>ITA</b> Eseguire una frenata e, mantenendo la pressione, controllare con l'attrezzo T1 lo spessore "S" tra i dischi.<br/>"S" minimo: 4,5 mm<br/><b>ATTENZIONE!</b> Se necessario, sostituire i dischi freno ed intermedi di ambedue i lati.</p> <p><b>D</b> Die Bremse einmal betätigen und bei betätigter Bremse mit dem T1 Werkzeug das Distanzstück "S" zwischen den Scheiben kontrollieren.<br/>"S" mindestens: 4,5 mm<br/><b>ACHTUNG!</b> Wenn nötig, die Bremsscheiben und die mittleren Scheiben auf beiden Seiten auswechseln.</p> <p><b>ESP</b> Ejecutar un frenado y, manteniendo la presión, controlar con la herramienta T1, el espesor "S" entre los discos.<br/>"S" mínimo: 4,5 mm<br/><b>CUIDADO!</b> Si fuera necesario, sustituir los discos del freno y los intermedios a ambos lados.</p> <p><b>F</b> Effectuer un freinage, puis en tenant sous pression, contrôler à l'aide de l'outil T1 la cale "S" entre les disques.<br/>"S" minimum: 4,5 mm.<br/><b>ATTENTION!</b> Si besoin, substituer les disques de freinage et les intermédiaires des deux côtés.</p> |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere il supporto oscillante (2) del lato opposto alla presa di moto.<br/><b>NOTA.</b> Se si deve sostituire la bronzina (17) perché usurata, annotare il senso di montaggio del taglio di giunzione "A".</p> <p><b>D</b> Schwenkbare Halterung (2) an der der Zapfwelle entgegengesetzten Seite abnehmen.<br/><b>BEMERKUNG.</b> Soll das Bronzelager (17) wegen Verschleiß ausgewechselt werden, Montagerichtung des Verbindungsschnitts "A" beachten.</p> <p><b>ESP</b> Remover el soporte oscilante (2) del lado opuesto a la toma de movimiento.<br/><b>NOTA.</b> Si hay que sustituir la chumacera (17) porque está gastada, anotar el sentido de montaje del corte de unión "A".</p> <p><b>F</b> Enlever le support oscillant (2) du côté opposé à celui de la prise de mouvement.<br/><b>NOTE.</b> Si on doit remplacer le coussinet (17) parce qu'il est usé, prendre note du sens de montage de l'entaille de jonction "A".</p> | <p><b>ITA</b> Scollegare dalle scatole snodo i perni delle barre di sterzata (Vedere «RIMOZIONE DEL CILINDRO DI STERZATURA»).</p> <p>Imbragare il braccio (3) da asportare e mettere in leggera tensione la fune.</p> <p><b>D</b> Von den Gelenkgehäusen die Stifte der Lenkstangen abtrennen (Siehe «LENKZYLINDER ABMONTIEREN»).<br/>Arm (3) anschlagen und das Seil spannen.</p> <p><b>ESP</b> Desconectar de los cárter de las rótulas los pernos de las barras de dirección (Véase «REMOCIÓN DEL CILINDRO DE DIRECCION»).</p> <p>Eslingar el brazo (3) que hay que sacar y poner en tensión ligera el cable.</p> <p><b>F</b> Débrancher des boîtiers articulation les tourillons des barres de braquage (Voir «DEPOSE DU CYLINDRE DE BRAQUAGE»).</p> <p>Elinguer le bras (3) à extraire et mettre légèrement en tension la corde.</p>                                                                                                                                                                                                                                                  |
| <p><b>e</b></p> <p><b>ITA</b> Allentare ed asportare le viti (4) e le rondelle (5) che fissano il braccio (3) al corpo centrale (6).</p> <p><b>D</b> Schrauben (4) mit den Unterlegscheiben (5) lockern und abschrauben, die den Arm (3) am zentralen Körper (6) befestigen.</p> <p><b>ESP</b> Aflojar y extraer los tornillos (4) y las arandelas (5) que fijan el brazo (3) al cuerpo central (6).</p> <p><b>F</b> Desserrer et enlever les vis (4), les rondelles (5) qui fixent le bras (3) au corps central (6).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>ITA</b> Rimuovere il braccio (3) e con esso il pacco dei dischi di frenatura (7).<br/>Posizionare il braccio su un banco di lavoro.</p> <p><b>D</b> Arm (3) samt Bremsscheiben (7) abnehmen.<br/>Arm auf die Werkbank legen.</p> <p><b>ESP</b> Remover el brazo (3) y con el mismo el paquete de discos de frenado (7).<br/>Posicionar el brazo en un banco de trabajo.</p> <p><b>F</b> Déposer le bras (3) et avec ce dernier le paquet de disques de freinage (7).<br/>Placer le bras sur l'établi d'usinage.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



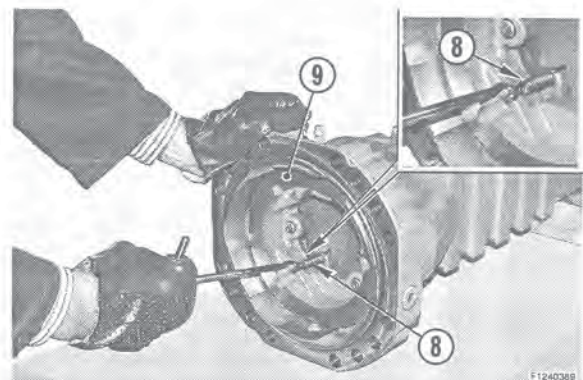


**CHECKING WEAR AND REPLACING THE BRAKING DISKS - CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO - VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN - CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO - CONTROLE D'USURE ET SUBSTITUTION DES DISQUES DE FREINAGE**



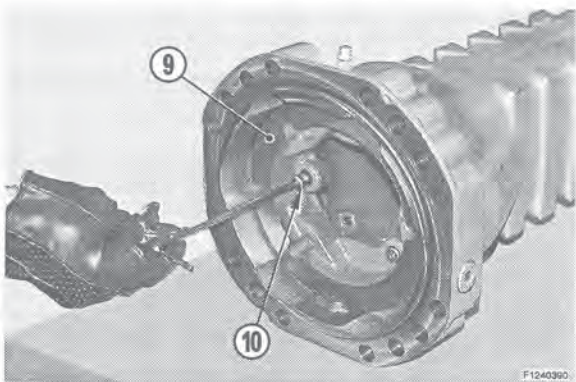
Remove the braking disks (7) and note down their order of assembly.

**NOTE.** 1 - If the disks do not need replacing, avoid switching their position.  
2 - Extract the u-joint (18).



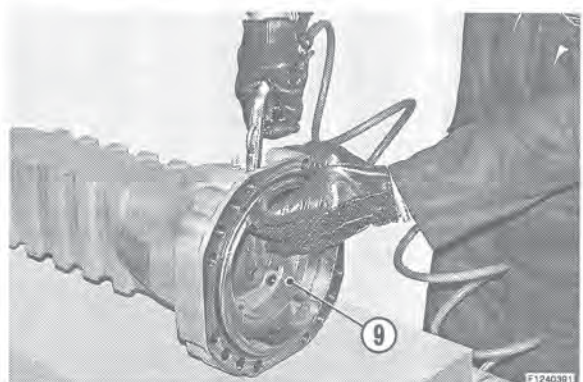
Remove the reversal springs (8) from the piston (9).

**NOTE.** If the springs (8) are weak or deformed they must be replaced.



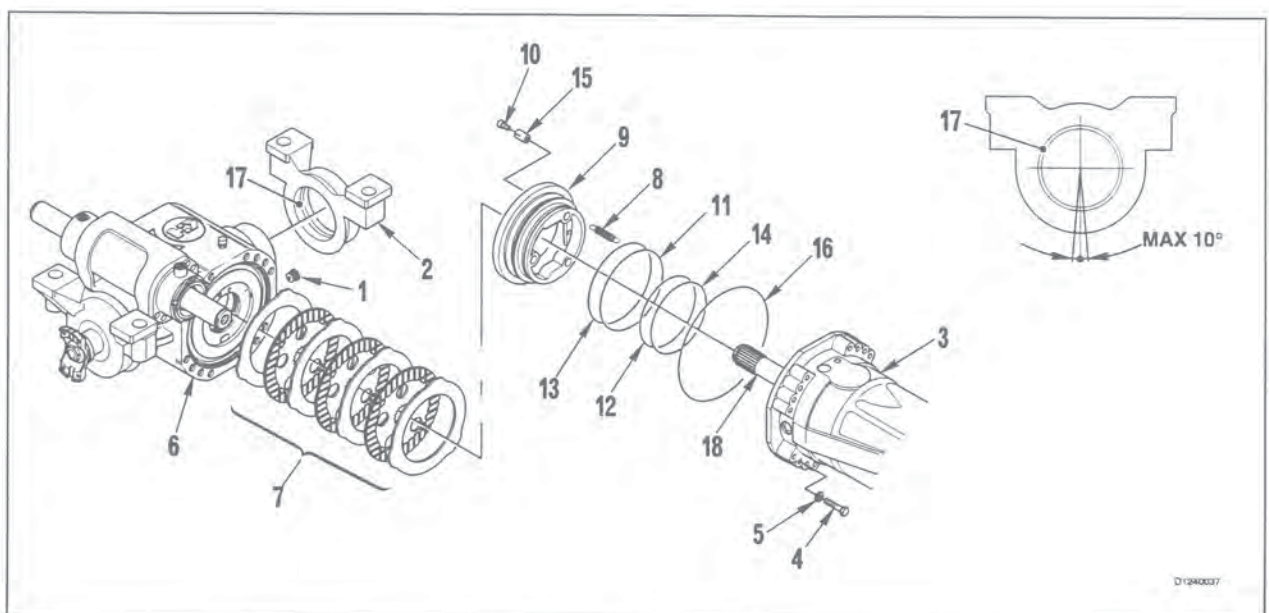
Remove the pin screws (10) guiding the piston (9).

**CAUTION!** If the screws are to be replaced, note down the different colours for the different brake gap.  
(See «HOW TO ASSEMBLE THE BRAKING UNITS»)



Slowly introduce compressed air through the connection of the braking circuit in order to extract the entire piston.

**CAUTION!** Hold on to the piston as it may be suddenly ejected and damaged.







ITA

Rimuovere i dischi di frenatura (7) annotando l'ordine di montaggio.

**NOTA.** 1 - Se i dischi non vanno sostituiti, evitare lo scambio di posizione.  
2 - Estrarre il doppio giunto cardanico (18).

D

Bremsscheiben (7) abnehmen und auf die Reihenfolge der Montage achten.

**BEMERKUNG.** 1 - Sollen die Scheiben nicht ausgetauscht werden, diese in der richtigen Reihenfolge zur Seite legen.

2 - Doppelgelenkwelle (18) abnehmen.

ESP

Remover los discos de frenado (7) anotando el orden de montaje.

**NOTA.** 1 - Si los discos no tienen que ser sustituidos, evitar el intercambio de posición.  
2 - Extraer el semieje (18).

F

Enlever les disques de freinage (7) en prenant note de l'ordre de montage.

**NOTE.** 1 - Si les disques ne sont pas à remplacer, éviter le changement de position.  
2 - Extraire le joint de cardan double (18).

ITA

Rimuovere le viti a perno (10) di guida del pistone (9).

**ATTENZIONE!** Se le viti devono essere sostituite, annotare la colorazione distintiva per i giochi freno (Vedere «ASSEMBLAGGIO GRUPPI DI FRENATURA»).

D

Die Stiftschraube (10) zur Kolbenführung (9) entfernen.

**ACHTUNG!** Sollen die Schrauben ausgewechselt werden, auf die farbige Kennzeichnung für das Bremsenspiel achten (Siehe «ZUSAMMENBAU DER BREMSAGGREGATE»).

ESP

Remover los pernos roscados (10) de guía del pistón (9).

**CUIDADO!** Si hay que sustituir los pernos, anotar el color distintivo para los juegos del freno (Véase «MONTAJE DE LOS GRUPOS DE FRENADO»).

F

Enlever les vis goujon (10) de guidage du piston (9).

**ATTENTION!** Si les vis doivent être remplacées, prendre note de la couleur de distinction des jeux de frein (Voir «ASSEMBLAGE DU GROUPE DE FREINAGE»).

ITA

Rimuovere le molle (8) di rientro del pistone (9).

**NOTA.** Se le molle (8) risultano snervate o deformate, devono essere sostituite.

D

Rückzugsfedern (8) des Kolbens (9) abnehmen.

**BEMERKUNG.** Wenn die Federn (8) nachgesetzt oder verformt sind, diese auswechseln.

ESP

Remover los muelles (8) de vuelta del pistón (9).

**NOTA.** Si los muelles (8) están desnervados o deformados, hay que sustituirlos.

F

Enlever les ressorts (8) de rentrée du piston (9).

**NOTE.** Si les ressorts (8) sont éternés ou déformés, il faut les remplacer.

ITA

Immettere lentamente aria compressa attraverso l'attacco del circuito frenante per estrarre il pistone completo.

**ATTENZIONE!** Trattenere il pistone che può essere espulso velocemente ed essere danneggiato.

D

Langsam Druckluft in den Bremskreislauf blasen, um den kompletten Kolben herauszuziehen.

**ACHTUNG!** Den Kolben mit der Hand halten, um zu vermeiden daß er zu schnell herausgestoßen und beschädigt wird.

ESP

Introducir lentamente aire comprimido a través de la unión del circuito frenante para extraer el pistón completo.

**CUIDADO!** Retener el pistón porque puede ser expulsado rápidamente y quedar dañado.

F

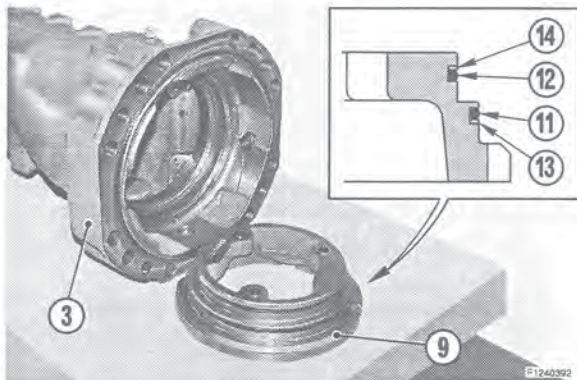
Injecter tout doucement de l'air comprimé à travers le raccord du circuit freinant pour extraire le piston complet.

**ATTENTION!** Retenir le piston qui pourrait être éjecté fortement et s'abîmer.

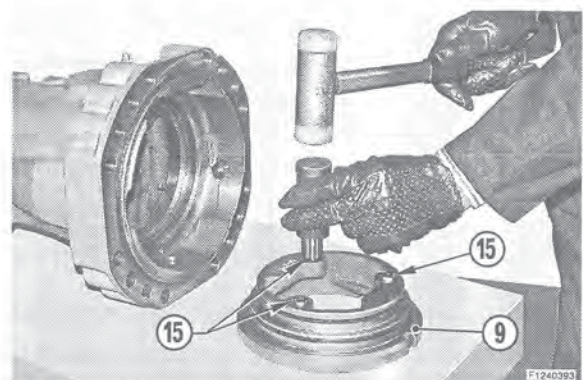




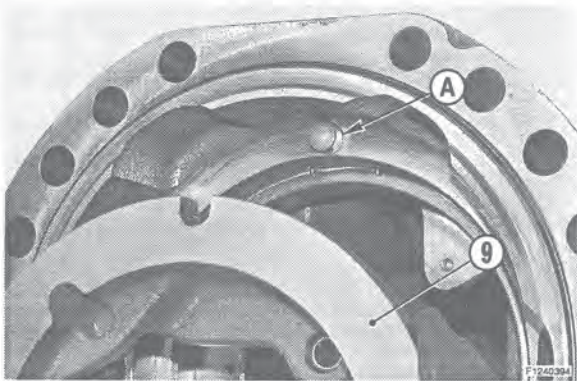
HOW TO ASSEMBLE THE BRAKING UNITS - ASSEMBLAGGIO DEI GRUPPI DI FRENATURA - BREMSAGGREGATE MONTIEREN -  
MONTAJE DE LOS GRUPOS DE FRENADO - ASSEMBLAGE DES GROUPES DE FREINAGE



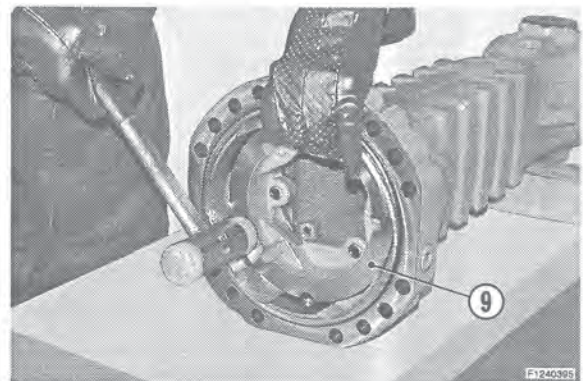
Accurately clean the piston (9) and the seats of slide and seal. Replace the O-rings (11) and (12) and the anti-extrusion rings (13) and (14); make sure that the assembly side is correct.  
**CAUTION!** Accurately check the positioning of the anti-extrusion rings (13) and (14).



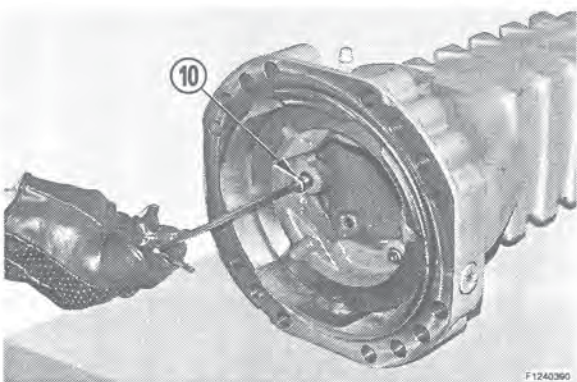
Insert the stroke automatic regulation springs (15); place them in line with the piston (9).



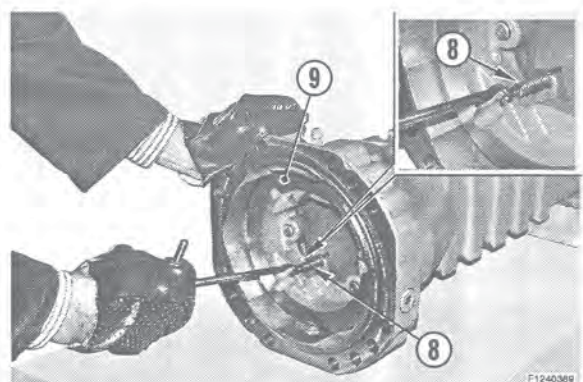
Lubricate the seals (11) and (12) and fit the piston (9) into the arm (3).  
**CAUTION!** Make sure that the piston seat fits into the stop pin (A) inside the arm.



Assist the insertion of the piston (9) by lightly hammering around the edge with a plastic hammer.



Fit the pin screws (10) making sure that they are all of the same colour. White: 1 mm gap  
Yellow: 0.75 mm gap  
Blue: 0.5 mm gap  
Apply Loctite 270 to the thread.  
Torque wrench setting: 5-7 Nm.



Fit the reversal springs (8) on the piston (9).  
**CAUTION!** Pay due attention not to deform the connections of the springs.

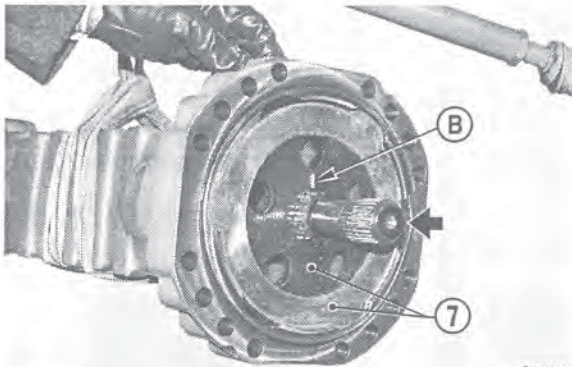




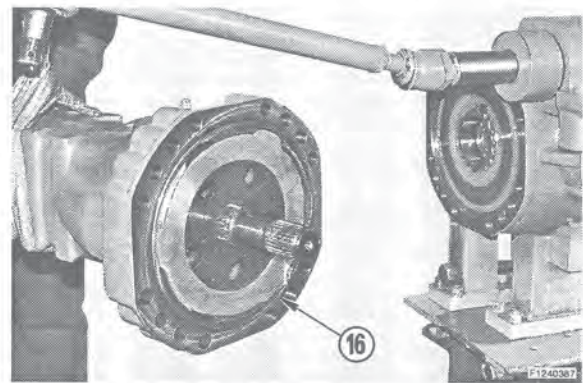
- ITA** Pulire accuratamente il pistone (9) e le sedi di scorrimento e tenuta.  
Sostituire le guarnizioni OR (11) e (12) e gli anelli antiestrusione (13) e (14), rispettando il senso di montaggio.  
**ATTENZIONE!** Controllare attentamente il posizionamento degli anelli antiestrusione (13) e (14).
- D** Kolben (9) sowie Gleit- und Dichtungssitze sorgfältig reinigen.  
O-Ringe (11) und (12) sowie die Halteringe (13) und (14) auswechseln; dabei auf die Reihenfolge der Montage achten.
- a** **ACHTUNG!** Position der Halteringe (13) und (14) sorgfältig kontrollieren.
- ESP** Limpiar minuciosamente el pistón (9) y los alojamientos de deslizamiento y estanqueidad.  
Sustituir las juntas OR (11) y (12) y los anillos antiextrusión (13) y (14) teniendo en cuenta el sentido de montaje.  
**CUIDADO!** Controlar atentamente el posicionamiento de los anillos antiextrusión (13) y (14).
- F** Nettoyer soigneusement le piston (9), les logements de coulissement et d'étanchéité.  
Remplacer les garnitures OR (11) et (12), les anneaux anti-extrusion (13) et (14) en respectant le sens du montage.  
**ATTENTION!** Contrôler soigneusement la position des anneaux anti-extrusion (13) et (14).
- ITA** Lubrificare le guarnizioni (11) e (12) e montare nel braccio (3) il pistone (9).  
**ATTENZIONE!** Controllare che la sede del pistone imbocchi la spina di arresto (A) interna al braccio.
- D** Dichtungen (11) und (12) schmieren und Arm (3) und Kolben (9) montieren.  
**ACHTUNG!** Der Kolben muß den Anhaltstift (A) im Inneren des Arms aufnehmen.
- c**
- ESP** Lubricar las juntas (11) y (12) y montar en el brazo (3) el pistón (9).  
**CUIDADO!** Controlar que el alojamiento del pistón encaje en la clavija de tope (A) dentro del brazo.
- F** Lubrifier les garnitures (11) et (12), puis monter dans le bras (3) le piston (9).  
**ATTENTION!** Contrôler que le logement du piston s'emboîte bien avec la broche d'arrêt (A) à l'intérieur du bras.
- ITA** Montare le viti a perno (10) controllando che siano tutte dello stesso colore. Bianco: gioco 1 mm  
Giallo: gioco 0,75 mm  
Azzurro: gioco 0,5 mm.  
Spalmare la filettatura con Loctite 270.  
Coppia di serraggio: 5÷7 Nm
- D** Die Stiftschrauben (10) einsetzen. Diese müssen alle gleichfarbig sein. Weiß: Spiel 1 mm  
Gelb: Spiel 0,75 mm  
Hellblau: Spiel 0,5 mm.
- e** Das Gewinde mit Loctite 270 schmieren.  
Anzugsmoment: 5÷7 Nm.
- ESP** Montar los pernos roscados (10) controlando que sean todos del mismo color. Blanco: juego 1 mm  
Amarillo: juego 0,75 mm  
Azul: juego 0,5 mm.  
Pasar en la rosca Loctite 270.  
Par de torsión: 5÷7 Nm.
- F** Monter les vis à tourillon (10) en contrôlant si elles sont toutes de la même couleur. Blanc: jeu 1 mm  
Jaune: jeu 0,75 mm  
Bleu ciel: jeu 0,5 mm.  
Enduire le filetage de Loctite 270.  
Couple de serrage: 5÷7 Nm.
- ITA** Inserire a filo del pistone (9) le molle (15) per l'autoregolazione della corsa.
- D** Den Kolben (9) und die Federn (15) zur Selbstregelung des Hubs genau einsetzen.
- b**
- ESP** Introducir a ras del pistón (9) los muelles (15) para la autorregulación de la carrera.
- F** Introduire, au fil du bord du piston (9) les ressorts (15) pour l'autorégulation de la course.
- ITA** Aiutare l'inserimento del pistone (9) con leggeri colpi di mazzuolo in materiale plastico distribuiti lungo la circonferenza.
- D** Den Kolben (9) einsetzen; diesen dazu leicht mit einem Gummihammer entlang seiner Kreislinie schlagen.
- d**
- ESP** Facilitar la inserción del pistón (9) con ligeros golpes de martillo de material plástico distribuidos en toda la circunferencia.
- F** Accompagner l'introduction du piston (9) par de légers coups de maillet en matière plastique distribués tout le long de la circonférence.
- ITA** Montare le molle (8) di ritorno del pistone (9).  
**ATTENZIONE!** Usare molta cautela per non deformare gli attacchi delle molle.
- D** Die Rückzugsfedern (8) des Kolbens (9) montieren.  
**ACHTUNG!** Sehr vorsichtig vorgehen, um die Federn am Anschluß nicht zu verformen.
- f**
- ESP** Montar los muelles (8) de retorno del pistón (9).  
**CUIDADO!** Tener mucho cuidado a fin de no deformar las uniones de los muelles.
- F** Monter les ressorts (8) de retour du piston (9).  
**ATTENTION!** Faire très attention à ne pas déformer les raccords des ressorts.



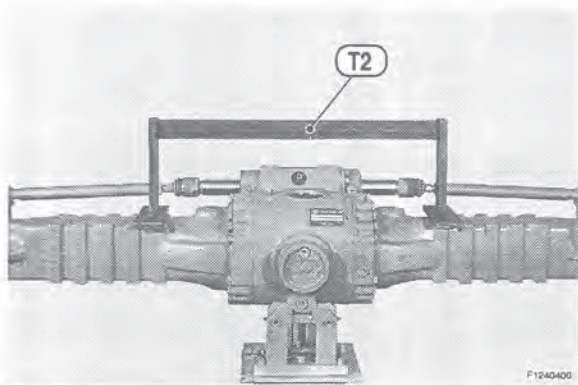
HOW TO ASSEMBLE THE BRAKING UNITS - ASSEMBLAGGIO DEI GRUPPI DI FRENATURA - BREMSAGGREGATE MONTIEREN -  
MONTAJE DE LOS GRUPOS DE FRENADO - ASSEMBLAGE DES GROUPES DE FREINAGE



Slightly lubricate the braking disks (7) and fit them in the arm following the correct sequence; orient them so that the oil circulation holes and the marks "B" are perfectly lined up.  
**NOTE.** When installing the steel discs, the slot corresponding to the oil level cap should always be kept free.



Check that the positioning of the sealing ring (16) on the arm is intact; install the complete arm. Lock it into position using two facing screws (4) and washers (5).



Check the flatness of the arms using tool T2 and finally lock the arms with the screws (4) and the washer (5) using the cross-tightening method.  
Torque wrench setting: 298 Nm





**ITA**

Lubrificare leggermente i dischi di frenatura (7) e montarli nel braccio con la giusta sequenza, orientati in modo che i fori di circolazione dell'olio ed i contrassegni "B" siano perfettamente allineati.

**NOTA.** I dischi in acciaio devono essere montati lasciando libera la cava corrispondente al tappo livello olio.

**D**

Die Bremsscheiben (7) leicht schmieren und in der richtigen Reihenfolge auf den Arm montieren. Dabei müssen sie so orientiert sein, daß Ölleitungslöcher genau mit den Kennzeichnungen "B" übereinstimmen.

**a** **BEMERKUNG.** Bei der Montage der Stahlscheiben die dem Ölfüllstopfen entspricht, freilassen.

**ESP**

Lubricar ligeramente los discos de frenado (7) y montarlos en el brazo con la secuencia exacta, orientados de manera que los orificios de circulación del aceite y las marcas "B" estén perfectamente alineados.

**NOTA.** Los discos en acero deben de ser ensamblados dejando libre el nicho correspondiente a la tapa de nivel aceite.

**F**

Lubrifier légèrement les disques de freinage (7), puis monter ceux-ci dans le bras à la juste séquence, orientés de telle sorte à ce que les trous de circulation de l'huile et ceux marqués "B" soient parfaitement alignés.

**NOTE.** Les disques en acier doivent être montés sans déranger la rainure du bouchon du niveau de l'huile.

**ITA**

Verificare l'integrità ed il posizionamento dell'anello di tenuta (16) del braccio; installare il braccio completo. Fissarlo in posizione con due viti (4) e rondelle (5) contrapposte.

**D**

Kontrollieren ob der Kolbenring (16) unbeschädigt und auf den Arm richtig montiert ist; den kompletten Arm montieren.

**b** In seiner Position mit zwei Schrauben (4) und den entgegengesetzten Unterlegscheiben (5) befestigen.

**ESP**

Comprobar la integridad y el posicionamiento del segmento de compresión (16) del brazo; instalar el brazo completo.

Fijarlo en su posición con dos tornillos (4) y arandelas (5) contrapuestas.

**F**

Vérifier le bon état et la position de la bague d'étanchéité (16) du bras, installer le bras complet. Fixer celui-ci à sa place à l'aide des deux vis (4) et des rondelles (5) superposées.

**ITA**

Controllare la planarità dei bracci con l'attrezzo T2 e fissarli definitivamente con le viti (4) e le rondelle (5) con il metodo del serraggio incrociato.

Coppia di serraggio: 298 Nm

**D**

Die Ebenheit der Arme mit dem Werkzeug T2 kontrollieren und die Arme endgültig mit den Schrauben (4) und Unterlegscheiben (5) abwechselnd und gegenseitig festschrauben.

**c** Anzugsmoments: 298 Nm

**ESP**

Controlar la planaridad de los brazos utilizando la herramienta T2 y fijarlos definitivamente con los tornillos (4) y las arandelas (5) con el método de torsión cruzado.

Par de torsión: 298 Nm

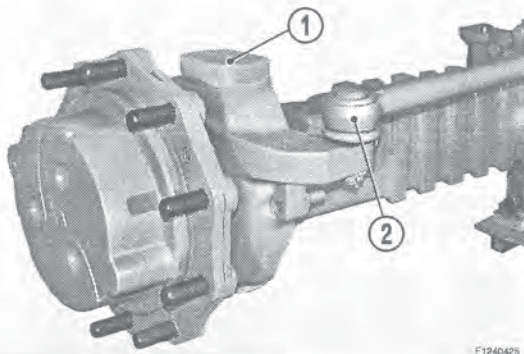
**F**

Contrôler l'uniformité des bras à l'aide de l'outil T2 puis fixer définitivement ces derniers avec les vis (4) et les rondelles (5) par le biais du mode de serrage croisé.

Couple de serrage: 298 Nm



**HOW TO REMOVE THE COMPLETE STEERING CASE - RIMOZIONE SCATOLA SNODO COMPLETA- KOMPLETTES GELENKGEHÄUSE ABMONTIEREN - REMOCION CARTER DE ROTULA COMPLETO - DEPOSE DU BOITIER ARTICULATION COMPLET**



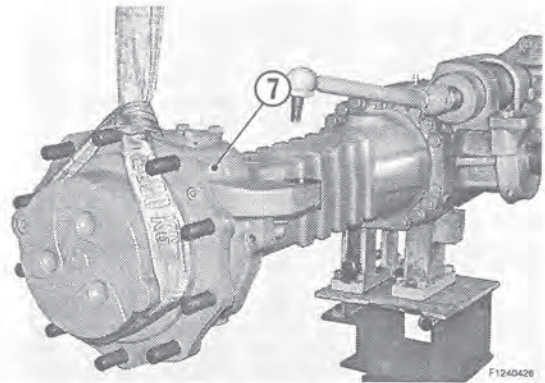
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GB

a

Remove the guard (1) and disconnect the articulation pin (2) (See «HOW TO REMOVE THE STEERING CYLINDER»).



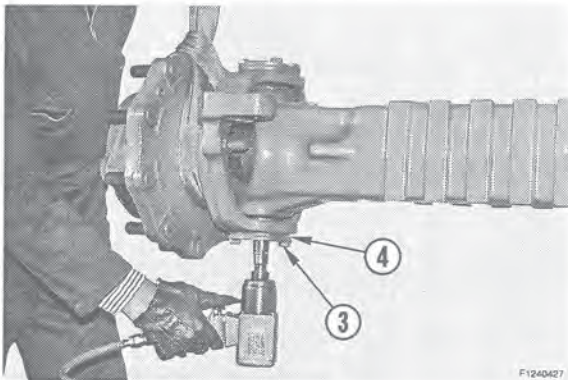
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GB

b

Sling the entire unit (7) and connect it to the hoist, putting the rod under light tension.



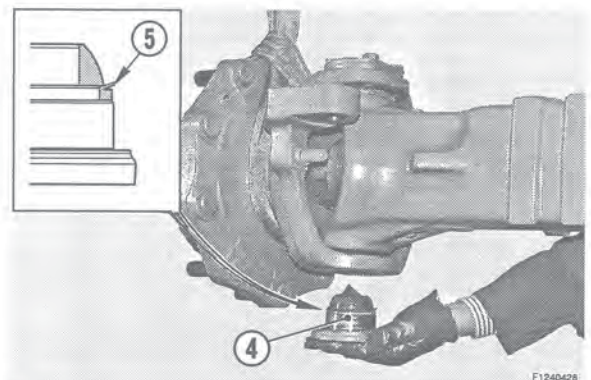
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GB

c

Unloose and remove the fitting screws (3) from the bottom articulation pin (4).  
**NOTE.** Screws cannot be re-used.



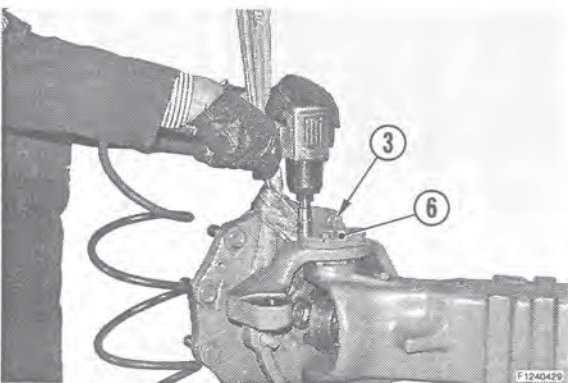
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GB

d

Remove the bottom articulation pin (4) complete with front sealing ring (5).



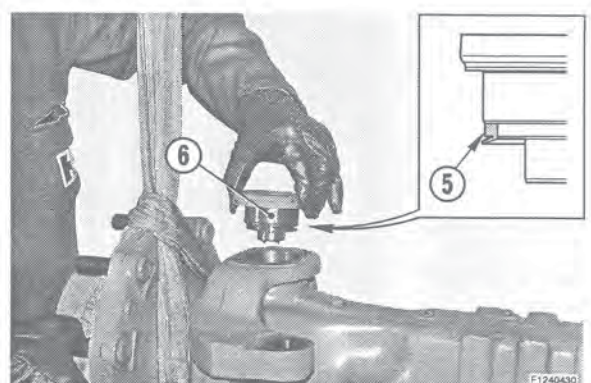
F1240429



GB

e

Unloose and remove the fitting screws (3) from the top articulation pin (6).



F1240430



GB

f

Using two levers, remove the top articulation pin (6) complete with front seal (5).  
Pay attention not to damage the surfaces.





- a**
- ITA** Rimuovere la protezione (1) e scollegare il perno snodo (2) (Vedere «RIMOZIONE CILINDRO DI STERZATURA»).
- D** Abdeckung (1) abnehmen und den Gelenkstift (2) abtrennen (Siehe «LENKZYLINDER ABMONTIEREN»).
- ESP** Remover la protección (1) y desconectar la rótula (2) (Véase «REMOCION CILINDRO DE DIRECCION»).
- F** Enlever la protection (1) et débrancher le tourillon d'articulation (2) (Voir «DEPOSE DU CYLINDRE DE BRAQUAGE»).

- b**
- ITA** Imbragare il gruppo completo (7) e collegarlo al mezzo di sollevamento mettendo in leggera tensione la fune.
- D** Komplettes Aggregat (7) anschlagen und an das Hebmittel hängen. Das Seil spannen.
- ESP** Eslingar el grupo completo (7) y conectarlo al medio de elevación con el cable en ligera tensión.
- F** Elinguer le groupe complet (7) puis le hisser au moyen de relevage en tendant légèrement la corde.

- c**
- ITA** Allentare ed asportare le viti (3) di ritegno del perno snodo inferiore (4).  
**NOTA.** Le viti non sono riutilizzabili.
- D** Schrauben (3) des unteren Gelenkstiftes (4) lockern und abschrauben.  
**BEMERKUNG.** Die Schrauben dürfen nicht wieder verwendet werden.
- ESP** Aflojar y sacar los tornillos (3) de retención de la rótula inferior (4).  
**NOTA.** Los tornillos no son reutilizables.
- F** Desserrer et enlever les vis (3) de fixation du tourillon inférieur d'articulation (4).  
**NOTE.** Les vis ne peuvent plus être utilisées.

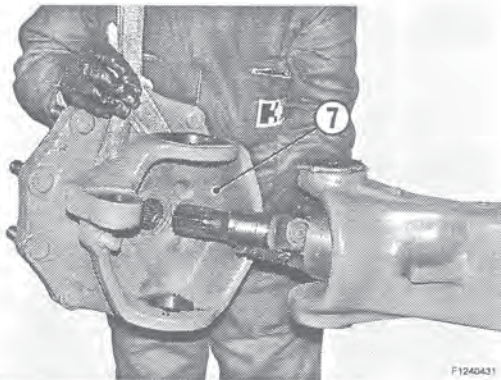
- d**
- ITA** Rimuovere il perno snodo inferiore (4) completo di anello di tenuta frontale (5).
- D** Unteren Gelenkstift (4) samt frontalem Kolbenring (5) abnehmen.
- ESP** Remover la rótula inferior (4) completa de segmento de compresión frontal (5).
- F** Enlever le tourillon inférieur d'articulation (4) équipé de la bague d'étanchéité frontale (5).

- e**
- ITA** Allentare ed asportare le viti di ritegno (3) del perno snodo superiore (6).
- D** Schrauben (3) des oberen Gelenkstiftes (6) lockern und abschrauben.
- ESP** Aflojar y sacar los tornillos de retención (3) de la rótula superior (6).
- F** Desserrer et enlever les vis de fixation (3) du tourillon supérieur d'articulation (6).

- f**
- ITA** Utilizzando due leve, rimuovere il perno snodo superiore (6) completo di guarnizione frontale (5). Prestare attenzione per non rovinare i piani.
- D** Mit Hilfe von zwei Hebeln, oberen Gelenkstift (6) samt frontalem Kolbenring (5) abnehmen. Achtung, die Flächen nicht verkratzen.
- ESP** Utilizando dos palancas, remover la rótula superior (6) completa de junta frontal (5). Tener cuidado a fin de no estropear las superficies.
- F** A l'aide de deux leviers, enlever le tourillon supérieur d'articulation (6) équipé de la garniture frontale (5). Faire très attention de ne pas abîmer les plateaux.



**HOW TO REMOVE THE COMPLETE STEERING CASE - RIMOZIONE SCATOLA SNODO COMPLETA - KOMPLETTES GELENKGEHÄUSE ABMONTIEREN - REMOCION CARTER DE ROTULA COMPLETO - DEPOSE DU BOITIER ARTICULATION COMPLET**



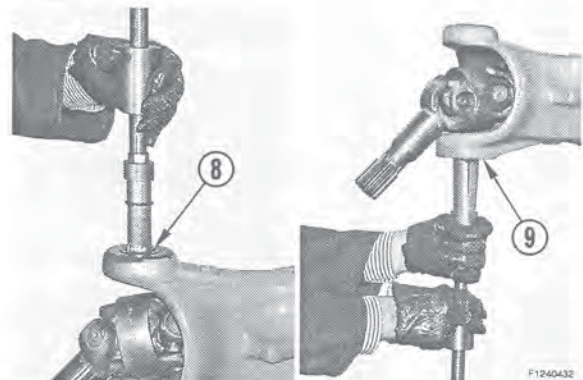
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**GB**

**a**

Remove the complete steering case (7).



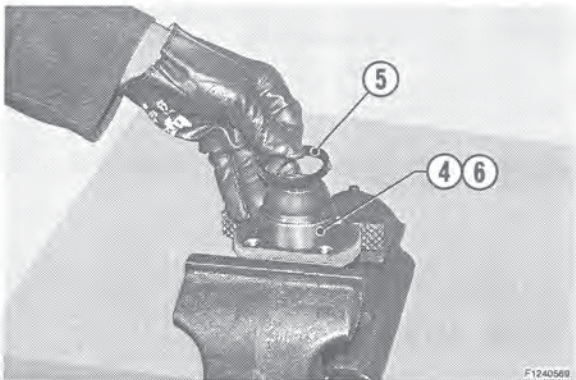
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**GB**

**b**

Using a puller for inner parts, remove the top bush (8) and the bottom ball-bush (9).



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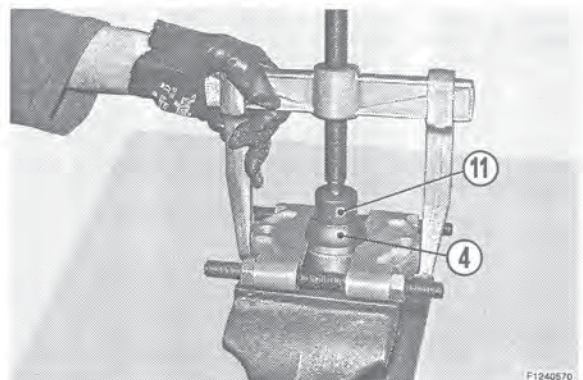


**GB**

**c**

Remove the articulation pins (4) and (6) and the front sealing rings (5).

**NOTE.** Note down the side for assembly.



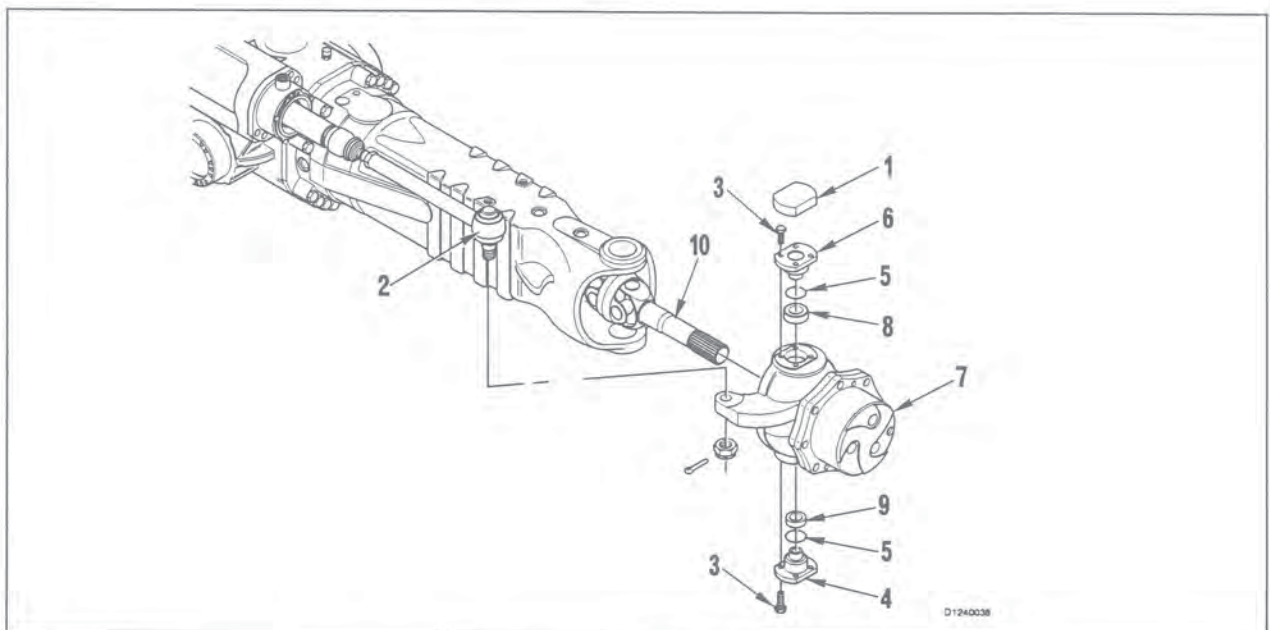
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**GB**

**d**

If the ball cover (11) needs replacing, remove it from the bottom articulation pin (4).







- a**
- ITA** Rimuovere il gruppo snodo completo (7).
  - D** Komplettes Gelenkaggregat (7) abnehmen.
  - ESP** Remover el grupo rótula completo (7).
  - F** Enlever le groupe d'articulation complet (7).

- b**
- ITA** Utilizzando un estrattore per interni, rimuovere la boccia superiore (8) e la boccia sferica inferiore (9).
  - D** Mit einem Abzieher, die obere Buchse (8) und die untere Kugelbuchse (9) herausnehmen.
  - ESP** Utilizando un extractor, remover el casquillo superior (8) y el casquillo esférico inferior (9).
  - F** A l'aide d'un extracteur, enlever la bague supérieure (8) et la bague à roulement inférieure (9).

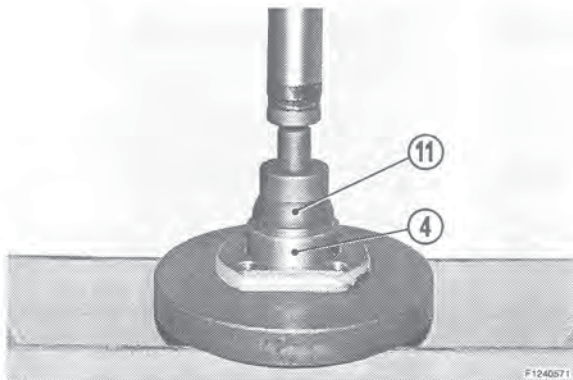
- c**
- ITA** Rimuovere dai perni snodo (4) e (6) gli anelli di tenuta frontale (5).  
**NOTA.** Annotare il senso di montaggio.
  - D** Von den Gelenkstiften (4) und (6) die frontalen Dichtungen (5) abnehmen.  
**BEMERKUNG.** Montagerichtung beachten.
  - ESP** Remover de las rótulas (4) y (6), los segmentos de compresión frontal (5).  
**NOTA.** Anotar el sentido de montaje.
  - F** Enlever des tourillons d'articulation (4) et (6) les bagues d'étanchéité frontales (5).  
**NOTE.** Prendre note du sens de montage.

- d**
- ITA** Se è da sostituire, asportare dal perno snodo inferiore (4) la calotta sferica (11).
  - D** Wenn der untere Gelenkstift (4) ausgewechselt werden muß, diesen und den Deckel (11) abnehmen.
  - ESP** Si hay que sustituirla, sacar de la rótula inferior (4) el casquete esférico (11).
  - F** Si elle est à remplacer, extraire du tourillon d'articulation inférieur (4), la calotte sphérique (11).





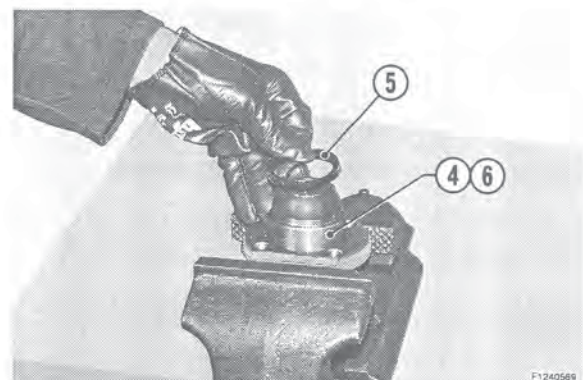
**HOW TO ASSEMBLE THE COMPLETE STEERING CASE - ASSEMBLAGGIO SCATOLA SNODO COMPLETA - KOMPLETTES GELENKGEHÄUSE MONTIEREN - MONTAJE CAJA DE ROTULA COMPLETA - ASSEMBLAGE DU BOITIER ARTICULATION COMPLET**



GB

a

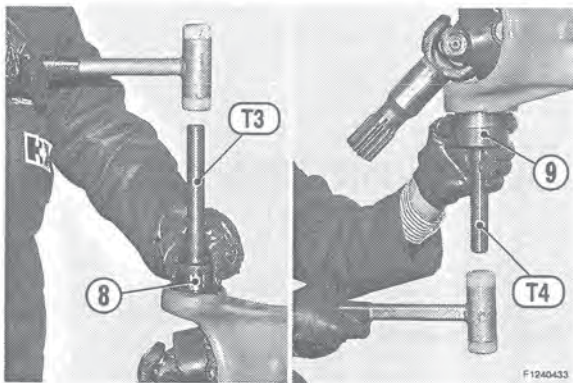
If the bottom articulation pin (4) has been extracted, position the pin under a press and fit the ball cover (11).



GB

b

Fit the front sealing rings (5) onto the articulation pins (4) and (6).  
**NOTE.** Carefully check that the rings are properly oriented (5).



GB

c

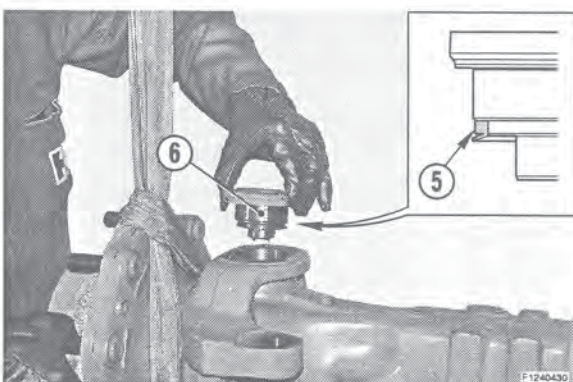
Lubricate the top bush (8) or the bottom ball bush (9) and fit them into the fulcrum holes of the arm.  
Use tools T3 and T4.



GB

d

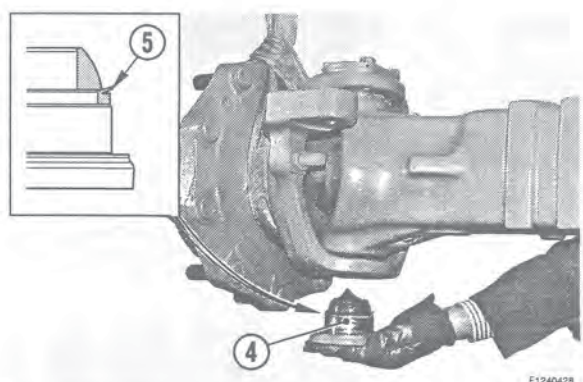
Lubricate the terminal of the u-joint (10) and install the steering case (7).  
Pay due attention not to damage the dust cover rings and the sealing rings.



GB

e

Fit a new seal (5) onto the top articulation pin (6). Lubricate and install the unit in the steering case. Position the screws (3) and lightly tighten.  
Check the correct assembly side of the seal (5).



GB

f

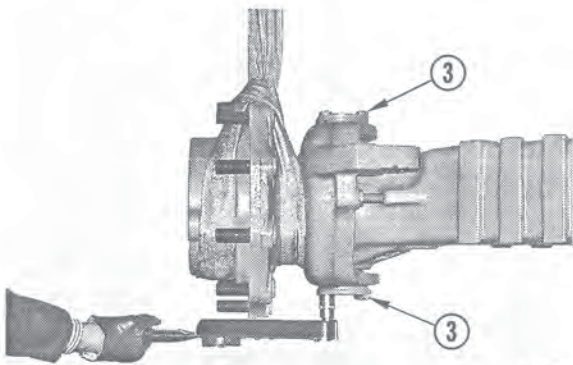
Fit a new seal (5) onto the bottom articulation pin (4). Lubricate and fit the unit in the steering case. Position the screws (3) and lightly tighten.  
Check for the correct assembly side of the seal (5).



- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Se è stato smontato, posizionare il perno snodo inferiore (4) sotto una pressa e montare la calotta sferica (11).</p> <p><b>D</b> Wenn montiert, den unteren Gelenkstift (4) unter eine Presse montieren und den Deckel (11) anbringen.</p> <p><b>ESP</b> Si ha sido desmontada, posicionar la rótula inferior (4) debajo de una prensa y montar el casquete esférico (11).</p> <p><b>F</b> S'il a déjà été démonté, placer le tourillon d'articulation inférieur (4) sous une presse, puis monter la calotte sphérique (11).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p><b>ITA</b> Montare sui perni snodo (4) e (6) gli anelli di tenuta frontale (5).<br/><b>NOTA.</b> Controllare attentamente l'orientamento degli anelli (5).</p> <p><b>D</b> Auf den Gelenkstiften (4) und (6) die frontalen Dichtringe (5) montieren.<br/><b>BEMERKUNG.</b> Richtung der Ringe (5) sorgfältig kontrollieren.</p> <p><b>ESP</b> Montar en las rótulas (4) y (6) los segmentos de compresión frontal (5).<br/><b>NOTA.</b> Controlar atentamente la orientación de los anillos (5).</p> <p><b>F</b> Monter les tourillons d'articulation (4) et (6) les bagues d'étanchéité frontales (5).<br/><b>NOTE.</b> Faire très attention au sens des bagues (5).</p>                                                                                                                                                                                                                                                                                                                                                                   |
| <p><b>c</b></p> <p><b>ITA</b> Lubrificare la boccia superiore (8) e la boccia sferica inferiore (9) e montarle nei fori di fulcro del braccio. Utilizzare gli attrezzi T3 e T4.</p> <p><b>D</b> Die obere Buchse (8) und untere kugelige Buchse (9) schmieren und in die Löcher des Arm. Dazu die Werkzeuge T3 und T4 verwenden.</p> <p><b>ESP</b> Lubricar el casquillo superior (8) y el casquillo esférico inferior (9) y montarlos en los orificios de centro del brazo. Utilizar las herramientas T3 y T4.</p> <p><b>F</b> Lubrifier la bague supérieure (8) et la bague sphérique inférieure (9), puis monter celles-ci dans les trous du point d'appui du bras. Utiliser les outils T3 et T4.</p>                                                                                                                                                                                                                                                                                                                                                 | <p><b>ITA</b> Lubrificare il terminale del doppio giunto cardanico (10) e montare il gruppo scatola snodo (7). Prestare molta attenzione per non danneggiare gli anelli parapolvere e di tenuta.</p> <p><b>D</b> Das Endstück der Doppelgelenkwelle (10) schmieren und das Gelenkgehäuse-Aggregat (7) montieren. Vorsicht: Staubschutzringe und Dichtungsringe nicht beschädigen.</p> <p><b>ESP</b> Lubricar el terminal del semieje (10) y montar el grupo caja de rótula (7). Tener mucho cuidado a fin de no dañar los segmentos de protección del polvo y los de compresión.</p> <p><b>F</b> Lubrifier l'extrémité de joint de cardan double (10), puis monter le groupe du boîtier articulation (7). Faire très attention à ne pas abîmer les bagues anti-poussière et d'étanchéité.</p>                                                                                                                                                                                                                                                  |
| <p><b>e</b></p> <p><b>ITA</b> Montare sul perno (6) di fulcro snodo superiore una nuova guarnizione (5), lubrificare e montare il gruppo nella scatola snodo. Montare le viti (3) e serrarle leggermente. Controllare il senso di montaggio della guarnizione (5).</p> <p><b>D</b> Auf den Zentrierstift (6) des oberen Gelenks eine neue Dichtung (5) montieren, schmieren und das Aggregat in das Gelenkgehäuse montieren. Die Schrauben (3) anbringen und leicht zuschrauben. Montagerichtung der Dichtungen (5) kontrollieren.</p> <p><b>ESP</b> Montar en el perno (6) de centro de la rótula superior una junta nueva (5), lubricar y montar el grupo en la rótula. Montar los tornillos (3) y apretarlos ligeramente. Controlar el sentido de montaje de la guarnición (5).</p> <p><b>F</b> Monter sur le tourillon (6) du point d'appui articulation supérieur, une garniture neuve (5), lubrifier et monter le groupe dans boîtier articulation. Monter les vis (3) et serrer légèrement. Contrôler le sens de montage de la garniture (5).</p> | <p><b>ITA</b> Montare sul perno di fulcro snodo inferiore (4) una nuova guarnizione (5), lubrificare e montare il gruppo nella scatola snodo. Montare le viti (3) e serrarle leggermente. Controllare il senso di montaggio della guarnizione (5).</p> <p><b>D</b> Auf den Zentrierstift des unteren Gelenks (4) eine neue Dichtung (5) montieren, schmieren und das Aggregat in das Gelenkgehäuse montieren. Die Schrauben (3) anbringen und leicht zuschrauben. Montagerichtung der Dichtungen (5) kontrollieren.</p> <p><b>ESP</b> Montar en el perno de fulcro de la rótula inferior (4) una junta nueva (5), lubricar y montar el grupo en la caja de la rótula. Montar los tornillos (3) y apretarlos ligeramente. Controlar el sentido de montaje de la junta (5).</p> <p><b>F</b> Monter sur le tourillon du point d'appui articulation inférieur (4) une garniture neuve (5), lubrifier et monter le groupe dans boîtier articulation. Monter les vis (3) et serrer légèrement. Contrôler le sens de montage de la garniture (5).</p> |



**HOW TO ASSEMBLE THE COMPLETE STEERING CASE - ASSEMBLAGGIO SCATOLA SNODO COMPLETA - KOMPLETTES GELENKGEHÄUSE  
MONTIEREN - MONTAJE CAJA DE ROTULA COMPLETA - ASSEMBLAGE DU BOITIER ARTICULATION COMPLET**



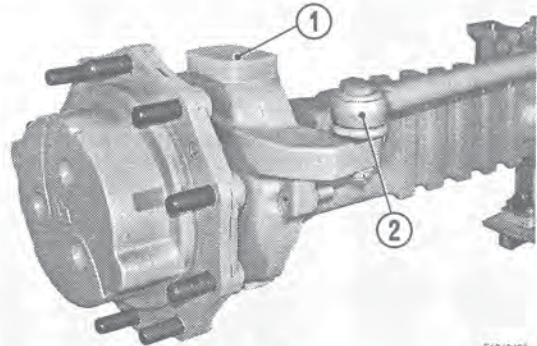
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**GB**

**a**

Tighten the new fitting screws (3) of top and bottom articulation pins in sequence using the cross tightening method.  
Torque wrench setting: 128–142 Nm



F1240425



**GB**

**b**

Connect the articulation pin (2) (See «HOW TO INSTALL THE STEERING CYLINDER»)  
Lubricate articulations with Molikote and fit the dust cover (1).



SPICER CLARK-HURTH

a

ITA

Serrare in sequenza con il metodo incrociato, le nuove viti (3) di ritegno dei perni snodo inferiore e superiore. Coppia di serraggio:  $128 \div 142$  Nm

D

Entgegengesetzt und abwechselnd die Schrauben (3) der unteren und oberen Gelenkstiften festschrauben. Anzugsmoment:  $128 \div 142$  Nm

ESP

Apretar en secuencia con el método cruzado, los tornillos (3) de retención de las rótulas inferior y superior.  
Par de torsión:  $128 \div 142$  Nm

F

Serrer dans l'ordre, par le biais du mode croisé, les vis (3) de fixation des tourillons d'articulation inférieur et supérieur.  
Couple de serrage:  $128 \div 142$  Nm

b

ITA

Collegare il perno snodo (2) (Vedere «INSTALLAZIONE CILINDRO DI STERZATURA»). Lubrificare gli snodi con Molikote e montare il coperchio parapolvere (1).

D

Den Gelenkstift (2) anschließen (Siehe «GELENKZYLINDER INSTALLIEREN»). Gelenke mit Molikote schmieren und den Schutzdeckel (1) abschrauben.

ESP

Conectar la rótula (2) (Véase «INSTALACION CILINDRO DE DIRECCION»). Lubricar las rótulas con Molikote y montar la tapa de protección del polvo (1).

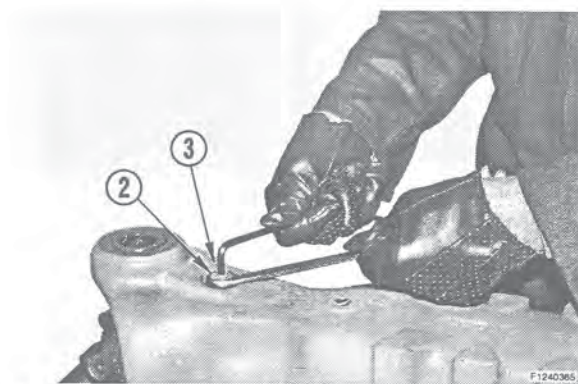
F

Brancher le tourillon d'articulation (2) (Voir «INSTALLATION DU CYLINDRE DE BRAQUAGE»). Lubrifier les articulations avec du Molikote, puis monter le couvercle anti-poussière (1).





HOW TO REMOVE THE U-JOINT - RIMOZIONE DOPPIO GIUNTO CARDANICO - DOPPELGELENKWELLE ABMONTIEREN -  
REMOCION SEMIEJES - DEPOSE DE JOINT DE CARDAN DOUBLE



 GB a

Unloose and remove the top and bottom check nuts (2) from the dowels (3).



 GB b

Remove top and bottom check dowels (3) from the flange (5) or bush (13).

## NOTES - NOTE - BEMERKUNG - NOTAS - NOTE

**GB**

The u-joint can only be removed after extraction of the steering case has been performed (See: «REMOVING THE STEERING CASE»). Different procedures need to be followed depending on the kind of repair operation needed and the type of axle:

- 1 - Axle without parking brakes: compressed air (7 bar approx.) should be introduced in the braking circuit in order to hold the braking disks in position.
- 2 - Axle with negative brake: does not require any preparation as the disks are mechanically locked in position.
- 3 - Axle with mechanical brake: requires that the external control levers are put under tension in relation to each other.
- 4 - Disassembly to be carried out with the arm resting on the bench.

The explanations reported herewith refer to removal operations carried out on the bench; the different stages of u-joint removal also apply to all other solutions or versions.

**ITA**

La rimozione del doppio giunto cardanico può essere eseguita solo dopo la rimozione della scatola snodo (Vedere «RIMOZIONE SCATOLA SNODO») ed in modo diversificato, in funzione del tipo di riparazione da eseguire e del tipo di assale:

- 1 - Assale senza freni di stazionamento: è necessario immettere aria compressa (circa 7 bar) nel circuito di frenatura per tenere in posizione i dischi freni.
- 2 - Assale con freno negativo: non richiede alcuna preparazione in quanto i dischi restano bloccati meccanicamente.
- 3 - Assale con freno a comando meccanico: richiede di mettere in tensione tra loro le leve esterne di comando.
- 4 - Smontaggio eseguito con il braccio appoggiato sul banco.

Le spiegazioni riportate si riferiscono alla rimozione eseguita al banco e le fasi sono comuni alle altre soluzioni o versioni.

**D**

Die Doppelgelenkwelle können erst abmontiert werden, wenn das Gelenkgehäuse schon abgenommen worden ist (Siehe, «GELENKGEHÄUSE ABMONTIEREN»). Der Vorgang ist je nach benötigter Reparatur und je nach Achsentyp unterschiedlich:

- 1 - Achse ohne Feststellbremse: die Bremsanlage mit ca. 7 bar unter Druck setzen, um die Bremsscheiben in ihrer Position festzuhalten.
- 2 - Achse mit negativer Bremse: benötigt keinerlei Vorbereitung, da die Scheiben mechanisch blockiert bleiben.

- 3 - Achse mit mechanisch gesteuerten Bremsen: in diesem Fall müssen die äußeren Steuerhebel untereinander unter Spannung gesetzt werden.

- 4 - Zum Abmontieren, Arm auf die Werkbank legen.

Die Erläuterungen beziehen sich auf das Abmontieren an der Werkbank, wobei die Vorgänge für alle anderen Lösungen oder Ausführungen gleich sind.

**ESP**

La remoción de los semiejes se puede ejecutar solamente después de la remoción del cárter de la rótula (Véase «REMOCION CAJA DE ROTULA») y de manera diversificada en función del tipo de reparación que hay que ejecutar y del tipo de eje:

- 1 - Eje sin frenos de estacionamiento: es necesario hacer entrar aire comprimido (aproximadamente 7 bares) en el circuito de frenado para mantener en posición los discos de los frenos.
- 2 - Eje con freno negativo: no requiere ninguna preparación puesto que los discos quedan bloqueados mecánicamente.
- 3 - Eje con freno de mando mecánico: requiere la puesta en tensión entre sí de las palancas exteriores de mando.
- 4 - Desmontaje ejecutado con el brazo apoyado en el banco.

Las explicaciones que aquí figuran se refieren a la remoción ejecutada en el banco y las fases son comunes para otras soluciones o versiones.

**F**

La dépose de joint de cardan double ne peut être effectuée qu'après la dépose du boîtier articulation (Voir, DEPOSE DU BOITIER ARTICULATION), d'une façon diversifiée, en fonction du type de réparation à effectuer et du type d'essieu:

- 1 - Essieu sans freins de stationnement: il faut introduire de l'air comprimé (environ 7 bar) dans le circuit de freinage pour maintenir les disques de freinage en place.
- 2 - Essieu à frein négatif: ne requiert aucune préparation parce que les disques mécaniquement restent bloqués.
- 3 - Essieu à frein de commande mécanique: requiert de mettre sous tension des leviers externes de commande entre-eux.
- 4 - Démontage effectué et bras déposé sur l'établi.

Les explications reportées se réfèrent à la dépose effectuée sur l'établi, les phases sont les mêmes que pour les autres solutions ou versions.

**ITA**

Allentare ed asportare i dadi superiori ed inferiori (2) di bloccaggio dei grani (3).

**D**

Obere und untere Muttern (2) die die Stifte (3) blockieren, abschrauben.

**ESP**

Alojar y sacar las tuercas superiores e inferiores (2) que bloquean las espigas (3).

**F**

Desserrer puis enlever les écrous supérieurs et inférieurs (2) de blocage des grains (3).

**ITA**

Asportare i grani superiore ed inferiore (3) di ritegno flangia (5) o della bussola (13).

**D**

Obere und untere Stifte (3), die den Flansch (5) oder die Buchse (13) halten, abnehmen.

**ESP**

Sacar la espigas superior y la inferior (3) de retención de la brida (5) o del manguito (13).

**F**

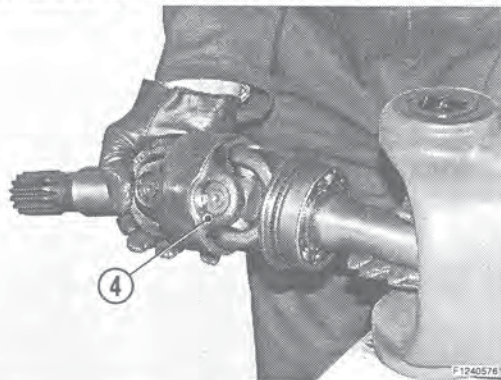
Enlever les grains supérieurs et inférieurs (3) de fixation de la flasque (5) ou de la douille (13).





**HOW TO REMOVE THE U-JOINT - RIMOZIONE DOPPIO GIUNTO CARDANICO - DOPPELGELLENKWELLE ABMONTIEREN - REMOCION SEMIEJES - DEPOSE DE JOINT DE CARDAN DOUBLE**

**FLANGED VERSION - VERSIONE A FLANGIA - AUSFÜHRUNG MIT FLANSCH - VERSION A BRIDA - VERSION A FLASQUE**

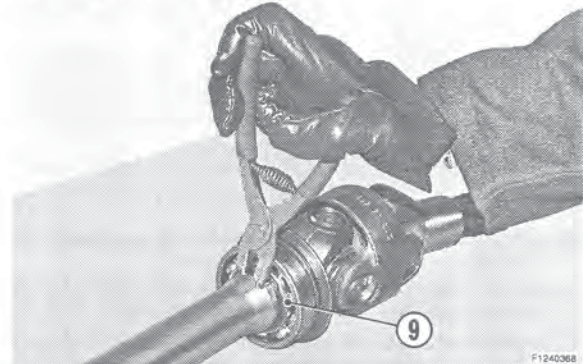


**GB**

**a**

Remove the u-joint (4).

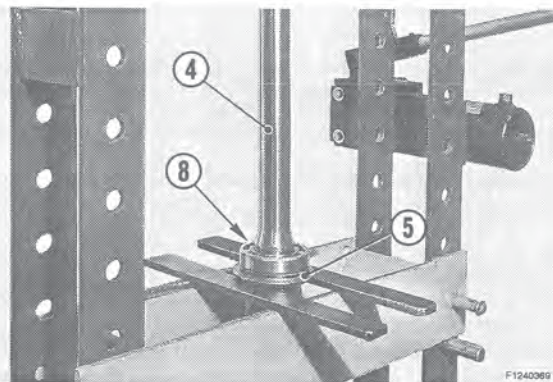
**NOTE.** To remove the u-joint use, if necessary, a plastic hammer or a lever.



**GB**

**b**

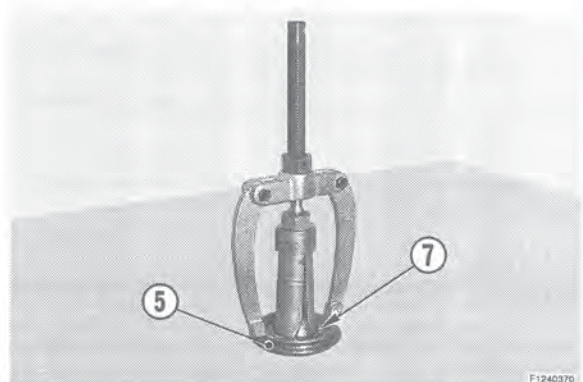
Remove the snap ring (9) from the bearing as well as the packing ring (5).



**GB**

**c**

Position the entire u-joint (4) under a press and remove the bearing (8) and the ring (5) simultaneously.

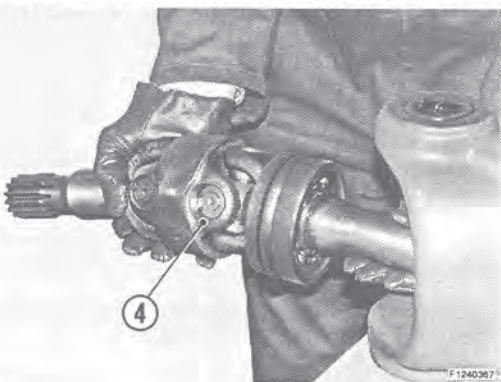


**GB**

**d**

Extract the sealing ring of the shaft from the flange (5).  
**NOTE.** Note down the assembly side of the ring.

**COUPLING VERSION - VERSIONE A MANICOTTO - AUSFÜHRUNG MIT MUFFE - VERSION A MANGUITO - VERSION A MANCHON**

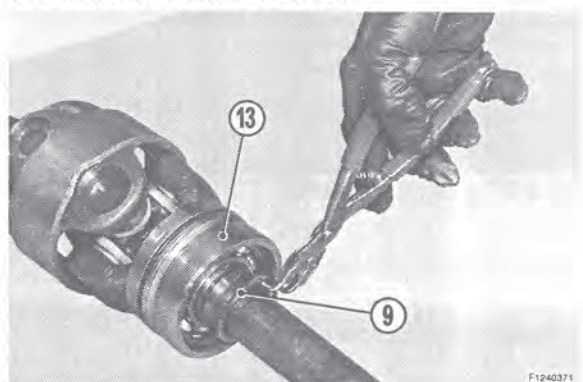


**GB**

**e**

Remove the entire u-joint (4).

**NOTE.** To remove the u-joint use, if necessary, a plastic hammer or a lever.



**GB**

**f**

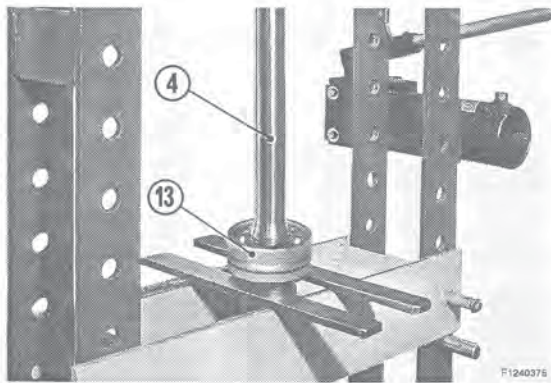
Remove the snap ring (9) from the bushing unit (13).



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Estrarre il doppio giunto cardanico (4) completo.<br/><b>NOTA.</b> Se necessario, per l'estrazione del doppio giunto cardanico usare un mazzuolo in materiale plastico od una leva.</p> <p><b>D</b> Komplette Doppelgelenkwelle (4) heraus ziehen.<br/><b>BEMERKUNG.</b> Wenn nötig, einen Gummihammer oder einen Hebel verwenden, um die Doppelgelenkwelle heraus zu ziehen.</p> <p><b>ESP</b> Extraer el semieje (4) completo.<br/><b>NOTA.</b> Si fuera necesario, para extraer el semieje, utilizar un martillo de material plástico o una palanca.</p> <p><b>F</b> Extraire le joint de cardan double (4) complet.<br/><b>NOTE.</b> Si besoin, pour l'extraction du joint de cardan double, utiliser un maillet en matière plastique ou un levier.</p> | <p><b>ITA</b> Asportare l'anello di ritegno (9) del cuscinetto e dell'anello porta guarnizioni (5).</p> <p><b>D</b> Den Haltering (9) des Lagers und des Dichtungs rings (5) abnehmen.</p> <p><b>ESP</b> Sacar el anillo de retención (9) del cojinete y del anillo porta juntas (5).</p> <p><b>F</b> Enlever la bague de retenue (9) du palier, puis la bague porte-garniture (5).</p>                                                                                                                                                                     |
| <p><b>c</b></p> <p><b>ITA</b> Sistemare il doppio giunto cardanico completo (4) sotto una pressa e rimuovere il cuscinetto (8) e contemporaneamente l'anello (5).</p> <p><b>D</b> Die komplette Doppelgelenkwelle (4) unter eine Presse setzen und gleichzeitig das Lager (8) und den Ring (5) abnehmen.</p> <p><b>ESP</b> Colocar el semieje completo (4) debajo de una prensa y remover el cojinete (8) y al mismo tiempo el anillo (5).</p> <p><b>F</b> Ajuster le joint de cardan double complet (4) sous une presse puis enlever le palier (8) et la bague (5) en même temps.</p>                                                                                                                                                                                                    | <p><b>ITA</b> Estrarre dalla flangia (5) l'anello di tenuta dell'albero.<br/><b>NOTA.</b> Annotare il senso di montaggio dell'anello.</p> <p><b>D</b> Vom Flansch (5) den Wellenkolbenring abnehmen.<br/><b>BEMERKUNG.</b> Auf die Montagerichtung des Ringes achten.</p> <p><b>ESP</b> Extraer de la brida (5) el segmento de compresión del eje.<br/><b>NOTA.</b> Anotar el sentido de montaje del anillo.</p> <p><b>F</b> Extraire de la flasque (5) la bague d'étanchéité de l'arbre.<br/><b>NOTE.</b> Prendre note du sens de montage de la bague.</p> |
| <p><b>e</b></p> <p><b>ITA</b> Estrarre il doppio giunto cardanico (4) completo.<br/><b>NOTA.</b> Se necessario, per l'estrazione del doppio giunto cardanico usare un mazzuolo in materiale plastico od una leva.</p> <p><b>D</b> Komplette Doppelgelenkwelle (4) heraus ziehen.<br/><b>BEMERKUNG.</b> Wenn nötig, einen Gummihammer oder einen Hebel verwenden, um die Doppelgelenkwelle heraus zu ziehen.</p> <p><b>ESP</b> Extraer el semieje (4) completo.<br/><b>NOTA.</b> Si fuera necesario, para extraer el semieje, utilizar un martillo de material plástico o una palanca.</p> <p><b>F</b> Extraire le joint de cardan double (4) complet.<br/><b>NOTE.</b> Si besoin, pour l'extraction du joint de cardan double, utiliser un maillet en matière plastique ou un levier.</p> | <p><b>ITA</b> Asportare l'anello elastico di ritegno (9) del gruppo bussola (13).</p> <p><b>D</b> Haltering (9) von der Buchse (13) abnehmen.</p> <p><b>ESP</b> Sacar el anillo elástico de retención (9) del grupo del manguito (13).</p> <p><b>F</b> Enlever l'anneau élastique de retenue (9) du groupe de douille (13).</p>                                                                                                                                                                                                                             |



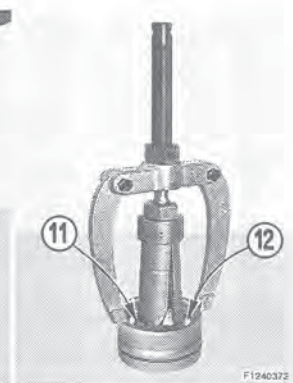
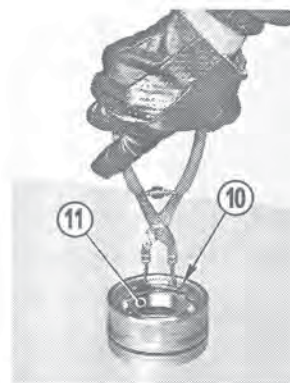
**HOW TO REMOVE THE U-JOINT - RIMOZIONE DOPPIO GIUNTO CARDANICO - DOPPELGelenkwelle abmontieren -  
REMOCION SEMIEJES - DEPOSE DE JOINT DE CARDAN DOUBLE**



GB

a

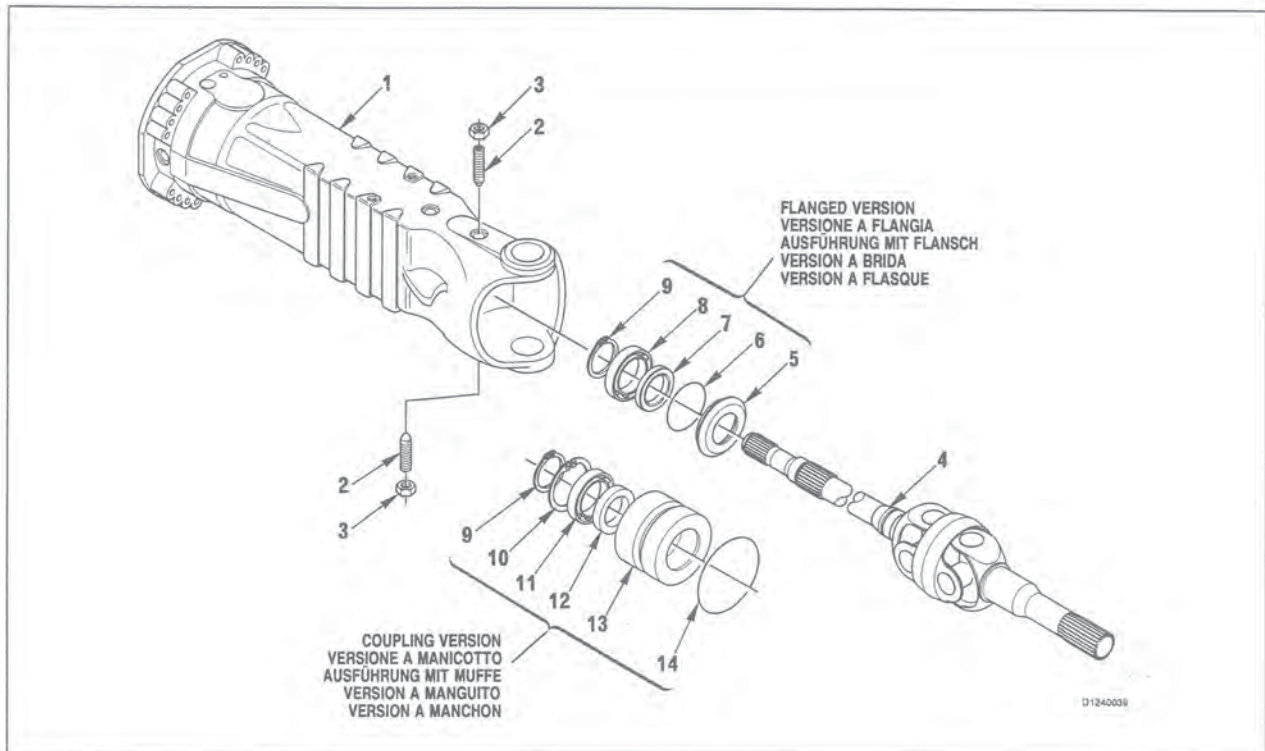
Position the entire u-joint (4) under a press and remove the complete bush (13).



GB

b

Remove the snap ring (10) from the bearing (11). Use a puller to remove the bearing (11), the sealing ring (12) and the O-ring (14).  
**NOTE.** Note down the assembly side of the ring (12).





a

ITA

Sistemare il doppio giunto cardanico completo (4) sotto una pressa e rimuovere la bussola (13) completa.

D

Die komplette Doppelgelenkwelle (4) unter eine Presse setzen und die komplette Buchse (13) abnehmen.

ESP

Colocar el semieje completo (4) debajo de una prensa y remover el manguito (13) completo.

F

Ajuster le joint de cardan double complet (4) sous une presse, puis enlever la douille (13) complète.

b

ITA

Asportare l'anello elastico di ritegno (10) del cuscinetto (11).  
Con un estrattore, rimuovere il cuscinetto (11) e l'anello di tenuta (12) e la guarnizione OR (14).

**NOTA.** Annotare il senso di montaggio dell'anello (12).

D

Haltering (10) des Lagers (11) abnehmen.  
Mit dem Abzieher, das Lager (11) und den Dichtring (12) sowie den O-Ring (14) abnehmen.

**BEMERKUNG.** Auf die Montagerichtung des Ringes (12) achten.

ESP

Sacar el anillo de retención (10) del cojinete (11).  
Utilizando un extractor, remover el cojinete (11) y el segmento de compresión (12) y la junta OR (14).

**NOTA.** Anotar el sentido de montaje del anillo (12).

F

Enlever l'anneau de retenue (10) du palier (11).  
A l'aide d'un extracteur, enlever le palier (11) et la bague d'étanchéité (12) puis la garniture OR (14).

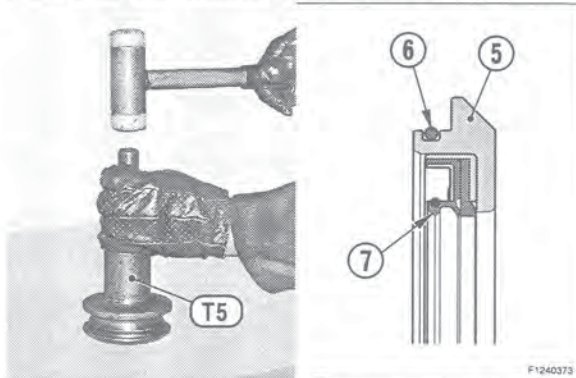
**NOTE.** Prendre note du sens de montage de la bague (12).



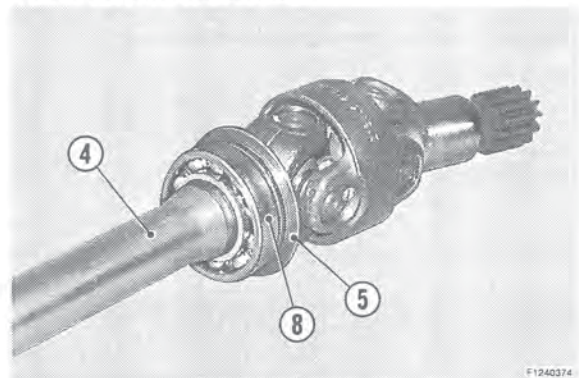


INSTALLATION OF U-JOINT - INSTALLAZIONE DOPPIO GIUNTO CARDANICO - DOPPELGELENKWELLE INSTALLIEREN -  
INSTALACION SEMIEJES - INSTALLATION DE JOINT DE CARDAN DOUBLE

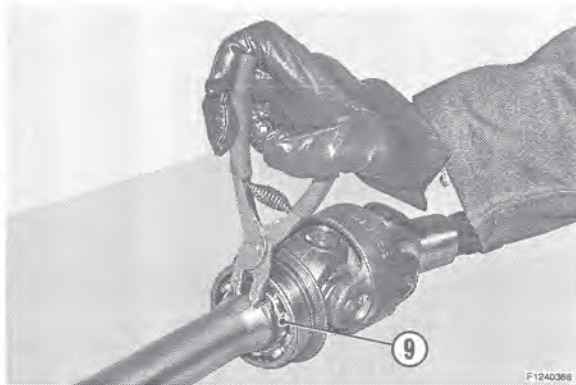
FLANGED VERSION - VERSIONE A FLANGIA - AUSFÜHRUNG MIT FLANSCH - VERSION A BRIDA - VERSION A FLASQUE



Insert the sealing ring (7) of the shaft in the flange (5), using tool T5.  
**NOTE.** Carefully check the assembly side. Also replace the outer O-ring (6).

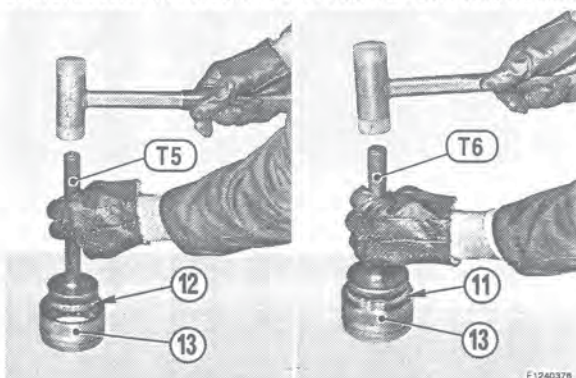


Fit the flange (5) onto the u-joint (4).  
Heat the bearing (8) at an approx. temperature of 100° C, fit it on the u-joint and fasten.

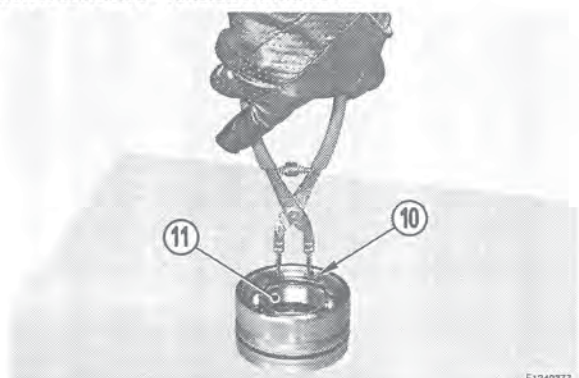


Fit the snap ring (9) on the bearing (8).

COUPLING VERSION - VERSIONE A MANICOTTO - AUSFÜHRUNG MIT MUFFE - VERSION A MANGUITO - VERSION A MANCHON



Using tools T5 and T6, insert the sealing ring (12) and the bearing (11) in the bush (13).  
**NOTE.** Carefully check the assembly side of the seal (12).



Fit the snap ring (10) on the bearing (11).



SPICER CLARK-HURTH

- a**
- ITA** Utilizzando l'attrezzo T5 inserire nella flangia (5) l'anello di tenuta (7) dell'albero.  
**NOTA.** Controllare attentamente il senso di montaggio. Sostituire anche l'anello OR esterno (6).
- D** Mit dem Werkzeug T5, den Kolbenring (7) in den Flansch (5) montieren.  
**BEMERKUNG.** Montagerichtung sorgfältig kontrollieren. Den äußeren O-Ring (6) auswechseln.
- ESP** Utilizando la herramienta T5 introducir en la brida (5) el segmento de compresión (7) del eje.  
**NOTA.** Controlar atentamente el sentido de montaje. Sustituir también el anillo OR exterior (6).
- F** A l'aide d'un outil T5 introduire dans la flasque (5) la bague d'étanchéité (7) de l'arbre.  
**NOTE.** Contrôler soigneusement le sens de montage. Remplacer également la garniture OR (6).

- b**
- ITA** Infilare la flangia (5) sul doppio giunto cardanico (4). Scaldare il cuscinetto (8) a circa 100°C, infilarlo sul doppio giunto cardanico e mandarlo in battuta.
- D** Flansch (5) in die Doppelgelenkwelle (4) einsetzen. Lager (8) auf ca. 100°C erhitzen und auf die Doppelgelenkwelle setzen; bis zum Anschlag schieben.
- ESP** Introducir la brida (5) en el semieje (4). Calentar el cojinete (8) a unos 100°C, introducirlo en el semieje hasta el tope.
- F** Enfiler la flasque (5) sur le joint de cardan double (4). Chauffer le palier (8) à environ 100°C, enfiler celui-ci sur le joint de cardan double et l'envoyer en butée.

- c**
- ITA** Montare l'anello elastico (9) di ritegno del cuscinetto (8).
- D** Haltering (9) auf das Lager (8) montieren.
- ESP** Montar el anillo elástico (9) de retención del cojinete (8).
- F** Monter l'anneau élastique (9) de retenue du palier (8).

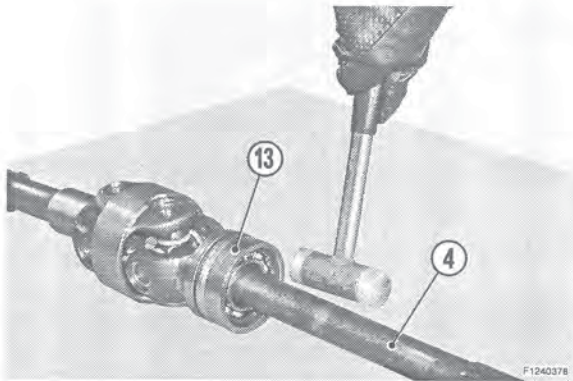
- e**
- ITA** Utilizzando gli attrezzi T5 e T6 inserire nella bussola (13) l'anello di tenuta (12) ed il cuscinetto (11).  
**NOTA.** Controllare attentamente il senso di montaggio della guarnizione (12).
- D** Mit den Werkzeugen T5 und T6 den Haltering (12) und das Lager (11) in die Buchse (13) setzen.  
**BEMERKUNG.** Montagerichtung der Dichtung (12) aufmerksam kontrollieren.
- ESP** Utilizando las herramientas T5 y T6, introducir en el manguito (13) el segmento de compresión (12) y el cojinete (11).  
**NOTA.** Controlar atentamente el sentido de montaje de la junta (12).
- F** A l'aide des outils T5 et T6 introduire dans la douille (13) la bague d'étanchéité (12) et le palier (11).  
**NOTE.** Contrôler soigneusement le sens de montage de la garniture (12).

- f**
- ITA** Montare l'anello elastico (10) di ritegno del cuscinetto (11).
- D** Haltering (10) des Lagers (11) montieren.
- ESP** Montar el anillo elástico (10) de retención del cojinete (11).
- F** Monter l'anneau élastique (10) de retenue du palier (11).





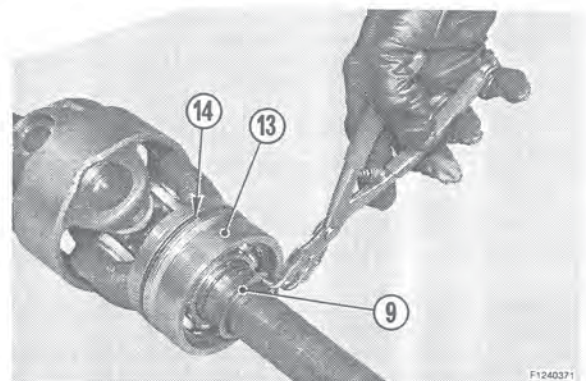
INSTALLATION OF U-JOINT - INSTALLAZIONE DOPPIO GIUNTO CARDANICO - DOPPELGELENKWELLE INSTALLIEREN -  
INSTALACION SEMIEJES - INSTALLATION DE JOINT DE CARDAN DOUBLE



GB

a

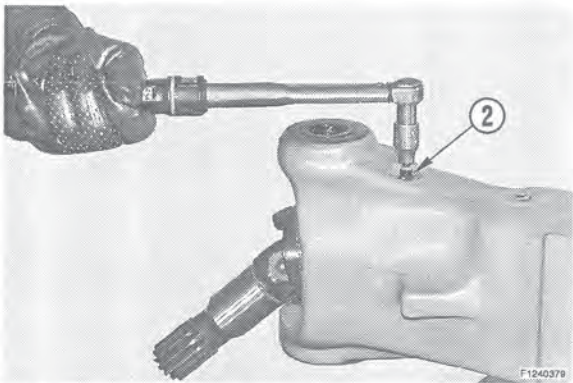
Heat the bearing in oil at an approx. temperature of 100°C and fit the entire bush (13) on the u-joint (4).



GB

b

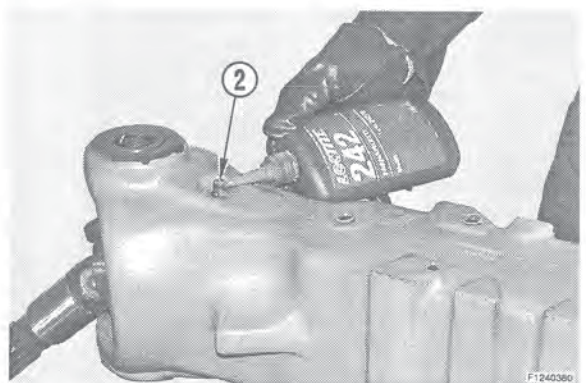
Fit the check ring (9) on the bushing unit (13); also put the O-ring (14) into position.



GB

c

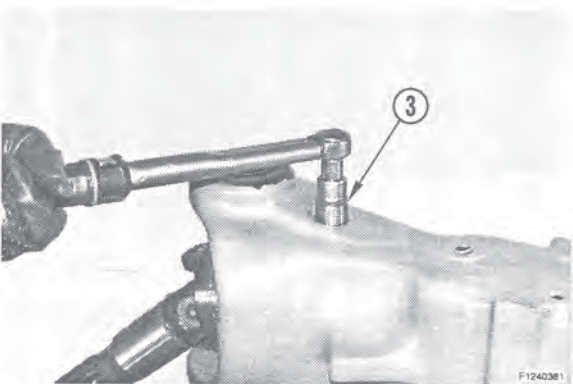
Insert the u-joint and tighten the top and bottom dowels (2).  
Torque wrench setting: Max. 15 Nm.  
**NOTE.** For u-joint coming with a bush, centre the point of the check dowels in the slot.



GB

d

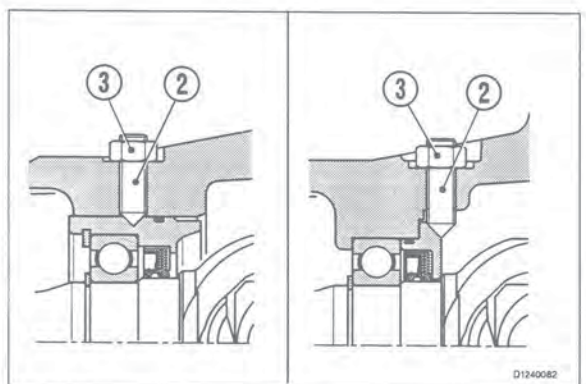
Apply Loctite 242 to the jutting parts of the dowels (2).



GB

e

Screw the check nuts (3) of the dowels (2) and lock them using a dynamometric wrench.  
Torque wrench setting: 122 Nm



- a**

**ITA** Scaldare in olio il cuscinetto a circa 100°C ed infilare sul doppio giunto cardanico (4) la bussola completa (13).

**D** Lager in Öl auf ca. 100°C erhitzen und auf die Doppelgelenkwelle (4) die komplette Buchse (13) schieben.

**ESP** Calentar en aceite el cojinete a unos 100°C e introducir en el semieje (4) el manguito completo (13).

**F** Chauffer dans l'huile à environ 100°C le palier puis enfiler sur le joint de cardan double (4) la douille complète (13).

**c**

**ITA** Infilare il doppio giunto cardanico e serrare i grani superiore ed inferiore (2).  
Coppia di serraggio: Max. 15 Nm.  
**NOTA.** Per il doppio giunto cardanico con bussola, centrare la punta dei grani di ritegno nella cava.

**D** Doppelgelenkwelle einsetzen und obere und untere Stifte (2) festschrauben.  
Anzugsmoment: Max. 15 Nm  
**BEMERKUNG.** Bei der Doppelgelenkwelle mit Buchse, Stiftspitze genau zentrieren.

**ESP** Introducir el semieje y apretar la espiga superior y la inferior (2).  
Par de torsión: Máx. 15 Nm.  
**NOTA.** Para el semieje con manguito, centrar la punta de las espigas de retención en la ranura.

**F** Enfiler le joint de cardan double et serrer les grains supérieurs et inférieurs (2).  
Couple de serrage: Max. 15 Nm.  
**NOTE.** Pour le joint de cardan double à douille, centrer la pointe des grains de fixation dans le creux.

**e**

**ITA** Avvitare i dadi (3) di bloccaggio dei grani (2) e bloccarli con chiave dinamometrica.  
Coppia di serraggio: 122 Nm

**D** Muttern (3) zur Befestigung der Stifte (2) zuschrauben und mit einem Momentenschlüssel blockieren.  
Anzugsmoment: 122 Nm

**ESP** Atornillar las tuercas (3) de bloqueo de las espigas (2) y bloquearlas con llave dinamométrica.  
Par de torsión: 122 Nm

**F** Visser les écrous (3) de blocage des grains (2), puis bloquer à l'aide d'une clé dynamométrique.  
Couple de serrage: 122 Nm

**b**

**ITA** Montare l'anello di ritegno (9) del gruppo bussola (13); posizionare anche la guarnizione OR (14).

**D** Haltering (9) des Buchsenaggregats (13) montieren; O-Ring (14) ebenfalls montieren.

**ESP** Montar el anillo de retención (9) del grupo del manguito (13); posicionar también la junta OR (14).

**F** Monter l'anneau de retenue (9) du groupe douille (13); placer également la garniture OR (14).

**d**

**ITA** Spalmare con Loctite 242 le porzioni sporgenti dei grani (2).

**D** Mit Loctite 242 die herausragenden Stifte (2) schmieren.

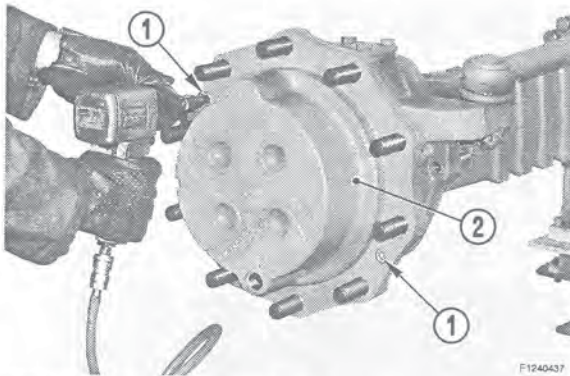
**ESP** Pasar Loctite 242 en las partes salientes de las espigas (2).

**F** Enduire de Loctite 242 les parties saillantes des grains (2).





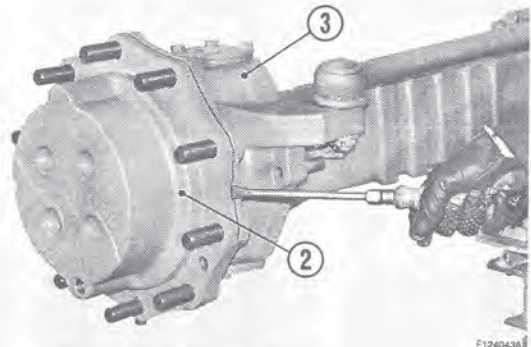
**HOW TO DISASSEMBLE THE PLANETARY REDUCTION - SMONTAGGIO RIDUTTORE EPICICLOIDALE - PLANETENGETRIEB ABMONTIEREN - DESMONTAJE REDUCTOR EPICICLOIDAL - DESASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL**



F1240437



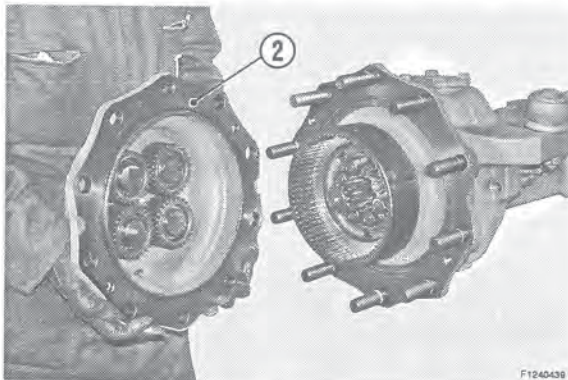
Disconnect the steering bars from the steering case (3).  
For details, see «HOW TO REMOVE THE COMPLETE STEERING CASE».  
Remove the securing screws (1) from the planetary carrier cover (2).



F1240438



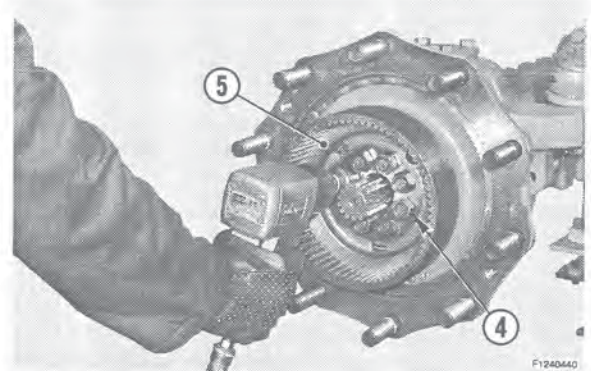
Disjoin the planetary carrier cover (2) from the steering case (3) by alternatively forcing a screwdriver into the appropriate slots.



F1240439



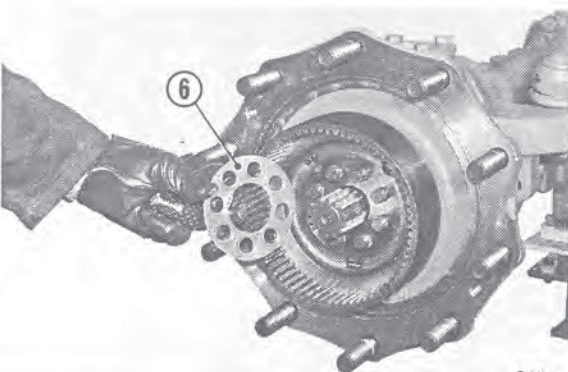
Remove the complete planetary carrier cover (2).



F1240440



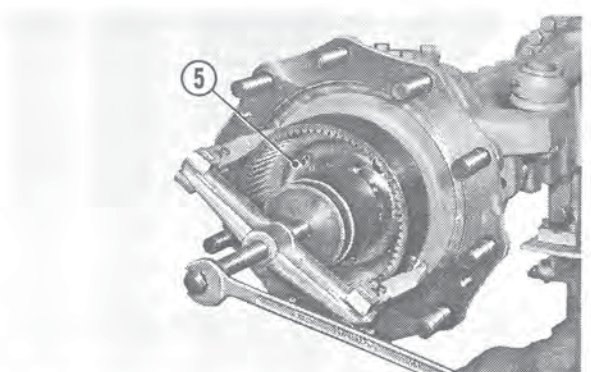
Unloose and remove the tightening nuts (4) from the crown flange (5).



F1240441



Remove the safety flange (6).



F1240442



Using a puller, remove the complete crown flange (5) by acting on the stud bolts.





- a**
- ITA** Scollegare dalla scatola snodo (3) le barre di sterzata.  
Per i dettagli, vedere «RIMOZIONE SCATOLA SNODO COMPLETA».  
Asportare le viti (1) di fissaggio del coperchio portasatelliti (2).
- D** Gelenkgehäuse (3) von den Lenkstangen trennen.  
Siehe «KOMPLETTES GELENKGEHÄUSE ABMONTIEREN».  
Befestigungsschrauben (1) vom Planetenradhalterdeckel (2) abschrauben.
- ESP** Separar de la caja de rótula (3) las barras de dirección.  
Para los detalles, véase «REMOCION CAJA DE ROTULA COMPLETA».  
Sacar los tornillos (1) de fijación de la tapa portasatélites (2).
- F** Débrancher, du boîtier articulation (3), les barres de braquage.  
Pour de plus amples détails, voir «DEPOSE DU BOITIER D'ARTICULATION COMPLET».  
Enlever les vis de fixation (1) du couvercle porte-satellites (2).

- b**
- ITA** Utilizzando un cacciavite inserito alternativamente nelle cave predisposte, staccare il coperchio portasatelliti (2) dalla scatola snodo (3).
- D** Mit einem Schraubenzieher den Planetenradhalterdeckel (2) vom Gelenkgehäuse (3) trennen. Dazu den Schraubenzieher abwechselnd in die vorgesehenen Nuten stecken und anheben.
- ESP** Utilizando un destornillador introducido alternativamente en las ranuras predispuestas, desprender la tapa portasatélites (2) de la caja de la rótula (3).
- F** A l'aide d'un tournevis introduit au fur et à mesure dans les creux prédisposés, décrocher le couvercle porte-satellites (2) du boîtier articulation (3).

- c**
- ITA** Asportare il coperchio portasatelliti (2) completo.
- D** Kompletter Planetenradhalterdeckel (2) abnehmen.
- ESP** Sacar la tapa portasatélites (2) completa.
- F** Enlever le couvercle porte-satellites (2) complet.

- d**
- ITA** Allentare ed asportare i dadi (4) che fissano la flangia portacorona (5).
- D** Befestigungsmuttern (4) des Kranzhalterflansches (5) lockern.
- ESP** Aflojar y quitar las tuercas (4) que fijan la brida portacorona (5).
- F** Desserrer et enlever les écrous (4) de fixation de la flasque porte-couronne (5).

- e**
- ITA** Rimuovere la flangia di sicurezza (6).
- D** Sicherheitsflansch (6) abnehmen.
- ESP** Remover la brida de seguridad (6).
- F** Enlever la flasque de sécurité (6).

- f**
- ITA** Utilizzando un estrattore e, facendo reazione sui prigionieri, rimuovere la flangia portacorona (5) completa.
- D** Durch einen Abzieher über die Stiftschrauben, den kompletten Kranzhalterflansch (5) abnehmen.
- ESP** Utilizando un extractor y apalancando los prisioneros, remover la brida portacorona (5) completa.
- F** En utilisant l'extracteur et en faisant réagir les prisonniers, enlever la flasque porte-couronne (5) complète.





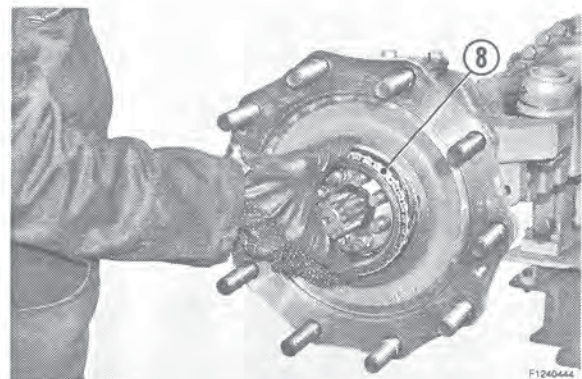
HOW TO DISASSEMBLE THE PLANETARY REDUCTION - SMONTAGGIO RIDUTTORE EPICICLODALE - PLANETENGETRIEB ABMONTIEREN -  
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a

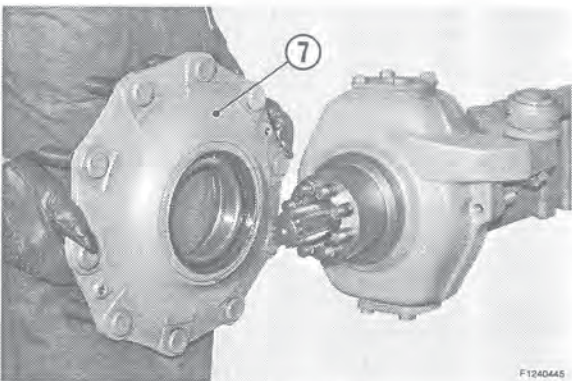
Partially extract the hub (7) using a plastic hammer.  
**NOTE.** Alternately hammer on several equidistant points.



GB

b

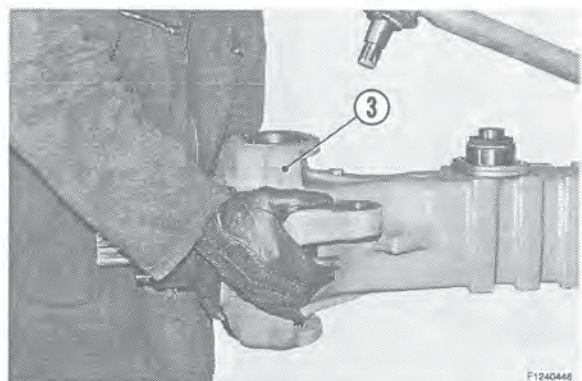
Remove the external bearing (8).



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c

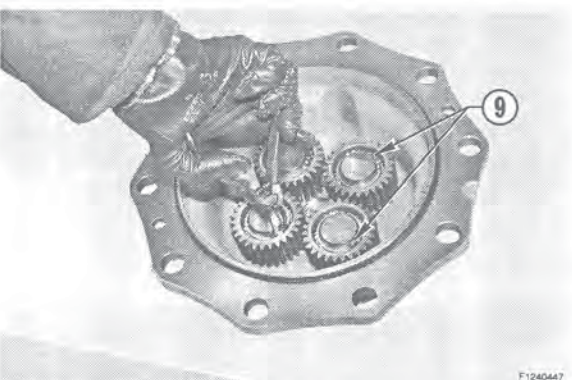
By hand remove the complete hub (7).



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d

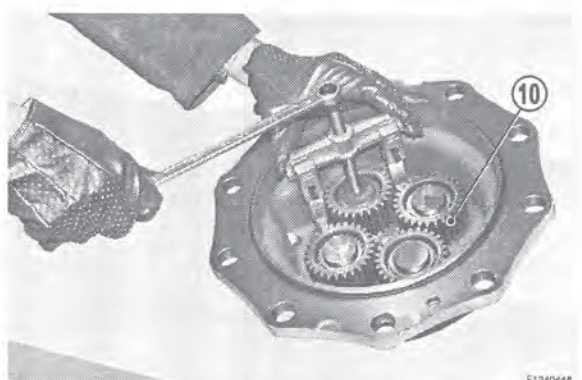
Remove the pins and remove the steering case (3).  
For details, see «HOW TO REMOVE THE COMPLETE STEERING CASE»



GB

e

Remove the snap rings (9).



GB

f

With the help of a puller, remove the planet wheel gears (10).  
**NOTE.** Note down the assembly side of planet wheels.





- a**
- ITA** Utilizzando un mazzuolo in materiale plastico, sfilare parzialmente il mozzo portaruota (7).  
**NOTA.** Battere alternativamente in più punti equidistanti.
- D** Mit einem Gummihammer, die Radhalternabe (7) etwas heraus schieben.  
**BEMERKUNG.** Abwechselnd an verschiedenen, gleich entfernten Stellen schlagen.
- ESP** Utilizando un martillo de material plástico, extraer parcialmente el cubo portarruedas (7).  
**NOTA.** Golpear alternativamente en varios puntos equidistantes.
- F** A l'aide d'un maillet en matière plastique, extraire partiellement le moyeu porte-roue (7).  
**NOTE.** Frapper sur plusieurs points à la même distance.

- c**
- ITA** Sfilare il mozzo portaruota (7).
- D** Radhalternabe (7) herausziehen.
- ESP** Extraer el cubo portarruedas (7).
- F** Extraire le moyeu porte-roue (7).

- e**
- ITA** Asportare gli anelli elastici (9).
- D** Die Kolbenringe (9) entfernen.
- ESP** Sacar los anillos elásticos (9).
- F** Enlever les anneaux élastiques (9).

- b**
- ITA** Asportare il cuscinetto esterno (8).
- D** Äußeres (8) Lager abnehmen.
- ESP** Sacar el cojinete exterior (8).
- F** Enlever le palier externe (8).

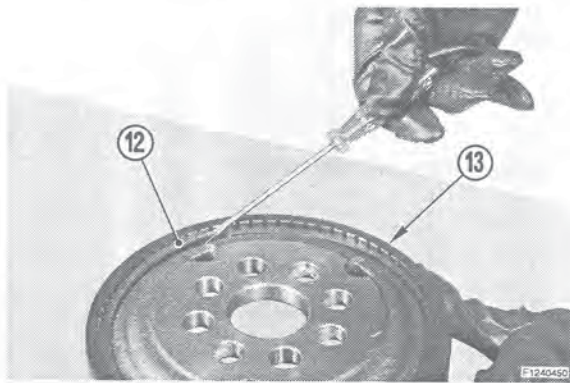
- d**
- ITA** Asportare i perni e rimuovere la scatola snodo (3).  
Per i dettagli di rimozione dei perni, vedere «RIMOZIONE SCATOLA SNODO COMPLETA».
- D** Stifte und Gelenkgehäuse (3) entfernen.  
Siehe «KOMPLETTES GELENKGEHÄUSE ABMONTIEREN».
- ESP** Sacar los pernos y remover la caja de la rótula (3).  
Para los detalles de remoción de los pernos, véase «REMOCION CAJA DE ROTULA COMPLETA».
- F** Enlever les tourillons, enlever le boîtier articulation (3).  
Pour de plus amples détails, voir «DEPOSE DU BOITIER ARTICULATION COMPLET».

- f**
- ITA** Utilizzando un estrattore, asportare gli ingranaggi satelliti (10).  
**NOTA.** Annotare il senso di montaggio dei satelliti.
- D** Mit einem Abzieher, die Planetenräder (10) heraus nehmen.  
**BEMERKUNG.** Montagerichtung der Planetenräder beachten.
- ESP** Utilizando un extractor, sacar los engranajes satélites (10).  
**NOTA.** Anotar el sentido de montaje de los satélites.
- F** A l'aide d'un extracteur, extraire les engrenages satellites (10).  
**NOTE.** Prendre note du sens de montage des satellites.





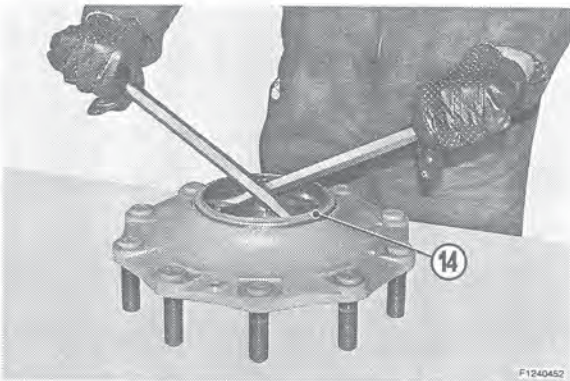
HOW TO DISASSEMBLE THE PLANETARY REDUCTION - SMONTAGGIO RIDUTTORE EPICICLOIDALE - PLANETENGETRIEB ABMONTIEREN -  
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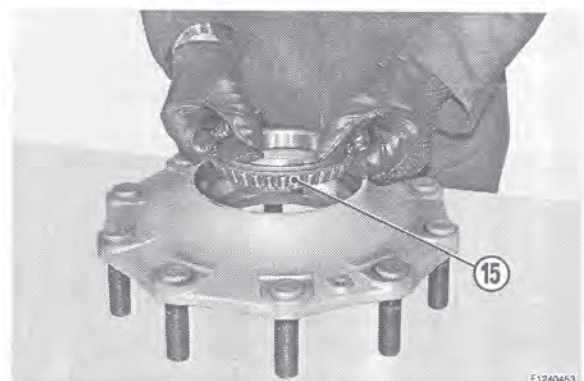
Remove the snap ring (12) from the crown (13).



Remove the crown flange (5).



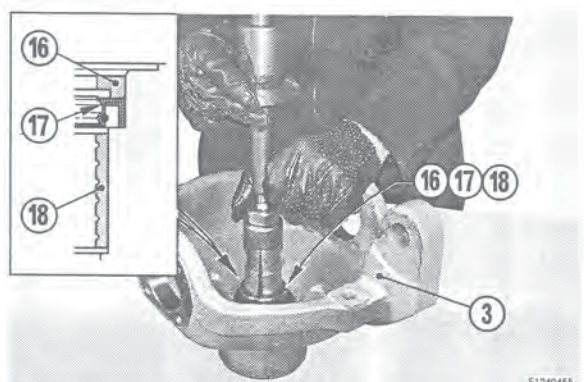
Remove the sealing ring from the hub (14).



Remove the internal bearing (15).



Remove the external thrust blocks from the bearings (8) and (15) forcing a pin-driver into the appropriate slots on the hub (7).  
**NOTE.** Hammer in an alternate way so as to avoid crawling or deformation of the thrust blocks.



Use a puller to remove the centring ring (16), the sealing ring (17) and the bearing (18) from the steering case (3).  
**NOTE.** Note down the orientation of both centring ring (16) and sealing ring (17).



- a**
- ITA** Asportare l'anello elastico (12) di ritegno della corona (13).
- D** Den Kolbenring (12) vom Kranz (13) abnehmen.
- ESP** Sacar el anillo elástico (12) de retención de la corona (13).
- F** Enlever l'anneau élastique (12) de retenue de la couronne (13).

- b**
- ITA** Rimuovere la flangia portacorona (5).
- D** Kranzhalterflansch (5) abnehmen.
- ESP** Remover la brida portacorona (5).
- F** Déposer la flasque porte-couronne (5).

- c**
- ITA** Rimuovere dal mozzo portaruota (14) l'anello di tenuta.
- D** Von der Radhalternabe (14) den Kolbenring abnehmen.
- ESP** Remover del cubo portarruedas (14) el segmento de compresión.
- F** Enlever, du moyeu porte-roue (14), la bague d'étanchéité.

- d**
- ITA** Rimuovere il cuscinetto interno (15).
- D** Inneres Lager (15) abnehmen.
- ESP** Remover el cojinete interior (15).
- F** Enlever le palier interne (15).

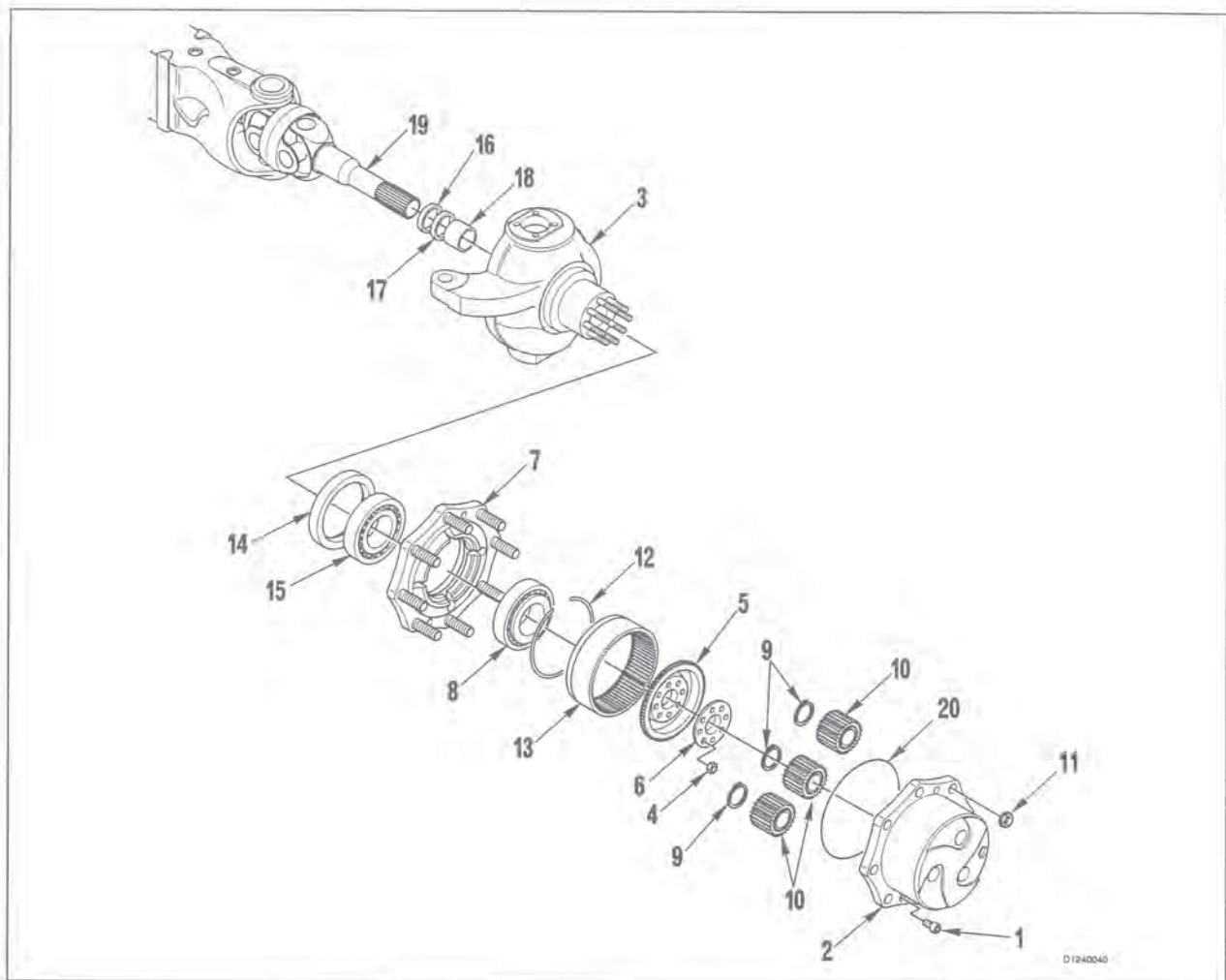
- e**
- ITA** Rimuovere le ralle esterne dei cuscinetti (8) e (15) utilizzando un cacciapine inserito nelle cave predisposte sul mozzo (7).
- NOTA.** Battere in modo alternato per evitare impuntamenti e deformazione delle ralle.
- D** Die äußeren Scheiben der Lager (8) und (15) mit einem Dübel durch die Nabenlöcher (7) herausschlagen.
- BEMERKUNG.** Abwechselnd herausschlagen, um Verformungen zu vermeiden.
- ESP** Remover las rangas exteriores (8) y (15) de los cojinetes utilizando un extractor para clavijas insertado en las ranuras predispuestas en el cubo (7).
- NOTA.** Golpear de manera alternada para evitar daños y deformaciones de las rangas.
- F** Enlever les crapaudines externes des paliers (8) et (15) à l'aide d'une chasse-goupilles placée dans les creux spécialement conçus à cet effet sur le moyeu (7).
- NOTE.** Taper d'une manière alternée afin d'éviter talonnage et déformation des crapaudines.

- f**
- ITA** Utilizzando un estrattore, asportare dalla scatola snodo (3), l'anello centratore (16), l'anello di tenuta (17) e la bronzina (18).
- NOTA.** Annotare gli orientamenti dell'anello centratore (16) e dell'anello di tenuta (17).
- D** Mit einem Abzieher das Gelenkgehäuse (3), den Zentrierring (16), den Kolbenring (17) und das Bronzelager (18) abnehmen.
- BEMERKUNG.** Auf die Montagerichtung des Zentrierringes (16) und des Kolbenringes (17) achten.
- ESP** Utilizando un extractor, sacar de la caja de la rótula (3) el anillo de centrado (16), el segmento de compresión (17) y la chumacera (18).
- NOTA.** Anotar las orientaciones del anillo de centrado (16) y del segmento de compresión (17).
- F** A l'aide d'un extracteur, extraire le boîtier articulation (3), l'anneau de centrage (16), la bague d'étanchéité (17) et le coussinet (18).
- NOTE.** Prendre note du sens de l'anneau de centrage (16) et de la bague d'étanchéité (17).





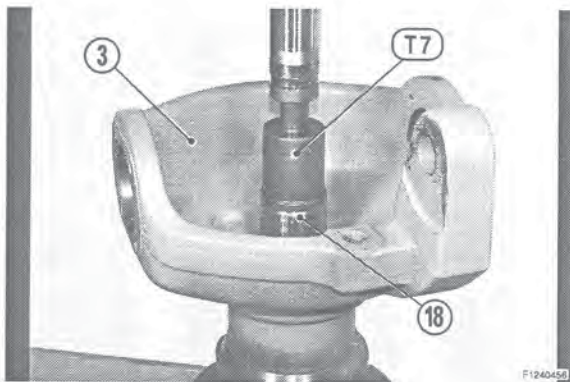
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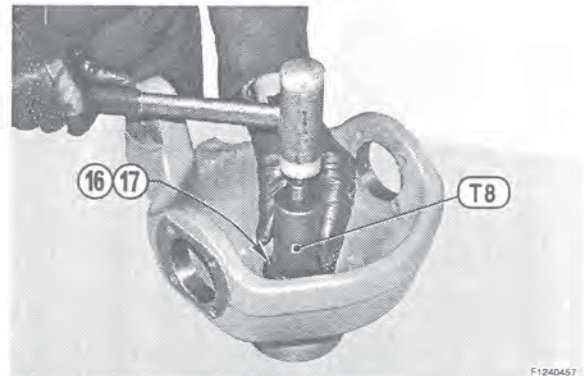
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a

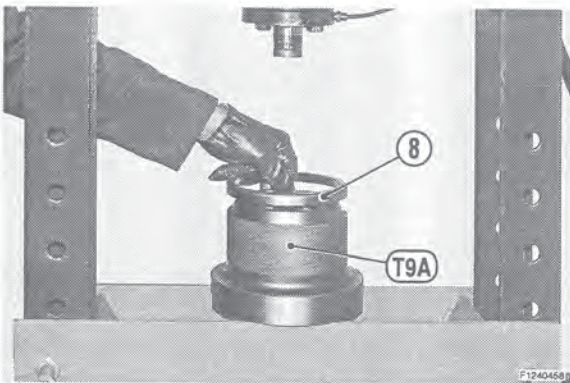
Lubricate the bushing (18) and the seat of the steering case (3).  
Install the bushing (18), using tool T7.



GB

b

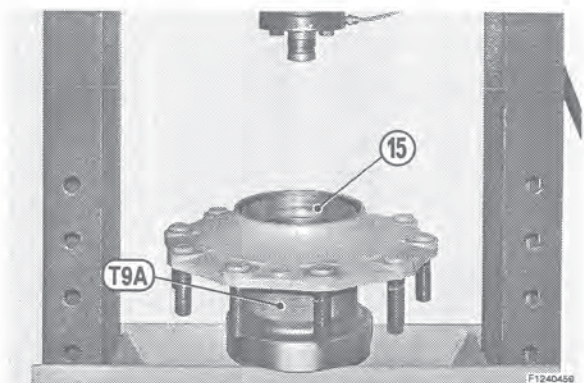
Lubricate the outer surface of the sealing ring (17) and centring ring (16); fit them into their seat using tool T8.



GB

c

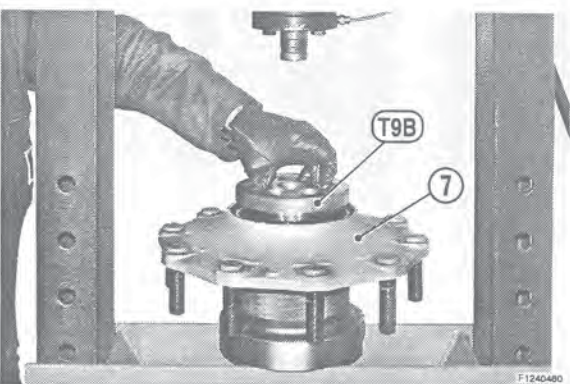
Position the lower part of tool T9A and the thrust block of the external bearing (8) under the press.



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d

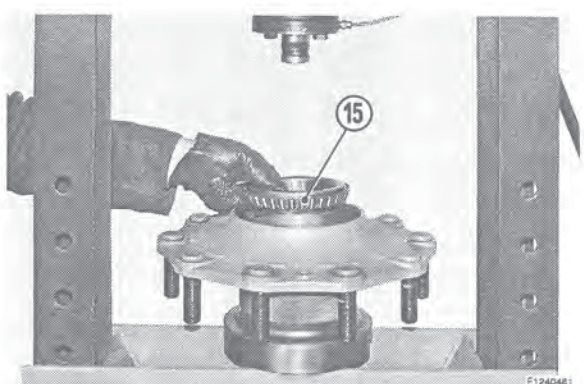
Lubricate the seats of the bearings and position the hub (7) on tool T9A; position the thrust block of the internal bearing (15).  
**NOTE.** Check that the thrust block is correctly oriented.



GB

e

Position the upper part of tool T9B and press the thrust blocks into the hub (7) all the way down.



GB

f

Fit the bearing (15) into the internal thrust block.



- a**
- ITA** Lubrificare la bronzina (18) e la sede della scatola snodo (3). Utilizzando l'attrezzo T7 montare la bronzina (18).
- D** Das Bronzelager (18) und das Gelenkgehäuse (3) schmieren. Mit einem Werkzeug T7 das Bronzelager (18) montieren.
- ESP** Lubricar la chumacera (18) y el alojamiento de la caja de la rótula (3). Montar la chumacera (18) utilizando la herramienta T7.
- F** Lubrifier le coussinet (18) et le logement du boîtier articulation (3). A l'aide de l'outil T7 monter le coussinet (18).

- c**
- ITA** Posizionare sotto la pressa la parte inferiore dell'attrezzo T9A e la ralla del cuscinetto esterno (8).
- D** Unter einer Presse den unteren Teil des Werkzeugs T9A und die Scheibe des äußeren Lagers (8) positionieren.
- ESP** Posicionar debajo de la prensa la parte inferior de la herramienta T9A y la rangua del cojinete exterior (8).
- F** Placer sous la presse la partie inférieure de l'outil T9A et la crapaudine du palier externe (8).

- e**
- ITA** Posizionare la parte superiore dell'attrezzo T9B e pressare a fondo le ralle nel mozzo portaruota (7).
- D** Das obere Teil des Werkzeugs T9B positionieren und die Scheiben in die Radhalternabe (7) fest eindrücken.
- ESP** Posicionar la parte superior de la herramienta T9B y presionar a fondo las ranguas en el cubo portarruedas (7).
- F** Placer la partie supérieure de l'outil T9B, puis presser à fond les crapaudines du moyeu porte-roue (7).

- b**
- ITA** Lubrificare la superficie esterna dell'anello di tenuta (17) e dell'anello centratore (16); montarli in sede utilizzando l'attrezzo T8.
- D** Die äußere Fläche des Kolbenringes (17) und des Zentrierringes (16) schmieren; die beiden Ringe mit einem Werkzeug T8 montieren.
- ESP** Lubricar la superficie exterior del segmento de compresión (17) y del anillo de centrado (16); montarlos en un alojamiento utilizando la herramienta T8.
- F** Lubrifier la surface externe de la bague d'étanchéité (17), et de l'anneau de centrage (16), puis monter ceux-ci dans leur logement à l'aide de l'outil T8.

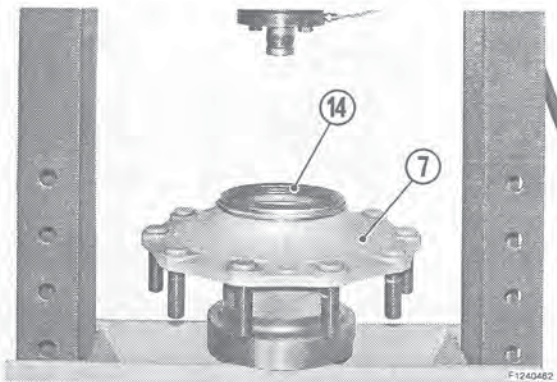
- d**
- ITA** Lubrificare le sedi dei cuscinetti e posizionare sull'attrezzo T9A il mozzo portaruota (7); posizionare la ralla del cuscinetto interno (15).  
**NOTA.** Controllare l'orientamento della ralla.
- D** Die Lagersitze schmieren und am Werkzeug T9A die Radhalternabe (7) positionieren; die Scheibe des inneren Lagers (15) positionieren.  
**BEMERKUNG.** Die Position der Scheibe beachten.
- ESP** Lubricar los alojamientos de los cojinetes y posicionar en la herramienta T9A el cubo portarruedas (7); posicionar la rangua del cojinete interior (15).  
**NOTA.** Controlar la orientación de la rangua.
- F** Lubrifier le logement des paliers et placer sur l'outil T9A le moyeu porte-roue (7); placer la crapaudine du palier interne (15).  
**NOTE.** Contrôler les sens de la crapaudine.

- f**
- ITA** Montare il cuscinetto (15) nella ralla interna.
- D** Lager (15) in die innere Scheibe montieren.
- ESP** Montar el cojinete (15) en la rangua interior.
- F** Monter le palier (15) dans la crapaudine interne.

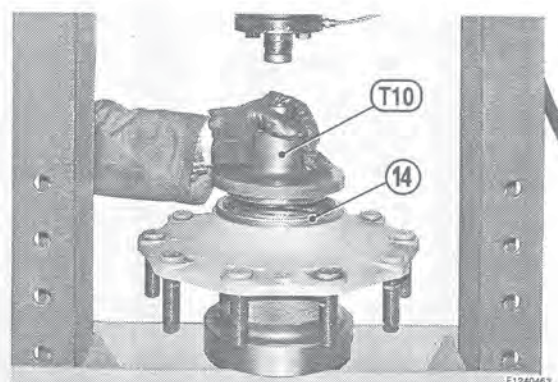




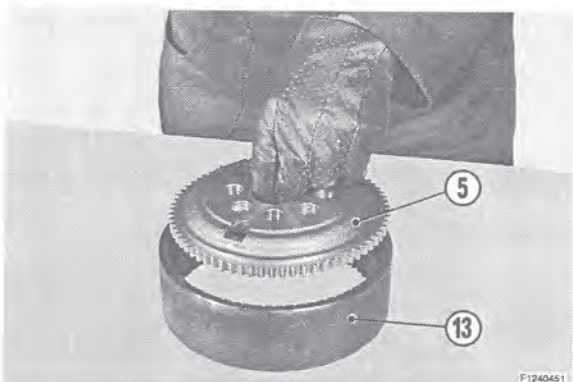
ASSEMBLING THE PLANETARY REDUCTION - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE - PLANETENGETRIEB MONTIEREN -  
MONTAJE REDUCTOR EPICICLOIDAL - ASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL



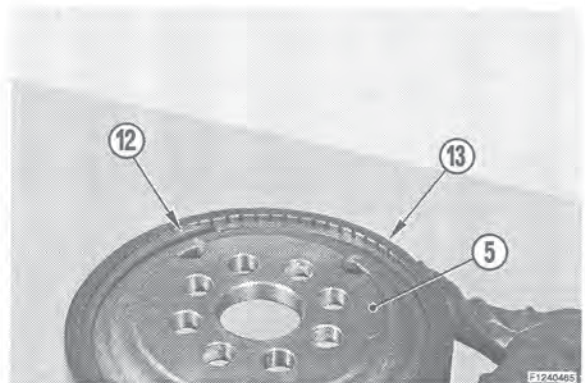
Apply a repositionable jointing compound for seals to the outer surface of the sealing ring (14). Position the sealing ring (14) in the hub (7).  
**NOTE.** Check that the ring (14) is correctly oriented.



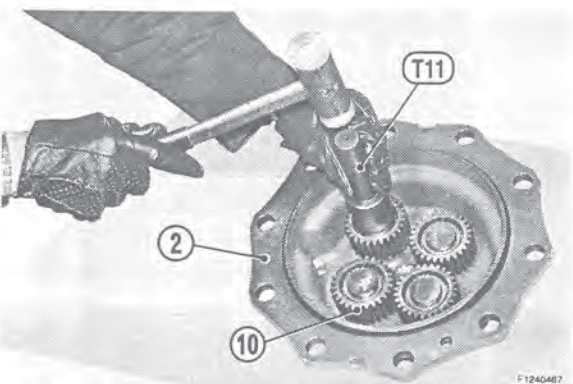
Position tool T10 and press the sealing ring (14) into its seat.



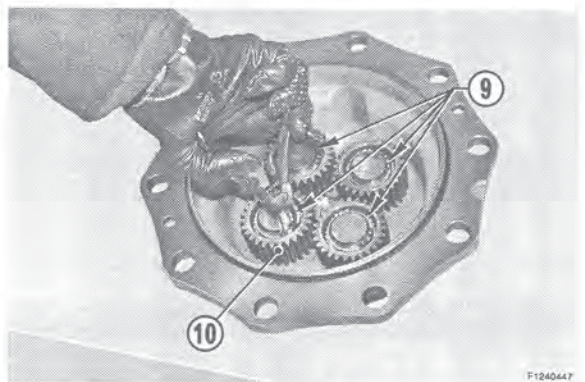
Insert the flange (5) in the crown (13).



Insert the snap ring (12) in order to fix the flange (5) in the crown (13).  
**NOTE.** Carefully check that ring (12) is properly inserted in the slot of the crown (13)



With the help of tool T11, insert the planet wheel gears (10) into the cover (2).  
Accurately check the orientation.



Lock the gears (10) into position by fitting the snap rings (9).



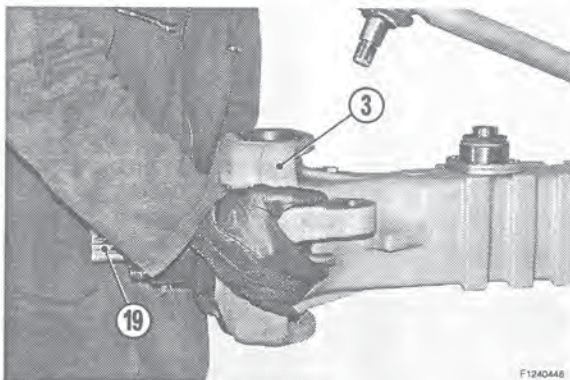


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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Spalmare la superficie esterna dell'anello di tenuta (14) con mastice per guarnizioni riposizionabile. Posizionare l'anello di tenuta (14) nel mozzo (7).<br/><b>NOTA.</b> Controllare l'orientamento dell'anello (14).</p> <p><b>D</b> Die äußere Fläche des Kolbenringes (14) mit Klebstoff für verstellbare Dichtungen schmieren. Den Kolbenring (14) in die Nabe (7) montieren.<br/><b>BEMERKUNG.</b> Richtung des Ringes (14) beachten.</p> <p><b>ESP</b> Pasar sobre la superficie exterior del anillo de compresión (14) un pasta para juntas reposicionable. Posicionar el segmento de compresión (14) en el cubo (7).<br/><b>NOTA.</b> Controlar la orientación del anillo (14).</p> <p><b>F</b> Enduire la surface externe de la bague d'étanchéité (14) avec mastic pour garnitures à remettre en place. Placer la bague d'étanchéité (14) dans le moyeu (7).<br/><b>NOTE.</b> Contrôler le sens de la bague (14).</p> | <p><b>ITA</b> Posizionare l'attrezzo T10 e pressare in sede l'anello di tenuta (14).</p> <p><b>D</b> Das Werkzeug T10 positionieren und den Kolbenring (14) in seinen Sitz pressen.</p> <p><b>ESP</b> Posicionar la herramienta T10 y presionar en su alojamiento el segmento de compresión (14).</p> <p><b>F</b> Placer l'outil T10 et presser dans son logement la bague d'étanchéité (14).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p><b>c</b></p> <p><b>ITA</b> Inserire la flangia (5) nella corona (13).</p> <p><b>D</b> Flansch (5) in den Kranz (13) montieren.</p> <p><b>ESP</b> Introducir la brida (5) en la corona (13).</p> <p><b>F</b> Introduire la flasque (5) dans la couronne (13).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><b>ITA</b> Inserire l'anello elastico (12) per fissare la posizione della flangia (5) nella corona (13).<br/><b>NOTA.</b> Controllare attentamente l'inserimento dell'anello (12) nella cava della corona (13).</p> <p><b>D</b> Den Kolbenring (12) einsetzen, um die Position des Flansches (5) im Kranz (13) zu sichern.<br/><b>BEMERKUNG.</b> Sorgfältig kontrollieren, ob der Ring (12) in der Nut des Kranzes (13) richtig eingesetzt ist.</p> <p><b>ESP</b> Introducir el anillo elástico (12) para fijar la posición de la brida (5) en la corona (13).<br/><b>NOTA.</b> Controlar atentamente la inserción del anillo (12) en la ranura de la corona (13).</p> <p><b>F</b> Introduire l'anneau élastique (12) pour fixer la position de la flasque (5) dans la couronne (13).<br/><b>NOTE.</b> Contrôler soigneusement l'introduction de la bague (12) dans le creux de la couronne (13).</p> |
| <p><b>e</b></p> <p><b>ITA</b> Utilizzando l'attrezzo T11 inserire nel coperchio (2) gli ingranaggi satelliti (10).<br/>Controllare attentamente l'orientamento.</p> <p><b>D</b> Mit dem Werkzeug T11 in den Deckel (2) die Planetenräder (10) einsetzen.<br/>Die Position sorgfältig kontrollieren.</p> <p><b>ESP</b> Utilizando la herramienta T11 introducir en la tapa (2) los engranajes satélites (10).<br/>Controlar atentamente la orientación.</p> <p><b>F</b> A l'aide de l'outil T11 introduire dans le couvercle (2) les engrenages satellites (10).<br/>Contrôler attentivement le sens.</p>                                                                                                                                                                                                                                                                                                                                                        | <p><b>ITA</b> Bloccare la posizione degli ingranaggi (10) montando gli anelli elastici di ritegno (9).</p> <p><b>D</b> Die Position der Räder (10) mit den Halteringen (9) blockieren.</p> <p><b>ESP</b> Bloquear la posición de los engranajes (10) montando los anillos elásticos de retención (9).</p> <p><b>F</b> Bloquer la position des engrenages (10) en montant les anneaux élastiques de retenue (9).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

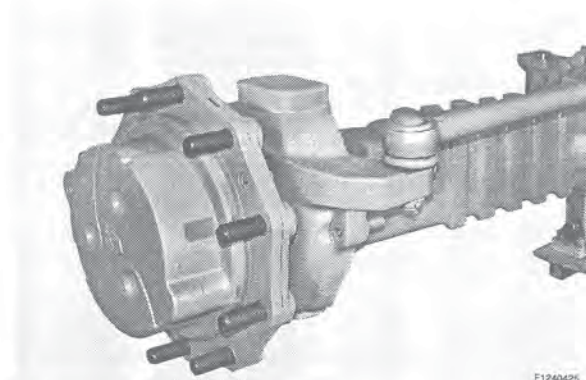




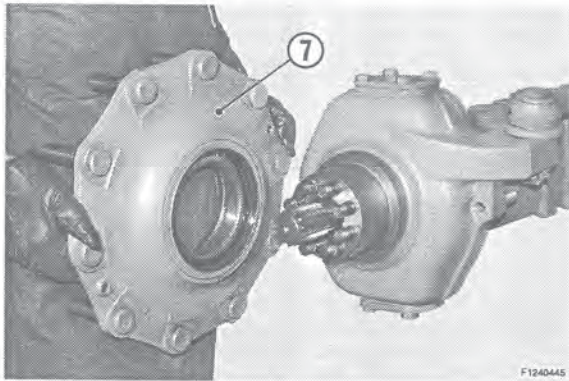
ASSEMBLING THE PLANETARY REDUCTION - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE - PLANETENGETRIEB MONTIEREN -  
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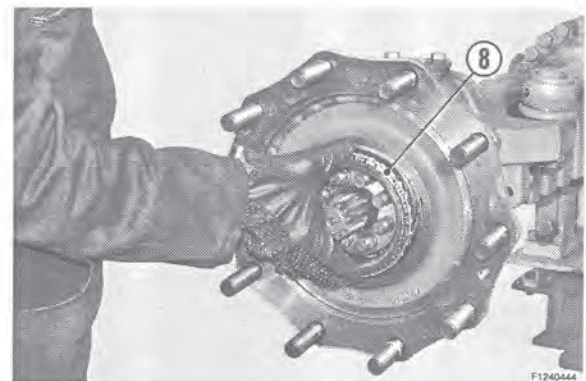
**GB** **a**  
Fit the steering case (3) onto the U-joint (19) and install the articulation pins. For pin assembly details, see «HOW TO ASSEMBLE THE COMPLETE STEERING CASE».



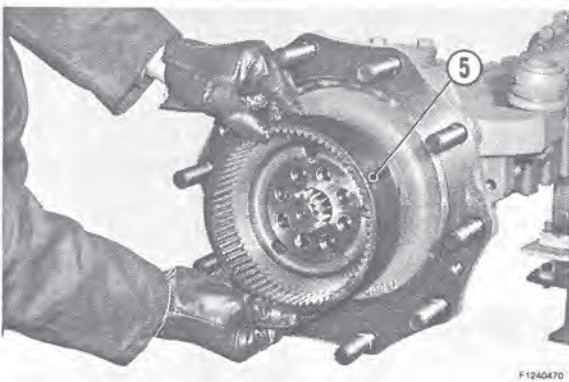
**GB** **b**  
Connect the steering bars.  
For details, see «HOW TO INSTALL THE COMPLETE STEERING CASE».



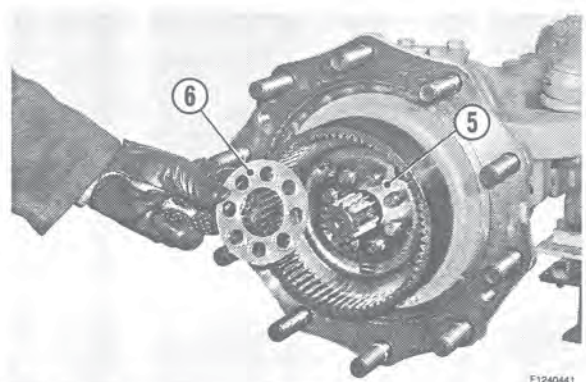
**GB** **c**  
Install the hub (7).



**GB** **d**  
Install the external bearing (8).  
**NOTE.** Using a plastic hammer, drive the bearing to the limit stop by lightly hammering around the edge.



**GB** **e**  
Fit the complete crown flange (5).  
**NOTE.** In order to fasten the flange (5), use a plastic hammer and alternately hammer on several equidistant points.



**GB** **f**  
Apply Tecnolube Seal 101 grease to the surface of the safety flange (6) which touches the crown flange (5).  
Fit the safety flange (6).

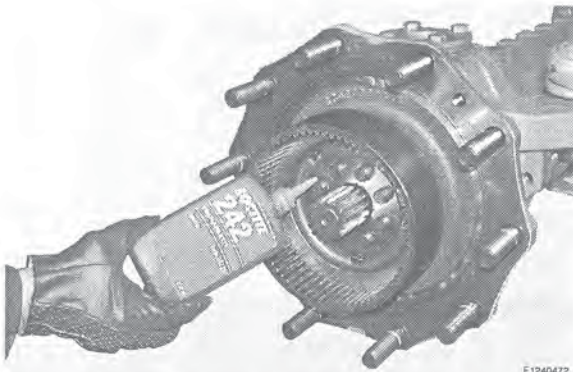




- a**
- ITA** Infilare la scatola snodo (3) sul doppio giunto (19) e montare i perni snodo.  
Per i dettagli di montaggio dei perni snodo, vedere «ASSEMBLAGGIO SCATOLA SNODO COMPLETA».
- D** Gelenkgehäuse (3) auf die Doppelkupplung (19) setzen und die Gelenkstifte montieren.  
Siehe zur Montage der Gelenkstifte «KOMPLETTES GELENKGEHÄUSE ZUSAMMENBAUEN».
- ESP** Introducir la caja de la rótula (3) en la junta doble (19) y montar las rótulas.  
Para los detalles de montaje de las rótulas, véase «MONTAJE DE LA CAJA DE ROTULA COMPLETA».
- F** Introduire le boîtier articulation (3) sur le double joint (19), puis monter les tourillons d'articulation.  
Pour de plus amples détails sur le montage des tourillons d'articulation, voir «ASSEMBLAGE DU BOITIER ARTICULATION COMPLET».
- b**
- ITA** Collegare le barre di sterzata.  
Per i dettagli, vedere «INSTALLAZIONE SCATOLA SNODO COMPLETA».
- D** Lenkstangen anschließen.  
Siehe «KOMPLETTES GELENKGEHÄUSE INSTALLIEREN».
- ESP** Conectar las barras de dirección.  
Para los detalles, véase «INSTALACION CAJA DE ROTULA COMPLETA».
- F** Relier les barres de braquage.  
Pour de plus amples détails voir «INSTALLATION DU BOITIER ARTICULATION COMPLET».
- c**
- ITA** Montare il mozzo portaruota (7).
- D** Radhalternabe (7) montieren.
- ESP** Montar el cubo portarruedas (7).
- F** Monter le moyeu porte-roue (7).
- d**
- ITA** Montare il cuscinetto esterno (8).  
**NOTA.** Mandare a fondo corsa il cuscinetto con leggeri colpi di mazzuolo distribuiti su tutta la circonferenza.
- D** Äußeres Lager (8) montieren.  
**BEMERKUNG.** Das Lager bis zum Anschlag einsetzen; dazu einen Gummihammer verwenden und entlang der Kreislinie einschlagen.
- ESP** Montar el cojinete exterior (8).  
**NOTA.** Llevar al fondo de carrera al cojinete con ligeros golpes de martillo distribuidos en toda la circunferencia.
- F** Monter le palier externe (8).  
**NOTE.** Envoyer le palier en fin de course avec des petits coups de maillet distribués sur toute la circonférence.
- e**
- ITA** Montare la flangia portacorona (5) completa.  
**NOTA.** Per mandare in battuta la flangia (5), usare un mazzuolo in materiale plastico battuto alternativamente in più punti equidistanti.
- D** Kompletter Kranzhlaterflansch (5) montieren.  
**BEMERKUNG.** Um den Flansch (5) bis zum Anschlag einzusetzen, einen Gummihammer verwenden und abwechselnd an gleich entfernten Stellen einschlagen.
- ESP** Montar la brida portacorona (5).  
**NOTA.** Para llevar a tope la brida (5) usar un martillo de material plástico golpeándolo alternativamente en varios puntos equidistantes.
- F** Monter la flasque porte-couronne (5) complète.  
**NOTE.** Pour envoyer la flasque (5) en butée, utiliser un maillet en matière plastique en battant sur plusieurs points équidistants.
- f**
- ITA** Lubrificare con grasso Tecnolube Seal 101 la superficie della flangia di sicurezza (6) a contatto con la flangia portacorona (5).  
Montare la flangia di sicurezza (6).
- D** Mit Fett Typ Tecnolube Seal 101 die Oberfläche des Sicherheitsflansch (6) schmieren, der am Kranzhalterflansch (5) anliegt.  
Sicherheitsflansch (6) montieren.
- ESP** Lubricar con grasa Tecnolube Seal 101 la superficie de la brida de seguridad (6) en contacto con la brida portacorona (5).  
Montar la brida de seguridad (6).
- F** Lubrifier avec du gras Tecnolube Seal 101 la surface de la flasque de sécurité (6) en contact avec la flasque porte-couronne (5).  
Monter la flasque de sécurité (6).



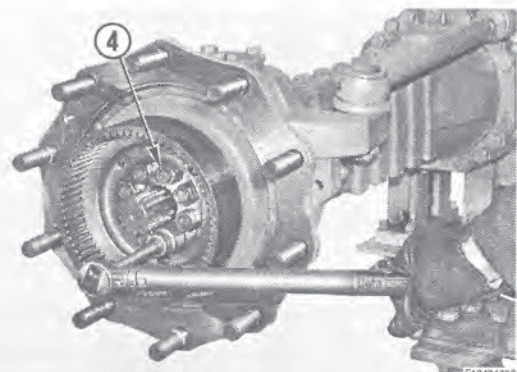
ASSEMBLING THE PLANETARY REDUCTION - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE - PLANETENGETRIEB MONTIEREN -  
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GB

a

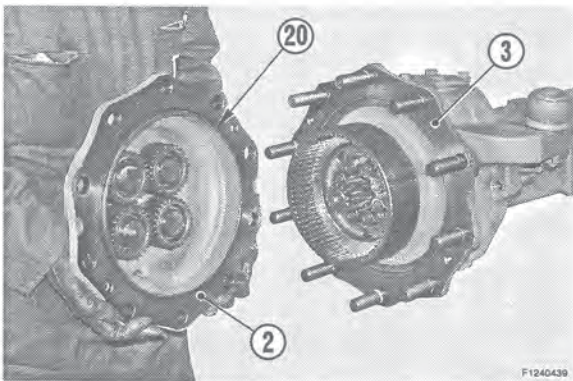
Apply Loctite 242 to the studs and fit in the nuts (4).



GB

b

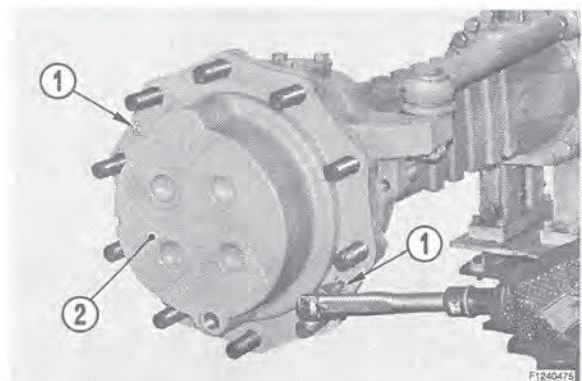
Cross tighten the nuts (4) in two stages.  
Initial torque wrench setting: 120 Nm  
Final torque wrench setting: 255-285 Nm



GB

c

Fit the planetary carrier cover (2) onto the hub (3).  
**CAUTION!** Check that the O-ring (20) is in good condition and in position.



GB

d

Lock the planetary carrier cover (2) by tightening the screws (1).  
Torque wrench setting for screws: 40-50 Nm





- a**
- ITA** Spalmare i prigionieri con Loctite 242 e montare i dadi (4).
- D** Die Stiftschrauben mit Loctite 242 schmieren und die Muttern (4) montieren.
- ESP** Pasar en los prisioneros Loctite 242 y montar las tuercas (4).
- F** Enduire les prisonniers avec du Loctite 242 puis monter les écrous (4).

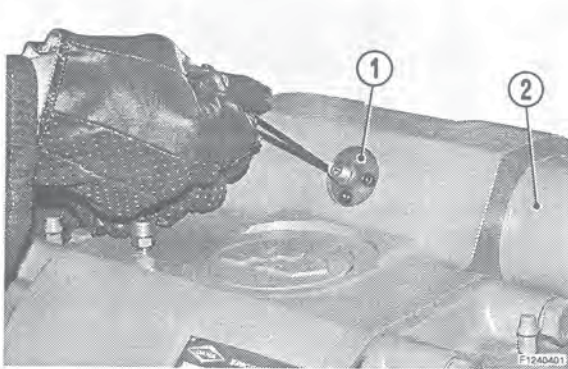
- ITA** Serrare i dadi (4) in due tempi e con il metodo del serraggio incrociato.  
Coppia di serraggio iniziale: 120 Nm  
Coppia di serraggio finale 255÷285 Nm
- D** Die Mutter (4) abwechseln und entgegengesetzt fest-schrauben.  
Anfänglicher Anzugsmoment: 120 Nm  
Endgültiger Anzugsmoment: 255÷285 Nm
- ESP** Apretar las tuercas (4) en dos tiempos y siempre con el método de torsión cruzada.  
Par de torsión inicial: 120 Nm  
Par de torsión final 255÷285 Nm
- F** Serrer les écrous (4) en deux temps par le biais du mode de serrage croisé.  
Couple de serrage initial: 120 Nm  
Couple de serrage final: 255÷285 Nm

- c**
- ITA** Montare il coperchio portasatelliti (2) sul mozzo portaruota (3).  
**ATTENZIONE!** Controllare lo stato e la posizione della guarnizione OR (20).
- D** Planetenradhalterdeckel (2) auf die Radhalternabe (3) montieren.  
**ACHTUNG!** Den Zustand und die Position des O-Ringes (20) kontrollieren.
- ESP** Montar la tapa portasatélites (2) en el cubo portarruedas (3).  
**CUIDADO!** Controlar el estado y la posición de la junta OR (20).
- F** Monter le couvercle porte-satellites (2) sur le moyeu porte-roue (3).  
**ATTENTION!** Contrôler l'état et la position de la garniture OR (20).

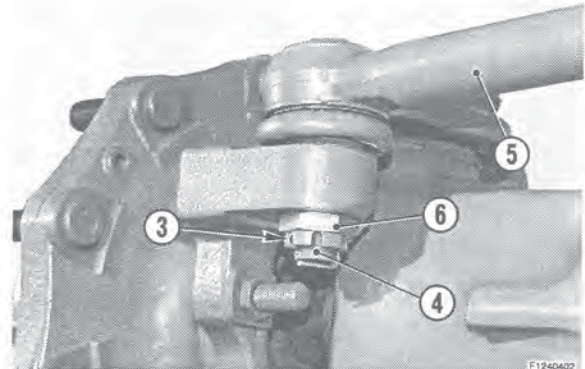
- ITA** Bloccare il coperchio portasatelliti (2) con le viti (1).  
Coppia di serraggio viti: 40÷50 Nm
- D** Planetenhalterdeckel (2) mit den Schraube (1) fest-schrauben.  
Anzugsmoment der Schrauben: 40÷50 Nm
- ESP** Bloquear la tapa portasatélites (2) con los tornillos (1).  
Par de torsión tornillos: 40÷50 Nm
- F** Bloquer le couvercle porte-satellites (2) avec les vis (1).  
Couple de serrage vis: 40÷50 Nm



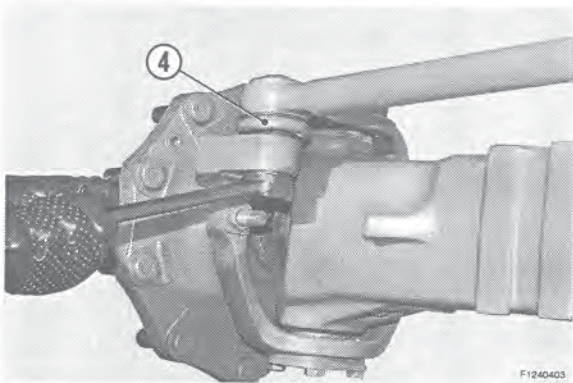
**HOW TO REMOVE THE STEERING CYLINDER - RIMOZIONE CILINDRO DI STERZATURA - LENKZYLINDER ABMONTIEREN - REMOCION CILINDRO DE DIRECCION - DEPOSE DU CYLINDRE DE BRAQUAGE**



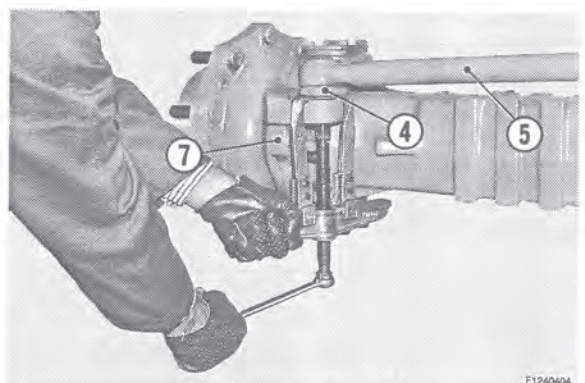
**a** **GB**  
Remove the centring sensor (1) of the steering piston (2), if supplied.



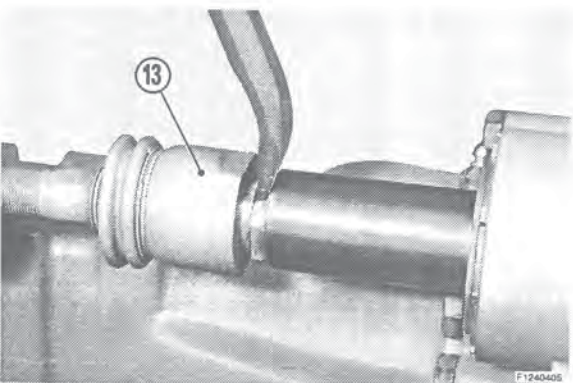
**b** **GB**  
Remove the safety cotter pins (3) from the articulation pins (4) of the steering bars (5).  
**CAUTION!** Dispose of used cotter pins.



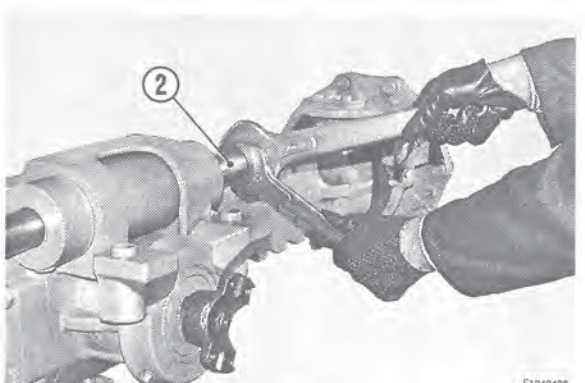
**c** **GB**  
Remove the castellated nuts (6) that lock the articulation pins (4).



**d** **GB**  
Disconnect the tapered pins of the articulation (4) from the steering case (7) by means of a puller.



**e** **GB**  
If the connection of the steering bars includes a safety collar (13), raise the border.



**f** **GB**  
Disconnect left and right steering bars (5) from the piston (2).



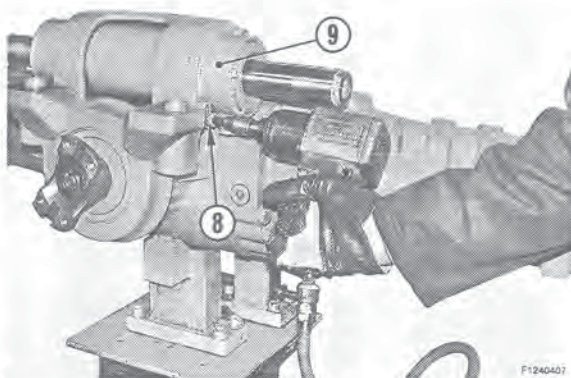


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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Se è previsto rimuovere il sensore (1) di centraggio della corsa del pistone di sterzata (2).</p> <p><b>D</b> Wenn vorgesehen, Sensor (1) zur Zentrierung des Hubs des Lenkkolbens (2) abnehmen.</p> <p><b>ESP</b> Si ha sido previsto, remover el sensor (1) de centrado de la carrera del pistón de dirección (2).</p> <p><b>F</b> Si prévu, enlever le capteur (1) de centrage de la course du piston de braquage (2).</p>                             | <p><b>ITA</b> Asportare le copiglie (3) di sicurezza perni snodo (4) delle barre di sterzata (5).<br/><b>ATTENZIONE!</b> Scartare le copiglie usate.</p> <p><b>D</b> Splint (3) der Gelenkstifte (4) der Lenkstangen (5) abnehmen.<br/><b>ACHTUNG!</b> Verbrauchte Splinte nicht verwenden.</p> <p><b>ESP</b> Sacar las clavijas (3) de seguridad de la rótulas (4) de las barras de dirección (5).<br/><b>CUIDADO!</b> Tirar las clavijas usadas.</p> <p><b>F</b> Enlever la goupille (3) de sûreté des tourillons d'articulation (4) des barres de braquage (5).<br/><b>ATTENTION!</b> Eliminer les goupilles usées.</p> |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere i dadi ad intaglio (6) di ritegno perni snodo (4).</p> <p><b>D</b> Kronenmutter (6) von den Gelenkstiften (4) abnehmen.</p> <p><b>ESP</b> Remover las tuercas ranuradas (6) de retención de las rótulas (4).</p> <p><b>F</b> Enlever les écrous cannelés (6) de fixation des tourillons d'articulation (4).</p>                                                                                                                                 | <p><b>d</b></p> <p><b>ITA</b> Utilizzando un estrattore, scollegare i perni conici dello snodo sterzo (4) dalla scatola snodo (7).</p> <p><b>D</b> Mit einem Abzieher, die Kegelstifte des Gelenks (4) von dem Gelenkgehäuse (7) abnehmen.</p> <p><b>ESP</b> Utilizando un extractor, desconectar los pernos cónicos de la rótula de dirección (4) del cárter de la rótula (7).</p> <p><b>F</b> A l'aide d'un extracteur, débrancher les pivots coniques d'articulation de braquage (4) du boîtier articulation (7).</p>                                                                                                   |
| <p><b>e</b></p> <p><b>ITA</b> Se il collegamento delle barre di sterzata prevede il collare di sicurezza (13) rialzare la bordatura.</p> <p><b>D</b> Falls die Lenkstangen mit einem Sicherheitsbund (13) versehen sind, den Rand anheben.</p> <p><b>ESP</b> Si la conexión de las barras de dirección prevé el collarín de seguridad (13) elevar los rebordes.</p> <p><b>F</b> Si le raccordement des barres de braquage est équipé de collet de sécurité (13) relever la bordure.</p> | <p><b>f</b></p> <p><b>ITA</b> Scollegare dal pistone (2) le barre di sterzata destra e sinistra (5).</p> <p><b>D</b> Vom Kolben (2) die rechte und linke Lenkstange (5) abnehmen.</p> <p><b>ESP</b> Desconectar del pistón (2) las barras de dirección derecha e izquierda (5).</p> <p><b>F</b> Désassembler du piston (2) les barres de braquage droite et gauche (5).</p>                                                                                                                                                                                                                                                |

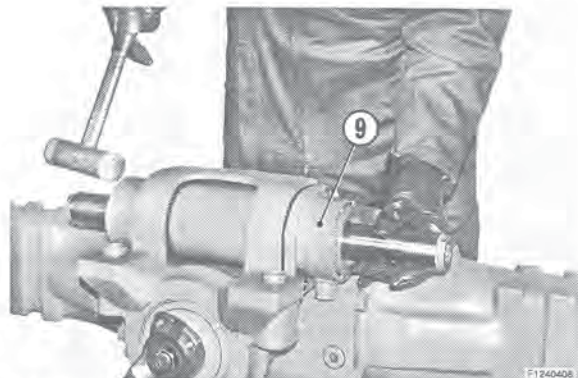




**HOW TO REMOVE THE STEERING CYLINDER - RIMOZIONE CILINDRO DI STERZATURA - LENKZYLINDER ABMONTIEREN - REMOCION CILINDRO DE DIRECCION - DEPOSE DU CYLINDRE DE BRAQUAGE**

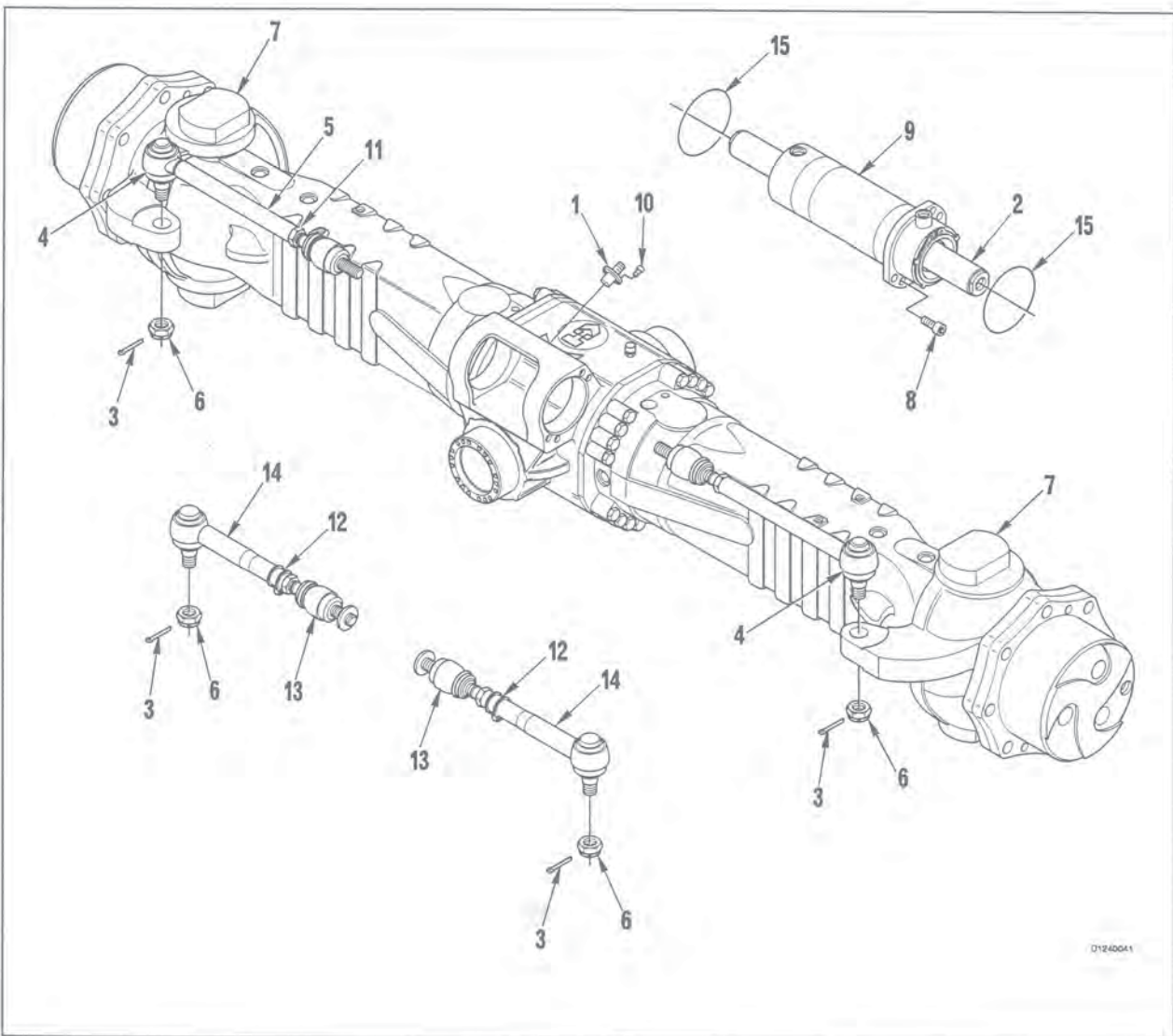


Remove the securing screws (8) from the steering cylinder (9).



Extract the cylinder (9) using a plastic hammer.

**NOTE.** For cylinder disassembly, refer to «HOW TO DISASSEMBLE THE STEERING CYLINDER».



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a

ITA

Asportare le viti (8) di fissaggio del cilindro di sterzata (9).

D

Die Befestigungsschrauben (8) des Lenkzylinders (9) abnehmen.

ESP

Sacar los tornillos (8) que fijan el cilindro de dirección (9).

F

Enlever les vis (8) de fixation du cylindre de braquage (9).

b

ITA

Estrarre il cilindro (9) utilizzando un mazzuolo in materiale plastico.  
**NOTA.** Per lo smontaggio del cilindro, vedere «SMONTAGGIO CILINDRO DI STERZATURA».

D

Den Zylinder (9) mit einem Gummihammer heraus-schlagen.  
**BEMERKUNG.** Um den Zylinder abzumontieren, siehe «LENKZYLINDER ABMONTIEREN».

ESP

Extraer el cilindro (9) utilizando un martillo de material plástico.  
**NOTA.** Para desmontar el cilindro, véase «DESMON-TAJE CILINDRO DE DIRECCIÓN».

F

Extraire le cylindre (9) à l'aide d'un maillet en matière plastique.  
**NOTE.** Pour démonter le cylindre, voir «DEMONTAGE DU CYLINDRE DE BRAQUAGE».

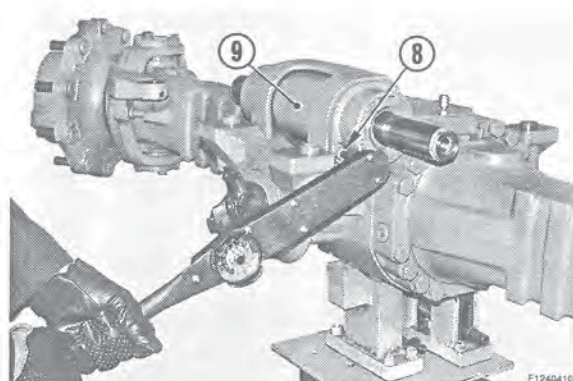




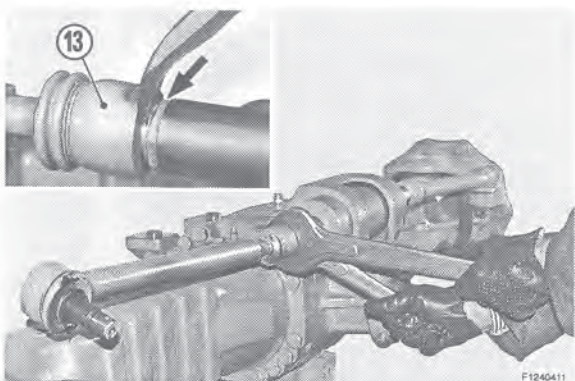
HOW TO INSTALL THE STEERING CYLINDER - INSTALLAZIONE CILINDRO DI STERZATURA - LENKZYLINDER INSTALLIEREN -  
INSTALACION CILINDRO DE DIRECCIÓN - INSTALLATION DU CYLINDRE DE BRAQUAGE



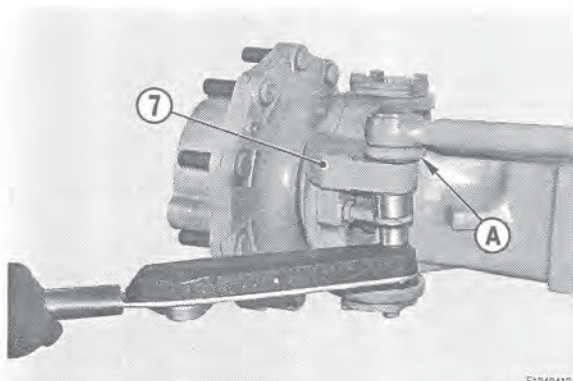
Check that the O-rings (15) of the axle unit are in good condition; lubricate the seats of the seals (15) and fit the steering cylinder (9) into its seat.



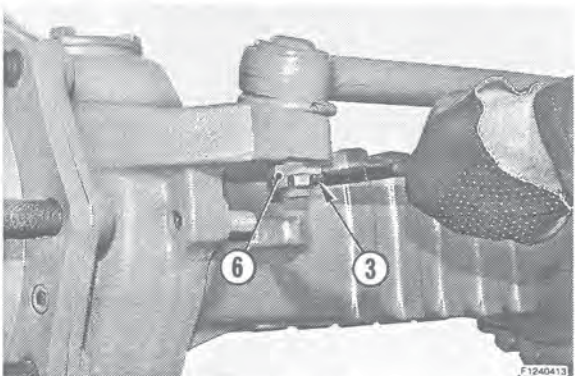
Lock the cylinder by cross-tightening the screws (8).  
Torque wrench setting: 116–128 Nm



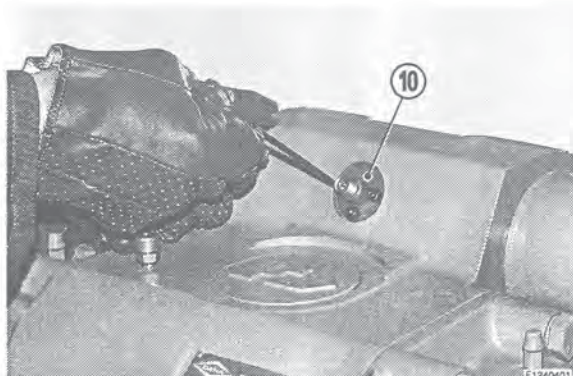
Apply Loctite 242 to the thread and connect the steering bars by screwing the terminals onto the piston stem.  
Torque wrench setting: 240–270 Nm  
**NOTE.** Versions with coupling require that the rim of the articulation (13) is riveted onto the surfaces of the piston stem.



Insert the pins (4) in the steering case (7) and lock into position using a torque wrench setting of 260–290 Nm.  
Find the position of the notching in relation to the hole of the cotter pins and tighten the nut (6) further.  
**CAUTION!** Check that rubber guards (A) are intact.



Insert the cotter pins (3) and bend the safety stems.  
**CAUTION!** Use new cotter pins.



Install the pins (1) for checking piston centring - if applicable - and tighten the screws (10).  
Torque wrench setting: 5–6 Nm





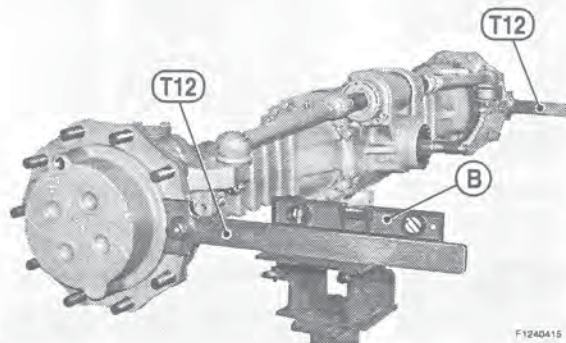
SPICER CLARK-HURTH

- a**
- ITA** Controllare lo stato delle guarnizioni OR (15) del corpo assale; lubrificare le sedi di tenuta delle guarnizioni (15) e montare in sede il cilindro di sterzata (9).
- D** O-Ringe (15) des Achsenkörpers kontrollieren; die Sitze der Dichtungen (15) schmieren und den Lenkzylinder (9) in seinen Sitz montieren.
- ESP** Controlar el estado de las juntas OR (15) del cuerpo del eje; lubricar los alojamientos de estanqueidad de las juntas (15) y montar en el alojamiento el cilindro de dirección (9).
- F** Contrôler le bon état des garnitures OR (15) du corps d'essieu, lubrifier les logements d'étanchéité des garnitures (15), puis monter le logement du cylindre de braquage (9).
- b**
- ITA** Bloccare il cilindro con le viti (8) serrate con il metodo incrociato.  
Coppia di serraggio: 116÷128 Nm
- D** Zylinder mit den Schrauben (8) blockieren; dabei die Schrauben entgegengesetzt und abwechselnd festschrauben.  
Anzugsmoment 116÷128 Nm
- ESP** Bloquear el cilindro con los tornillos (8) apretados con el método cruzado.  
Par de torsión: 116÷128 Nm
- F** Bloquer le cylindre à l'aide des vis (8) serrées par le biais du mode croisé.  
Couple de serrage: 116÷128 Nm
- c**
- ITA** Spalmare la filettatura con Loctite 242 e collegare le barre di sterzata avvitando nello stelo del pistone i terminali.  
Coppia di serraggio: 240÷270 Nm  
**NOTA.** Per la versione a manicotto, ribadire il bordo dello snodo (13) sui piani dello stelo del pistone.
- D** Das Gewinde mit Loctite 242 schmieren und die Lenkstangen verbinden; dabei die Endstücke auf den Kolbenschaft festschrauben.  
Anzugsmoment: 240÷270 Nm  
**BEMERKUNG.** Bei der Ausführung mit Muffe, den Gelenkrand (13) an den Kolbenschaftflächen bündeln.
- ESP** Pasar por la rosca Loctite 242 y conectar las barras de dirección atornillando en el vástago del pistón los terminales.  
Par de torsión: 240÷270 Nm  
**NOTA.** Para la versión de manguito, rebordar el borde de la rótula (13) en las superficies más importantes del vástago del pistón.
- F** Enduire le filetage avec du Loctite 242 et brancher la barre de braquage en vissant les embouts dans la tige du piston.  
Couple de serrage: 240÷270 Nm  
**NOTE.** Dans la version à manchon, river le bord de l'articulation (13) sur les plans clé de la tige du piston.
- d**
- ITA** Inserire nella scatola snodo (7) i perni (4) e bloccare la posizione serrandoli con una coppia di 260÷290 Nm. Ricerare la posizione dell'intaglio rispetto al foro delle copiglie serrando ulteriormente il dado (6).  
**ATTENZIONE!** Controllare l'integrità delle protezioni in gomma (A).
- D** In das Gelenkgehäuse (7) die Stifte (4) einsetzen und mit einem Anzugsmoment von 260÷290 Nm festschrauben. Die Position des Schnitts zum Loch der Splinte suchen, und die Mutter (6) nochmals festziehen.  
**ACHTUNG!** Kontrollieren ob die Gummiringe (A) in Ordnung sind.
- ESP** Introducir en el cárter de la rótula (7) los pernos (4) y bloquear la posición apretándolos con un par de 260÷290 Nm.  
Buscar la posición de la ranura con respecto al orificio de las clavijas apretando aún la tuerca (6).  
**CAUIDADO!** Controlar la integridad de las protecciones de goma (A).
- F** Introduire dans le boîtier articulation (7) les tourillons (4), puis bloquer dans la position en serrant ceux-ci à un couple de 260÷290 Nm.  
Chercher la position de l'entaille par rapport au trou de la goupille en serrant encore l'écrou (6).  
**ATTENTION!** Contrôler le bon état des protections en caoutchouc (A).
- e**
- ITA** Inserire le copiglie (3) e piegare i gambi di sicurezza.  
**ATTENZIONE!** Usare copiglie nuove.
- D** Die Splinte (3) einsetzen und die beiden Sicherheitsstifte knicken.  
**ACHTUNG!** Neue Splinte verwenden.
- ESP** Introducir las clavijas (3) y doblar las patas de seguridad.  
**CAUIDADO!** Usar clavijas nuevas.
- F** Introduire les goupilles (3) et plier les tiges de sécurité.  
**ATTENTION!** Utiliser des goupilles neuves.
- f**
- ITA** Se è previsto, installare il sensore di prossimità (1) per il controllo della centratura del pistone e serrare le viti (10).  
Coppia di serraggio: 5÷6 Nm
- D** Wenn vorgesehen, den Näherungsschalter (1) zur Kontrolle der Kolbenzentrierung installieren und mit den Schrauben (10) festschrauben.  
Anzugsmoment: 5÷6 Nm
- ESP** Si ha sido previsto, instalar el sensor de proximidad (1) para el control del centrado del pistón y apretar los tornillos (10).  
Par de torsión: 5÷6 Nm
- F** Si prévu, installer le capteur de proximité (1) de contrôle de centrage piston et serrer les vis (10).  
Couple de serrage: 5÷6 Nm





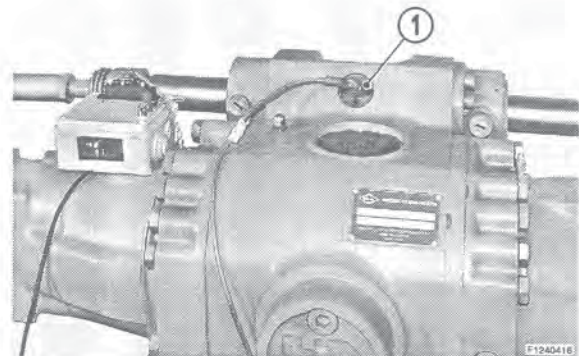
HOW TO INSTALL THE STEERING CYLINDER - INSTALLAZIONE CILINDRO DI STERZATURA - LENKZYLINDER INSTALLIEREN -  
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GB

a

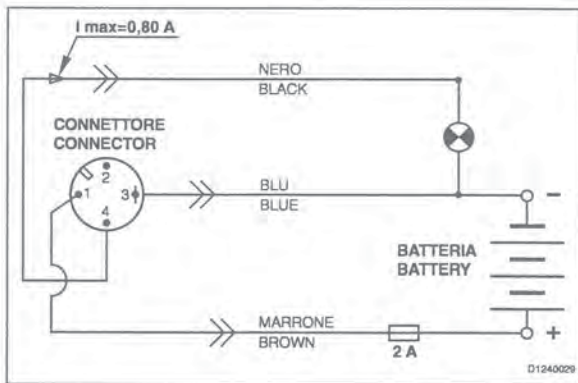
**CAUTION.** Eliminate the action of the negative brake, if fitted.  
Apply tools T12 to the hubs and lock them.  
Using a level "B", check that tools are perfectly flat and parallel to each other.



GB

b

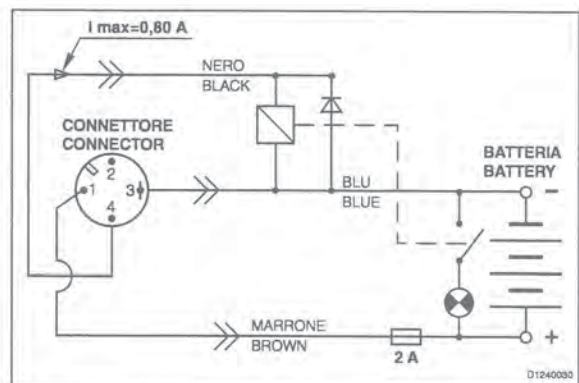
Connect the sensor (1) to the inspection device according to either diagram.



GB

c

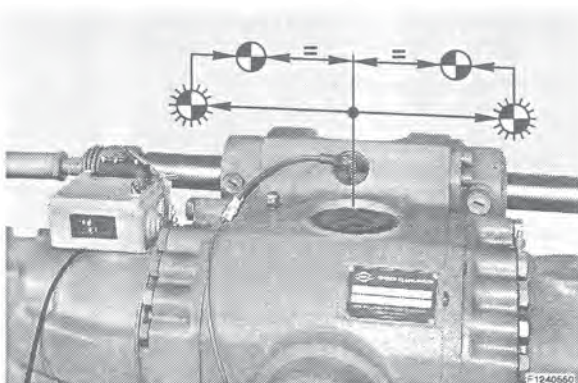
Sensor connection card, STANDARD version.



GB

d

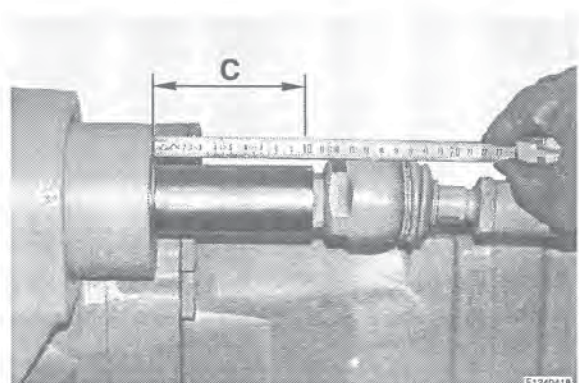
Sensor connection card, OPTIONAL version.



GB

e

Centre the piston by slowly moving it first in one direction then in the other and position it half way on the stroke, which is determined by the switching on and off of the signal lamp of the inspection device in the reversal stage.



GB

f

Inspect jut "C" on one side of the piston and note down the size for checking later adjustments.

**NOTE.** If cylinders come without a sensor, the centring of the piston must be carried out on the basis of the maximum stroke.





- a**
- ITA** **ATTENZIONE!** Se previsto, eliminare l'azione del freno negativo.  
Applicare sui mozzi portaruota gli attrezzi T12 e bloccarli.  
Controllare con una livella "B" che gli attrezzi siano perfettamente in piano e paralleli tra loro.
- D** **ACHTUNG!** Wenn vorgesehen, Wirkung der Negativbremse beseitigen.  
An den Radhalternaben die T12 Werkzeuge anbringen und blockieren.  
Mit einer Libelle "B" kontrollieren, ob die Werkzeuge livelliert und parallel liegen.
- ESP** **CUIDADO!** Si ha sido previsto, eliminar la acción el freno negativo.  
Aplicar en los cubos portarruedas las herramientas T12 y bloquearlas.  
Controlar utilizando un nivel "B" que las herramientas estén perfectamente niveladas y paralelas entre si.
- F** **ATTENTION!** Si prévu, éliminer l'action du frein négatif.  
Appliquer sur les moyeux des roues les outils T12 puis bloquer.  
Contrôler à l'aide d'un niveau "B" que les outils soient parfaitement à plat et parallèles entre-eux.

- b**
- ITA** Collegare il sensore (1) al dispositivo di controllo secondo uno dei due schemi.
- D** Sensor (1) mit der Kontrollvorrichtung nach einem der beiden Pläne verbinden.
- ESP** Conectar el sensor (1) al dispositivo de control según uno de los dos esquemas.
- F** Connecter le capteur (1) au dispositif de contrôle à l'aide de l'un des deux schémas.

- c**
- ITA** Scheda collegamento sensore versione STANDARD.
- D** Verbindungskarte für Sensor STANDARD Ausführung.
- ESP** Tarjeta de conexión sensor versión ESTÁNDAR.
- F** Carte de connexion du capteur version STANDARD.

- d**
- ITA** Scheda collegamento sensore versione OPZIONALE.
- D** Verbindungskarte für Sensor OPTION Ausführung.
- ESP** Tarjeta de conexión sensor versión OPCIONAL.
- F** Carte de connexion du capteur version OPTIONNEL.

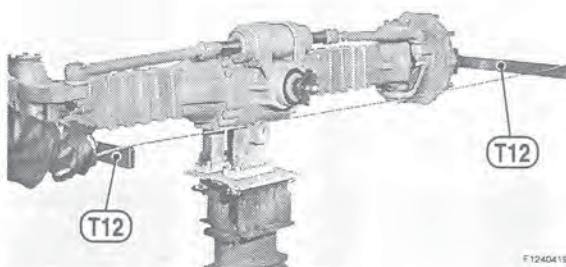
- e**
- ITA** Eseguire la centratura spostando lentamente il pistone prima in un senso e poi nell'altro, posizionandolo a metà della corsa determinata dalle accensioni e dallo spegnimento in fase di ritorno, della lampada di segnalazione del dispositivo di controllo.
- D** Die Zentrierung vornehmen, dabei den Kolben zuerst leicht in die eine, dann in die andere Richtung drehen und auf halbem Hubweg positionieren. Dieser halber Weg liegt zwischen dem Ein- und Ausschalten der Kontrollleuchte der Kontrollvorrichtung.
- ESP** Ejecutar el centraje desplazando lentamente el pistón primero en un sentido y después en el otro, posicionándolo a mitad de la carrera determinada por el encendido y el apagado en fase de retorno, de la lámpara de señalización del dispositivo de control.
- F** Effectuer le centrage en déplaçant lentement le piston d'abord dans un sens, puis dans l'autre, en le plaçant à mi-course qui est déterminée par la lampe-témoin qui s'allume et qui s'éteint pendant la phase de retour et qui se trouve sur le dispositif de contrôle.

- f**
- ITA** Controllare la sporgenza "C" del pistone su un lato ed annotare la misura per il controllo delle regolazioni successive.  
**NOTA.** Per i cilindri senza sensore, la centratura del pistone deve essere eseguita in base alla corsa massima.
- D** Den Vorsprung "C" des Kolbens an einer Seite kontrollieren und das Maß zur Kontrolle der nachfolgenden Einstellungen notieren.  
**BEMERKUNG.** Für Zylinder ohne Sensor, erfolgt die Kolbenzentrierung aufgrund des maximalen Hubs.
- ESP** Controlar la parte saliente de "C" del pistón en un lado y anotar la medida para el control de las regulaciones sucesivas.  
**NOTA.** Para los cilindros sin sensor, el centraje del pistón tiene que ser ejecutado de acuerdo con la carrera máxima.
- F** Contrôler la saillie "C" d'un côté du piston et prendre note de la mesure pour contrôler les régulations suivantes.  
**NOTE.** Pour les cylindres sans capteur, le centrage du piston doit être effectué en se basant sur la course maximale.





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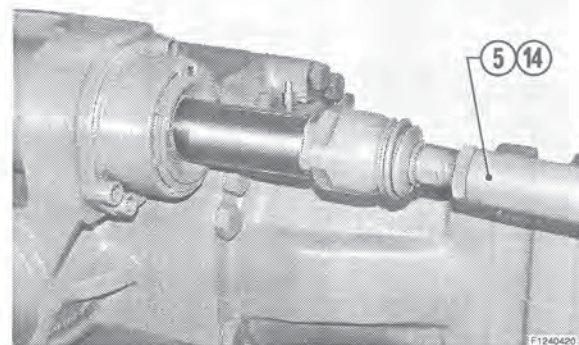
F1240419



Without moving the piston, check front and rear size at the edge of tools T12.

Max. difference: 0.6–0.7 mm

**NOTE.** In order to check the rear size, rotate the bevel pinion and check that tools T12 are flat.

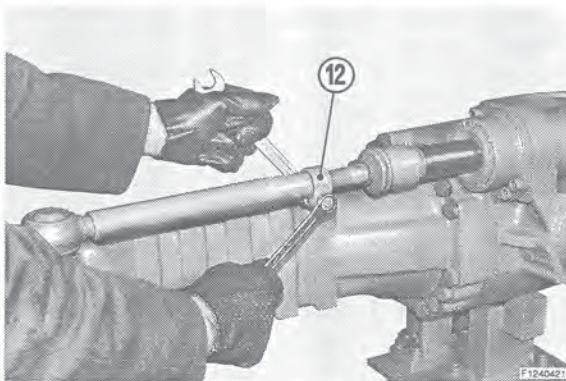


F1240420



If necessary, adjust convergency without moving the centring of the piston and adjust the length of the steering bars (5) or (14).

**NOTE.** With a half turn of screw, the front size is reduced by about 3 mm, whereas the rear one is increased by about 3 mm.

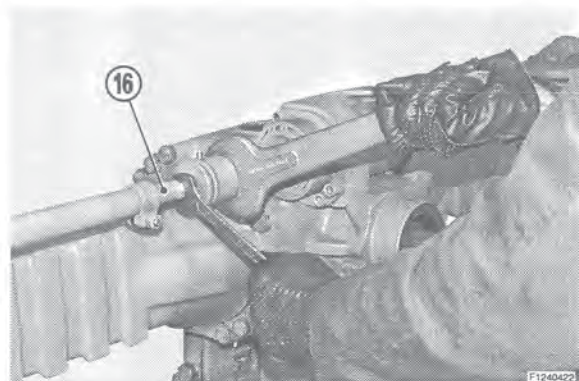


F1240421



**CONVERGENCY ADJUSTMENT ON UNITS WITH COLLAR**

Unloose the nuts on the collars (12).



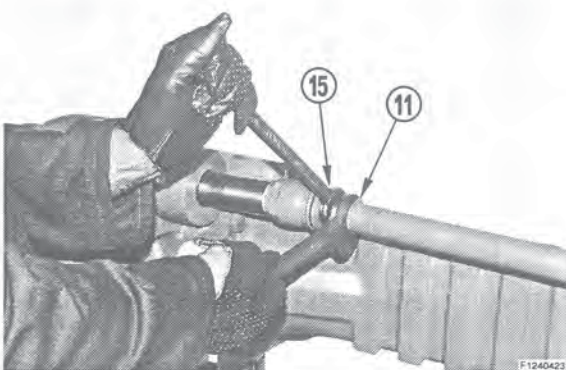
F1240422



Rotate the ball-and-socket joints (16) until convergency has been obtained.

Check that articulations move easily and lock the collars (12).

Torque wrench setting for nuts: 42–52 Nm

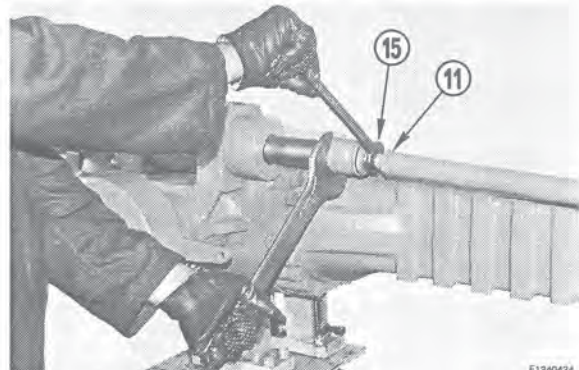


F1240423



**CONVERGENCY ADJUSTMENT ON ALTERNATIVE VERSIONS**

Unloose the nuts (11) and screw them onto the ball-and-socket joints (15).



F1240424



Hold the articulations still and rotate the ball-and-socket joints (15). Once the convergency has been adjusted, lock the nuts (11).

Torque wrench setting for nuts: 298–328 Nm





**ITA** Senza spostare il pistone controllare la misura anteriore e posteriore all'estremità degli attrezzi T12. Differenza max: 0,6÷0,7 mm

**NOTA.** Per controllare la misura posteriore, far ruotare il pignone conico e controllare planarità e parallelismo degli attrezzi T12.

**D** Ohne den Kolben zu verstellen, das vordere und hintere Maß am Endstück der Werkzeuge T12 kontrollieren. Max. Unterschied: 0,6÷0,7 mm

**a** **BEMERKUNG.** Um das hintere Maß zu kontrollieren, das Kegelrad drehen und kontrollieren ob die Werkzeuge T12 eben und parallel liegen.

**ESP** Sin desplazar el pistón, controlar la medida anterior y posterior en los extremos de las herramientas T12. Diferencia máx.: 0,6÷0,7 mm

**NOTA.** Para controlar la medida posterior, hacer girar el piñón cónico y controlar la planaridad y el paralelismo de las herramientas T12.

**F** Sans déplacer le piston, contrôler les mesures avant et arrière de l'extrémité des outils T12. Différence max.: 0,6÷0,7 mm

**NOTE.** Pour contrôler la mesure arrière, faire tourner le pignon conique et contrôler l'uniformité et le parallélisme des outils T12.

**ITA** Se necessario, regolare la convergenza senza spostare la centratura del pistone, regolando la lunghezza delle barre di sterzata (5) o (14).

**NOTA.** Mezzo giro di avvitamento restringe la misura anteriore di circa 3 mm ed allarga la posteriore di circa 3 mm.

**D** Wenn nötig, die Konvergenz einstellen, ohne die Kolbenzentrierung zu verstellen; dazu die Länge der Lenkstangen (5) oder (14) einstellen.

**b** **BEMERKUNG.** Eine halbe Umdrehung verringert das Vordermaß um ca. 3 mm und erweitert das hintere Maß um ca. 3 mm.

**ESP** Si fuera necesario, regular la convergencia sin desplazar el centraje del pistón, regulando la longitud de las barras de dirección (5) o (14).

**NOTA.** Media vuelta de atornillado restringe la medida anterior en aproximadamente 3 mm y ensancha la posterior en aproximadamente 3 mm.

**F** Si besoin, régler la convergence sans déplacer le centrage du piston, en réglant la longueur des barres de braquage (5) ou (14).

**NOTE.** Un demi-tour de vis diminue la mesure avant d'environ 3 mm et élargit celle de derrière d'environ 3 mm.

**ITA** **REGOLAZIONE CONVERGENZA PER VERSIONI CON COLLARE**  
Allentare i dadi dei collari (12).

**D** **KONVERGENZ BEI DEN AUSFÜHRUNGEN MIT BUND EINSTELLEN**  
Die Bundmutter (12) lockern.

**c** **ESP** **REGULACIÓN CONVERGENCIA PARA VERSIONES CON COLLARÍN**  
Aflojar las tuercas de los collarines (12).

**F** **REGLAGE DE CONVERGENCE DES VERSION A COLLIER DE SERRAGE**  
Desserrer les écrous des colliers de serrage (12).

**ITA** Ruotare i perni sferici (16) fino ad ottenere la convergenza.  
Controllare la libertà di movimento degli snodi e bloccare i collari (12).  
Coppia di serraggio dadi: 42÷52 Nm

**D** Die kugeligen Stifte (16) drehen, bis die Konvergenz erreicht worden ist.  
Die freie Bewegung der Gelenke überprüfen und mit den Bunden (12) blockieren.  
Anzugsmoment der Muttern: 42÷52 Nm

**d** **ESP** Girar los pernos esféricos (16) hasta obtener la convergencia.  
Controlar la libertad de movimiento de las rótulas y bloquear los collarines (12).  
Par de torsión de las tuercas: 42÷52 Nm

**F** Tourner les tourillons sphériques (16) jusqu'à obtenir la convergence.  
Contrôler le libre mouvement des articulations et bloquer les colliers de serrage (12).  
Couple de serrage des écrous: 42÷52 Nm

**ITA** **REGOLAZIONE CONVERGENZA PER VERSIONE ALTERNATIVA**  
Allentare i dadi (11) ed avvitarli sui perni sferici (15).

**D** **KONVERGENZ BEI DEN ALTERNATIVEN AUSFÜHRUNGEN EINSTELLEN**  
Die Muttern (11) lockern und auf die kugeligen Stifte (15) festschrauben.

**e** **ESP** **REGULACIÓN CONVERGENCIA PARA VERSIÓN ALTERNATIVA**  
Aflojar las tuercas (11) y atornillarlas en los pernos esféricos (15).

**F** **REGLAGE DE LA CONVERGENCE EN VERSION ALTERNATIVE**  
Desserrer les écrous (11) puis visser les tourillons sphériques (15).

**ITA** Mantenendo fermi gli snodi, ruotare i perni sferici (15). A convergenza regolata, bloccare i dadi (11).  
Coppia di serraggio dadi: 298÷328 Nm

**D** Die Gelenke festhalten und die kugeligen Stifte (15) drehen.  
Wenn die Konvergenz eingestellt ist, die Muttern (11) blockieren.  
Anzugsmoment der Muttern: 298÷328 Nm

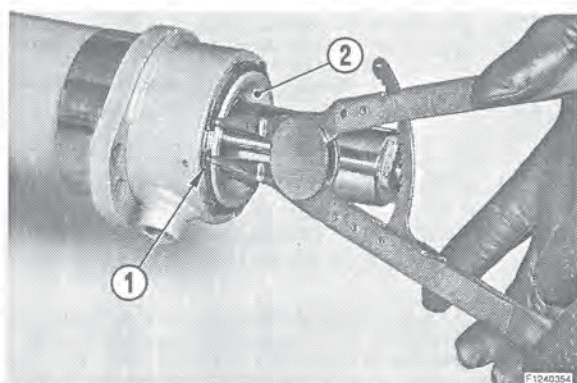
**f** **ESP** Manteniendo firmes las rótulas, girar los pernos esféricos (15).  
Una vez regulada la convergencia, bloquear las tuercas (11).  
Par de torsión de las tuercas: 298÷328 Nm

**F** Tout en maintenant fermement les articulations, tourner les tourillons sphériques (15).  
Lorsque la convergence est réglée, bloquer les écrous (11).  
Couple de serrage des écrous: 298÷328 Nm





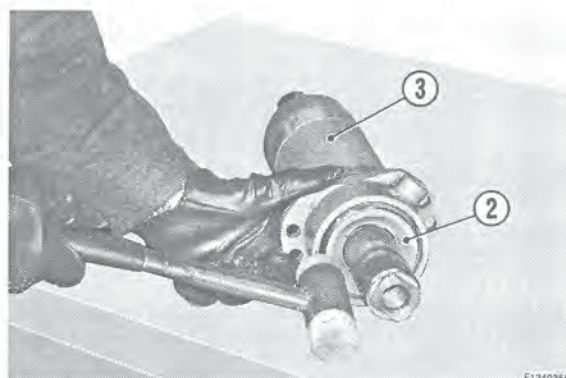
HOW TO DISASSEMBLE THE STEERING CYLINDER - SMONTAGGIO CILINDRO DI STERZATURA - LENKZYLINDER ABMONTIEREN -  
DESMONTAJE CILINDRO DE DIRECCION - DEMONTAGE DU CYLINDRE DE BRAQUAGE



GB

a

Remove the snap ring (1) from the cylinder head (2).

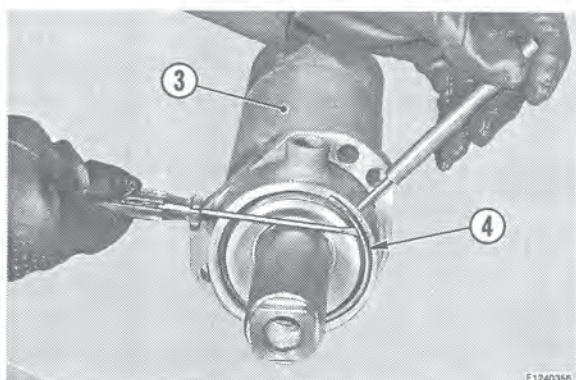


GB

b

With the help of a plastic hammer, push the head (2) inside the cylinder (3).

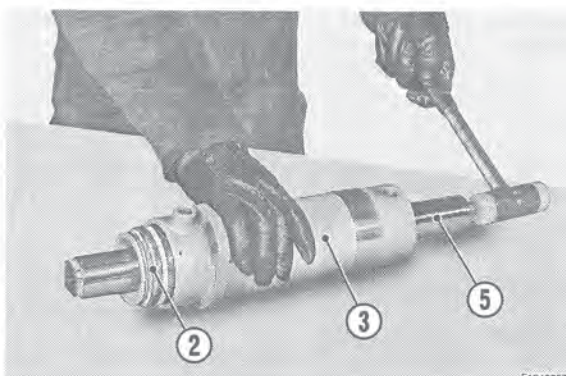
**NOTE.** The head should line up with the edge of the cylinder.



GB

c

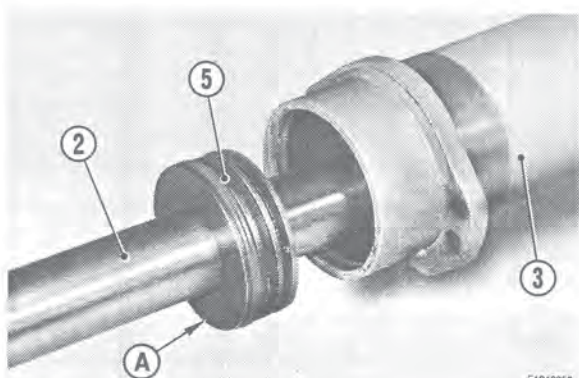
With the help of a drift, apply pressure to the stop ring (4) that is placed inside the cylinder (3) and extract the ring using a screwdriver.



GB

d

Hammer the piston (5) on the rear of the head (2) using a plastic hammer. Continue hammering until the head (2) is ejected from the cylinder (3).



GB

e

Disassemble the cylinder unit (3) by extracting first the head (2), then the piston (5).

**CAUTION!** Note down the assembly side of the piston (5). The bevelled part "A" of the piston is oriented towards the head (2).



GB

f

Remove all seals, anti-extrusion rings and scraper rings from head (2), cylinder (3) and piston (5).

**NOTE.** 1 - All seals must be replaced every time the unit is disassembled. 2 - Particular attention must be paid not to damage the seats of both seals and piston slide.





- a**
- ITA** Rimuovere l'anello elastico (1) di ritegno della testata (2).
- D** Kolbenring (1) vom Kopf (2) abnehmen.
- ESP** Remover el anillo elástico (1) de retención de la culata (2).
- F** Enlever l'anneau élastique (1) de retenue de la culasse (2).

- b**
- ITA** Con leggeri colpi di un mazzuolo in materiale plastico, spingere la testata (2) verso l'interno del cilindro (3).  
**NOTA.** Inserire la testata fino a filo del cilindro.
- D** Mit einem Gummihammer den Kopf (2) leicht zum Zylinder (3) hin schlagen.  
**BEMERKUNG.** Den Kopf bis an den Zylinderrand hinein schlagen.
- ESP** Con ligeros golpes de martillo de material plástico, empujar la culata (2) dentro del cilindro (3).  
**NOTA.** Introducir la culata hasta que quede a ras del cilindro.
- F** Avec de légers coups de maillet en matière plastique, pousser la culasse (2) à l'intérieur du cylindre (3).  
**NOTE.** Introduire la culasse jusqu'au bord du cylindre.

- c**
- ITA** Utilizzando un punteruolo, forzare l'anello di arresto (4) interno al cilindro (3) ed estrarlo utilizzando un cacciavite.
- D** Mit einem Dübel den Sprengring (4) in den Zylinder (3) ausdrücken und mit einem Schraubenzieher herausnehmen.
- ESP** Utilizando un punzón, forzar el anillo de tope (4) dentro del cilindro (3) y extraerlo utilizando un destornillador.
- F** A l'aide d'un pointeau forcer l'anneau de butée (4) à l'intérieur du cylindre (3), extraire ce dernier à l'aide d'un tournevis.

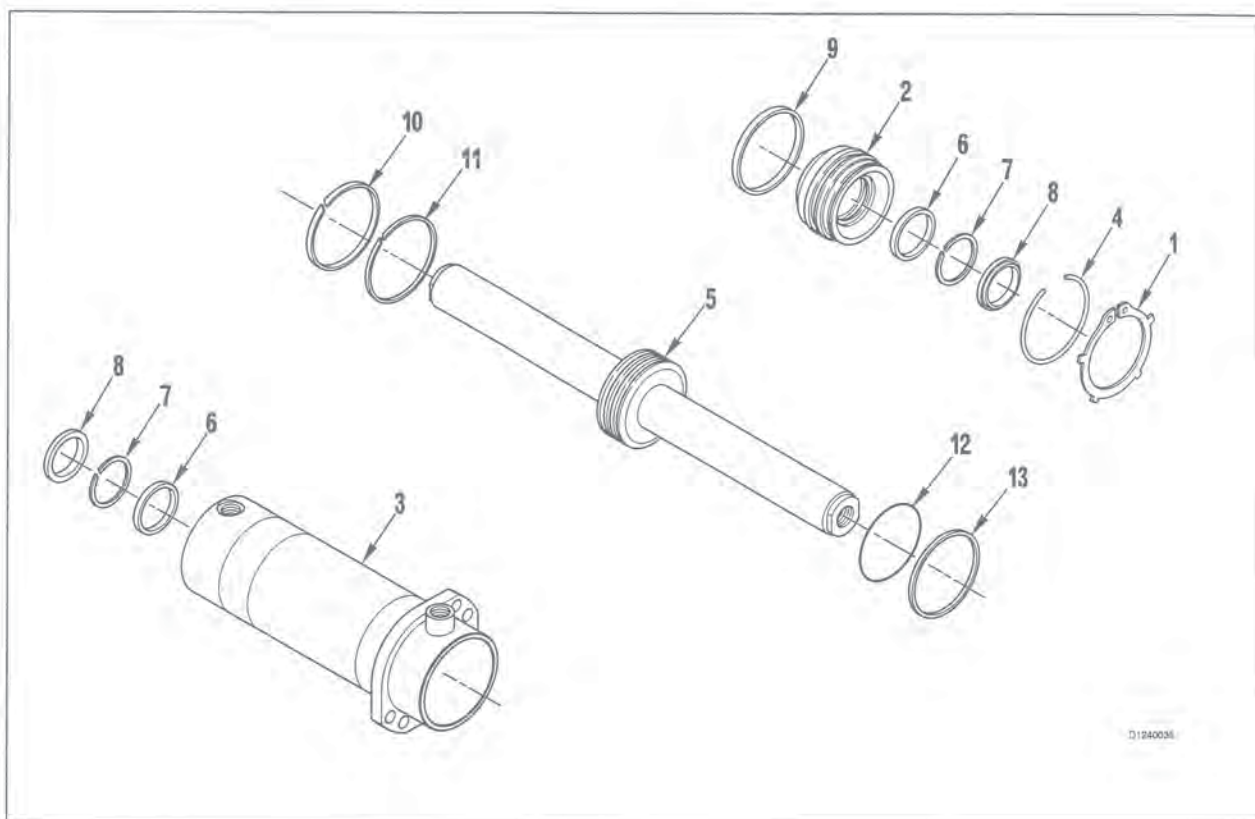
- d**
- ITA** Con un mazzuolo in materiale plastico, mandare in battuta il pistone (5) a ridosso della testata (2).  
Proseguire fino all'espulsione della testata (2) dal cilindro (3).
- D** Mit einem Gummihammer den Kolben (5) bis zum Anschlag des Kopfes (2) bringen.  
Weiter schlagen, bis der Kopf (2) aus dem Zylinder (3) geschlagen worden ist.
- ESP** Con un martillo de material plástico, mandar a tope el pistón (5) detrás de la culata (2).  
Continuar hasta la expulsión de la culata (2) del cilindro (3).
- F** A l'aide d'un maillet en matière plastique, envoyer en butée le piston (5) à l'abri de la culasse (2).  
Continuer jusqu'à l'éjection de la culasse (2) hors du cylindre (3).

- e**
- ITA** Scomporre il gruppo cilindro (3) estraendo nell'ordine la testata (2) ed il pistone (5).  
**ATTENZIONE!** Annotare il senso di montaggio del pistone che ha la parte smussata "A" orientata verso la testata (2).
- D** Das Zylinderaggregat (3) zerlegen; dazu der Reihenfolge nach den Kopf (2) und den Kolben (5) abnehmen.  
**ACHTUNG!** Montagerichtung des Kolbens beachten; das abgerundete Teil "A" muß zum Kopf (2) gerichtet sein.
- ESP** Descomponer el grupo cilindro (3) extrayendo en su orden la culata (2) y el pistón (5).  
**ATENCION!** Anotar el sentido de montaje del pistón que tiene la parte descantillada "A" orientada hacia culata (2).
- F** Décomposer le groupe cylindre (3) en extrayant dans l'ordre d'abord la culasse (2), puis le piston (5).  
**ATTENTION!** Prendre note du sens de montage du piston, la partie arrondie "A" tournée vers la culasse (2).

- f**
- ITA** Rimuovere dalla testata (2), dal cilindro (3) e dal pistone (5) tutte le guarnizioni, gli anelli antiestrusione e gli anelli raschiatori.  
**NOTA.** 1 - Tutte le tenute devono essere sostituite ad ogni smontaggio. 2 - Prestare molta attenzione per non rovinare le sedi delle guarnizioni e dello scorrimento del pistone.
- D** Vom Kopf (2), vom Zylinder (3) und vom Kolben (5) alle Dichtungen, Halteringe und Abschaiber wegnehmen.  
**BEMERKUNG.** 1 - Alle Dichtungen müssen jedesmal gewechselt werden, wenn der Zylinder zerlegt wird. 2 - Sehr vorsichtig vorgehen, um die Dichtungs- und Kolbensitze nicht zu beschädigen.
- ESP** Remover de la culata (2) del cilindro (3) y del pistón (5) todas las juntas, los anillos antiextrusión y los anillos raspadores.  
**NOTA.** 1 - Todas las estanqueidades tienen que ser sustituidas a cada desmontaje. 2 - Tener mucho cuidado a fin de no dañar los alojamientos de las juntas y del deslizamiento del pistón.
- F** Enlever de la culasse (2), du cylindre (3) et du piston (5), toutes les garnitures, anneaux anti-extrusion et les anneaux racleurs.  
**NOTE.** 1 - Toutes les étanchéités doivent être remplacées à chaque démontage. 2 - Faire très attention à ne pas abîmer les logements des garnitures et de coulissement du piston.



HOW TO DISASSEMBLE THE STEERING CYLINDER - SMONTAGGIO CILINDRO DI STERZATURA - LENKZYLINDER ABMONTIEREN -  
DESMONTAJE CILINDRO DE DIRECCION - DEMONTAGE DU CYLINDRE DE BRAQUAGE

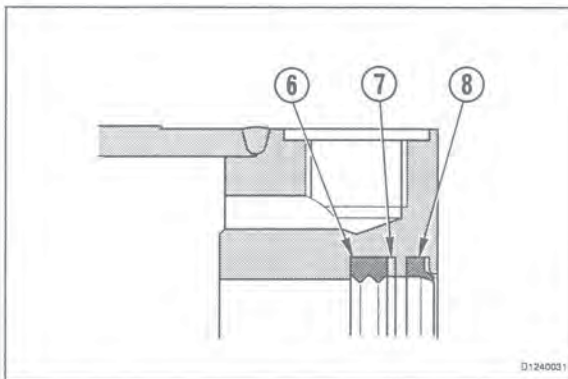








HOW TO ASSEMBLE THE STEERING CYLINDER - ASSEMBLAGGIO CILINDRO DI STERZATURA - LENKZYLINDER MONTIEREN - MONTAJE CILINDRO DE DIRECCION - ASSEMBLAGE DU CYLINDRE DE BRAQUAGE



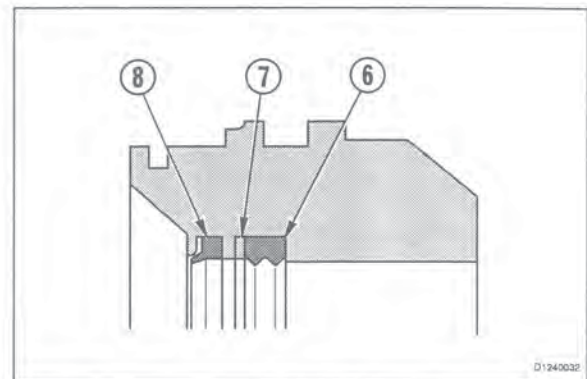
D1240031



GB

a

After applying grease, install the sealing ring (6) of the shaft, the anti-extrusion ring (7) and the scraper ring (8) inside the cylinder (3).  
**CAUTION!** Thoroughly check that positioning of the anti-extrusion ring (7) is correct.



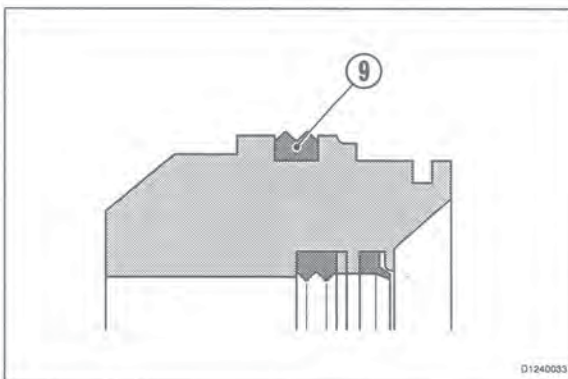
D1240032



GB

b

After applying grease, install the sealing ring (6) of the shaft, the anti-extrusion ring (7) and the scraper ring (8) in the head (2).  
**CAUTION!** Thoroughly check that positioning of the anti-extrusion ring (7) is correct.



D1240033



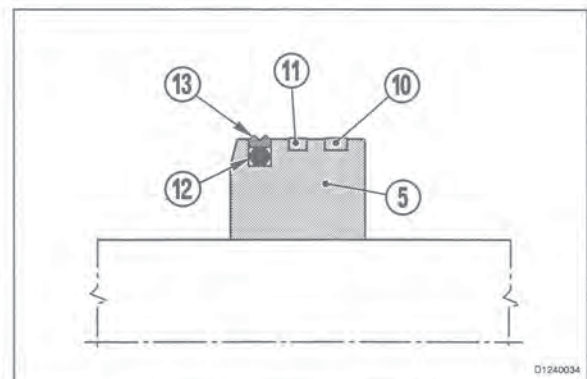
GB

c

Fit the seal (9) onto the outside of the head (2).

**CAUTION!**

- 1 - In order to facilitate assembly, apply grease to the outer surface of the piston.
- 2 - Do not roll the seal (9) up.



D1240034



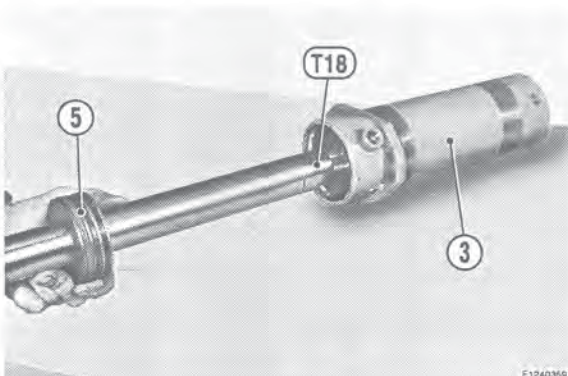
GB

d

Prepare the piston (5) by fitting it with the guide ring (10), the magnetic ring (11), the O-ring (12) and the seal (13).

**CAUTION!**

- 1 - In order to facilitate assembly, apply grease.
- 2 - If a centring sensor is not fitted, then the magnetic ring (11) should be replaced by another guide ring (10).



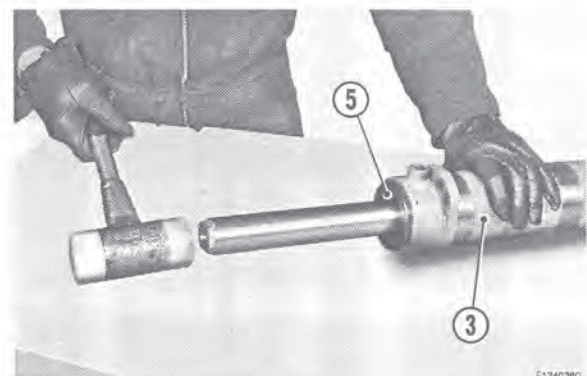
F1240359



GB

e

Apply tool T18 to the shaft on the opposite side of the head (2) and centre it on the cylinder (3) so that it fits into the piston (5).  
**NOTE.** Apply a little grease to seals and cylinder.



F1240360



GB

f

Push the piston (5) into the cylinder for 100 mm using a plastic hammer.



**ITA**

Lubrificare con grasso ed installare nel cilindro (3) l'anello di tenuta (6) dello stelo, l'anello antiestrusione (7) e l'anello raschiatore (8).

**ATTENZIONE!** Controllare attentamente il posizionamento dell'anello antiestrusione (7).

**D**

Mit Fett die Dichtung (6) des Schaftes, den Haltering (7) und den Abschaber (8) schmieren und in den Zylinder (3) montieren.

**ACHTUNG!** Sorgfältig die Position des Halterings (7) kontrollieren.

**ESP**

Lubricar con grasa e instalar en el cilindro (3) el segmento de compresión (6) del vástago, el anillo antiextrusión (7) y el anillo raspador (8).

**CUIDADO!** Controlar atentamente el posicionamiento del anillo antiextrusión (7).

**F**

Lubrifier avec du gras et installer dans le cylindre (3) la bague d'étanchéité (6) de la tige, l'anneau anti-extrusion (7) et l'anneau racleur (8).

**ATTENTION!** Contrôler attentivement le positionnement de l'anneau anti-extrusion (7).

**ITA**

Montare all'esterno della testata (2) la guarnizione (9).

**ATTENZIONE!**

1 - Per facilitare il montaggio, lubrificare con grasso la superficie esterna del pistone.

2 - Non arrotolare la guarnizione (9).

**D**

Außen am Kopf (2) die Dichtung (9) montieren.

**ACHTUNG!**

1 - Um die Montage zu erleichtern, die äußere Kolbenfläche mit Fett schmieren.

2 - Die Dichtung (9) nicht wickeln.

**ESP**

Montar fuera de la culata (2) la junta (9).

**CUIDADO!**

1 - Para facilitar el montaje, lubricar con grasa la superficie exterior del pistón.

2 - No enrollar la junta (9).

**F**

Monter à l'extérieur de la culasse (2) la garniture (9).

**ATTENTION!**

1 - Pour rendre plus aisé le montage, lubrifier avec du gras la surface externe du pistón.

2 - Ne pas enrouler les garnitures (9).

**ITA**

Applicare l'attrezzo T18 sullo stelo lato opposto testata (2) e centrarlo nel cilindro (3) fino ad imboccare il pistone (5).

**NOTA.** Lubrificare leggermente con grasso le guarnizioni ed il cilindro.

**D**

Das Werkzeug T18 auf den Schaft an der dem Kopf (2) entgegengesetzten Seite anbringen und auf den Zylinder (3) zentrieren, bis es auf dem Kolben (5) sitzt.

**BEMERKUNG.** Die Dichtungen und den Zylinder leicht mit Fett schmieren.

**ESP**

Aplicar la herramienta T18 sobre el vástago lado opuesto culata (2) y centrarlo en el cilindro (3) hasta entrar en el pistón. (5).

**NOTA.** Lubrificar ligeramente con grasa las juntas y el cilindro.

**F**

Appliquer l'outil T18 sur la tige du côté opposé à la culasse (2) et centrer celui-ci dans le cylindre (3) jusqu'à engager le pistón (5).

**NOTE.** Lubrifier légèrement les garnitures et le cylindre avec du gras.

**ITA**

Lubrificare con grasso ed installare nella testata (2) l'anello di tenuta (6) dello stelo, l'anello antiestrusione (7) e l'anello raschiatore (8).

**ATTENZIONE!** Controllare attentamente il posizionamento dell'anello antiestrusione (7).

**D**

Mit Fett die Dichtung (6) des Schaftes, den Haltering (7) und den Abschaber (8) schmieren und in den Kopf (2) montieren.

**ACHTUNG!** Sorgfältig die Position des Halterings (7) kontrollieren.

**ESP**

Lubricar con grasa e instalar en la culata (2) el segmento de compresión (6), el anillo antiextrusión (7) y el anillo raspador (8).

**CUIDADO!** Controlar atentamente el posicionamiento del anillo antiextrusión (7).

**F**

Lubrifier avec du gras et installer dans le cylindre (2) la bague d'étanchéité (6) de la tige, l'anneau anti-extrusion (7) et l'anneau racleur (8).

**ATTENTION!** Contrôler attentivement le positionnement de l'anneau anti-extrusion (7).

**ITA**

Preparare il pistone (5) montando l'anello di guida (10), l'anello magnetico (11), l'OR (12) e la guarnizione (13).

**ATTENZIONE!** 1 - Per facilitare il montaggio, lubrificare con grasso.

2 - Se non è previsto il sensore di centratura, l'anello magnetico (11) è sostituito con un secondo anello di guida (10).

**D**

Den Kolben (5) mit dem Führungsring (10), dem magnetischen Ring (11), den O-Ring (12) und der Dichtung (13) vorbereiten.

**ACHTUNG!** 1 - Um die Montage zu erleichtern, mit Fett schmieren.

2 - Wenn kein Zentrierungssensor vorgesehen ist, ist der magnetische Ring (11) mit einem zweiten Führungsring (10) ersetzt.

**ESP**

Preparar el pistón (5) montando el anillo de guía (10), el anillo de imán (11), el OR (12) y la junta (13).

**CUIDADO!** 1 - Para facilitar el montaje, lubricar con

grasa.

2 - Si no ha sido previsto el sensor de centrado, el anillo de imán (11) es sustituido por un segundo anillo de guía (10).

**F**

Préparer le piston (5) en montant l'anneau de guidage (10), l'anneau magnétique (11), la OR (12) et la garniture (13).

**ATTENTION!** 1 - Pour rendre plus aisé le montage, lubrifier avec du gras. 2 - Si le capteur de centrage n'est pas prévu, l'anneau magnétique (11) est remplacé par un second anneau de guidage (10).

**ITA**

Con un mazzuolo in materiale plastico, inserire il pistone (5) nel cilindro per circa 100 mm.

**D**

Mit einem Gummihammer, den Kolben (5) in den Zylinder 100 mm lang schlagen.

**ESP**

Con un martillo de material plástico, introducir el pistón (5) en el cilindro unos 100 mm.

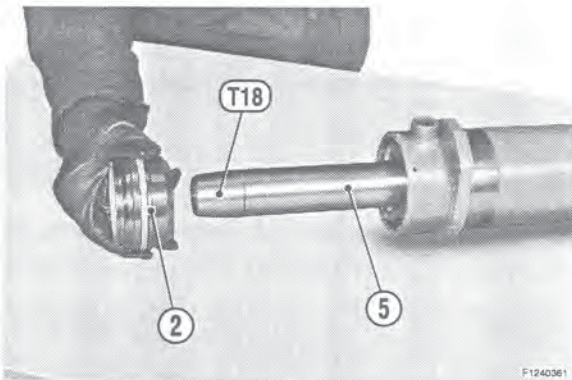
**F**

A l'aide d'un maillet en matière plastique, introduire le piston (5) d'environ 100 mm dans le cylindre.





HOW TO ASSEMBLE THE STEERING CYLINDER - ASSEMBLAGGIO CILINDRO DI STERZATURA - LENKZYLINDER MONTIEREN -  
MONTAJE CILINDRO DE DIRECCION - ASSEMBLAGE DU CYLINDRE DE BRAQUAGE



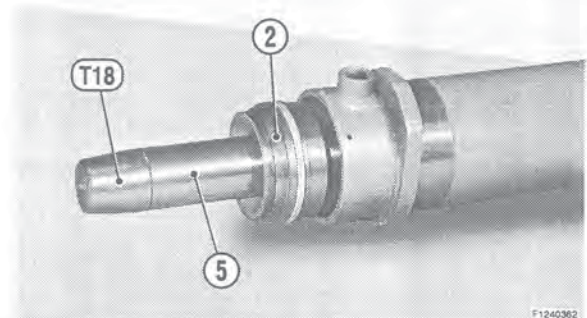
F1240361



GB

a

Remove tool T18 and apply it to the opposite side of the piston (5).



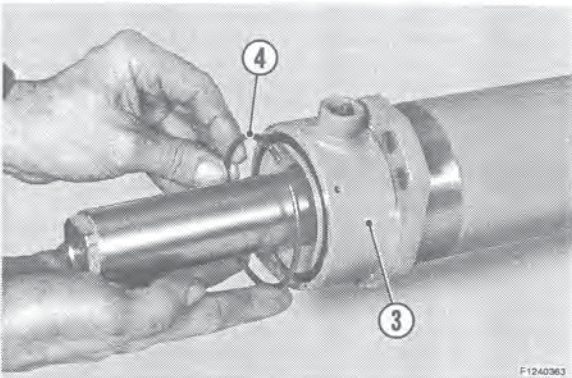
F1240362



GB

b

Apply grease to head (2) seals, fit the head onto the piston and push it into the cylinder (3) using a plastic hammer.  
**NOTE.** Insert the head as to line it up with the edge of the cylinder.



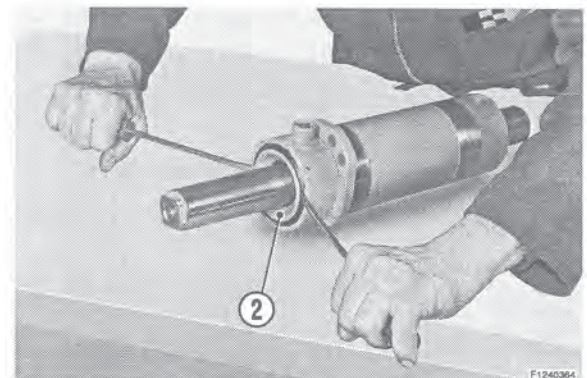
F1240363



GB

c

Insert the stop ring (4) ensuring that it fits into the seat of the cylinder (3).



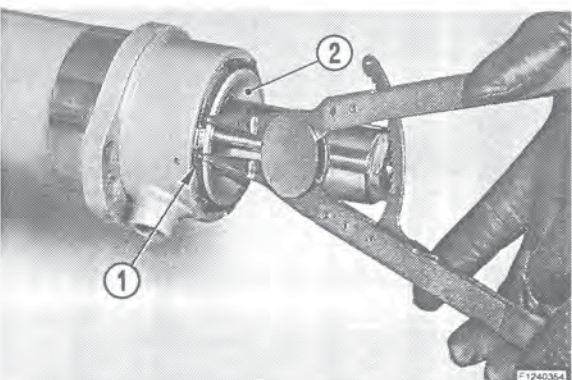
F1240364



GB

d

Apply pressure to the head using two screwdrivers or levers until the head is fastened onto the stop ring (4).



F1240364



GB

e

Fit the snap ring (1) on the head (2).  
**CAUTION!** Make sure that the snap ring (1) is securely fastened in its seat.  
If necessary, force it into its seat using a drift and a hammer.



- a**
- ITA** Rimuovere l'attrezzo T18 ed applicarlo sul lato opposto del pistone (5).
- D** Werkzeug T18 abnehmen und an der anderen Kolbenseite (5) anbringen.
- ESP** Remover la herramienta T18 y aplicarla en el lado opuesto del pistón (5).
- F** Enlever l'outil T18 et appliquer ce dernier sur le côté opposé du piston (5).

- ITA** Lubrificare con grasso le guarnizioni della testata (2), infilarla sul pistone e, con un mazzuolo in materiale plastico, inserirla nel cilindro (3).
- NOTA.** Inserire la testata fino a filo del cilindro.

- b**
- D** Die Dichtungen des Kopfes (2) mit Fett schmieren. Den Kopf auf den Kolben schieben und mit einem Gummihammer in den Zylinder (3) schlagen.
- BEMERKUNG.** Den Kopf bis zum Zylinderrand hinein schlagen.

- ESP** Lubricar con grasa las juntas de la culata (2), introducirla en el pistón y, utilizando un martillo de material plástico, introducirla en el cilindro (3).
- NOTA.** Introducir la culata hasta nivel del cilindro.

- F** Lubrifier avec du gras les garnitures de la culasse (2). Enfiler celle-ci sur le piston, et à l'aide d'un maillet en matière plastique, introduire dans le cylindre (3).
- NOTE.** Introduire la culasse jusqu'au bord du cylindre.

- c**
- ITA** Inserire l'anello di arresto (4) assicurandosi che si assesti nella sede del cilindro (3).
- D** Den Haltering (4) einsetzen und kontrollieren, ob er richtig im Sitz des Zylinders (3) sitzt.
- ESP** Introducir el anillo de tope (4) asegurándose de que se ajusta en el alojamiento del cilindro (3).
- F** Introduire l'anneau de butée (4) en s'assurant qu'il s'ajuste bien dans le logement du cylindre (3).

- ITA** Utilizzando due cacciaviti o leve, forzare la testata fino alla battuta sull'anello di arresto (4).

- d**
- D** Mit zwei Schraubenzieher oder Hebeln, den Kopf bis zum Anschlag des Sprengings (4) schieben.

- ESP** Utilizando dos destornilladores o palancas, forzar la culata hasta el tope en el anillo de tope (4).

- F** A l'aide de deux tournevis ou leviers, envoyer en butée la tête sur l'anneau de butée (4).

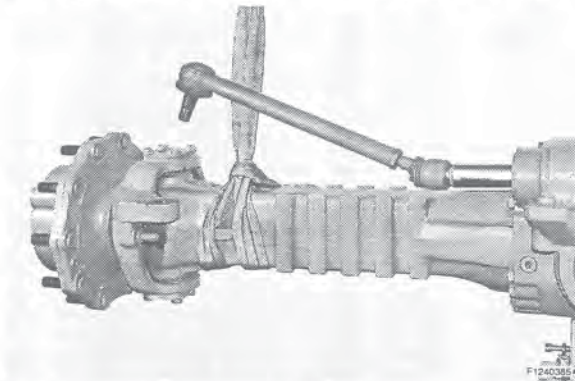
- e**
- ITA** Montare l'anello elastico (1) di ritegno della testata (2). **ATTENZIONE!** Assicurarsi che l'anello elastico (1) sia impegnato a fondo nella sede. Se necessario, forzarlo in sede con un punteruolo ed un martello.
- D** Den Kolbenring (1) des Kopfes (2) montieren. **ACHTUNG!** Kontrollieren ob der Kolbenring (1) in seinem Sitz richtig sitzt. Wenn nötig, in seinen Sitz mit einem Dübel und einen Hammer schlagen.
- ESP** Montar el anillo elástico (1) de retención de la culata (2). **CUIDADO!** Asegurarse de que el anillo elástico (1) está colocado a fondo en la sede. Si fuera necesario, forzarlo en el alojamiento utilizando un punzón y un martillo.
- F** Monter l'anneau élastique (1) de retenue de la culasse (2). **ATTENTION!** S'assurer que l'anneau élastique (1) soit engagé à fond dans le logement. Si besoin, forcer dans le logement à l'aide d'un poinçon et d'un marteau.





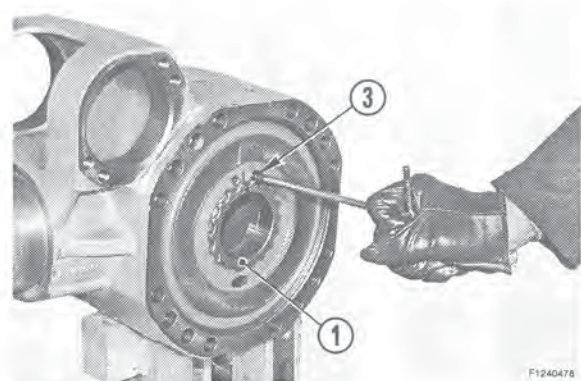
**HOW TO REMOVE AND DISASSEMBLE THE DIFFERENTIAL UNIT - RIMOZIONE E SMONTAGGIO GRUPPO DIFFERENZIALE - DIFFERENTIAL ABMONTIEREN UND ZERLEGEN - REMOCION Y DESMONTAJE GRUPO DIFERENCIAL - DEPOSE ET DEMONTAGE DU GROUPE DIFFERENTIEL**

REMOVING - RIMOZIONE - ABMONTIEREN - REMOCION - DEPOSE



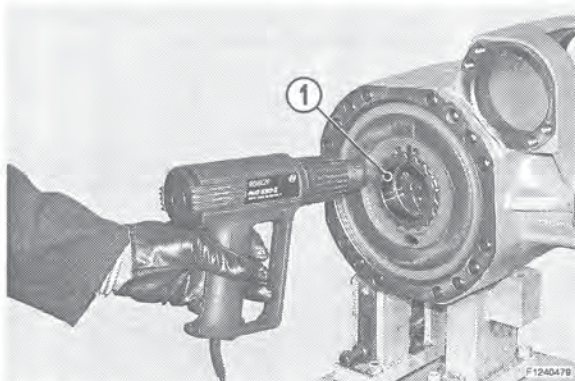
**GB** **a**

Remove the complete arms.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS».



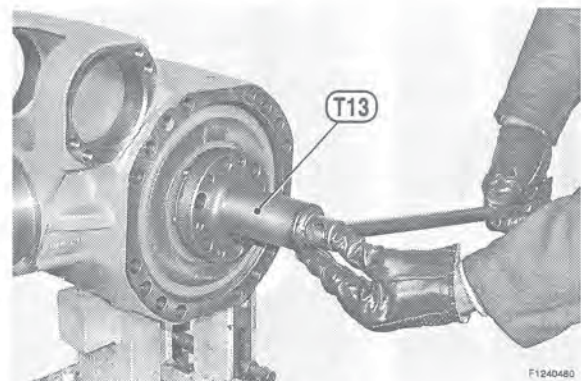
**GB** **b**

Mark the position of the ring nuts (1). Remove the fitting screws (3) from the ring nuts (1).



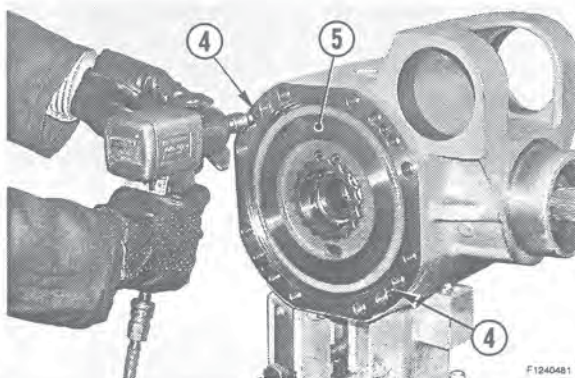
**GB** **c**

Uniformly heat the ring nuts (1) up to a temperature of 80° C.



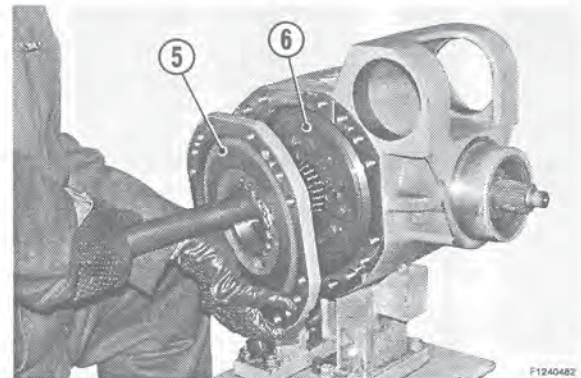
**GB** **d**

Apply tool T13 and remove the ring nuts.  
**NOTE.** Accurately clean the threaded portions on ring nuts of body and cover.



**GB** **e**

Remove the fitting screws (4) from the middle cover (5).



**GB** **f**

Insert a screw-driver in the opposing slots then force and remove the middle cover (5) and the complete differential unit (6).  
**NOTE.** Support the pieces using a rod.





- a**
- ITA** Rimuovere i bracci completi.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Die kompletten Arme abmontieren.  
Siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Remover los brazos completos.  
Para los detalles, véase «CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO».
- F** Déposer les bras complets.  
Pour de plus amples détails voir «CONTROLE D'USURE ET SUBSTITUTION DES DISQUES DE FREINAGE».

- b**
- ITA** Contrassegnare la posizione delle ghiere (1).  
Rimuovere le viti (3) di ritagno delle ghiere (1).
- D** Position der Nutmutter (1) markieren. Schrauben (3) der Nutmutter (1) abschrauben.
- ESP** Marcar la posición de las virolas (1).  
Remover los tornillos (3) de retención de las virolas (1).
- F** Marquer la position des colliers de serrage (1). Enlever les vis (3) de fixation des colliers de serrage (1).

- c**
- ITA** Scaldare le ghiere (1) in modo uniforme fino ad una temperatura di circa 80°C.
- D** Nutmutter (1) gleichmäßig auf ca. 80°C erhitzen.
- ESP** Calentar las virolas (1) de manera uniforme hasta un temperatura de unos 80°C.
- F** Chauffer les colliers de serrage (1) de façon uniforme jusqu'à une température d'environ 80°C.

- d**
- ITA** Applicare l'attrezzo T13 ed asportare le ghiere.  
**NOTA.** Pulire accuratamente le filettature delle ghiere del corpo e del coperchio.
- D** Werkzeug T13 anbringen und Nutmutter entfernen.  
**BEMERKUNG.** Sorgfältig das Gewinde der Nutmutter, des Körpers und des Deckels reinigen.
- ESP** Aplicar la herramienta T13 y sacar las virolas.  
**NOTA.** limpiar con cuidado las roscas de las virolas del cuerpo y de la tapa.
- F** Appliquer l'outil T13 et enlever les anneaux de fixation.  
**NOTE.** Nettoyer soigneusement le filetage des anneaux de fixation, du corps et du couvercle.

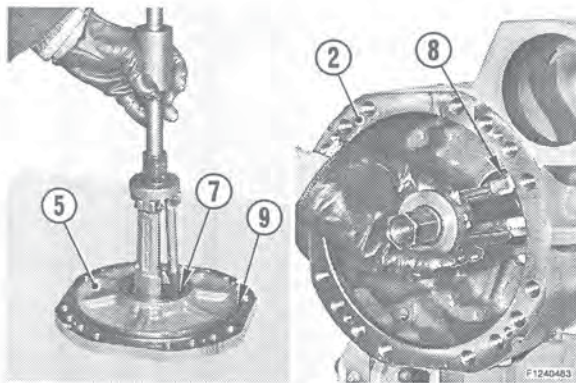
- e**
- ITA** Asportare le viti (4) di ritagno del coperchio intermedio (5).
- D** Schrauben (4) des mittleren Deckels (5) abschrauben.
- ESP** Sacar los tornillos (4) de retención de la tapa intermedia (5).
- F** Enlever les vis (4) de fixation du couvercle intermédiaire (5).

- f**
- ITA** Forzare con un cacciavite introdotto nei vani contrapposti e rimuovere il coperchio intermedio (5) ed il gruppo differenziale completo (6).  
**NOTA.** Sostenere i pezzi con un'asta.
- D** Einen Schraubenzieher in die Hohlräume stecken und anheben, um den mittleren Deckel (5) und das komplette Differentialaggregat (6) zu entfernen.  
**BEMERKUNG.** Die Teile mit einem Stab halten.
- ESP** Forzar utilizando un destornillador introducido en los compartimentos contrapuestos y remover la tapa intermedia (5) y el grupo diferencial completo (6).  
**NOTA.** Sostener las piezas utilizando una varilla.
- F** Forcer à l'aide d'un tournevis, introduit dans les creux interposés, enlever le couvercle intermédiaire (5) et le groupe différentiel complet (6).  
**NOTE.** Soutenir les pièces avec une tige.



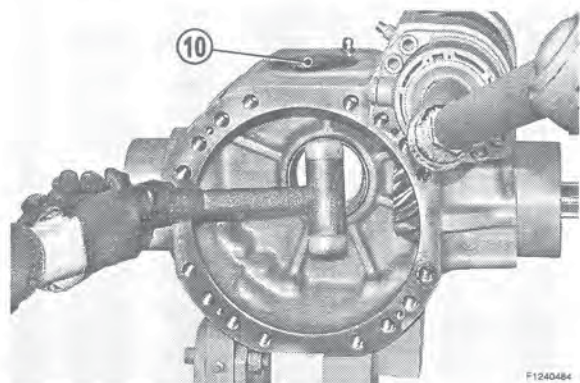


**HOW TO REMOVE AND DISASSEMBLE THE DIFFERENTIAL UNIT - RIMOZIONE E SMONTAGGIO GRUPPO DIFFERENZIALE - DIFFERENTIAL ABMONTIEREN UND ZERLEGEN - REMOCION Y DESMONTAJE GRUPO DIFERENCIAL - DEPOSE ET DEMONTAGE DU GROUPE DIFFERENTIEL**



If the bearings need replacing, extract the external thrust blocks of the bearings (7) and (8) from middle cover (5) and central body (2).  
**NOTE.** Accurately check the O-ring (9).

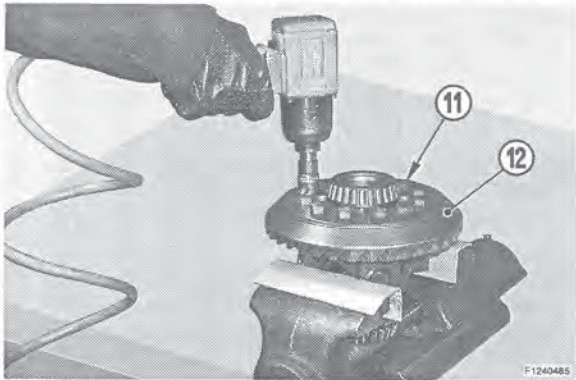
**a**



Remove the top plug (10).

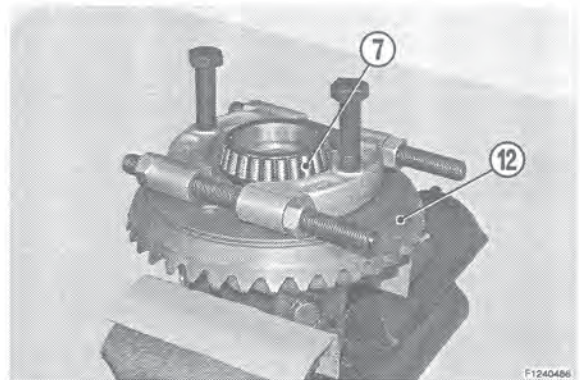
**b**

**DISASSEMBLING - SMONTAGGIO - ZERLEGEN - DESMONTAJE - DESASSEMBLAGE**



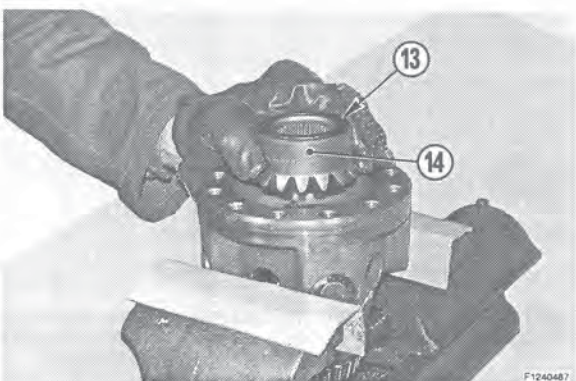
Remove the fittin screws (11) from the crown (12).

**c**



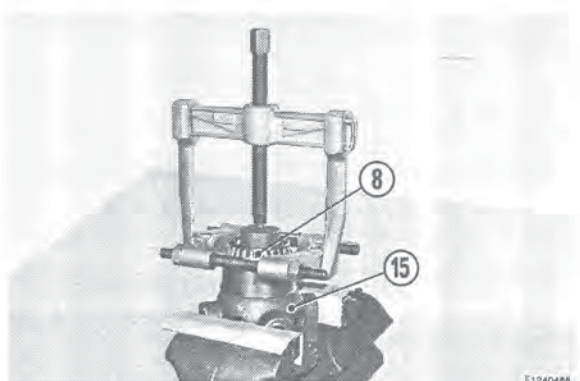
If the bearing need replacing, extract the bearing (7) and remove the crown (12).

**d**



Remove the shim washer (13) and the planetary gear (14).

**e**



If the bearing need replacing, extract the bearing (8) from the differential carrier (15).

**f**



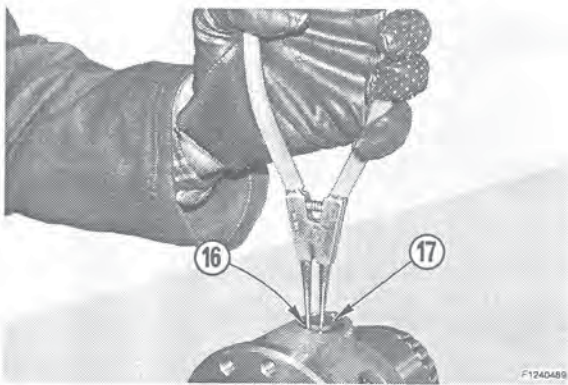


|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Se si devono sostituire i cuscinetti, estrarre dal coperchio intermedio (5) e dal corpo centrale (2) le ralle esterne dei cuscinetti (7) e (8).<br/><b>NOTA.</b> Controllare attentamente l'anello OR (9).</p> <p><b>D</b> Wenn Lager ausgewechselt werden müssen, vom mittleren Deckel (5) und vom zentralen Körper (2) die äußeren Scheiben der Lager (7) und (8) entfernen.<br/><b>BEMERKUNG.</b> O-Ring (9) sorgfältig kontrollieren.</p> <p><b>ESP</b> Si hay que sustituir los cojinetes, extraer de la tapa intermedia (5) y del cuerpo central (2) las ranguas exteriores (7) y (8) de los cojinetes.<br/><b>NOTA.</b> Controlar atentamente el anillo OR (9).</p> <p><b>F</b> Si on doit remplacer les paliers, extraire du couvercle intermédiaire (5) et du corps central (2), les crapaudines externes des paliers (7) et (8).<br/><b>NOTE.</b> Contrôler attentivement la garniture OR (9).</p> | <p><b>ITA</b> Rimuovere il tappo superiore (10).<br/><b>NOTA.</b> Il tappo deve essere sostituito ad ogni rimozione.</p> <p><b>D</b> Oberer Stopfen (10) entfernen.</p> <p><b>ESP</b> Remover el tapón superior (10).</p> <p><b>F</b> Enlever le bouchon supérieur (10).</p>                                                                                                                                                       |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere le viti (11) di ritegno della corona (12).</p> <p><b>D</b> Die Schrauben (11) des Kranzes (12) abschrauben.</p> <p><b>ESP</b> Remover los tornillos (11) de retención de la corona (12).</p> <p><b>F</b> Enlever les vis (11) de fixation de la couronne (12).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p><b>ITA</b> Se si deve sostituire, estrarre il cuscinetto (7) e rimuovere la corona (12).</p> <p><b>D</b> Falls das Lager ausgewechselt werden muß, Lager (7) heraus nehmen und Kranz (12) entfernen.</p> <p><b>ESP</b> Si hay que sustituirlo, extraer el cojinete (7) y remover la corona (12).</p> <p><b>F</b> Extraire le palier (7) et déposer la couronne (12) en cas que le premier doit être remplacé.</p>               |
| <p><b>e</b></p> <p><b>ITA</b> Rimuovere la rondella di rasamento (13) e l'ingranaggio planetario (14).</p> <p><b>D</b> Zwischenlegscheibe (13) und Planetenrad (14) entfernen.</p> <p><b>ESP</b> Remover la arandela de espesor (13) y el engranaje planetario (14).</p> <p><b>F</b> Enlever la rondelle de rasage (13) et l'engrenage planétaire (14).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p><b>ITA</b> Se si deve sostituire, estrarre il cuscinetto (8) dalla scatola differenziale (15).</p> <p><b>D</b> Wenn das Lager ausgewechselt werden muß, Lager (8) aus dem Differentialgehäuse (15) nehmen.</p> <p><b>ESP</b> Si hay que sustituirlo, extraer el cojinete (8) de la caja del diferencial (15).</p> <p><b>F</b> Extraire le palier (8) du boîtier différentiel (15) en cas que le premier doit être remplacé.</p> |

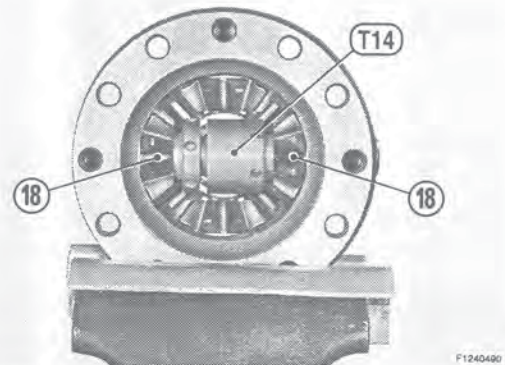




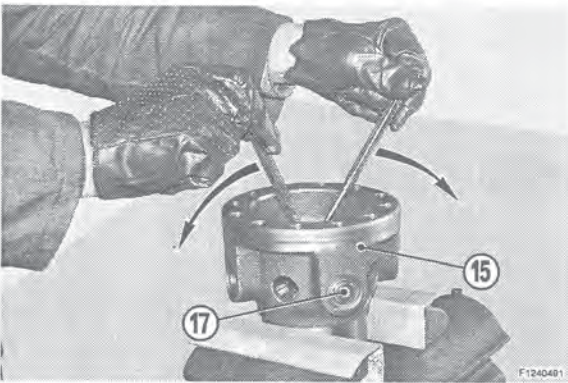
**HOW TO REMOVE AND DISASSEMBLE THE DIFFERENTIAL UNIT - RIMOZIONE E SMONTAGGIO GRUPPO DIFFERENZIALE - DIFFERENTIAL ABMONTIEREN UND ZERLEGEN - REMOCION Y DESMONTAJE GRUPO DIFERENCIAL - DEPOSE ET DEMONTAGE DU GROUPE DIFFERENTIEL**



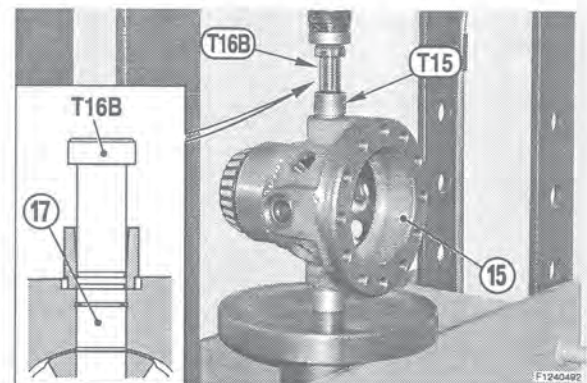
Remove the snap rings (16) from the two pins (17) of the planet wheel gears (18).



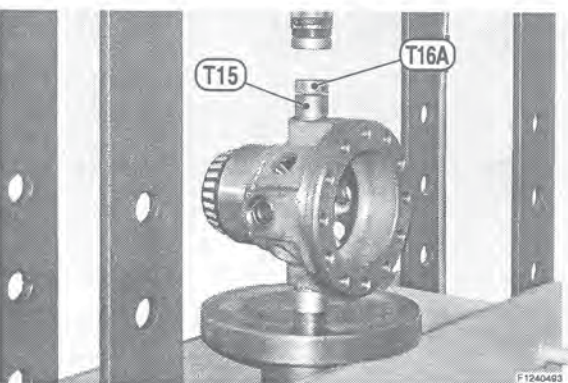
Insert tool T14 between the planet wheel gears (18).



Force tool T14 in-between the planet wheel gears (18) using two pin-drivers.  
**CAUTION!** Make sure that tool T14 is perfectly lined up with the pins (17) when locked.



Place the differential carrier (15) under a press, position bush T15 and insert gudgeon T16A. Press T16A pin to limit position.



Remove gudgeon T16A and bush T15.  
**NOTE.** In this condition the tool T14 contains pin (17).



Remove tool T14 together with the pin (17) of the planet wheel.





- a**
- ITA** Rimuovere gli anelli elastici (16) dai perni (17) degli ingranaggi satelliti (18).
- D** Kolbenringe (16) von den Stiften (17) der Planetenräder (18) entfernen.
- ESP** Remover los anillos elásticos (16) de los dos pernos (17) de los engranajes satélites (18).
- F** Enlever les anneaux élastiques (16) des tourillons (17) des engrenages satellites (18).

- b**
- ITA** Inserire tra gli ingranaggi satelliti (18) l'attrezzo T14.
- D** Zwischen den Planetenrädern (18) das Werkzeug T14 einsetzen.
- ESP** Introducir entre los engranajes satélites (18) la herramienta T14.
- F** Introduire entre les engrenages satellites (18) l'outil T14.

- c**
- ITA** Operando con due cacciaspine, forzare l'attrezzo T14 tra gli ingranaggi satelliti (18).  
**ATTENZIONE!** Controllare attentamente che l'attrezzo T14 rimanga allineato ai perni (17) quando è bloccato.
- D** Mit zwei Dübeln, das Werkzeug T14 zwischen den Planetenrädern (18) fest einsetzen.  
**ACHTUNG:** Sorgfältig darauf achten, daß das blockierte Werkzeug T14 mit den Stiften (17) fluchtgerecht ist.
- ESP** Trabajando con dos extractores de clavijas, forzar la herramienta T14 entre los engranajes satélite (18).  
**CUIDADO!** Controlar atentamente que la herramienta T14 quede alineada con los pernos (17) cuando está bloqueada.
- F** En oeuvrant avec deux chasse-goupilles, forcer l'outil T14 entre les engrenages satellites (18).  
**ATTENTION!** Contrôler attentivement si l'outil T14 reste aligné aux tourillons (17) quand il est bloqué.

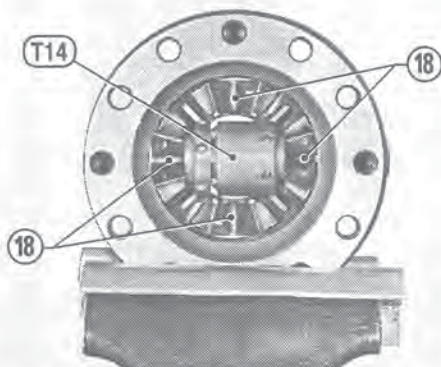
- d**
- ITA** Sistemare il corpo differenziale (15) sotto una pressa, posizionare la boccola T15 ed inserire lo spinotto T16A. Pressare lo spinotto T16A fino a fondo corsa.
- D** Das Differentialgehäuse (15) unter eine Presse legen und die Buchse T15 positionieren; Bolzen T16A einsetzen. Drücken, bis der Bolzen T16A.
- ESP** Colocar la caja del diferencial (15) debajo de una prensa; posicionar el casquillo T15 e introducir la cruceta T16A. Presionar la cruceta T16A.
- F** Ajuster le boîtier différentiel (15) sous la presse, placer la bague T15 et introduire le goujon T16A. Presser le goujon T16A.

- e**
- ITA** Asportare lo spinotto T16A e la bussola T15.  
**NOTA.** In questa condizione, il perno (17) è contenuto nell'attrezzo T14.
- D** Bolzen T16A und die Buchse T15 abnehmen.  
**BEMERKUNG.** In diesem Zustand, ist der Stift (17) im Werkzeug T14 enthalten.
- ESP** Sacar la cruceta T16A y el manguito T15.  
**NOTA.** En esta condición el perno (17) se encuentra en la herramienta T14.
- F** Enlever le goujon T16A et la douille T15.  
**NOTE.** Dans cette condition le tourillon (17) se trouve dans l'outil T14.

- f**
- ITA** Rimuovere l'attrezzo T14 e con esso il perno (17) del satellite.
- D** Das Werkzeug T14 und damit den Stift (17) des Planetenrades abnehmen.
- ESP** Remover la herramienta T14 y con ella el perno (17) del satélite.
- F** Enlever l'outil T14 et, avec ce dernier, le tourillon (17) du satellite.



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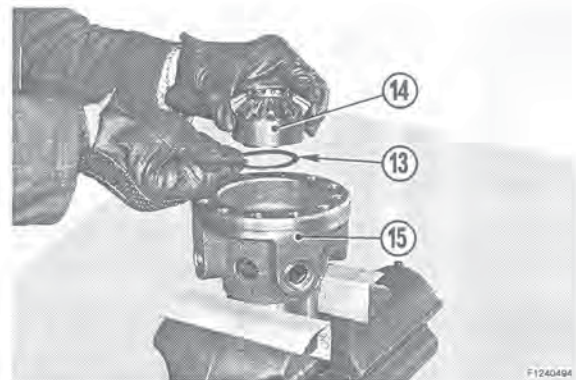
F1240400



**GB**

**a**

Leave the released planetary gear in position and again lock tool T14.  
Repeat the operations for the extraction of the pin of the 2<sup>nd</sup> planet wheel (17).  
Repeat the operations for all other pins.



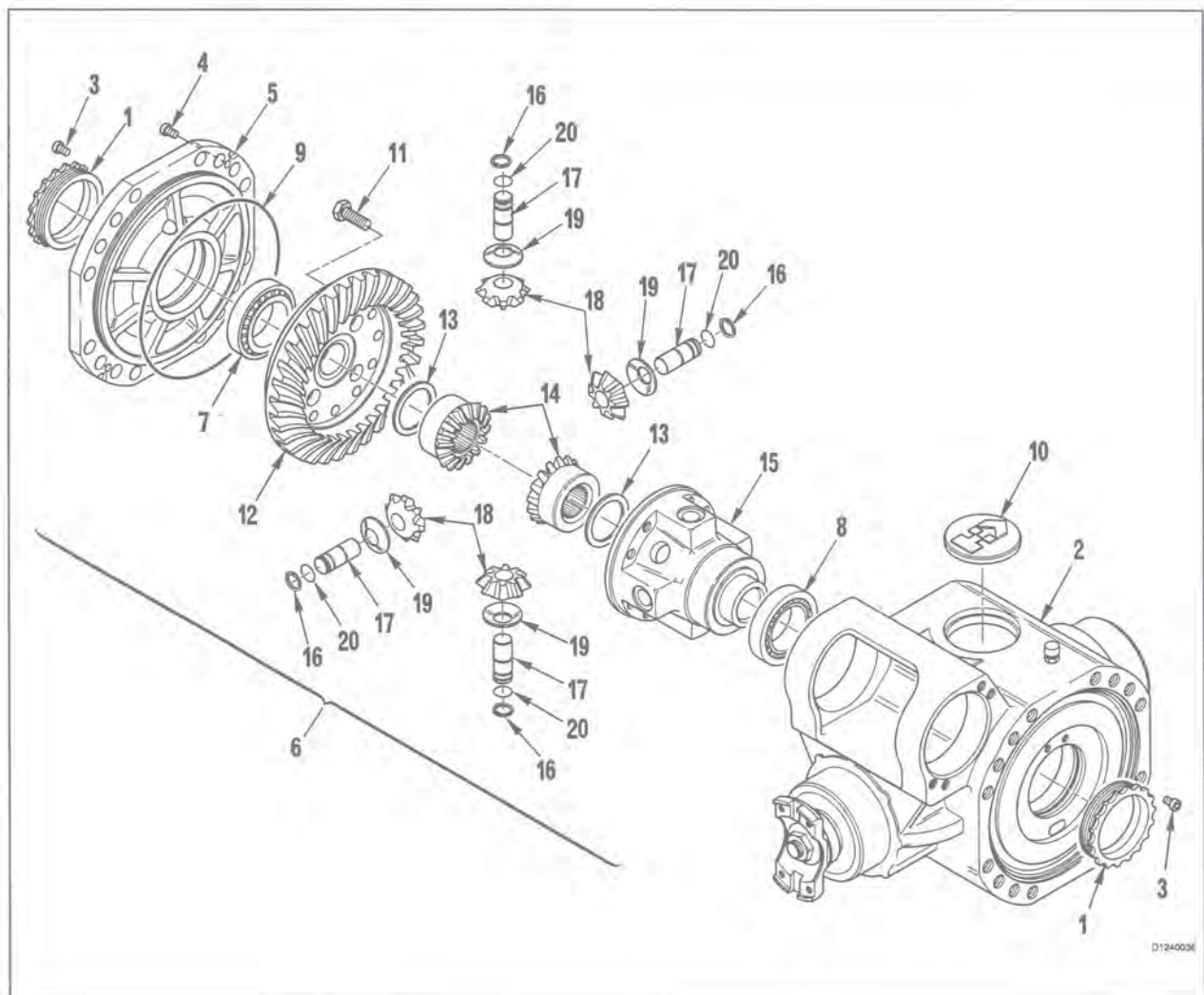
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**GB**

**b**

Remove tool T14 and remove the last two planet wheel gears (18), the 2<sup>nd</sup> differential unit gear (14) and the relative shim washer (13) from the differential carrier.



D1240036





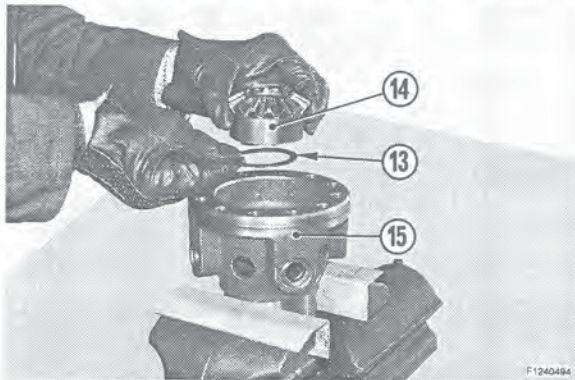
- a**
- ITA** Lasciando in posizione l'ingranaggio satellite che si è liberato, bloccare nuovamente l'attrezzo T14.  
Ripetere le operazioni di estrazione del perno del secondo perno satellite (17).  
Ripetere le operazioni per gli altri perni.
- D** Das nun freie Planetenrad in seiner Position lassen und das Werkzeug T14 wieder blockieren.  
Die Vorgänge für das Herausnehmen des Stiftes des 2. Planetenrades (17) wiederholen.  
Die Vorgänge auch für die anderen Stifte wiederholen.
- ESP** Dejando en posición el engranaje satélite que ha quedado libre, bloquear otra vez la herramienta T14.  
Repetir las operaciones de extracción del perno del segundo perno satélite (17).  
Repetir las operaciones con los demás pernos.
- F** En maintenant la position de l'engrenage satellite dégagé, bloquer de nouveau l'outil T14.  
Répéter les opérations d'extraction du tourillon du 2<sup>e</sup> satellite (17).  
Répéter les opérations pour les autres tourillons.

- b**
- ITA** Rimuovere l'attrezzo T14 ed asportare dal corpo differenziale gli ultimi due ingranaggi satelliti (18), il 2° ingranaggio planetario (14) e la relativa rondella di rasamento (13).
- D** Werkzeug T14 entfernen und vom Differentialgehäuse die letzten beiden Planetenräder (18), das 2. Differentialrad (14) und die Zwischenlegscheibe (13) abnehmen.
- ESP** Remover la herramienta T14 y sacar de la caja del diferencial los últimos dos engranajes satélite (18), el 2° engranaje diferencial (14) y la arandela de espesor correspondiente (13).
- F** Enlever l'outil T14 et extraire du boîtier différentiel les deux derniers engrenages satellites (18), le 2° engrenage du différentiel (14) et la relative rondelle de rasage (13).



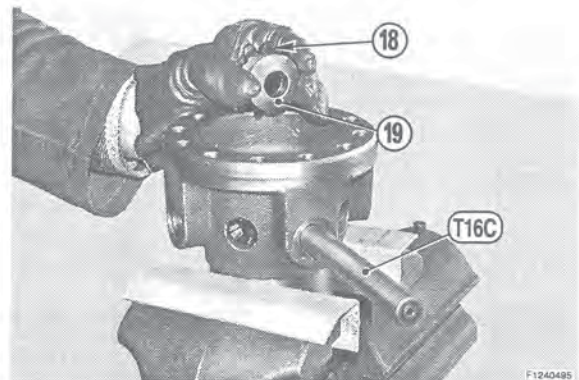
**HOW TO ASSEMBLE AND INSTALL THE DIFFERENTIAL UNIT - ASSEMBLAGGIO ED INSTALLAZIONE GRUPPO DIFFERENZIALE - DIFFERENTIALAGGREGAT MONTIEREN UND INSTALLIEREN - MONTAJE E INSTALACION DEL GRUPO DIFERENCIAL - ASSEMBLAGE ET INSTALLATION DU GROUPE DIFFERENTIEL**

**ASSEMBLING - ASSEMBLAGGIO - MONTIEREN - MONTAJE - MONTAGE**



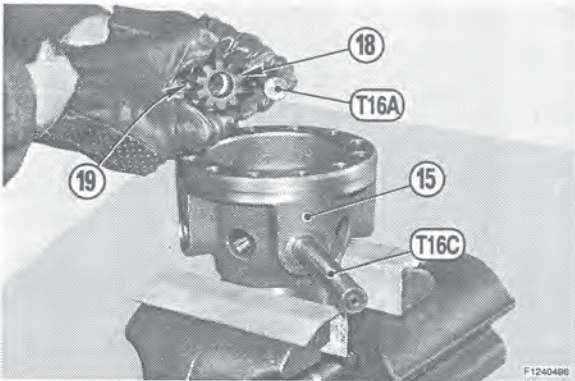
**GB** **a**

Insert the shim washer (13) and the planetary gear (14) in the differential carrier (15).



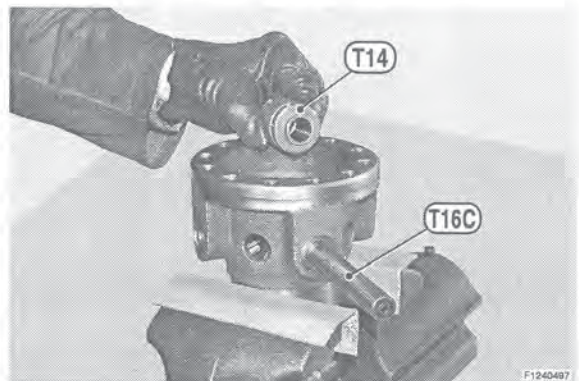
**GB** **b**

Position the shim washer (19) and the first planet wheel gear (18). Hold them in position using bar T16C.



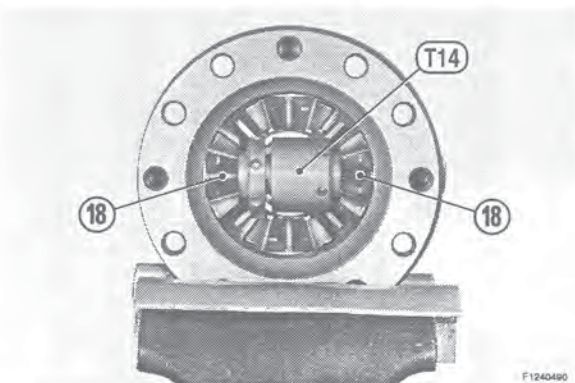
**GB** **c**

With the help of gudgeon T16A, position the second planet wheel gear (18) and the relative shim washer (19).



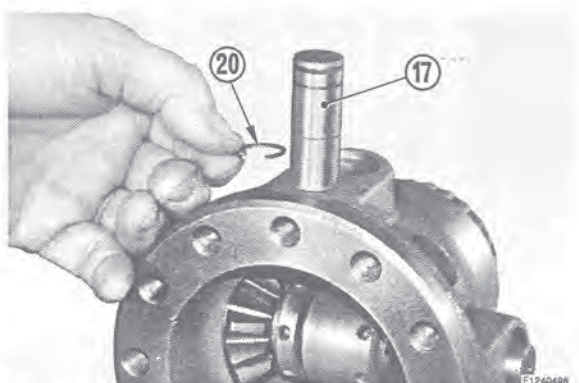
**GB** **d**

Insert tool T14 between the two planetary gears (18). Line up the entire unit by pushing bar T16C all the way down until gudgeon T16A is ejected.



**GB** **e**

Lock tool T14 behind the planet wheel gears (18). After locking, remove bar T16C.



**GB** **f**

Fit the snap rings (20) onto the pins (17).



- a**
- ITA** Inserire nel corpo differenziale (15), la rondella di rasamento (13) e l'ingranaggio planetario (14).
- D** Das Differentialgehäuse (15), die Zwischenlegscheibe (13) und das Planetenrad (14) einsetzen.
- ESP** Introducir en la caja del diferencial (15) la arandela de espesor (13) y el engranaje planetario (14).
- F** Introduire, dans le boîtier du différentiel (15), la rondelle de rasage (13) et l'engrenage planétaire (14).

- c**
- ITA** Utilizzando lo spinotto **T16A**, posizionare il secondo ingranaggio satellite (18) e la relativa rondella di rasamento (19).
- D** Mit dem Bolzen **T16A** das zweite Planetenrad (18) und die entsprechende Zwischenlegscheibe (19) positionieren.
- ESP** Utilizando la cruceta **T16A**, posicionar el segundo engranaje satélite (18) y la arandela de espesor correspondiente (19).
- F** A l'aide du goujon **T16A** placer le second engrenage satellite (18) et sa relative rondelle de rasage (19).

- e**
- ITA** Bloccare l'attrezzo **T14** a ridosso degli ingranaggi satelliti (18). Dopo il bloccaggio, rimuovere la barra **T16C**.
- D** Werkzeug **T14** an den Planetenrädern (18) anliegend, blockieren. Danach Stab **T16C** entfernen.
- ESP** Bloquear la herramienta **T14** detrás de los engranajes satélite (18). Después de bloquearlos, remover la barra **T16C**.
- F** Bloquer l'outil **T14** à l'abri des engrenages satellites (18). Après avoir bloqué, enlever la barre **T16C**.

- b**
- ITA** Posizionare la rondella di rasamento (19), il primo ingranaggio satellite (18). Tenerli in posizione con la barra **T16C**.
- D** Die Zwischenlegscheibe (19) und das erste Planetenrad (18) positionieren. Mit dem Stab **T16C** diese in ihrer Position halten.
- ESP** Posicionar la arandela de espesor (19), el primer engranaje satélite (18). Mantenerlos en posición por medio de la barra **T16C**.
- F** Placer la rondelle de rasage (19) et le premier engrenage satellite (18). Maintenir ceux-ci en place à l'aide de la barre **T16C**.

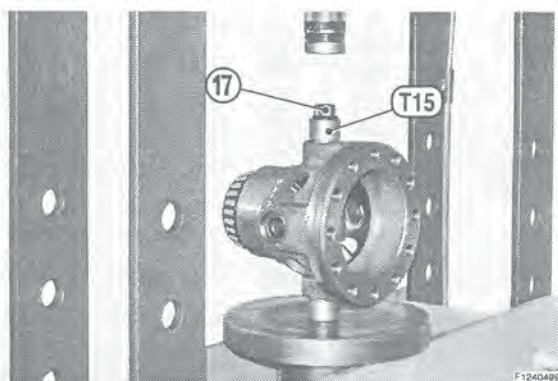
- d**
- ITA** Inserire tra i due ingranaggi satelliti (18) l'attrezzo **T14**. Allineare tutto il gruppo inserendo a fondo la barra **T16C** fino ad espellere lo spinotto **T16A**.
- D** Zwischen den beiden Planetenrädern (18) das Werkzeug **T14** einsetzen. Das gesamte Aggregat fluchten; dazu den Stab **T16C** ganz einschieben bis die Bolzen **T16A** herausgestoßen worden sind.
- ESP** Introducir entre los dos engranajes satélite (18) la herramienta **T14**. Alinear todo el grupo introduciendo a fondo la barra **T16C** hasta expulsar la cruceta **T16A**.
- F** Introduire entre les deux engrenages satellites (18) l'outil **T14**. Aligner tout le groupe en insérant à fond la barre **T16C** jusqu'à éjecter le goujon **T16A**.

- f**
- ITA** Montare sui perni (17) gli anelli elastici (20).
- D** Auf die Stifte (17) die Kolbenringe (20) montieren.
- ESP** Montar en los pernos (17) los anillos elásticos (20).
- F** Monter sur les tourillons (17) les anneaux élastiques (20).

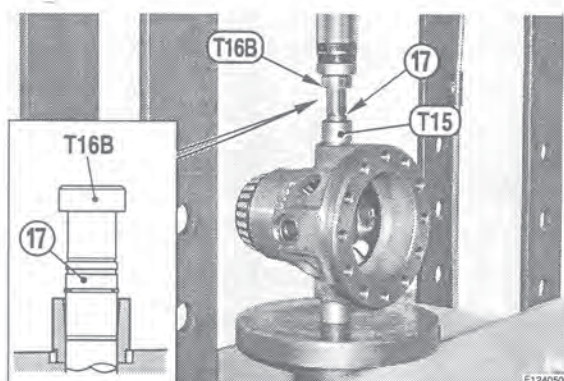




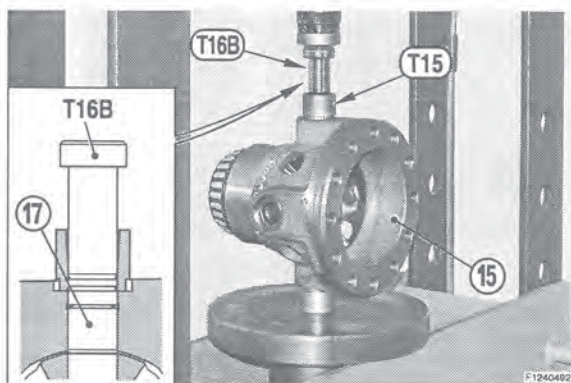
HOW TO ASSEMBLE AND INSTALL THE DIFFERENTIAL UNIT - ASSEMBLAGGIO ED INSTALLAZIONE GRUPPO DIFFERENZIALE -  
DIFFERENTIALAGGREGAT MONTIEREN UND INSTALLIEREN - MONTAJE E INSTALACION DEL GRUPO DIFERENCIAL -  
ASSEMBLAGE ET INSTALLATION DU GROUPE DIFFERENTIEL



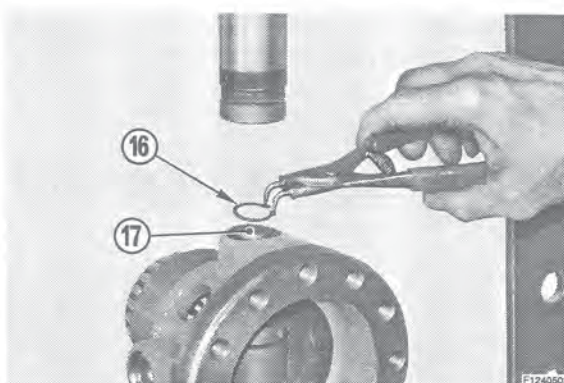
Place the differential carrier (15) under the press, position bush T15 and insert the planet wheel pin (17).



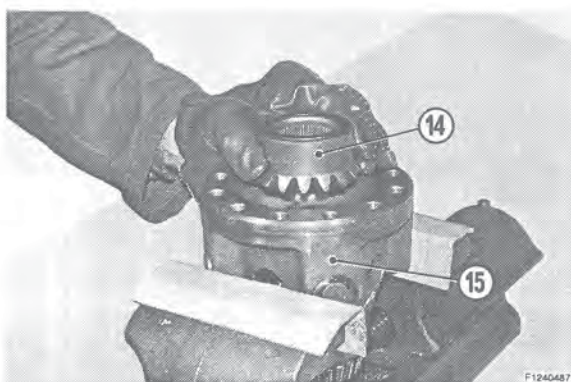
Put gudgeon T16B on top of the planet wheel pin (17).



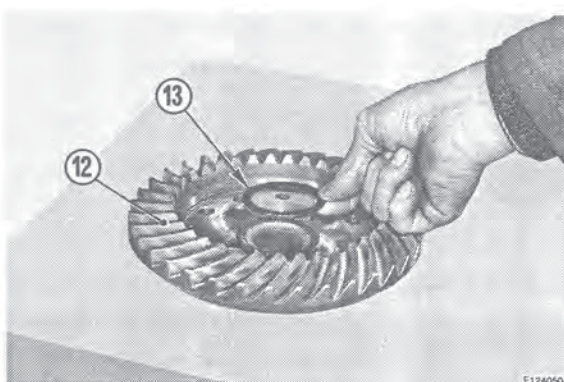
Press T16B pin all the way down.



Remove gudgeon T16B, bush T15 and fit the snap ring (16) on the pin (17).  
**CAUTION!** Make sure that the snap ring centres the seat and that it rests on the surface of the differential carrier.  
Repeat the operations on the other planet wheel pin or planet wheel axle.



Position the second planetary gear (14) in the differential carrier (15).



Position the shim washer (13) on the crown (12).  
**NOTE.** In order to hold the shim washer (13) in position, apply grease to it.



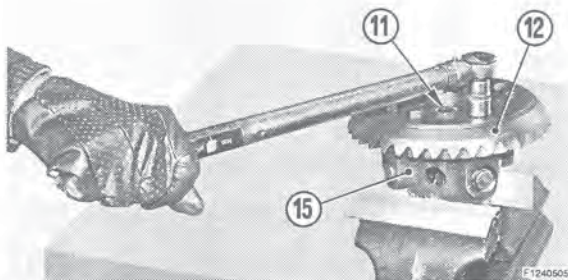


SPICER CLARK-HURTH

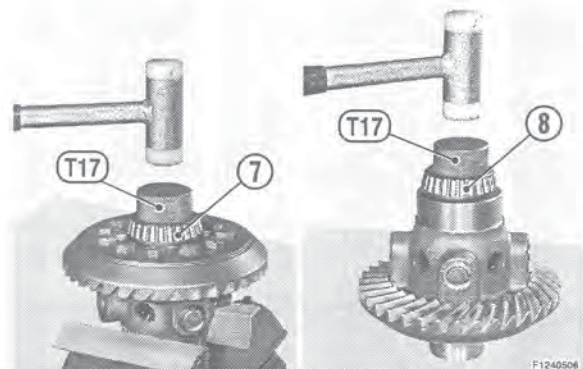
- a**
- ITA** Posizionare sotto la pressa il corpo differenziale (15), sistemare la boccia T15 ed inserire il perno satellite (17).
- D** Unter der Presse das Differentialgehäuse (15) positionieren, die Buchse T15 anbringen und den Planetenradstift (17) einsetzen.
- ESP** Posicionar debajo de la prensa la caja del diferencial (15), colocar el casquillo T15 e introducir el engranaje satélite (17).
- F** Placer sous la presse le boîtier différentiel (15), ajuster la bague T15 et introduire le tourillon satellite (17).
- b**
- ITA** Sovrapporre al perno satellite (17) lo spinotto T16B.
- D** Über den Planetenradstift (17) den Bolzen T16B anbringen.
- ESP** Superponer al perno satélite (17) la cruceta T16B.
- F** Juxtaposer sur le tourillon satellite (17) le goujon T16B.
- c**
- ITA** Pressare lo spinotto T16B a fondo.
- D** Den Stift T16B fest hinein drücken.
- ESP** Apretar la cruceta T16B a fondo.
- F** Presser à fond sur l'axe T16B.
- d**
- ITA** Rimuovere lo spinotto T16B, la boccia T15 e montare sul perno (17) l'anello elastico (16).  
**ATTENZIONE!** Assicurarsi che l'anello elastico centri la sede e che appoggi sul piano del corpo differenziale. Ripetere le operazioni per l'altro perno satellite e per l'altro asse satelliti.
- D** Bolzen T16B, Buchse T15 entfernen und auf den Stift (17) den Kolbenring (16) montieren.  
**ACHTUNG!** Der Kolbenring muß im Sitz zentriert sein und an der Fläche des Differentialgehäuses anliegen. Dieselben Vorgänge für den anderen Planetenradstift und die andere Planetenradachse wiederholen.
- ESP** Remover la cruceta T16B, el casquillo T15 y montar en el perno (17) el anillo elástico (16).  
**CUIDADO!** Asegurarse de que el anillo elástico esté centrado en el alojamiento y que esté apoyado en la superficie de la caja del diferencial. Repetir las operaciones en el otro perno satélite y en el otro eje satélite.
- F** Enlever le goujon T16B de la douille T15 puis monter sur le tourillon (17) l'anneau élastique (16).  
**ATTENTION!** S'assurer que l'anneau élastique est bien centré dans son logement et qu'il repose sur le plan du boîtier différentiel. Répéter ces mêmes opérations pour l'autre tourillon satellite et pour l'autre axe satellites.
- e**
- ITA** Posizionare il secondo ingranaggio planetario (14) nel corpo differenziale (15).
- D** Das zweite Planetenrad (14) im Differentialkörper (15) positionieren.
- ESP** Posicionar el segundo engranaje planetario (14) en el cuerpo del diferencial (15).
- F** Placer le second engrenage planétaire (14) dans le corps différentiel (15).
- f**
- ITA** Posizionare la rondella di rasamento (13) sulla corona (12).  
**NOTA.** Per mantenere la posizione, spalmare la rondella di rasamento (13) con grasso.
- D** Zwischenlegscheibe (13) auf den Kranz (12) positionieren.  
**BEMERKUNG.** Um die Position zu sichern, die Zwischenlegscheibe (13) mit Fett einschmieren.
- ESP** Posicionar la arandela de espesor (13) en la corona (12).  
**NOTA.** Para mantener la posición, pasar grasa en la arandela de espesor (13).
- F** Placer la rondelle de rasage (13) sur la couronne (12).  
**NOTE.** Pour maintenir cette position, enduire la rondelle de rasage (13) avec du gras.



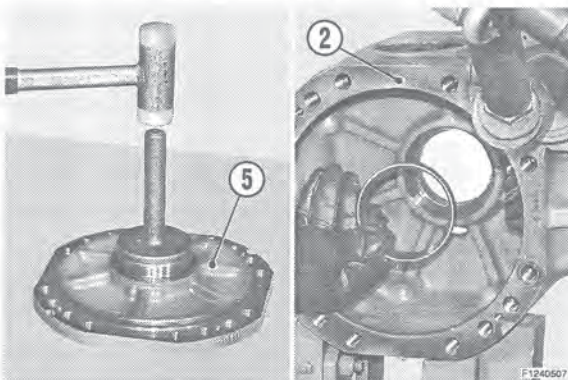
HOW TO ASSEMBLE AND INSTALL THE DIFFERENTIAL UNIT - ASSEMBLAGGIO ED INSTALLAZIONE GRUPPO DIFFERENZIALE -  
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Position the crown (12) on the differential carrier (15) and lock it with screws (11) applied with Loctite 242.  
Torque wrench setting for screws: 128–142 Nm  
**NOTE.** Secure the screws using the cross-tightening method.

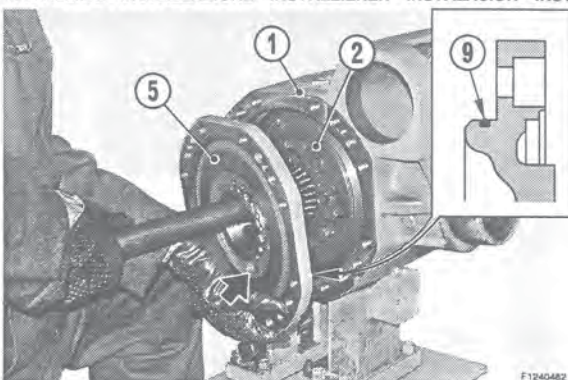


Install the bearings (7) and (8) using tool T17.

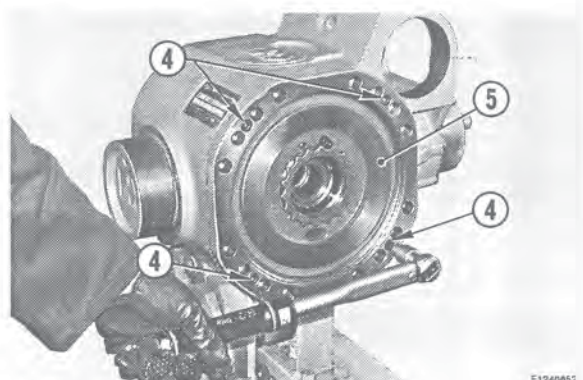


If the bearings are replaced, insert the external thrust blocks in the middle cover (5) and in the central body (2).

INSTALLING - INSTALLAZIONE - INSTALLIEREN - INSTALACION - INSTALLATION



Position the differential unit (6) in the central body (2) with the help of a bar and fit the middle cover (5).  
**NOTE.** Thoroughly check the state of the O-ring (9) and make sure that the cover is fitted with the oil discharge in the lower position.



Lock the middle cover (5) with screws (4).  
Torque wrench setting for screw: 23.8–26.2 Nm





**ITA**

Posizionare la corona (12) sul corpo differenziale (15) e bloccarla con le viti (11) spalmate con Loctite 242. Coppia di serraggio viti: 128÷142 Nm

**NOTA.** Serrare le viti con il metodo del serraggio incrociato.

**D**

Den Kranz (12) auf den Differentialkörper (15) positionieren und mit den Schrauben (11) blockieren. Anzugsmoment der Schrauben: 128÷142 Nm

**a**

**BEMERKUNG.** Die Schrauben abwechselnd und entgegengesetzt festschrauben.

**ESP**

Posicionar la corona (12) en el cuerpo del diferencial (15) y bloquearla con los tornillos (11) pasarles Loctite 242.

Par de torsión: 128÷142 Nm

**NOTA.** Apretar los tornillos con el método de torsión cruzado.

**F**

Placer la couronne (12) sur le corps du différentiel (15) puis bloquer avec les vis (11) enduites avec Loctite 242.

Couple de serrage des vis: 128÷142 Nm.

**NOTE.** Serrer les vis par le biais du mode de serrage croisé.

**ITA**

Utilizzando l'attrezzo T17, montare i cuscinetti (7) e (8).

**D**

Mit dem Werkzeug T17 die Lager (7) und (8) montieren.

**b**

**ESP**

Utilizando la herramienta T17, montar los cojinetes (7) y (8).

**F**

A l'aide de l'outil T17 monter les paliers (7) et (8).

**ITA**

Se vengono sostituiti i cuscinetti, inserire nel coperchio intermedio (5) e nel corpo centrale (2) le ralle esterne.

**D**

Falls die Lager ausgewechselt werden sollen, in den mittleren Deckel (5) und in den zentralen Körper (2) die äußeren Scheiben einsetzen.

**c**

**ESP**

Si se sustituyen los cojinetes, introducir en la tapa intermedia (5) y en el cuerpo central (2) las ranguas exteriores.

**F**

Si les paliers doivent être remplacés, introduire dans le couvercle intermédiaire (5) et, dans le corps central (2), les crapaudines externes.

**ITA**

Utilizzando una barra, posizionare il gruppo differenziale (6) nel corpo centrale (2) e montare il coperchio intermedio (5).

**NOTA.** Controllare attentamente la condizione dell'anello OR (9) e che il coperchio venga montato con lo scarico olio nella posizione inferiore.

**D**

Mit einem Stab das Differentialaggregat (6) in den zentralen Körper (2) positionieren und den mittleren Deckel (5) montieren.

**e**

**BEMERKUNG.** Sorgfältig den Zustand des O-Ringes (9) kontrollieren und sicherstellen, daß der Deckel mit dem Ölablaßstopfen nach unten gerichtet montiert wird.

**ESP**

Utilizando una barra, posicionar el grupo diferencial (6) en el cuerpo central (2) y montar la tapa intermedia (5).

**NOTA.** Controlar atentamente las condiciones del segmento OR (9) y que la tapa venga montada con el descarge aceite en la posición inferior.

**F**

A l'aide d'une barre, placer le groupe différentiel (6) dans le corps central (2) et monter le couvercle intermédiaire (5).

**NOTE.** Contrôler attentivement les conditions de l'anneau torique (9) et que le couvercle soit monté avec le bouchon de vidange pour l'huile dans la position inférieure.

**ITA**

Bloccare il coperchio intermedio (5) con le viti (4). Coppia di serraggio viti: 23,8÷26,2 Nm

**D**

Mit den Schrauben (4) blockieren den mittleren Deckel (5). Anzugsmoment der Schrauben: 23,8÷26,2 Nm

**f**

**ESP**

Bloquear la tapa intermedia (5) con los tornillos (4). Par de torsión tornillos: 23,8÷26,2 Nm

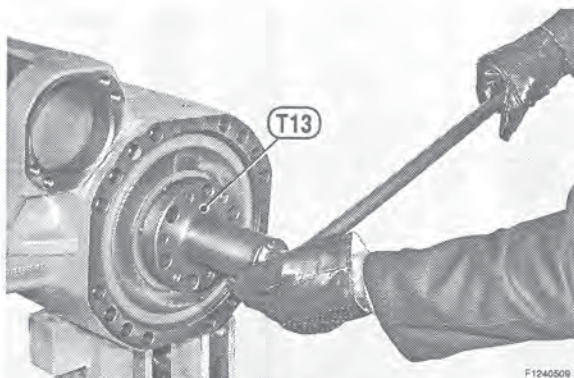
**F**

Bloquer le couvercle intermédiaire (5) dernier avec les vis (4). Couple de serrage des vis: 23,8÷26,2 Nm





HOW TO ASSEMBLE AND INSTALL THE DIFFERENTIAL UNIT - ASSEMBLAGGIO ED INSTALLAZIONE GRUPPO DIFFERENZIALE -  
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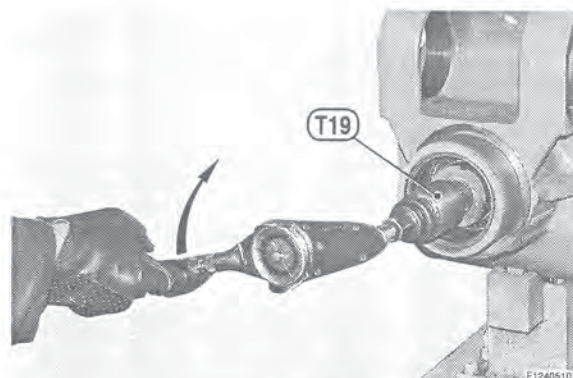


F1240509



**NOTE.** If the ring nuts (1) are removed, spread them with Loctite 242.

Tighten ring nuts on the crown side until clearance between pinion and crown is zero, then lock the crown; go back  $1/4 \div 1/2$  turn.

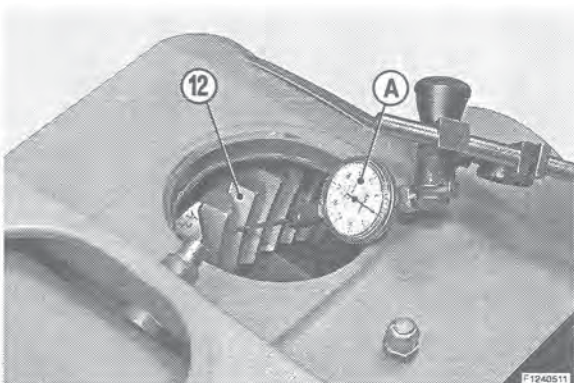


F1240510



Pre-set the bearings by means of the ring nut situated on the opposite side of the crown, so as to increase pinion torque up to  $140 \div 210$  Ncm.

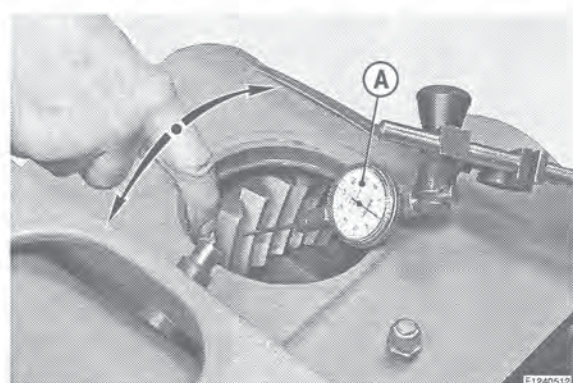
**CAUTION!** If bearings are not new, check the static torque; if bearings are new, check the continuous torque.



F1240511



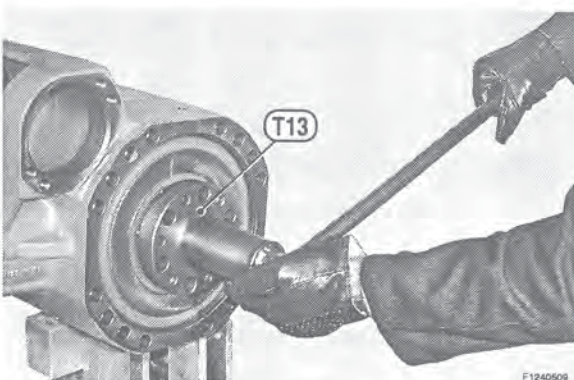
Introduce a comparator with rotary key "A" through the top plug hole (10). Position the comparator on the centre of one of the teeth of the crown (12), pre-set it to 1mm and reset it.



F1240512



Manually move the crown (12) in both directions in order to check the existing backlash between the pinion and the crown.



F1240509



Adjust the backlash between the pinion and the crown by unloosening one of the ring nuts (1) and tightening the opposite to compensate.  
Normal backlash: see table.

| RATIO - RAPPORTO<br>VERHÄLTNIS<br>RAPORTE - RAPPORT | CLEARANCE - GIOCO - SPIEL<br>JUEGO - JEU |      |
|-----------------------------------------------------|------------------------------------------|------|
|                                                     | MIN.                                     | MAX. |
| 9 ÷ 34                                              | 0,18                                     | 0,23 |
| 9 ÷ 35                                              | 0,13                                     | 0,18 |
| 11 ÷ 31                                             | 0,20                                     | 0,28 |
| 11 ÷ 35                                             | 0,13                                     | 0,18 |
| 12 ÷ 35                                             | 0,13                                     | 0,18 |
| 12 ÷ 41                                             | 0,15                                     | 0,20 |
| 14 ÷ 32                                             | 0,18                                     | 0,23 |
| 14 ÷ 36                                             | 0,15                                     | 0,20 |
| 14 ÷ 41                                             | 0,15                                     | 0,20 |
| 15 ÷ 32                                             | 0,18                                     | 0,23 |
| 15 ÷ 47                                             | 0,13                                     | 0,18 |

Difference between MIN and MAX clearance for whole circumference should not exceed 0,09 mm.

La differenza tra gioco MIN e MAX rilevata sull'intera circonferenza non deve superare il valore di 0,09 mm.

Der Unterschied zwischen dem MIN e MAX Spiel der gesamten Kreislinie darf den Wert von 0,09 mm nicht überschreiten.

La diferencia entre el juego Min y Max determinada sobre la entera circunferencia no debe de superar el valor de 0,09 mm.

La différence de jeu entre MIN et MAX relevée sur toute la circonférence ne doit pas aller au-delà de la valeur de 0,09 mm.





ITA

**NOTA.** Se le ghiera (1) vengono rimosse, spalmarle con Loctite 242.  
Serrare le ghiera dal lato corona fino ad azzerare i giochi tra pignone e corona e bloccarla; ritornare indietro di circa  $1/4 \div 1/2$  giro.

D

**BEMERKUNG.** Wenn die Nutmutter (1) ausgewechselt werden, diese mit Loctite 242 schmieren.  
Nutmutter an der Kranzseite fest ziehen bis kein Spiel mehr zwischen Rad und Kranz übrig bleibt; danach um  $1/4 \div 1/2$  Umdrehung wieder aufschrauben.

a

ESP

**NOTA.** Si se remueven las virolas (1) pasarles Loctite 242.  
Apertar las virolas del lado corona hasta acerar los juegos entre el pinon y la corona y bloquearla, volver atras de  $1/4 \div 1/2$  giro approx.

F

**NOTE.** Si les anneaux (1) sont enlevés, les enduire avec du Loctite 242.  
Serrer les anneaux de fixation du côté couronne jusqu'à mettre à zéro les jeux entre pignon et couronne et bloquer; revenir en arrière d'environ  $1/4 \div 1/2$  tour.

ITA

Precaricare i cuscinetti tramite la ghiera lato opposto corona per incrementare la coppia di rotazione pignone fino a  $140 \div 210$  Ncm.

**ATTENZIONE!** Con cuscinetti usati, controllare la coppia di spunto; con cuscinetti nuovi, controllare la coppia di rotazione continua.

D

Lager durch die Nutmutter an der dem Kranz entgegengesetzten Seite vorladen, um das Gegenmoment des Rades auf  $140 \div 210$  Ncm zu bringen.

b

**ACHTUNG!** Bei verbrauchten Lagern, das Anlaufdrehmoment kontrollieren; bei neuen Lagern, das kontinuierliche Drehmoment kontrollieren.

ESP

Precargar los cojinetes a través la virola lado opuesto corona para incrementar el par de rotación pinon hasta  $140 \div 210$  Ncm.

**CUIDADO!** Con cojinetes usados, controlar el par de inicio, con cojinetes nuevos, controlar el par de rotación continua.

F

Précharger les paliers au moyen d'anneaux de fixation du côté opposé de la couronne pour augmenter le couple de rotation pignon jusqu'à  $140 \div 210$  Ncm.

**ATTENTION!** Avec les paliers usés, contrôler le couple de pointe; avec les paliers neufs, contrôler le couple de rotation continu.

ITA

Posizionare, attraverso il foro per il tappo superiore (10), un comparatore a tasto orientabile "A".  
Posizionarlo sul centro di un dente della corona (12), precaricarlo di circa 1 mm ed azzerarlo.

D

Durch das Loch des oberen Stopfens (10) eine schwenkbare Meßuhr "A" in der Mitte eine Kranzzahnes (12) anbringen. Die Meßuhr auf 1 mm vorladen und auf Null stellen.

c

ESP

Posicionar, a través del orificio para el tapón superior (10), un comparador de tecla orientable "A".  
Posicionarlo en el centro de un diente de la corona (12), precargarlo de aproximadamente 1 mm y ponerlo a cero.

F

Placer, par le trou du bouchon supérieur (10), un comparateur à touche orientable "A".  
Placer ce dernier au centre d'une dent de la couronne (12), précharger d'environ 1 mm, puis le mettre à zéro.

ITA

Muovere manualmente nei due sensi la corona (12) per controllare il gioco esistente tra pignone e corona.

D

Den Kranz (12) von Hand in beide Richtungen bewegen und das Spiel zwischen Rad und Kranz prüfen.

d

ESP

Mover manualmente en los dos sentidos la corona (12) para controlar el juego que hay entre el piñón y la corona.

F

Déplacer la couronne (12) manuellement dans les deux sens pour contrôler le jeu existant entre pignon et couronne.

ITA

Regolare il gioco tra pignone e corona allentando una ghiera (1) e serrando la ghiera opposta in egual misura.  
Gioco normale: vedere tabella.

D

Das Spiel zwischen Rad und Kranz einstellen; dazu eine Nutmutter (1) lockern und die entgegengesetzte Nutmutter auf dieselbe Weise zuschrauben.  
Normales Spiel: siehe Tabelle.

e

ESP

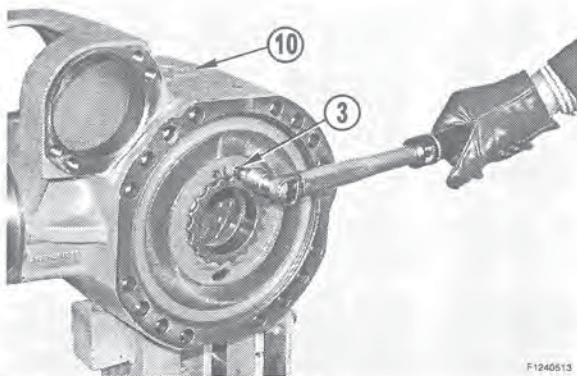
Regular el juego entre el piñón y la corona aflojando una virola (1) y apertando la virola opuesta en la misma medida.  
Juego normal: véase la tabla.

F

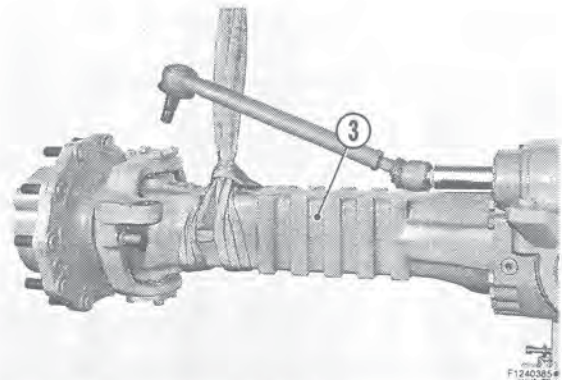
Régler le jeu entre pignon et couronne en desserrant un collier de serrage (1) puis en serrant le collier de serrage opposé avec la même mesure de jeu.  
Jeu normal: voir tableau.



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Apply Loctite 242 to the screws (3), fit them into one of the two holes and tighten.  
Torque wrench setting: 23.8–26.2 Nm  
Fit the top plug (10) after applying repositionable jointing compound for seals to the rims.



Re-install the complete arms.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS».



SPICER CLARK-HURTH

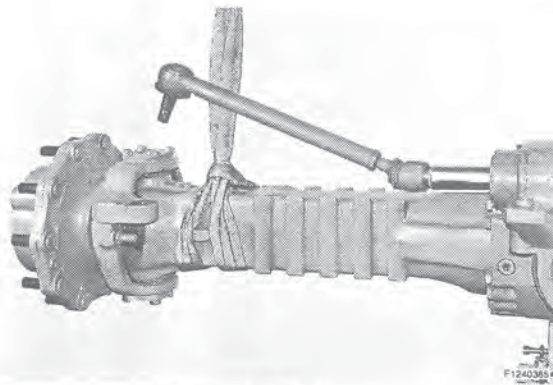
- a**
- ITA** Spalmare le viti (3) con Loctite 242 ed avvitarle in uno dei due fori predisposti.  
Coppia di serraggio: 23,8÷26,2 Nm  
Montare il tappo superiore (10) dopo aver spalmato i bordi con mastice per guarnizioni riposizionabile.
- D** Die Schrauben (3) mit Loctite 242 schmieren und in eines der beiden vorgesehenen Löcher schrauben.  
Anzugsmoment: 23,8÷26,2 Nm  
Die Ränder des oberen Stopfens (10) mit Klebstoff für verstellbare Dichtungen schmieren und den Stopfen montieren.
- ESP** Pasar Loctite 242 en los tornillos (3) y atornillarlos en uno de los dos orificios predispuestos.  
Par de torsión: 23,8÷26,2 Nm  
Montar el tapón superior (10) después de repasar los bordes con pasta para juntas reposicionable.
- F** Enduire les vis (3) avec du Loctite 242, puis visser celles-ci dans l'un des deux trous prédisposés.  
Couple de serrage: 23,8÷26,2 Nm  
Monter le bouchon supérieur (10) après avoir enduit les bords avec mastic pour garnitures à remettre en place.

- b**
- ITA** Rimontare i bracci completi.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Die beiden kompletten Arme montieren.  
Siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Volver a montar los brazos completos.  
Para los detalles, véase «CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO».
- F** Remonter les bras complets.  
Pour de plus amples détails, voir «CONTROLE USURE ET SUBSTITUTION DES DISQUES DE FREINAGE».





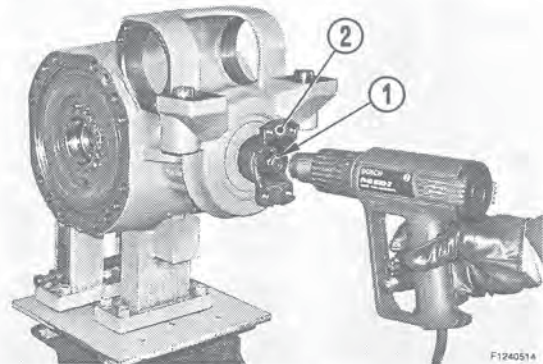
HOW TO REMOVE THE BEVEL PINION - RIMOZIONE PIGNONE CONICO - KEGELRAD ABMONTIEREN -  
REMOCION PIÑÓN CONICO - DEPOSE DU PIGNON CONIQUE



GB

a

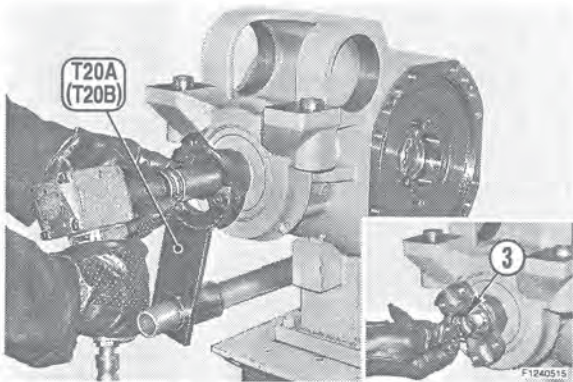
Remove the complete arms and the differential unit.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS» and «REMOVING THE DIFFERENTIAL UNIT».



GB

b

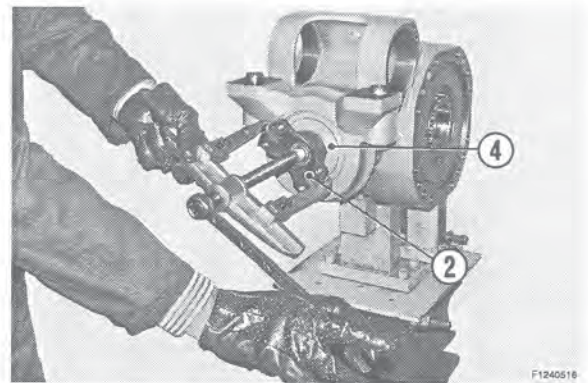
If disassembly is awkward, heat the check nut (1) of the flange (2) at 80°C.  
**NOTE.** Heating is meant to unloose the setting of Loctite on the nut (1).



GB

c

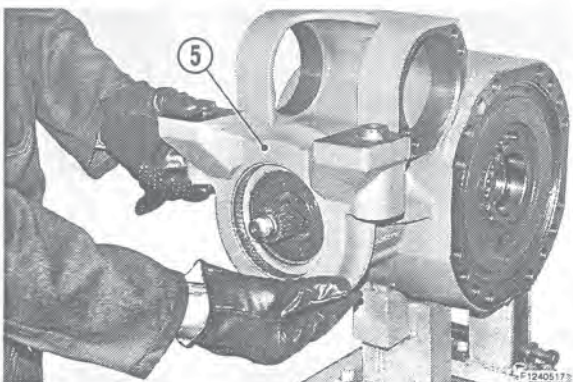
Position tool T20A (or T20B), so as to avoid pinion rotation.  
Unloose and remove the nut (1); also remove the C-ring (3).



GB

d

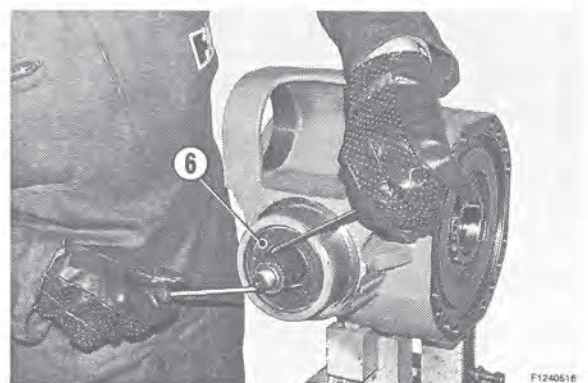
Remove the flange (2) complete with guard (4) by means of a puller.



GB

e

Remove the swinging support (5).



GB

f

Remove the sealing ring (6).





SPICER CLARK-HURTH

**ITA** Rimuovere i bracci completi ed il differenziale.  
Per i dettagli, vedere «CONTROLLO USURA E  
SOSTITUZIONE DISCHI FRENO» e «RIMOZIONE  
GRUPPO DIFFERENZIALE».

**D** Komplette Arme und Differential abnehmen.  
Siehe «VERSCHLEISS KONTROLLIEREN UND  
BREMSSCHEIBEN AUSWECHSELN» und «DIFFE-  
RENTIALAGGREGAT ABMONTIEREN».

**ESP** Remover los brazos completos y el diferencial.  
Para los detalles véase «CONTROL DESGASTE Y  
SUSTITUCION DE LOS DISCOS DEL FRENO» y  
«REMOCION GRUPO DIFERENCIAL».

**F** Enlever complètement les bras complets et le diffé-  
rentiel.  
Pour de plus amples détails, voir «CONTROLE  
USURE ET SUBSTITUTION DES DISQUES DE FREINAGE» et  
«DEPOSE DU GROUPE DIFFERENTIEL».

**ITA** Applicare l'attrezzo T20A (oppure T20B) ed impe-  
gnarlo in modo da evitare la rotazione del pignone.  
Allentare ed asportare il dado (1); asportare anche  
l'anello OR (3).

**D** Werkzeug T20A (T20B) so anbringen, daß das Rad  
nicht mehr drehen kann.  
Mutter (1) lockern und abschrauben; O-Ring (3)  
ebenfalls abnehmen.

**ESP** Aplicar la herramienta T20A (T20B) y bloquearla a fin  
de evitar la rotación del piñón.  
Aflojar y sacar la tuerca (1); sacar también el anillo OR  
(3).

**F** Appliquer l'outil T20A (ou T20B) engager ce dernier  
de manière à éviter la rotation du pignon.  
Relâcher et enlever l'écrou (1) enlever également la  
garniture OR (3).

**ITA** Rimuovere il supporto oscillante (5).

**D** Schwenkbare Halterung (5) entfernen.

**ESP** Remover el soporte oscilante (5).

**F** Enlever le support oscillant (5).

**ITA** Se lo smontaggio risulta faticoso, scaldare a circa  
80°C il dado (1) di rifegno della flangia (2).  
**NOTA.** Il riscaldamento ha lo scopo di allentare la  
presa del Loctite di bloccaggio del dado (1).

**D** Wenn das Abmontieren schwierig ist, die Mutter (1)  
zur Halterung des Flansches (2) auf ca. 80°C erwär-  
men.

**BEMERKUNG.** Durch das Erhitzen wird das Fett aufgeweicht, das  
die Mutter (1) blockiert.

**ESP** Si el desmontaje resulta difícil, calentar a unos 80°C la  
tuerca (1) de retención de la brida (2).  
**NOTA.** El calentamiento tiene la finalidad de aflojar la  
adhesión del Loctite de bloqueo de la tuerca (1).

**F** Si démonter est difficile, chauffer l'écrou (1) de fixation  
de la flasque (2) à environ 80°C.  
**NOTE.** Le chauffage a pour objet de ralentir la prise du  
Loctite de blocage de l'écrou (1).

**ITA** Utilizzando un estrattore, rimuovere la flangia (2)  
completa della protezione (4).

**D** Mit einem Abzieher, Flansch (2) samt Schutzteil (4)  
abnehmen.

**ESP** Utilizando un extractor, remover la brida (2) completa  
con la protección (4).

**F** A l'aide d'un extracteur, enlever la flasque (2)  
complète de la protection (4).

**ITA** Rimuovere l'anello di tenuta (6).

**D** Kolbenring (6) entfernen.

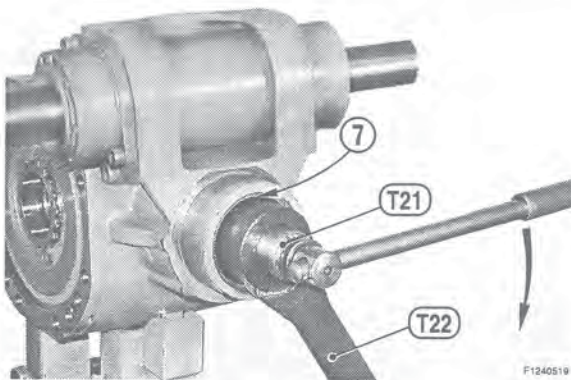
**ESP** Remover el segmento de compresión (6).

**F** Enlever la bague d'étanchéité (6).





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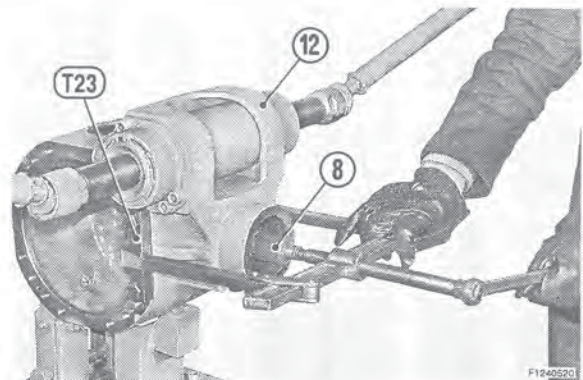


GB

a

Position wrench T22 onto the ring nut (7) and apply bar hold T21 to the pinion (8). Stop wrench T22 and rotate the pinion so as to release and remove the ring nut (7).

**NOTE.** If disassembly proves awkward, weld the ring nut at approx. 80°C.



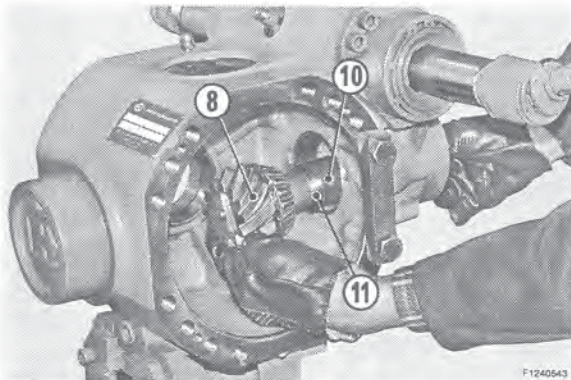
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GB

b

Apply blocks T23 and, with the help of a puller, extract the pinion (8) complete with the internal bearing (9), the distance piece (10) and shims (11).

**NOTE.** The thrust blocks of the bearings remain in the central body (12).



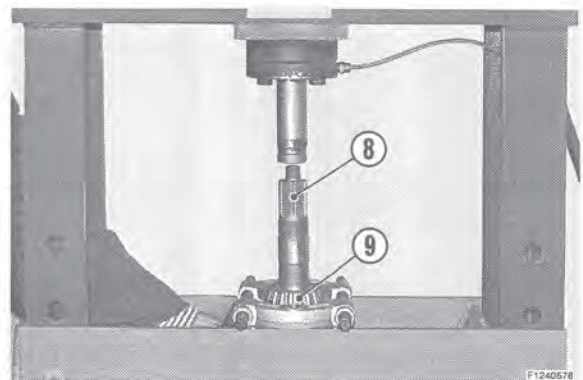
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GB

c

Remove the pinion (8), shims (11) and distance piece (10).

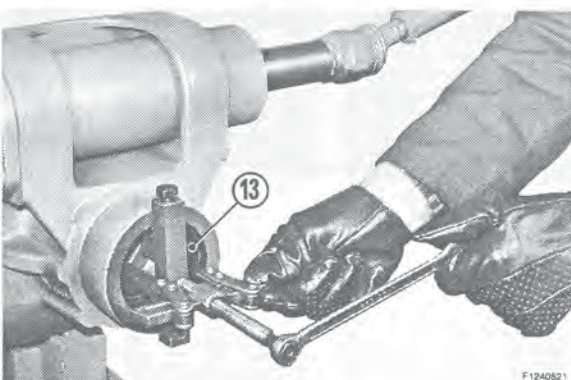


F1240578

GB

d

Using a puller and a press, remove the inner bearing (9) from the pinion (8).

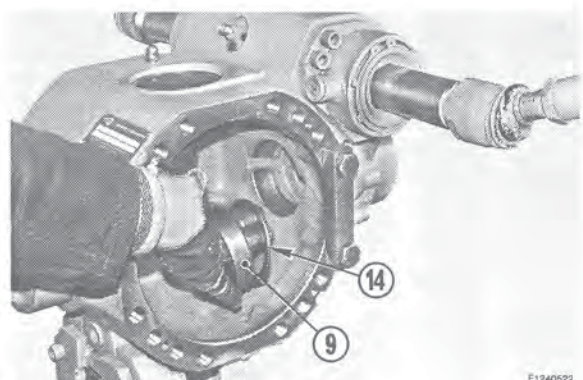


F1240521

GB

e

Remove the thrust block of the external bearing (13).



F1240522

GB

f

Insert a drift in the appropriate holes and remove the thrust block of the internal bearing (9) as well as the shim washers (14).



**ITA** Impegnare la chiave speciale **T22** sulla ghiera (7) ed applicare sul pignone (8) il codolo **T21**.  
Fermare la chiave **T22** e ruotare il pignone per allentare ed asportare la ghiera (7).  
**NOTA.** Se lo smontaggio risulta faticoso, scaldare la ghiera a circa 80 °C.

**D** Den speziellen Schlüssel **T22** in die Nutmutter (7) setzen und am Rad (8) den Schaft **T21** anbringen.  
Schlüssel **T22** festhalten und das Rad drehen, um die Nutmutter (7) zu lockern und abzunehmen.

**a** **BEMERKUNG.** Falls die Nutmutter zu fest sitzt, diese auf ca. 80°C erhitzen.

**ESP** Bloquear la llave especial **T22** en la virola (7) y aplicar en el piñón (8) el mango **T21**.  
Bloquear la llave **T22** y girar el piñón para aflojar y extraer la virola (7).  
**NOTA.** Si el desmontaje resulta difícil, calentar la virola a unos 80°C.

**F** Engager la clé spéciale **T22** sur le collier de serrage (7) et appliquer sur le pignon (8) le cône **T21**.  
Bloquer la clé **T22**, tourner le pignon pour relâcher et enlever le collier de serrage (7).  
**NOTE.** Si le désassemblage est rendu difficile, chauffer la bague à une chaleur de 80°C.

**ITA** Applicare i blocchi **T23** e con un estrattore, estrarre il pignone (8) completo del cuscinetto interno (9), del distanziale (10) e degli spessori (11).

**NOTA.** Le ralle dei cuscinetti rimangono nel corpo centrale (12).

**D** Die Blöcke **T23** anbringen und mit einem Abzieher das Rad (8) samt dem inneren Lager (9), Distanzstück (10) und der Scheiben (11) herausziehen.

**b** **BEMERKUNG.** Die Lagerscheiben bleiben im zentralen Körper (12) sitzen.

**ESP** Aplicar los bloques **T23** y con un extractor, extraer el piñón (8) con su cojinete interior (9) del separador (10) y de los posibles espesores (11).

**NOTA.** Las ranguas de los cojinetes quedan en el cuerpo central (12).

**F** Appliquer les blocs **T23** et à l'aide d'un extracteur, extraire le pignon (8) complet du palier interne (9), du différentiel (10) et des éventuelles cales (11).

**NOTE.** Les crapaudines des paliers demeurent dans le corps central (12).

**ITA** Asportare il pignone (8), gli spessori (11) ed il distanziale (10).

**D** Rad (8), Unterlegscheibe (11) und Distanzstück (10) abnehmen.

**c** **ESP** Sacar el piñón (8), los espesores (11) y el separador (10).

**F** Enlever le pignon (8), les cales (11) et l'entretoise (10).

**ITA** Utilizzando un estrattore ed una pressa, rimuovere dal pignone (8) il cuscinetto interno (9).

**D** Mit einem Abzieher und einer Presse, vom Rad (8) das Innere Lager (9) abnehmen.

**d** **ESP** Utilizando un extractor y una prensa, remover del piñón (8) el cojinete interior (9).

**F** A l'aide de l'extracteur et d'une presse, ôter du pignon (8) le palier interne (9).

**ITA** Rimuovere la ralla del cuscinetto esterno (13).

**D** Scheibe vom äußeren Lager (13) abnehmen.

**e** **ESP** Remover la rangua del cojinete exterior (13).

**F** Enlever la crapaudine du palier externe (13).

**ITA** Con un punzone inserito nelle cave predisposte, rimuovere la ralla del cuscinetto interno (9) e gli spessori di rasamento (14).

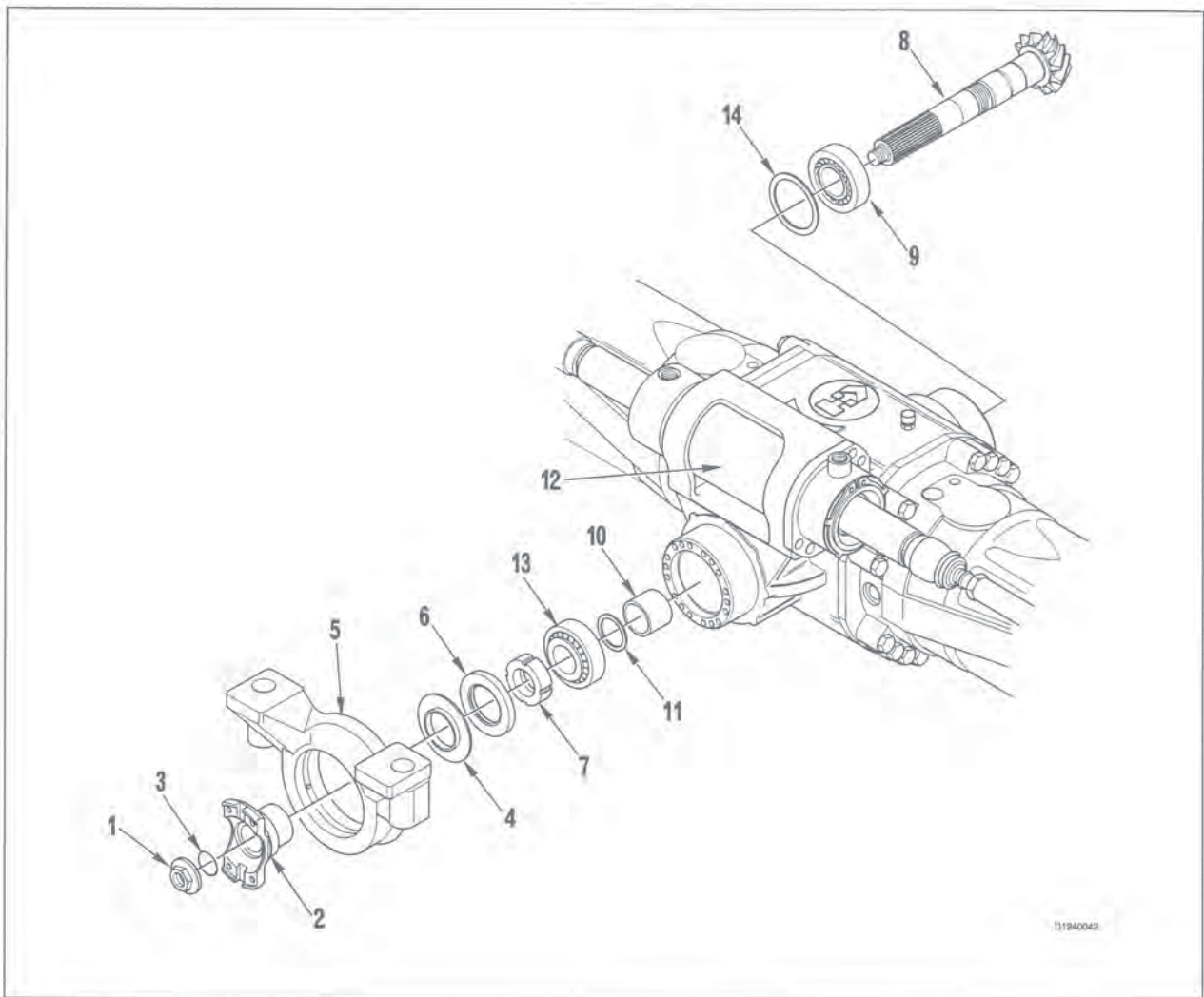
**D** Einen Dübel in die vorgesehenen Nuten stecken und die Scheibe des inneren Lagers (9) und die Zwischenlegscheiben (14) entfernen.

**f** **ESP** Utilizando un punzón introducido en las ranuras predisuestas, remover la rangua del cojinete interior (9) y los espesores (14).

**F** A l'aide d'un poussoir introduit dans le creux prédisposé, enlever la crapaudine du palier interne (9) et les cales de rasage (14).



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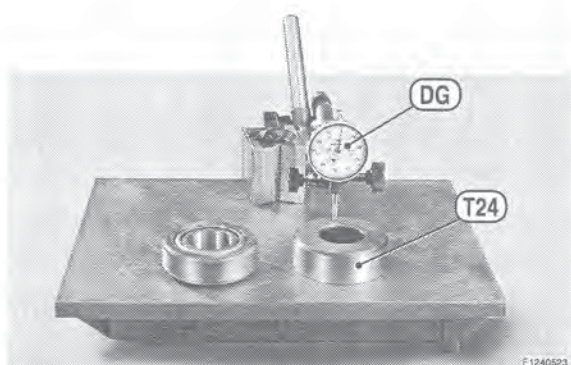








HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PIÑON CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE



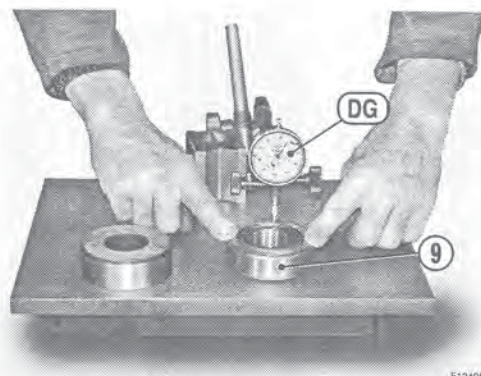
F1240523



GB

a

Using a surface plate, reset a centesimal comparator "DG" and place it on the measurement ring T24 (with a thickness of 30.2 mm).  
Preset the comparator to approx. 2 mm.



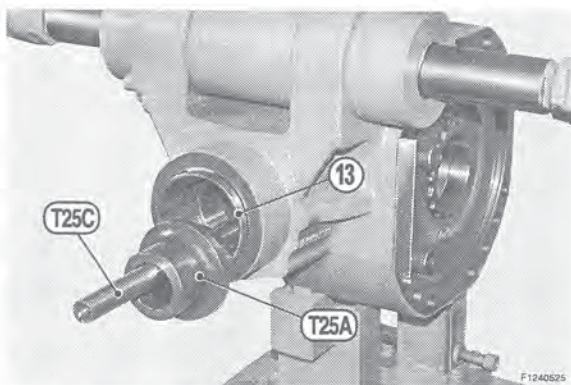
F1240524



GB

b

Bring the internal bearing (9), complete with its thrust block, under the comparator "DG".  
Determine overall thickness "D" of the bearing checking the discrepancy between this size and the size of the measurement ring.  
**CAUTION!** Press the thrust block in the centre and take several measurements while rotating the thrust block.



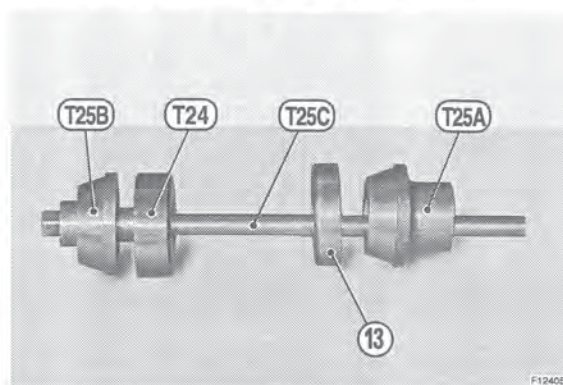
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GB

c

Partially insert the thrust block of the external bearing (13).



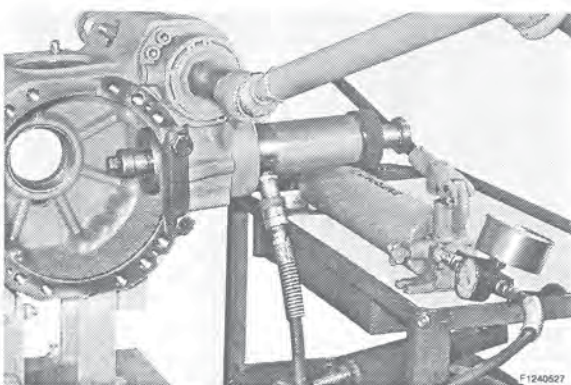
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GB

d

Install tension rod T25C, measurement ring T24 and front guide tool T25A on the thrust block of the external bearing (13).



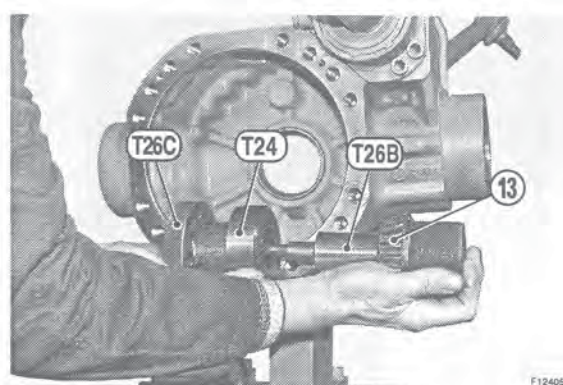
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GB

e

Connect the tension rod to the press and move the thrust block of the external bearing (13) into its seat.  
Disconnect the press and remove the tension rod.  
**NOTE.** Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.



F1240528



GB

f

Insert tool T26B complete with external bearing (13), measurement ring T24 and gauged ring nut T26C.  
Manually tighten.





**ITA** Utilizzando un piano di riscontro, azzerare sull'anello di misura T24 (di spessore conosciuto pari a 30,2 mm) un comparatore centesimale "DG".  
Precaricare il comparatore di circa 2 mm.

**D** Mit Hilfe eines Anschlags am Meßring T24 (bekannte Stärke 30,2 mm) eine hundertteilige Meßuhr "DG" auf Null stellen.  
Meßuhr auf 2 mm vorladen.

**ESP** Utilizando una superficie para la comparación, poner a cero en el anillo de medida T24 (del que se conoce el espesor igual a 30,2 mm) un comparador centesimal "DG".  
Precargar el comparador en 2 mm aproximadamente.

**F** A l'aide d'un plan de comparaison, mettre à zéro sur l'anneau de mesurage T24 (d'une épaisseur connue égale à 30,2 mm), un comparateur centésimal "DG".  
Précharger le comparateur d'environ 2 mm.

**ITA** Inserire parzialmente nel corpo centrale (12) la ralla del cuscinetto esterno (13).

**D** Auf den zentralen Körper (12) die Scheibe des äußeren Lagers (13).

**ESP** Introducir parcialmente en el cuerpo central (12) la rangua el cojinete exterior (13).

**F** Introduire, partiellement dans le corps central (12), la crapaudine du palier externe (13).

**ITA** Collegare il tirante alla pressa e mandare in sede la ralla del cuscinetto esterno (13).  
Scollegare la pressa e rimuovere il tirante.  
**NOTA.** Prima di proseguire, assicurarsi dell'inserimento totale della ralla.

**D** Spannstange mit der Presse verbinden und die Scheibe in ihren Sitz im äußeren Lager (13) einsetzen.  
Von der Presse abnehmen und Spannstange abnehmen.

**BEMERKUNG.** Sorgfältig kontrollieren, ob die Scheibe richtig eingesetzt worden ist.

**ESP** Conectar el tirante a la prensa y colocar en el alojamiento la rangua del cojinete exterior (13).  
Sacar la prensa y remover el tirante.

**NOTA.** Antes de continuar, asegurarse de que la rangua está completamente insertada.

**F** Brancher la tringle à la presse, puis envoyer dans son logement la crapaudine du palier externe (13).  
Débrancher la presse et enlever la tringle.

**NOTE.** Avant de continuer, s'assurer que la crapaudine est complètement insérée.

**ITA** Portare sotto il comparatore "DG" il cuscinetto interno (9) completo di ralla.  
Determinare lo spessore totale "D" del cuscinetto controllando lo scostamento rispetto la misura dell'anello di misura.  
**ATTENZIONE!** Premere la ralla in modo centrato ed eseguire più volte la misurazione ruotando la ralla.

**D** Unter die Meßuhr "DG" das innere Lager (9) samt Scheibe legen.  
Gesamte Stärke "D" des Lagers messen und die Abweichung im Verhältnis zum Meßring kontrollieren.  
**ACHTUNG!** Die Scheibe muß zentriert sein und den Meßvorgang mehrmals bei gedrehter Scheibe wiederholen.

**ESP** Poner debajo del comparador "DG" el cojinete interior (9) con la rangua.  
Determinar el espesor total "D" del cojinete controlando la diferencia con respecto al tamaño del anillo de medida.  
**CUIDADO!** Presionar la rangua de manera centrada y ejecutar varias veces la medida girando la rangua.

**F** Amener sous le comparateur "DG" le palier interne (9) équipé de crapaudine.  
Définir l'épaisseur totale "D" du palier en contrôlant l'écart par rapport à celle mesurée par l'anneau de mesurage.  
**ATTENTION!** Presser la crapaudine vers le centre, puis en effectuer plusieurs fois le mesurage en tournant la crapaudine.

**ITA** Montare il tirante T25C, l'anello di misura T24, ed infine l'attrezzo anteriore T25A di guida della ralla (13) del cuscinetto esterno.

**D** Die Spannstange T25C, den Meßring T24, und zuletzt das vordere Werkzeug T25A zur Führung der Scheibe (13) des äußeren Lagers montieren.

**ESP** Montar el tirante T25C, el anillo de medida T24, y por último la herramienta anterior T25A guía de la rangua (13) del cojinete exterior.

**F** Monter la tringle T25C, l'anneau de mesurage T24, et enfin l'outil antérieur T25A de guidage de la crapaudine (13) du palier externe.

**ITA** Inserire l'attrezzo T26B completo di cuscinetto esterno (13) anello di misura T24 e ghiera di altezza calibrata T26C.  
Serrare a fondo manualmente.

**D** Werkzeug T26B mit dem äußeren Lager (13), Meßring T24 und in der Höhe kalibrierte Nutmutter T26C einsetzen.  
Von Hand festschrauben.

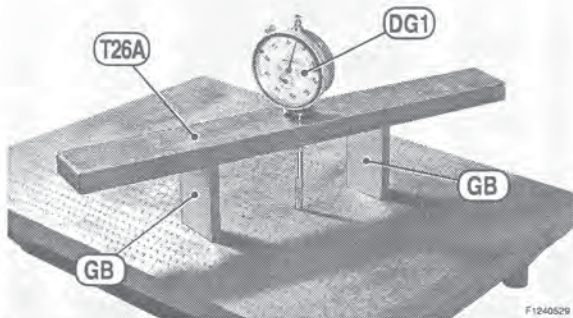
**ESP** Introducir la herramienta T26B con el cojinete exterior (13), el anillo de medida T24 y la virola de altura calibrada T26C.  
Apretar a fondo manualmente.

**F** Introduire l'outil T26C équipé du palier externe (13), l'anneau de mesurage T24 et le collier de serrage de hauteur taraudé T26C.  
Serrer à fond manuellement.

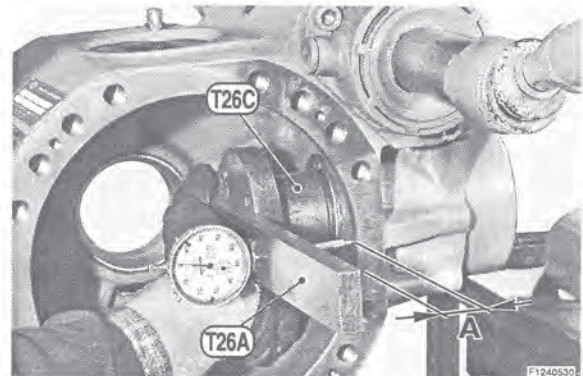




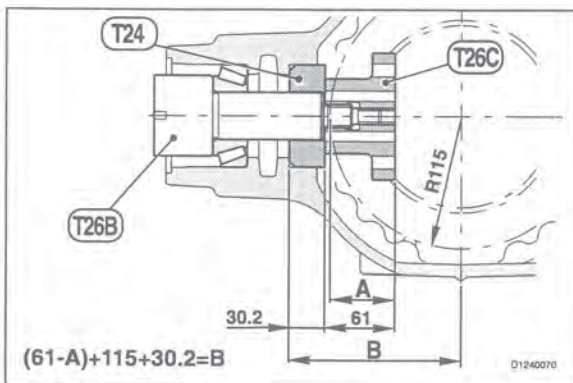
HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PIÑÓN CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE



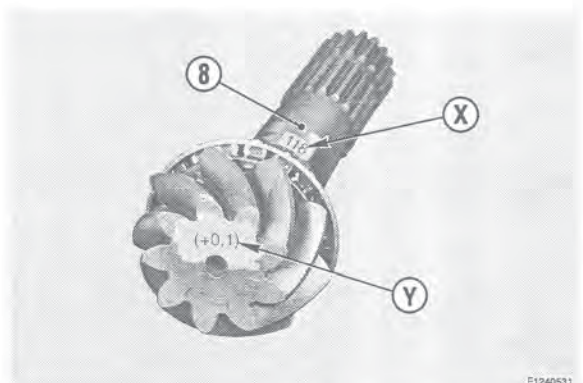
Fit a centesimal comparator "DG1" with long stem into bar T26A; when the bar rests on two size-blocks "GB" of 57 mm, reset the comparator.  
Preset the comparator to approx. 2 mm and reset.



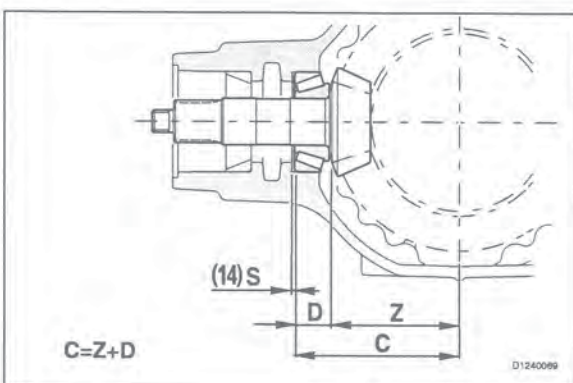
Lay bar T26A on gauged nut T26C and take the size "A" at about 57 mm corresponding to the maximum diameter of arms centring.



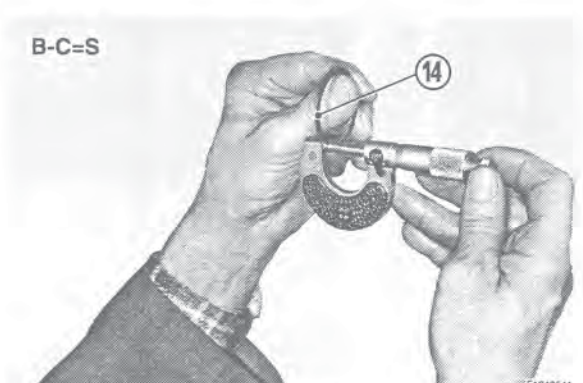
Calculate size "B" which will be the first useful value for calculating the size of the shims (14) that are to be inserted under the thrust block of the internal bearing (9).



Check the nominal size (X) marked on the pinion and add or subtract the indicated variation (Y) so as to obtain size "Z".  
e.g.:  $Z = 118 + 0.1 = 118.1$   
 $Z = 118 - 0.2 = 117.8$



Calculate size "C" which represents the second value for calculating the size of the shims "S" that are to be placed under the thrust block of the internal bearing (9).



Calculate the difference between sizes "B" and "C" so as to obtain the size "S" of the shim (14) that will go under the thrust block of the internal bearing (9).

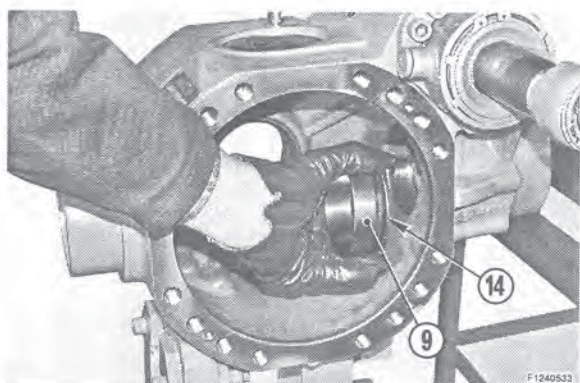


- a**
- ITA** Montare un comparatore centesimale "DG1" con stelo prolungato, nella barra T26A; azzerare il comparatore quando la barra appoggia su due blocchetti "GB" calibrati da 57 mm.  
Precaricare il comparatore di circa 2 mm ed azzerarlo.
- D** Die hundertteilige Meßuhr "DG1" mit dem Verlängerungsstift in den Stab T26A montieren; die Meßuhr auf Null stellen, nachdem der Stab auf zwei kalibrierte Blöcke "GB" zu 57 mm gelegt worden ist.  
Meßuhr auf 2 mm vorladen und auf Null stellen.
- ESP** Montar un comparador centesimal "DG1" con vástago prolongado en la barra T26A; poner a cero el comparador cuando la barra está apoyada en dos bloques "GB" calibrados de 57 mm.  
Precargar el comparador en 2 mm aproximadamente y ponerlo a cero.
- F** Monter un comparateur centésimal "DG1" muni de tige de prolongation dans la barre T26A; mettre le comparateur à zéro lorsque la barre posée sur les deux blocs calibrés "GB" est à 57 mm.  
Précharger le comparateur à environ 2 mm et remettre à zéro.
- b**
- ITA** Appoggiare la barra T26A sulla ghiera calibrata T26C e rilevare la misura "A" circa 57mm in corrispondenza del diametro massimo della centratura dei bracci.
- D** Stab T26A auf die kalibrierte Nutmutter T26C legen und das Maß "A" bei ca. 57 mm am maximalen Durchmesser der Armzentrierung messen.
- ESP** Apoyar la barra T26A en la virola calibrada T26C y registrar la medida "A" unos 57 mm en correspondencia del diámetro máximo del centrage de los brazos.
- F** Poser la barre T26A sur le collier de serrage taraudé T26C, relever la mesure "A" à environ 57 mm en correspondance du diamètre de centrage maximal des bras.
- c**
- ITA** Eseguire il calcolo per ottenere la prima misura utile "B", per il calcolo degli spessori (14) da inserire sotto la ralla del cuscinetto interno (9).
- D** Das Maß "B" ausrechnen, das zur Ermittlung der Distanzstücke (14) dient, die unterhalb der Scheibe des inneren Lagers (9) eingesetzt werden sollen.
- ESP** Ejecutar el cálculo para obtener la primera medida útil "B" para el cálculo de los espesores (14) que hay que insertar debajo de la rangua del cojinete interior (9).
- F** Faire le calcul pour obtenir la première mesure utile "B" pour calculer les cales (14) à introduire au-dessous de la crapaudine du palier interne (9).
- d**
- ITA** Controllare la misura nominale (X) segnata sul pignone e sommare o sottrarre ad essa la variazione indicata: (Y) per ottenere la misurazione "Z".  
Es:  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$
- D** Das Nennmaß (X), das am Rad markiert ist, kontrollieren und die Abweichung addieren oder abziehen. (Y) für das Maß "Z".  
Beisp.:  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$
- ESP** Controlar la medida nominal (X) marcada en el piñón y sumarle o restarle la variación indicada (Y) para obtener la medida "Z".  
Ej.:  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$
- F** Contrôler la mesure nominale (X) marquée sur le pignon et additionner ou soustraire à celle-ci la variation indiquée (Y) pour obtenir le mesurage "Z".  
Exp.  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$
- e**
- ITA** Calcolare la seconda misura utile "C" per il calcolo dello spessore "S" da inserire sotto la ralla del cuscinetto interno (9).
- D** Das zweite Maß "C" für das Distanzstück "S" ausrechnen, das unter die Scheibe des inneren Lagers (9) eingesetzt werden soll.
- ESP** Calcular la segunda medida útil "C" para el cálculo del espesor "S" a insertar debajo de la rangua del cojinete interior (9).
- F** Calculer la seconde mesure utile "C" pour calculer la cale "S" à introduire au-dessous de la crapaudine du palier interne (9).
- f**
- ITA** Eseguire la differenza tra le misure "B" e "C" per stabilire la misura "S" dello spessore (14) da inserire sotto la ralla del cuscinetto interno (9).
- D** Den Unterschied zwischen Maß "B" und "C" ausrechnen, um das Distanzstück "S" (14) auszurechnen, das unter die Scheibe des inneren Lagers (9) eingesetzt werden soll.
- ESP** Sacar la diferencia entre las medidas "B" y "C" para establecer la medida "S" del espesor (14) a insertar debajo de la rangua del cojinete interior (9).
- F** Effectuer la différence entre les mesures "B" et "C" pour établir la mesure "S" de la cale (14) à introduire au-dessous de la crapaudine du palier interne (9).

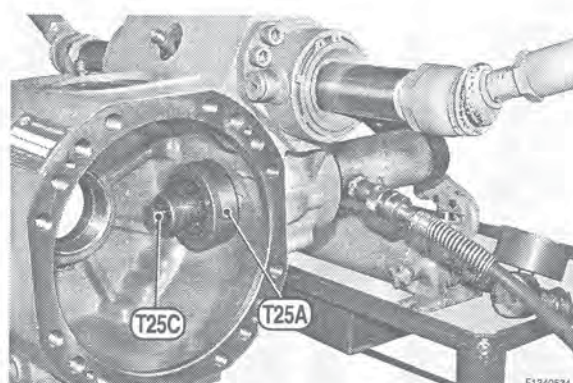




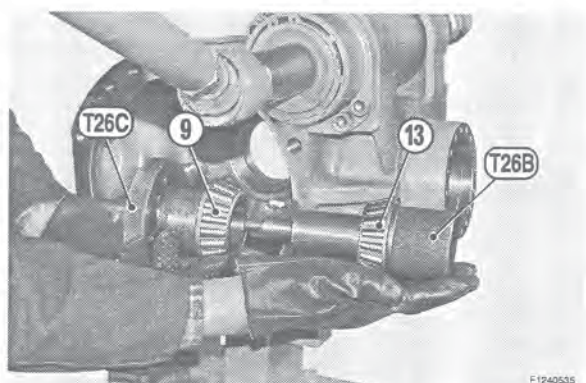
HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PIÑÓN CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE



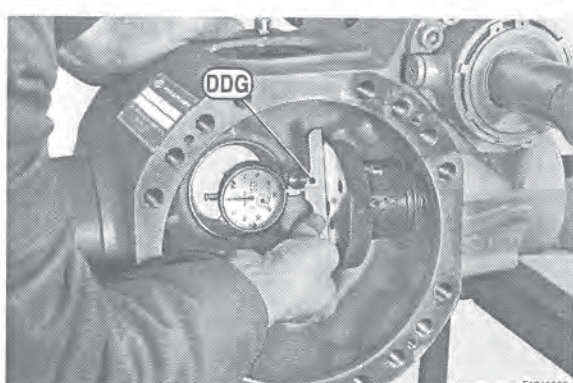
Insert shim "S" (14) and the thrust block of the internal bearing (9) in the central body.  
**NOTE.** To hold shim "S" (14) in position, apply grease.



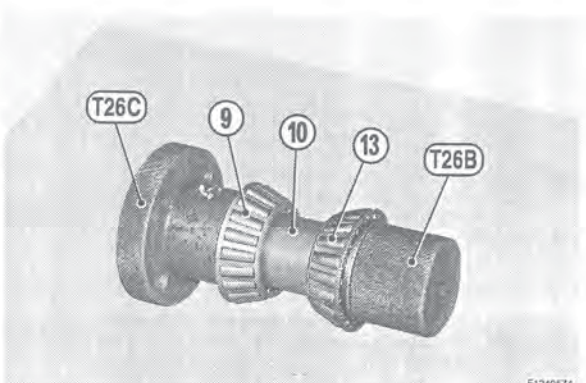
Position tool T25A and tension rod T25C. Connect the tension rod to the press, fasten the thrust block and then remove the tools.  
**NOTE.** Before going on to the next stage, make sure that the thrust block has been completely inserted.



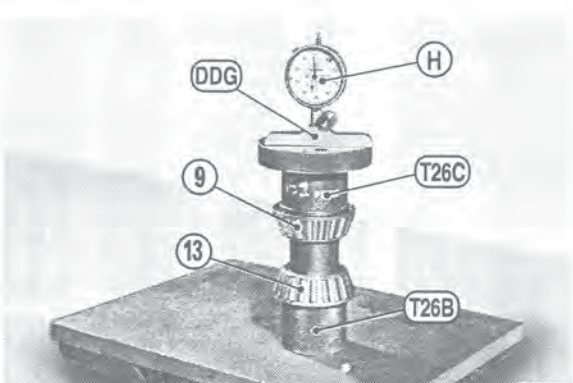
Position tools T26C and T26B complete with tapered bearings (9) and (13); manually tighten until a rolling torque has been obtained.



Insert the stem of a depth comparator "DDG" in either side hole of tool T26C; reset the comparator with a presetting of approx. 3 mm.



Remove the comparator and release tools and bearings from the central body. Re-install all and insert the distance piece (10) between bearings (9) and (13); manually tighten the whole pack.



Insert depth comparator "DDG" into tool T26B-T26C and measure variation "H" in relation to the zero setting performed back at point d.



**ITA** Inserire nel corpo centrale lo spessore "S" (14) e la ralla del cuscinetto interno (9).  
**NOTA.** Per tenere in posizione lo spessore "S" (14), spalmarlo leggermente con grasso.

**D** In den zentralen Körper das Distanzstück "S" (14) und die Scheibe des inneren Lagers (9) einsetzen.  
**BEMERKUNG.** Um das Distanzstück "S" (14) in seiner Position festzuhalten, dieses leicht mit Fett schmieren.

**ESP** Introducir en el cuerpo central el espesor "S" (14) y la rangua del cojinete interior (9).  
**NOTA.** Para mantener en su posición el espesor "S" (14), pasarle ligeramente un poco de grasa.

**F** Introduire dans le corps central la cale "S" (14) et la cale du palier interne (9).  
**NOTE.** Enduire légèrement celle-ci de gras pour la maintenir dans sa position.

**a**

**ITA** Inserire gli attrezzi T26C e T26B completi dei cuscinetti conici (9) e (13); serrare manualmente fino ad avere sicuramente una coppia di rotolamento.

**D** Die Werkzeuge T26C und T26B samt Kegellager (9) und (13) einsetzen; von Hand zudrehen bis ein Drehmoment erreicht worden ist.

**ESP** Introducir las herramientas T26C y T26B con sus cojinetes cónicos (9) y (13); apretar manualmente hasta obtener con seguridad un par de rodamiento.

**F** Introduire les outils T26C et T26B équipés des paliers coniques (9) et (13); serrer manuellement jusqu'à être sûr d'avoir un couple de roulement.

**c**

**ITA** Rimuovere il comparatore e smontare dal corpo centrale il gruppo attrezzi e cuscinetti.  
Rimontare il tutto inserendo tra i cuscinetti (9) e (13) il distanziale (10); serrare manualmente l'intero pacco.

**D** Die Meßuhr abnehmen und vom zentralen Körper die Werkzeuge und Lager abmontieren.  
Das ganze wieder montieren und dabei zwischen den Lagern (9) und (13) das Distanzstück (10) einsetzen; von Hand das Ganze festschrauben.

**ESP** Remover el comparador y desmontar del cuerpo central el grupo de las herramientas y cojinetes.  
Volver a montar todo introduciendo entre los cojinetes (9) y (13) el separador (10); apretar manualmente todo el paquete.

**F** Enlever le comparateur et démonter du corps central le groupe outils et paliers.  
Remonter le tout en insérant entre les paliers (9) et (13), l'entretoise (10); serrer tout le paquet à la main.

**e**

**ITA** Montare l'attrezzo T25A ed il tirante T25C.  
Collegare il tirante alla pressa, mandare in battuta la ralla e quindi smontare gli attrezzi.

**NOTA.** Prima di proseguire, assicurarsi dell'inserimento totale della ralla.

**D** Werkzeug T25A und Spannstanze T25C montieren.  
Spannstanze mit der Presse verbinden und die Scheibe bis zum Anschlag einsetzen. Danach die Werkzeuge abmontieren.

**BEMERKUNG.** Sorgfältig kontrollieren ob die Scheibe richtig eingesetzt worden ist.

**ESP** Montar la herramienta T25A y el tirante T25C.  
Conectar el tirante a la prensa, llevar a tope la rangua y luego desmontar las herramientas.

**NOTA.** Antes de continuar, asegurarse de que la rangua ha sido totalmente introducida.

**F** Monter l'outil T25A et la tringle T25C.  
Relier la tringle à la presse, envoyer en butée la crapaudine, puis démonter les outils.

**NOTE.** Avant de continuer, s'assurer que la crapaudine est entièrement insérée.

**b**

**ITA** Inserire in uno dei due fori laterali dell'attrezzo T26C lo stelo di un comparatore di profondità "DDG"; azzerare il comparatore con un precarico di circa 3 mm.

**D** In eines der beiden seitlichen Löcher des Werkzeugs T26C den Stift der Meßuhr "DDG" stecken; die Meßuhr auf 3 mm vorladen und auf Null stellen.

**ESP** Introducir en uno de los dos orificios laterales de la herramienta T26C el vástago de un comparador de profundidad "DDG"; poner a cero el comparador con una precarga de aproximadamente 3 mm.

**F** Introduire dans l'un des deux trous latéraux de l'outil T26C, la tige d'un comparateur de profondeur "DDG", mettre le comparateur à zéro avec une précharge d'environ 3 mm.

**d**

**ITA** Inserire nell'attrezzo T26B-T26C il comparatore di profondità "DDG" e rilevare lo scostamento "H" rispetto l'azzeramento eseguito al punto d.

**D** In das Werkzeug T26B-T26C die Meßuhr "DDG" für die Tiefe einsetzen und die Abweichung "H" im Verhältnis zur unter Punkt d vorgenommenen Nullstellung messen.

**ESP** Introducir en la herramienta T26B-T26C el comparador de profundidad "DDG" y relevar el alejamiento "H" respecto al aceramiento efectuado al punto d.

**F** Introduire l'outil T26B-T26C le comparateur de profondeur "DDG" et relever l'écart "H" par rapport à la mise à zéro effectué au point d.

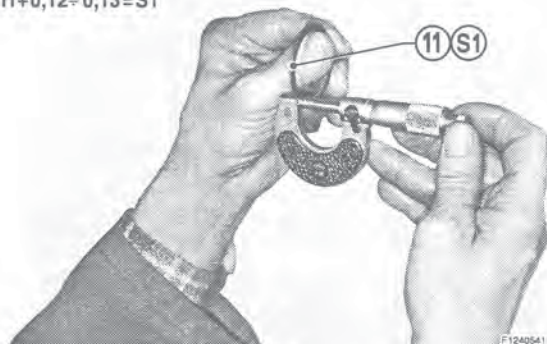
**f**





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$H+0,12\div 0,13=S1$



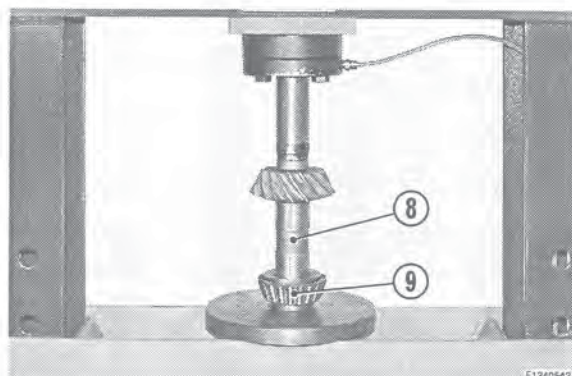
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GB

a

The variation is to be added to a set value of 0.12–0.13 mm., so as to obtain the size of shim "S1" (11) which will be inserted between the external bearing (13) and the distance piece (10) and subsequently, to determine the preload for the bearings.



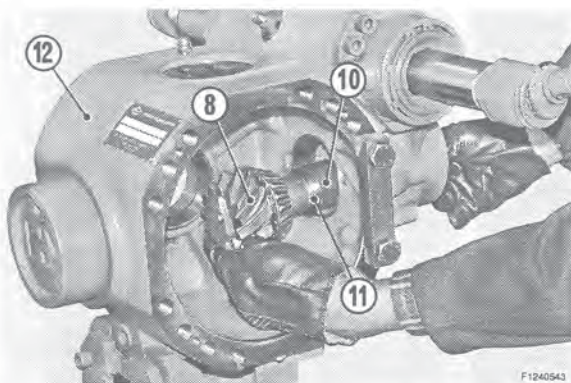
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b

Position the internal bearing (9) and the pinion (8) under a press; force the bearing onto the pinion.



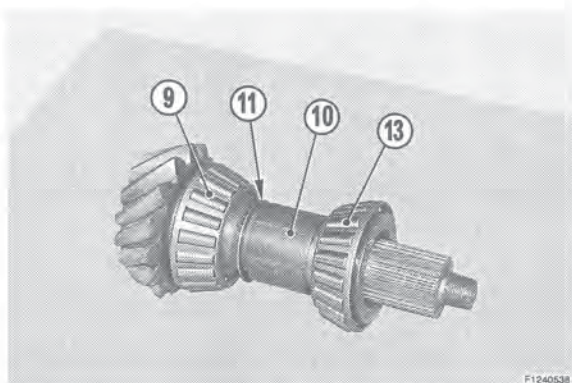
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c

Fit the pinion (8), shim "S1" (11) and distance piece (10) in the main body (12).

**NOTE.** The finer shims must be placed in- between the thicker ones



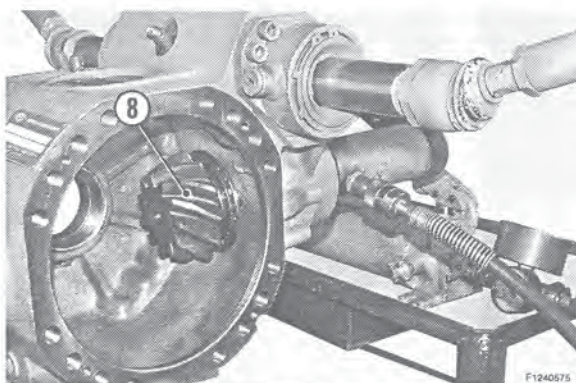
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d

Insert the external bearing (13) in the central body in order to complete the pack arranged as in the figure.



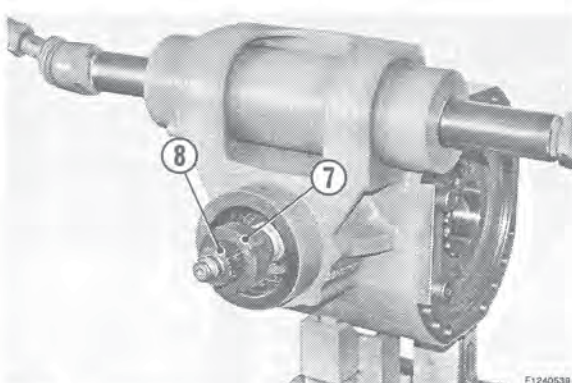
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GB

e

Connect the pinion (8) to the tie rod T28A and T28B; connect the tie rod T28C (see special tools) to the press and block.



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f

Apply Loctite 242 to the thread of the ring nut (7) and screw the nut onto the pinion (8).



**ITA** Lo scostamento rilevato è da sommare ad una misura fissa di 0,12÷0,13 mm, per ottenere lo spessore "S1" (11) da inserire tra cuscinetto esterno (13) e distanziale (10) e quindi, determinare il precarico stabilito per i cuscinetti.

**D** Die ermittelte Abweichung wird dem festen Maß von 0,12÷0,13 mm hinzu gerechnet, um das Distanzstück "S1" (11) zu ermitteln, das zwischen dem äußeren Lager (13) und das Distanzstück (10) eingesetzt werden soll und folglich die benötigte Vorkraft der Lager festzulegen.

**ESP** La separación registrada hay que sumarla a una medida fija de 0,12÷0,13 mm para obtener el espesor "S1" (11) que hay que introducir entre el cojinete exterior (13) y el separador (10) y luego, determinar la precarga establecida para los cojinetes.

**F** L'écart relevé est à additionner à une mesure fixe de 0,12÷0,13 mm pour obtenir la cale "S1" (11) à introduire entre le palier externe (13) et entretoise (10) et par conséquent déterminer la précharge préconisée pour les paliers.

**ITA** Montare nel corpo centrale (12), il pignone (8), gli spessori "S1" (11) e il distanziale (10).  
**NOTA.** Gli spessori più fini devono essere contenuti tra quelli più spessi.

**D** Zentralen Körper (12), Rad (8), Unterlegscheibe "S1" (11) und Distanzstück (10) montieren.  
**BEMERKUNG.** Die dünneren Unterlegscheiben müssen zwischen den stärkeren gelegt werden.

**ESP** Montar en el cuerpo central (12) el piñón (8) los espesores "S1" (11) y el separador (10).  
**NOTA.** Los espesores más delgados tienen que colocarse entre los más gruesos.

**F** Monter le corps central (12), le pignon (8), les cales "S1" (11) et l'entretoise (10).  
**NOTE.** Les cales plus minces doivent être intercalées parmi les plus épaisses.

**ITA** Collegare il pignone (8) al tirante T28A e T28B; collegare il tirante T28C (Vedere attrezzature speciali) alla pressa e mandare in blocco.

**D** Ritzel (8) mit der Zugstange T28A und T28B verbinden; Zugstange T28C (siehe Spezialausrüstung) mit der Presse verbinden und blockieren.

**ESP** Conectar el pignon (8) al tirante T28A y T28B; conectar el tirante T28C (Versee herramientas especiales) a la prensa y bloquear.

**F** Brancher le pignon (8) à la tringle T28A et T28B; relier la tringle T28C (voir installations spéciales) à la presse puis envoyer en butée.

**ITA** Posizionare il cuscinetto interno (9) e pignone (8) sotto una pressa; forzare sul pignone il cuscinetto.

**D** Das innere Lager (9) und das Rad (8) unter eine Presse setzen; auf das Rad das Lager drücken.

**ESP** Posicionar el cojinete interior (9) y el piñón (8) debajo de una prensa; forzar en el piñón el cojinete.

**F** Placer le palier interne (9) et le pignon (8) sous presse; forcer sur pignon et palier.

**ITA** Inserire nel corpo centrale il cuscinetto esterno (13) in modo da completare il pacco come composto in figura.

**D** In den zentralen Körper das äußere Lager (13) einsetzen wie in der Abbildung gezeigt.

**ESP** Introducir en el cuerpo central el cojinete exterior (13) de manera que el paquete quede completo como ha sido formado en la figura.

**F** Introduire dans le corps central, le palier externe (13), de manière à compléter le paquet comme composé sur la figure.

**ITA** Spalmare la filettatura della ghiera (7) con Loctite 242 ed avvitarela sul pignone (8).

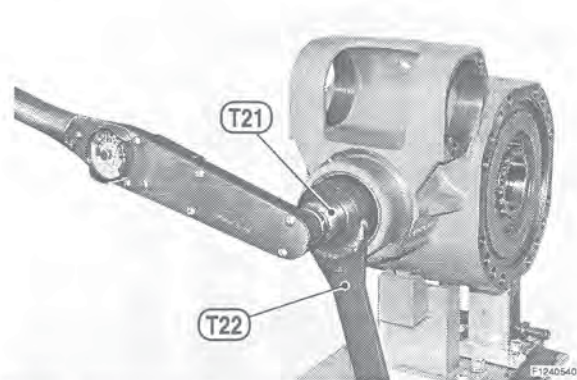
**D** Das Gewinde der Nutmutter (7) mit Loctite 242 schmieren und auf das Rad (8) schrauben.

**ESP** Pasar sobre la rosca de la virola (7) Loctite 242 y atornillarla en el piñón (8).

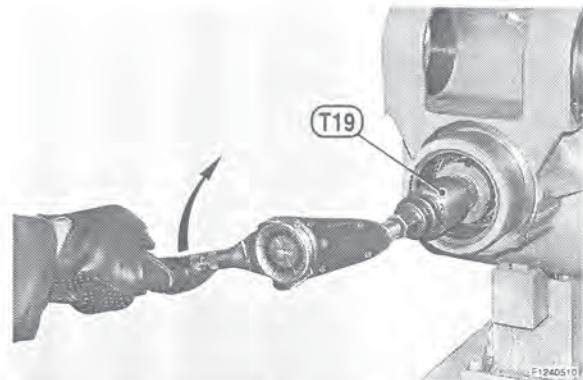
**F** Enduire le filetage du collier de serrage (7) avec du Loctite 242, puis visser celui-ci sur le pignon (8).



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Apply special wrench T22 to the ring nut (7) and bar-hold T21 to the pinion (8).  
Lock the wrench T22 and rotate the pinion using a dynamometric wrench, up to a minimum required torque setting of 500 Nm.



Apply onto the pinion (8) the bar-hold and with the help of a torque metre, check the torque of the pinion (8).  
Torque: 120-170 Ncm

**CAUTION!** If torque exceeds the maximum value, then the size of shim "S1" (11) between the bearing (13) and the distance piece (10) needs to be increased.  
If torque does not reach the set value, increase the torque setting of the ring nut (7) in different stages to obtain a maximum value of 570 Nm.

**CAUTION!** If torque does not reach the minimum value, then the size of shim "S1" (11) needs to be reduced.

**CAUTION!** When calculating the increase or decrease in size of shim "S1", bear in mind that a variation of shim (11) of 0.01 mm corresponds to a variation of 60 Ncm in the torque of the pinion (8).



**ITA** Impegnare la chiave speciale T22 sulla ghiera (7) ed applicare il codolo T21 sul pignone (8).  
Fermare la chiave T22 e ruotare il pignone con una chiave dinamometrica fino alla coppia minima richiesta di 500 Nm.

**D** Den speziellen Schlüssel T22 auf die Nutmutter (7) setzen und den Schaft T21 auf das Rad (8) montieren. Den Schlüssel T22 festhalten und das Rad mit einem Momentenschlüssel drehen bis das mindeste Anzugsmoment von 500 Nm erreicht worden ist.

**ESP** Colocar la llave especial T22 en la virola (7) y aplicar el mango T21 en el piñón (8).  
Parar la llave T22 y girar el piñón con una llave dinamométrica hasta el par mínimo requerido de 500 Nm.

**F** Engager la clé spéciale T22 sur le collier (7) et appliquer la queue T21 sur le pignon (8).  
Bloquer la clé T22, tourner le pignon avec une clé dynamométrique jusqu'au couple minimum requis de 500 Nm.

**ITA** Applicare sul pignone (8) il codolo T19 e con un torsiometro, controllare la coppia di rotazione del pignone.

Coppia di rotazione:  $120 \div 170$  Ncm

**ATTENZIONE!** Se la coppia supera il valore massimo bisogna aumentare lo spessore "S1" (11) tra cuscinetto (13) e distanziale (10).

Se la coppia di rotazione non raggiunge il valore stabilito, aumentare la coppia di serraggio della ghiera (7) in più tempi fino a raggiungere il valore massimo ammesso di 570 Nm.

**ATTENZIONE!** Se la coppia di rotazione non raggiunge il valore minimo, è necessario diminuire lo spessore "S1" (11).

**ATTENZIONE!** Al fine di poter calcolare gli incrementi o la diminuzione dello spessore "S1", è necessario considerare che la variazione dello spessore (11) di 0,01 mm, fa variare la coppia di rotazione del pignone (8) di 60 Ncm.

**D** Den Schaft T19 montieren auf das Rad (8) und mit einem Drehungsmesser das Drehmoment des Rads kontrollieren.

Drehmoment:  $120 \div 170$  Ncm

**ACHTUNG!** Falls das Drehmoment größer als der maximale Wert sein sollte, muß ein größeres Distanzstück "S1" (11) zwischen Lager (13) und Distanzstück (10) eingesetzt werden.

Falls das Drehmoment den benötigten Wert nicht erreicht, muß das Drehmoment der Nutmutter (7) stufenweise erhöht werden, bis der maximal zugelassene Wert von 570 Nm erreicht worden ist.

**ACHTUNG!** Falls das Drehmoment den minimalen Wert nicht erreicht, muß das Distanzstück "S1" (11) kleiner gewählt werden.

**ACHTUNG!** Um die Erhöhungen oder Verringerungen des Distanzstücks "S1" ausrechnen zu können, muß beachtet werden, daß ein Unterschied von 0,01 mm des Distanzstücks (11), das Drehmoment des Rads (8) um 60 Ncm verändert.

**ESP** Aplicar el mango T19 en el piñón (8) y con un torsiómetro, controlar el par de rotación del piñón.  
Par de rotación:  $120 \div 170$  Ncm

**CUIDADO!** Si el par supera el valor máximo, hay que aumentar el espesor "S1" (11) entre el cojinete (13) y el separador (10).

Si el par de rotación no alcanza el valor establecido, aumentar el par de torsión de la virola (7) varias veces hasta alcanzar el valor máximo admitido de 570 Nm.

**CUIDADO!** Si el par de rotación no alcanza el valor mínimo, hay que disminuir el espesor "S1" (11).

**CUIDADO!** A fin de poder calcular los incrementos o la disminución del espesor "S1", hay que considerar que el espesor (11) de 0,01 mm hace variar el par de rotación del piñón (8) en 60 Ncm.

**F** Appliquer la queue T19 sur le pignon (8) et l'aide d'un torsiomètre, contrôler le couple de rotation du pignon.  
Couple de rotation:  $120 \div 170$  Ncm

**ATTENTION!** Si le couple dépasse la valeur maximale, il faut augmenter la cale "S1" (11) entre palier (13) et entretoise (10).

Si le couple de rotation n'atteint pas la valeur établie, augmenter le couple de serrage du collier de serrage (7) en plusieurs fois jusqu'à atteindre la valeur maximale préconisée de 570 Nm.

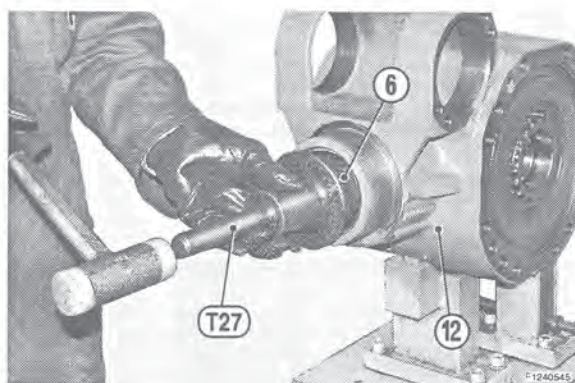
**ATTENTION!** Si le couple de rotation n'atteint pas la valeur minimale, il faut diminuer la cale "S1" (11).

**ATTENTION!** Pour pouvoir calculer l'incrémentation ou la diminution de la cale "S1", il faut tenir compte que la variation de la cale (11) de 0,01 mm, modifie le couple de rotation du pignon (8) de 60 Ncm.

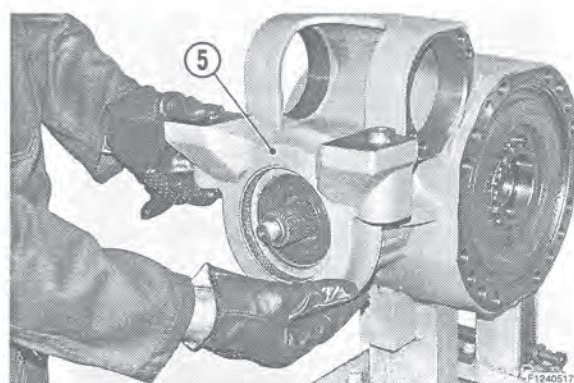




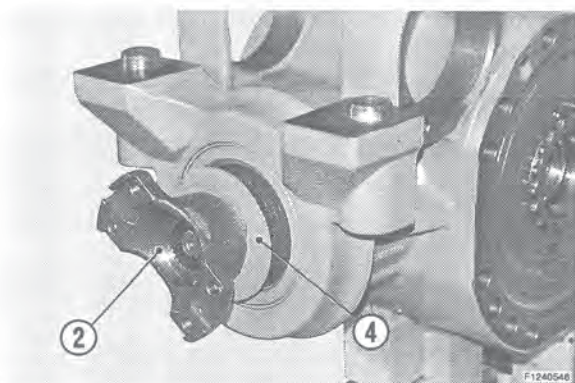
**HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PIÑÓN CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE**



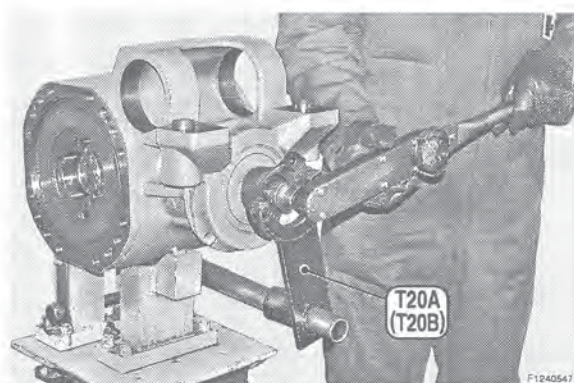
Lubricate the outer surface of the new sealing ring (6) and fit it onto the central body (12) using tool T27.



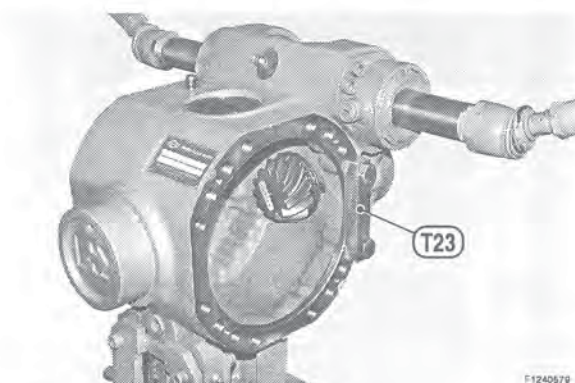
Install the swinging support (5).  
**NOTE.** Check that it is properly oriented.



Fit the flange (2) complete with the guard (4) and fasten it.  
For keying the flange (2), use a plastic hammer if necessary.  
**NOTE.** Make sure that the guard (4) is securely fastened onto the flange and that it is not deformed.



Apply Loctite 242 to the threaded part of the pinion (8).  
Position tool T20A (or T20B) and fasten it in order to avoid rotation.  
Insert O-ring (3) the nut (1) and tighten it using a dynamometric wrench.  
Torque wrench setting: 280–310 Nm



Remove blocks T23 (used for extracting the pinion) and re-install the arms.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS».



- a**
- ITA** Lubrificare la superficie esterna del nuovo anello di tenuta (6) e montarlo nel corpo centrale (12) utilizzando l'attrezzo T27.
- D** Die äußere Fläche des neuen Ringes (6) schmieren und den zentralen Körper (12) mit Hilfe des Werkzeugs T27 montieren.
- ESP** Lubricar la superficie exterior del nuevo segmento de compresión (6) y montarlo en el cuerpo central (12) utilizando la herramienta T27.
- F** Lubrifier la surface externe de la bague d'étanchéité neuve (6), puis monter celle-ci dans le corps central (12) à l'aide de l'outil T27.

- b**
- ITA** Montare il supporto oscillante (5).  
**NOTA:** Controllare attentamente l'orientamento.
- D** Die schwenkbare Halterung (5) montieren.  
**BEMERKUNG:** Richtung sorgfältig kontrollieren.
- ESP** Montar el soporte oscilante (5).  
**NOTA:** Controlar atentamente la orientación.
- F** Monter le support oscillant (5).  
**NOTE:** Contrôler attentivement le sens.

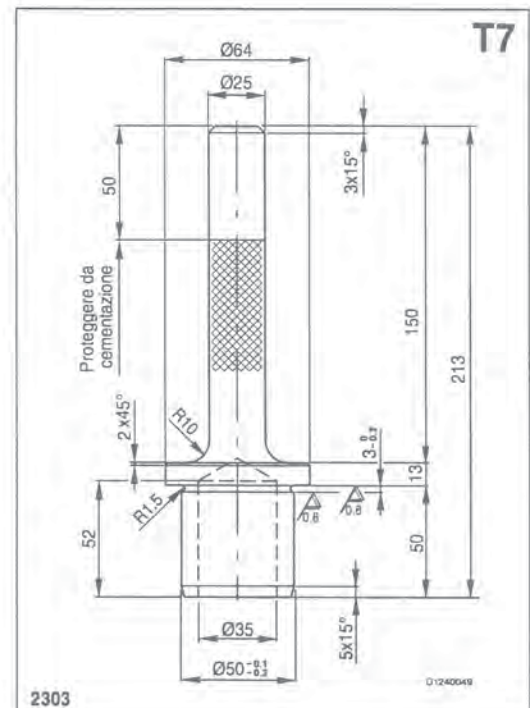
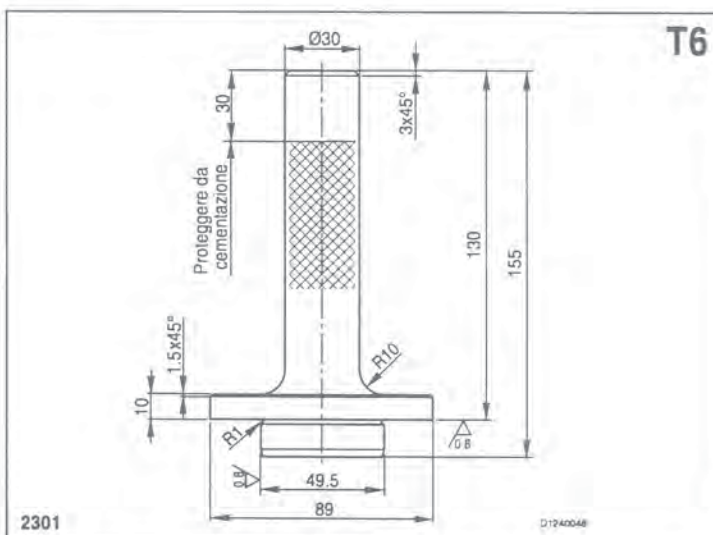
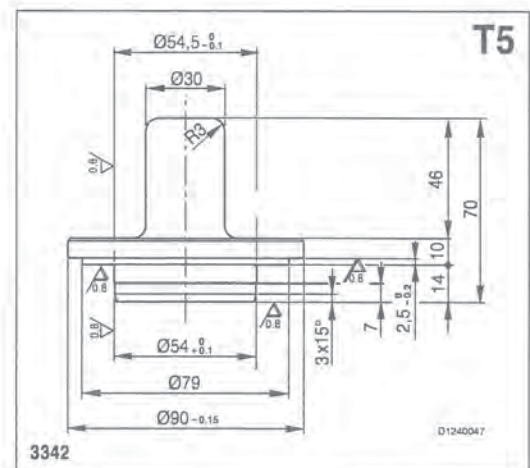
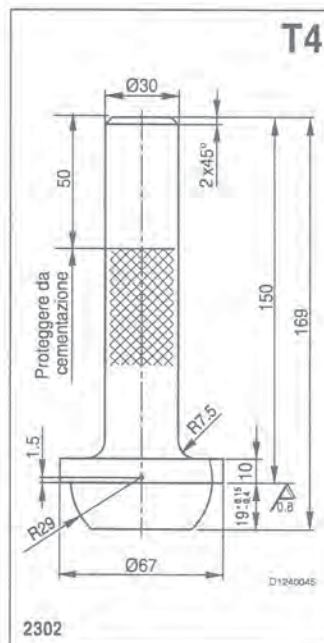
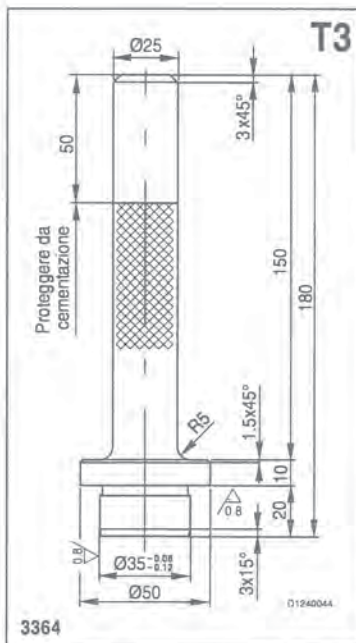
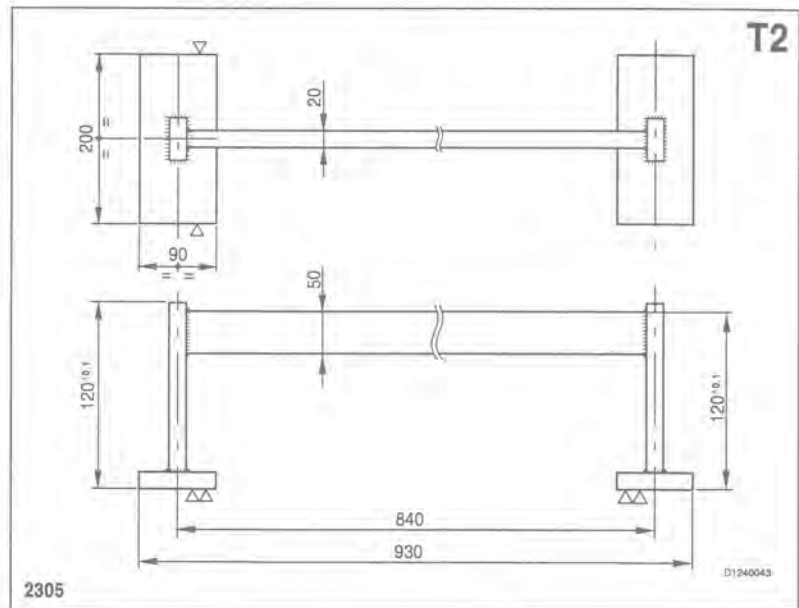
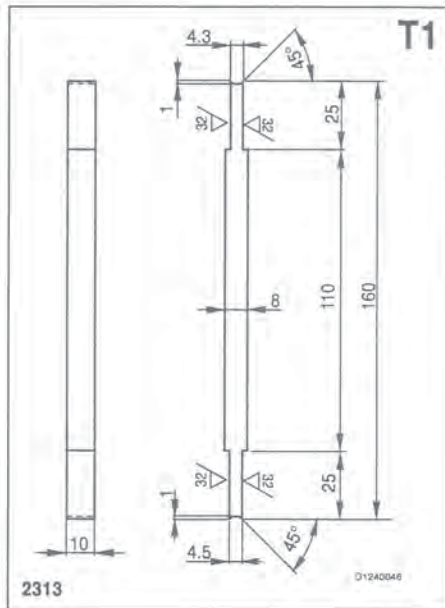
- c**
- ITA** Montare la flangia (2) completa della protezione (4) e mandarla in battuta.  
Se necessario, per il calettamento della flangia (2), usare un mazzuolo in materiale plastico.  
**NOTA:** Controllare che la protezione (4) sia ben forzata sulla flangia e che non sia deformata.
- D** Flansch (2) samt Schutzteil (4) montieren und bis zum Anschlag bringen.  
Wenn nötig, den Flansch (2) mit einem Gummihammer einschieben.  
**BEMERKUNG:** Kontrollieren ob das Schutzteil (4) richtig auf dem Flansch sitzt und nicht verformt ist.
- ESP** Montar la brida (2) con su protección (4) y llevarla hasta el tope.  
Si fuera necesario, para ensamblar de la brida (2) usar un martillo de material plástico.  
**NOTA:** Controlar que la protección (4) está bien forzada en la brida y que no está deformada.
- F** Monter la flasque (2) équipée de protection (4), puis envoyer celle-ci en butée.  
Si besoin, pour caler la flasque (2) utiliser un maillet en matière plastique.  
**NOTE:** Veiller à ce que la protection (4) est bien forcée sur la flasque et qu'elle n'est pas déformée.

- d**
- ITA** Spalmare la porzione filettata del pignone (8) con Loctite 242.  
Montare l'attrezzo T20A (oppure T20B) ed impegnarlo per evitare la rotazione. Montare l'anello OR (3) ed il dado (1); serrare con chiave dinamometrica.  
Coppia di serraggio: 280÷310 Nm
- D** Das Gewinde des Rads (8) mit Loctite 242 schmieren. Das Werkzeug T20A (T20B) montieren und blockieren, damit es nicht drehen kann.  
O-Ring (3) und Mutter (1) montieren und mit einem Momentenschlüssel festschrauben.  
Anzugsmoment: 280÷310 Nm
- ESP** Pasar en la parte roscada del piñón (8) Loctite 242. Montar la herramienta T20A (o T20B) y bloquearla para evitar la rotación.  
Montar el anillo OR (3) y la tuerca (1) y apretarlos con llave dinamométrica.  
Par de torsión: 280÷310 Nm
- F** Enduire la partie filetée du pignon (8) avec du Loctite 242. Monter et fixer l'outil T20A (ou T20B) pour éviter la rotation.  
Monter le OR (3) et l'écrou (1), puis serrer à l'aide de la clé dynamométrique.  
Couple de serrage: 280÷310 Nm

- e**
- ITA** Asportare i blocchi T23 montati per l'estrazione del pignone e rimontare i bracci.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Blöcke T23 abnehmen, die zum Herausnehmen des Rads montiert wurden und Arme wieder montieren.  
Siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Sacar los bloques T23 montados para la extracción del piñón y volver a montar los brazos.  
Para los detalles, véase «CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO».
- F** Enlever les blocs T23 montés pour l'extraction des pignons, puis remonter les bras.  
Pour de plus amples détails, voir «CONTROLE DE L'USURE ET SUBSTITUTION DES FREINS».



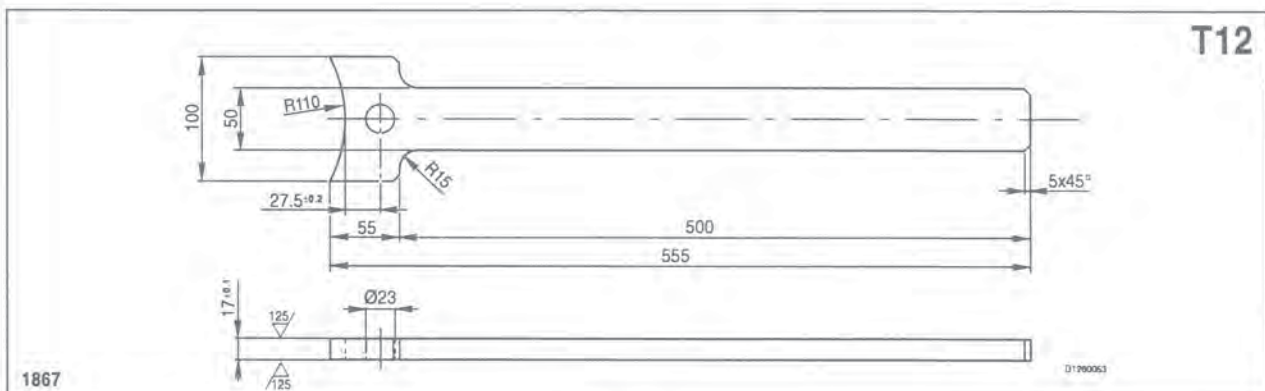
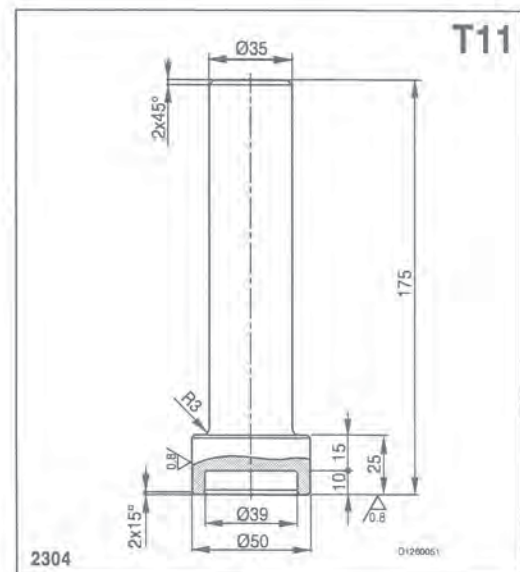
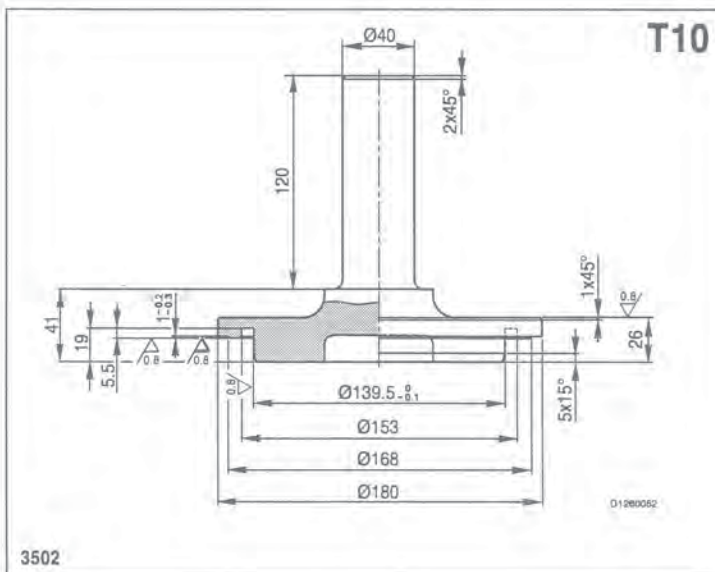
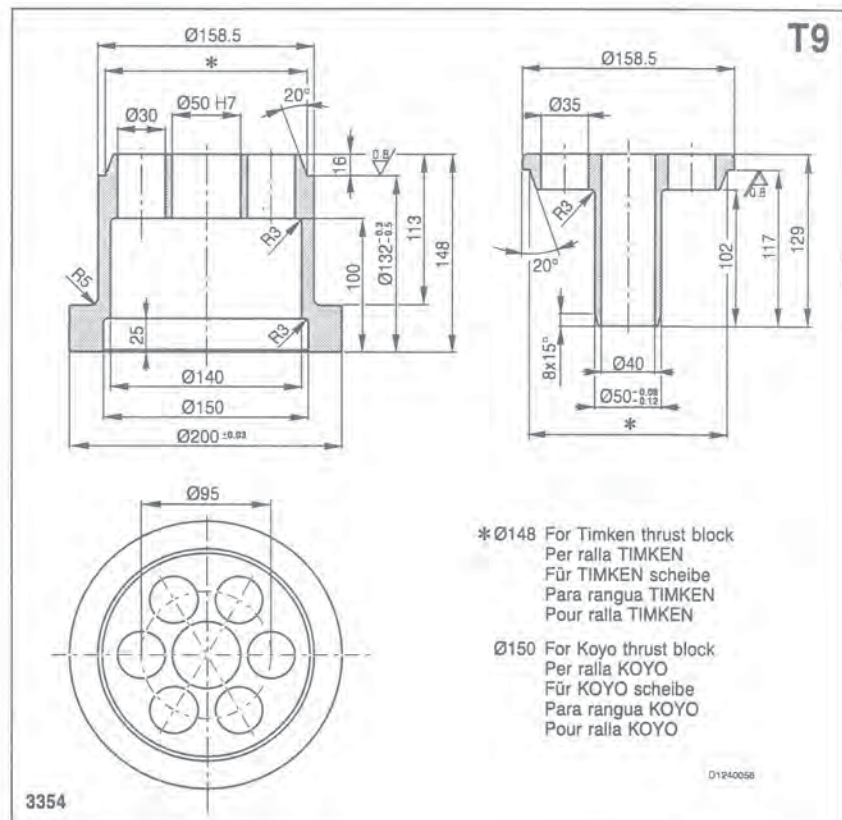
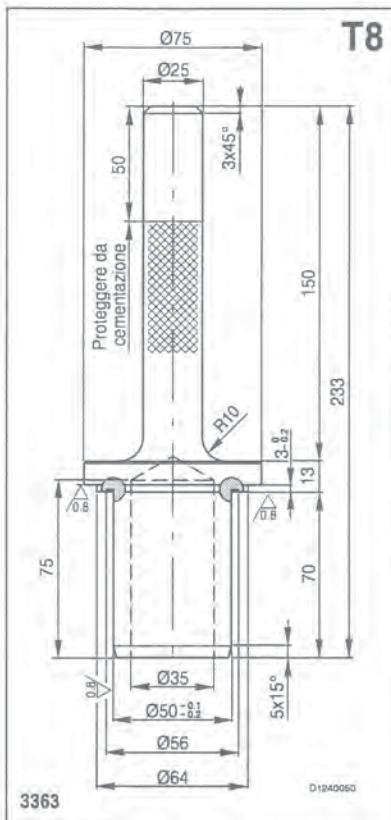
SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZGEUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL





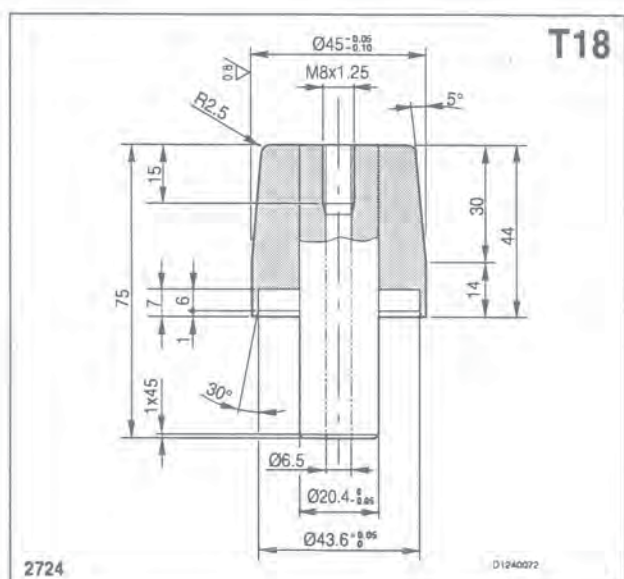
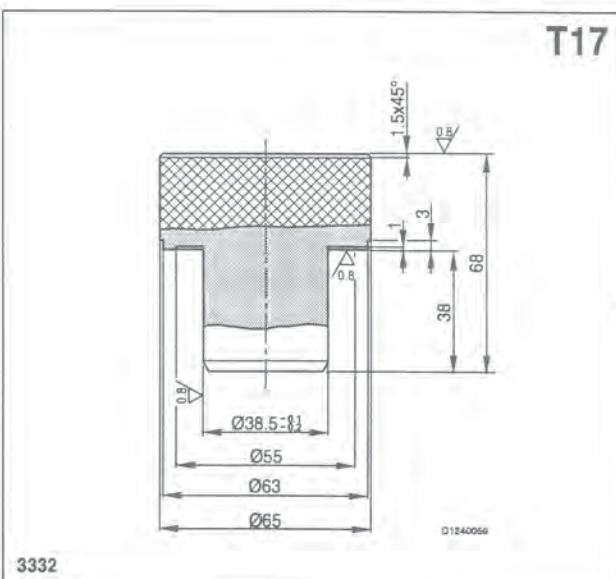
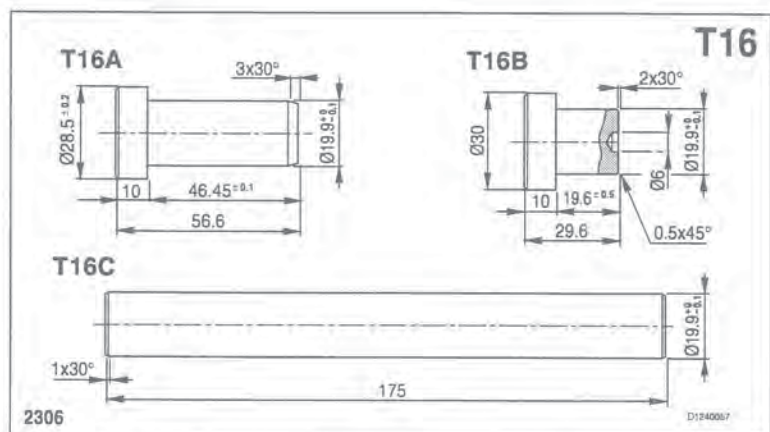
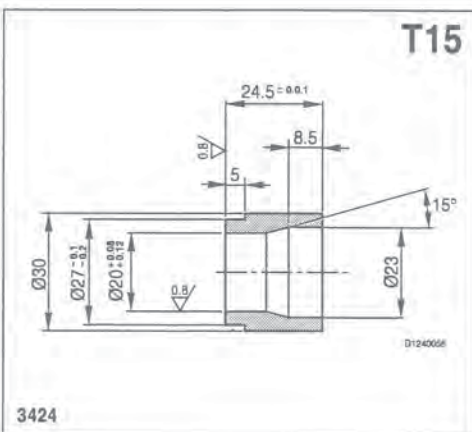
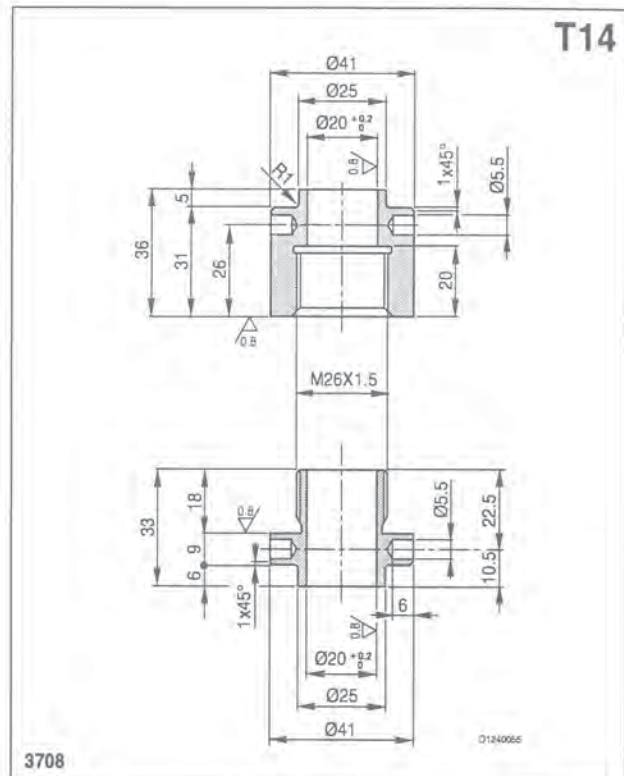
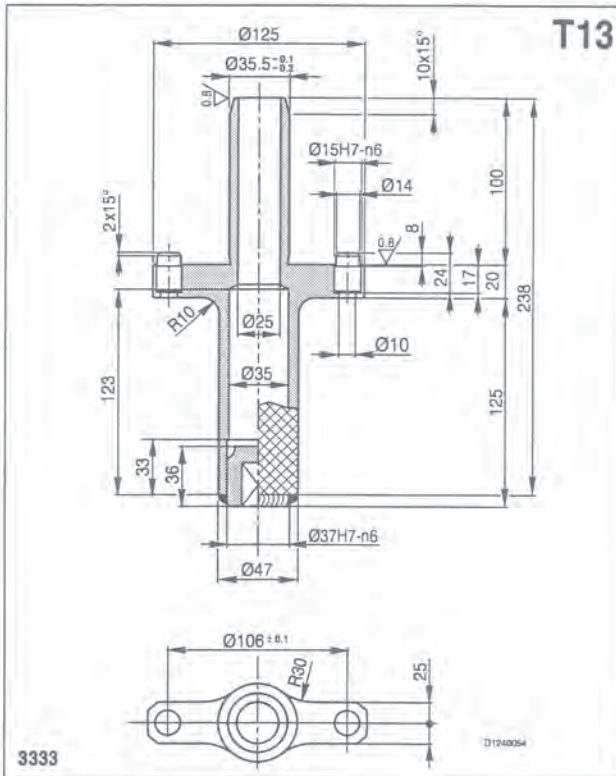


SPICER CLARK-HURTH





SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZGEUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL

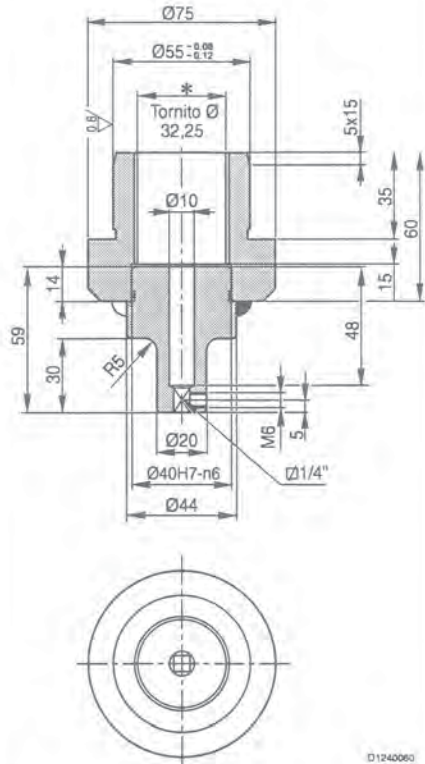






## T19

\* 38x1.25x29 DIN 5480

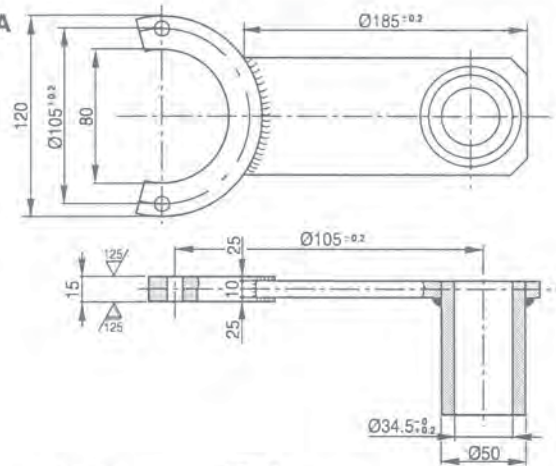


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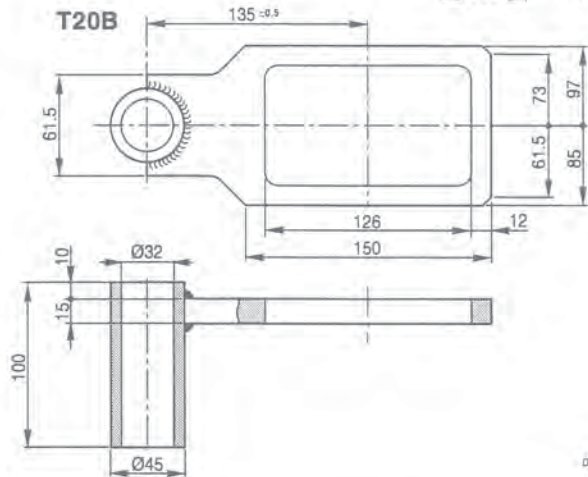
## T20

T20A



2307

T20B

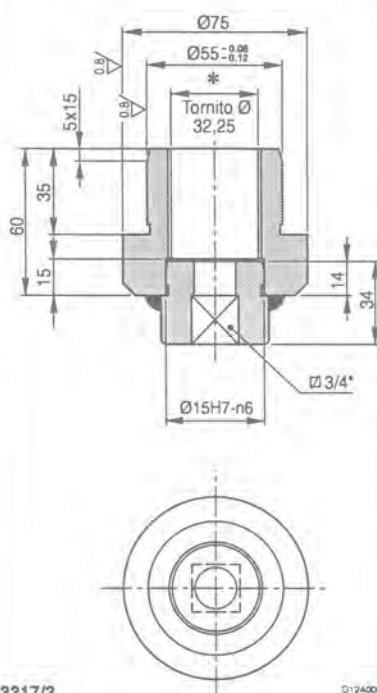


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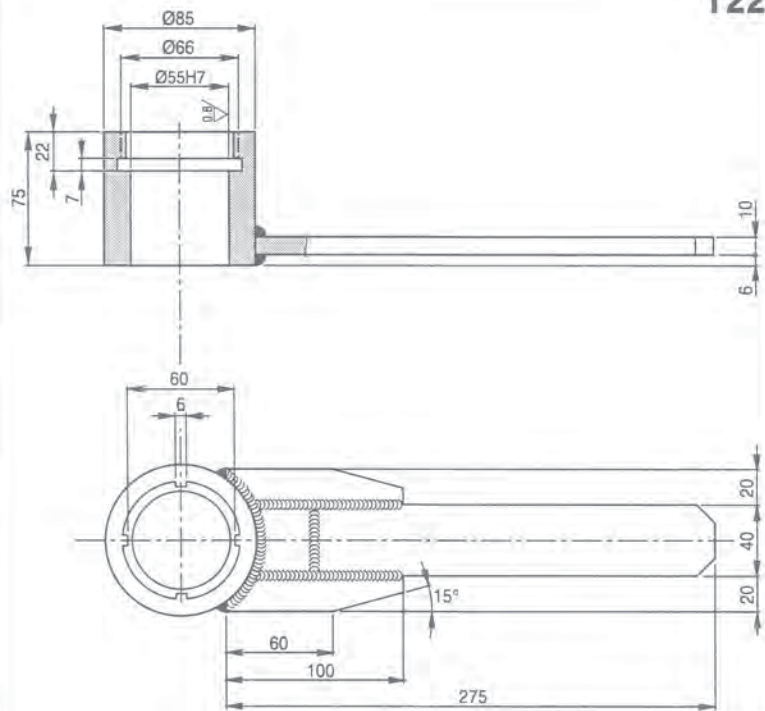
\* 38x1.25x29 DIN 5480



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## T22

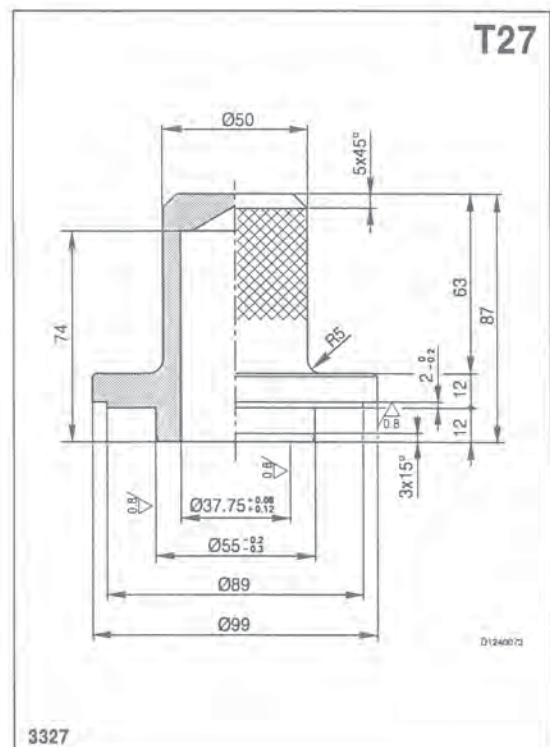
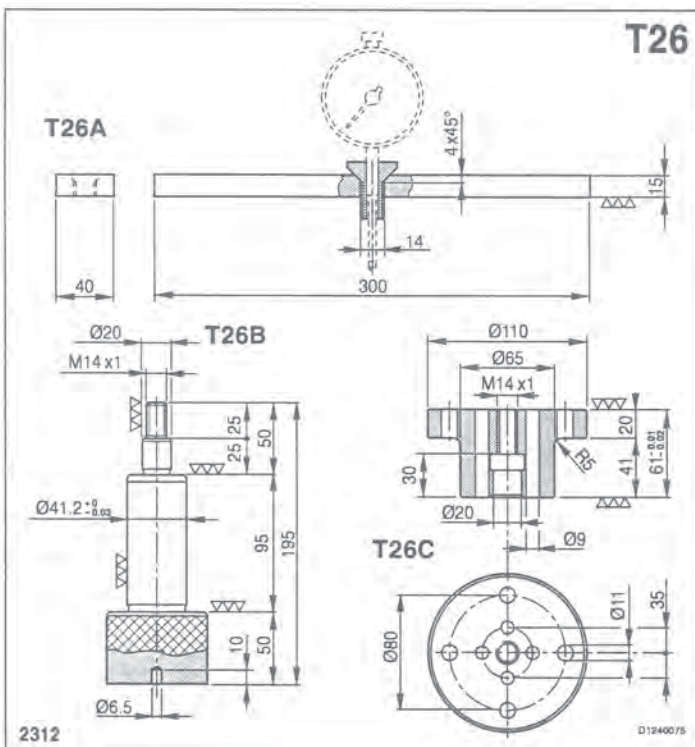
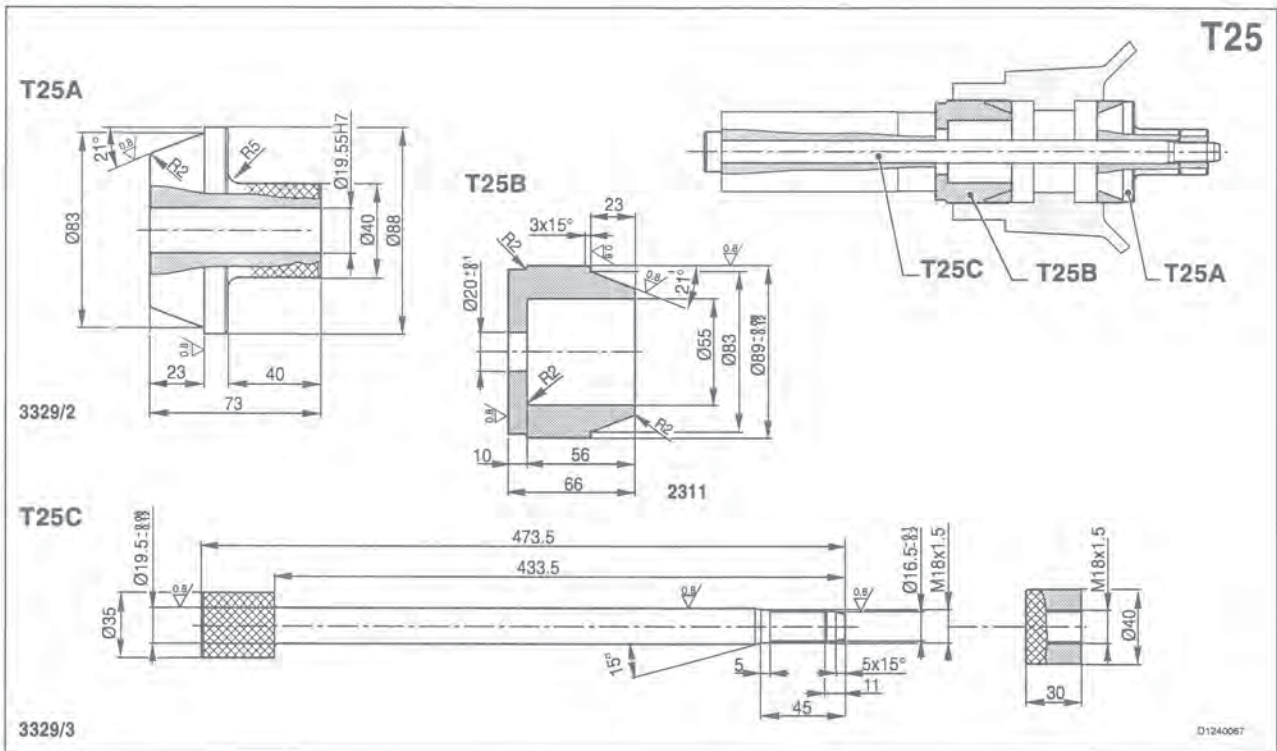
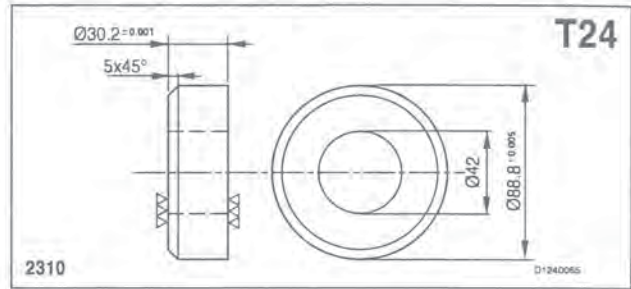
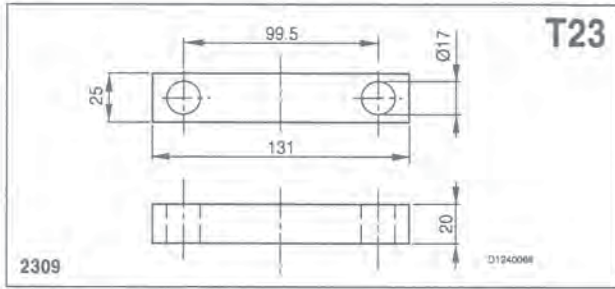


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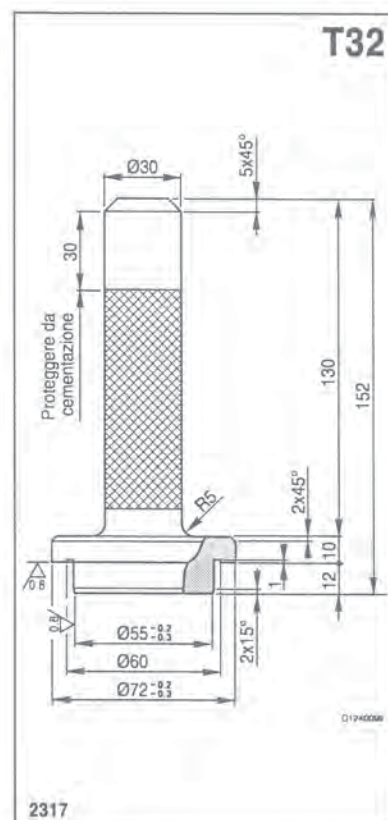
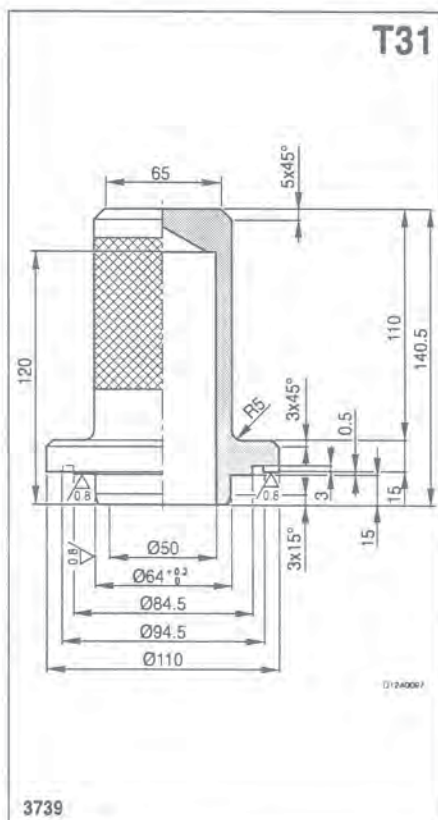
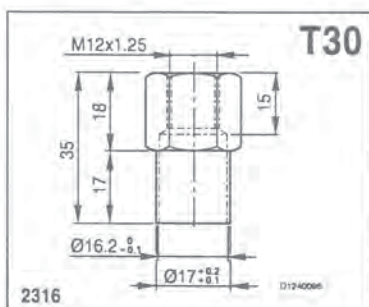
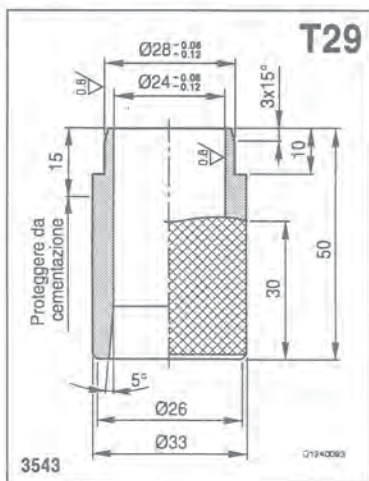
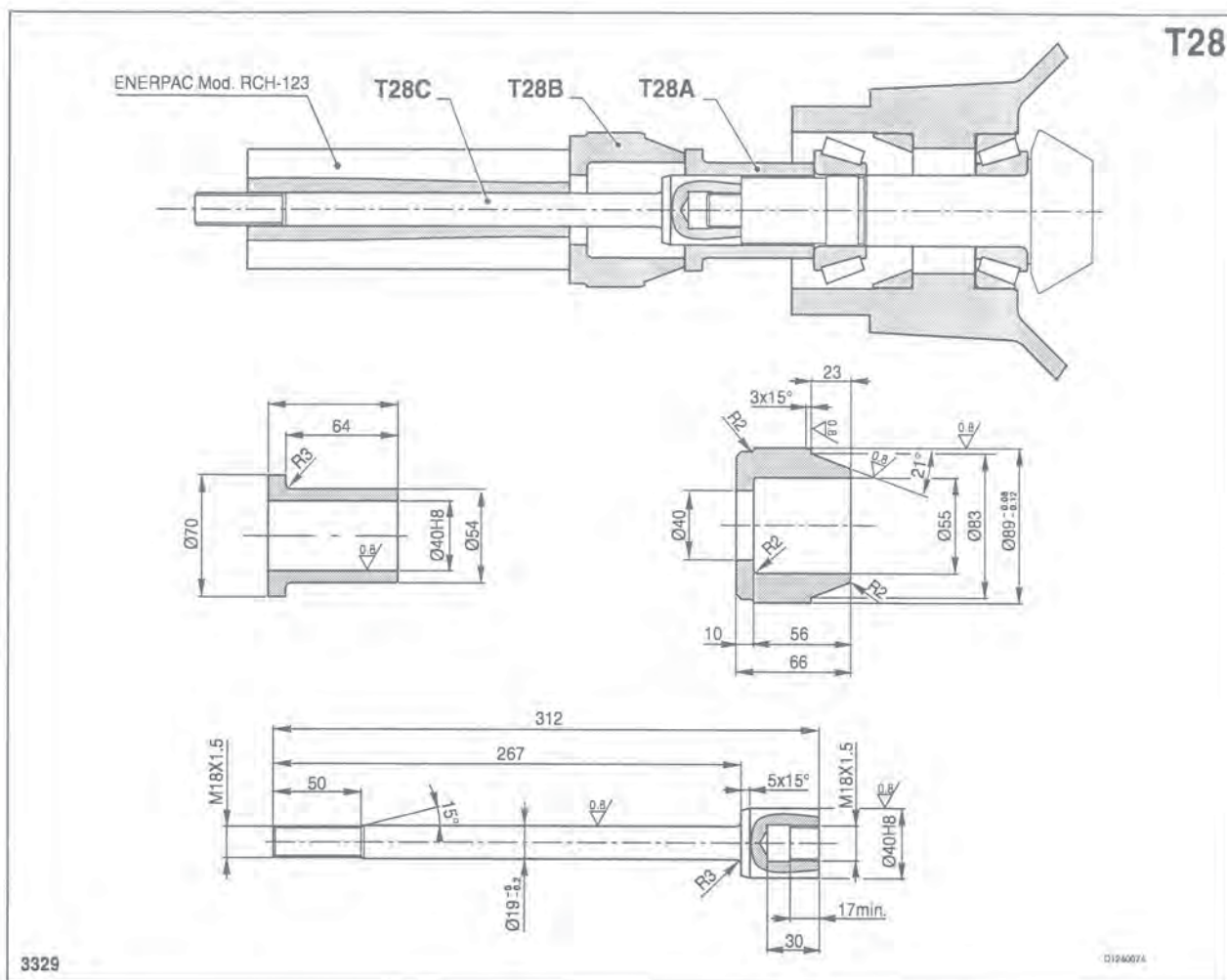
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SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZGEUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL













| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                  | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                            | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Insufficient braking<br/>Frenatura insufficiente<br/>Ungenügende Bremswirkung<br/>Frenado insuficiente<br/>Freinage insuffisant</p> | <p>1. Incorrect adjustment</p> <p>1. Incorretta registrazione</p> <p>1. Fehlerhafte Einstellung</p> <p>1. Ajuste incorrecto</p> <p>1. Mauvais réglage</p>                                                              | <p>Inspect disc thickness and if discs are usable read-just brakes to the specifications in the vehicle's manual.</p> <p>Controllare lo spessore dei dischi freno e, se i dischi freno possono essere riutilizzati, registrarli come da istruzioni del manuale del veicolo.</p> <p>Bremsscheibenstärke überprüfen, koennen die Bremscheiben noch verwendet werden, Spiel neu einstellen gemäß Anweisungen im Handbuch des Fahrzeuges.</p> <p>Controlar el espesor de los discos del freno y, si los discos del freno pueden volver a utilizarse, ajustarlos de acuerdo con las instrucciones del manual del vehículo.</p> <p>Inspecter l'épaisseur des disques frein et, si les disques frein sont en bon état, régler selon les instructions du manuel du véhicule.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                        | <p>2. Brake discs worn out</p> <p>2. Dischi freno usurati</p> <p>2. Bremsscheiben verschlissen</p> <p>2. Discos del freno gastados</p> <p>2. Disques frein usés</p>                                                    | <p>Inspect disc thickness and replace if necessary.</p> <p>Controllare lo spessore dei dischi freno e, se necessario, sostituirli.</p> <p>Bremsscheibenstärke überprüfen und falls erforderlich ersetzen.</p> <p>Controlar el espesor de los discos del freno y, si fuera necesario, sustituirlos.</p> <p>Inspecter l'épaisseur des disques frein et si nécessaire remplacer les disques.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                        | <p>3. Incorrect brake fluid</p> <p>3. Fluido non idoneo nel circuito</p> <p>3. Ungeeignete Flüssigkeit in der Bremsanlage</p> <p>3. Fluido no adecuado para el circuito</p> <p>3. Fluide inadéquat dans le circuit</p> | <p>Replace all seals in axle and master cylinder that have made contact with the incorrect fluid and all brake hoses.</p> <p>If incorrect fluid leaked into axle oil, seals and o-rings in axle must be replaced.</p> <p>Sostituire tutti gli anelli di tenuta del ponte e del cilindro master che sono venuti a contatto con il fluido non idoneo nonché i tubi flessibili.</p> <p>Se il fluido non idoneo è entrato nel ponte e si è mescolato con il lubrificante devono essere sostituiti tutti gli anelli di tenuta ed gli O-rings.</p> <p>Alle Dichtringe und Gummischläuche die mit der falschen Flüssigkeit in Kontakt gekommen sind, in der Achse und im Hauptbremszylinder ersetzen.</p> <p>Sollte diese Flüssigkeit auch in die Achse gelaugt sein, sind auch sämtliche O-Ringe und Dichtringe der Achse zu ersetzen.</p> <p>Sustituir todos los segmentos de compresión del puente y del cilindro principal que han estado en contacto con el fluido no adecuado como así también los tubos flexibles.</p> <p>Si el fluido no adecuado ha entrado en el puente y se ha mezclado con el lubricante, hay que sustituir todos los segmentos de compresión y los O-Rings.</p> <p>Substituer tous les joints d'étanchéité du pont et du maître-cylindre qui ont été en contact avec ce fluide mais aussi les tubes flexibles.</p> <p>Si le fluide incorrect est entré dans le pont et s'est mélangé avec le lubrifiant tous les joints d'étanchéité et o-ring doivent être changés.</p> |

| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                     | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insufficient braking<br><i>Frenatura insufficiente</i><br>Ungenügende Bremswirkung<br><i>Frenado insuficiente</i><br>Freinage insuffisant | 4. Loss of brake fluid<br><br><i>4. Perdita del fluido del circuito freno</i><br><br>4. Verlust von Bremsflüssigkeit<br><br><i>4. Pérdida del fluido del circuito del freno</i><br><br>4. Fluidé dans le circuit de freinage                                                                                                                                                                                                                                                                                                                                                                                                                | Inspect for and repair any leaks in outside circuit or master cylinder.<br>If caused by incorrect brake fluid see correction N. 3.<br>If leak is to the outside replace the o-rings between the center and intermediate housings.<br>If leak is to the inside replace above o-rings and brake piston o-rings.<br><br><i>Controllare e riparare tutte le perdite del circuito esterno o del circuito master.</i><br><i>Se la causa è dovuta al fluido non idoneo vedere rimedio n. 3.</i><br><i>Se la perdita è verso l'esterno del ponte sostituire gli O-ring tra la scatola centrale ed il coperchio intermedio.</i><br><i>Se la perdita è verso l'interno del ponte, sostituire gli O-ring sopra menzionati e quelli del pistone freno.</i><br><br>Äussere Bremsanlage und Hauptbremszylinder auf Ölverluste prüfen.<br>Sollte der Verlust auf ungeeignete Bremsflüssigkeit zurückzuführen sein, siehe Abhilfe N.3.<br>Sollte der Verlust nach aussen sein, die O-Ringe zwischen dem Achsmittengehäuse und den Zwischengehäuse ersetzen.<br>Sollte der Verlust nach innen sein, oben genannte O-Ringe und jene der Bremskolben ersetzen.<br><br><i>Controlar y reparar todas las pérdidas del circuito exterior o del cilindro principal.</i><br><i>Si la causa se debe al fluido no idóneo, véase el remedio nº3.</i><br><i>Si la pérdida es hacia fuera del puente, sustituir los O-Ring entre la caja central y la tapa intermedia.</i><br><i>Si la pérdida es hacia el interior del puente, sustituir los O-Ring mencionados más arriba y los del pistón del freno.</i><br><br>Inspecter et réparer toutes les fuites du circuit externe ou du maître-cylindre.<br>Si la cause est due à l'utilisation d'un fluide non indiqué voir remède N. 3.<br>Si la fuite est vers l'extérieur du pont, substituer les o-rings entre le carter central et les carters intermédiaires.<br>Si la fuite est vers l'intérieur du pont substituer les o-rings mentionnés ci-dessus et ceux des pistons frein. |
|                                                                                                                                           | 5. Overheated axle causing brake fluid to vaporize.<br>(Brake return when axle cools)<br><i>5. Surriscaldamento del ponte con vaporizzazione del fluido.</i><br><i>(I freni ritornano quando il ponte si raffredda)</i><br><br>5. Verdunstung der Bremsflüssigkeit wegen Überhitzung.<br>(Im abgekühlten Zustand ist die Bremswirkung wieder hergestellt)<br><br><i>5. Sobre calentamiento del puente con vaporización del fluido.</i><br><i>(Los frenos vuelven a funcionar cuando se enfría el puente)</i><br><br>5. Surchauffe du pont avec vaporisation du fluide.<br>(Les freins fonctionnent à nouveau quand le fluide se refroidit). | See «overheating» problem.<br><br><i>Vedere problema: Surriscaldamento.</i><br><br>Siehe Problem: Überhitzung.<br><br><i>Véase el problema: Sobre calentamiento.</i><br><br>Voir probleme: Surchauffe.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                       | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                             | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Soft brake pedal<br><i>Pedale del freno non risponde</i><br>Leichtes Bremspedal<br><i>El pedal del freno no funciona</i><br>Pedale du frein ne repond pas                   | 6. Air in brake circuit<br><i>6. Aria nel circuito frenante</i><br>6. Luft in der Bremsanlage<br><i>6. Aire en el circuito frenante</i><br>6. Air dans le circuit                                                       | Bleed brakes as described in the vehicle's service manual.<br><i>Spurgare il circuito frenante come da istruzioni di spurgo del manuale del veicolo.</i><br>Bremsen entlüften gemäß Anweisungen im Handbuch des Fahrzeugs.<br><i>Purgar el circuito frenante se acuerdo con las instrucciones de purga del manual del vehículo.</i><br>Purger le circuit de frein selon «instructions de purge» du manuel du véhicule. |
| Ineffective safety brake<br><i>Freno negativo inefficiente</i><br>Federspeicherbremse ohne Funktion.<br><i>Freno negativo inefficiente</i><br>Inefficacite du frein negatif | 7. Incorrect adjustment<br><i>7. Registrazione incorretta</i><br>7. Fehlerhafte Einstellung des Bremsscheibenspieles<br><i>7. Ajuste incorrecto</i><br>7. Mauvais réglage                                               | See correction N. 1.<br><i>Vedere rimedio N. 1.</i><br>Siehe Abhilfe N. 1.<br><i>Véase remedio N.1.</i><br>Voir remède N. 1.                                                                                                                                                                                                                                                                                           |
|                                                                                                                                                                             | 8. Brake disc worn out<br><i>8. Dischi freno usurati</i><br>8. Bremslamellen verschlissen<br><i>8. Discos del freno gastados</i><br>8. Usure disques frein                                                              | See correction N. 2.<br><i>Vedere rimedio N. 2.</i><br>Siehe Abhilfe N. 2.<br><i>Véase remedio N. 2.</i><br>Voir remède N. 2.                                                                                                                                                                                                                                                                                          |
| Overheating<br><i>Surriscaldamento</i><br>Überhitzung<br><i>Sobrecalentamiento</i><br>Surchauffe                                                                            | 9. Oil level wrong<br><i>9. Livello olio non corretto</i><br>9. Niedriger Ölspiegel-Falscher Ölstand<br><i>9. Nivel de aceite no correcto</i><br>9. Niveau d'huile pas incorrect                                        | Drain, flush and refill oil to proper level.<br><i>Scaricare, eseguire un lavaggio e riempire d'olio fino a livello.</i><br>Öl ablassen, reinigen und richtigen Ölstand wieder herstellen.<br><i>Descargar, ejecutar un lavado y llenar con aceite hasta el nivel.</i><br>Vidanger, rincer et refaire le niveau d'huile.                                                                                               |
|                                                                                                                                                                             | 10. Too small of a brake gap<br><i>10. Poco gioco tra i dischi freno</i><br>10. Zu wenig Spiel zwischen den Bremslamellen<br><i>10. Poco juego entre los discos del freno</i><br>10. Peu de jeu entre les disques frein | Readjust brakes to the specifications in the vehicle's service manual.<br><i>Registare il freno come istruzioni da manuale del veicolo.</i><br>Spiel gemäß Anweisungen im Handbuch des Fahrzeuges herstellen.<br><i>Ajustar el freno de acuerdo con las instrucciones del manual del vehículo</i><br>Regler le frein selon les instructions du manuel du véhicule.                                                     |
|                                                                                                                                                                             | 11. Park brake dragging<br><i>11. Freno di parcheggio in trazione</i><br>11. Feststellbremse zieht<br><i>11. Freno de estacionamiento en tracción</i><br>11. Frein de parc mal réglé                                    | Unlock the brake and adjust the correct gap.<br><i>Sbloccare il freno ripristinando il gioco corretto.</i><br>Bremsen lösen und richtiges Lamellenspiel einstellen.<br><i>Desbloquear el freno restableciendo el juego correcto.</i><br>Débloquer le frein et régler le jeu.                                                                                                                                           |



TROUBLESHOOTING - RICERCA GUASTI - FEHLERSUCHE - BUSQUEDA DE AVERIAS - RECHERCHE DES PANNES

| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                            | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                             | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| Overheating<br><i>Surriscaldamento</i><br>Überhitzung<br><i>Sobrecalentamiento</i><br>Surchauffe | 12. Incorrect brake fluid in system<br><i>12. Fluido non idoneo nel circuito</i><br>12. Ungeeignete Flüssigkeit in der Bremsanlage<br><i>12. Fluido no adecuado en el circuito</i><br>12. Fluide incorrect dans le circuit                                                                                              | See correction N. 3.<br><i>Vedere rimedio N. 3.</i><br>Siehe Abhilfe N. 3.<br><i>Véase remedio N. 3</i><br>Voir remède N. 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                  | 13. No free-pedal at master cylinder<br><i>13. Non c'è corsa a vuoto sul cilindro master</i><br>13. Kein Leerweg am Bremspedal<br><i>13. No hay carrera en vacío en el cilindro principal</i><br>13. Pas de garde sur la pedale du maître-cylindre                                                                      | Readjust brake pedal as described in the vehicle's service manual.<br><i>Registare il pedale del freno come istruzioni da manuale del veicolo.</i><br>Bremspedal gemäß Anweisungen im Handbuch des Fahrzeuges einstellen.<br><i>Ajustar el pedal del freno de acuerdo con las instrucciones del manual del vehículo.</i><br>Régler la pedale du frein selon les instructions du manuel du véhicule.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                  | 14. Restriction in brake lines<br><i>14. Restringimento sul circuito del freno</i><br>14. Verengung in der Bremsanlage<br><i>14. Circuito del freno restringido</i><br>14. Reglage sur circuit du frein                                                                                                                 | Inspect for and replace damage lines.<br><i>Controllare e riparare i condotti ammaccati o piegati.</i><br>Anlage überprüfen und verbeulte oder geknickte Leitungen ersetzen.<br><i>Controlar y reparar los conductos golpeados o plegados.</i><br>Inspecter et réparer les conduites endommagées.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                  | 15. Restriction in return line of brake Servo system<br><i>15. Restringimento sul condotto di ritorno del sistema servo</i><br>15. Verengung in der Rückflussleitung des Servobremssystems<br><i>15. Conducto de retorno del sistema servo restringido</i><br>15. Etranglement sur la conduite de retour du servo-frein | Inspect for and replace damaged return line.<br>Inspect for and remove any filter, tee'd in line or any other source of back pressure from the return line.<br><i>Controllare e riparare il condotto ammaccato o piegato. Controllare e sostituire tutti i filtri e raccordi sul circuito o qualsiasi altro ostacolo nel condotto di ritorno.</i><br>Anlage überprüfen und verbeulte oder geknickte Leitungen ersetzen.<br>Alle Filter und Abzweigungen in der Anlage überprüfen, sämtliche Hindernisse für den freien Durchfluß entfernen.<br><i>Controlar y reparar el conducto golpeado o plegado. Controlar y sustituir todos los filtros y empalmes en el circuito o cualquier otro obstáculo en el conducto de retorno.</i><br>Inspecter et réparer la conduite endommagée.<br>Inspecter et changer tous les filtres, raccords en «T» ou autre obstacle sur le circuit de retour. |
|                                                                                                  | 16. Incorrect lubricant<br><i>16. Lubrificante non idoneo</i><br>16. Ungeeignetes Schmieröl<br><i>16. Lubrificante no adecuado</i><br>16. Lubrifiant incorrect                                                                                                                                                          | Change the retaining rings of the brake circuit and brake pump.<br><i>Sostituire gli anelli di tenuta del circuito freno e della pompa freno.</i><br>Die Abdichtungsringe des Bremskreislafs der Bremspumpe ersetzen.<br><i>Sustituir los segmentos de compresión del circuito del freno y de la bomba del freno.</i><br>Remplacer les anneaux d'étanchéité du circuit et de la pompe de frein.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                        | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                         |
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| Diff-lock inoperative<br><i>Il blocco differenziale non funziona</i><br>Differentialsperre ohne Wirkung<br><i>El bloque del diferencial no funciona</i><br>Mauvais fonctionnement du blocage du différentiel | 17. If manual control, loose or misadjusted linkage<br>17. <i>Se il comando è manuale: comando scollegato o registrato male</i><br>17. Bei mechanisch betätigter Sperre, loser oder schlecht eingestellter Hebel<br>17. <i>Si el mando es manual: mando desconectado o mal ajustado</i><br>17. Si la commande est manuel: commande déconnectée ou mal réglée                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Inspect and correct linkage and readjust as indicated in vehicle's service manual.<br>Controllare, riparare e registrare il comando indicato nel manuale del veicolo.<br>Hebel überprüfen und gemäß Anweisungen im Handbuch des Fahrzeuges einstellen.<br>Controlar, reparar y ajustar el mando indicado en el manual del vehículo.<br>Inspecter, réparer et régler la commande selon le manuel du véhicule. |
|                                                                                                                                                                                                              | 18. If hydraulic control, problems in the hydraulic or electrical circuits of the vehicle<br>18. <i>Se il comando è idraulico: problemi nel circuito elettrico del veicolo</i><br>18. Bei hydraulisch betätigter Sperre, Probleme in der hydraulischen oder elektrischen Anlage des Fahrzeuges<br>18. <i>Si el mando es hidráulico: problemas en el circuito eléctrico del vehículo</i><br>18. Si la commande est hydraulique: problème dans le circuit électrique dans le véhicule                                                                                                                                                                                                                                                                                                                                    | Refer to the service manual for the vehicle.<br>Fare riferimento alle istruzioni nel manuale del veicolo.<br>Siehe Anweisungen im Handbuch des Fahrzeuges.<br>Consultar las instrucciones del manual del vehículo.<br>Voir instructions dans manuel du véhicule.                                                                                                                                             |
|                                                                                                                                                                                                              | 19. If hydraulic control: problems in actuating cylinder (noteable through loss of hydraulic oil or increase of the oillevel in axle)<br>19. <i>Se il comando è idraulico: problemi nell'attuatore (caratterizzati da perdite del fluido idraulico o da aumento del livello d'olio nel ponte)</i><br>19. Bei hydraulisch betätigter Sperre, Ölverlust im Betätigungszylinder (erkentlich durch Verlust von hydraulisch Flüssigkeit oder Anstieg des Ölniveaus in der Achse)<br>19. <i>Si el mando es hidráulico: problemas en el actuador (caracterizados por pérdidas del fluido hidráulico o por un aumento del nivel del aceite en el puente)</i><br>19. Si la commande est hydraulique: problèmes dans le vérin (caractérisés par des fuites de fluide hydraulique ou augmentation du niveau d'huile dans le pont) | Rebuilt cylinder.<br>Controllare e riparare il cilindro.<br>Überprüfen und Zylinder reparieren.<br>Controlar y reparar el cilindro.<br>Inspecter et réparer le cylindre.                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                              | 20. If with lim. slip differential, worn discs<br>20. <i>Se il differenziale è del tipo autobloccante, dischi usurati</i><br>20. Wenn mit Selbstsperrdifferential, Scheiben verschlissen<br>20. <i>Si el diferencial es del tipo autobloqueante: discos gastados</i><br>20. Si avec différentiel à glissement limité, usure sur les disques                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Replace discs.<br>Sostituire i dischi.<br>Scheiben ersetzen.<br>Sustituir los discos.<br>Remplacer les disques.                                                                                                                                                                                                                                                                                              |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Oil coming out of breather<br><i>Olio fuoriesce dallo sfiato</i><br><i>Ölaustritt aus dem Entlüfter</i><br><i>El aceite sale del purgador</i><br><i>Huile sort du reniflard</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 21. Leak in internal brake system<br><i>21. Perdita di fluido idraulico dal sistema frenante</i><br>21. Verlust von hydraulisch Flüssigkeit der Bremsanlage<br><i>21. Pérdida de fluido hidráulico del sistema frenante</i><br>21. Fuite de fluide hydraulique du système de freinage                                                                                                                                                                                                                                                                                                                                                                                                                                          | See correction N. 2 and 3.<br><i>Vedere rimedio N. 2 e 3.</i><br>Siehe Abhilfe N. 2 und 3.<br><i>Véanse remedios N. 2 y 3.</i><br>Voir remède N. 2 et 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 22. Leak in diff-lock actuating cylinder<br><i>22. Perdita d'olio idraulico dal circuito del blocco differenziale</i><br>22. Verlust von Hydraulisch Flüssigkeit der hydraulisch Anlage der Differentialsperre<br><i>22. Pérdida de aceite hidráulico del circuito del bloque del diferencial</i><br>22. Fuite d'huile hydraulique du circuit de blocage du différentiel                                                                                                                                                                                                                                                                                                                                                       | See correction N. 19.<br><i>Vedere rimedio N. 19.</i><br>Siehe Abhilfe N. 19.<br><i>Véase remedio N. 19.</i><br>Voir remède N. 19.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| NoSpin indexing noise when driving straight<br><b>CAUTION!</b> With NoSpin, fatigue damage can occur on the side with the larger tire.<br><i>Il NoSpin è rumoroso viaggiando sul rettilineo</i><br><b>ATTENZIONE!</b> Con il NoSpin possono verificarsi avarie da fatica sul lato con il pneumatico più grande.<br>NoSpin macht Geräusche bei Geradeausfahrt<br><b>ACHTUNG!</b> Mit NoSpin können auf der Seite mit dem grösseren Reifenradius Ermüdungsschäden auftreten.<br><i>El NoSpin hace ruido andando en un rectilíneo</i><br><b>CUIDADO!</b> con el No Spin se pueden producir averías por fatiga en un lado en el neumático más grande.<br>Le No-Spin fait du bruit en roulant en ligne droite<br><b>ATTENTION!</b> Avec le NoSpin, des ruptures de fatigue peuvent se produire du côté des pneumatiques les plus grands. | 23. Unequal tire pressure left and right<br><i>23. Pressione disuguale nei pneumatici sui due lati</i><br>23. Ungleichmässiger Reifendruck links und rechts<br><i>23. Presión desigual en los neumáticos a ambos lados</i><br>23. Pressions différentes dans les pneumatiques sur les deux côtes du véhicule<br>24. Different style, size or brand of tires between left and right hand side<br><i>24. Pneumatico di disegno, marca o costruttore diversi sui due lati</i><br>24. Unterschiedliche Reifen, -größen - marken, links und rechts<br><i>24. Neumáticos de diseño, marca o fabricante distintos a los dos lados</i><br>24. Pneumatiques de sculptures ou de constructeurs différents sur les deux côtes du véhicule | Inflate tires to the recommended pressure in the service manual, or until the rolling radius is equal.<br><i>Gonfiare i pneumatici alla pressione raccomandata nel manuale o comunque fino ad ottenere un raggio statico uguale.</i><br>Reifen vorschriftsgemäß aufpumpen bis ein gleichgroßer statischer Halbmesser erreicht wird.<br><i>Hinchar los neumáticos a la presión recomendada en el manual o, de todas formas, hasta obtener un rayo estático igual.</i><br>Gonfler les pneumatiques selon la pression recommandée dans le manuel ou jusqu'à obtenir le même rayon sous charge.<br>Change tires to make the rolling radius equal.<br>Vary the tire pressure within the specifications until the rolling radius is equal.<br><i>Cambiare pneumatici o rendere i raggi statici dei pneumatici eguali.</i><br><i>Variare la pressione dei pneumatici nei campi di tolleranza prescritti dai costruttori dei pneumatici stessi, fino ad ottenere un raggio statico uguale.</i><br>Reifen ersetzen sodaß ein gleichgroßer Statischer Halbmesser erreicht wird.<br>Reifendruck im Bereich der Vorschriften ändern bis ein gleichgroßer Halbmesser erreicht wird.<br><i>Cambiar los neumáticos o hacer que los rayos estáticos de los neumáticos sean iguales.</i><br><i>Variar la presión de los neumáticos en los campos de tolerancia prescritos por los fabricantes de dichos neumáticos, hasta obtener un radio estático igual.</i><br>Changer les pneumatiques ou rendre les rayons sans charge des pneumatiques égaux.<br>Modifier la pression des pneumatiques dans les tolérances prescrites par les constructeurs de ces mêmes pneumatiques, jusqu'à obtenir un rayon sous charge identique. |



| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                        | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                             | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                               |
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| Noise during coast and under<br>power the same<br><i>Rumorosità uguale sia in tiro<br/>che in rilascio</i><br>Geräusch im Zug und im<br>Schub gleich stark<br><i>Ruido igual tanto en tracción<br/>como en inercia</i><br>Bruit en traction ou en retenue                    | 25. Wheel bearings damaged<br><i>25. Cuscinetti dei mozzi danneggiati</i><br>25. Lager der Radnaben beschädigt<br><i>25. Cojinetes de los cubos dañados</i><br>25. Roulements des moyeux endom-<br>magés                                                                                                                | Replace and adjust.<br><i>Sostituire i particolari in avaria.</i><br>Beschädigte Teile gemäß Anweisungen.<br><i>Sostituire las piezas averiadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                          |
| Noise under power greater<br>than during coast<br><i>Rumorosità più elevata in tiro<br/>piuttosto che in rilascio</i><br>Geräusch stärker im Zug als<br>im Schub<br><i>Ruido más elevado en tracción<br/>que en inercia</i><br>Bruit pus éleve en traction<br>qu'en retenue. | 26. Low oil level<br><i>26. Livello olio basso</i><br>26. Niedriger Ölstand<br><i>26. Nivel de aceite bajo</i><br>26. Niveau d'huile insuffisant                                                                                                                                                                        | Refill oil to proper level.<br><i>Ripristinare il livello olio.</i><br>Schmieröl nachfüllen bis richtiger Ölstand wieder<br>hergestellt ist.<br><i>Restablecer el nivel del aceite.</i><br>Refaire le niveau d'huile.                                                                                                                                                                              |
|                                                                                                                                                                                                                                                                              | 27. Incorrect lubricant<br><i>27. Olio non idoneo</i><br>27. Ungeeignetes Schmieröl<br><i>27. Aceite no adecuado</i><br>27. Huile incorrect                                                                                                                                                                             | See correction N. 16.<br><i>Vedere rimedio N. 16.</i><br>Siehe Abhilfe N. 16.<br><i>Véase remedio N. 16.</i><br>Voir remède N. 16.                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                              | 28. Ring and pinion worn<br><i>28. Coppia conica usurata</i><br>28. Kegel- und Tellerrad verschlissen<br><i>28. Par cónico gastado</i><br>28. Usure du couple conique                                                                                                                                                   | Inspect through top cover. Replace and adjust.<br><i>Controllare attraverso il coperchio superiore.</i><br><i>Sostituire la coppia conica.</i><br>Durch die obere Bohrung überprüfen. Kegel- und Tel-<br>lerrad ersetzen.<br><i>Controlar a través de la tapa superior.</i><br><i>Sustituir el par cónico.</i><br>Inspectionner au travers du couvercle supérieur.<br>Remplacer le couple conique. |
|                                                                                                                                                                                                                                                                              | 29. Worn ring and pinion bearings<br><i>29. Cuscinetti della coppia conica<br/>usurati</i><br>29. Kegelrollenlager des Kegel- und<br>Tellerradpaares verschlissen<br><i>29. Cojinetes del par cónico gastados</i><br>29. Usure des roulements du couple<br>conique                                                      | Replace and adjust.<br><i>Sostituire i particolari in avaria.</i><br>Beschädigte Teile ersetzen.<br><i>Sostituire las piezas averiadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                              | 30. Worn planetary gears or bearings<br><i>30. Planetari o cuscinetti dell'epiciclo-<br/>dale usurati</i><br>30. Planetenräder oder Lager der Pla-<br>netenabtriebe verschlissen<br><i>30. Planetarios y cojinetes del epiciclo-<br/>dal gastados</i><br>30. Usure des planétaires ou roule-<br>ment de l'épicycloïdale | Replace.<br><i>Sostituire i particolari in avaria.</i><br>Beschädigte Teile ersetzen.<br><i>Sostituire las piezas averiadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                                              |





| PROBLEM - PROBLEMA - PROBLEM - PROBLEMA - PROBLEME                                                                                                                                                                                                                                                                                                                | CAUSE - CAUSE - URSACHE - CAUSAS - CAUSE                                                                                                                                                                                                                                                                                  | CORRECTION - RIMEDI - ABHILFE - REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| <p>Noise during coast greater than under power</p> <p><i>Rumorosità più elevata in rilascio piuttosto che in tiro</i></p> <p>Geräusch stärker im Schub als im Zug</p> <p><i>Ruido más elevado en inercia que en tracción</i></p> <p>Bruit plus élevé en retenue qu'en traction</p>                                                                                | <p>31. Loose pinion nut</p> <p><i>31. Ghiera pignone allentata</i></p> <p>31. Wellenmutter des Kegelritzels lose</p> <p><i>31. Virola del piñón floja</i></p> <p>31. Ecou du pinion dévissé</p>                                                                                                                           | <p>Inspect ring, pinion and pinion bearings. If undamaged, retighten nut.</p> <p><i>Controllare la coppia conica ed i rispettivi cuscinetti, se non fossero danneggiati serrare la ghiera.</i></p> <p>Kegel- und Tellerrad und Lager überprüfen. Sollten diese nicht beschädigt sein, Wellenmutter anziehen.</p> <p><i>Controlar el par cónico y los cojinetes correspondientes.</i></p> <p>Inspecter le couple conique et les roulements et si rien n'est endommagé, resserrer l'écrou.</p>                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                   | <p>32. Only pinion bearing damaged</p> <p><i>32. Solo un cuscinetto del pignone è danneggiato</i></p> <p>32. Nur eines der Lager des Kegelritzels ist beschädigt</p> <p><i>32. Sólo un cojinete del piñón está dañado</i></p> <p>32. Seulement un roulement du pignon est endommagé</p>                                   | <p>See correction N. 29.</p> <p><i>Vedere rimedio N. 29.</i></p> <p>Siehe Abhilfe N. 29.</p> <p><i>Véase remedio N. 29.</i></p> <p>Voir remède N. 29.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p>Noise during turn (without NoSpin)</p> <p><i>Rumore sotto sterzo (senza NoSpin)</i></p> <p>Geräusch während der Kurvenfahrt (ohne NoSpin)</p> <p><i>Ruido en la dirección (sin NoSpin)</i></p> <p>Bruit en braquage (sans NoSpin)</p>                                                                                                                          | <p>33. Worn spider and/or side gears</p> <p><i>33. Satelliti e/o planetari del differenziale danneggiati</i></p> <p>33. Ausgleich kegelräder und/oder welleräder verschlissen</p> <p><i>33. Satélites y/o planetarios del diferencial dañados</i></p> <p>33. Satellites et/ou planétaires du différentiel endommagées</p> | <p>Replace.</p> <p><i>Sostituire i particolari danneggiati.</i></p> <p>Beschädigte Teile ersetzen.</p> <p><i>Sustituir las piezas dañadas.</i></p> <p>Remplacer les pièces endommagées.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>A «Stick slip» noise when going from forward to reverse</p> <p><i>Un rumore tipo «Stick slip» si manifesta durante l'inversione di marcia</i></p> <p>«Stick slip» -Geräusch bei Änderung der Fahrtrichtung</p> <p><i>Un ruido tipo «Stick slip» se manifiesta al invertir la marcha</i></p> <p>Un bruit type «Stick slip» se manifeste pendant l'inversion</p> | <p>34. Worn or damaged cardanshaft</p> <p><i>34. Giunto cardanico danneggiato</i></p> <p>34. Kardanwelle beschädigt</p> <p><i>34. Junta cardánica dañada</i></p> <p>34. Joint cardan endommagé</p>                                                                                                                        | <p>Inspect and replace as described in vehicle's service manual.</p> <p><i>Controllare e sostituire il giunto come indicato nel manuale del veicolo.</i></p> <p>Überprüfen und Kardanwelle gemäß. Anweisungen im Handbuch des Fahrzeuges ersetzen.</p> <p><i>Controlar y sustituir la junta como se indica en el manual del vehículo.</i></p> <p>Inspecter et remplacer le joint cardan selon les indications du manuel du véhicule.</p>                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                   | <p>35. Loose wheel</p> <p><i>35. Ruota allentata</i></p> <p>35. Rad lose</p> <p><i>35. Rueda floja</i></p> <p>35. Roue dévissée</p>                                                                                                                                                                                       | <p>Inspect for wheel and wheel stud damage. Replace if needed and retorque lugnuts.</p> <p><i>Ispezionare eventuali danni al disco ed alle colonnette del mozzo ruota, se necessario sostituire i particolari danneggiati e serrare i dadi alla coppia prescritta.</i></p> <p>Eventuelle Schäden an der Felge und an den Radbolzen überprüfen. Falls erforderlich beschädigte Teile ersetzen und Radmuttern gemäß vorgeschriebenem Drehmoment anziehen.</p> <p><i>Inspeccionar los posibles daños al disco y a las columnas del cubo de la rueda; si fuera necesario, sustituir las piezas dañadas y apretar las tuercas al par prescrito.</i></p> <p>Inspecter les éventuels dommages au disque et aux goujons du moyeu de rue. Si nécessaire remplace les pièces endommagées et serrer les écrous au couple prescrit.</p> |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                                                                                                             | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                            | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A «Stick slip» noise when going from forward to reverse</p> <p><i>Un rumore tipo «Stick slip» si manifesta durante l'inversione di marcia</i></p> <p>«Stick slip» -Geräusch bei Änderung der Fahrtrichtung</p> <p><i>Un ruido tipo «Stick slip» se manifiesta al invertir la marcha</i></p> <p>Un bruit type «Stick slip» se manifeste pendant l'inversion</p> | <p>36. Articulation box joint and achsel shaft damaged</p> <p><i>36. Giunti della scatola snodo, semiassi o snodi di sterzata danneggiati</i></p> <p>36. Kupplung des Gelenkgehäuseg, Halbachse beschädigt</p> <p><i>36. Juntas de la caja de la rótula, semi-eje o perno de dirección dañados</i></p> <p>36. Joint boîtier d'articulation, demi-es-sieu endommagé</p> | <p>Inspect and replace.</p> <p><i>Ispezionare e sostituire i particolari danneggiati.</i></p> <p>Überprüfen und beschädigte Teile ersetzen.</p> <p><i>Inspeccionar y sustituir las piezas dañadas.</i></p> <p>Inspecter et remplacer les pièces endommagées.</p>                                                            |
|                                                                                                                                                                                                                                                                                                                                                                   | <p>37. Spider pins loose in diff-carrier</p> <p><i>37. Satelliti liberi nella scatola differenziale</i></p> <p>37. Ausgleich kegelräder im Differential lose</p> <p><i>37. Satélites libres en la caja del diferencial</i></p> <p>37. Satellites libres dans le carter central</p>                                                                                     | <p>Inspect through top cover. Replace.</p> <p><i>Controllare attraverso il coperchio superiore, sostituire i particolari danneggiati.</i></p> <p>Durch die obere Bohrung überprüfen. Beschädigte Teile ersetzen.</p> <p><i>Inspectioner au travers du couvercle supérieur.</i></p> <p>Remplacer les pièces endommagées.</p> |
|                                                                                                                                                                                                                                                                                                                                                                   | <p>38. Damaged or missing spider and/or side gear washers</p> <p><i>38. Rondelle di rasamento del differenziale usurate</i></p> <p>38. Anlaufscheiben im Differential verschlissen</p> <p><i>38. Arandelas de espesor del diferencial gastadas</i></p> <p>38. Usure des rondelles du différentiel</p>                                                                  | <p>See correction N. 33.</p> <p><i>Vedere rimedio N. 33.</i></p> <p>Siehe Abhilfe N. 33.</p> <p><i>Véase remedio N. 33.</i></p> <p>Voir remède N. 33.</p>                                                                                                                                                                   |
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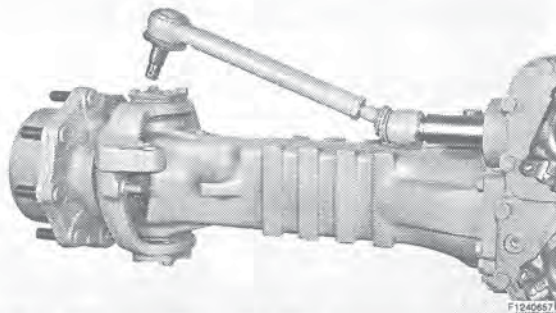
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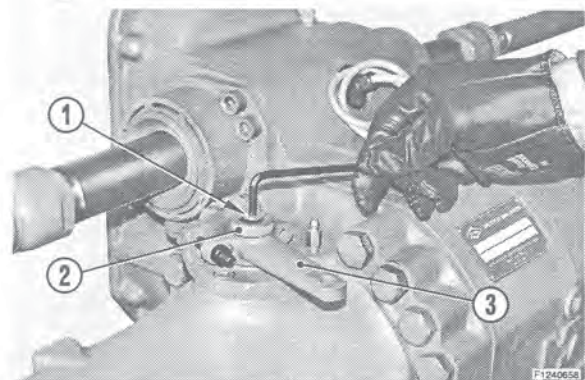
**HOW TO DISASSEMBLE THE MECHANIC PARKING BRAKE UNIT - SMONTAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE ABMONTIEREN - DESMONTAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - DEMONTAGE DU FREIN DE STATIONNEMENT MECANIQUE**



GB

a

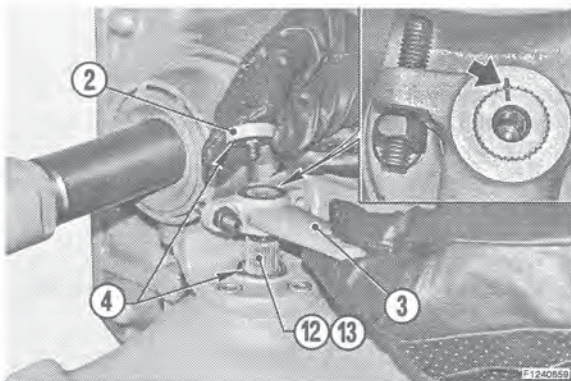
**NOTE.** The same disassembly procedure applies to both arms and may only be carried out when levers (3) are released. Disconnect the tension bar from the steering case. For details, see «HOW TO REMOVE THE STEERING CYLINDER».



GB

b

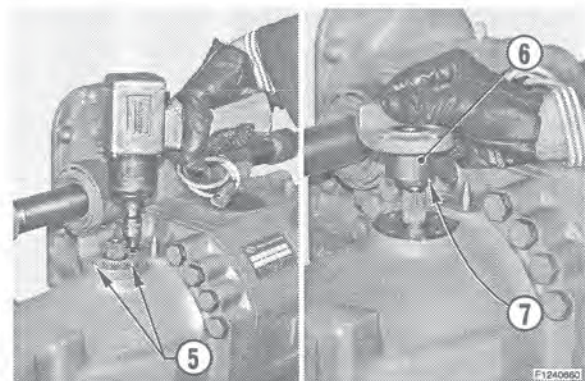
Draw out the screw (1) locking the washer (2) that stops the lever (3).



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c

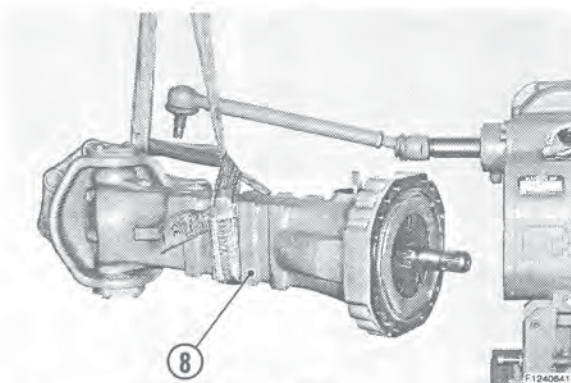
Remove washer (2), lever (3) and O-rings (4). Mark the positions of levers (3) in relation to the thrust levers (12) and (13).



GB

d

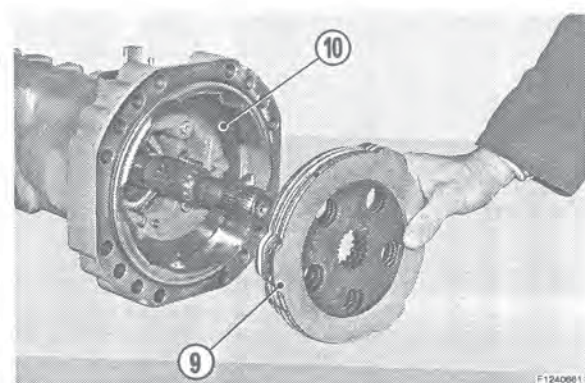
Draw out the screws (5) and remove bush (6) along with O-ring (7).



GB

e

Connect the whole arm (8) to the hoist and put the rod under light tension. Remove the whole arm; for details, see «CHECKING AND REPLACING THE BRAKING DISKS».



GB

f

Remove the braking disks (9) and the whole piston (10). For details, see «CHECKING AND REPLACING THE BRAKING DISKS».

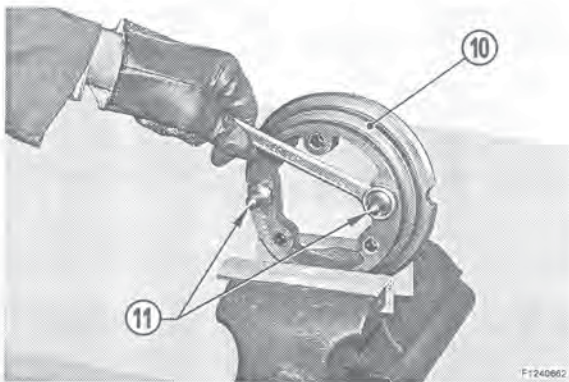




- ITA** **NOTA.** Lo smontaggio è uguale per i due bracci e può essere eseguito solo a leve (3) libere.  
Scollegare dalla scatola snodo il tirante di sterzata.  
Per i dettagli, vedere «RIMOZIONE CILINDRO DI STERZATURA».
- D** **BEMERKUNG.** Beide Arme werden auf dieselbe Weise abmontiert; dies kann jedoch nur erfolgen, wenn die Hebel (3) frei sind.  
Spannstange vom Gelenkgehäuse abtrennen.  
Weitere Einzelheiten im Paragraph «LENKZYLINDER ABMONTIEREN».
- ESP** **NOTA** El desmontaje es igual por los dos brazos y puede ser efectuado solo a palancas (3) libres.  
Desconectar del carter de las rotulas el tirante de direccion.  
Para los detalles, vease «REMOCION CILINDRO DE DIRECCION».
- F** **NOTE.** Le démontage est pareil pour les deux bras et ne peut être effectué que lorsque les leviers (3) sont libres.  
Débrancher de la boîte articulation la tringle de braquage.  
Pour tout détail, voir «DEPOSE CYLINDRE DE BRAQUAGE».
- ITA** Rimuovere la rondella (2), la leva (3) e le guarnizioni OR (4).  
Contrassegnare le posizioni delle leve (3) rispetto le leve di spinta (12) e (13).
- D** Unterlegscheibe (2), Hebel (3) und O-Ringe (4) abnehmen.  
Die Positionen der Hebel (3) im Verhältnis zu den Druckhebeln (12) und (13) kennzeichnen.
- ESP** Remover la arandela (2), la palanca (3) y las guarniciones OR (4).  
Senalar las posiciones de las palancas (3) respecto a las palancas de empuje (12)
- F** Enlever la rondelle (2), le levier (3) et les garnitures OR (4).  
Marquer les positions des leviers (3) par rapport aux leviers (12) et (13).
- ITA** Asportare la vite (1) di bloccaggio della rondella (2) di ritegno della leva (3).
- D** Die Schraube (1) zur Befestigung der Unterlegscheibe (2) des Hebels (3) abschrauben.
- ESP** Sacar el tornillo (1) de bloqueo de la arandela (2) de retencion palanca (3).
- F** Enlever la vis (1) de blocage de la rondelle (2) de fixation du levier (3).
- ITA** Asportare le viti (5) e rimuovere la boccia (6) completa di guarnizione OR (7).
- D** Schrauben (5) abschrauben und Buchse (6) samt O-Ring (7) abnehmen.
- ESP** Sacar los tornillos (5) y remover el casquillo (6) completo de guarniciones OR (7).
- F** Enlever les vis (5) et extraire la douille (6) équipée de garnitures OR (7).
- ITA** Agganciare il braccio completo (8) ad un mezzo di sollevamento e mettere il leggera tensione la fune.  
Rimuovere il braccio completo; per i dettagli, vedere «CONTROLLO E SOSTITUZIONE DISCHI FRENI».
- D** Vollständigen Arm (8) mit einem Hebekarren anheben bis das Seil gespannt ist.  
Vollständigen Arm abtrennen; weitere Einzelheiten im Paragraph «BREMSSCHEIBEN KONTROLLIEREN UND AUSWECHSELN».
- ESP** Enganchar el brazo completo (8) y un medio de levantamiento y poner en ligera tensión el cable.  
Remover el brazo completo; por los detalles, vease «CONTROL Y SUSTITUCION DISCOS FRENS».
- F** Accrocher le bras complet (8) à un moyen de relevage et mettre la corde légèrement en tension.  
Enlever le bras complet: pour tout détail, voir «CONTROLE ET SUBSTITUTION DES DISQUES FREINS».
- ITA** Rimuovere i dischi freni (9) ed il pistone completo (10).  
Per i dettagli, vedere «CONTROLLO E SOSTITUZIONE DISCHI FRENI».
- D** Bremsscheiben (9) und den ganzen Kolben (10) abnehmen. Weitere Einzelheiten im Paragraph «BREMSSCHEIBEN KONTROLLIEREN UND AUSWECHSELN».
- ESP** Remover los discos frenos (9) y el piston completo (10).  
Por los detalles, vease «CONTROL Y SUSTITUCION DISCOS FRENS».
- F** Enlever les disques freins (9) et le piston complet (10).  
Pour tout détail, voir «CONTROLE ET SUBSTITUTION DES DISQUES FREINS».



**HOW TO DISASSEMBLE THE MECHANIC PARKING BRAKE UNIT - SMONTAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE ABMONTIEREN - DESMONTAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - DEMONTAGE DU FREIN DE STATIONNEMENT MECANIQUE**



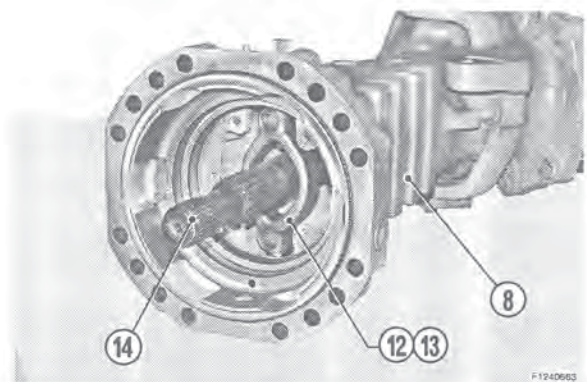
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GB

a

If pins (11) need replacing, block the piston (10) into a vice whose jaws are covered in smooth material and remove the pins.

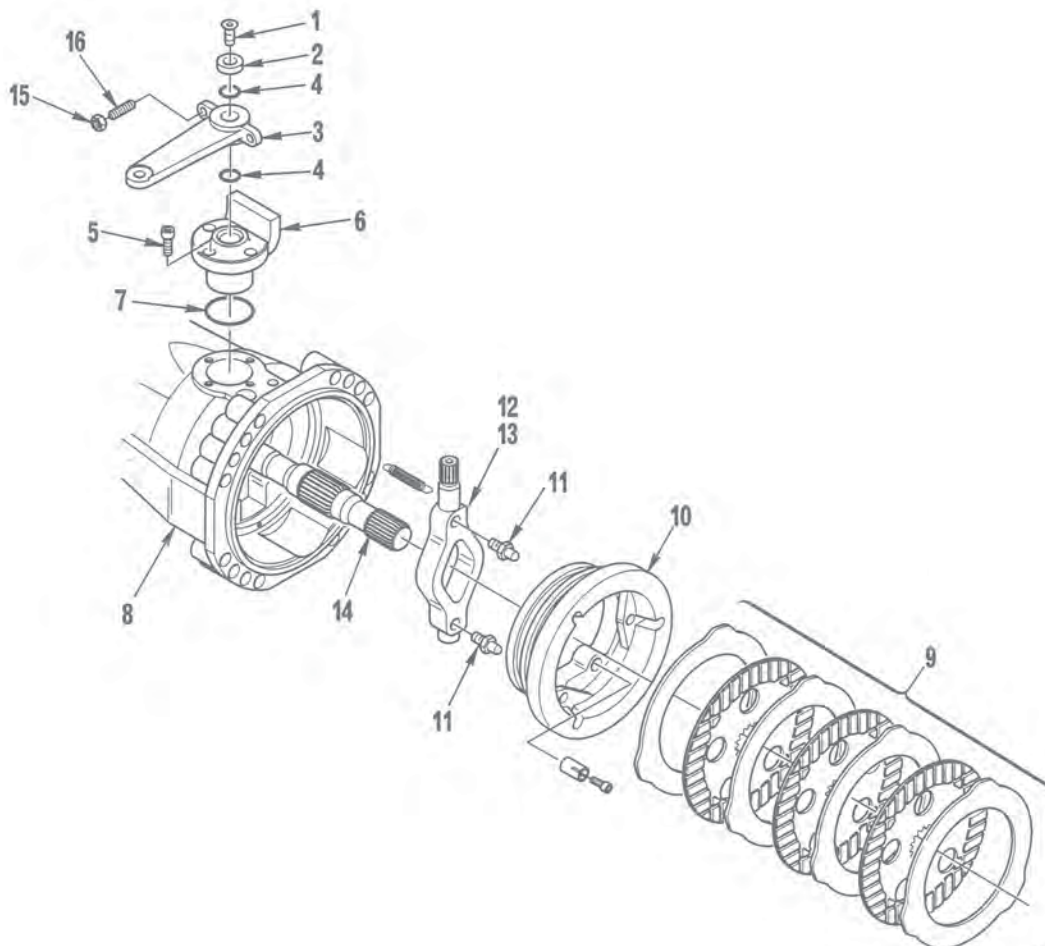


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GB

b

If thrust levers (12) and (13) need replacing, remove the U-joint (14) before removing the arms (8).  
For details, see «HOW TO REMOVE THE U-JOINT».



F1240079





a

ITA

Se si devono sostituire i puntali (11), bloccare il pistone (10) in una morsa con ganasce in materiale tenero e rimuovere i puntali.

D

Falls die Schäfte (11) ausgewechselt werden sollen, Kolben (10) in einem Spannbackenpaar aus weichem Material blockieren und Schäfte abnehmen.

ESP

Si se deben cambiar las puntas (11), bloquear el pistón (10) en un corchete con mordazas en material tierno y remover las puntas.

F

Si l'on doit substituer les tiges (11), bloquer le piston (10) dans un étau à mâchoire en matériel tendre, puis enlever les tiges.

b

ITA

Se si devono sostituire le leve di spinta (12) e (13), prima di rimuovere i bracci (8) rimuovere il giunto cardanico (14).

Per i dettagli, vedere «RIMOZIONE DEL DOPPIO GIUNTO CARDANICO».

D

Falls die Druckhebel (12) und (13) ausgewechselt werden sollen, zuerst die Doppelgelenkwelle (14) und dann die Arme (8) abnehmen. Weitere Einzelheiten im

Paragraph «DOPPELGELENKWELLE INSTALLIEREN».

ESP

Si se deben cambiar las palancas de empuje (12) y (13), antes de remover los brazos (8) remover los semiejes (14).

Por los detalles, vease «REMOCION DE LOS SEMIEJES».

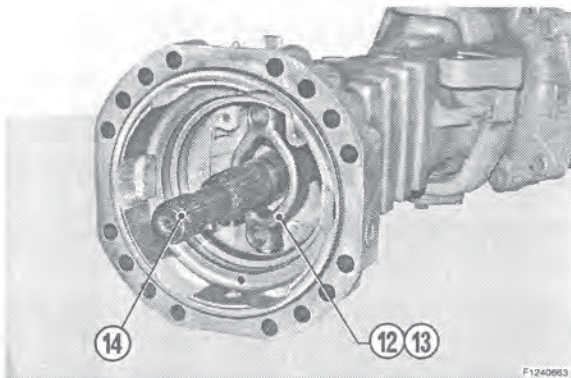
F

Si l'on doit substituer les leviers de poussée (12) et (13), avant d'enlever les bras (8) enlever le joint de cardan double (14).

Pour tout détail, voir «DEPOSE DE JOINT DE CARDAN DOUBLE».



**HOW TO ASSEMBLE THE MECHANIC PARKING BRAKE UNIT - ASSEMBLAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE MONTIEREN - ASSEMBLAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - ASSEMBLAGE DU FREIN DE STATIONNEMENT MECANIQUE**



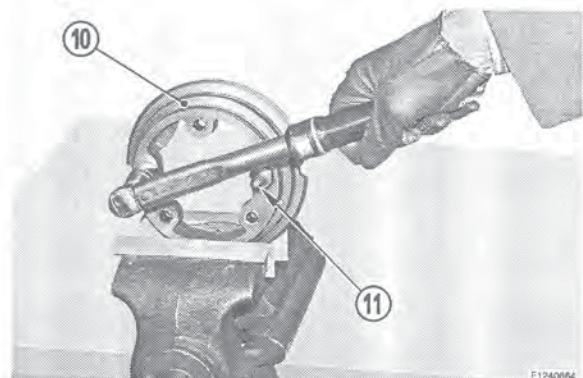
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GB

a

Install thrust levers (12) and (13), then install the U-joint (14). For details, see «HOW TO INSTALL THE U-JOINT».



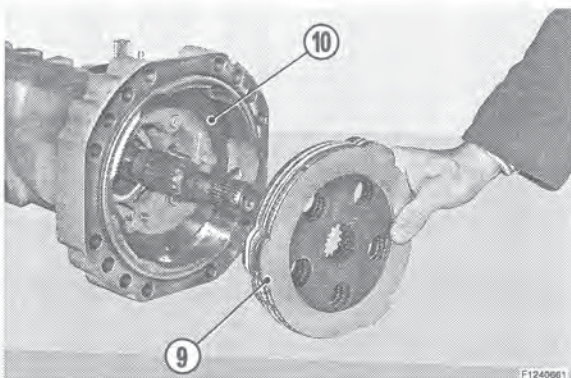
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b

Apply Loctite 270 to the threaded portion of the pins (11) and fit them onto the piston (10). Block them: torque wrench setting 30 – 35 Nm.



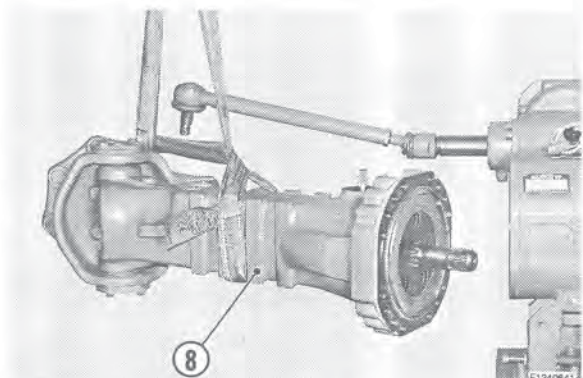
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GB

c

Re-install the piston (10) and the braking disks (9). For details, see «HOW TO ASSEMBLE THE BRAKING UNITS».



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d

Install the arms (8) into the main body; check flatness and block arms following the appropriate procedures illustrated in section «HOW TO ASSEMBLE THE BRAKING UNITS».



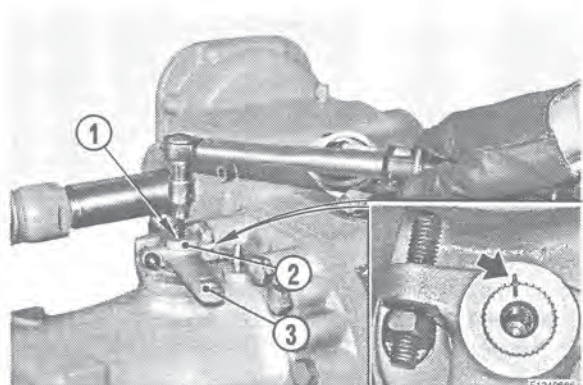
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GB

e

Install the bush (6) complete with O-ring (7) and block it with screws (5). Tighten screws with a torque wrench setting of 23.8 – 26.2 Nm.



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f

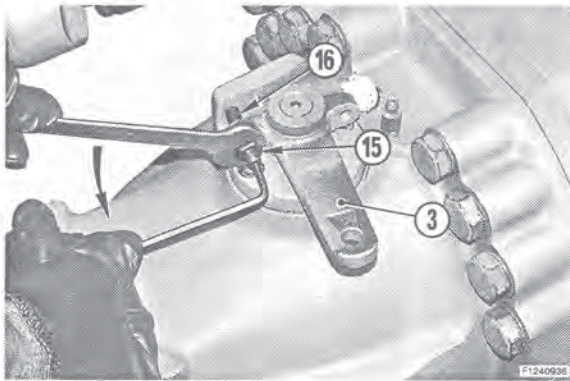
Install in sequence the lower O-ring (4), the lever (3) and the washer (2) with the relative O-ring (4). Block with screw (1) and tighten using a torque wrench setting of 23.8 – 26.2 Nm.  
**CAUTION!** Refer and keep to the positions marked during disassembly.



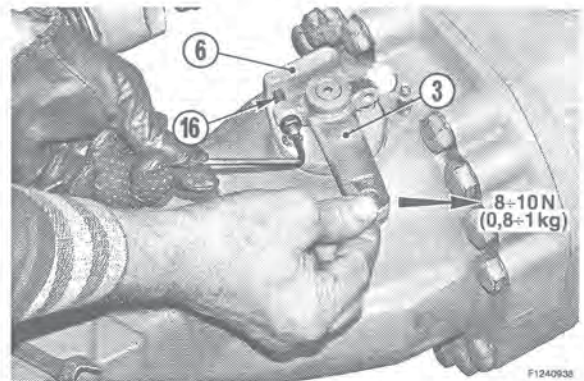
- a**
- ITA** Montare le leve di spinta (12) e (13) e successivamente il doppio giunto cardanico (14).  
Per i dettagli di montaggio del doppio giunto cardanico, vedere «INSTALLAZIONE DEL DOPPIO GIUNTO CARDANICO».
- D** Druckhebel (12) und (13) montieren; danach Doppelgelenkwelle (14) montieren.  
Weitere Einzelheiten im Paragraph «DOPPELGELENKWELLE INSTALLIEREN».
- ESP** Montar la palancas de empuje (12) y (13) y al final los semiejes (14).  
Por los detalles de montaje de los semiejes, vease «INSTALACION DE LOS SEMIEJES».
- F** Monter les leviers de poussée (12) et (13) et ensuite le joint de cardan double (14).  
Pour tout détail, voir «DEPOSE DE JOINT DE CARDAN DOUBLE».
- b**
- ITA** Spalmare la filettatura dei puntali (11) con Loctite 270 e montarli sul pistone (10).  
Bloccarli con una coppia di serraggio di 30÷35 Nm.
- D** Schäfte (11) mit Loctite 270 schmieren und auf den Kolben (10) montieren.  
Anzugsmoment: 30÷35 Nm.
- ESP** Pasar la rosca de las puntales (11) con Loctite 270 y montarlas sobre los pistones (10).  
Bloquearlos con un par de torsión de 30÷35 Nm.
- F** Enduire le filetage des tiges (11) avec du Loctite 270 puis les monter sur le piston (10).  
Bloquer à un couple de serrage de 30÷35 Nm.
- c**
- ITA** Rimontare il pistone (10) ed i dischi freno (9).  
Per i dettagli, vedere «ASSEMBLAGGIO DEI GRUPPI DI FRENATURA».
- D** Kolben (10) und Bremsscheiben (9) wieder montieren.  
Weitere Einzelheiten im Paragraph «ZUSAMMENBAU DER BREMSAGGREGATE».
- ESP** Remontar los pistones (10) y los discos frenos (9).  
Por los detalles, vease «ASEMBLAJE DE LOS GRUPOS DE FRENADURA».
- F** Remonter le piston (10) et les disques freins (9).  
Pour tout détail, voir «ASSEMBLAGE DES GROUPE DE FREINAGE».
- d**
- ITA** Montare i bracci (8) sul corpo centrale; controllare il livellamento e quindi bloccarli con le modalità descritte per l'«ASSEMBLAGGIO DEI GRUPPI DI FRENATURA».
- D** Die Arme (8) auf den zentralen Körper montieren; danach abrichten und laut Anweisungen des Paragraphs «ZUSAMMENBAU DER BREMSAGGREGAT» blockieren.
- ESP** Montar los brazos (8) sobre el cuerpo central, controlar el nivelamiento y entonces bloquearlos con las modalidades descritas por «ASEMBLAJE DE LOS GRUPOS DE FRENADURA».
- F** Monter les bras (8) sur le corps central; contrôler le niveau, puis bloquer en suivant le mode décrit dans l'«ASSEMBLAGE DES GROUPE DE FREINAGE».
- e**
- ITA** Montare la boccola (6) completa di guarnizione OR (7) e bloccarla con le viti (5).  
Serrare le viti con una coppia di 23,8÷26,2 Nm.
- D** Buchse (6) samt O-Ring (7) montieren und mit den Schrauben (5) festschrauben.  
Anzugsmoment der Schrauben: 23,8÷26,2 Nm.
- ESP** Montar el casquillo (6) completa de guarnición OR (7) y bloquearla con tornillos (5).  
Apretar los tornillos con un par de 23,8÷26,2 Nm.
- F** Monter la douille (6) équipée de garniture OR (7) et bloquer cette dernière avec les vis (5).  
Serrer les vis à un couple de serrage de 23,8÷26,2 Nm.
- f**
- ITA** Montare nell'ordine la guarnizione OR inferiore (4), la leva (3) e la rondella (2) completa della relativa guarnizione OR (4).  
Bloccarla con la vite (1) serrata ad una coppia di 23,8÷26,2 Nm.  
**ATTENZIONE!** Rispettare le posizioni contrassegnate in fase di smontaggio.
- D** Der Reihenfolge nach den unteren O-Ring (4), Hebel (3) und Unterlegscheibe (2) samt O-Ring (4) montieren.  
Mit der Schraube (1) festschrauben. Anzugsmoment der Schraube: 23,8÷26,2 Nm.  
**ACHTUNG!** Die beim Abmontieren markierten Positionen einhalten.
- ESP** Montar en el orden la guarnición OR inferior (4), la palanca (3) y la arandela (2) completa de la relativa guarnición OR (4).  
Bloquearla con el tornillo (1) apretada a un par de 23,8÷26,2 Nm.  
**ATENCIÓN!** Respetar las posiciones señaladas en fase de montaje.
- F** Monter dans l'ordre la garniture OR inférieure (4), le levier (3) et la rondelle (2) équipée de sa relative garniture OR (4).  
Bloquer celle-ci avec la vis (1) serrer à un couple de 23,8÷26,2 Nm.  
**ATTENTION!** Respecter les positions notées en phase de démontage.



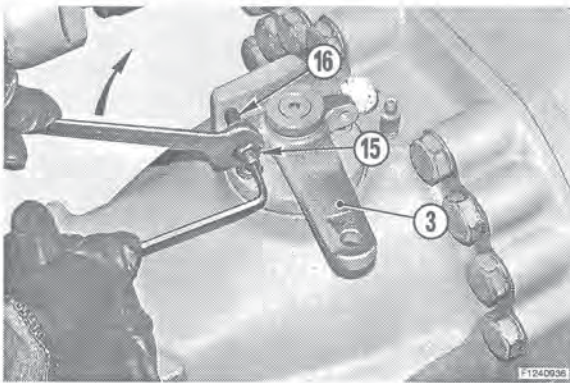
HOW TO ASSEMBLE THE MECHANIC PARKING BRAKE UNIT - ASSEMBLAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE MONTIEREN - ASEMBLAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - ASSEMBLAGE DU FREIN DE STATIONNEMENT MECANIQUE



Connect the braking circuit and apply maximum working pressure to set the disks.  
Release the pressure, loosen nut (15) and unscrew dowel (16) by a few turns.



Apply a force of 8–10 N (0.8–1 kg) to lever (3). Direct the force towards the braking direction in order to eliminate the idle stroke. While the force is being applied, tighten dowel (16) until it is caused to rest onto bush (6).



Lock dowel (16) in this position with nut (15).  
Torque wrench setting: 20–25 Nm.  
**CAUTION!** The idle stroke should be eliminated without preloading thrust levers (12) and (13).



**CAUTION!** After connecting the control cable, check that when brakes are released both dowels (16) do lean against bush (6).





**ITA** Collegare il circuito frenante ed inserire la massima pressione di lavoro per assestare i dischi.  
Rilasciare la pressione, allentare il dado (15) e svitare di qualche giro il grano (16).

**D** Den Bremskreislauf anschließen und den maximale Arbeitsdruck einlassen, um die Scheiben zu setzen.  
Den Druck ablassen, die Mutter (15) lockern und den Stift (16), um einige Umdrehungen aufschrauben.

**ESP** Conectar el circuito frenante y introducir la máxima presión de trabajo para ajustar los discos.  
Soltar la presión, aflojar las tuercas (15) y destornillar de algún giro la espiga (16).

**F** Brancher le circuit freinant et insérer le maximum de pression d'usinage pour ajuster les disques.  
Relâcher la pression, desserrer l'écrou (15) et dévisser le grain (16) de quelques tours.

**ITA** Bloccare il grano (16) in questa posizione con il dado (15). Coppia di serraggio: 20÷25 Nm.  
**ATTENZIONE!** La corsa a vuoto va eliminata senza precaricare le leve di spinta (12) e (13).

**D** Stift (16) in dieser Position mit der Mutter (15) blockieren.  
Anzugsmoment: 20÷25 Nm.

**ACHTUNG!** Der leere Lauf muß beseitigt werden ohne die Druckhebel (12) und (13) vorzuladen.

**ESP** Bloquear la espiga (16) en esta colocación con la tuerca (15).  
Par de torsión: 20÷25 Nm.

**ATENCION!** La carrera a vacío debe de ser eliminada sin precargar las palancas de impulso (12) y (13).

**F** Bloquer le grain (16) dans cette position à l'aide de l'écrou (15).  
Couple de serrage: 20÷25 Nm.

**ATTENTION!** La course à vide doit être éliminée sans précharger les leviers d'appui (12) et (13).

**ITA** Applicare alla leva (3) una forza di 8÷10 N (0,8÷1 kg), diretta nel senso di frenatura per eliminare la corsa a vuoto.

Mantenendo la forza, avvitare il grano (16) fino all'appoggio sulla boccola (6).

**D** Auf den Hebel (3) eine Kraft von 8÷10 N (0,8÷1 kg) in die Bremsrichtung anbringen, um den leeren Lauf auszuschließen.

Bei angebrachter Kraft, Stift (16) aufschrauben, bis er an der Buchse (6) anliegt.

**ESP** Aplicar a la palanca (3) una fuerza de 8÷10 N (0,8÷1 kg), directa en el sentido de frenadura para eliminar la carrera a vacío.

Manteniendo la fuerza, atornillar la espiga (16) hasta el apoyo sobre el casquillo (6).

**F** Appliquer au levier (3) une contrainte de 8÷10 N (0,8÷1 kg), orientée dans le sens du freinage pour éliminer la course à vide.

En maintenant la contrainte, visser le grain (16) jusqu'à ce qu'il se pose sur le fourreau (6).

**ITA** **ATTENZIONE!** Dopo il collegamento del cavo di comando, controllare che in fase di rilascio dei freni, ambedue i grani (16) vadano in appoggio sulla boccola (6).

**D** **ACHTUNG!** Nach dem Anschluß des Steuerkabels, kontrollieren, ob beim Loslassen der Bremsen, beide Stifte (16) an der Buchse anliegen (6).

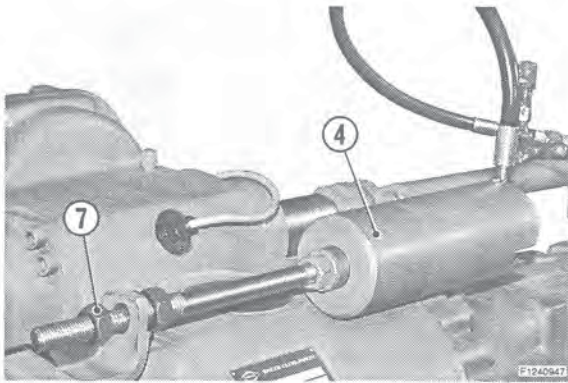
**ESP** **ATENCION!** Después de la conexión del cable de mando, controlar que en fase de suelte de los frenos, las dos espigas (16) vayan en apoyo sobre el casquillo (6).

**F** **ATTENTION!** Après avoir branché le câble de commande, contrôler que pendant la phase de relâchement des freins, les deux grains (16) aillent se poser sur l'embout (6).





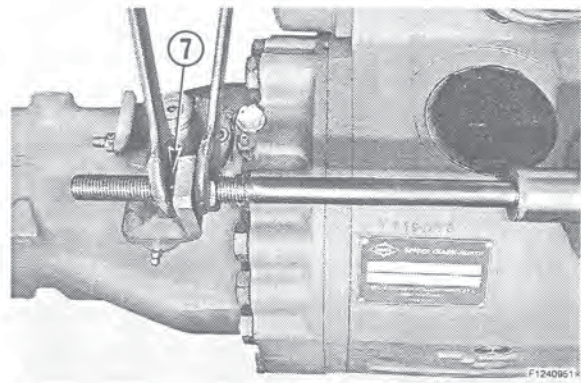
**HOW TO REMOVE AND DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - RIMOZIONE E SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO - AÜßERE HYDRAULISCHE NEGATIVBREMSE ABMONTIEREN - REMOCION Y DESMONTAJE FRENO NEGATIVO IDRAULICO EXTERIOR - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE**



GB

a

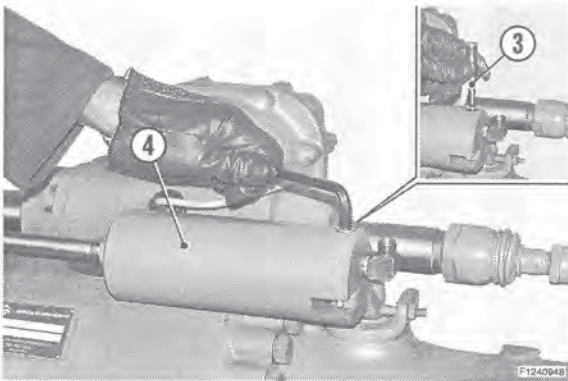
Insert pressure into cylinder (4) in order to release the brakes.  
**NOTE.** If the machine hydraulic system cannot be used, use an external manual pump.



GB

b

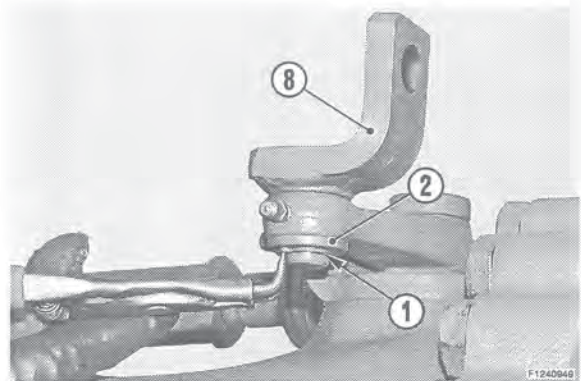
Loosen and remove the external nut (7).



GB

c

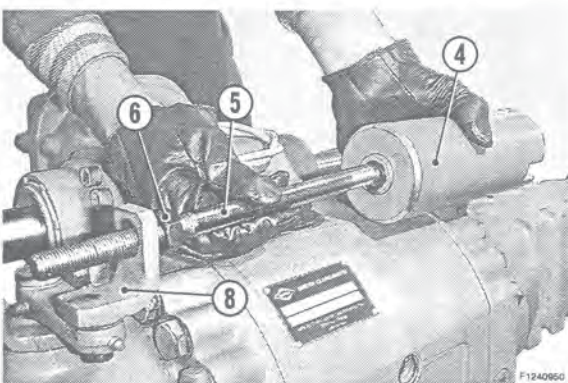
Release the pressure in the cylinder and disconnect the pressure delivery tube.  
Remove the fulcrum pin (3) from the cylinder (4).



GB

d

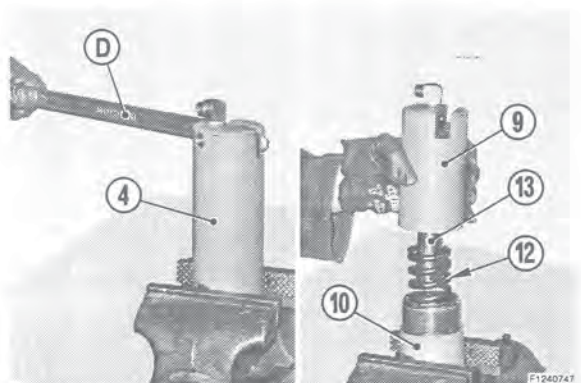
Remove the snap ring (1) that checks the support (8) and remove the distance piece (2).



GB

e

Remove the cylinder assembly (4) complete with rod (5), internal nut (6) and support (8).



GB

f

Place cylinder (4) into a vice with the spring seat side (10) engaged in it and, using a bar "D", loosen and remove the cylinder unit (9) complete with piston (13) and spring (12).





**ITA** Immettere pressione nel cilindro (4) per sbloccare i freni.  
**NOTA.** Se non è possibile utilizzare l'impianto idraulico macchina, utilizzare una pompa manuale esterna.

**D** Den Druck in den Zylinder (4) lassen, um die Bremsen frei zu machen.  
**BEMERKUNG:** Falls die hydraulische Anlage der Maschine nicht verwendet werden kann, eine manuelle getrennte Pumpe verwenden.

**ESP** Meter presión en el cilindro (4) para bloquear los frenos.  
**NOTA.** Si no es posible utilizar el equipo hidráulico máquina, utilizar una bomba manual exterior.

**F** Envoyer de la pression dans le cylindre (4) pour débloquer les freins.  
**NOTE.** Si utiliser l'installation hydraulique de la machine n'est pas possible, utiliser une pompe manuelle externe.

a

**ITA** Allentare ed asportare il dado esterno (7).

**D** Die äußere Mutter (7) abschrauben.

**ESP** Aflojar y sacar la tuerca externa (7).

**F** Desserrer et enlever l'écrou externe (7).

b

**ITA** Rilasciare la pressione del cilindro e scollegare il tubo di mandata della pressione.  
Rimuovere il perno di fulcro (3) del cilindro (4).

**D** Den Druck vom Zylinder ablassen und die Druckleitung abtrennen.  
Den Zentrierstift (3) des Zylinders (4) abnehmen.

**ESP** Solter la presión del cilindro y desconectar el tubo de ida de la presión.  
Remover la rotula (3) del cilindro (4).

**F** Relâcher la pression du cylindre et débrancher le tube de refoulement de pression. Enlever l'axe du point d'appui (3) du cylindre (4).

c

**ITA** Rimuovere l'anello elastico (1) di ritegno supporto (8) ed asportare il distanziale (2).

**D** Den Kolbenring (1) der Halterung (8) abnehmen und das Distanzstück (2) abnehmen.

**ESP** Remover el anillo elastico (1) de retención soporte (8) y sacar el distancial (2).

**F** Enlever l'anneau à ressort (1) de retenue au support (8), puis enlever l'entretoise (2).

d

**ITA** Rimuovere il gruppo cilindro (4), completo di asta (5), dado interno (6) e supporto (8).

**D** Das Zylinderaggregat (4) samt Stab (5), innere Mutter (6) und Halterung (8) abnehmen.

**ESP** Remover el grupo cilindro (4), completo de varilla (5), tuerca interna (6) y soporte (8).

**F** Enlever le groupe cylindre (4), complet de tige (5), écrou interne (6) et support (8).

e

**ITA** Fissare il cilindro (4) in una morsa dal lato sede molla (10) e, utilizzando una barra "D", allentare ed asportare il corpo cilindro (9) completo di pistone (13) e la molla (12).

**D** Den Zylinder (4) in einem Spannstock an der Federseite (10) einklemmen und mit dem Stab "D" den Zylinderkörper (9) lockern und samt Kolben (13) und Feder (12) abnehmen.

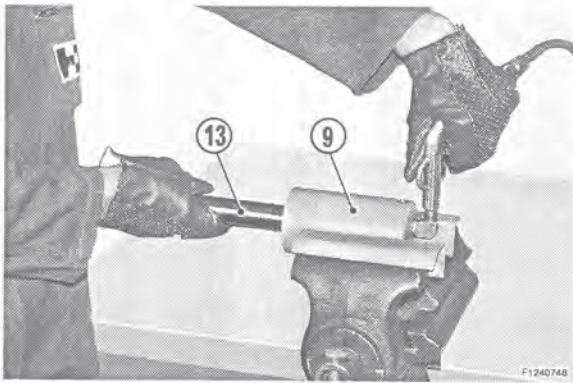
**ESP** Fijar el cilindro (4) en un corchete del lado muelle (10) y, utilizando un varilla "D", aflojar y sacar el cuerpo cilindro (9) completo de pistón (13) y el muelle (12).

**F** Fixer le cylindre (4) dans un étau du côté du siège ressort (10), puis à l'aide d'une barre "D", desserrer et enlever le corps cylindre (9) complet du piston (13) et du ressort (12).

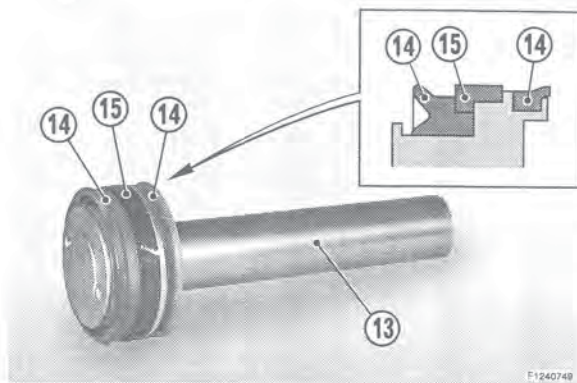
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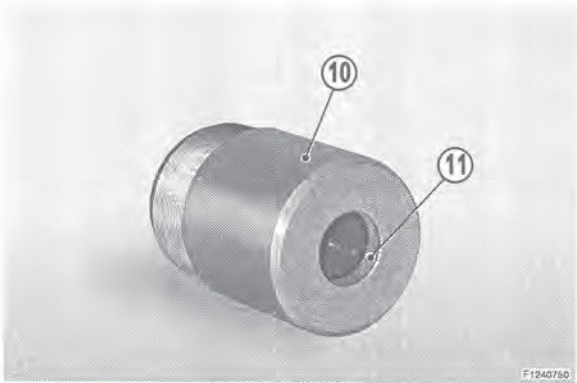
**HOW TO REMOVE AND DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - RIMOZIONE E SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO - AUßERE HYDRAULISCHE NEGATIVBREMSE ABMONTIEREN - REMOCION Y DESMONTAJE FRENO NEGATIVO HYDRAULICO EXTERIOR - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE**



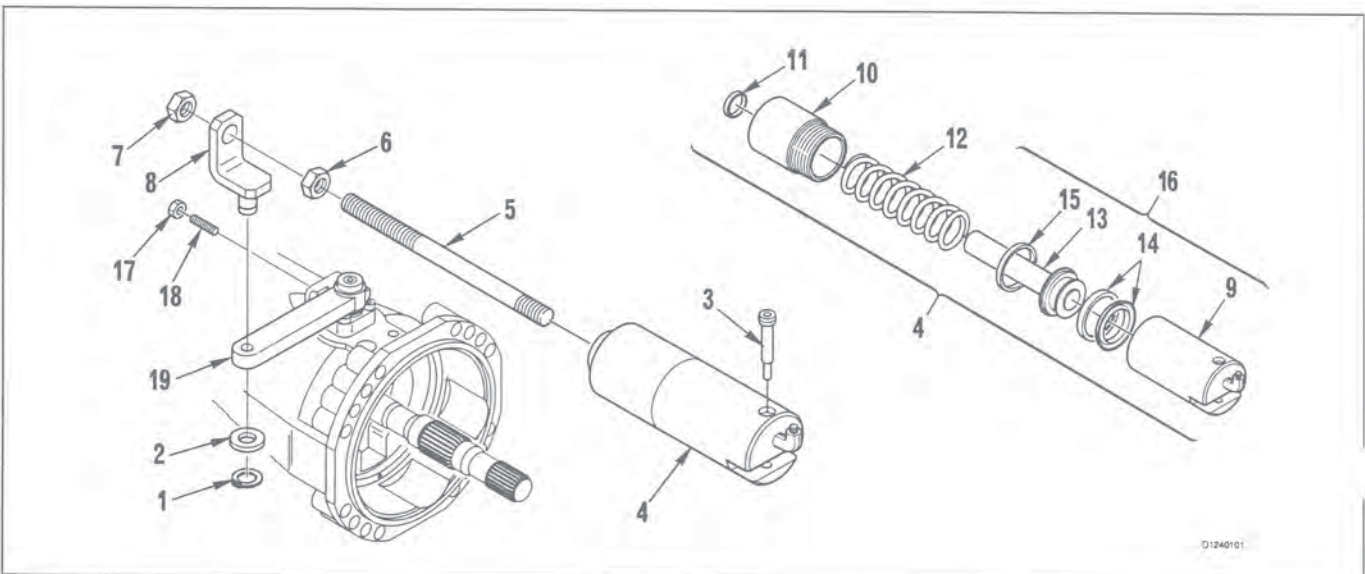
Gently introduce the union piece of the cylinder unit (9) so as to eject the piston (13).  
**CAUTION!** Hold the piston as it may be forced out rapidly and be damaged.



Remove seals (14) and guide ring (15) from the piston (13).  
**NOTE.** Note down seals direction of assembly.



**ONLY IF NECESSARY**  
Remove the guide ring (11) from the spring seat (10).  
**CAUTION!** If the guide ring (11) is removed, it must be replaced.







SPICER CLARK-HURTH

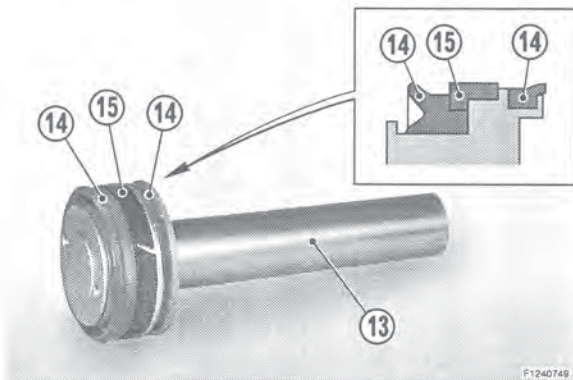
- a**
- ITA** Immettere lentamente il raccordo del corpo cilindro (9) per espellere il pistone (13).  
**ATTENZIONE!** Trattenere il pistone che può essere espulso velocemente ed essere danneggiato.
- D** Langsam das Anschlußstück des Zylinderkörpers (9) einsetzen, um den Kolben (13) auszustoßen.  
**ACHTUNG!** Den Kolben halten, denn er könnte plötzlich herausspringen und beschädigt werden.
- ESP** Meter lentamente el empalme del cuerpo cilindro (9) para la expulsión del pistón (13).  
**ATENCIÓN!** Tener el pistón que pueda ser expulsado rápidamente y danarse.
- F** Introduire lentement le raccord du corps cylindre (9) et expulser le piston (13).  
**ATTENTION!** Retenir le piston qui expulsé rapidement peut par conséquent s'endommager.

- b**
- ITA** Rimuovere dal pistone (13) le guarnizioni (14) e l'anello di guida (15).  
**NOTA.** Annotare il senso di montaggio delle guarnizioni.
- D** Den Kolben (13), die Dichtungen (14) und den Führungsring (15) abnehmen.  
**BEMERKUNG.** Montagerichtung der Dichtungen bemerken.
- ESP** Remover del pistón (13) las guarniciones (14) y el anillo de guía (15).  
**NOTA.** Anotar el sentido de desmontaje de las guarniciones.
- F** Enlever du piston (13) les garnitures (14) et la bague de guidage (15).  
**NOTE.** Prendre note du sens de montage des garnitures.

- c**
- ITA** **SOLO SE NECESSARIO**  
Rimuovere dalla sede molla (10) l'anello di guida (11).  
**ATTENZIONE!** Se l'anello di guida (11) viene smontato, deve essere sostituito.
- D** **NUR WENN NOTWENDIG**  
Aus dem Federsitz (10) den Führungsring (11) nehmen.  
**ACHTUNG!** Falls der Führungsring (11) abmontiert wird, muß er ausgetauscht werden.
- ESP** **SOLO SI NECESARIO**  
Remover de la sede muelle (10) el anillo de guía (11).  
**ATENCIÓN!** Si el anillo de guía (11) viene desmontado, debe de ser substituido.
- F** **SEUL SI BESOIN**  
Enlever du siège ressort (10), la bague de guidage (11).  
**ATTENTION!** Si la bague de guidage (11) est démontée, il faut la substituer.



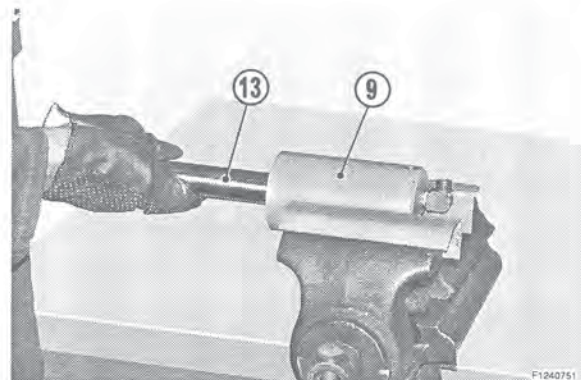
**HOW TO ASSEMBLE AND INSTALL THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - ASSEMBLAGGIO ED INSTALLAZIONE FRENO NEGATIVO IDRAULICO ESTERNO - ÄußERE HYDRAULISCHE NEGATIVBREMSE MONTIEREN - ASEMBLAJE Y INSTALACION FRENO NEGATIVO IDRAULICO EXTERIOR - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE**



GB

a

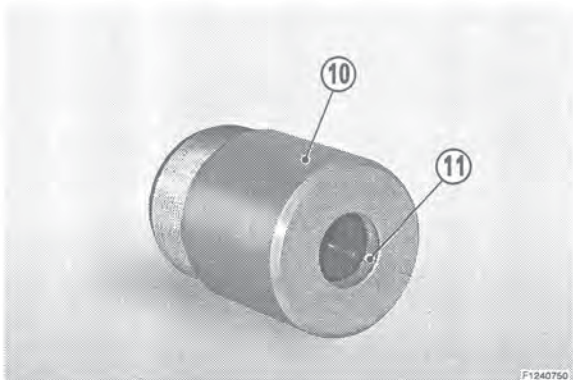
Install guide ring (15) and seals (14) onto the piston (13).  
**CAUTION!** Carefully check seals assembly direction.



GB

b

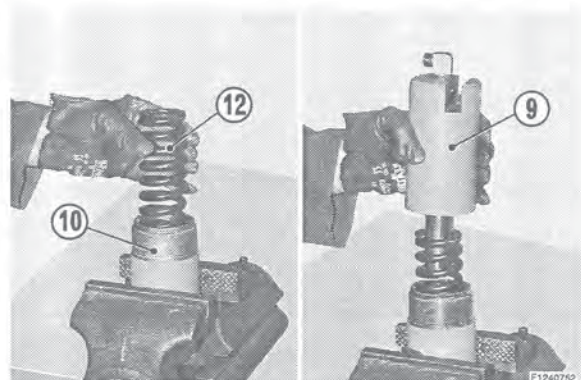
Lubricate the seals (14) and the inside of the cylinder (9); introduce the whole piston and move it to end of stroke.



GB

c

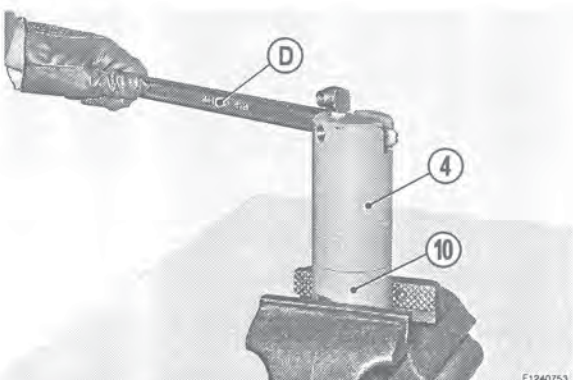
If guide ring has been removed, insert a new one (11) into the seat of the spring.  
Lubricate the guide ring.



GB

d

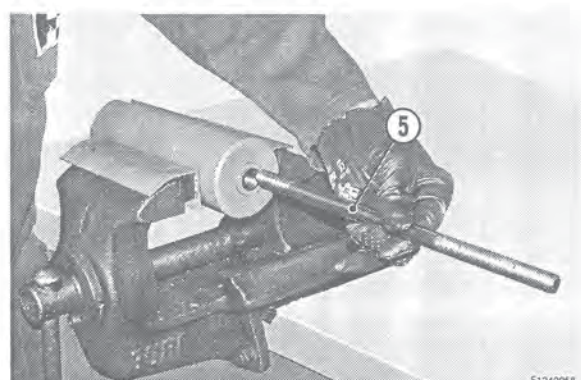
Position the spring seat (10) in a vice and insert spring (12).  
Lubricate the thread. Assemble the whole cylinder (9).



GB

e

Screw the cylinder (9) into the spring seat (10) and lock it using a bar "D".



GB

f

Apply Loctite 270 to the rod (5) and screw it in the piston (13) as far as it will go.





SPICER CLARK-HURTH

- a**
- ITA** Montare sul pistone (13) l'anello di guida (15) e le guarnizioni (14).  
**ATTENZIONE!** Controllare attentamente il senso di montaggio delle guarnizioni.
- D** Auf den Kolben (13) den Führungsring (15) und die Dichtungen (14) montieren.  
**ACHTUNG!** Auf die Montagerichtung der Dichtungen sorgfältig achten.
- ESP** Montar sobre el piston (13) el anillo de guía (15) y las guarniciones (14).  
**ATENCIÓN!** Controlar atentamente el sentido de montaje de las guarniciones.
- F** Monter sur le piston (13) la bague de guidage (15) et les garnitures (14).  
**ATTENTION!** Contrôler attentivement le sens du montage des garnitures.

- ITA** Lubrificare le guarnizioni (14) e l'interno del cilindro (9); inserire il pistone completo e mandarlo a fine corsa.
- D** Dichtungen (14) und das Zylinderinnere (9) schmieren; den vollständigen Kolben einsetzen und bis zum Anschlag einschieben.
- ESP** Lubrificar las guarniciones (14) y el interno del cilindro (9); introducir el piston completo y mandarlo a final de carrera.
- F** Lubrifier les garnitures (14) à l'intérieur du cylindre (9); y introduire le piston complet et l'envoyer en fin de course.

- c**
- ITA** Se è stato smontato, inserire il nuovo anello di guida (11) nella sede molla (10).  
Lubrificare l'anello di guida.
- D** Falls der Führungsring (11) abmontiert worden ist, diesen in den Federsitz (10) einsetzen.  
Den Führungsring schmieren.
- ESP** Si ha sido desmontado, introducir el nuevo anillo de guía (11) en la sede muelle (10).  
Lubricar el anillo de guía.
- F** Si elle a été démontée, introduire la bague de guidage neuve (11) dans le siège ressort (10).  
Lubrifier la bague de guidage.

- ITA** Posizionare la sede molla (10) in una morsa ed inserire la molla (12).  
Lubrificare la filettatura. Montare il cilindro completo (9).
- D** Federsitz (10) in einen Spannbock einklemmen und die Feder (12) einsetzen.  
Gewinde schmieren. Den vollständigen Zylinder (9) montieren.
- ESP** Colocar la sede muelle (10) en un corchete y introducir un muelle (12).  
Lubricar la rosca. Montar el cilindro completo (9).
- F** Placer le siège ressort (10) dans un étau et y introduire le ressort (12).  
Lubrifier le filetage. Monter le cylindre complet (9).

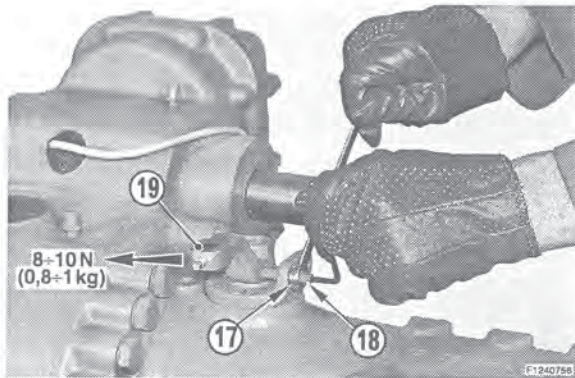
- e**
- ITA** Avvitare il cilindro (9) nella sede molla (10) e bloccarlo utilizzando una barra "D".
- D** Den Zylinder (9) in den Sitze der Feder (10) schrauben und mit Hilfe des Stabs "D" blockieren.
- ESP** Atornillar el cilindro (9) en la sede muelle (10) y bloquearlo utilizando una varilla "D".
- F** Visser le cylindre (9) dans le siège ressort (10), puis bloquer celui-ci à l'aide d'une barre "D".

- ITA** Spalmare l'asta (5) con Loctite 270 ed avvitare a fondo nel pistone (13).
- D** Den Stab (5) mit Loctite 270 schmieren und in den Kolben (13) festschrauben.
- ESP** Pasa la varilla (5) con Loctite 270 y atornillarla a fondo en el piston (13).
- F** Enduire la tige (5) avec du Loctite 270 et visser celle-ci à fond dans le piston (13).



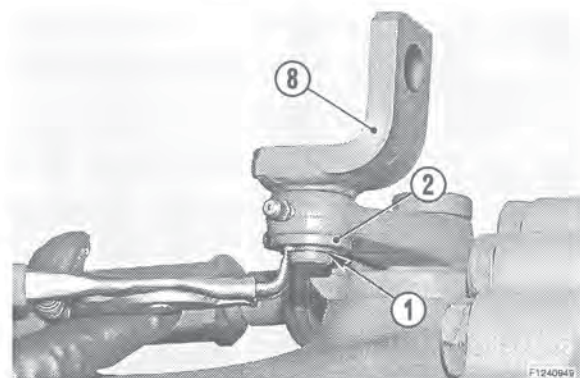


**HOW TO ASSEMBLE AND INSTALL THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - ASSEMBLAGGIO ED INSTALLAZIONE FRENO NEGATIVO IDRAULICO ESTERNO - ÄußERE HYDRAULISCHE NEGATIVBREMSE MONTIEREN - ASEMBLAJE Y INSTALACION FRENO NEGATIVO IDRAULICO EXTERIOR - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE**

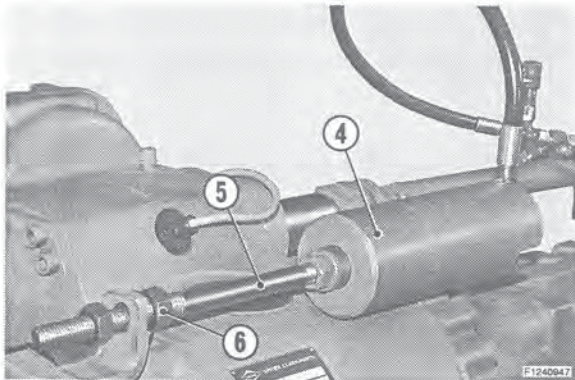


Loosen nuts (17) and set braking levers (19) clearances to zero by turning dowels (18); lock nuts (17) with a torque wrench setting of 20–25 Nm.

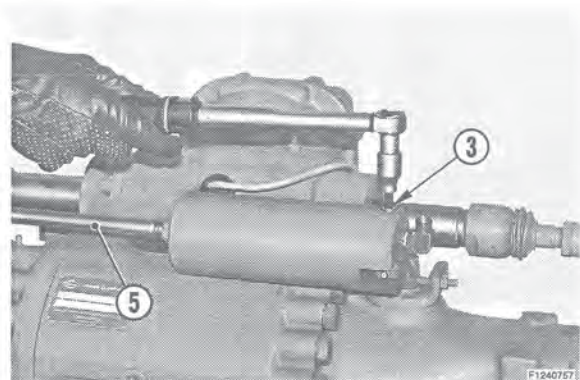
**CAUTION!** Clearances should be set to zero without causing any preloading.



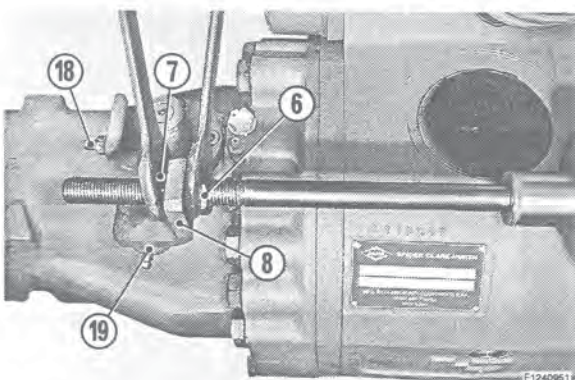
Install distance piece (2) and insert the pin of support (10) into the right-hand braking lever. Fit the second distance piece (2) and snap ring (1).



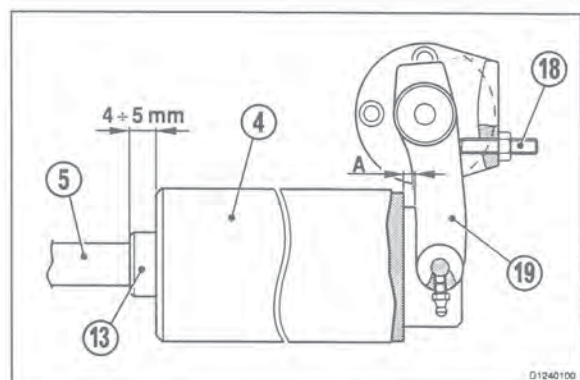
Install cylinder (4) complete with rod (5) and internal nut (6).



Centre the hole of fulcrum pin (3). Apply Loctite 242 to the pin thread, screw and tighten pin with a dynamometric wrench set at 25–30 Nm.



Introduce pressure into the cylinder (4) and whilst holding both levers (19) back against the adjusting screws (18), move nuts (6) and (7) so that they are made to rest against support (8); lock the nuts with a torque wrench setting of 50–60 Nm.



Check that, when the brakes are released (pressure inserted), levers (19) do lean against the screws (18) without prestressing them and make sure that a clearance "A" is left between cylinder (4) and lever (19). Also check that when pressure is released, piston (13) projects out by 4–5 mm.



**ITA** Allentare i dadi (17) ed azzerare i giochi delle leve di frenatura (19) con i grani (18); bloccare i dadi (17) ad una coppia di 20÷25 Nm.

**ATTENZIONE!** I giochi devono risultare azzerati senza provocare precarico.

**D** Muttern (17) lockern und die Spiele der Bremshebel (19) mit den Stiften (18) zurückstellen; die Mutter (17) bei einem Anzugsmoment von 20÷25 Nm bockieren.

**ACHTUNG!** Die Spiele müssen zurückgestellt werden, ohne das Teil vorzuladen.

**ESP** Aflojar las tuercas (17) y poner a zero los juegos de las palancas de frenadura (19) con las espigas (18); bloquear las tuercas (17) a un par de 20÷25 Nm.

**ATENCION!** Los juegos deben de resultar a zero sin provocar precarga.

**F** Desserrer les écrous (17) et mettre à zéro les jeux des leviers de freinage (19) avec les grains (18); bloquer les écrous (17) à un couple de 20÷25 Nm.

**ATTENTION!** Les jeux doivent être mis à zéro sans provoquer de précharge.

**ITA** Montare il cilindro (4) completo di asta (5) e del dado interno (6).

**D** Den Zylinder (4) samt Stab (5) und innere Mutter (6) montieren.

**ESP** Montar el cilindro (4) completo de varilla (5) y de la tuerca interna (6).

**F** Monter le cylindre (4) équipé de la tige (5) et de l'écrou interne (6).

**ITA** Immettere pressione nel cilindro (4) e, mantenendo entrambe le leve (19) appoggiate alle viti di registro (18), mandare in appoggio i dadi (6) e (7) sul supporto (8); bloccare i dadi con una coppia di 50÷60 Nm.

**D** Den Druck in den Zylinder (4) einlassen. Beide Hebel (19) an den Stellschrauben (18) anliegen lassen und die Muttern (6) und (7) bis zum Anschlag der Halterung (8) bringen; die Muttern mit einem Anzugsmoment von 50÷60 Nm fest ziehen.

**ESP** Meter presión en el cilindro (4) y, manteniendo las dos palancas (19) en apoyo a las tuercas de registro (18), mandar en apoyo las tuercas (6) y (7) sobre el soporte (8); bloquear las tuercas con un par de 50÷60 Nm.

**F** Emettre de la pression dans le cylindre (4), puis en maintenant les deux leviers (19) posés sur les vis de réglage (18), envoyer les écrous (6) et (7) en appui sur le support (8); bloquer les écrous à un couple de 50÷60 Nm.

**ITA** Montare il distanziale (2) ed infilare il perno del supporto (10) nella leva di frenatura destra. Montare il secondo distanziale (2) e l'anello elastico (1).

**D** Das Distanzstück (2) montieren und den Halterungsstift (10) in den rechten Bremshebel einsetzen. Das zweite Distanzstück (2) in den Kolbenring (1) montieren.

**ESP** Montar el distancial (2) y insertar el perno del soporte (10) en la palanca de frenadura derecha. Montar el segundo distancial (2) y el anillo elastico.

**F** Monter l'entretoise (2), puis introduire l'axe du support (10) dans le levier de freinage droit. Monter la deuxième entretoise (2) et l'anneau à ressort (1).

**ITA** Centrare il foro del perno di fulcro (3). Spalmare la filettatura del perno (3) con Loctite 242, avvitare e serrarlo con chiave dinamometrica tarata a 25÷30 Nm.

**D** Das Loch des Zentrierstiftes (3) zentrieren. Das Stiftdgewinde (3) mit Loctite 242 schmieren und mit einem Momentenschlüssel bei 25÷30 Nm fest ziehen.

**ESP** Centrar el agujero de la rotula del fulcro (3). Pasar la rosca de la rotula (3) con Loctite 242, atomillarlo y apretarlo con llave dinamometrica tarada a 25÷30 Nm.

**F** Centrer le trou de l'axe du fourreau (3). Enduire le filetage de l'axe (3) avec du Loctite 242, visser et serrer celui-ci à l'aide d'une clé dynamométrique calibrée à 25÷30 Nm.

**ITA** Controllare che a freni sbloccati (pressione inserita), le leve (19) vadano in appoggio sulle viti (18) senza precaricarle e che tra cilindro (4) e leva (19) rimanga un gioco "A". Controllare anche che a pressione rilasciata, il pistone (13) abbia una sporgenza di 4÷5 mm.

**D** Kontrollieren, ob bei freien Bremsen (eingelassener Druck), die Hebel (19) an den Schrauben (18) anliegen, ohne sie vorzuladen und ob zwischen Zylinder (4) und Hebel (19) ein Spiel "A" besteht. Kontrollieren, ob bei abgelassenem Druck, der Kolben (13) um 4÷5 mm herausragt.

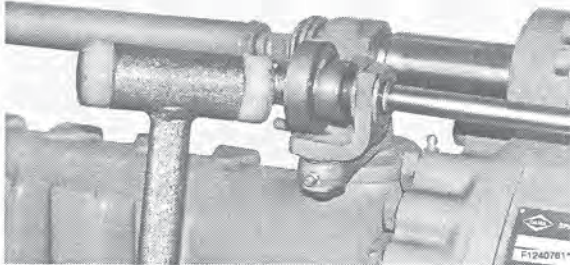
**ESP** Controlar que a frenos bloqueados (presión insertada), las palancas (19) vayan en apoyo sobre los tornillos (18) sin precargarlas y que entre el cilindro (4) y la palanca (19) haya un juego "A". Controlar también que a presión soltada el pistón (13) tenga una resalte de 4÷5 mm.

**F** Contrôler que lorsque les freins sont débloqués (pression introduite), les leviers (19) aient se poser sur les vis (18) sans précharger ces dernières, et qu'entre cylindre (4) et levier (19) il y ait un jeu "A". Contrôler également que lorsque la pression est relâchée, le piston (13) ait une saillie de 4÷5 mm.

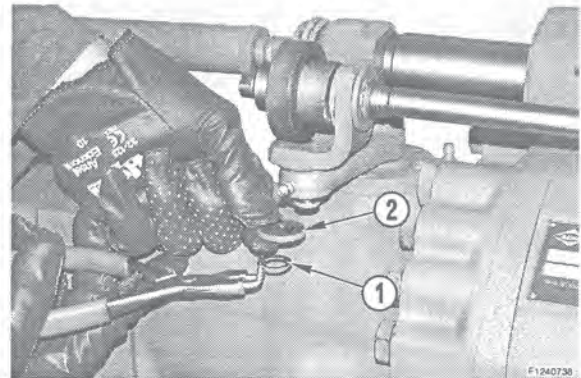




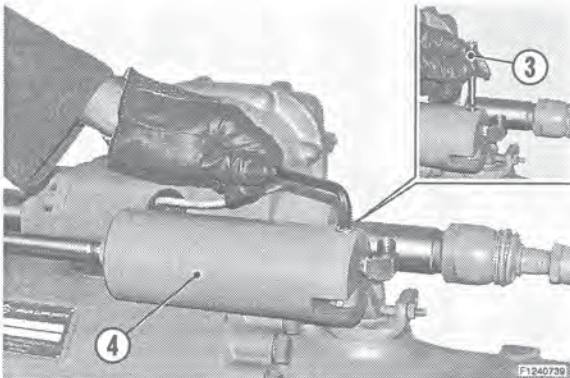
**HOW TO DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE WITH QUICK RELEASE - SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOCCAGGIO RAPIDO - AUßERE HYDRAULISCHE NEGATIVBREMSE MIT SCHNELLENTSICHERUNG ABMONTIEREN - DESMONTAJE FRENO NEGATIVO HYDRAULICO ESTERNO CON SBLOQUEO RAPIDO - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE AVEC DEBLOCAGE RAPIDE**



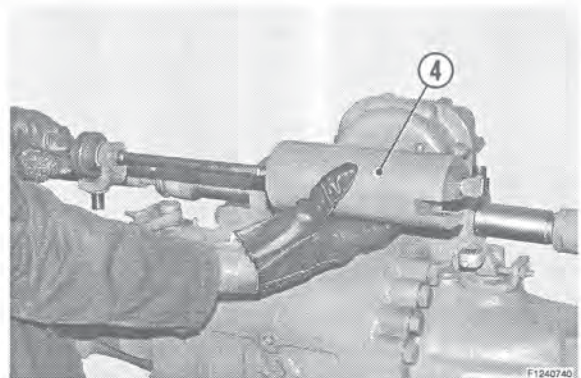
**CAUTION!** Before starting any operation on the assembly, disable the cylinder by giving a light hammer blow to the external ring of the check unit.



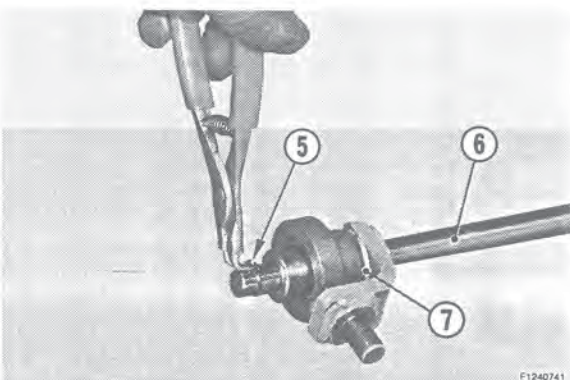
Remove snap ring (1) and extract distance piece (2).



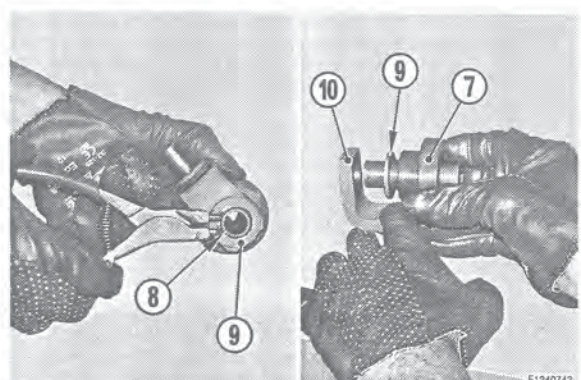
Remove the fulcrum pin (3) from the cylinder (4).



Remove the complete cylinder set (4).



Remove snap ring (5) from stem (6) and extract the check unit (7).



Remove snap ring (8) and washer (9) and separate support (10) and second washer (9) from the check unit (7).



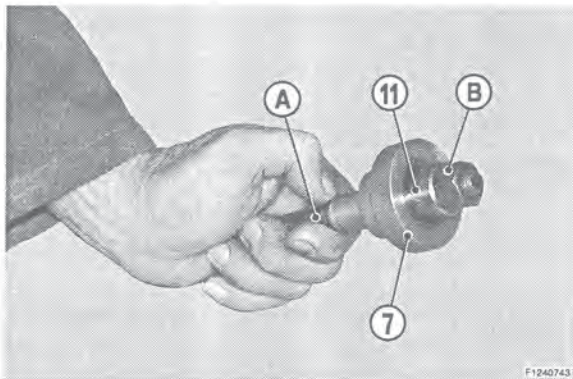


- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> <b>ATTENZIONE!</b> Prima di intervenire nel gruppo, disattivare l'azione del cilindro con un leggero colpo di mazzuolo sull'anello esterno del gruppo di ritegno.</p> <p><b>D</b> <b>ACHTUNG!</b> Bevor am Aggregat gearbeitet wird, die Zylinderwirkung mit einem leichten Hammerschlag auf den äußeren Ring des Halteaggregats löschen.</p> <p><b>ESP</b> <b>ATENCIÓN!</b> Antes de intervenir en el grupo, desconectar la acción del cilindro con un ligero golpe de martillo sobre el anillo exterior del grupo de retención.</p> <p><b>F</b> <b>ATTENTION!</b> Avant d'intervenir dans le groupe, désactiver l'action du cylindre par un léger coup de maillet sur l'anneau externe du groupe de fixation.</p> | <p><b>ITA</b> Rimuovere l'anello elastico (1) ed asportare il distanziale (2).</p> <p><b>D</b> Den Kolbenring (1) entfernen und das Distanzstück (2) abnehmen.</p> <p><b>ESP</b> Remover el anillo elastico (1) y sacar el distancial (2).</p> <p><b>F</b> Enlever l'anneau à ressort (1), puis enlever l'entretoise (2).</p>                                                                                                                                                                                                                                                                                                   |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere il perno di fulcro (3) del cilindro (4).</p> <p><b>D</b> Den Zentrierstift (3) des Zylinders (4) abnehmen.</p> <p><b>ESP</b> Remover la rotula de fulcro (3) del cilindro (4).</p> <p><b>F</b> Enlever l'axe du fourreau (3) du cylindre (4).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p><b>d</b></p> <p><b>ITA</b> Asportare il gruppo cilindro completo (4).</p> <p><b>D</b> Gesamtes Zylinderaggregat (4) abnehmen.</p> <p><b>ESP</b> Sacar el grupo cilindro completo (4).</p> <p><b>F</b> Enlever le groupe cylindre complet (4).</p>                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>e</b></p> <p><b>ITA</b> Rimuovere l'anello elastico (5) dallo stelo (6) e sfilare il gruppo di ritegno (7).</p> <p><b>D</b> Den Kolbenring (5) vom Schaft (6) abnehmen und das Halteaggregat (7) abziehen.</p> <p><b>ESP</b> Remover el anillo elastico (5) del vástago (6) y deshilar el grupo de retención (7).</p> <p><b>F</b> Enlever l'anneau à ressort (5) de la tige (6) et extraire le groupe de retenue (7).</p>                                                                                                                                                                                                                                                                                                                   | <p><b>f</b></p> <p><b>ITA</b> Asportare l'anello elastico (8), la rondella (9) e separare dal gruppo di ritegno (7) il supporto (10) e la seconda rondella (9).</p> <p><b>D</b> Den Kolbenring (8), die Unterlegscheibe (9) abnehmen und das Halteaggregat (7) von der Halterung (10) und der Unterlegscheibe (9) trennen.</p> <p><b>ESP</b> Sacar el anillo elastico (8), la arandela (9) y separar del grupo de retención (7) el soporte (10) y la segunda arandela (9).</p> <p><b>F</b> Enlever l'anneau à ressort (8), la rondelle (9) et séparer du groupe de retenue (7) le support (10) et la deuxième rondelle (9).</p> |





**HOW TO DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE WITH QUICK RELEASE - SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOCCAGGIO RAPIDO - ÄUßERE HYDRAULISCHE NEGATIVBREMSE MIT SCHNELLENTSICHERUNG ABMONTIEREN - DESMONTAJE FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOQUEO RAPIDO - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE AVEC DEBLOCAGE RAPIDE**



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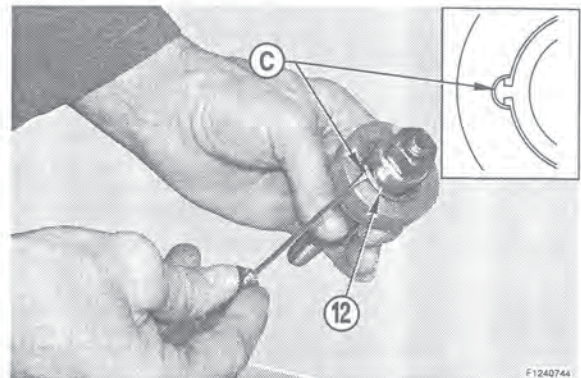


GB

a

Introduce an M14x100 screw "A" into the hole of the check unit (7) and screw a nut "B" until the spring seat (11) is moved to the end of stroke.

**NOTE.** Use a T.C.E.I. screw.



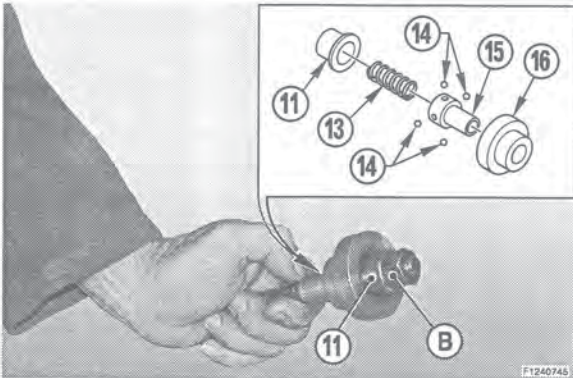
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GB

b

Rotate snap ring (12) until ring ends match slot "C". Remove snap ring (12).



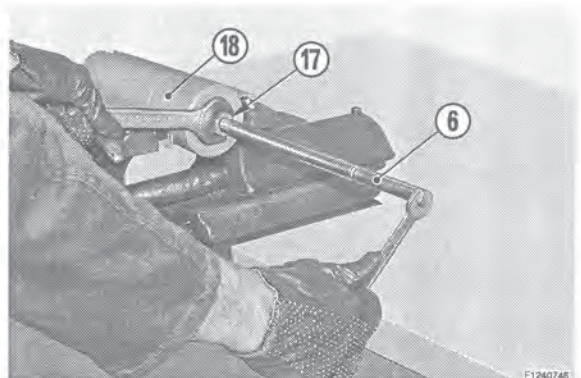
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GB

c

Slowly release nut "B" and disassemble the check unit.



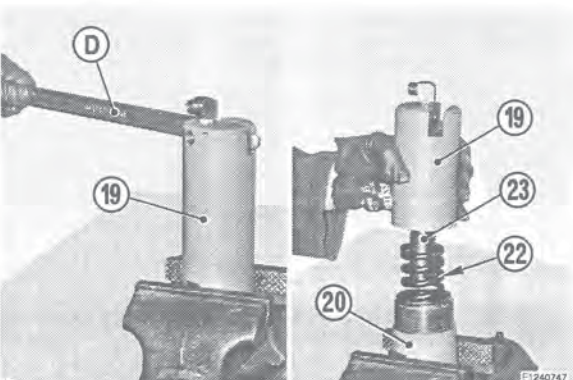
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GB

d

Loosen nut (17) and remove stem (6) from the cylinder (18).



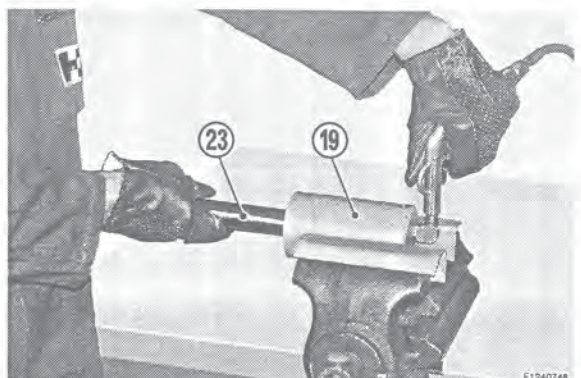
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GB

e

Place the cylinder in a vice with the spring seat (20) side engaged in it and, using a bar "D", loosen and remove the cylinder unit (19) complete with piston (23) and spring (22).



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GB

f

Slowly introduce air through the union piece of the cylinder unit (19) to expel the piston (23).

**CAUTION!** Hold the piston as it may be rapidly ejected and damaged.



**ITA**

Inserire nel foro del gruppo di ritagno (7) una vite "A" da M14x100 ed avvitare un dado "B" fino a mandare a fondo corsa la sede molla (11).

**NOTA.** Usare una vite T.C.E.I.

**D**

In das Loch des Halteaggregats (7) eine Schraube "A" M14x100 einsetzen und eine Mutter "B" bis zum Federsitz (11) einschrauben.

**BEMERKUNG.** Eine T.C.E.I. Schraube verwenden.

**a****ESP**

Insertar en el agujero del grupo de retención (7) un tornillo "A" de M14x100 y atornillar una tuerca "B" hasta mandar a fondo carrera el alojamiento muelle (11).

**NOTA.** Usar un tornillo T.C.E.I.

**F**

Introduire dans le trou du groupe de fixation (7) une vis "A" de M 14 x 100 et visser un écrou "B" jusqu'à envoyer en fin de course le siège ressort (11).

**NOTE.** Utiliser une vis T.C.E.I.

**ITA**

Far ruotare l'anello elastico (12) fino a portare le estremità in corrispondenza della nicchia "C". Rimuovere l'anello elastico (12).

**D**

Den Kolbenring (12) drehen, bis die Enden die Nische "C" erreichen. Kolbenring (12) abnehmen.

**b****ESP**

Hacer girar el anillo elastico (12) hasta llevar las extremidades en correspondencia del nicho "C". Remover el anillo elastico (12).

**F**

Faire tourner l'anneau à ressort (12) jusqu'à en amener l'extrémité face à la niche "C". Enlever l'anneau à ressort (12).

**ITA**

Rilasciare lentamente il dado "B" e scomporre il gruppo di ritagno.

**D**

Langsam die Mutter "B" abschrauben und das Halteaggregat auseinander nehmen.

**c****ESP**

Dejar lentamente la tuerca "B" y descomponer el grupo de retención.

**F**

Desserrer lentement l'écrou "B" et désassembler le groupe de retenue.

**ITA**

Allentare il dado (17) e rimuovere dal cilindro (18) lo stelo (6).

**D**

Mutter (17) lockern und den Schaft (6) vom Zylinder (18) abnehmen.

**d****ESP**

Aflojar la tuerca (17) y remover del cilindro (18) el vástago (6).

**F**

Desserrer l'écrou (17), puis enlever le cylindre (18) la tige (6).

**ITA**

Fissare il cilindro (18) in una morsa dal lato sede molla (20) e, utilizzando una barra "D", allentare ed asportare il corpo cilindro (19) completo di pistone (23) e la molla (22).

**D**

Den Zylinder (18) in einem Spannbock an der Federseite (20) einklemmen und mit Hilfe des Stabs "D" den Zylinderkörper (19) lockern und samt Kolben (23) und Feder (22) abnehmen.

**e****ESP**

Fijar el cilindro (18) en un corchete del lado de alojamiento de varilla "D", aflojar y sacar el cuerpo cilindro (19) completo de pistón (23) y el muelle (22).

**F**

Fixer le cylindre (18) dans un étau du côté du siège ressort (20), puis, à l'aide d'une barre "D", desserrer et enlever le corps cylindre (19) complet de piston (23), puis le ressort (22).

**ITA**

Immettere lentamente aria attraverso il raccordo del corpo cilindro (19) per espellere il pistone (23). **ATTENZIONE!** Trattenere il pistone che può essere espulso velocemente ed essere danneggiato.

**D**

Langsam Luft durch das Anschlußstück des Zylinderkörpers (19) einlassen, um den Kolben (23) auszu stoßen.

**f**

**ACHTUNG!** Den Kolben halten, denn er könnte plötzlich heraus springen und beschädigt werden.

**ESP**

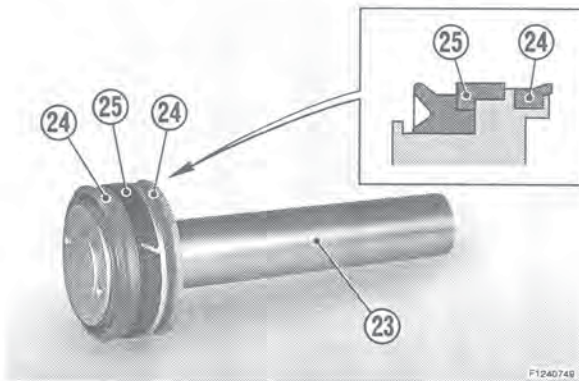
Meter lentamente aire a través del empalme del cuerpo cilindro (19) para expulsar el pistón (23). **ATENCIÓN!** Tener el pistón que puede ser expulsado rápidamente y ser danado.

**F**

Emettre lentement de l'air à travers le raccord du corps cylindre (19) et expulser le piston (23). **ATTENTION!** Retenir le piston qui expulsé rapidement peut par conséquent s'endommager.



HOW TO DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE WITH QUICK RELEASE - SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOCCAGGIO RAPIDO - ÄußERE HYDRAULISCHE NEGATIVBREMSE MIT SCHNELLENTSICHERUNG ABMONTIEREN - DESMONTAJE FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOQUEO RAPIDO - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE AVEC DEBLOCAGE RAPIDE



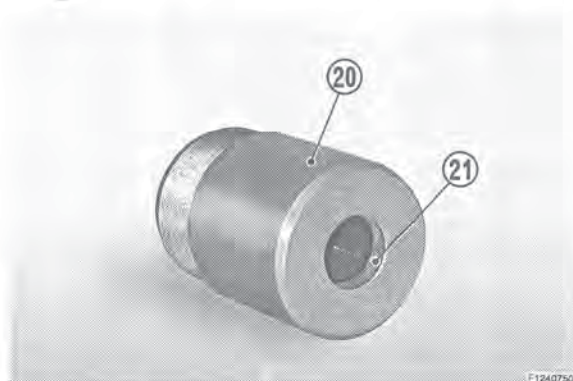
F1240749



GB

a

Remove seals (24) and guide ring (25) from the piston (23).  
NOTE. Note down seals installation direction.



F1240750



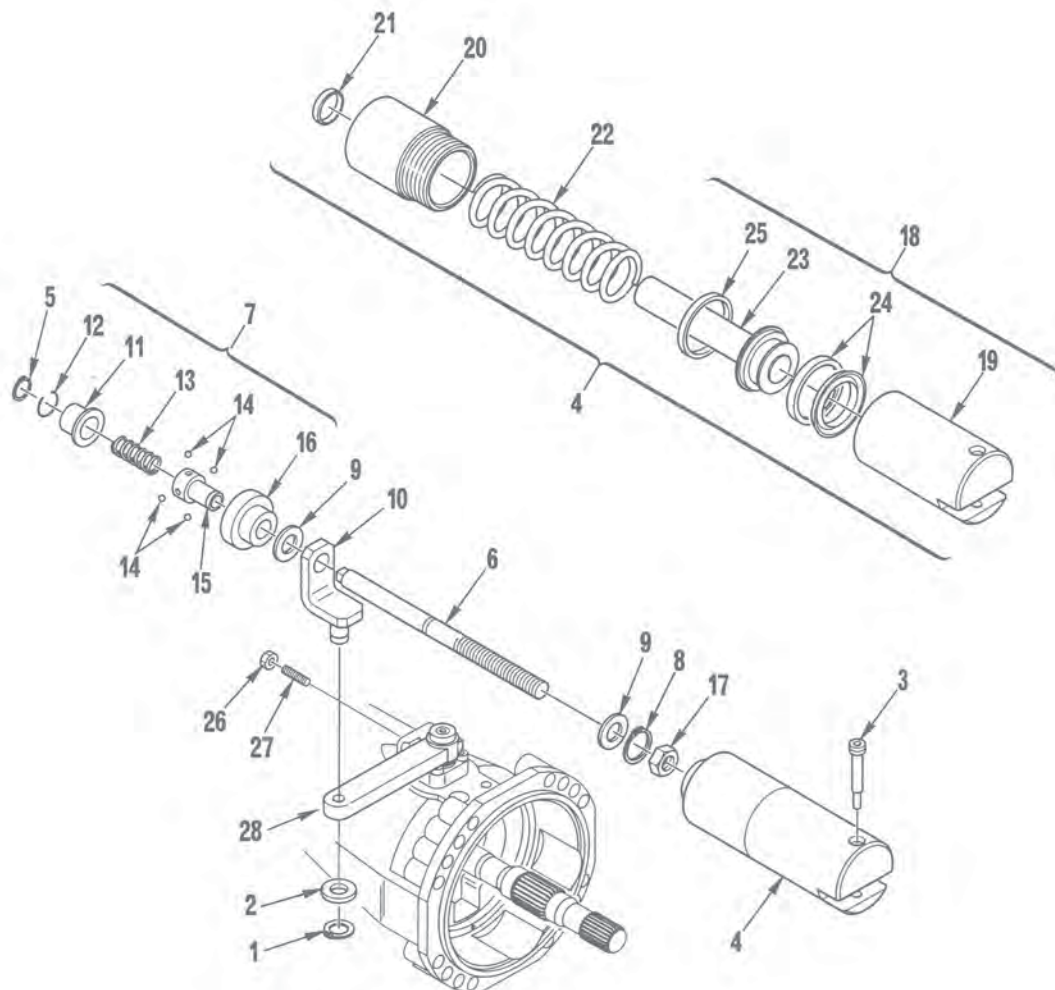
GB

b

ONLY IF NECESSARY

Remove guide ring (21) from spring seat (20).

CAUTION! If guide ring (21) is taken out, it must be replaced.



D1240081

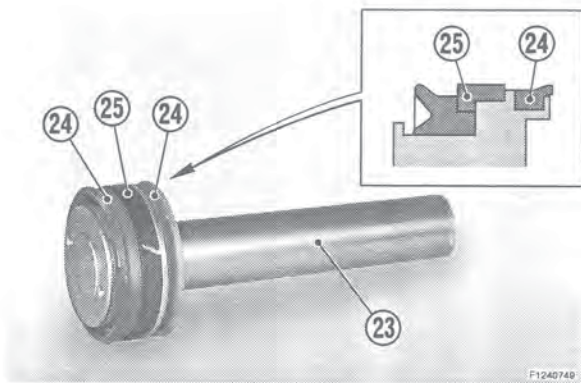


- a**
- ITA** Rimuovere dal pistone (23) le guarnizioni (24) e l'anello di guida (25).  
**NOTA.** Annotare il senso di montaggio delle guarnizioni.
- D** Den Kolben (23) und die Dichtungen (24) sowie den Führungsring (25) abnehmen.  
**BEMERKUNG.** Montagerichtung der Dichtungen bemerken.
- ESP** Remover del pistón (23) las guarniciones (24) y el anillo de guía (25).  
**NOTA.** Anotar el sentido de desmontaje de las guarniciones.
- F** Enlever le piston (23), les garnitures (24) et la bague de guidage (25).  
**NOTE.** Noter le sens du montage des garnitures.

- b**
- ITA** **SOLO SE NECESSARIO**  
Rimuovere dalla sede molla (20) l'anello di guida (21).  
**ATTENZIONE!** Se l'anello di guida (21) viene smontato, deve essere sostituito.
- D** **NUR WENN NÖTIG**  
Vom Federsitz (20) den Führungsring (21) abnehmen.  
**ACHTUNG!** Wird der Führungsring (21) abmontiert, muß er ausgewechselt werden.
- ESP** **SOLO SI FUERA NECESARIO**  
Remover del alojamiento muelle (20) el anillo de guía (21).  
**ATENCION!** Si el anillo de guía (21) viene desmontado, debe de ser sobstituido.
- F** **SEULEMENT SI BESOIN**  
Enlever du siège ressort (20) la bague de guidage (21).  
**ATTENTION!** Une fois la bague de guidage (21) démontée, elle doit être substituée.



HOW TO ASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE WITH QUICK RELEASE - ASSEMBLAGGIO FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOCCAGGIO RAPIDO - ÄußERE HYDRAULISCHE NEGATIVBREMSE MIT SCHNELLENTSICHERUNG MONTIEREN - ASEMBLAJE FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOQUEO RAPIDO - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE AVEC DEBLOCAGE RAPIDE

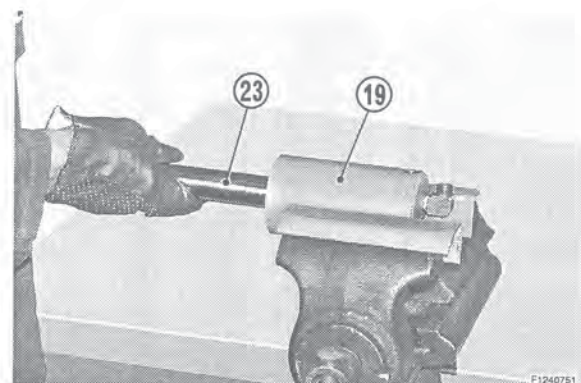


F1240740



a

Fit guide ring (25) and seals (24) onto the piston (23).  
**CAUTION!** Carefully check seals installation direction.

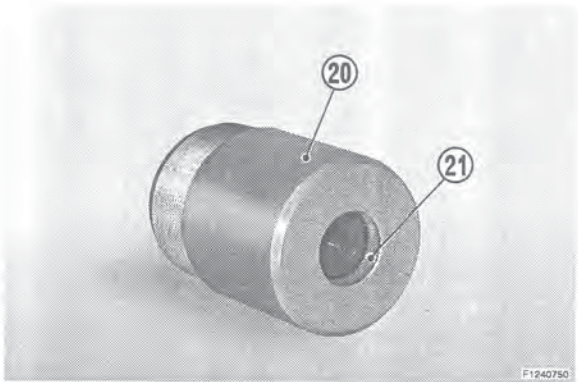


F1240751



b

Lubricate seals (24) and the inside part of the cylinder (19); introduce the whole piston and move it to end of stroke.

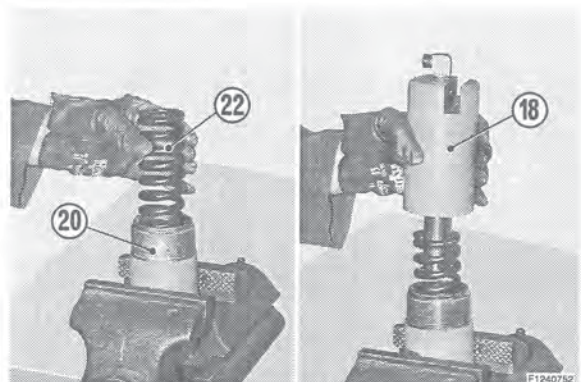


F1240750



c

If the guide ring has been taken out, fit a new one (21) into the spring seat (20).  
Lubricate the guide ring.

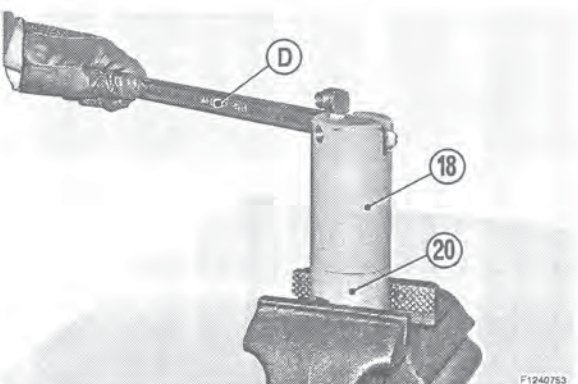


F1240752



d

Position the spring seat (20) in a vice and insert spring (22).  
Lubricate the thread. Install the whole cylinder (18).

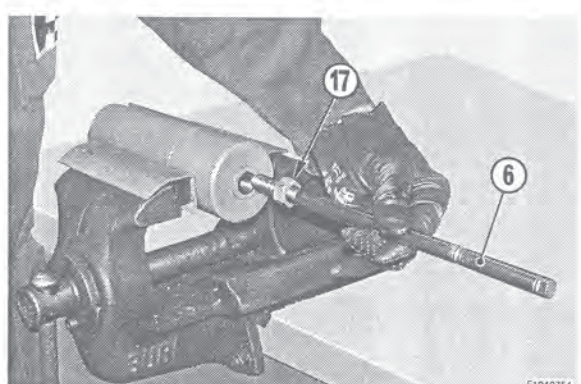


F1240753



e

Screw the cylinder (18) into the spring seat (20) and lock it using a bar "D".



F1240754



f

Screw stem (6) into the piston (17) without locking the nut (17).



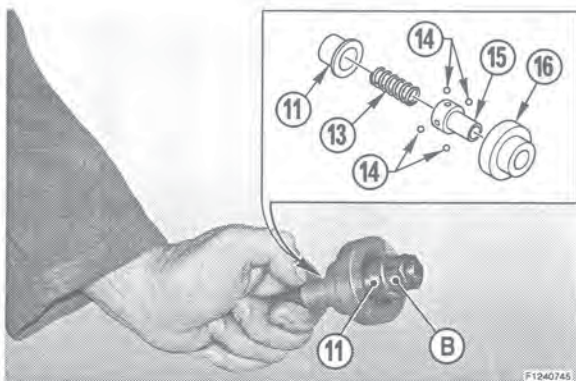


- a**
- ITA** Montare sul pistone (23) l'anello di guida (25) e le guarnizioni (24).  
**ATTENZIONE!** Controllare attentamente il senso di montaggio delle guarnizioni.
- D** Auf den Kolben (23) den Führungsring (25) und die Dichtungen (24) montieren.  
**ACHTUNG!** Montagerichtung der Dichtungen sorgfältig kontrollieren.
- ESP** Montar sobre el piston (23) el anillo de guía (25) y las guarniciones (24).  
**ATENCIÓN!** Controlar atentamente el sentido de montaje de las guarniciones.
- F** Monter sur le piston (23) la bague de guidage (25) et les garnitures (24).  
**ATTENTION!** Contrôler attentivement le sens de montage des garnitures.
- b**
- ITA** Lubrificare le guarnizioni (24) e l'interno del cilindro (19); inserire il pistone completo e mandarlo a fine corsa.
- D** Dichtungen (24) und das Zylinderinnere (19) schmieren; den vollständigen Kolben einsetzen und bis zum Anschlag einschieben.
- ESP** Lubrificar las guarniciones (24) y el interno del cilindro (19); introducir el piston completo y mandarlo a final de carrera.
- F** Lubrifier les garnitures (24) et l'intérieur du cylindre (19); introduire le piston complet et envoyer celui-ci en fin de course.
- c**
- ITA** Se è stato smontato, inserire il nuovo anello di guida (21) nella sede molla (20).  
Lubrificare l'anello di guida.
- D** Falls der Führungsring (21) abmontiert worden ist, diesen in den Federsitz (20) einsetzen.  
Den Führungsring schmieren.
- ESP** Si ha sido desmontado, introducir un nuevo anillo de guía (21) en el alojamiento muelle (20).  
Lubricar el anillo de guía.
- F** Si elle a été démontée, introduire la bague de guidage neuve (21) dans le siège ressort (20).  
Lubrifier la bague de guidage.
- d**
- ITA** Posizionare la sede molla (20) in una morsa ed inserire la molla (22).  
Lubrificare la filettatura. Montare il cilindro completo (18).
- D** Federsitz (20) in einen Spannbock einklemmen und die Feder (22) einsetzen.  
Gewinde schmieren. Den vollständigen Zylinder (18) montieren.
- ESP** Colocar el alojamiento muelle (20) en un corchete y introducir la muelle (22).  
Lubricar la rosca. Montar el cilindro completo (18).
- F** Placer le siège ressort (20) dans un étau et y introduire le ressort (22).  
Lubrifier le filetage. Monter le cylindre (18) complet.
- e**
- ITA** Avvitare il cilindro (18) nella sede molla (20) e bloccarlo utilizzando una barra "D".
- D** Den Zylinder (18) in den Federsitz (20) montieren und mit Hilfe eines Stabs "D" blockieren.
- ESP** Atornillar el cilindro (18) en el alojamiento muelle (20) y bloquearlo utilizando una varilla "D".
- F** Visser le cylindre (18) dans le siège ressort (20) puis bloquer celui-ci à l'aide d'une barre "D".
- f**
- ITA** Avvitare lo stelo (6) nel pistone senza bloccare il dado (17).
- D** Den Schaft (6) in den Kolben schrauben, ohne die Mutter (17) zu blockieren.
- ESP** Atornillar el vástago (6) en el piston sin bloquear la tuerca (17).
- F** Visser la tige (6) dans le piston sans bloquer l'écrou (17).





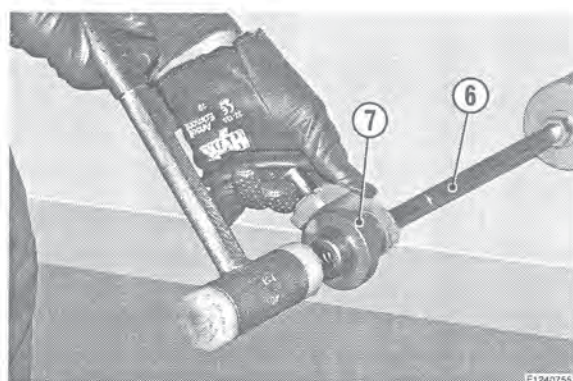
HOW TO ASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE WITH QUICK RELEASE - ASSEMBLAGGIO FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOCCAGGIO RAPIDO - ÄußERE HYDRAULISCHE NEGATIVBREMSE MIT SCHNELLENTSICHERUNG MONTIEREN - ASEMBLAJE FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOQUEO RAPIDO - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE AVEC DEBLOCAGE RAPIDE



GB

a

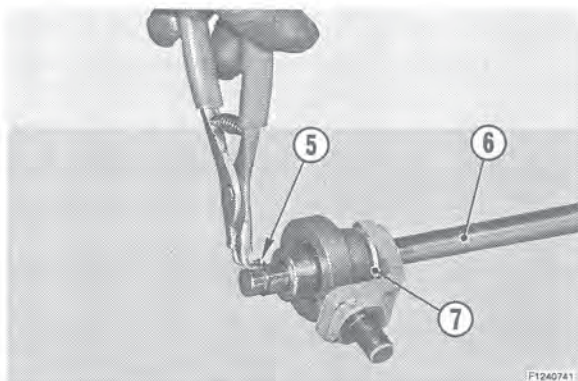
Assemble the check unit (7) by inverting the steps followed in the disassembly procedure.



GB

b

Using a plastic hammer, install the check unit (7) onto the stem (6).



GB

c

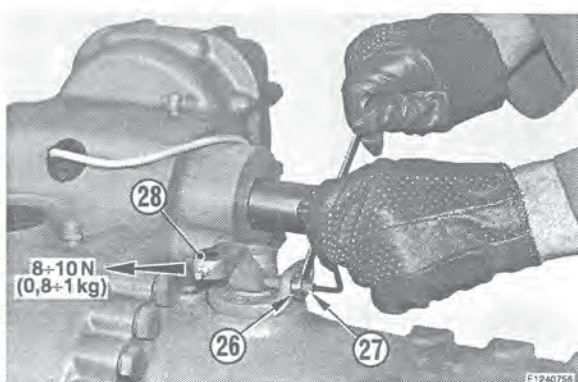
Fit the safety snap ring (5) onto the stem (6).



GB

d

**CAUTION!** In case the braking disks have been replaced or if brake pistons have been removed: before adjusting the negative braking unit, apply the brakes several times at maximum pressure in order to set clearances.

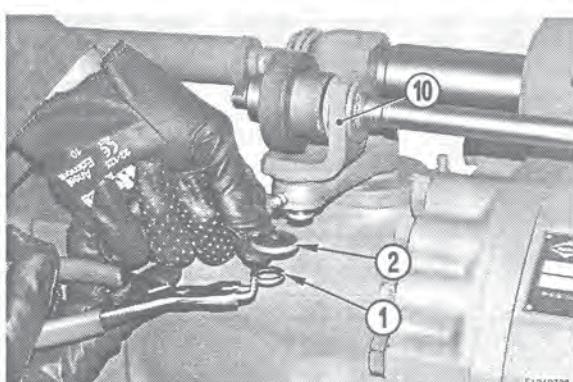


GB

e

Loosen nuts (26) and apply a force of 8–10 N (0.8–1 kg) to levers (28). Direct the force towards the braking direction to eliminate the clearances by using dowels (27); lock nuts (26) to a torque wrench setting of 20–25 Nm.

**CAUTION!** The idle stroke should be eliminated without causing any preloading.



GB

f

Fit the distance piece (2) and insert the pin of support (10) in the right-hand braking lever. Fit the snap ring (1).





- a**
- ITA** Assemblare il gruppo di ritegno (7) seguendo la procedura di smontaggio in senso inverso.
- D** Halteaggregat (7) in umgekehrter Reihenfolge als beim Abmontieren, wieder zusammenbauen.
- ESP** Asemblar el grupo de retención (7) siguiendo la procedura de desmontaje en sentido invertido.
- F** Assembler le groupe de retenue (7) en suivant la procédure du démontage mais dans le sens contraire.

- b**
- ITA** Utilizzando un mazzuolo in materiale plastico, montare il gruppo di ritegno (7) sullo stelo (6).
- D** Mit einem Gummihammer das Halteaggregat (7) auf den Schaft (6) montieren.
- ESP** Utilizando un martillo de plastica, montar el grupo de retención (7) sobre el vástago (6).
- F** A l'aide d'un maillet en matière plastique, monter le groupe de retenue (7) sur la tige (6).

- c**
- ITA** Montare sullo stelo (6) l'anello elastico di sicurezza (5).
- D** Auf den Schaft (6) den Sicherheitskolbenring (5) montieren.
- ESP** Montar sobre vástago (6) el anillo elastico de seguridad (5).
- F** Monter sur la tige (6) l'anneau à ressort de sécurité (5).

- d**
- ITA** **ATTENZIONE!** Se sono stati sostituiti i dischi di frenatura o sono stati smontati i pistoni dei freni, prima di registrare il gruppo freno negativo eseguire più frenate alla massima pressione per assestare i giochi.
- D** **ACHTUNG!** Falls die Bremscheiben ausgewechselt oder die Bremskolben abmontiert worden sind, mehrmals bei maximalen Druck bremsen, um das Spiel zu setzen, bevor das Bremsaggregat eingestellt wird.
- ESP** **ATENCION!** Si han sido substituidos los discos de frenadura o han sido desmontados los pistones de los frenos, antes de registrar el grupo freno negativo ejecutar mas frenadas a la maxima presión para asestar los juegos.
- F** **ATTENTION!** Si les disques de freinage ont été remplacés ou que les pistons des freins ont été démontés, avant de régler le groupe frein négatif, effectuer quelques freinages au max. de la pression pour ajuster les jeux.

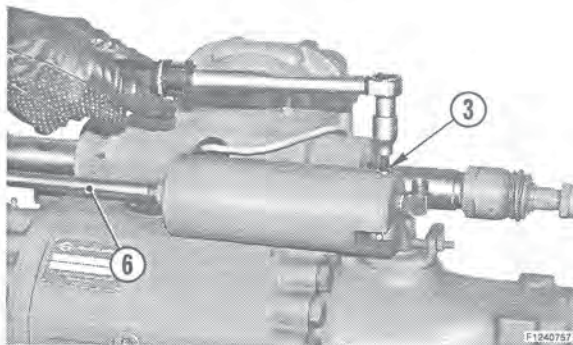
- e**
- ITA** Allentare i dadi (26) ed applicare alle leve (28) una forza di  $8 \div 10$  N ( $0,8 \div 1$  kg) diretta nel senso di frenatura per eliminare i giochi utilizzando i grani (27); bloccare i dadi (26) ad una coppia di  $20 \div 25$  Nm.  
**ATTENZIONE!** La corsa a vuoto deve essere eliminata senza provocare precarico.
- D** Muttern (26) lockern und an den Hebeln (28) eine Kraft von  $8 \div 10$  N ( $0,8 \div 1$  kg) in die Bremsrichtung anbringen, um die Spiele der Stifte (27) zu beseitigen; die bei einem Anzugsmoment von  $20 \div 25$  Nm blockieren.  
**ACHTUNG!** Der leere Lauf muß beseitigt werden, ohne das Teil vorzuladen.
- ESP** Aflojar las tuercas (26) y aplicar a las palancas (28) una fuerza de  $8 \div 10$  N ( $0,8 \div 1$  kg) directa en el sentido de frenadura para eliminar los juegos utilizando las espigas (27); bloquear las tuercas (26) a un par de  $20 \div 25$  Nm.  
**ATENCION!** La carrera a vacío debe de ser eliminada sin provocar precarga.
- F** Desserrer les écrous (26), puis appliquer aux leviers (28) une contrainte de  $8 \div 10$  N ( $0,8 \div 1$  kg) orientée dans le sens du freinage pour éliminer les jeux à l'aide des grains (27); bloquer les écrous (26) à un couple de  $20 \div 25$  Nm.  
**ATTENTION!** La course à vide doit être éliminée sans provoquer de précharge.

- f**
- ITA** Montare il distanziale (2) ed infilare il perno del supporto (10) nella leva di frenatura destra. Montare l'anello elastico (1).
- D** Das Distanzstück (2) montieren und den Stift der Halterung (10) in den rechten Bremshebel montieren. Den Kolbenring (1) montieren.
- ESP** Montar el distancial (2) y introducir la rotula del soporte (10) en la palanca de frenadura derecha. Montar el anillo elastico (1).
- F** Monter l'entretoise (2) et introduire l'axe du support (10) dans le levier de freinage droit. Monter l'anneau à ressort (1).

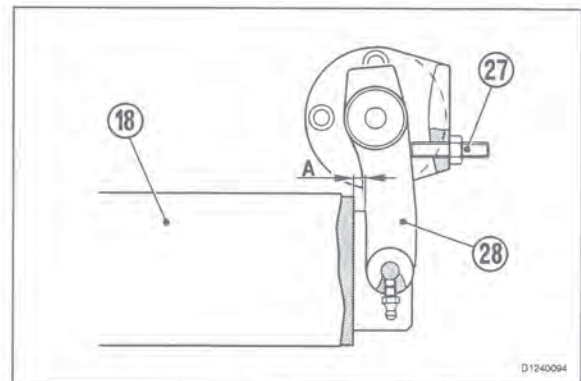




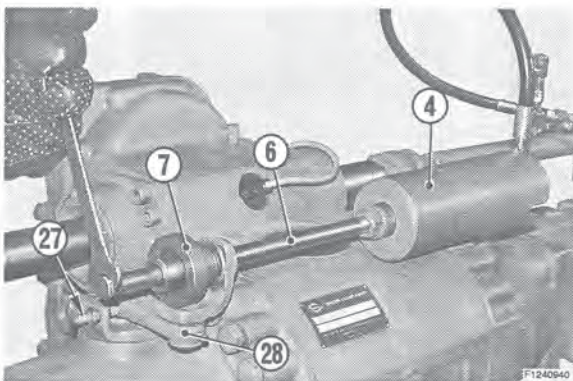
**HOW TO ASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE WITH QUICK RELEASE - ASSEMBLAGGIO FRENO NEGATIVO IDRAULICO ESTERNO CON SBLOCCAGGIO RAPIDO - ÄUßERE HYDRAULISCHE NEGATIVBREMSE MIT SCHNELLENTSICHERUNG MONTIEREN - ASEMBLAJE FRENO NEGATIVO HYDRAULICO ESTERNO CON SBLOQUEO RAPIDO - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE AVEC DEBLOCAGE RAPIDE**



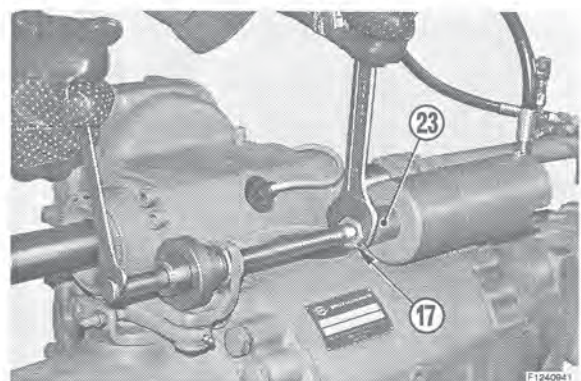
Rotate stem (6) to centre the hole of the fulcrum pin (3). Apply Loctite 242 to the thread of the fulcrum pin (3), screw and tighten pin with a dynamometric wrench set to 25 – 30 Nm.



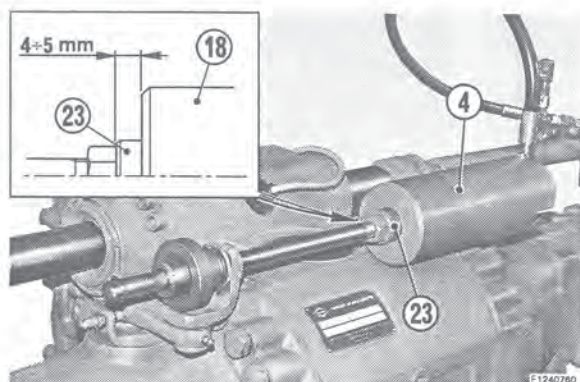
Check that a clearance "A" is left between the lever (28) on the cylinder side (resting against the adjustment dowel) and cylinder (18). If necessary, remove the lever, turn it by one tooth in relation to the spline and repeat idle stroke elimination procedure.



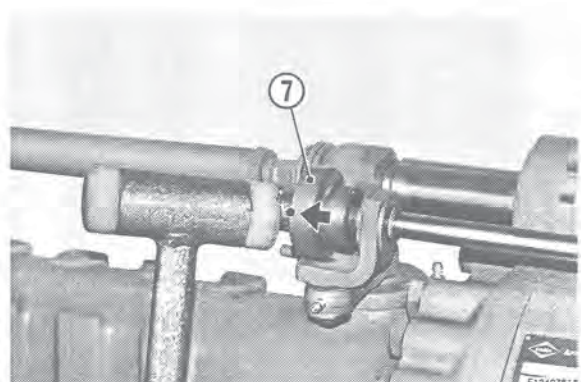
Introduce pressure into the cylinder (4) and, with the levers (28) resting against the adjustment dowels (27), screw rod (6) to engage the quick release (7) in the slot.



Lock nut (17) in position against the stem of the piston (23). Torque wrench setting for the nut: max. 40 Nm.



Release the pressure and check that piston (23) returns and stops in a position where it projects out from the cylinder head (4) by 4 – 5 mm.



Release the check unit (7) by giving a hammer blow to the external ring. Introduce pressure again and check that at the end of piston stroke, the check unit (7) is actually engaged onto the rod (6).



**ITA** Ruotare lo stelo (6) fino a centrare il foro del perno di fulcro (3).  
Spalmare la filettatura del perno di fulcro (3) con Loctite 242, avvitare e serrarlo con chiave dinamometrica tarata a 25÷30 Nm.

**D** Den Schaft (6) drehen bis das Loch des Zentrierstifts (3) zentriert ist.  
Das Gewinde des Zentrierstifts (3) mit Loctite 242 schmieren und mit einem Momentenschlüssel bei 25÷30 Nm fest ziehen.

**ESP** Girar el vástago (6) hasta centrar el agujero de la rotula de fulcro (3).  
Pasar la rosca de la rotula del fulcro (3) con Loctite 242, atornillarla y apretarla con llave dinamométrica tarata a 25÷30 Nm.

**F** Tourner la tige (6) jusqu'à centrer le trou de l'axe du fourreau (3).  
Enduire le filetage de l'axe du fourreau (3) avec du Loctite 242, visser celui-ci à l'aide de la clé dynamométrique calibrée à 25÷30 Nm.

**ITA** Controllare che tra la leva (28) lato cilindro (in appoggio sul grano di registrazione) ed il cilindro (18) rimanga un gioco "A".  
Se necessario, rimuovere la leva, ruotarla di un dente rispetto al profilo scanalato e ripetere l'eliminazione della corsa a vuoto.

**D** Kontrollieren, ob zwischen dem Hebel (28) an der Zylinderseite (am Stellstift anliegend) und dem Zylinder (18) ein Spiel "A" übrig bleibt.  
Wenn nötig, den Hebel abnehmen, um einen Zahn drehen und den Vorgang wiederholen.

**ESP** Controlar que entre la palanca (28) lado cilindro (en apoyo sobre la espiga de registraci3n) y el cilindro (18) quede un juego "A".  
Si necesario, remover la palanca, girar de un diente respecto al perfil rayado y repetir la eliminaci3n de la carrera a vaci3.

**F** Contr3ler qu'entre le levier (28) du c3t3 cylindre (pos3 sur le grain de r3glage) et le cylindre (18) il y ait un jeu "A".  
Si besoin, enlever le levier, tourner celui-ci d'une dent par rapport au profil cannel3 et 3liminer de nouveau la course à vide.

**ITA** Inserire pressione nel cilindro (4) e, mantenendo le leve (28) appoggiate ai grani di registro (27), avvitare l'asta (6) fino ad agganciare lo sblocco rapido (7) nella cava.

**D** Druck in den Zylinder (4) einlassen. Die Hebel (28) am Stellstift (27) anliegen lassen und den Stab (6) festschrauben, bis er in der Schnellentsicherung (7) der Nut einrastet.

**ESP** Introducir presi3n en el cilindro (4) y, manteniendo las palancas (28) en apoyo a las espigas del registro (27), atornillar la varilla (6) hasta enganchar el bloqueo rapido (7) en el nicho.

**F** Introduire de la pression dans le cylindre (4), puis en maintenant le levier (28) pos3 sur les grains de r3glage (27), visser la tige (6) jusqu'à accrocher le d3blocage rapide (7) dans le creux.

**ITA** Bloccare il dado (17) contro lo stelo del pistone (23).  
Coppia di serraggio dado: max. 40 Nm.

**D** Mutter (17) gegen den Kolbenschaft (23) blockieren.  
Anzugsmoment für die Mutter: max. 40 Nm.

**ESP** Bloquear la tuerca (17) contra el vástago del pist3n (23).  
Par de torsion tuerca: max. 40 Nm.

**F** Bloquer l'écrou (17) contre la tige du piston (23).  
Couple de serrage 3crou: max. 40 Nm.

**ITA** Rilasciare la pressione e controllare che il pistone (23) rientri fino ad avere una sporgenza di 4÷5 mm rispetto la testata del cilindro (4).

**D** Den Druck ablassen und kontrollieren, ob der Kolben (23) zurück fährt bis er um 4÷5 mm im Verhältnis zum Zylinderkopf (4) herausragt.

**ESP** Dejar la presi3n y controlar que el pist3n (23) vuelva hasta tener un resalte de 4÷5 mm respecto la culata del cilindro (4).

**F** Relâcher la pression et contr3ler que le piston (23) rentre jusqu'à ce qu'il y ait une saillie de 4÷5 mm par rapport à la culasse du cylindre (4).

**ITA** Sbloccare il gruppo di ritegno (7) con un colpo di mazzuolo sull'anello esterno.  
Inserire nuovamente pressione e controllare che a fine corsa del pistone avvenga l'aggancio del gruppo di ritegno (7) sull'asta (6).

**D** Das Halteaggregat (7) mit einem Hammerschlag am äußeren Ring entsichern.  
Nochmals Druck einlassen und kontrollieren, ob am Hubende des Kolbens das Halteaggregat (7) im Stab (6) einrastet.

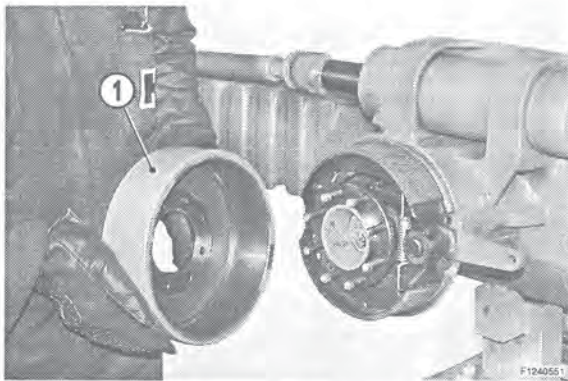
**ESP** Sbloquear el grupo de retenci3n (7) con un golpe de martillo sobre el anillo el3tico.  
Introducir de nuevo presi3n y controlar que a final carrera del pist3n suceda el enganche del grupo de retenci3n (7) sobre la varilla (6).

**F** D3bloquer le groupe de retenue (7) par un coup de maillet sur l'anneau externe.  
Introduire de nouveau de la pression et contr3ler qu'à la fin de course du groupe piston, il y ait un accrochage du groupe de retenue (7) sur la tige (6).

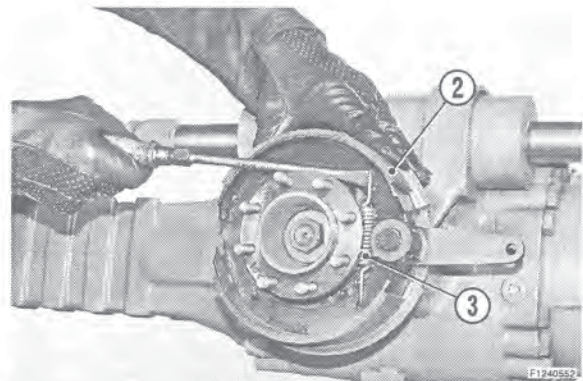




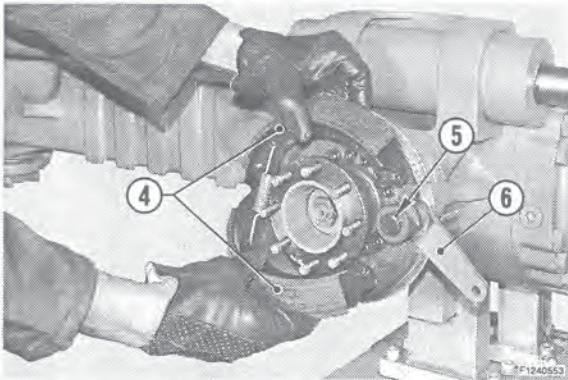
**DISASSEMBLING THE INCOMING DRUM BRAKE - SMONTAGGIO FRENO A TAMBURO IN ENTRATA - TROMMELBREMSE AM EINGANG  
ABMONTIEREN - DESMONTAJE FRENO DE TAMBOR EN ENTRADA- DEMONTAGE DU FREIN D'ENTREE A TAMBOUR**



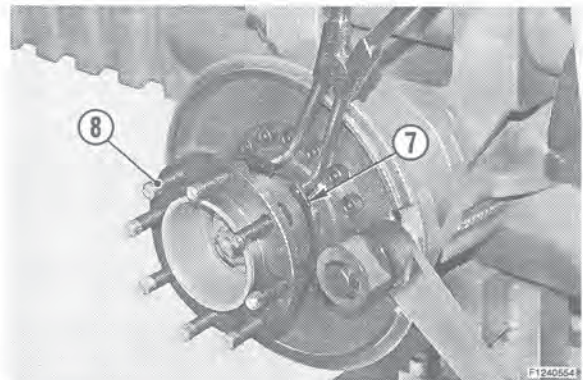
Pull out the drum (1) and remove dust from friction surfaces.  
**CAUTION!** Use only brush-type vacuum cleaners.



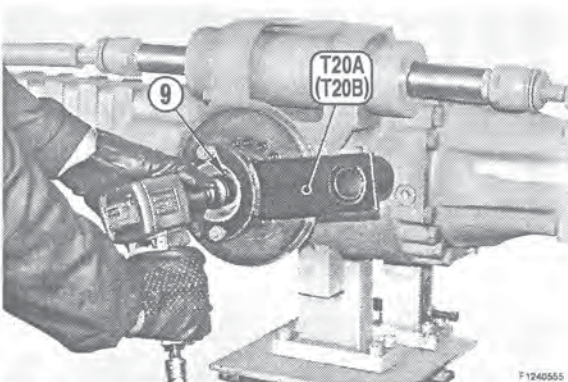
Hold the upper shoe into position (2) and release the spring (3)



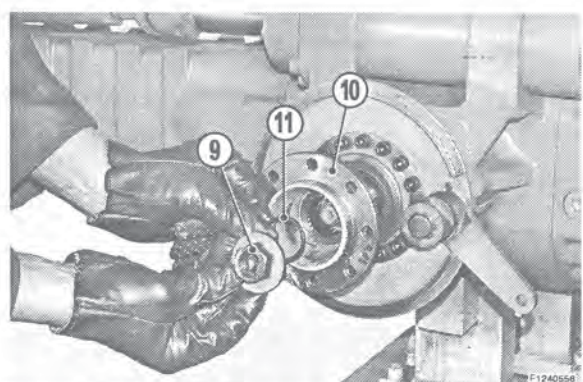
Remove the shoe assembly (4).  
If necessary, remove the snap ring (5) and pull out the lever (6)



Remove the snap ring (7) from its seat around the screws (8).  
Remove the screws (8).



Fit tool T20A (T20B), engage the stop rod and loosen the check nut (9) of the flange (10).



Remove parts in the following sequence: nut (9), O-ring (11), flange (10) and stop ring (7).

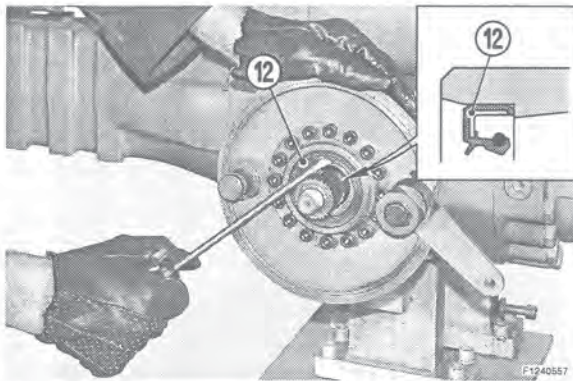




|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Rimuovere il tamburo (1) ed asportare la polvere delle guarnizioni di attrito.<br/><b>ATTENZIONE!</b> Usare solo aspirapolvere e pennello.</p> <p><b>D</b> Trommel (1) abnehmen und die Reibungsdichtungen vom Staub reinigen.<br/><b>ACHTUNG!</b> Nur mit einem Staubsauger und einem Pinsel.</p> <p><b>ESP</b> Remover el tambor (1) y sacar el polvo de las juntas de roce.<br/><b>CUIDADO!</b> Usar sólo aspirador y pincel.</p> <p><b>F</b> Déplacer le tambour (1) et enlever la poussière des garnitures de frottement.<br/><b>ATTENTION!</b> Utiliser seulement un aspirateur et un pinceau.</p> | <p><b>ITA</b> Tenendo in posizione la ganaschia superiore (2), sganciare la molla (3).</p> <p><b>D</b> Die obere Backe (2) festhalten und Feder (3) abnehmen.</p> <p><b>ESP</b> Manteniendo en posición la mordaza superior (2), desenganchar el muelle (3).</p> <p><b>F</b> En tenant bien en place la mâchoire supérieure (2) décrocher le ressort (3).</p>                                                                                                                          |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere il gruppo ganasce (4).<br/>Se necessario, rimuovere l'anello elastico (5) e sfilare la leva (6).</p> <p><b>D</b> Backeneinheit (4) abnehmen. Wenn nötig Federring (5) abnehmen und Hebel (6) heraus ziehen.</p> <p><b>ESP</b> Remover el grupo mordazas (4).<br/>Si fuera necesario, remover el anillo elástico (5) y sacar la palanca (6).</p> <p><b>F</b> Enlever le groupe mâchoire (4).<br/>Si besoin, enlever l'anneau ressort (5) et extraire le levier (6).</p>                                                                                                                         | <p><b>ITA</b> Rimuovere dalla sede l'anello elastico (7) di ritagno in posizione delle viti (8).<br/>Asportare le viti (8).</p> <p><b>D</b> Federring (7) von den Schrauben (8) abnehmen. Schrauben (8) abschrauben.</p> <p><b>ESP</b> Remover de su alojamiento el anillo elástico (7) de retención en posición de los tornillos (8).<br/>Sacar los tornillos (8).</p> <p><b>F</b> Extraire de son logement l'anneau à ressort (7) fixé sur les vis (8).<br/>Enlever les vis (8).</p> |
| <p><b>e</b></p> <p><b>ITA</b> Montare l'attrezzo T20A (oppure T20B), impegnare l'asta di arresto ed allentare il dado (9) di ritagno della flangia (10).</p> <p><b>D</b> Werkzeug T20A (T20B) montieren und Sperrstab einsetzen; Mutter (9) zur Befestigung des Flansches (10) lockern.</p> <p><b>ESP</b> Montar la herramienta T20A (T20B), bloquear la varilla de tope y aflojar la tuerca (9) de retención de la brida (10).</p> <p><b>F</b> Monter l'outil T20A (T20B) engager la tige de butée et desserrer l'écrou (9) de fixation de la flasque (10).</p>                                                                       | <p><b>ITA</b> Asportare nell'ordine, il dado (9), la guarnizione OR (11), la flangia (10) e l'anello di arresto (7).</p> <p><b>D</b> Der Reihe nach Mutter (9), O-Ring (11), Flansch (10) und Sperring (7) abnehmen.</p> <p><b>ESP</b> Sacar en su orden, la tuerca (9), la junta OR (11), la brida (10) y el anillo de tope (7).</p> <p><b>F</b> Enlever dans l'ordre, l'écrou (9), la garniture OR (11), la flasque (10) et la bague de butée (7).</p>                               |

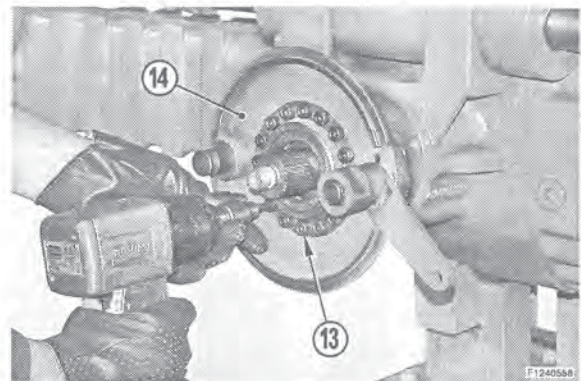


DISASSEMBLING THE INCOMING DRUM BRAKE - SMONTAGGIO FRENO A TAMBURO IN ENTRATA - TROMMELBREMSE AM EINGANG  
ABMONTIEREN - DESMONTAJE FRENO DE TAMBOR EN ENTRADA - DEMONTAGE DU FREIN D'ENTRÉE A TAMBOUR



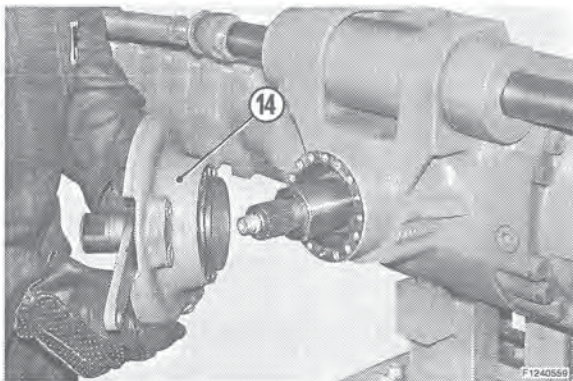
Remove the seal (12) and discard it.  
**NOTE.** Note down assembly direction.

a



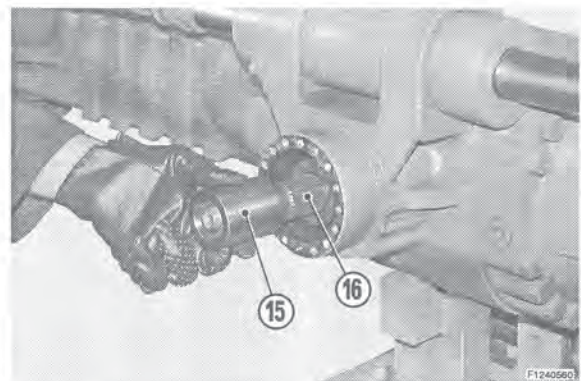
Remove the securing screws (13) from brake support (14).

b



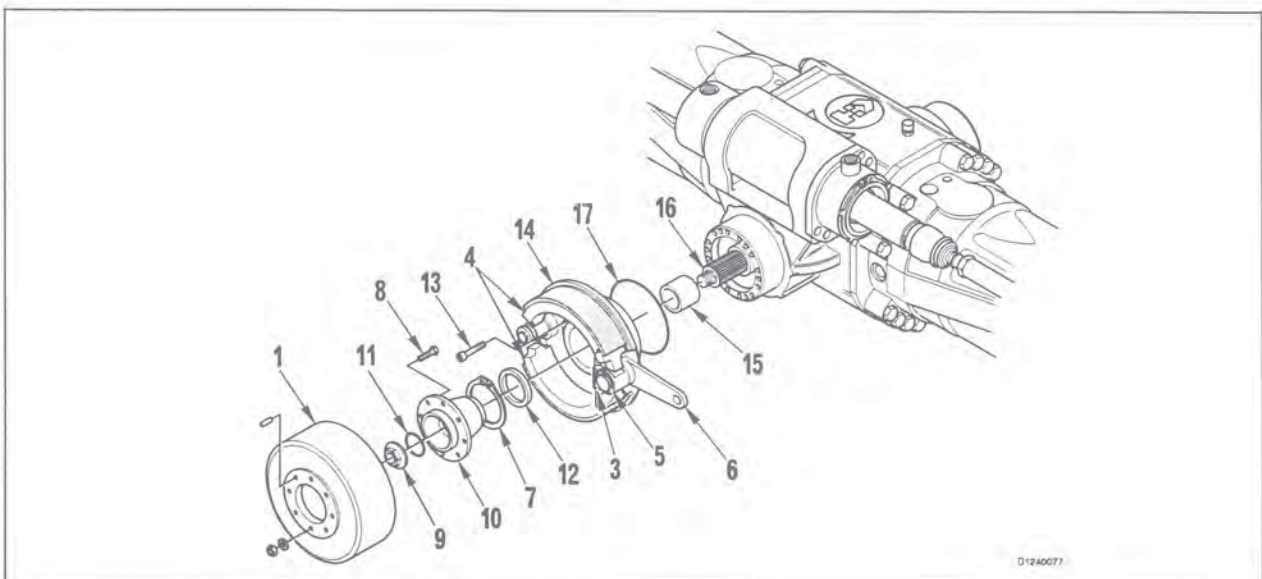
Remove brake support (14).

c



Remove the distance piece (15).  
**NOTE.** If operations are to be carried out the bevel pinion, see the specific axle section.

d



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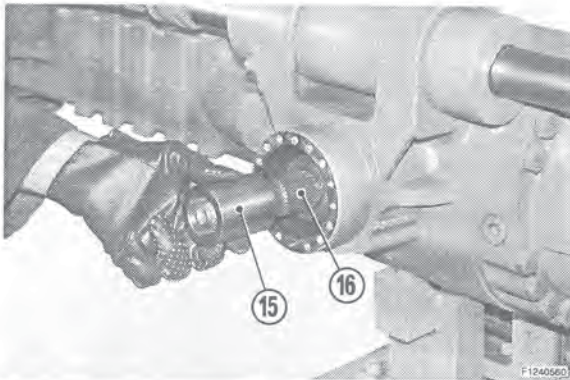


SPICER CLARK-HURTH

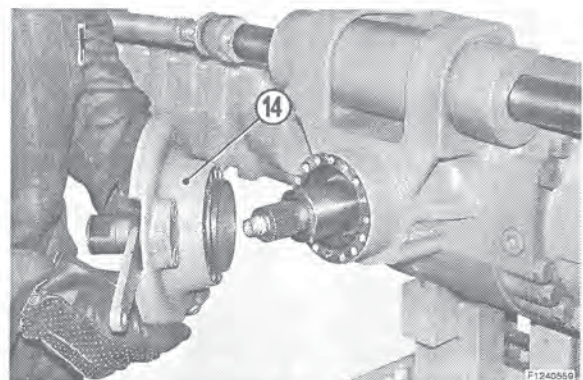
- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Rimuovere l'anello di tenuta (12) e scartarlo.<br/><b>NOTA.</b> Annotare il senso di montaggio.</p> <p><b>D</b> Dichtung (12) abnehmen und nicht mehr verwenden.<br/><b>BEMERKUNG.</b> Montagerichtung bemerken.</p> <p><b>ESP</b> Remover la junta (12) y descartarla.<br/><b>NOTA.</b> Anotar el sentido de montaje.</p> <p><b>F</b> Enlever la garniture (12) puis l'éliminer.<br/><b>NOTE.</b> Prendre note du sens du montage.</p> | <p><b>ITA</b> Rimuovere le viti (13) di fissaggio del supporto freno (14).</p> <p><b>D</b> Schrauben (13) zur Befestigung der Bremsenhalterung (14) abschrauben.</p> <p><b>ESP</b> Remover los tornillos (13) de fijación del soporte del freno (14).</p> <p><b>F</b> Enlever les vis (13) de fixation du support du frein (14).</p>                                                                                                                                                                                                                                                                                                                                  |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere il supporto freno (14).</p> <p><b>D</b> Bremsenhalterung (14) abnehmen.</p> <p><b>ESP</b> Remover el soporte del freno (14).</p> <p><b>F</b> Enlever le support du frein (14).</p>                                                                                                                                                                                                                                            | <p><b>d</b></p> <p><b>ITA</b> Rimuovere il distanziale (15).<br/><b>NOTA.</b> Se si deve intervenire sul gruppo pignone conico, vedere il paragrafo specifico dell'assale.</p> <p><b>D</b> Distanzstück (15) abnehmen.<br/><b>BEMERKUNG.</b> Falls Eingriffe am Kegelrad nötig sind, siehe entsprechender Abschnitt betreffend Achsen.</p> <p><b>ESP</b> Remover el separador (15).<br/><b>NOTA.</b> Si hay que intervenir en el grupo piñón cónico, véase el apartado específico del eje.</p> <p><b>F</b> Enlever l'entretoise (15).<br/><b>NOTE.</b> Si on doit intervenir sur le groupe pignon conique, voir le paragraphe concernant spécifiquement l'essieu.</p> |



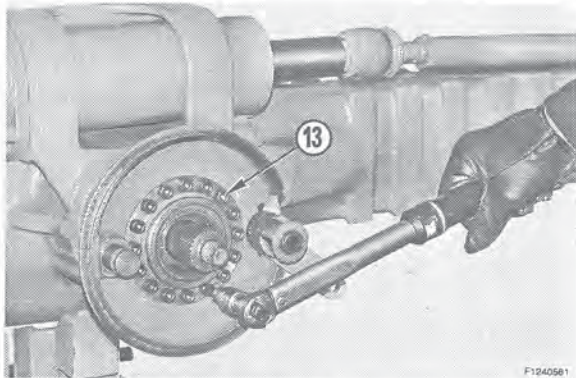
**ASSEMBLING THE INCOMING DRUM BRAKE - ASSEMBLAGGIO FRENO A TAMBURO IN ENTRATA - TROMMELBREMSE AM EINGANG  
MONTIEREN - MONTAJE DEL FRENO DE TAMBOR EN ENTRADA - ASSEMBLAGE DU FREIN D'ENTREE A TAMBOUR**



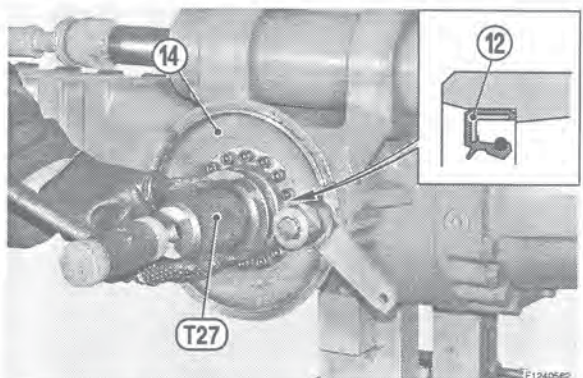
Fit the distance piece (15) onto the pinion (16).



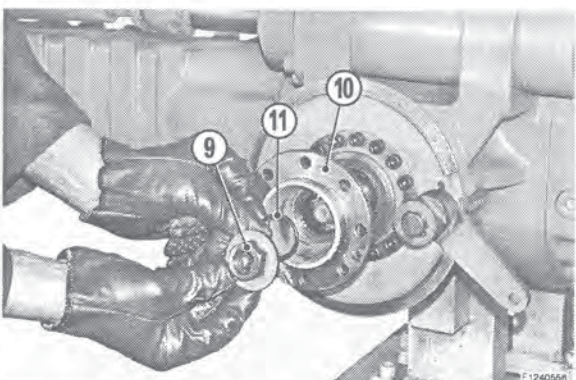
Lubricate the coupling surfaces and position brake support (14). Check that the O-ring (17) is intact.



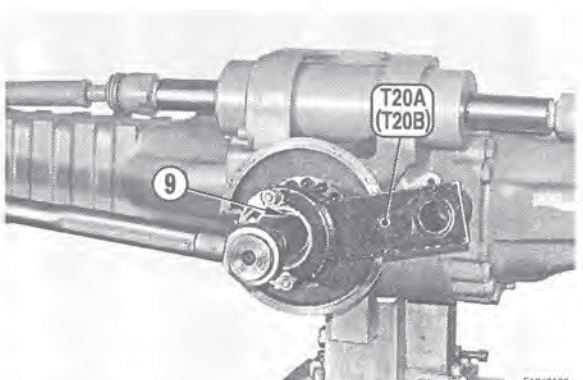
Apply Loctite 242 to the screws (13) and tighten using the criss-cross method. Torque wrench setting: 34.2–37.8 Nm



Lubricate the outer part of the seal (12) and insert it into the brake support (14) using tool T27.  
**NOTE.** Carefully check assembly direction.



Install parts in the following sequence: flange (10), O-ring (11) and nut (9). Spread Loctite 242 on the threaded portion of the pinion (16)



Fit tools T20A (or T20B), engage the stop rod and tighten the nut (9). Torque wrench setting: 280–310 Nm

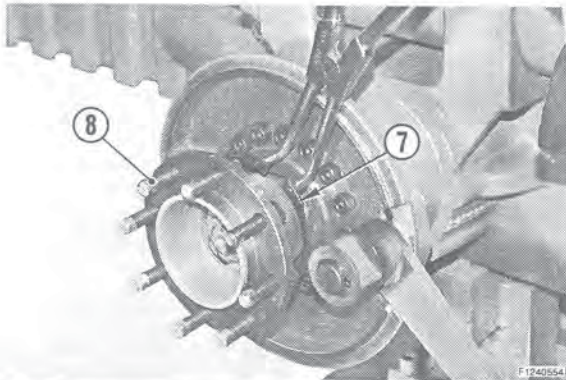




- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Montare sul pignone (16) il distanziale (15).</p> <p><b>D</b> Distanzstück (15) auf das Rad (16) montieren</p> <p><b>ESP</b> Montar en el piñón (16), el separador.</p> <p><b>F</b> Monter sur le pignon (16) l'entretoise (15).</p>                                                                                                                                                                                                                                                                                                                                   | <p><b>ITA</b> Lubrificare le superfici di accoppiamento e posizionare il supporto freno (14).<br/>Controllare l'integrità della guarnizione OR (17).</p> <p><b>D</b> Kupplungsflächen schmieren und Bremsenhalterung (14) positionieren.<br/>Zustand des O-Rings (17) kontrollieren.</p> <p><b>ESP</b> Lubricar las superficies de acoplamiento y posicionar el soporte del freno (14).<br/>Controlar la integridad de la junta OR (17).</p> <p><b>F</b> Lubrifier les surfaces d'accouplement et mettre en place le support du frein (14).<br/>Contrôler le bon état de la garniture OR (17).</p>                                                                                                                                                           |
| <p><b>c</b></p> <p><b>ITA</b> Spalmare le viti (13) con Loctite 242 ed avvitare serrandole con il metodo incrociato.<br/>Coppia di serraggio: 34,2÷37,8 Nm</p> <p><b>D</b> Schrauben (13) mit Loctite 242 schmieren und im Kreuz anziehen.<br/>Anzugsmoment: 34,2÷37,8 Nm</p> <p><b>ESP</b> Pasar sobre los tornillos (13) Loctite 242 y atornillarlos apretándolos con el método cruzado.<br/>Par de torsión: 34,2÷37,8 Nm.</p> <p><b>F</b> Enduire les vis (13) avec du Loctite 242, et les visser en les serrant avec la méthode croisée.<br/>Couple de serrage: 34,2÷37,8 Nm</p>                 | <p><b>ITA</b> Lubrificare l'esterno dell'anello di tenuta (12) ed inserirla nel supporto freno (14) con l'attrezzo T27.<br/><b>NOTA.</b> Controllare attentamente il senso di montaggio.</p> <p><b>D</b> Dichtung (12) außen schmieren und in die Bremsenhalterung (14) mit dem Werkzeug T27 einsetzen.<br/><b>BEMERKUNG.</b> Montagerichtung prüfen.</p> <p><b>ESP</b> Lubricar la parte externa de la junta (12) e introducirla en el soporte del freno (14) con la herramienta T27.<br/><b>NOTA.</b> Controlar atentamente el sentido de montaje.</p> <p><b>F</b> Lubrifier la partie externe de la garniture (12) puis l'insérer dans le support du frein (14) à l'aide de l'outil T27.<br/><b>NOTE.</b> Contrôler soigneusement le sens du montage.</p> |
| <p><b>e</b></p> <p><b>ITA</b> Montare nell'ordine la flangia (10), la guarnizione OR (11) ed il dado (9).<br/>Spalmare il filetto del pignone (16) con Loctite 242.</p> <p><b>D</b> Der Reihe nach Flansch (10), O-Ring (11) und Mutter (9) montieren.<br/>Radgewinde (16) mit Loctite 242 schmieren.</p> <p><b>ESP</b> Montar en su orden la brida (10), la junta OR (11) y la tuerca (9).<br/>Pasar en la rosca del piñón (16) Loctite 242.</p> <p><b>F</b> Monter dans l'ordre la flasque (10), la garniture OR (11) et l'écrou (9).<br/>Enduire le filet du pignon (16) avec du Loctite 242.</p> | <p><b>ITA</b> Montare gli attrezzi T20A (oppure T20B), impegnare l'asta di arresto e serrare il dado (9).<br/>Coppia di serraggio: 280÷310 Nm</p> <p><b>D</b> Werkzeug T20A (oder T20B) montieren, Sperrstab einsetzen und Mutter (9) anziehen.<br/>Anzugsmoment: 280÷310 Nm</p> <p><b>ESP</b> Montar la herramienta T20A (o T20B), bloquear la varilla de tope y apretar la tuerca (9).<br/>Par de torsión: 280÷310 Nm.</p> <p><b>F</b> Monter l'outil T20A (ou T20B), engager la tige de butée et serrer l'écrou (9).<br/>Couple de serrage: 280÷310 Nm</p>                                                                                                                                                                                                |



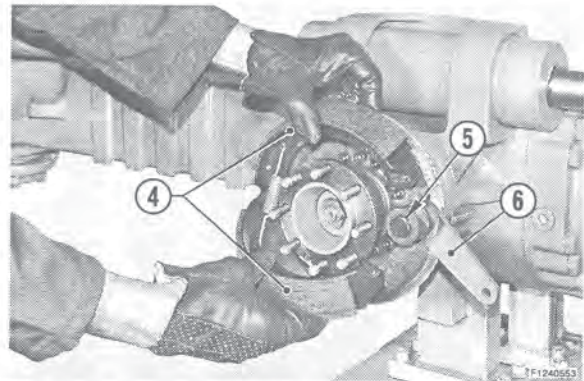
**ASSEMBLING THE INCOMING DRUM BRAKE - ASSEMBLAGGIO FRENO A TAMBURO IN ENTRATA - TROMMELBREMSE AM EINGANG  
MONTIEREN - MONTAJE DEL FRENO DE TAMBOR EN ENTRADA - ASSEMBLAGE DU FREIN D'ENTREE A TAMBOUR**



GB

a

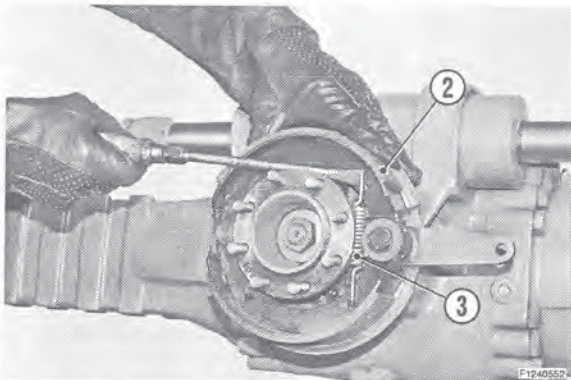
Insert the screws (8) and hold them in position with the snap ring (7).  
**NOTE.** Make sure that the ring is properly set in its seat.



GB

b

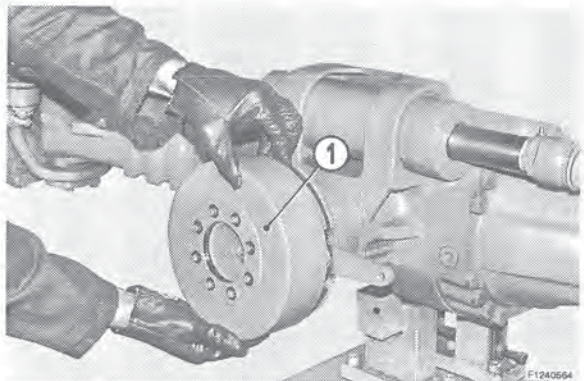
If the lever (6) has been removed, install it and hold it in position with the snap ring (5). Fit the shoes assembly (4).



GB

c

Make sure that the shoes (4) centre the slot of the fulcrum pin and rest on the surface of the lever (6).



GB

d

Fit the drum (1).

**NOTE.** Make sure that the friction surface of the drum carries no trace of grease and is perfectly clean.





SPICER CLARK-HURTH

- a**
- ITA** Inserire le viti (8) e mantenerle in posizione con l'anello elastico (7).  
**NOTA.** Assicurarsi che l'anello elastico sia perfettamente in sede.
- D** Schraube (8) einsetzen und mit dem Federring (7) positionieren.  
**BEMERKUNG.** Sicherstellen, daß der Federring richtig sitzt.
- ESP** Introducir los tornillos (8) y mantenerlos en posición por medio del anillo elástico (7).  
**NOTA.** Asegurarse de que el anillo elástico se encuentra perfectamente en sede.
- F** Insérer les vis (8) et les tenir en place avec l'anneau ressort (7).  
**NOTE.** S'assurer que l'anneau soit parfaitement dans son logement.

- c**
- ITA** Assicurarsi che le ganasce (4) centrino la cava del perno di fulcro ed appoggino sui piani della leva (6). Aiutandosi con un cacciavite, impegnare la molla (3).
- D** Kontrollieren ob die Backen (4) in der Nut des Zentrierstiftes zentriert sind und auf die Flächen des Hebels (6) anliegen.  
Mit Hilfe eines Schraubenziehers, Feder (3) einhaken.
- ESP** Asegurarse de que las mordazas (4) centren la ranura del perno de fulcro y apoyen sobre las superficies de la palanca (6).  
Ayudándose con un destornillador, bloquear el muelle (3).
- F** S'assurer que les mâchoires (4) sont au centre du creux de l'axe du point d'appui et qu'elles reposent sur les surfaces du levier (6).  
A l'aide d'un tournevis, engager le ressort (3).

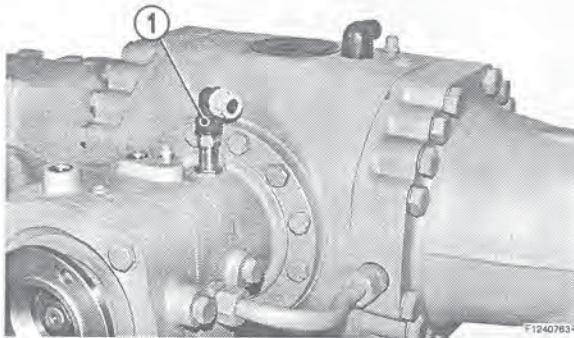
- b**
- ITA** Se è stata rimossa, montare la leva (6) e mantenerla in posizione con l'anello elastico (5).  
Montare il gruppo ganasce (4).
- D** Falls der Hebel (6) abmontiert worden ist, diesen wieder montieren und mit dem Federring (5) positionieren.  
Backeneinheit (4) montieren.
- ESP** Si ha sido quitada, montar la palanca (6) y mantenerla en posición con el anillo elástico (5).  
Montar el grupo mordazas (4).
- F** Si enlevé, remonter le levier (6) et le tenir en place à l'aide de l'anneau ressort (5).  
Monter le groupe mâchoires (4).

- d**
- ITA** Montare il tamburo (1).  
**NOTA.** Assicurarsi che la superficie di attrito del tamburo sia perfettamente sgrassata e pulita.
- D** Trommel (1) montieren.  
**BEMERKUNG.** Kontrollieren ob die Reibungsfläche der Trommel richtig entfettet und sauber ist.
- ESP** Montar el tambor (1).  
**NOTA.** Asegurarse de que la superficie de roce del tambor está perfectamente desengrasada y limpia.
- F** Monter le tambour (1).  
**NOTE.** S'assurer que la surface de frottement du tambour est bien dégraissée et propre.





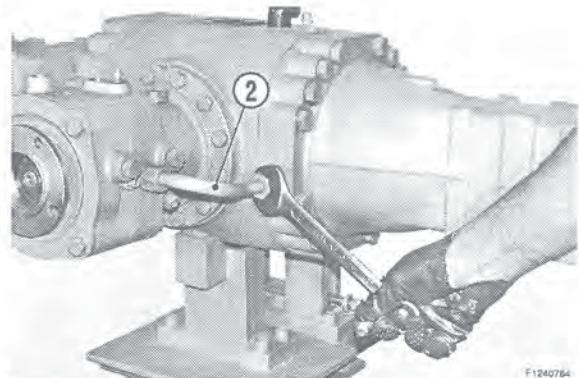
**HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



GB

a

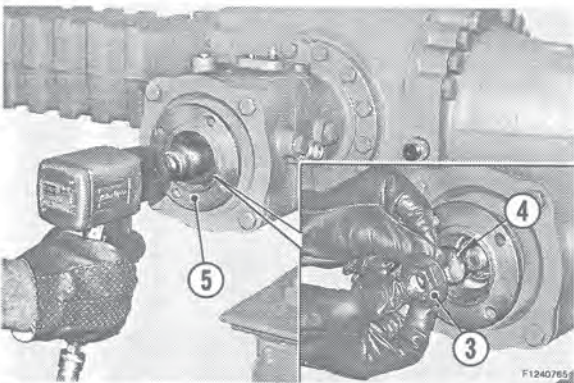
Remove movement sensor (1), if fitted.



GB

b

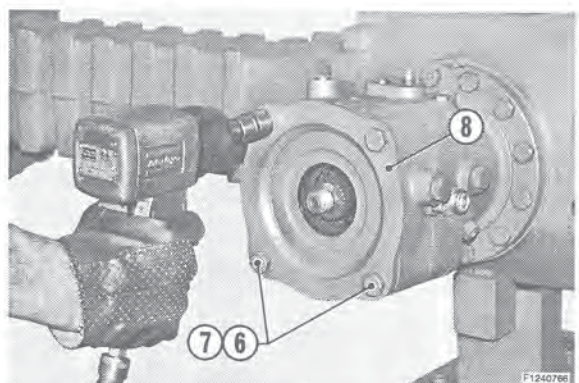
Loosen the two nuts and remove lubrication tube (2).



GB

c

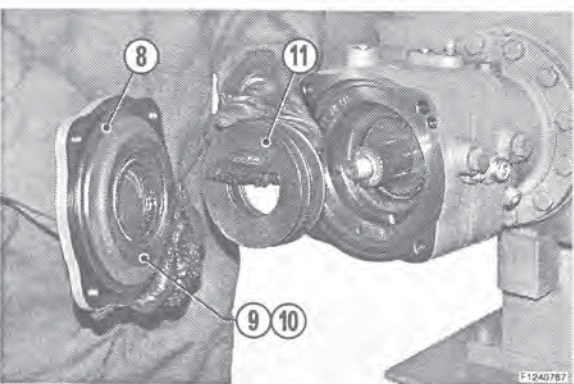
Remove nut (3), O-ring (4) and flange (5).  
**NOTE.** If disassembly is awkward, heat nut (3) at about 80°C.



GB

d

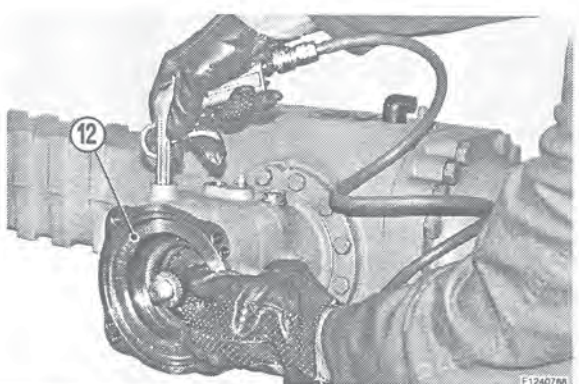
Loosen screws (6) in an alternate and criss-cross manner until the action of Belleville washers (11) becomes null.  
Remove screws (6) and spring washers of cover (8).



GB

e

Pull out cover (8), shims (9) separating ring (10) and Belleville washers (11).  
**NOTE.** Take note of the assembly direction of: shims (9) and Belleville washers (11).



GB

f

Slowly introduce compressed air through the negative brake connection point in order to extract the piston (12).  
**CAUTION!** Hold piston (12) as it may be rapidly ejected and damaged.





- a**
- ITA** Se è montato, rimuovere il sensore di movimento (1).
- D** Wenn montiert, den Bewegungsgeber (1) abnehmen.
- ESP** Si ha sido montado, remover el sensor de movimiento (1).
- F** S'il est monté, enlever le capteur de déplacement (1).

- b**
- ITA** Allentare i due dadi e rimuovere il tubo (2) della lubrificazione.
- D** Die beiden Muttern lockern und die Schmierleitung (2) abnehmen.
- ESP** Aflojar las dos tuercas y remover el tubo (2) de la lubricación.
- F** Dévisser le deux écrous et enlever le tuyau (2) pour la lubrification.

- c**
- ITA** Rimuovere il dado (3), la guarnizione OR (4) e la flangia (5).  
**NOTA.** Se lo smontaggio risulta difficoltoso, scaldare il dado (3) a circa 80°C.
- D** Die Mutter (3), den O-Ring (4) und den Flansch (5) abnehmen.  
**BEMERKUNG.** Falls das Abmontieren schwer sein sollte, die Mutter (3) bis auf ca. 80°C erwärmen.
- ESP** Remover la tuerca (3), la guarnición OR (4) y la brida (5).  
**NOTA.** Si el desmontaje resulta difícil, calentar la tuerca (3) a 80°C approx.
- F** Enlever l'écrou (3), la garniture OR (4) et la flasque (5).  
**NOTE.** Si le démontage est difficile, chauffer l'écrou (3) à environ 80°C.

- d**
- ITA** Allentare in modo alternato ed incrociato le viti (6) fino ad annullare l'azione delle molle a tazza (11). Rimuovere le viti (6) e le rondelle elastiche di ritagno coperchio (8).
- D** Abwechselnd und im Kreuz die Schrauben (6) lockern, bis die Wirkung der Tellerfeder (11) gleich Null ist. Schrauben (6) und Federscheiben des Deckels (8) abnehmen.
- ESP** Aflojar de manera alterna y cruzada los tornillos (6) hasta anular la acción de los muelles a taza (11). Remover los tornillos (6) y las arandelas elasticas de retención tapa (8).
- F** Dévisser alternativement et de façon croisée les vis (6) jusqu'à annuler l'action des ressorts belleville (11). Enlever les vis (6) et les rondelles à segment de fixation du couvercle (8).

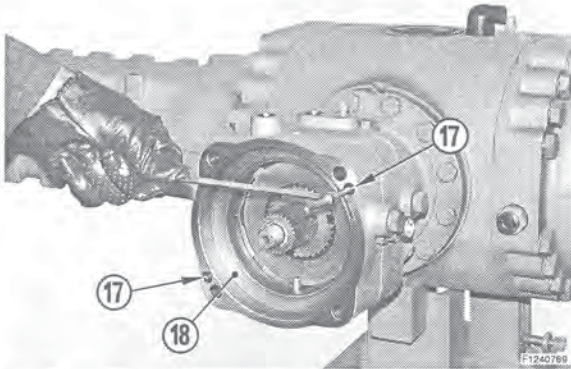
- e**
- ITA** Asportare il coperchio (8), i rasamenti (9), l'anello di battuta (10) e le molle a tazza (11).  
**NOTA.** Annotare il senso di montaggio dei rasamenti (9) e delle molle (11).
- D** Deckel (8), Scheiben (9), Anschlagring (10) und Tellerfedern (11) abnehmen.  
**BEMERKUNG.** Montagerichtung der Scheiben (9) und der Federn (11) bemerken.
- ESP** Quitar la tapa (8), las raspaduras (9), el anillo de tope (10) y los muelles a taza (11).  
**NOTA.** Anotar el sentido de las raspaduras (9) y de los muelles (11).
- F** Enlever le couvercle (8), les rasages (9), l'anneau de butée (10) et les ressorts belleville (11).  
**NOTE.** Noter le sens de montage des rasages (9) et des ressorts (11).

- f**
- ITA** Immettere lentamente aria compressa attraverso l'attacco per il freno negativo per estrarre il pistone (12).  
**ATTENZIONE!** Trattenerne il pistone (12) che può essere espulso velocemente ed essere danneggiato.
- D** Langsam Druckluft durch den Anschluß für die Negativbremse einlassen, um den Kolben (12) auszu stoßen.
- ACHTUNG!** Den Kolben (12) halten, denn er könnte plötzlich herausspringen und beschädigt werden.
- ESP** Introducir lentamente aire comprimida através el ataque para el freno negativo para extraer el piston (12).  
**ATENCION!** Tener el piston (12) que puede ser expulsado rapidamente y ser danado.
- F** Emettre lentement de l'air comprimé à travers le point d'enclenchement du frein négatif pour en extraire le piston (12).  
**ATTENTION!** Retenir le piston (12) qui être expulsé rapidement peut par conséquent s'endommager.

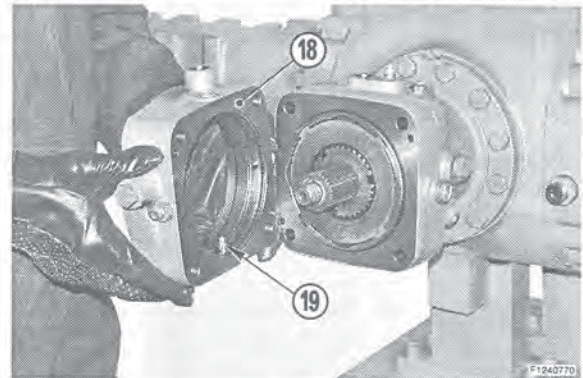




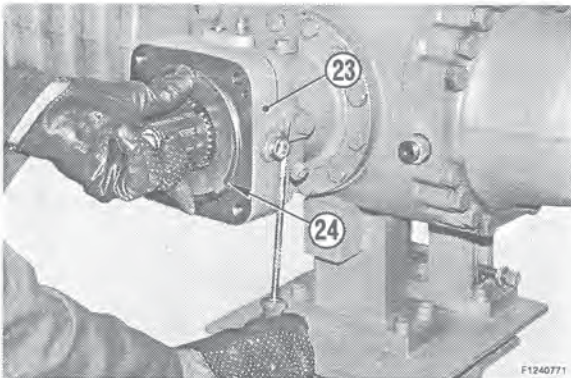
**HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



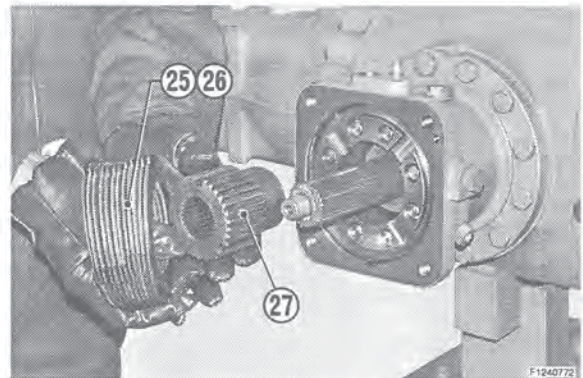
Remove check screws (17) from cylinder (18).



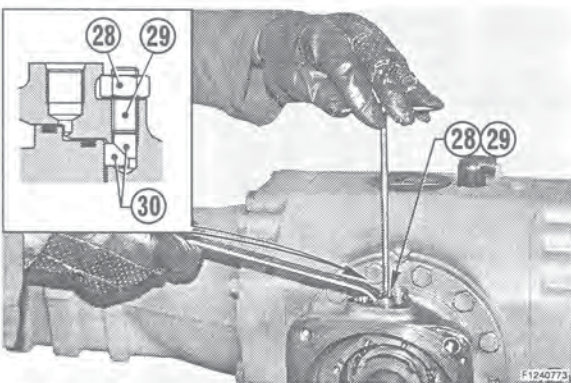
Remove cylinder (18) complete with guide pin (19) of piston (12).  
**NOTE.** Take note of direction of assembly.



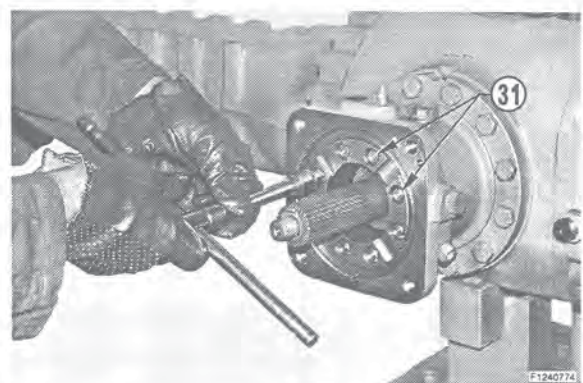
With the help of a lever, prize off the distance piece (23) complete with O-ring (24).  
**NOTE.** Thoroughly clean the face of bevel pinion support where the hub rests, check the O-ring (24) and replace it if necessary.



Remove friction discs (25), (26) and hub (27).



**3-FUNCTION VERSION ONLY**  
Loosen nuts (28) (no. 3) and unscrew dowels (29) (no. 3) to retract the adjustment points (30).  
**NOTE.** Loosen dowels (29) in an alternate manner until the piston comes to end of backstroke.  
**ONLY IF NECESSARY.** Remove points (30).



**3-FUNCTION VERSION ONLY**  
Loosen and remove the pin-type screws (31).  
**NOTE.** Loosen screws (31) in an alternate and criss-cross manner.



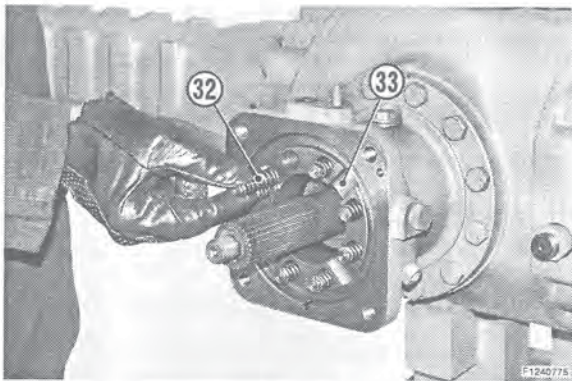


- a**
- ITA** Rimuovere le viti (17) di ritegno del cilindro (18).
- D** Die Schrauben (17) zur Halterung des Zylinders (18) abnehmen.
- ESP** Sacar los tornillos (17) de retención del cilindro (18).
- F** Enlever les vis (17) de fixation du cylindre (18).
- b**
- ITA** Rimuovere il cilindro (18) completo della spina (19) di guida del pistone (12).  
**NOTA.** Annotare il senso di montaggio.
- D** Den Zylinder (18) samt Stift (19) zur Führung des Kolbens (12) abnehmen.  
**BEMERKUNG.** Montagerichtung bemerken.
- ESP** Sacar el cilindro (18) completo de espina (19) de guía del piston (12).  
**NOTA.** Anotar el sentido de montaje.
- F** Enlever le cylindre (18) complet de broche (19) de guidage du piston (12).  
**NOTE.** Prendre note du sens de montage.
- c**
- ITA** Forzando con una leva, rimuovere il distanziale (23) completo di OR (24).  
**NOTA.** Pulire accuratamente la superficie di appoggio al mozzo di supporto pignone conico, controllare l'OR (24) e, se necessario, sostituirlo.
- D** Mit Hilfe eines Hebels, das Distanzstück (23) samt O-Ring (24) entfernen.  
**BEMERKUNG.** Sorgfältig die Auflagefläche an der Nabe des kegeligen Kolbenhalters reinigen und O-Ring (24) kontrollieren. Wenn nötig, auswechseln.
- ESP** Haciendo fuerza con una palanca, sacar el distancial (23) completo de OR (24).  
**NOTA.** Limpiar con atención la superficie de apoyo al cubo de soporte pinon conico, controlar el OR (24) y, si necesario, sobstituirlo.
- F** En forçant sur le levier, enlever l'entretoise (23) complet de OR (24).  
**NOTE.** Nettoyer soigneusement la surface d'appui du moyeu de support du pignon conique, contrôler la OR (24) et si besoin, la remplacer.
- d**
- ITA** Asportare i dischi di frizione (25), (26) ed il mozzo (27).
- D** Kupplungsscheiben (25), (26) und Nabe (27) abnehmen.
- ESP** Sacar los discos de frición (25), (26) y el cubo (27).
- F** Enlever les disques de friction (25), (26) et le moyeu (27).
- e**
- ITA** **SOLO PER VERSIONE A 3 FUNZIONI**  
Allentare i dadi (28) (n° 3) e svitare i grani (29) (n° 3) per far rientrare i puntali di registro (30).  
**NOTA.** Allentare i grani (29) in modo alternato fino a fine corsa di ritorno del pistone.  
**SOLO SE NECESSARIO.** Asportare i puntali (30).
- D** **NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**  
Muttern (28) (3 St.) lockern und Stifte (29) (3 St.) abschrauben. Stellschäfte (30) zurück zu fahren.  
**BEMERKUNG.** Stifte (29) abwechselnd bis zum Rücklaufende des Kolbens lockern.  
**NUR WENN NOTIG.** Schäfte (30) abnehmen.
- ESP** **SOLO POR VERSION A 3 FUNCIONES**  
Aflojar los dados (28) (n°3) y destornillar las espigas (29) (n°3) para hacer entrar los puntales de registro (30).  
**NOTA.** Aflojar las espigas (29) de manera alternada hasta final carrera de vuelta del piston.  
**SOLO SI NECESARIO.** Sacar los puntales (30).
- F** **SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
Desserrer les écrous (28) (n°3) et dévisser les grains (29) (n°3) pour faire rentrer les tringles de réglage (30).  
**NOTE.** Desserrer les grains (29) de façon alternée jusqu'au retour de fin de course du piston.  
**SEULEMENT SI BESOIN.** Enlever les tringles (30).
- f**
- ITA** **SOLO PER VERSIONE A 3 FUNZIONI**  
Allentare ed asportare le viti a perno (31).  
**NOTA.** Allentare le viti (31) in modo alternato ed incrociato.
- D** **NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**  
Stiftschrauben (31) abschrauben.  
**BEMERKUNG.** Schrauben (31) abwechselnd und im Kreuz abschrauben.
- ESP** **SOLO POR VERSION A 3 FUNCIONES**  
Aflojar y sacar los tornillos a rotula (31).  
**NOTA.** Aflojar los tornillos (31) de manera alternada y cruzada.
- F** **SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
Desserrer et enlever les vis à cheville (31).  
**NOTE.** Desserrer les vis (31) de façon alternée et croisée.





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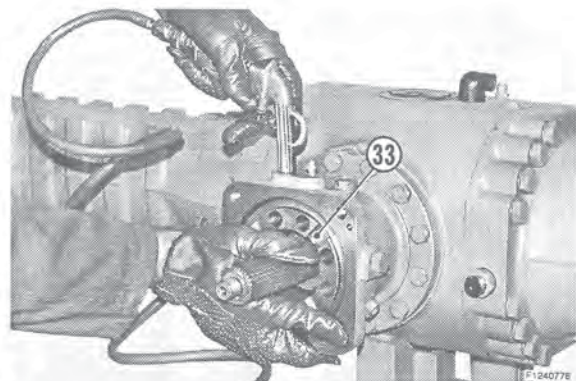


GB

a

**3-FUNCTION VERSION ONLY**

Remove springs (32) of piston (33) backward movement.



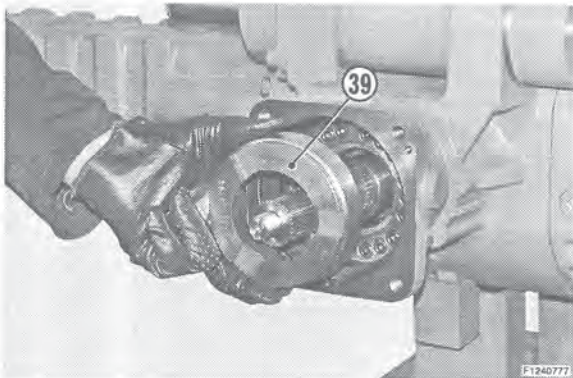
GB

b

**3-FUNCTION VERSION ONLY**

Slowly introduce compressed air through the connection point of the service brake to extract the piston (33).

**CAUTION!** Hold piston (33) as it may be rapidly ejected and damaged.

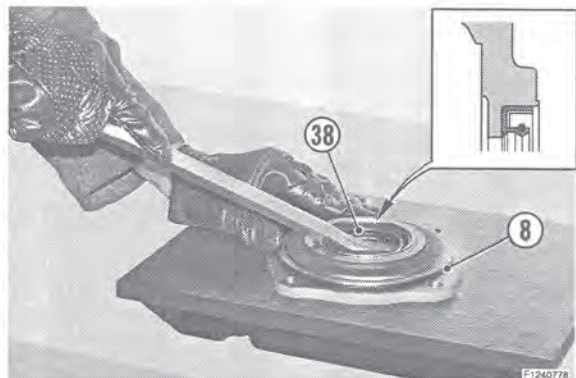


GB

c

**2-FUNCTION VERSION ONLY**

Remove the distance piece (39).

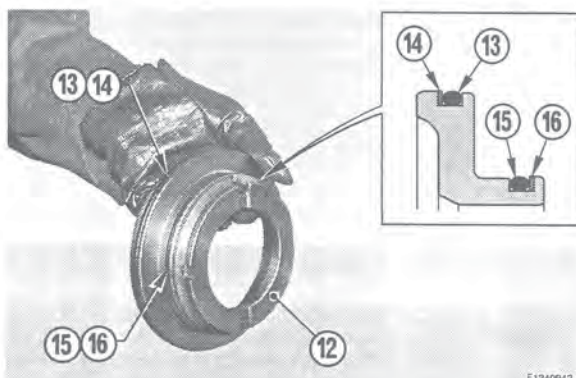


GB

d

Remove sealing ring (38) from cover (8).

**NOTE.** Take note of direction of assembly of ring (38) and replace ring every time the unit is disassembled.

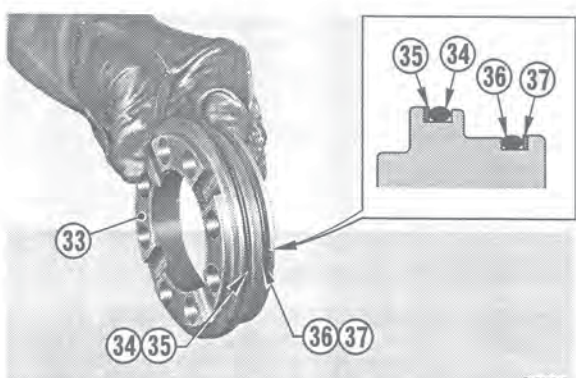


GB

e

Remove sealing rings (13) and (15) and anti-extrusion rings (14) and (16) from the piston (12).

**NOTE.** Sealing rings (13) and (15) and anti-extrusion rings (14) and (16) must be replaced each time the unit is disassembled.



GB

f

**3-FUNCTION VERSION ONLY**

Remove sealing rings (34) and (36) and anti-extrusion rings (35) and (37) from piston (33).

**NOTE.** Sealing rings (34), (36) and anti-extrusion rings (35), (37) must be replaced each time the unit is disassembled.





- a**
- ITA** SOLO PER VERSIONE A 3 FUNZIONI  
Rimuovere le molle (32) di ritorno del pistone (33).
- D** NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN  
Rückzugsfeder (32) des Kolbens (33) abnehmen.
- ESP** SOLO POR VERSION A 3 FUNCIONES  
Sacar los muelles (32) de vuelta del piston (33).
- F** SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.  
Enlever les ressorts (32) de retour du piston (33).

- b**
- ITA** SOLO PER VERSIONE A 3 FUNZIONI  
Immettere lentamente aria compressa attraverso l'attacco del freno di servizio per estrarre il pistone (33).  
**ATTENZIONE!** Trattenere il pistone (33) che può essere espulso velocemente ed essere danneggiato.
- D** NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN  
Langsam Druckluft durch den Anschluß der Hilfsbremse einlassen, um den Kolben (33) auszustoßen.  
**ACHTUNG!** Den Kolben (33) halten, denn er könnte plötzlich herausgestoßen und beschädigt werden.
- ESP** SOLO POR VERSION A 3 FUNCIONES  
Introducir lentamente aire comprimida através el ataque del freno de servicio para sacar el piston (33).  
**ATENCIÓN.** Tener el piston (33) que puede ser expulso rápidamente y ser danado.
- F** SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.  
Emettre lentement de l'air comprimé à travers le point de montage du frein de service pour en extraire le piston (33).  
**ATTENTION!** Retenir le piston (33) qui expulsé rapidement peut être par conséquent endommagé.

- c**
- ITA** SOLO PER VERSIONE A 2 FUNZIONI  
Asportare il distanziale (39).
- D** NUR FÜR AUSFÜHRUNG MIT 2 FUNKTIONEN  
Distanzstück (39) abnehmen.
- ESP** SOLO POR VERSION A 3 FUNCIONES  
Sacar el distancial (39).
- F** SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.  
Enlever l'entretoise (39).

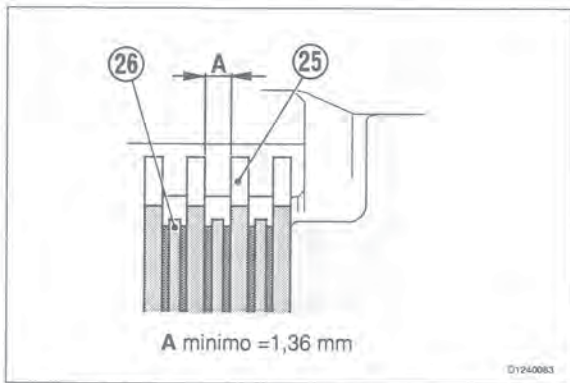
- d**
- ITA** Rimuovere dal coperchio (8) l'anello di tenuta (38).  
**NOTA.** Annotare il senso di montaggio dell'anello (38) e sostituirlo ad ogni smontaggio.
- D** Vom Deckel (8) den Dichtring (38) abnehmen.  
**BEMERKUNG.** Montagerichtung des Ringes (38) bemerken und beim Abmontieren jedesmal auswechseln.
- ESP** Remover de la tapa (8) el segmento de compresión (38).  
**NOTA.** Anotar el sentido de montaje del segmento (38) y sustituirlo cada desmontaje.
- F** Enlever du couvercle (8) la bague d'étanchéité (38).  
**NOTE.** Prendre note du sens de montage de la bague (38), la remplacer à chaque démontage.

- e**
- ITA** Rimuovere dal pistone (12) gli anelli di tenuta (13) e (15) e gli anelli antiestrusione (14) e (16).  
**NOTA.** Gli anelli di tenuta (13), (15) ed antiestrusione (14), (16) devono essere sostituiti ad ogni smontaggio.
- D** Vom Kolben (12) Dichtringe (13) und (15) sowie die Haltringe (14) und (16) abnehmen.  
**BEMERKUNG.** Die Dichtringe (13), (15) und Haltringe (14), (16) müssen bei jedem Abmontieren ausgewechselt werden.
- ESP** Sacar el piston (12) los segmentos de compresión (13) y (15) y los segmentos anti-extrusión (14) y (16).  
**NOTA.** Los segmentos de compresión (13) y (15) y anti-extrusión (14), (16) deben de ser cambiados cada desmontaje.
- F** Enlever le piston (12) les bagues d'étanchéité (13) et (15) et les anneaux anti-extrusion (14), et (16).  
**NOTE.** Les bagues d'étanchéité (13), (15) et anti-extrusion (14), (16) doivent être remplacées à chaque démontage.

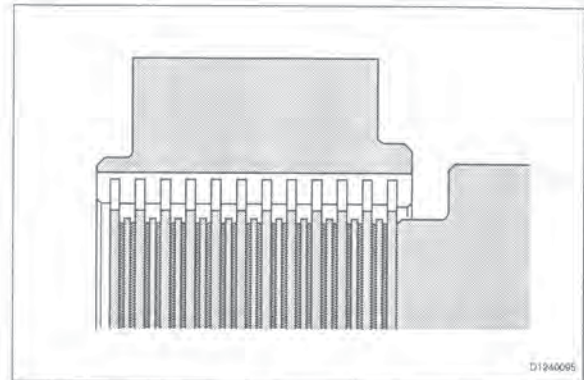
- f**
- ITA** SOLO PER VERSIONE A 3 FUNZIONI  
Rimuovere dal pistone (33) gli anelli di tenuta (34) e (36) e gli anelli antiestrusione (35) e (37).  
**NOTA.** Gli anelli di tenuta (34), (36) ed antiestrusione (35), (37) devono essere sostituiti ad ogni smontaggio.
- D** NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN  
Vom Kolben (33) die Dichtringe (34) und (36) sowie die Haltringe (35) und (37) abnehmen.  
**BEMERKUNG.** Die Dichtringe (34), (36) und Haltringe (35), (37) jedesmal auswechseln, wenn sie abmontiert werden.
- ESP** SOLO POR VERSION DE 3 FUNCIONES  
Remover del piston (33) los segmentos de compresión (34) y (36) y los segmentos anti-extrusión (35) y (37).  
**NOTA.** Los segmentos de compresión (34), (36) y anti-extrusión (35), (37) deben de ser substituidos a cada desmontaje.
- F** SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.  
Enlever du piston (33) les bagues d'étanchéité (34) et (36) et les anneaux anti-extrusion (35) et (37).  
**NOTE.** Les bagues d'étanchéité (34), (36) et anti-extrusion (35), (37) doivent être remplacées à chaque démontage.



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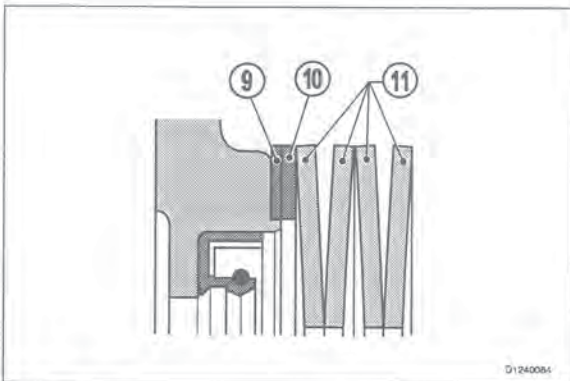


**CAUTION!** Always check the thickness of braking discs (26), even if the braking unit is being disassembled for other reasons than this. If thickness "A" of one of the discs (26) is close to the minimum admissible size of 1.36 mm, replace the whole pack.

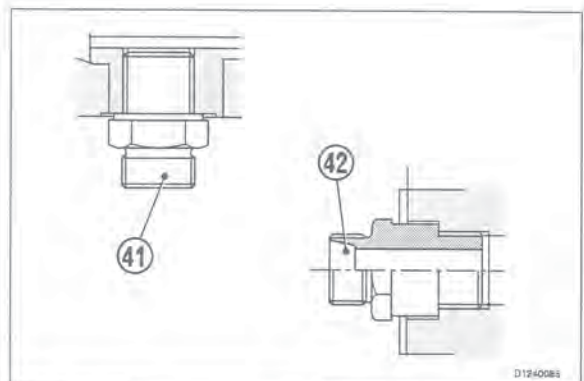


**BRAKING DISCS PACK CONTENTS**

The braking discs pack is comprised of: 11 braking discs and 12 steel counterdiscs.



**CAUTION!** If the braking discs unit is replaced, shims (9) - which determine the preloading of Belleville washers (11) - must be restored.



**ONLY WHEN REPLACEMENT IS NECESSARY**

Remove the union pieces (41) and (42) connecting the lubrication tube (2).

**NOTE.** During the assembly stage, union pieces (41) and (42) must be coated with Loctite 577 and tightened to a torque wrench setting of 35 - 50 Nm.



**ITA**

**ATTENZIONE!** Anche se il gruppo freno viene smontato solo per motivi diversi, controllare lo spessore dei dischi di frenatura (26).

Se lo spessore "A" di un solo disco (26) si avvicina alla misura minima ammessa di 1,36 mm, sostituire l'intero pacco.

**D**

**ACHTUNG!** Jedesmal wenn das Bremsaggregat aus irgend einem Grund abmontiert wird, die Stärke der Brems Scheiben (26) kontrollieren.

Falls die Stärke "A" auch nur einer Scheibe (26) dem Mindestmaß nah liegt, den ganzen Satz auswechseln.

**ESP**

**ATENCIÓN!** También si el grupo freno viene desmontado solo por motivos diferentes, controlar el espesor de los discos de frenadura (26).

Si el espesor "A" de un solo disco (26) se acerca a la medida mínima admitida de 1,36 mm, substituir el entero paquete.

**F**

**ATTENTION!** Même si le groupe frein est démonté pour des raisons diverses, contrôler les cales des disques de freinage (26).

Si la cale "A" d'un seul disque (26) se rapproche de la mesure minimum consentie de 1,36 mm, substituer tout le paquet.

**ITA**

**ATTENZIONE!** Nel caso venga sostituito il gruppo dei dischi di frenatura, è necessario ripristinare gli spessori (9) determinanti il precarico delle molle a tazza (11).

**D**

**ACHTUNG!** Falls das Brems Scheibenaggregat ausgetauscht wird, die Distanzstück wieder (9) wieder einsetzen, die die Tellerfedern (11) vorladen.

**ESP**

**ATENCIÓN!** En el caso venga substituido el grupo de los discos de frenadura, es necesario restablecer los espesores (9) determinados la precarga de los muelles a taza (11).

**F**

**ATTENTION!** Dans le cas où le groupe des disques de freinage est substitué, remettre les cales (9) qui déterminent la précharge des ressorts belleville (11).

**ITA**

**COMPOSIZIONE PACCO DISCHI DI FRENATURA**

Il pacco dei dischi di frenatura comprende: n° 11 dischi di frenatura e n° 12 controdismi in acciaio.

**D**

**DER SATZ DER BREMSSCHEIBEN BESTEHT AUS**

11 Brems Scheiben und 12 Gegenscheiben aus Stahl.

**ESP**

**COMPOSICION PAQUETE DISCOS DE FRENADURA**

El paquete de los discos de frenadura se compone de: n°11 discos de frenadura y n°12 contra-discos en acero.

**F**

**COMPOSITION DU PAQUET DE DISQUES DE FREINAGE**

Le paquet de disques de freinage comprend: n° 11 disques de freinage et n° 12 contre-disques en acier.

**ITA**

**SOLO SE È NECESSARIA LA SOSTITUZIONE**

Rimuovere i raccordi (41), (42) di attacco del tubo di lubrificazione (2).

**NOTA.** In fase di montaggio, i raccordi (41), (42) devono essere spalmati con Loctite 577 e serrati con una coppia di 35÷50 Nm.

**D**

**NUR WENN DAS AUSWECHSELN NÖTIG IST**

Anschlüsse (41), (42) der Schmierleitung (2) abnehmen.

**BEMERKUNG.** Bei der Montage, die Anschlüsse (41), (42) mit Loctite 577 schmieren und mit einem Anzugsmoment von 35÷50 Nm fest zeihen.

**ESP**

**SOLO SI NECESARIA LA SUBSTITUCION**

Remover los empalmes (41), (42) de ataque del tubo de lubricación (2).

**NOTA.** En fase de montaje, los empalmes (41), (42) deben de ser pasados con Loctite 577 y cerrados con un par de 35÷50 Nm.

**F**

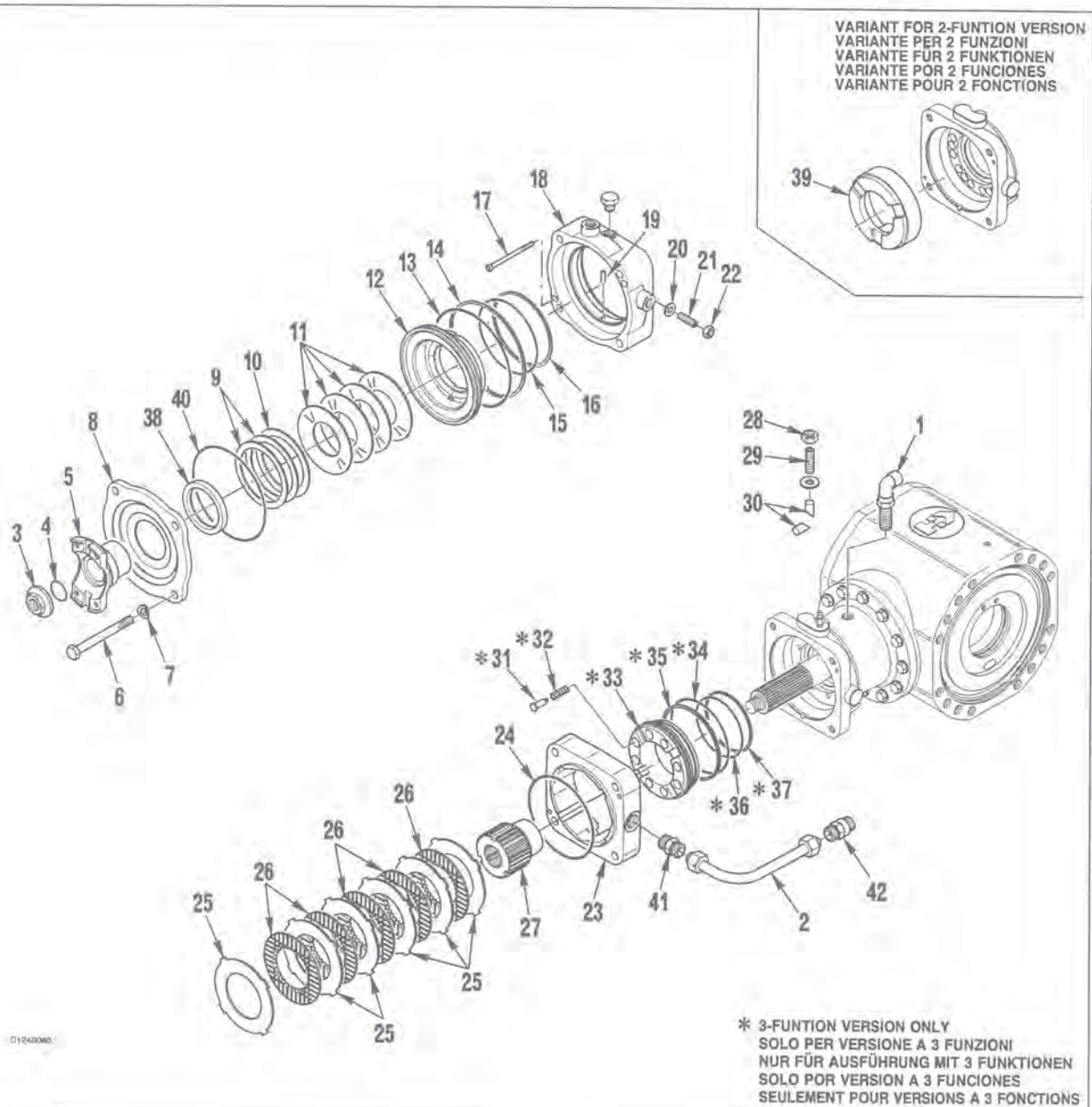
**SEULEMENT QUAND LA SUBSTITUTION EST NECESSAIRE**

Enlever les raccords (41), (42) de branchement du tube de lubrification (2).

**NOTE.** En phase de montage, les raccords (41), (42) doivent être enduits avec du Loctite 577 et serrés à un couple de 35÷50 Nm.



**HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**

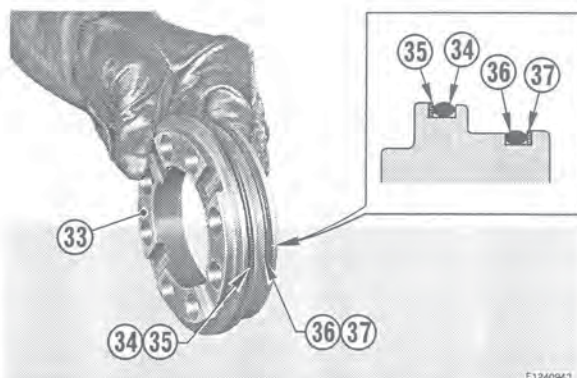








**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



F1240943

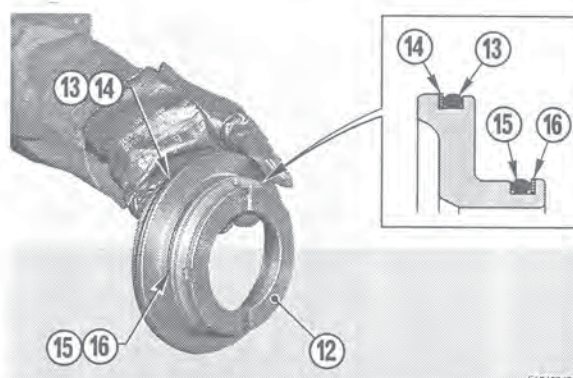


**a**

**3-FUNCTION VERSION ONLY**

Fit the sealing rings (34), (36) and the anti-extrusion rings (35), (37) onto the piston (33) of the service brake.

**NOTE.** Carefully check the assembly position of anti-extrusion rings.



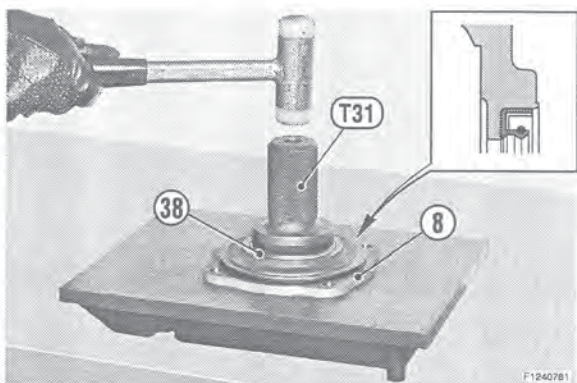
F1240942



**b**

Fit the sealing rings (13), (15) and the anti-extrusion rings (14), (16) onto the piston (12) of the negative brake.

**NOTE.** Carefully check the assembly position of the anti-extrusion rings.



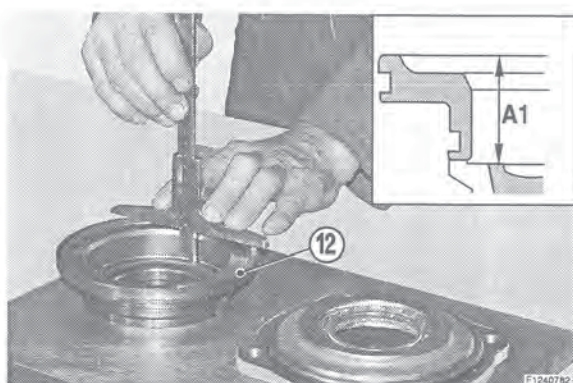
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**c**

Lubricate sealing ring (38) and, using tool T31, fit it into the cover (8).

**NOTE.** Carefully check the direction of ring (38).



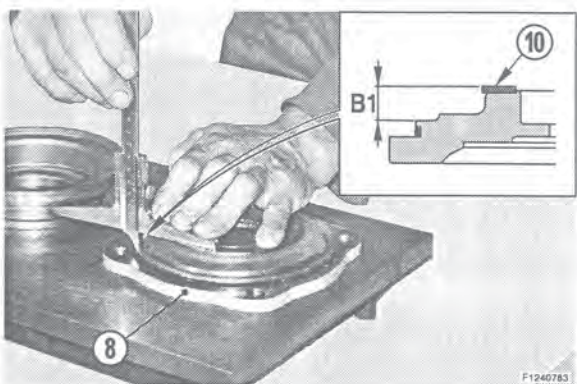
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**d**

**3-FUNCTION VERSION ONLY**

Measure size "A1" of piston (12) and note it down.



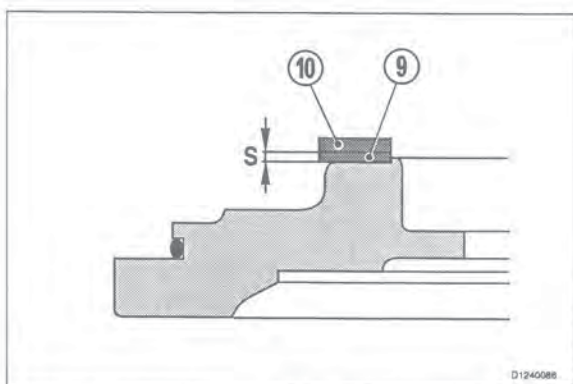
F1240783



**e**

**3-FUNCTION VERSION ONLY**

Fit the separating ring (10) of Belleville washers onto the cover (8), measure size "B1" and note it down.



D1240088



**f**

**3-FUNCTION VERSION ONLY**

Using the measurements just taken, calculate thickness "S" of shims (9) as follows:  $S = (A1 + 1.5) - (B1 + 18.4)$  where:  
S = Shim thickness - 1.5 mm = fixed measure of braking discs clearance - 18.4 mm = fixed measure of Belleville washers.



**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Montare sul pistone (33) del freno di servizio gli anelli di tenuta (34), (36) e gli anelli antiestrusione (35), (37).  
**NOTA.** Controllare attentamente la posizione di montaggio degli anelli antiestrusione.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Auf den Kolben (33) der Hilfsbremse die Dichtringe (34), (36) und die Halteringe (35), (37) montieren.  
**BEMERKUNG.** Sorgfältig die Montagerichtung der Halteringe prüfen.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Montar sobre el piston (33) del freno de servicio los segmentos de compresión (34), (36) y los segmentos de anti-extrusión (35), (37).  
**NOTA.** Controlar con cuidado la colocación de montaje de los segmentos anti-extrusión.

**F****SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Monter sur le piston (33) du frein de service les bagues d'étanchéité (34), (36) et les anneaux anti-extrusion (35), (37).  
**NOTE.** Contrôler attentivement la position du montage des anneaux anti-extrusion.

**ITA**

Lubrificare l'anello di tenuta (38) e, utilizzando l'attrezzo T31, montarlo nel coperchio (8).  
**NOTA.** Controllare attentamente l'orientamento dell'anello (38).

**D**

Dichtring (38) schmieren und mit Hilfe des Werkzeugs T31 den Deckel (8) montieren.  
**BEMERKUNG.** Sorgfältig die Montagerichtung des Ringes (38) prüfen.

**ESP**

Lubricar el segmento de compresión (38) y utilizando la herramienta T31, montarlo sobre la tapa (8).  
**NOTA.** Controlar con cuidado la dirección del segmento (38).

**F**

Lubrifier la bague d'étanchéité (38), puis à l'aide de l'outil T31, monter celle-ci dans le couvercle (8).  
**NOTE.** Contrôler attentivement l'orientation de la bague (38).

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Montare sul coperchio (8) l'anello di battuta (10) delle molle a tazza, rilevare la misura "B1" e trascriverla.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Auf den Deckel (8) den Anschlagring (10) der Tellerfedern montieren. Das Maß "B1" messen und anmerken.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Montar sobre la tapa (8) el segmento a tope (10) de los muelles a taza, relevar la medida "B1" y registrarla.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
 Monter sur le couvercle (8) l'anneau de butée (10) des ressorts Belleville, relever la mesure "B1" et enregistrer cette dernière.

**ITA**

Montare sul pistone (12) del freno negativo gli anelli di tenuta (13), (15) e gli anelli antiestrusione (14), (16).  
**NOTA.** Controllare attentamente la posizione di montaggio degli anelli antiestrusione.

**D**

Auf den Kolben (12) der Negativbremse die Dichtringe (13), (15) und die Halteringe (14), (16) montieren.  
**BEMERKUNG.** Sorgfältig die Montagerichtung der Halteringe prüfen.

**ESP**

Monter sobre el piston (12) del freno negativo los segmentos de compresión (13), (15) y los segmentos anti-extrusión (14), (16).  
**NOTA.** Controlar con cuidado la colocación de montaje de los segmentos anti-extrusión.

**F**

Monter sur le piston (12) du frein négatif les bagues d'étanchéité (13), (15) et les anneaux anti-extrusion (14), (16).  
**NOTE.** Contrôler attentivement la position du montage des anneaux anti-extrusion.

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Rilevare la misura "A1" del pistone (12) e trascriverla.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Maß "A1" des Kolbens (12) messen und anmerken.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Relevar la medida "A1" del piston (12) y registrarla.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
 Relever la mesure "A1" du piston (12) et enregistrer cette dernière.

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Utilizzando le misure rilevate, determinare lo spessore "S" dei rasamenti (9) con il seguente calcolo:  
 $S = (A1 + 1,5) - (B1 + 18,4)$  ove:  
 S = Spessori rasamenti - 1,5 mm = misura fissa del gioco dischi freno - 18,4 mm = misura fissa delle molle a tazza.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Anhand der ermittelten Maße die Stärke "S" der Scheiben (9) folgendermaßen ausrechnen:  
 $S = (A1 + 1,5) - (B1 + 18,4)$  wo:  
 S = Scheibenstärke - 1,5 mm = feste Maß für das Spiel der Brems-scheiben - 18,4 mm = feste Maß für Tellerfedern.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Utilizando las medidas relevadas, determinar el espesor "S" de las raspaduras (9) con el siguiente cálculo:  
 $S = (A1 + 1,5) - (B1 + 18,4)$  donde:  
 S = espesor raspaduras - 1,5 mm = medida fija del juego discos freno - 18,4 mm = medida fija de los muelles a taza.

**F**

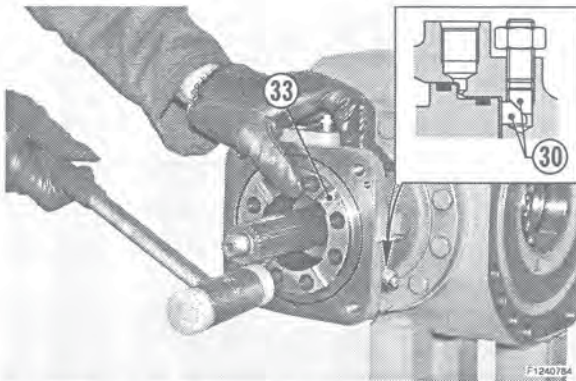
**SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**  
 A l'aide de la mesure relevée, définir la cale "S" des rasages (9) par le calcul suivant:

$S = (A1 + 1,5) - (B1 + 18,4)$  ou:  
 S = Cales rasages - 1,5 mm = mesure fixe du jeu des disques frein - 18,4 mm = mesure fixe des ressorts Belleville.





**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



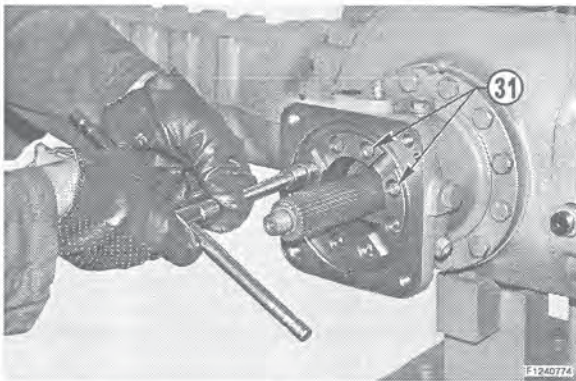
GB

a

**3-FUNCTION VERSION ONLY**

Lubricate the O-rings and install the whole piston (33). Orient the piston with the help of a lever and push it to end of stroke with a plastic hammer.

**CAUTION!** Check that the adjusting stakes (30) are thoroughly inserted and make sure they perform a sliding motion in relation to each other.



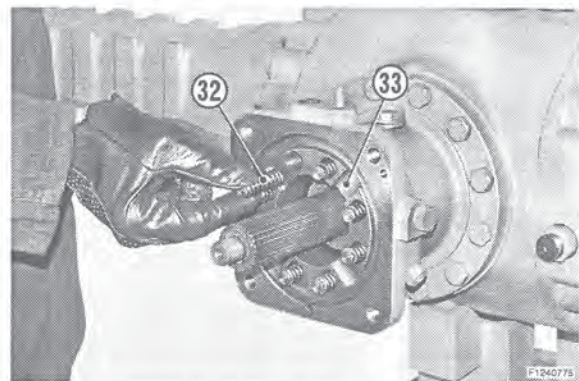
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c

**3-FUNCTION VERSION ONLY**

Apply Loctite 242 to the thread of screws (31) and tighten.

**NOTE.** Tighten the screws with a normal wrench in an alternate and criss-cross manner.

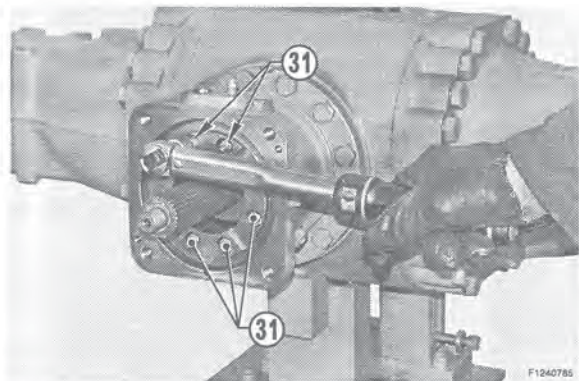


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b

**3-FUNCTION VERSION ONLY**

Insert springs (32) for piston (33) backward movement.



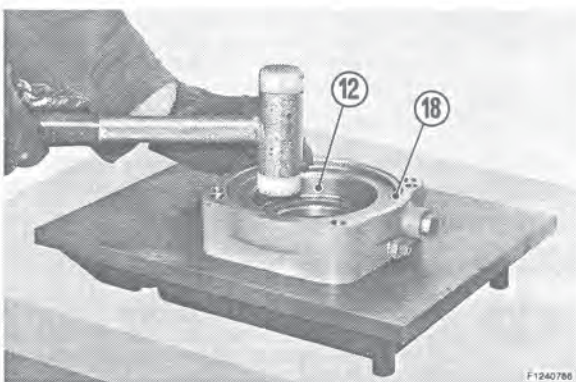
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d

**3-FUNCTION VERSION ONLY**

Lock screws (31) in a criss-cross manner by using a dynamometric wrench set to a max. torque of 10 Nm.

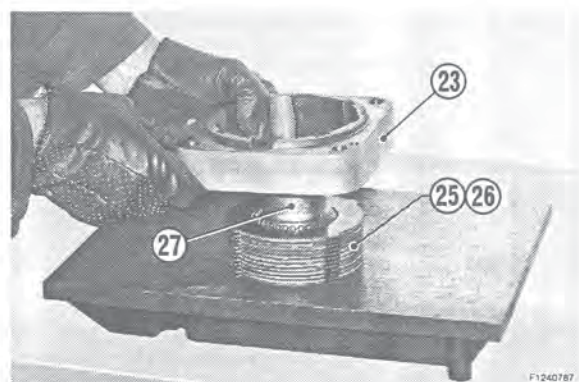
**CAUTION!** Do not exceed the specified torque setting.



GB

e

Lubricate seals (13), (15) and fit the piston (12) into the cylinder (18). Engage piston on the pin (19). For the assembly, use a plastic hammer and push the piston (12) to end of stroke.



GB

f

Lightly lubricate the braking discs (25), (26) and fit them onto the hub (27).

Align discs (25) and fit the distance piece (23).

**NOTE.** The braking discs pack starts and ends with steel discs (25).



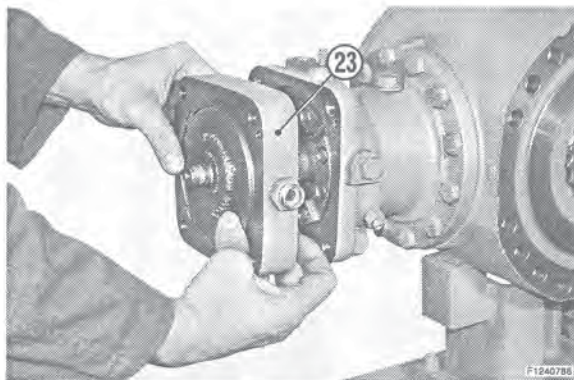


- ITA** SOLO PER VERSIONE A 3 FUNZIONI  
Lubrificare le guarnizioni OR e montare il pistone (33) completo. Orientare il pistone con una leva e mandarlo a fondo corsa con un mazzuolo in materiale plastico.  
**ATTENZIONE!** Controllare che i pioli di registro (30) siano inseriti a fondo e che scorrano tra loro.
- D** NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN  
O-Ringe schmieren und den vollständigen Kolben (33) montieren. Den Kolben mit einem Hebel orientieren und bis zum Hubende mit einem Gummihammer schlagen.  
**ACHTUNG!** Kontrollieren, ob die Regelungspole (30) bis zum Anschlag eingesetzt sind und verschoben werden können.
- ESP** SOLO POR VERSION A 3 FUNCIONES  
Lubricar las guarniciones OR y montar el pistón (33) completo. Orientar el pistón con una palanca y mandarlo a final carrera con un martillo en material plástico.  
**ATENCIÓN!** Controlar que las extremidades de registro (30) sean introducidas a fondo y que deslicen entre ellas.
- F** SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.  
Lubrifier les garnitures OR et monter le piston (33) complet. Orienter le piston à l'aide d'un levier puis l'envoyer en fin de course à l'aide d'un maillet en matière plastique.  
**ATTENTION!** Contrôler, que les pôles de régulation (30) soient insérés à fond et qu'ils puissent glisser.
- ITA** SOLO PER VERSIONE A 3 FUNZIONI  
Spalmare il filetto delle viti (31) con Loctite 242 ed avvitare.  
**NOTA.** Mandare in battuta le viti con una chiave normale con il metodo alternato ed incrociato.
- D** NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN  
Schraubengewinde (31) mit Loctite 242 schmieren und Schrauben fest schrauben.
- ESP** SOLO POR VERSION A 3 FUNCIONES  
Pasar la rosca de los tornillos (31) con Loctite 242 y atornillarlas.  
**NOTA.** Mandar a tope los tornillos con una llave normal de manera alternada y cruzada.
- F** SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.  
Enduire le filet des vis (31) avec du Loctite 242, puis visser.  
**NOTE.** Envoyer en butée les vis à l'aide d'une clé normale avec la méthode alternée, croisée.
- ITA** SOLO PER VERSIONE A 3 FUNZIONI  
Bloccare le viti (31) in modo incrociato utilizzando una chiave dinamometrica tarata ad una coppia massima di 10 Nm.  
**ATTENZIONE!** Non superare la coppia di serraggio indicata.
- D** NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN  
Die Schrauben (31) im Kreuz mit einem Momentenschlüssel und einem Anzugsmoment von 10 Nm fest schrauben.  
**ACHTUNG!** Das angegebene Moment nicht überschreiten.
- ESP** SOLO POR VERSION A 3 FUNCIONES  
Bloquear los tornillos (31) de manera cruzada utilizando una llave dinamométrica tarada a un par máximo de 10 Nm.  
**ATENCIÓN!** No superar el par de torsión indicado.
- F** SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.  
Bloquer les vis (31) de manière croisée à l'aide d'une clé dynamométrique calibrée à un couple max. de 10 Nm.  
**ATTENTION!** Ne jamais dépasser le couple de serrage indiqué.
- ITA** Lubrificare le guarnizioni (13), (15) e montare nel cilindro (18) il pistone (12) orientandolo sulla spina (19). Per il montaggio, utilizzare un mazzuolo in materiale plastico e mandare il pistone (12) a fondo corsa.
- D** Dichtungen (13), (15) schmieren und in den Zylinder (18) den Kolben (12) montieren und auf den Stift (19) orientieren. Zur Montage einen Gummihammer verwenden, um den Kolben (12) bis zum Hubende zu schlagen.
- ESP** Lubricar las guarniciones (13), (15) y montar en el cilindro (18) el pistón (12) dirigiéndolo sobre la espina (19). Para el montaje, utilizar un martillo en material plástico y mandar el pistón (12) a final carrera.
- F** Lubrifier les garnitures (13), (15) puis monter dans le cylindre (18) le piston (12) en l'orientant sur la broche (19). Pour le montage, utiliser un maillet en matière plastique et envoyer le piston (12) en fin de course.
- ITA** Lubrificare leggermente i dischi di frenatura (25), (26) e montarli sul mozzo (27). Allineare i dischi (25) e montare il distanziale (23).  
**NOTA.** La composizione del pacco dei dischi di frenatura inizia e termina con i dischi di acciaio (25).
- D** Bremsscheiben (25), (26) leicht schmieren und auf die Nabe (27) montieren. Scheiben (25) ausrichten und Distanzstück (23) montieren.
- ESP** Lubricar ligeramente los discos de frenadura (25), (26) y montarlos sobre el cubo (27). Alinear los discos (25) y montar el distancial (23).  
**NOTA.** La composición del paquete de los discos de frenadura empieza y termina con los discos en acero (25).
- F** Lubrifier légèrement les disques de freinage (25), (26) et monter ceux-ci sur le moyeu (27). Aligner les disques (25) et monter l'entretoise (23).  
**NOTE.** La composition du paquet des disques de freinage commence et s'achève par des disques en acier (25).

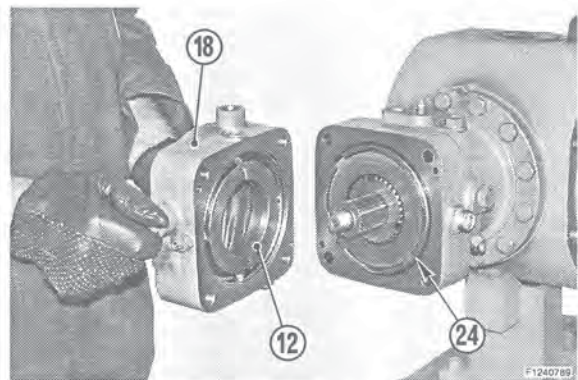




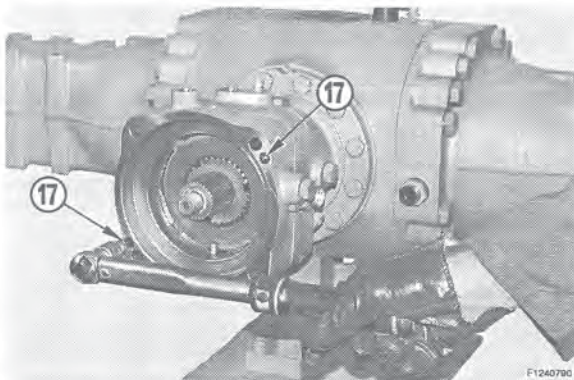
**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



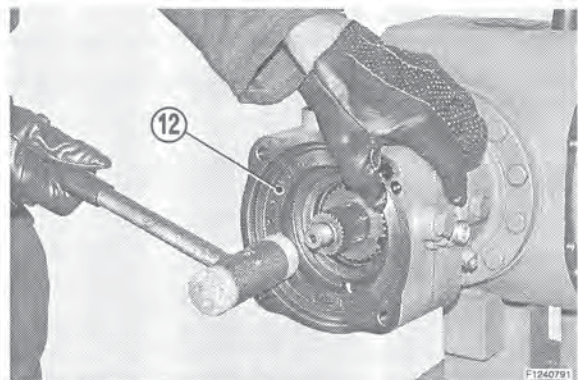
Apply Loctite 510 on the face of the distance piece (23).  
Fit the discs-hub-distance piece assembly prepared in the previous stages onto the pinion and engage it.



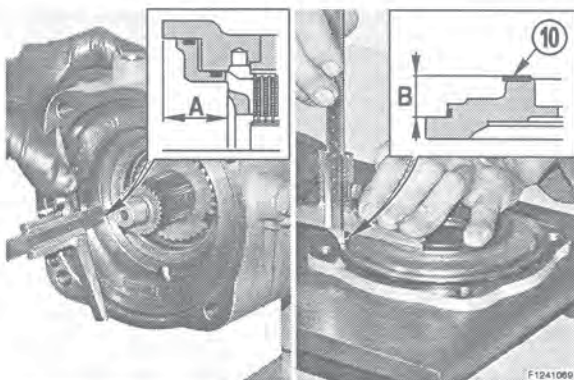
Lubricate the O-ring (24) and fit cylinder (18) complete with piston (12).



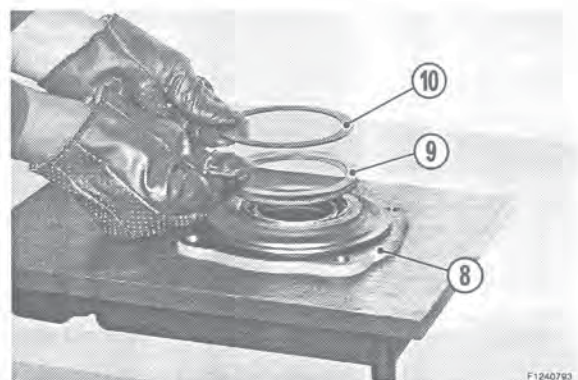
Introduce screws (17) and tighten in a criss-cross manner: use a torque wrench setting of 9.5 – 10.5 Nm.  
**NOTE.** Before giving the final tightening, align the external surfaces of the components.



**3-FUNCTION VERSION ONLY**  
Using a plastic hammer, push the piston (12) to the end of stroke.



**2-FUNCTION VERSION ONLY**  
Fit the separating ring (10) of Belleville washers onto the cover (8), measure size "B" and note it down.  
Measure size "A" which you will need for calculating the shims (9) according to the following:  
 $S = A - (B + 18.4)$  where: S = Shim thickness - 18.4 mm = fixed measure of Belleville washers.



Lightly lubricate the shims (9) required according to calculations and the separating ring (10) of the Belleville washers.  
Fit shims and ring on the cover (8).  
**NOTE.** Position the larger shim so that it leans against the cover.



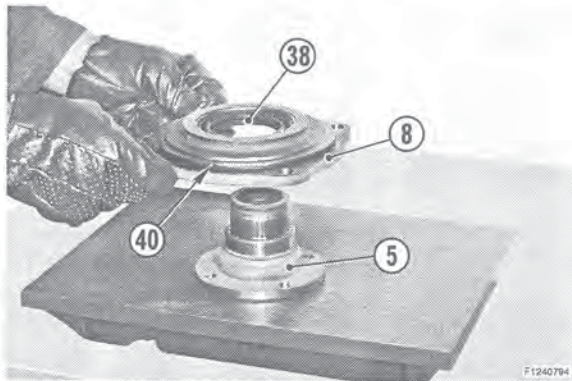


- ITA** Spalmare il piano di appoggio del distanziale (23) con Loctite 510.  
Montare sul pignone il gruppo dischi-mozzo-distanziale preparato nelle fasi precedenti e mandarlo in battuta.
- D** Die Auflagefläche des Distanzstückes (23) mit Loctite 510 schmieren.  
Auf den Kolben das Aggregat Scheiben-Nabe-Distanzstück montieren, das zuvor vorbereitet wurden und bis zum Anschlag einsetzen.
- ESP** Pasar la superficie de apoyo del distancial (23) con Loctite 510.  
Montar sobre el pinón el grupo discos-cubo-distancial preparado en la fase precedente y mandarlo a tope.
- F** Enduire le plan d'appui de l'entretoise (23) avec du Loctite 510.  
Monter sur le pignon le groupe disques-moyeu-entretoise préparé lors des phases précédentes et l'envoyer en butée.
- ITA** Inserirle le viti (17) ed avvitarle a fondo in modo incrociato; serrarle con una coppia di 9,5÷10,5 Nm.  
**NOTA.** Prima del serraggio finale, allineare le superfici esterne dei componenti.
- D** Schrauben (17) einsetzen und bis zum Anschlag im Kreuz mit einem Anzugsmoment von 9,5÷10,5 Nm fest schrauben.  
**BEMERKUNG.** Bevor die Teile endgültig festgezogen werden, die äußeren Flächen ausrichten.
- ESP** Introducir los tornillos (17) y atornillarlos a tope de manera cruzada; apretarlos con un par de 9,5÷10,5 Nm.  
**NOTA.** Antes de apretarlos definitivamente, alinear las superficies exteriores de los componentes.
- F** Introduire les vis (17) et visser à fond de façon croisée; serrer celles-ci à un couple de 9,5÷10,5 Nm.  
**NOTE.** Avant le serrage final, aligner les surfaces externes des composants.
- ITA** **SOLO PER VERSIONE A 2 FUNZIONI**  
Utilizzando un mazzuolo in materiale plastico, mandare a fondo corsa il pistone (12).
- D** **NUR FÜR AUSFÜHRUNG MIT 2 FUNKTIONEN**  
Mit einem Gummihammer den Kolben (12) bis zum Anschlag schlagen.
- ESP** **SOLO POR VERSION A 2 FUNCIONES**  
Utilizando un martillo en material plastico, mandar a final carrera el piston (12).
- F** **SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**  
A l'aide du maillet en matière plastique, envoyer le piston (12) en fin de course.
- ITA** **SOLO PER VERSIONE A 2 FUNZIONI**  
Montare sul coperchio (8) l'anello di battuta (10) delle molle a tazza, rilevare la misura "B" e trascriverla.  
Rilevare la misura "A" necessaria al calcolo dei rasamenti (9) con la formula:  $S = A - (B + 18,4)$  ove: S = Spessori rasamenti - 18,4 mm = misura fissa delle molle a tazza.
- D** **NUR FÜR AUSFÜHRUNG MIT 2 FUNKTIONEN**  
Auf den Deckel (8) den Anschlagring (10) der Tellerfedern montieren. Das Maß "B" messen und anmerken.  
Das Maß "A" messen, das zur Rechnung der Scheiben (9) mit nachstehender Formel nötig ist:  $S = A - (B + 18,4)$  wo: S = Scheibenstärke - 18,4 mm = feste Maß für Tellerfedern.
- ESP** **SOLO POR VERSION A 2 FUNCIONES**  
Montar sobre la tapa (8) el segmento a tope (10) de los muelles a taza, relevar la medida "B" y registrarla.  
Relevar la medida "A" necesaria al calculo de las raspaduras (9) con la formula:  $S = A - (B + 18,4)$  donde: S = espesor raspaduras - 18,4 mm = medida fija de los muelles a taza.
- F** **SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**  
Monter sur le couvercle (8) l'anneau de butée (10) des ressorts Belleville, relever la mesure "B" et enregistrer cette dernière. Relever la mesure "A" nécessaire pour calculer les rasages (9) avec la formule:  $S = A - (B + 18,4)$  ou: S = Cales rasages - 18,4 mm = mesure fixe des ressorts Belleville.
- ITA** Lubrificare leggermente gli spessori (9) calcolati e l'anello (10) di battuta delle molle a tazza.  
Montare spessori ed anello sul coperchio (8).  
**NOTA.** Posizionare lo spessore maggiore a ridosso del coperchio.
- D** Die Scheiben (9) und den Anschlagring (10) der Tellerfedern leicht schmieren.  
Scheiben und Ring auf den Deckel (8) montieren.  
**BEMERKUNG.** Die größere Scheibe sollte am Deckel anliegen.
- ESP** Lubrificar ligeramente los espesores (9) calculados y el segmento (10) a tope de los muelles a taza.  
Montar el espesor mayor detras de la tapa.  
**NOTA.** Colocar el espesor mayor detras de la tapa.
- F** Lubrifier légèrement les cales (9) calculées et l'anneau (10) de butée des ressorts Belleville.  
Monter cales et anneau sur le couvercle (8).  
**NOTE.** Placer la cale la plus grande au-dessus du couvercle.



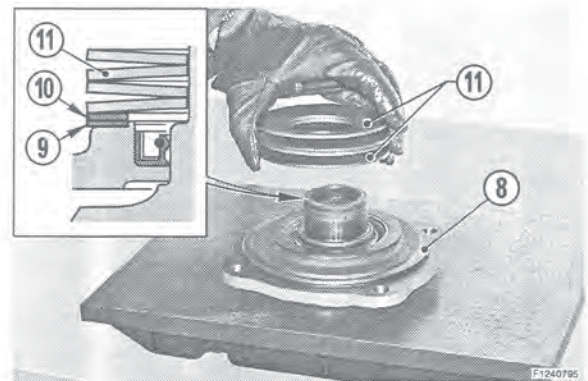


**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



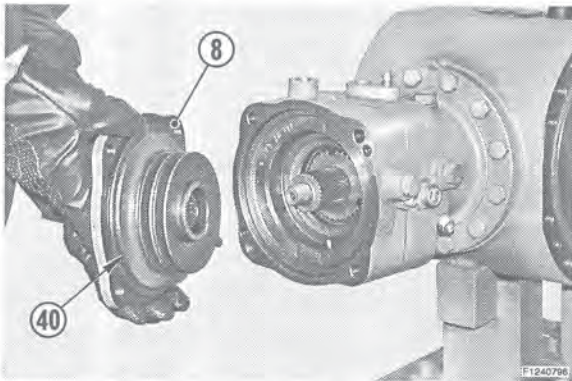
**GB** **a**

Check the state of the O-ring (40).  
Lubricate sealing ring (38) and fit flange (5) into the cover (8).



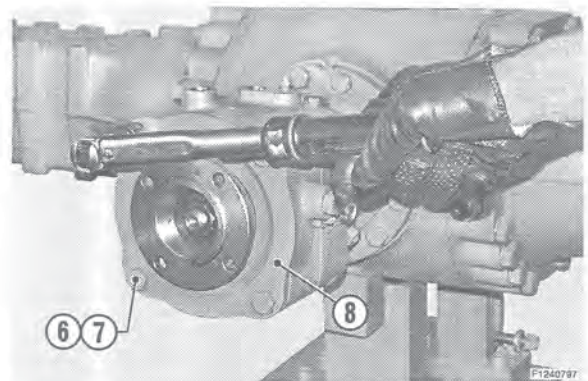
**GB** **b**

Fit the Belleville washers (11) onto the cover (8), thoroughly checking washers orientation.



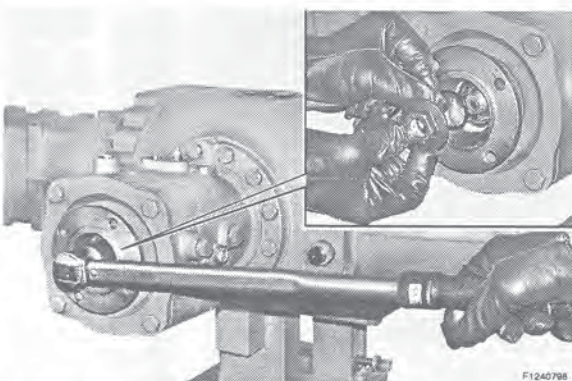
**GB** **c**

Lubricate the O-ring (40) and install the cover assembly (8).



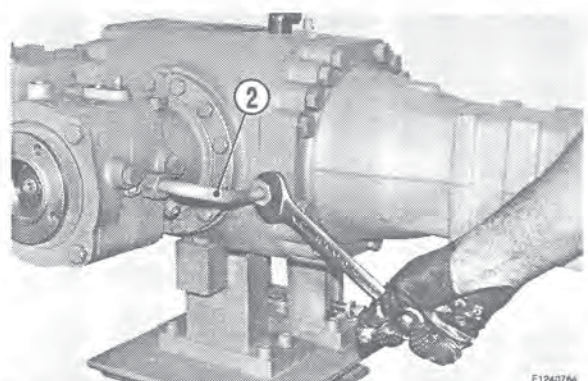
**GB** **d**

Fit screws (6) and washers (7); lock the cover with a torque wrench setting of 116 – 128 Nm.  
**NOTE.** Tighten in an alternate and criss-cross manner.



**GB** **e**

Apply Loctite 242 to the threaded portion of the pinion, fit O-ring (4) and nut (3); tighten the nut with a dynamometric wrench set to 280 – 310 Nm.  
**NOTE.** Use tools T21-T22.



**GB** **f**

Install the lubrication tube (2).





- a**
- ITA** Controllare lo stato dell'anello OR (40).  
Lubrificare l'anello di tenuta (38) e montare la flangia (5) nel coperchio (8).
- D** Zustand des O-Rings (40) kontrollieren.  
Dichtring (38) schmieren und Flansch (5) in den Deckel (8) montieren.
- ESP** Controlar el estado del anillo OR (40).  
Lubricar el anillo de compresión (38) y montar la brida (5) sobre la tapa (8).
- F** Contrôler l'état de la garniture OR (40).  
Lubrifier la bague d'étanchéité (38) et monter la flasque (5) dans le couvercle (8).

- ITA** Montare sul coperchio (8) le molle a tazza (11) controllandone attentamente l'orientamento.
- D** Auf den Deckel (8) die Tellerfeder (11) montieren und sorgfältig auf die Montagerichtung achten.
- ESP** Montar sobre la tapa (8) los muelles a taza (11) controlando con cuidado la dirección.
- F** Monter sur le couvercle (8) les ressorts belleville (11) en contrôlant attentivement leur orientation.

- c**
- ITA** Lubrificare l'anello OR (40) ed installare il gruppo coperchio (8).
- D** O-Ring (40) schmieren und Deckelaggregat (8) installieren.
- ESP** Lubricar el anillo OR (40) y montar el grupo tapa (8).
- F** Lubrifier la garniture OR (40) et installer le groupe couvercle (8).

- ITA** Montare le viti (6) e le rondelle (7); bloccare il coperchio con una coppia di 116÷128 Nm.  
**NOTA.** Eseguire il serraggio in modo alternato ed incrociato.
- D** Schrauben (6) und Unterlegscheiben (7) montieren; den Deckel mit einem Anzugsmoment von 116÷128 Nm blockieren.
- d** **BEMERKUNG.** Schrauben abwechselnd und im Kreuz fest schrauben.
- ESP** Montar los tornillos (6) y las arandelas (7); bloquear la tapa con un par de 116÷128 Nm.  
**NOTA.** Apretar de manera alternada y cruzada.
- F** Monter les vis (6) et les rondelles (7); bloquer le couvercle à un couple de 116÷128 Nm.  
**NOTE.** Effectuer le serrage de façon alternée et croisée.

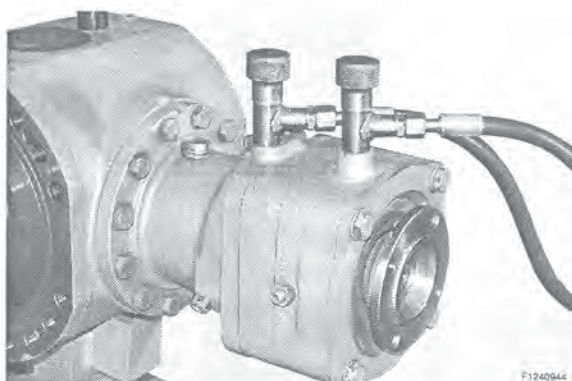
- e**
- ITA** Spalmare la porzione filettata del pignone con Loctite 242, montare l'anello OR (4) ed il dado (3); serrare il dado con chiave dinamometrica tarata a 280÷310 Nm.  
**NOTA.** Utilizzare gli attrezzi T21-T22.
- D** Das Gewinde des Kolbens mit Loctite 242 schmieren und den O-Ring (4) und die Mutter (3) montieren; die Mutter mit einem Anzugsmoment von 280÷310 Nm fest schrauben.  
**BEMERKUNG.** Werkzeuge T21-T22 verwenden.
- ESP** Pasar la parte roscada del pinón con Loctite 242, montar el segmento OR (4) y la tuerca (3); apretar la tuerca con llave dinamometrica tarada a 280÷310 Nm.  
**NOTA.** Utilizar las herramientas T21-T22.
- F** Enduire la partie filetée du pignon avec du Loctite 242, monter la garniture OR (4) et l'écrou (3); serrer l'écrou à l'aide d'une clé dynamométrique calibrée à 280÷310 Nm.  
**NOTE.** Utiliser les outils T21-T22.

- ITA** Montare il tubo (2) della lubrificazione.
- D** Schmierleitung (2) montieren.
- f**
- ESP** Montar el tubo (2) de la lubricación.
- F** Monter le tube (2) de lubrification.





**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



F1240944



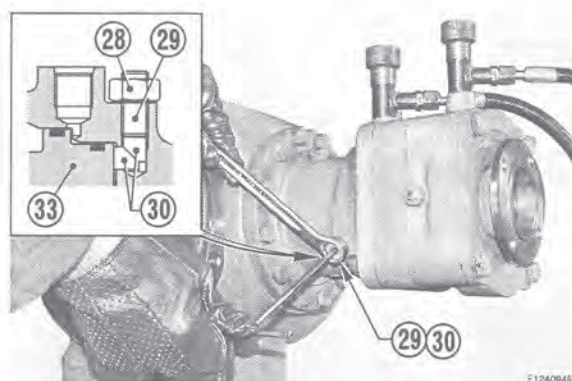
GB

a

**3-FUNCTION VERSION ONLY**

Connect the service and negative brakes to an external pump; introduce pressure up to a value of 20–25 Nm.

**NOTE.** Check that pressure is kept stable for at least 5 minutes and make sure there are no leaks.



F1240945



GB

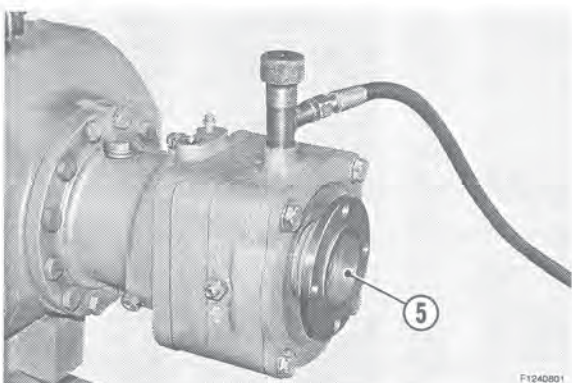
b

**3-FUNCTION VERSION ONLY**

Screw dowels (29) until pins (30) position themselves against the piston (33), then unscrew dowels by one turn to obtain a 1.5 mm stroke.

Lock dowels (29) into position with the nuts (28) tightened at 15 Nm.

Release pressure.



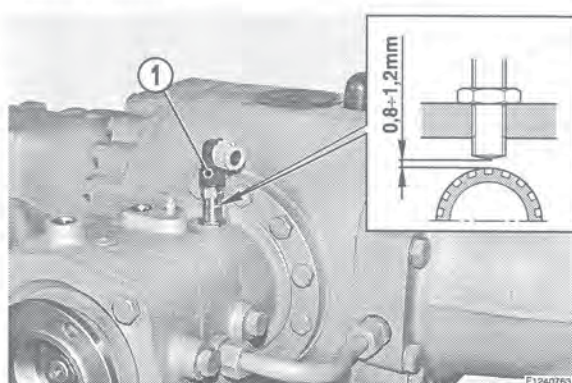
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GB

c

Check negative brake release by introducing a pressure of 16÷35 bar and by manually rotating the flange (5). Release pressure.



F1240763

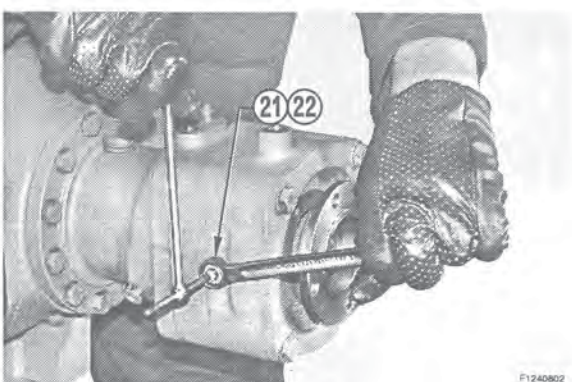


GB

d

Fit the movement sensor (1) and screw it up to the limit stop. Unscrew sensor by 3/4 turn and lock into position with nut. Locking torque: MAX 30 Nm.

**CAUTION!** Do not exceed the specified torque setting.



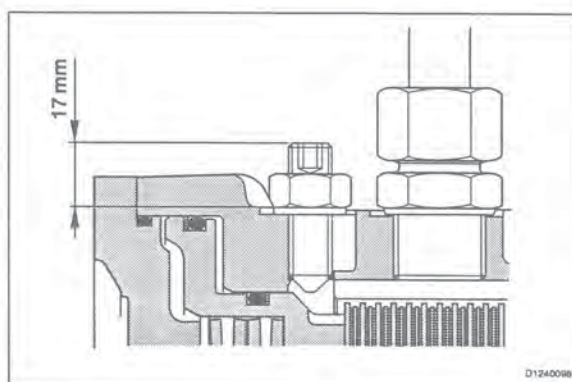
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GB

e

**CAUTION!** To release the negative brake during an emergency, (lack of pressure due to vehicle breakdown), loosen nuts (22) and screw dowels (21) in an alternate and gradual manner until you notice some preloading; continue by giving another 1.5 turns.



D1240098



GB

f

When the emergency is over, loosen the dowels in an alternate manner until a 17 mm projection is obtained; lock into position with the nuts (22) tightened to 15 Nm.



**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Collegare i freni di servizio e negativo ad una pompa esterna; immettere pressione fino ad un valore di 20÷25 Nm.

**NOTA.** Controllare che la pressione rimanga stabile per almeno 5 minuti e quindi non vi siano perdite.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Die Hilfsbremse und Negativbremse an eine getrennte Pumpe schließen; Druck bis zu einem Wert von 20÷25 Nm einlassen.

**a** **BEMERKUNG.** Kontrollieren, ob der Druck mindestens 5 Minuten lang stabil bleibt und nirgends austritt.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Conectar los frenos de servicio y negativo a una bomba externa; introducir hasta un valor de 20÷25 Nm.

**NOTA.** Controlar que la presión quede estable por lo menos por 5 minutos y que no hayan pérdidas.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.** Brancher les freins de service et négatif à une pompe externe; émettre de la pression jusqu'à une valeur de 20÷25 Nm.

**NOTE.** Contrôler que la pression soit stable pendant 5 minutes au moins et qu'il n'y ait pas de fuites.

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Avvitare i grani (29) fino all'appoggio dei pioli (30) sul pistone (33) e quindi sviarli di 1 giro per creare una corsa del pistone di 1,5 mm. Bloccare la posizione dei grani (29) con i dadi (28) serrati a 15 Nm. Rilasciare la pressione.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Stifte (29) bis zum Anschlag der Sprossen (30) am Kolben (33) schrauben und dann um 1 Umdrehung aufdrehen, um einen Hub von 1,5 mm herzustellen. Die Position der Stifte (29) mit den Muttern (28) bei einem Anzugsmoment von 15 Nm blockieren. Druck ablassen.

**b****ESP****SOLO POR VERSION A 3 FUNCIONES**

Atornillar las espigas (29) hasta el apoyo de las extremidades (30) sobre el pistón (33) y ahora destornillarlos de 1 giro para averiguar una carrera del pistón de 1,5 mm. Bloquear la posición de las espigas (29) con las tuercas (28) apretadas a 15 Nm. Dejar la presión.

**F****SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Visser les grains (29) jusqu'à la dépose des chevilles (30) sur le piston (33), puis dévisser ceux-ci d'un tour pour créer une course du piston de 1,5 mm. Bloquer la position des grains (29) avec les écrous (28) serrés à 15 Nm. Relâcher la pression.

**ITA**

Controllare lo sblocco del freno negativo immettendo una pressione di 16÷35 bar e ruotando manualmente la flangia (5).

Rilasciare la pressione.

**D**

Kontrollieren ob, beim einlassen von einem Druck von 16÷35 bar die Negativbremse entsichert und von Hand den Flansch (5) drehen.

Druck ablassen.

**c****ESP**

Controlar el bloqueo del frenonegativo introduciendo una presión de 16÷35 bar y ruotando manualmente la brida (5).

Dejar la presión.

**F**

Contrôler le débrayage du frein négatif en émettant de la pression à 16÷35 bar et en tournant la flasque (5) manuellement.

Relâcher la pression.

**ITA**

Montare il sensore di movimento (1) ed avvitarlo manualmente a fondo corsa. Svitare di 3/4 di giro e bloccare la posizione con il dado. Coppia di bloccaggio: MAX 30 Nm.

**ATTENZIONE!** Non superare la coppia indicata.

**D**

Den Bewegungsgeber (1) montieren und von Hand bis zum Anschlag montieren. Dann um 3/4 Umdrehung aufdrehen und die Position mit der Mutter blockieren. Anzugsmoment: max. 30 Nm.

**d**

**ACHTUNG!** Das Anzugsmoment nicht überschreiten.

**ESP**

Montar el sensor de movimiento (1) y atornillarlo manualmente a final carrera. Destornillarlo de 3/4 de vuelta y bloquear la posición con la tuerca.

Par de bloqueo: Max 30 Nm.

**ATENCIÓN!** No superar la medida indicada.

**F**

Monter le capteur de déplacement (1) et visser celui-ci à la main en fin de course. Dévisser encore celui-ci de 3/4 de tour et bloquer sa position avec l'écrou. Couple de blocage: MAX. 30 Nm.

**ATTENTION!** Ne jamais dépasser le couple indiqué.

**ITA**

**ATTENZIONE!** Per sbloccare il freno negativo in fase di emergenza (mancanza di pressione per avaria del veicolo), allentare i dadi (22) ed avvitare in modo progressivo alternato, i grani (21) fino ad avvertire un precarico; proseguire ulteriormente per 1,5 giri.

**D**

**ACHTUNG!** Um die Negativbremse im Notfall zu entsichern (Druck bleibt wegen einer Störung am Fahrzeug aus), die Muttern (22) lockern und abwechseln die Stifte (21) fest schrauben bis sie vorgeladen sind; um weitere 1,5 Umdrehungen fest drehen.

**e****ESP**

**ATENCIÓN!** Para sbloquear el freno negativo en fase de emergencia (falta de presión por gaste del vehículo), aflojar las tuercas (22) y atornillar de manera progresiva alternada, las espigas (21) hasta averiguar una precarga; seguir ulteriormente por 1,5 giros.

**F**

**ATTENTION!** Pour dégager le frein négatif en cas d'urgence (manque de pression en cas de panne du véhicule) desserrer les écrous (22) et visser de façon progressive alternée, les grains (21) jusqu'à avvertir une précharge; faire encore 1,5 tour.

**ITA**

Dopo l'emergenza svitare i grani in modo alternato fino ad ottenere una sporgenza di 17 mm; bloccare la posizione con i dadi (22) serrati a 15 Nm.

**D**

Nach dem Notfall, die Stifte abwechselnd aufschrauben, bis ein Vorsprung von 17 mm erreicht wird; die Position mit den Muttern (22) bei einem Anzugsmoment von 15 Nm blockieren.

**f****ESP**

Después de una emergencia destornillar las espigas de manera alternada hasta obtener una parte saliente de 17 mm; bloquear la posición con las tuercas (22) apretadas a 15 Nm.

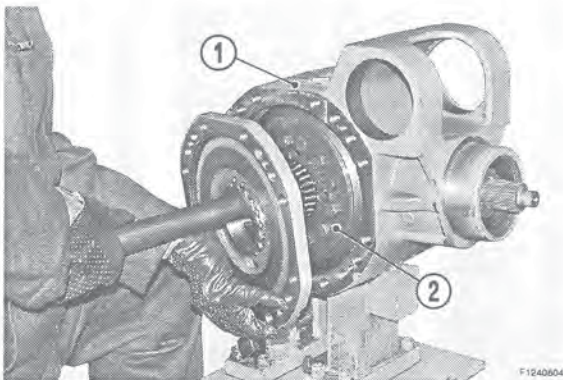
**F**

Après l'urgence dévisser les grains de façon alternée jusqu'à obtenir une saillie de 17 mm; bloquer la position à l'aide des écrous (22) serrés à 15 Nm.





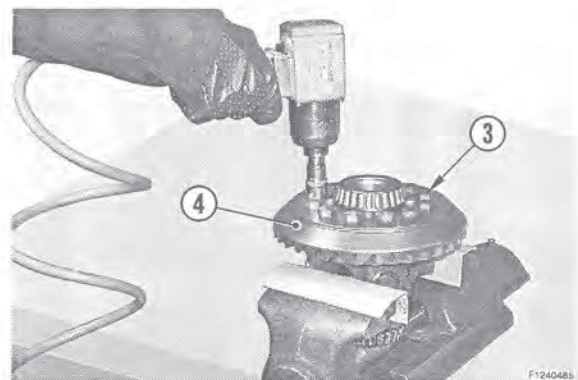
**HOW TO DISASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - SMONTAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) ABMONTIEREN - DESMONTAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - DESMONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



GB

a

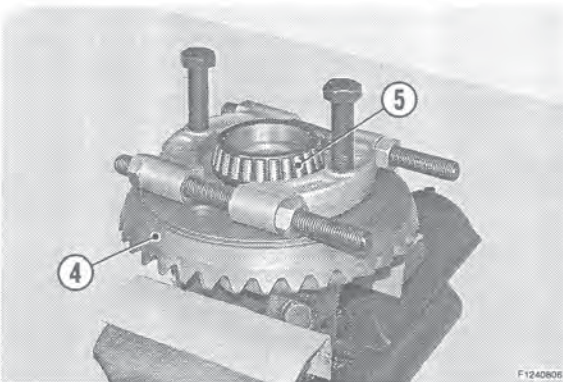
Remove the whole differential unit (2) from the central axle unit (1). For details, see «REMOVING THE DIFFERENTIAL UNIT».



GB

b

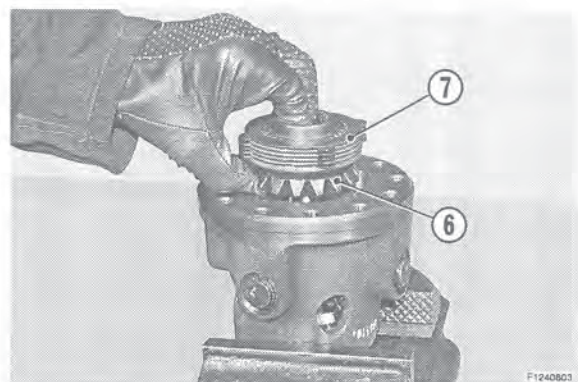
Remove the check screws (3) of the crown (4).  
**NOTE.** Note down the position of the niches of the central hole in relation to the protrusions of the friction unit steel discs.



GB

c

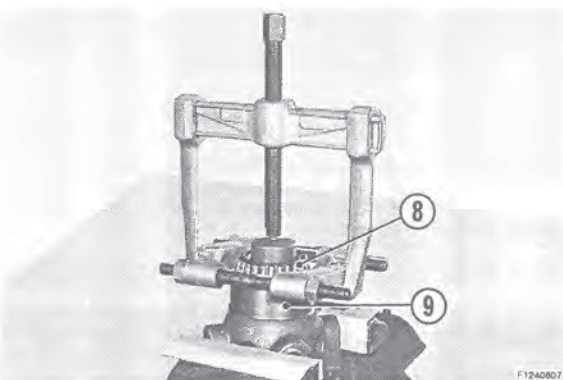
If bearing (5) needs replacing, remove it; remove crown (4).



GB

d

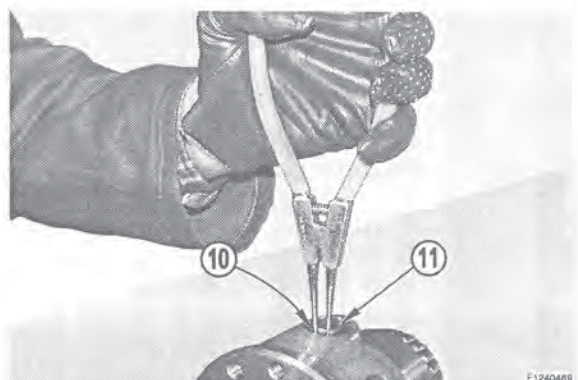
Remove the planetary gear (6) and the whole friction unit (7).



GB

e

If bearing (8) needs replacing, extract it from the differential unit (9).



GB

f

Remove the snap rings (10) from the pins (11) of the planet gears (12).





- a**
- ITA** Asportare dal corpo centrale assale (1) il gruppo differenziale (2) completo.  
Per i dettagli, vedere «RIMOZIONE GRUPPO DIFFERENZIALE».
- D** Vom zentralen Achsenkörper (1) das vollständige Differentialaggregat (2) abnehmen.  
Weitere Einzelheiten, siehe «DIFFERENTIALAGGREGAT ABNEHMEN».
- ESP** Sacar del cuerpo central axial (1) el grupo diferencial (2) completo.  
Por los detalles, vease «REMOCION GRUPO DIFERENCIAL».
- F** Enlever le corps central essieu (1) le groupe différentiel (2) complet.  
Pour tout détail, voir «DEPOSE DU GROUPE DIFFERENTIEL».

- c**
- ITA** Se si deve sostituire, estrarre il cuscinetto (5); rimuovere la corona (4).
- D** Wenn es ausgewechselt werden muß, das Lager (5) heraus nehmen; Kranz (4) abnehmen.
- ESP** Si se debe de substituir, extraer el cojinete (5); remover la corona (4).
- F** Si on doit substituer, extraire le palier (5); enlever la couronne (4).

- e**
- ITA** Se si deve sostituire, estrarre il cuscinetto (8) dal corpo differenziale (9).
- D** Wenn es ausgewechselt werden muß, das Lager (8) vom Differentialkörper (9) heraus nehmen.
- ESP** Si se debe de substituir, extraer el cojinete (8) del cuerpo diferencial (9).
- F** Si on doit substituer, extraire le palier (8) du corps différentiel (9).

- b**
- ITA** Rimuovere le viti (3) di ritegno della corona (4).  
**NOTA.** Annotare la posizione delle nicchie del foro centrale rispetto alle sporgenze dei dischi d'acciaio dei gruppi di frizione.
- D** Die Schrauben (3) zur Halterung des Kranzes (4) abnehmen.  
**BEMERKUNG.** Die Position der Nischen des zentralen Lochs im Verhältnis zu den Stahlscheiben der Kupplungsaggregate anmerken.
- ESP** Remover los tornillos (3) de retención de la corona (4).  
**NOTA.** Anotar la colocación de los nichos del agujero central respecto a las partes salientes de los discos de acero de los grupos de frición.
- F** Enlever les vis (3) de fixation de la couronne (4).  
**NOTE.** Prendre note de la position des logements du trou central par rapport à la saillie des disques d'acier des groupes de friction.

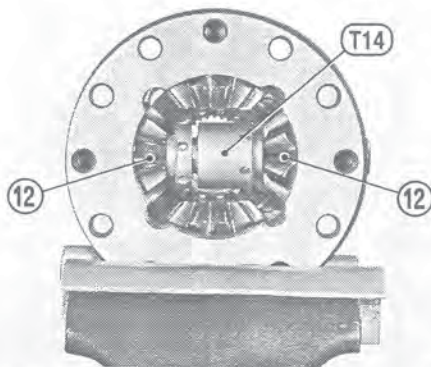
- d**
- ITA** Rimuovere l'ingranaggio planetario (6) ed il gruppo frizione (7) completo.
- D** Das Planetengetriebe (6) und das vollständige Kupplungsaggregat (7) abnehmen.
- ESP** Remover el engranaje planetario (6) y el grupo frición (7) completo.
- F** Enlever l'engrenage planétaire (6) et le groupe de friction (7) complet.

- f**
- ITA** Rimuovere gli anelli elastici (10) dai perni (11) degli ingranaggi satelliti (12).
- D** Die Kolbenringen (10) von den Stiften (11) der Planetengetriebe (12) abnehmen.
- ESP** Remover los segmentos elasticos (10) de los pernos (11) de los engranajes satélites (12).
- F** Enlever les anneaux à ressort (10) des axes (11) des engrenages satellites (12).





**HOW TO DISASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - SMONTAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) ABMONTIEREN - DESMONTAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - DESMONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



F1240809



GB

a

Introduce tool T14 in-between the planet gears (12).



F1240481

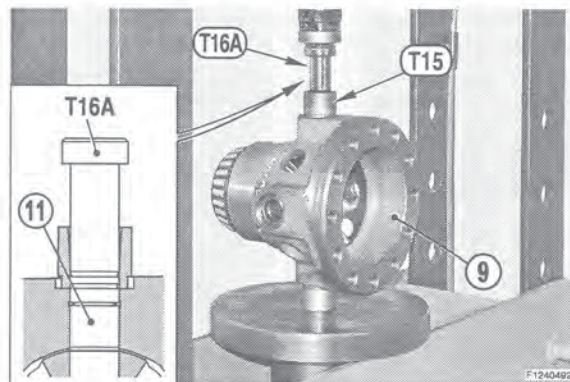


GB

b

Using two pin-drivers, engage tool T14 in-between the planet gears (12).

**CAUTION!** Carefully check that tool T14 keeps in an aligned position with the pins (11) when locked.



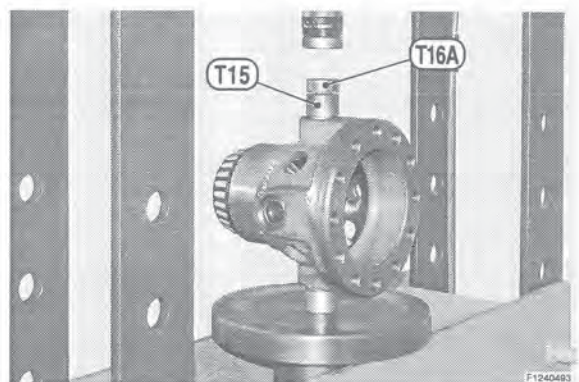
F1240492



GB

c

Place the differential unit (9) under a press, position bush T15 and insert gudgeon T16A. Press gudgeon T16A to end of stroke.



F1240483



GB

d

Remove gudgeon T16A and bush T15.

**NOTE.** In this state, the pin (11) is contained within tool T14.



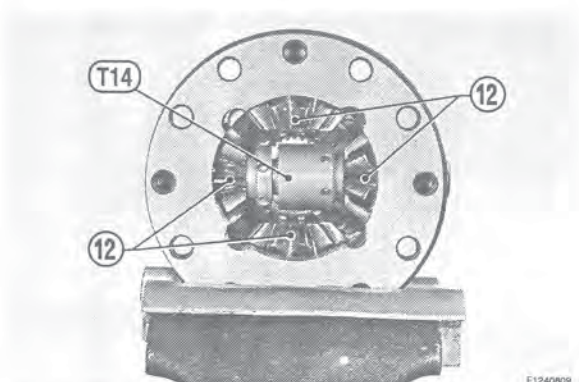
F1240491



GB

e

Remove tool T14 and planet pin (11) with it.



F1240809



GB

f

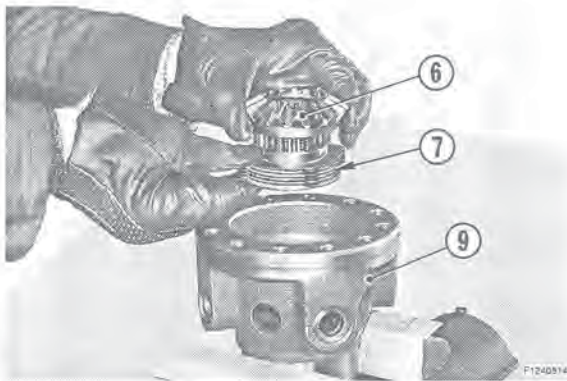
Leaving the released planet in its position, lock again tool T14. Repeat pin extraction operation on the second planet pin (11). Repeat the same operations on the remaining pins.



- a**
- ITA** Inserire tra gli ingranaggi satelliti (12) l'attrezzo T14.
- D** Zwischen den Planetengetriebe (12) das Werkzeug T14 stecken.
- ESP** Introducir entre los engranajes satelites (12) la herramienta T14.
- F** Introduire entre les engrenages satellites (12) l'outil T14.
- b**
- ITA** Operando con due cacciapine, forzare l'attrezzo T14 tra gli ingranaggi satelliti (12).  
**ATTENZIONE!** Controllare attentamente che l'attrezzo T14 rimanga allineato ai perni (11) quando è bloccato.
- D** Mit zwei Dübeln das Werkzeug T14 zwischen den Zahnradern des Planetengetriebes (12) forcieren.  
**ACHTUNG!** Sorgfältig kontrollieren, ob das Werkzeug T14 mit den Stiften (11) ausgerichtet ist, nachdem es blockiert worden ist.
- ESP** Obrando con dos extractores de clavijas, hacer fuerza sobre la herramienta T14 entre los engranajes satelites (12).  
**ATENCION!** Controlar con cuidado que la herramienta T14 quede en linea a los pernos (11) cuando esta bloqueado.
- F** En oeuvrant avec deux dispositifs arrache-broches, forcer l'outil T14 entre les engrenages satellites (12).  
**ATTENTION!** Contrôler attentivement que l'outil T14 demeure aligné aux axes (11) quand il est bloqué.
- c**
- ITA** Sistemare il corpo differenziale (9) sotto una pressa, posizionare la boccia T15 ed inserire lo spinotto T16A. Pressare lo spinotto T16A fino a fondo corsa.
- D** Den Differentialkörper (9) unter eine Presse legen, die Buchse T15 positionieren und den Bolzen T16A einsetzen. Den Bolzen T16A bis zum Anschlag einpressen.
- ESP** Sistamar el cuerpo diferencial (9) bajo una presa, colocar el carquillo T15 y introducir la cruceta T16A. Empujar la cruceta T16A a tope.
- F** Ajuster le corps différentiel (9) sous une presse, placer l'embout T15 et introduire la cheville T16A. Presser la cheville T16A jusqu'en fin de course.
- d**
- ITA** Asportare lo spinotto T16A e la bussola T15.  
**NOTA.** In questa condizione, il perno (11) è contenuto nell'attrezzo T14.
- D** Den Bolzen T16A und die Buchse T15 abnehmen.  
**BEMERKUNG.** In diesem Zustand befindet sich der Stift (11) im Werkzeug T14.
- ESP** Sacar la cruceta T16A y el manguito T15.  
**NOTA.** En esta condición, el perno (11) esta contenido en la herramineta T14.
- F** Enlever la cheville T16A et la bague T15.  
**NOTE.** Dans ces conditions, l'axe (11) est contenu dans l'outil T14.
- e**
- ITA** Rimuovere l'attrezzo T14 e con esso il perno (11) del satellite.
- D** Das Werkzeug T14 und damit auch den Stift (11) des Planetengetriebes abnehmen.
- ESP** Remover la herramienta T14 y con esta el perno (11) del satellite.
- F** Enlever l'outil T14 et avec celui-ci l'axe (11) du satellite.
- f**
- ITA** Lasciando in posizione l'ingranaggio satellite che si è liberato, bloccare nuovamente l'attrezzo T14. Ripetere le operazioni di estrazione del perno del secondo perno satellite (11). Ripetere le operazioni per gli altri perni.
- D** Das Planetengetriebe, das sich freigesetzt hat, in seiner Position lassen, und Werkzeug T14 wieder blockieren.  
Die Vorgänge zum Abnehmen des zweiten Stiftes des Planetengetriebes (11) wiederholen.  
Die Vorgänge für alle anderen Stifte wiederholen.
- ESP** Dejando en posición el engranaje satelite que se ha librado, bloquear de nuevo la herramienta T14. Repetir las operaciones de extracción del perno de segundo perno satellite (11). Repetir las operaciones para los otros pernos.
- F** En laissant dans sa position l'engrenage satellite qui s'est dégagé, bloquer de nouveau l'outil T14. Répéter les opérations pour extraire l'axe du deuxième axe satellite (11). Répéter les opérations pour les autres axes.



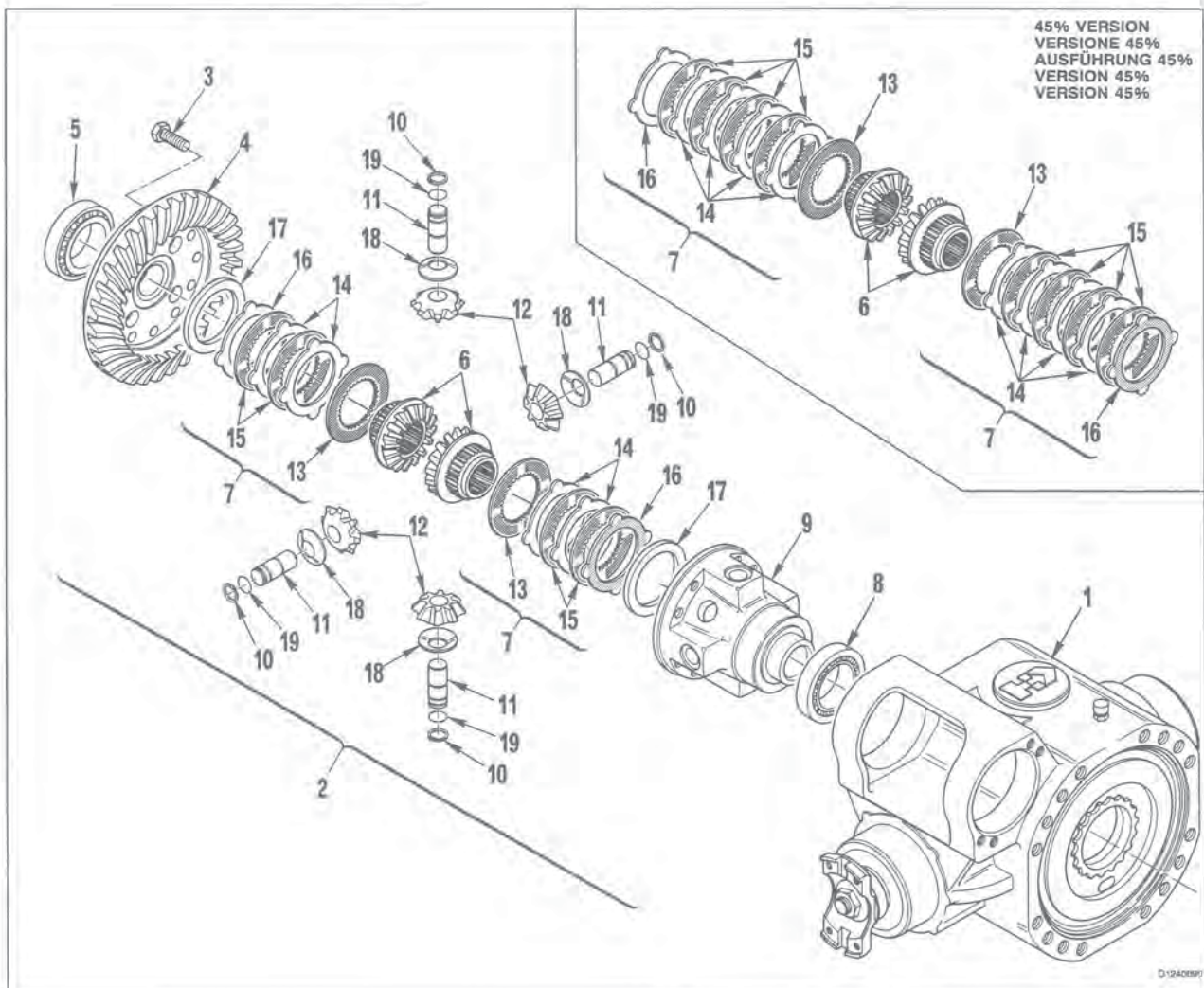
**HOW TO DISASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - SMONTAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM Gleitvermögen (25% UND 45%) ABMONTIEREN - DESMONTAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - DESMONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



GB

a

Remove tool T14 and extract from the differential unit (9) the two final planet gears (12), the 2<sup>nd</sup> planet gear (6) and the whole friction assembly concerned (7).







SPICER CLARK-HURTH

a

**ITA**

Rimuovere l'attrezzo **T14** ed asportare dal corpo differenziale (9) gli ultimi due ingranaggi satelliti (12), il 2° ingranaggio planetario (6) ed il relativo gruppo di frizione (7) completo.

**D**

Das Werkzeug **T14** abnehmen und vom Differentialkörper (9) die letzten beiden Zahnräder des Planetengetriebes (12), das 2. Planetengetriebe und das entsprechende Kupplungsaggregat (7) abnehmen.

**ESP**

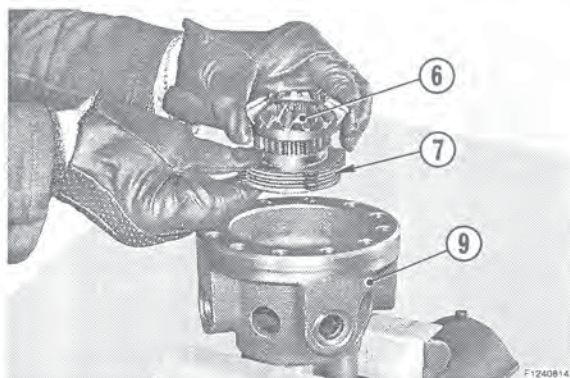
Remove la herramienta **T14** y sacar del cuerpo diferencial (9) los últimos dos engranajes satélites (12), el 2° engranaje planetario (6) y el relativo grupo de fricción (7) completo.

**F**

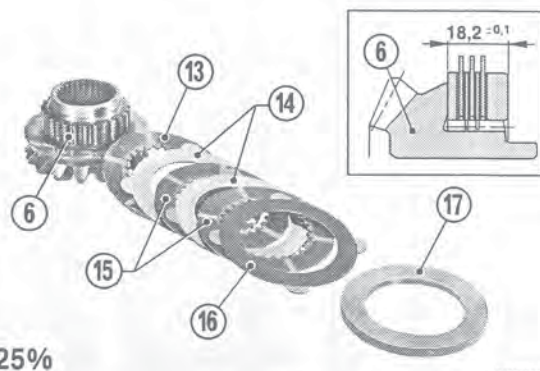
Enlever l'outil **T14** puis extraire du corps différentiel (9) les deux derniers engrenages satellites (12), le 2° engrenage planétaire (6) et le groupe de friction relatif (7) complet.



**HOW TO ASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - ASSEMBLAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) MONTIEREN - ASEMBLAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - MONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



Place a friction unit (7) - suitable for the specific type of slipping - and planetary gear (6) into the differential unit (9).  
The composition of the unit is illustrated in the points below.



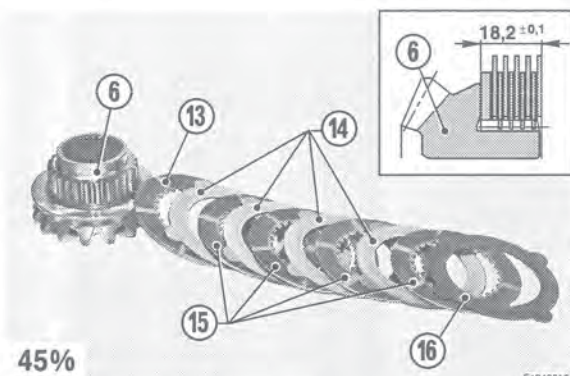
25%



**25% FRICTION UNIT COMPOSITION**

Friction ring with increased shim (13), steel rings (14) and friction rings (15) alternated, end ring (16) and distance piece (17).

**CAUTION!** As to rings (13) and (16), the side without notches must face outwards.



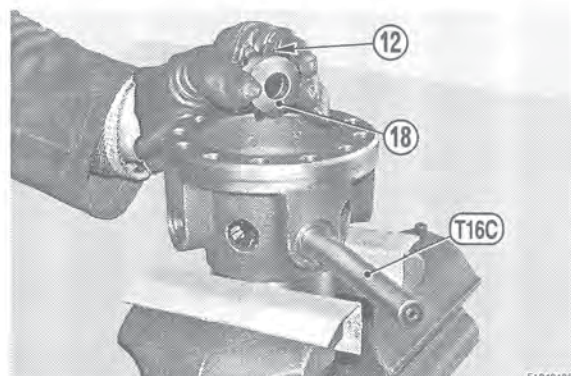
45%



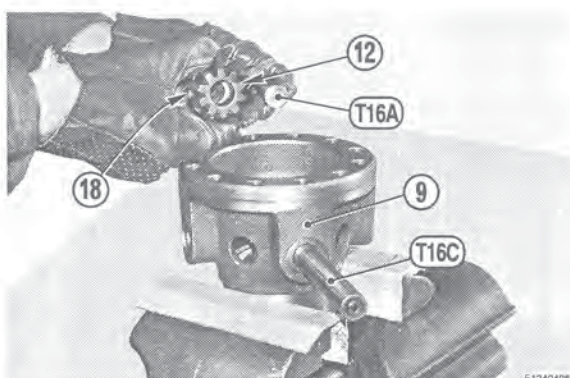
**45% FRICTION UNIT COMPOSITION**

Friction ring with increased shim (13), steel rings (14) and friction rings (15) alternated, end ring (16) and distance piece (17).

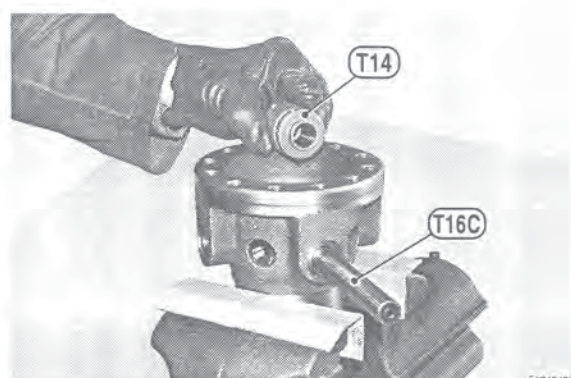
**CAUTION!** As to rings (13) and (16), the side without notches must face outwards.



Position shim washer (18) and the first planet gear (12).  
Hold them in position with bar T16C.



Using gudgeon T16A, position the second planet gear (12) and relative shim washer (18).



Insert tool T14 in-between the two planet gears (12). Align the whole unit, pushing bar T16C in as far as it will go, until gudgeon T16A is expelled.



**ITA**

Inserire nel corpo differenziale (9), il gruppo di frizione (7) specifico per il tipo di slittamento e l'ingranaggio planetario (6).

La composizione del gruppo di frizione è indicata in seguito.

**D**

In den Differentialkörper (9) das für die Gleitungsart und das Planetengetriebe (6) geeignete Kupplungsaggregat (7) einsetzen.

Die Zusammensetzung des Kupplungsaggregats ist nachstehend beschrieben.

**ESP**

Introducir en el cuerpo diferencial (9), el grupo de frición (7) específico por el tipo de deslizamiento y el engranaje planetario (6).

La composición del grupo de frición es indicada a seguir.

**F**

Introduire dans le corps différentiel (9), le groupe de friction (7) spécifique pour le type de patinage et l'engrenage planétaire (6).

La composition du groupe de friction est indiquée ci-dessous.

**ITA**

#### COMPOSIZIONE GRUPPO DI FRIZIONE 25%

Anello di frizione con spessore maggiorato (13), anelli d'acciaio (14) ed anelli di frizione (15) alternati, anello terminale (16), anello distanziatore (17).

**ATTENZIONE!** Gli anelli (13) e (16) devono avere la parte senza intagli rivolta verso l'esterno.

**D**

**ZUSAMMENBAU DES KUPPLUNGSAGGREGATS 25%**  
Kupplungsringe mit größerer Stärke (13), Stahlringe (14) und Kupplungsringe (15), Abschlußring (16), Distanzscheibe (17).

**ACHTUNG!** Die Ringe (13) und (16) müssen die glatte Seite nach außen gerichtet haben.

**ESP**

#### COMPOSICION GRUPO DE FRICION 25%

Segmento de frición con espesor mayor (13), segmento de acero (14) y segmento de frición (15) alternados, segmento terminal (16), segmento distancial (17).

**ATENCIÓN!** Los segmentos (13) y (16) deben de tener la parte sin ranaduras hacia el exterior.

**F**

#### COMPOSITION DU GROUPE DE FRICTION 25%

Garniture de friction avec cale majorée (13), anneaux d'acier (14) et garniture de friction (15) alternés, anneau terminal (16), bague entretoise (17).

**ATTENTION!** Les garnitures (13) et (16) doivent avoir la partie sans entailles tournée vers l'extérieur.

**ITA**

#### COMPOSIZIONE GRUPPO DI FRIZIONE 45%

Anello di frizione con spessore maggiorato (13), anelli d'acciaio (14) ed anelli di frizione (15) alternati, anello terminale (16).

**ATTENZIONE!** Gli anelli (13) e (16) devono avere la parte senza intagli rivolta verso l'esterno.

**D**

**ZUSAMMENBAU DES KUPPLUNGSAGGREGATS 45%**  
Kupplungsringe mit größerer Stärke (13), Stahlringe (14) und Kupplungsringe (15), Abschlußring (16).

**ACHTUNG!** Die Ringe (13) und (16) müssen die glatte Seite nach außen gerichtet haben.

**ESP**

#### COMPOSICION GRUPO DE FRICION 45%

Segmento de frición con espesor mayor (13), segmento de acero (14) y anillo de frición (15) alternados, segmento terminal (16).

**ATENCIÓN!** Los segmentos (13) y (16) deben tener la parte sin ranaduras hacia el exterior.

**F**

#### COMPOSITION DU GROUPE DE FRICTION 45%

Garniture de la friction avec cale majorée (13), anneaux d'acier (14) et garniture de friction (15) alternés, anneau terminal (16).

**ATTENTION!** Les garnitures (13) et (16) doivent avoir la partie sans entailles tournée vers l'extérieur.

**ITA**

Posizionare la rondella di rasamento (18), il primo ingranaggio satellite (12).

Tenerli in posizione con la barra T16C.

**D**

Die Zwischenlegscheibe (18) und das erste Planetengetriebe (12) positionieren.

In dieser Position mit dem Stab T16C halten.

**ESP**

Colocar la arandela de raspadura (18), el primer engranaje satélite (12).

Tenerlos en posición con la barra T16C.

**F**

Mettre la rondelle de rasage (18) en place, puis le premier engrenage satellite (12).

Maintenir ceux-ci en place avec la barre T16C.

**ITA**

Utilizzando lo spinotto T16A, posizionare il secondo ingranaggio satellite (12) e la relativa rondella di rasamento (18).

**D**

Mit einem Bolzen T16A das zweite Planetengetriebe (12) und die Zwischenlegscheibe (18) positionieren.

**ESP**

Utilizando la cruceta T16A, colocar el segundo engranaje satélite (12) y la relativa arandela de raspadura (18).

**F**

A l'aide de la cheville T16C, mettre en place le deuxième engrenage satellite (12) et sa rondelle de rasage (18).

**ITA**

Inserire tra i due ingranaggi satelliti (12) l'attrezzo T14. Allineare tutto il gruppo inserendo a fondo la barra T16C fino ad espellere lo spinotto T16A.

**D**

Die beiden Planetengetriebe (12) mit dem Werkzeug T14 einsetzen. Das ganze Aggregat ausrichten indem der Stab T16C eingesetzt wird, bis der Bolzen T16A ausgestoßen wird.

**ESP**

Introducir entre los dos engranajes satélites (12) la herramienta T14. Alinear todo el grupo introduciendo a tope la barra T16C hasta sacar la cruceta T16A.

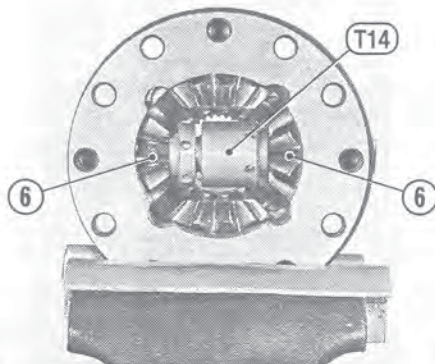
**F**

Introduire entre les deux engrenages satellites (12) l'outil T14. Aligner tout le groupe en introduisant la barre T16C à fond jusqu'à expulser la cheville T16A.





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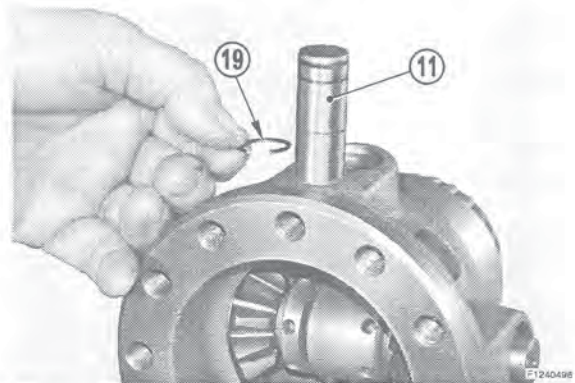


F1240809



Lock tool T14 behind the planet gears (12). After locking the tool, remove bar T16C.

a

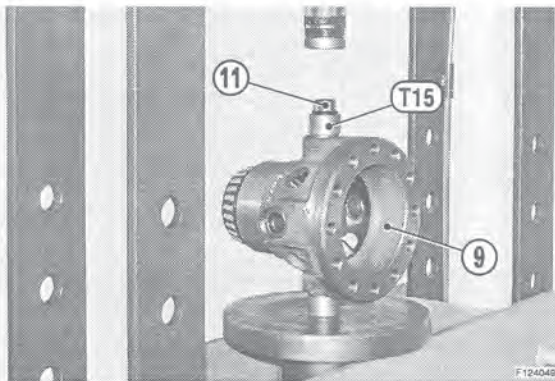


F1240498



Fit snap rings (19) onto the pins (11).

b

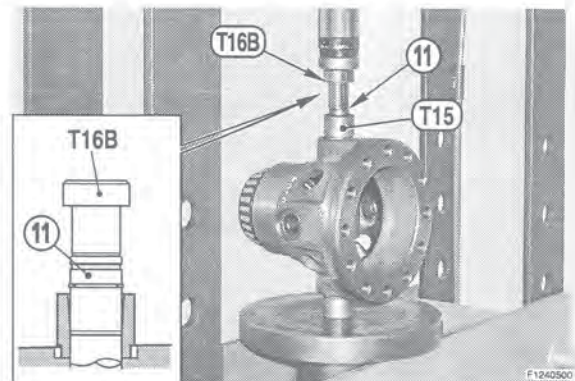


F1240499



Position the differential unit (9) under the press, position bush T15 and insert the planet pin (11).

c

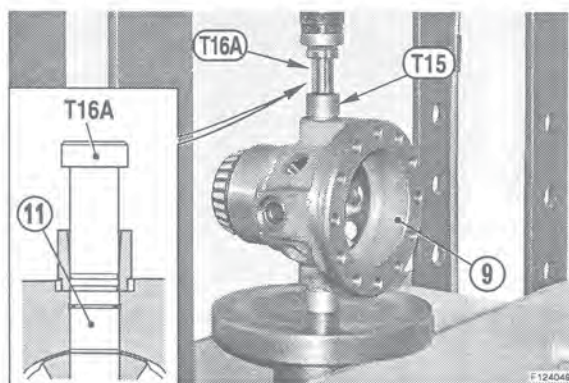


F1240500



Place gudgeon T16B on top of the planet pin (11).

d

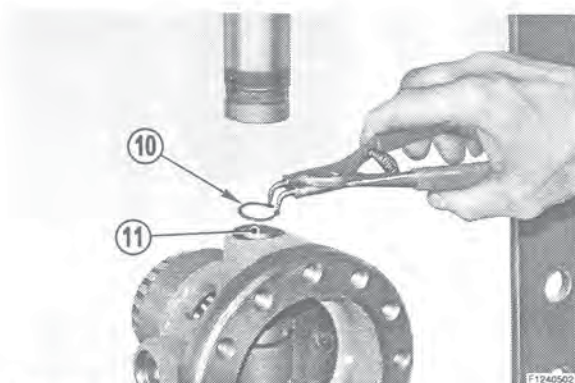


F1240482



Press gudgeon T16B as far down as it will go.

e



F1240502



Remove gudgeon T16B, bush T15, and fit the snap ring (10) onto the pin (11). **CAUTION!** Make sure that the snap ring centers the seat and positions itself on the differential unit face. Repeat the operations on the other planet pin and on the other planet unit.

f

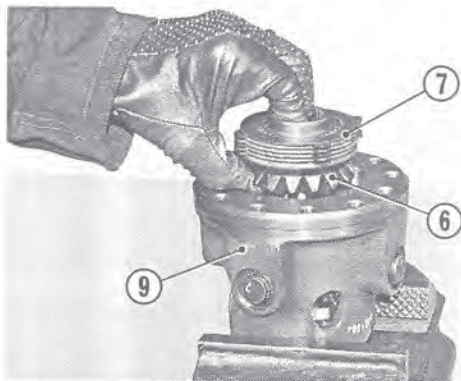




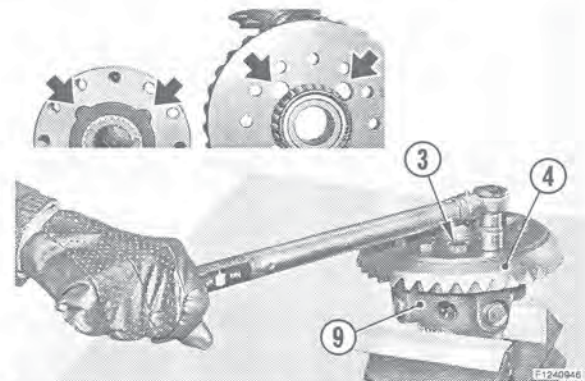
- a**
- ITA** Bloccare l'attrezzo **T14** a ridosso degli ingranaggi satelliti (12).  
Dopo il bloccaggio, rimuovere la barra **T16C**.
- D** Das Werkzeug **T14** am Anschlag der Planetengetriebe (12) blockieren.  
Danach Stab **T16C** abnehmen.
- ESP** Bloquear la herramienta **T14** detras de los engranajes satélites (12).  
Después del bloqueo, remover la barra **T16C**.
- F** Bloquer l'outil **T14** au-dessus des engrenages satellites (12).  
Après le blocage, enlever la barre **T16C**.
- b**
- ITA** Montare sui perni (11) gli anelli elastici (19).
- D** Auf die Stifte (11) die Kolbenringe (19) montieren.
- ESP** Montar sobre los pernos (11) los segmentos elásticos (19).
- F** Monter sur les axes (11) les anneaux à ressort (19).
- c**
- ITA** Posizionare sotto la pressa il corpo differenziale (9), sistemare la boccola **T15** ed inserire il perno satellite (11).
- D** Unter einer Presse den Differentialkörper (9) positionieren, die Buchse **T15** einlegen und den Planetenstift (11) einsetzen.
- ESP** Colocar bajo la prensa el cuerpo diferencial (9), colocar el casquillo **T15** y introducir el perno satélite (11).
- F** Placer le corps différentiel (9) sous la presse, ajuster l'embout **T15** et insérer l'axe satellite (11).
- d**
- ITA** Sovrapporre al perno satellite (11) lo spinotto **T16B**.
- D** Auf den Planetenstift (11) den Bolzen **T16B** legen.
- ESP** Sobreponer al perno satélite (11) la cruceta **T16B**.
- F** Poser sur l'axe satellite (11) la cheville **T16B**.
- e**
- ITA** Pressare lo spinotto **T16B** a fondo.
- D** Den Bolzen **T16B** fest einpressen.
- ESP** Apretar la cruceta **T16B** a tope.
- F** Presser la cheville **T16B** à fond.
- f**
- ITA** Rimuovere lo spinotto **T16B**, la boccola **T15** e montare sul perno (11) l'anello elastico (10).  
**ATTENZIONE!** Assicurarsi che l'anello elastico centri la sede e che appoggi sul piano del corpo differenziale. Ripetere le operazioni per l'altro perno satellite e per l'altro asse satelliti.
- D** Den Bolzen **T16B**, die Buchse **T15** abnehmen und auf den Stift (11) den Kolbenring (10) montieren.  
**ACHTUNG!** Kontrollieren, ob der Kolbenring im Sitz zentriert ist und auf der Fläche der Fläche des Differentialkörpers liegt. Die Vorgänge für den anderen Planetenstift und die andere Planetenachse wiederholen.
- ESP** Remover la cruceta **T16B**, el casquillo **T15** y montar sobre el perno (11) el segmento elastico (10).  
**ATENCIÓN!** Averiguar que el segmento elastico sea centrado en su alojamiento y que apoye sobre la superficie del cuerpo diferencial. Repetir las operaciones para el otro perno satélite y para el otro eje satélite.
- F** Enlever la cheville **T16B**, l'embout **T15** et monter sur l'axe (11) l'anneau à ressort (10).  
**ATTENTION!** S'assurer que l'anneau à ressort soit bien centré sur le siège et posé sur la surface du corps différentiel. Répéter les opérations pour l'autre axe satellite et l'autre essieu satellite.



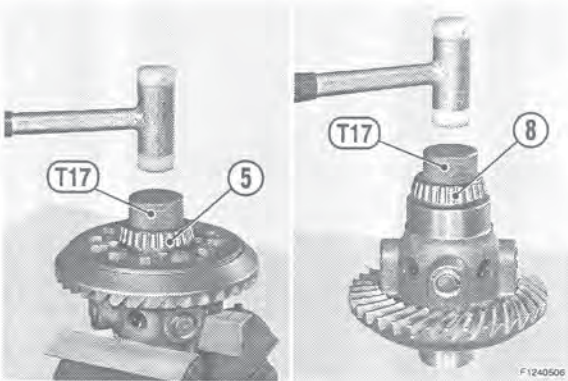
**HOW TO ASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - ASSEMBLAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) MONTIEREN - ASEMBLAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - MONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



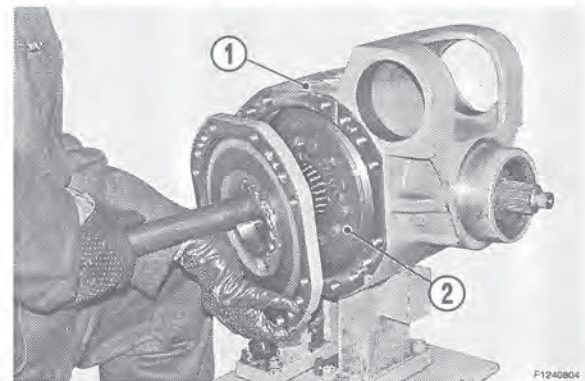
Check that planets have a light clearance in relation to the first planet gear.  
Position the second planetary gear (6) and the second friction unit (7) into the differential unit (9).



Line the lubrication holes up with the slots in the differential carrier.  
Orient the holes of the crown (4) towards the protrusions of the braking unit.  
Position the crown (4) on the differential unit (9) and lock it with the screws (3) previously coated with Loctite 242.  
Torque wrench setting for screws: 128 – 142 Nm.  
**NOTE.** Tighten screws using the criss-cross method.



If bearings (5) and (8) have been removed, install them using tool T17.



Install the whole differential assembly (2) into the central body (1).  
For details, see «INSTALLING THE DIFFERENTIAL UNIT».





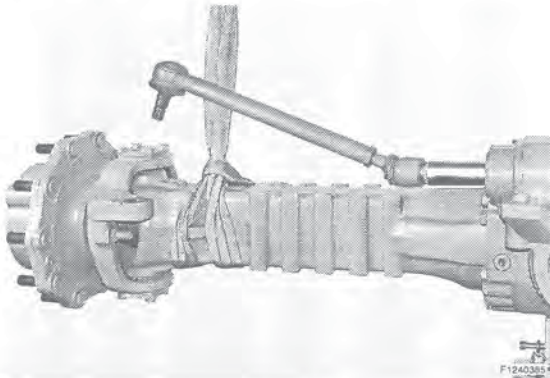
- a**
- ITA** Controllare che i satelliti abbiano un leggero gioco rispetto il primo ingranaggio planetario.  
Posizionare il secondo ingranaggio planetario (6) ed il secondo gruppo di frizione (7) nel corpo differenziale (9).
- D** Kontrollieren, ob die Planetengetriebe etwas Spiel im Verhältnis zum ersten Planetengetriebe haben.  
Das zweite Planetengetriebe (6) und das zweite Kupplungsaggregat (7) in den Differentialkörper (9) einsetzen.
- ESP** Controlar que los satélites tengan un ligero juego respecto al primero engranaje planetario.  
Colocar el segundo engranaje planetario (6) y el segundo grupo de frición (7) en el cuerpo diferencial (9).
- F** Contrôler que les satellites aient un peu de jeu par rapport au premier engrenage planétaire.  
Mettre le deuxième engrenage planétaire (6) en place ainsi que le second groupe de friction (7) du corps différentiel (9).
- c**
- ITA** Se sono stati rimossi, montare i cuscinetti (5) e (8) utilizzando l'attrezzo T17.
- D** Falls sie abmontiert wurden, die Lager (5) und (8) mit dem Werkzeug T17 montieren.
- ESP** Si han sido removidos, montar los cojinetes (5) y (8) utilizando la herramienta T17.
- F** S'ils ont été enlevés, remonter les paliers (5) et (8) à l'aide de l'outil T17.

- b**
- ITA** Allineare i fori di lubrificazione della corona (4) con le cave della scatola differenziale sulle sporgenze del gruppo di frenatura. Posizionare la corona (4) sul corpo differenziale (9) e bloccarla con le viti (3) spalmate con Loctite 242.  
Coppia di serraggio viti: 128÷142 Nm  
**NOTA.** Serrare le viti con il metodo del serraggio incrociato.
- D** Die Schmierlöcher des Kranzes (4) der Differential-schachtel mit den Vorsprüngen des Bremsaggregats ausrichten. Den Kranz (4) auf den Differentialkörper (9) positionieren und mit den Schrauben (3), die zuvor mit Loctite 242 geschmiert wurden, blockieren. Anzugsmoment der Schrauben: 128÷142 Nm.  
**BEMERKUNG.** Sie Schrauben im Kreuz fest schrauben.
- ESP** Alinear los agujeros de lubricación de la corona con los nichos de la caja diferencial (4) sobre las partes salientes del grupo de frenadura.  
Colocar la corona (4) sobre el cuerpo diferencial (9) y bloquearla con los tornillos: 128÷142 Nm.  
**NOTA.** Apretar los tornillos de manera cruzada.
- F** Aligner les trous de lubrification de la couronne (4) avec les creux du carter différentiel sur les saillies du groupe de freinage. Placer la couronne (4) sur le corps différentiel (9) et bloquer celle-ci avec les vis (3) enduites de Loctite 242.  
Couple de serrage des vis: 128÷142 Nm.  
**NOTE.** Serrer les vis avec la méthode de serrage croisée.
- d**
- ITA** Installare nel corpo centrale (1) il gruppo differenziale (2) completo.  
Per i dettagli, vedere «INSTALLAZIONE GRUPPO DIFFERENZIALE».
- D** In den zentralen Körper (1) das vollständige Differentialaggregat (2) installieren.  
Für weitere Einzelheiten, siehe «INSTALLATION DES DIFFERENTIALAGGREGATS».
- ESP** Introducir en el cuerpo central (1) el grupo diferencial (2) completo.  
Para los detalles, vease «INSTALACION GRUPO DIFERENCIAL».
- F** Installer dans le corps central (1) le groupe différentiel (2) complet.  
Pour tout détail, voir «INSTALLATION DU GROUPE DIFFERENTIEL».



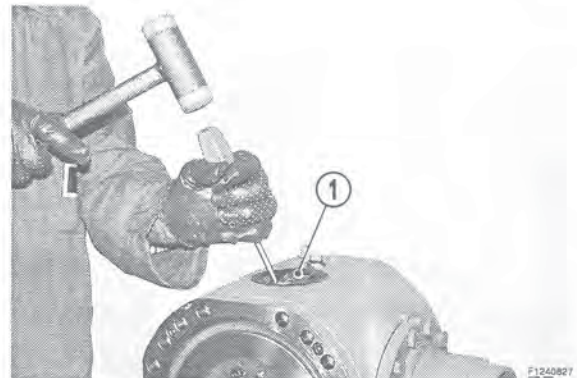


**HOW TO DISASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - SMONTAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - DESMONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



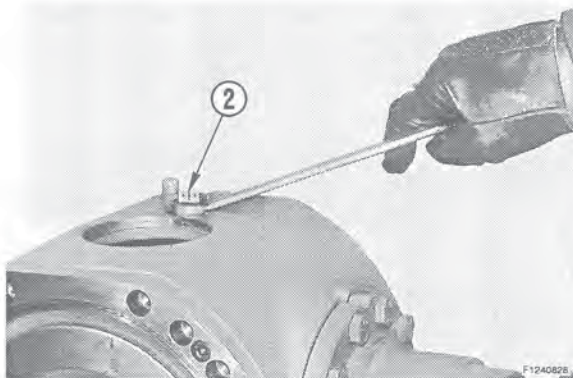
**GB** **a**

Remove the arms.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISCS».



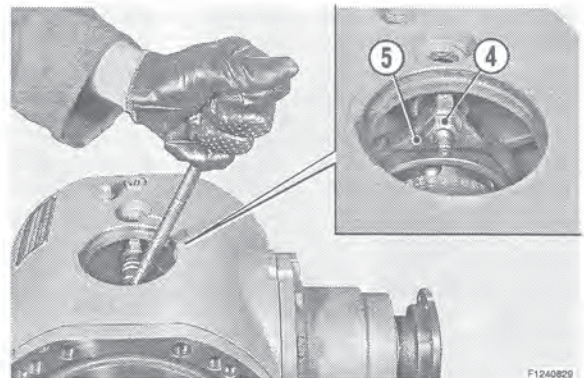
**GB** **b**

Remove the top cap (1).  
**NOTE.** The cap must be replaced each time the unit is disassembled.



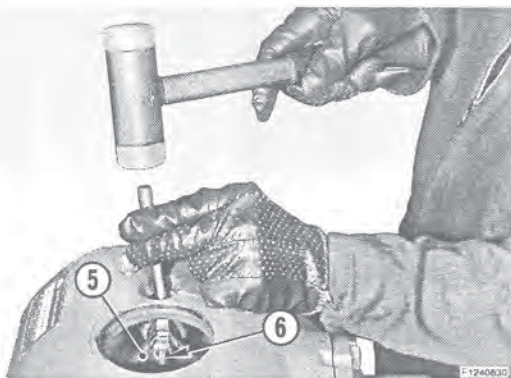
**GB** **c**

Remove the microswitch (2), signalling differential lock operation.  
**NOTE.** Check the state of the O-ring (3).



**GB** **d**

Loosen the lock nut (4) of fork (5) by about 2 turns.



**GB** **e**

Using a metal punch and a hammer, disengage fork (5) from piston cone (6).



**GB** **f**

Using two wrenches, lock piston (6) and remove nut (4).



- a**
- ITA** Asportare i bracci.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Die Arme abnehmen.  
Für weitere Einzelheiten, siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Sacar los brazos.  
Para los detalles, vease «CONTROL DESGASTE Y SOSTITUCION DISCOS FRENO».
- F** Enlever les bras.  
Pour tout détail, voir «CONTROLE DE L'USURE ET SUBSTITUTION DES DISQUES FREIN».

- c**
- ITA** Rimuovere il microinterruttore (2) di segnalazione inserimento bloccaggio differenziale.  
**NOTA.** Controllare lo stato della guarnizione OR (3).
- D** Den Mikroschalter (2) abnehmen, der den Einsatz der Differentialblockierung meldet.  
**BEMERKUNG.** Zustand des O-Rings (3) kontrollieren.
- ESP** Remover el microinterruptor (2) de señalación introducción bloqueo diferencial.  
**NOTA.** Controlar el estado de la guarnición OR (3).
- F** Enlever le microinterrupteur (2) qui signale l'insertion du blocage différentiel.  
**NOTE.** Contrôler l'état des garnitures OR (3).

- e**
- ITA** Utilizzando un punzone metallico ed un mazzuolo, sbloccare la forcella (5) dal cono del pistone (6).
- D** Mit einem Metallstift und einem Hammer die Gabel (5) von dem Kolbentrichter (6) freisetzen.
- ESP** Utilizando un punzon metalico y un martillo, bloquear l'horquilla (5) del cono del pistón (6).
- F** A l'aide d'un poussoir métallique et d'un maillet, débloquent la fourchette (5) du cône du piston (6).

- b**
- ITA** Rimuovere il tappo superiore (1).  
**NOTA.** Il tappo deve essere sostituito ad ogni smontaggio.
- D** Unterer Stopfen (1) abnehmen.  
**BEMERKUNG.** Der Stopfen muß jedesmal ausgetauscht werden, wenn er abmontiert wird.
- ESP** Remover la tapa superior (1).  
**NOTA.** La tapa debe de ser substituida a cada desmontaje.
- F** Enlever le bouchon supérieur (1).  
**NOTE.** Le bouchon doit être remplacé à chaque démontage.

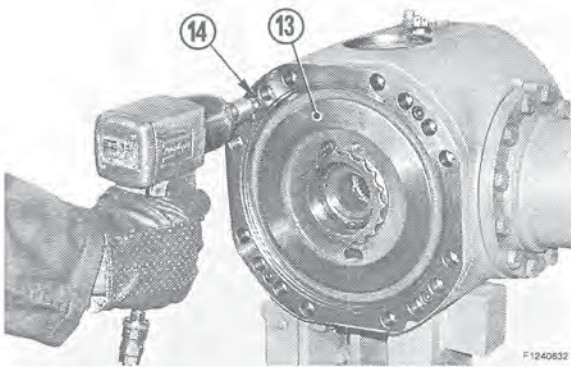
- d**
- ITA** Allentare il dado (4) di bloccaggio della forcella (5) di circa 2 giri.
- D** Mutter (4) zur Blockierung der Gabel (5) um ca. 2 Umdrehungen lockern.
- ESP** Aflojar la tuerca (4) de bloqueo de la horquilla (5) de 2 giros approx.
- F** Desserrer l'écrou (4) de blocage de la fourchette (5) d'environ 2 tours.

- f**
- ITA** Utilizzando due chiavi, bloccare il pistone (6) ed asportare il dado (4).
- D** Mit Hilfe von zwei Schlüsseln, den Kolben (6) blockieren und die Mutter (4) abnehmen.
- ESP** Utilizando dos llaves, bloquear el pistón (6) y sacar la tuerca (4).
- F** A l'aide de deux clés, bloquer le piston (6) et enlever l'écrou (4).





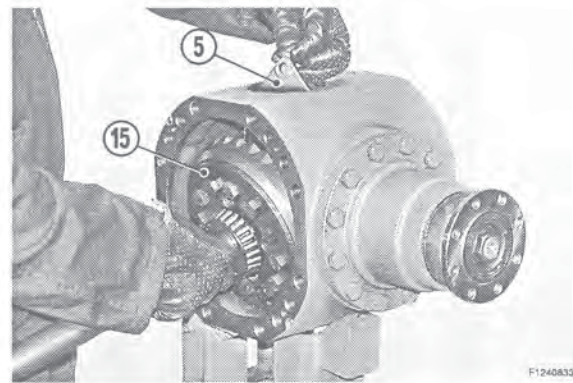
**HOW TO DISASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - SMONTAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - DESMONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



F1240832



Remove screws (14) and remove the intermediate cover (13).  
**NOTE.** Support the differential unit with a lever.



F1240833



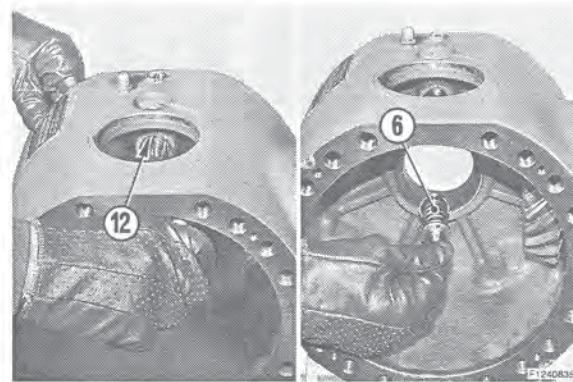
Disconnect fork (5) from piston (6). While holding the fork up, remove the differential unit (15).



F1240834



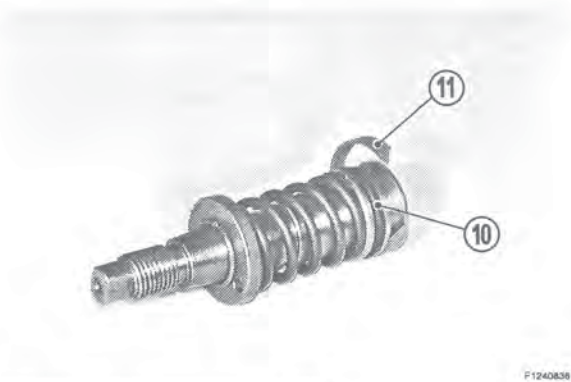
Extract fork (5).



F1240835



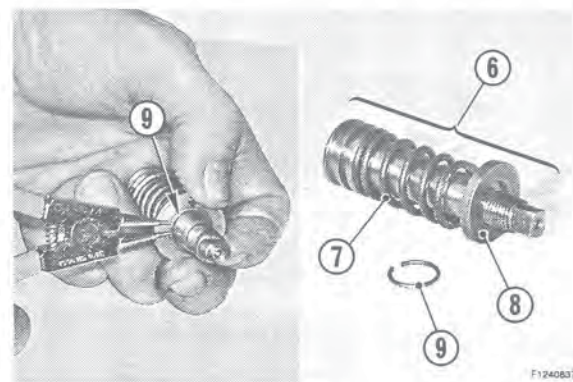
Remove snap ring (12) and whole piston (6).



F1240836



Remove guide ring (11) and O-ring (10).  
**NOTE.** The guide ring (11) and O-ring (10) must be replaced each time the unit is disassembled.



F1240837



Remove snap ring (9) and take piston unit (6) apart. Remove all component parts.



- a**
- ITA** Rimuovere le viti (14) e rimuovere il coperchio intermedio (13).  
**NOTA.** Sostenere il gruppo differenziale con una leva.
- D** Die Schrauben (14) abnehmen und den mittleren Deckel (13) entfernen.  
**BEMERKUNG.** Das Differentialaggregat mit einem Hebel stützen.
- ESP** Remover los tornillos (14) y remover la tapa intermedia (13).  
**NOTA.** Sostener el grupo diferencial con una palanca.
- F** Enlever les vis (14) puis enlever le couvercle intermédiaire (13).  
**NOTE.** Soutenir le groupe différentiel à l'aide d'un levier.

- b**
- ITA** Scollegare dal pistone (6) la forcella (5) e, tenendola sollevata, rimuovere il gruppo differenziale (15).
- D** Vom Kolben (6) die Gabel (5) abtrennen. Die anheben und des Differentialaggregat (15) entfernen.
- ESP** Desconectar del pistón (6) la horquilla y, teniéndola levantada, remover el grupo diferencial (15).
- F** Débrancher du piston (6) la fourchette (5) et en tenant cette dernière soulevée, enlever le groupe différentiel (15).

- c**
- ITA** Estrarre la forcella (5).
- D** Die Gabel (5) heraus nehmen.
- ESP** Extraer la horquilla (5).
- F** Extraire la fourchette (5).

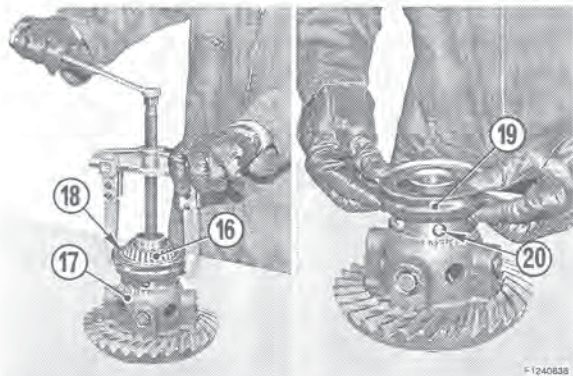
- d**
- ITA** Rimuovere l'anello elastico (12) ed il pistone completo (6).
- D** Den Kolbenring (12) und den vollständigen Kolben (6) abnehmen.
- ESP** Remover el segmento elastico (12) y el pistón completo (6).
- F** Enlever l'anneau à ressort (12) et le piston complet (6).

- e**
- ITA** Asportare l'anello di guida (11) e la guarnizione OR (10).  
**NOTA.** L'anello di guida (11) e la guarnizione (10) devono essere sostituiti ad ogni smontaggio.
- D** Den Führungsring (11) und den O-Ring (10) abnehmen.  
**BEMERKUNG.** Der Führungsring (11) und die Dichtung (10) müssen jedesmal ausgewechselt werden, wenn sie abmontiert werden.
- ESP** Sacar el segmento de guía (11) y la guarnición OR (10).  
**NOTA.** El segmento de guía (11) y la guarnición (10) deben de ser substituidos a cada desmontaje.
- F** Enlever la bague de guidage (11) et la garniture OR (10).  
**NOTE.** La bague de guidage (11) et la garniture (10) doivent être substituées à chaque démontage.

- f**
- ITA** Rimuovere l'anello elastico (9) e scomporre il gruppo pistone (6) in tutti i suoi componenti (7), (8).
- D** Den Kolbenring (9) abnehmen und das Kolbenaggregat (6) auseinander nehmen, um die Teile (7) und (8) frei zu setzen.
- ESP** Remover el segmento elastico (9) y descomponer el grupo pistón (6) en todos sus componentes (7) y (8).
- F** Enlever l'anneau à ressort (9) et désassembler le groupe piston (6) de tous ses composants (7), (8).



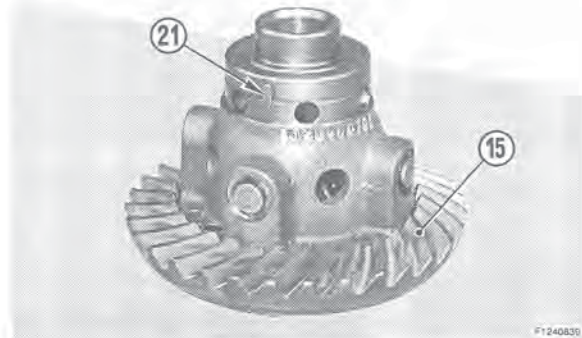
**HOW TO DISASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - SMONTAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - DESMONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



GB

a

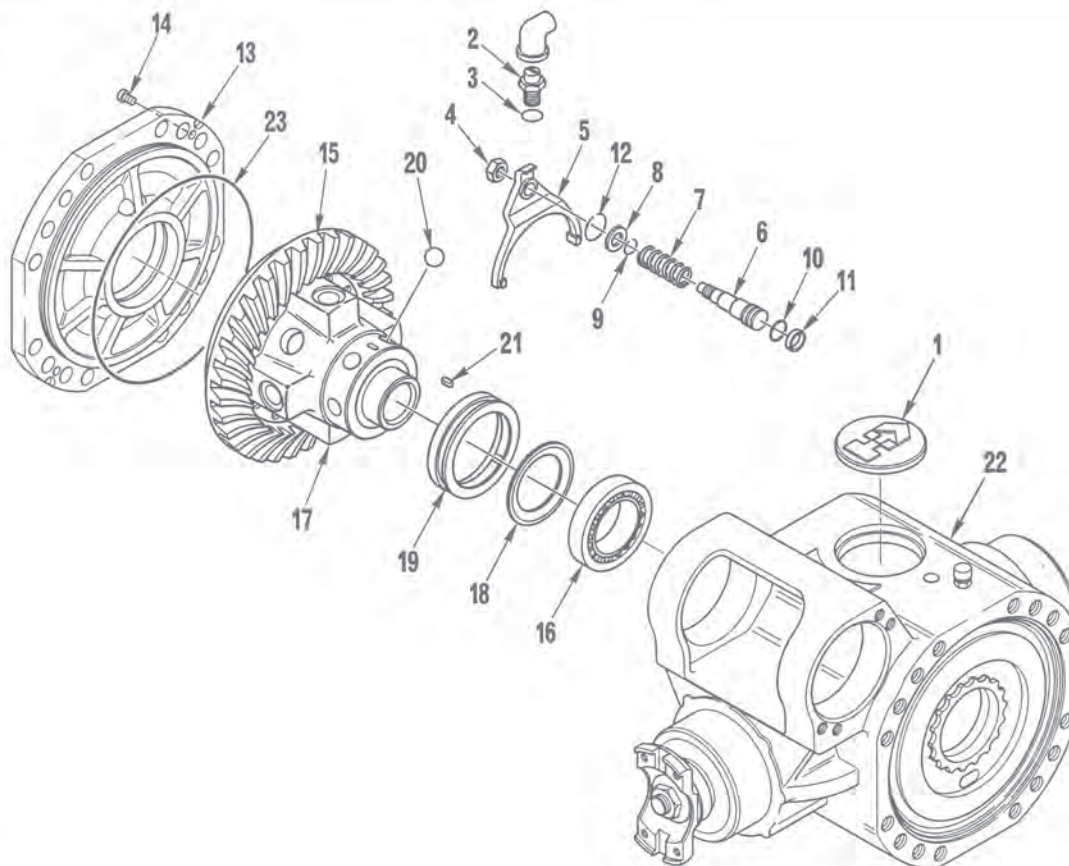
Remove bearing (16) from the differential carrier (17) as well as the stop ring (18), the coupling (19) and the spheres (20).  
**NOTE.** Note down the direction of assembly of the stop ring (18).



GB

b

**ONLY IF NECESSARY**  
Remove the coupling guide key (21) and disassemble the differential unit (15).  
(For details, see «HOW TO DISASSEMBLE THE DIFFERENTIAL UNIT».



Q1240092





SPICER CLARK-HURTH

**ITA**

Rimuovere il cuscinetto (16) dalla scatola differenziale (17), l'anello di arresto (18), il manicotto (19) e le sfere (20).

**NOTA.** Annotare il senso di montaggio dell'anello di arresto (18).

**D**

Lager (16) von der Differentialschachtel (17), den Sperring (18), die Hülse (19) und die Kugeln (20) entfernen.

**BEMERKUNG.** Montagerichtung des Sperrings (18) bemerken.

**ESP**

Remover los cojinetes (16) de la caja diferencial (17), el segmento de paro (18) el manguito (19) y las esferas (20).

**NOTA.** Anotar el sentido de montaje del segmento de paro (18).

**F**

Enlever le palier (16) du carter différentiel (17), la bague de butée (18), le manchon (19) et les sphères (20).

**NOTE.** Prendre note du sens de montage de la bague de butée (18).

**ITA**

**SOLO SE NECESSARIO**

Rimuovere la chiavetta (21) di guida del manicotto e smontare il gruppo differenziale (15).

(Per i dettagli, vedere «SMONTAGGIO GRUPPO DIFFERENZIALE»).

**D**

**NUR FALLS NOTWENDIG**

Den Keil (21) zur Führung der Hülse entfernen und das Differentialaggregat (15) abmontieren.

(Für weitere Einzelheiten, siehe «DIFFERENTIALAGGREGAT ABMONTIEREN»).

**ESP**

**SOLO SI NECESARIO**

Remover la Laave (21) de guía del manguito y desmontar el grupo diferencial (15).

Para los detalles, vease «DESMONTAJE GRUPO DIFERENCIAL».

**F**

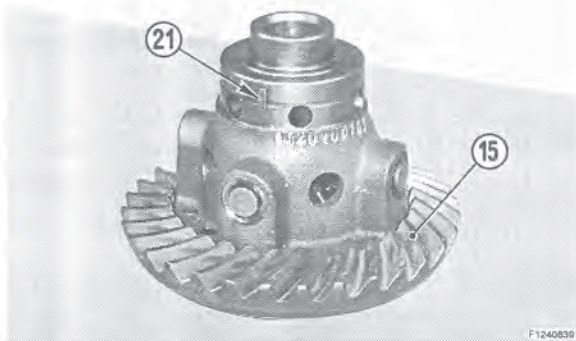
**SEULEMENT SI BESOIN**

Enlever la clavette (21) de guidage du manchon et démonter le groupe différentiel (15).

(Pour tout détail, voir «DEMONTAGE DU GROUPE DIFFERENTIEL»).



**HOW TO ASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - ASSEMBLAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG MONTIEREN - ASEMBLAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - MONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



F1240839

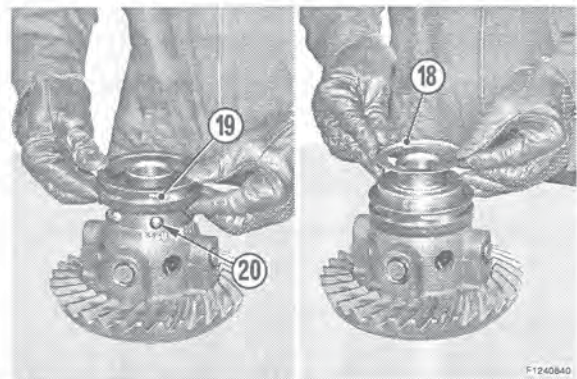


GB

a

**ONLY IF PREVIOUSLY DISASSEMBLED**

Assemble the differential unit (15).  
(For details, see «HOW TO ASSEMBLE THE DIFFERENTIAL UNIT».)  
Position the guide key (21) of coupling (19).



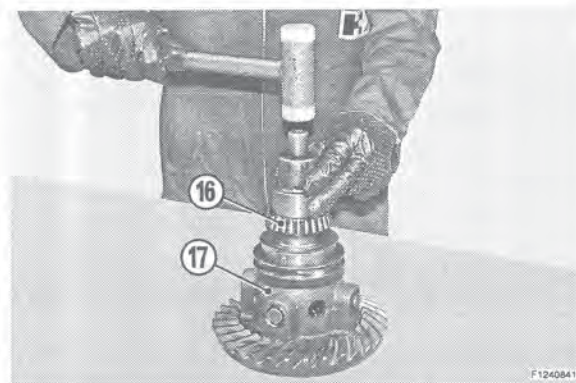
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GB

b

Install spheres (20), coupling (19) and stop ring (18).  
**NOTE.** Pay great attention to ring orientation (18).



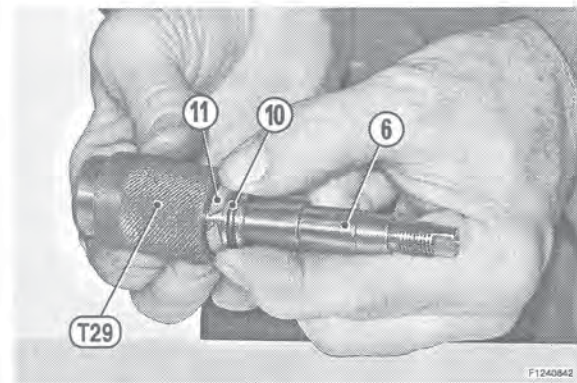
F1240841



GB

c

Fit bearing (16) onto the differential carrier (17).  
**NOTE.** Make sure that the bearing is well set in the differential carrier.



F1240842



GB

d

Fit O-ring (10) and guide ring (11) onto the piston (6). Lubricate seals and insert the assembly into tool T29.



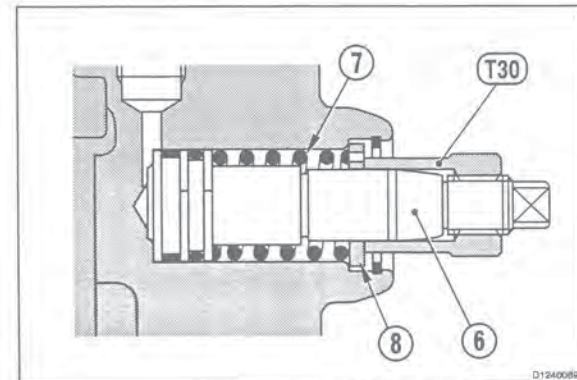
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GB

e

Insert tool T29 in the central unit (22) and push the piston (6) into the seat.  
Remove tool T29.



D1240089



GB

f

Fit spring (7) and washer (8) on the piston (6) and install tool T30.





SPICER CLARK-HURTH

**ITA** SOLO SE È STATO SMONTATO  
Assemblare il gruppo differenziale (15).  
(Per i dettagli, vedere «ASSEMBLAGGIO GRUPPO  
DIFFERENZIALE».)  
Posizionare la chiavetta (21) di guida del manicotto (19).

**D** NUR WENN ES ABMONTIERT WURDE  
Differentialaggregat (15) zusammenbauen.  
(Für weitere Einzelheiten, siehe «DIFFERENTIALAG-  
GREGAT ZUSAMMENBAUEN».)  
Den Keil (21) auf die Führung der Hülse (19) positionieren.

**ESP** SOLO SI ESTA DESMONTADO  
Assemblar el grupo diferencial (15).  
(Para los detalles, vease «ASEMBLAJE GRUPO  
DIFERENCIAL».)  
Colocar la llave (21) de guía del manguito (19).

**F** SEULEMENT SI DEMONTE  
Assembler le groupe différentiel (15).  
(Pour tout détail, voir «ASSEMBLAGE DU GROUPE  
DIFFÉRENTIEL».)  
Mettre la clavette (21) de guidage du manchon (19) en place.

**ITA** Montare le sfere (20), il manicotto (19) e l'anello di  
arresto (18).  
**NOTA.** Controllare attentamente l'orientamento del-  
l'anello (18).

**D** Die Kugeln (20), die Hülse (19) und den Sperring (18)  
montieren.

**ESP** Montar las esferas (20), el manguito (19) y el  
segmento de paro (18).  
**NOTA.** Controlar atentamente la dirección del seg-  
mento (18).

**F** Monter les sphères (20), le manchon (19) et l'anneau  
de butée (18).  
**NOTE.** Contrôler attentivement l'orientation de l'an-  
neau (18).

**ITA** Montare sulla scatola differenziale (17) il cuscinetto  
(16).  
**NOTA.** Assicurarsi che il cuscinetto vada in sicura  
battuta sulla scatola differenziale.

**D** Auf die Differentialschachtel (17) das Lager (16)  
montieren.  
**BEMERKUNG.** Sicherstellen, daß das Lager richtig in  
der Differentialschachtel anschlägt.

**ESP** Montar sobre la caja diferencial (17) el cojinete (16).  
**NOTA.** Asegurarse que el cojinete vaya seguramente  
a tope sobre la caja diferencial.

**F** Monter sur le carter du différentiel (17) le palier (16).  
**NOTE.** S'assurer que le palier aille en butée sur le  
carter du différentiel.

**ITA** Montare sul pistone (6) l'anello OR (10) e l'anello di  
guida (11). Lubrificare le guarnizioni ed inserire il  
gruppo nell'attrezzo T29.

**D** Auf den Kolben (6) den O-Ring (10) und den  
Führungsring (11) montieren. Die Dichtungen Schmie-  
ren und das Aggregat in das Werkzeug T29 setzen.

**ESP** Montar sobre el pistón (6) el segmento OR (10) y el  
segmento de guía (11). Lubricar las guarniciones y  
insertar el grupo en la herramienta T29.

**F** Monter sur le piston (6) la garniture OR (10) et la  
bague de guidage (11). Lubrifier les garnitures et  
introduire le groupe dans l'outil T29.

**ITA** Inserire l'attrezzo T29 nel corpo centrale (22) e  
spingere il pistone (6) nella sede.  
Rimuovere l'attrezzo T29.

**D** Das Werkzeug T19 in den zentralen Körper (22)  
setzen und den Kolben (6) in den Sitz drücken.  
Das Werkzeug T29 entfernen.

**ESP** Introducir la herramienta T29 en el cuerpo central (22)  
y empujar el pistón (6) en su alojamiento.  
Remover la herramienta T29.

**F** Introduire l'outil T29 dans le corps central (22) et  
pousser le piston (6) dans son siège.  
Enlever l'outil T29.

**ITA** Montare sul pistone (6) la molla (7) e la rondella (8) e  
montare l'attrezzo T30.

**D** Auf den Kolben (6) die Feder (7) und die Scheibe (8)  
montieren und das Werkzeug T30 montieren.

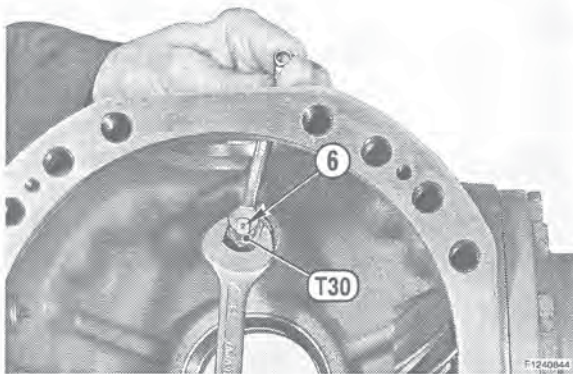
**ESP** Montar sobre el pistón (6) el muelle (7) y la arandela (8)  
y montar la herramienta T30.

**F** Monter sur le piston (6) le ressort (7) et la rondelle (8)  
puis monter l'outil T30.





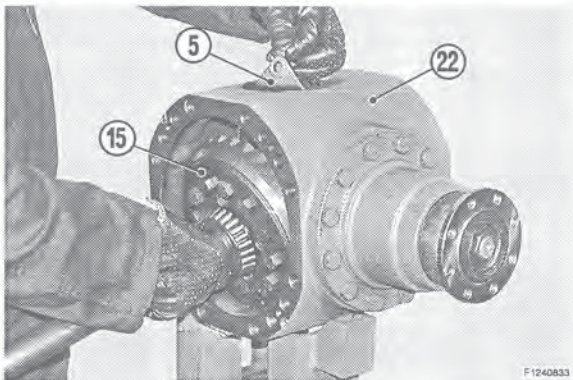
**HOW TO ASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - ASSEMBLAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG MONTIEREN - ASEMBLAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - MONTAJE BLOQUEO DIFFERENTIEL A COMMANDE HYDRAULIQUE**



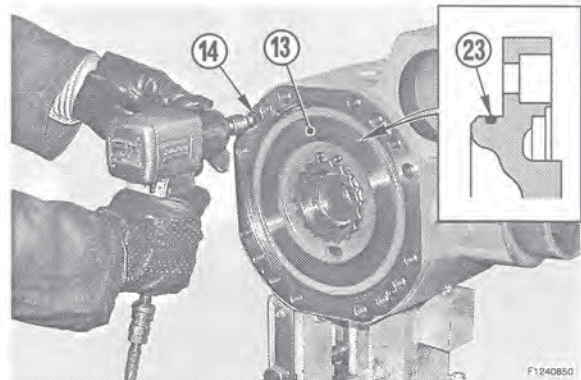
Screw tool T30 on the thread of the piston (6) to compress spring (7) and vacate the seat for introducing the snap ring (12).



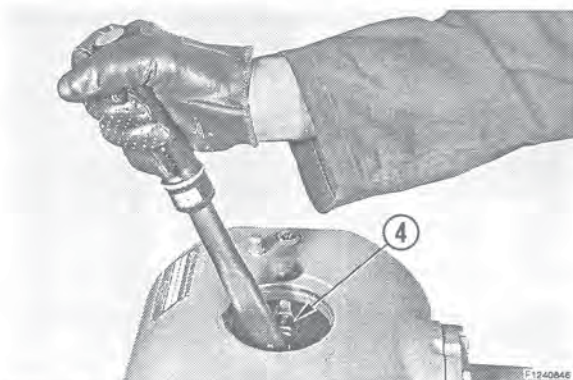
Fit the snap ring (12) of the unit.  
Remove tool T30 and fit the snap ring (9) of spring (7).



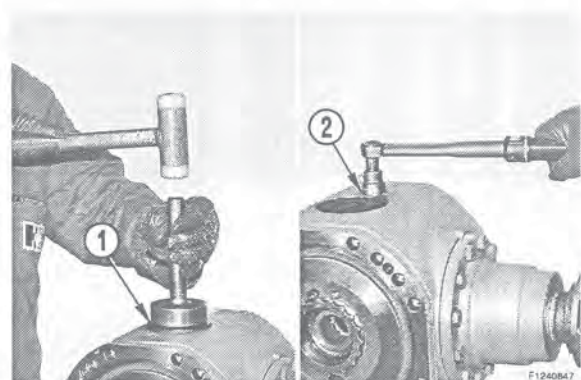
Insert the fork (5) and the differential unit (15) into the central unit (22).  
Engage the fork (5) in the coupling (19) and on the piston (6).



Fit the intermediate cover (13) and lock it with screws (14). Tighten screws using a torque wrench setting of 23.8 – 26.2 Nm.  
**NOTE.** Carefully check the state of the O-ring (23).



Fit the lock nut (4) of the fork (5) and lock it with a dynamometric wrench set to a torque of 70 – 75 Nm.



Fit the microswitch (2) complete with O-ring; torque wrench setting: max. 30 Nm.  
If necessary, adjust differential unit clearances. (see «DIFFERENTIAL UNIT ASSEMBLY».)  
Fit the top cap (1) and the arms. (For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS».)



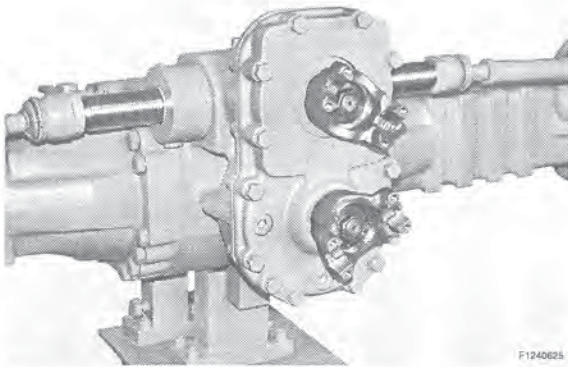


- a**
- ITA** Avvitare l'attrezzo T30 sul filetto del pistone (6) per comprimere la molla (7) e liberare la sede per l'anello elastico (12).
- D** Das Werkzeug T30 auf das Kolbengewinde (6) schrauben, um die Feder (7) zu komprimieren und den Sitz für den Kolbenring (12) freizusetzen.
- ESP** Atornillar la herramienta T30 sobre la rosca del pistón (6) para comprimir el muelle (7) y dejar libre el alojamiento para el anillo elastico (12).
- F** Visser l'outil T30 sur le filet du piston (6) pour comprimer le ressort (7) et dégager le siège pour l'anneau à ressort (12).
- b**
- ITA** Montare l'anello elastico (12) di ritegno del gruppo. Rimuovere l'attrezzo T30 e montare l'anello elastico (9) di ritegno molla (7).
- D** Den Kolbenring (12) zur Halterung des Aggregats montieren.  
Das Werkzeug T30 abnehmen und den Kolbenring (9) zur Halterung der Feder (7) montieren.
- ESP** Montar el segmento elastico (12) de compresión del grupo.  
Remover la herramienta T30 y montar el segmento elastico (9) de compresión muelle (7).
- F** Monter l'anneau à ressort (12) de retenue du groupe. Enlever l'outil T30 et monter l'anneau à ressort (9) de retenue ressort (7).
- c**
- ITA** Inserire nel corpo centrale (22) la forcella (5) ed il gruppo differenziale (15). Impegnare la forcella (5) nel manicotto (19) e sul pistone (6).
- D** In den zentralen Körper (22) die Gabel (5) und das Differentialaggregat (15) einsetzen. Die Gabel (5) in der Hülse (19) und auf den Kolben (6) einsetzen.
- ESP** Introducir en el cuerpo (22) la horquilla (5) y el grupo diferencial (15). Insertar la horquilla (5) en el manguito (19) y sobre el pistón (6).
- F** Introduire dans le corps central (22) la fourchette (5) et le groupe différentiel (15). Engager la fourchette (5) dans le manchon (19) puis sur le piston (6).
- d**
- ITA** Montare il coperchio intermedio (13) e bloccarlo con le viti (14) serrate con una coppia di 23,8÷26,2 Nm.  
**NOTA.** Controllare attentamente la condizione dell'anello OR (23).
- D** Den mittleren Deckel (13) montieren und mit den Schrauben (14) mit einem Anzugsmoment von 23,8÷26,2 Nm blockieren.  
**BEMERKUNG.** Zustand des O-Ringes (23) sorgfältig kontrollieren.
- ESP** Montar la tapa intermedia (13) y bloquearla con tornillos (14) apretadas con un par de 23,8÷26,2 Nm.  
**NOTA.** Controlar con cuidado la condición del segmento OR (23).
- F** Monter le couvercle intermédiaire (13) et bloquer celui-ci avec les vis (14) serrées à un couple de 23,8÷26,2 Nm.  
**NOTE.** Contrôler attentivement l'état de la garniture OR (23).
- e**
- ITA** Montare il dado (4) di ritegno forcella (5) e bloccarlo con una chiave dinamometrica tarata ad una coppia di 70÷75 Nm.
- D** Die Mutter (4) zur Halterung der Gabel (5) montieren und mit einem Momentenschlüssel und einem Anzugsmoment von 70÷75 Nm blockieren.
- ESP** Montar la tuerca (4) de compresión horquilla (5) y bloquearla con un llave dinamometrica tarada a un par de 70÷75 Nm.
- F** Monter l'écrou (4) de fixation fourchette (5) et bloquer celui-ci à l'aide d'une clé dynamométrique calibrée à un couple de 70÷75 Nm.
- f**
- ITA** Montare il microinterruttore (2) completo di guarnizione OR; coppia di serraggio: max. 30 Nm.  
Se necessario, registrare i giochi differenziale. (Vedere «ASSEMBLAGGIO DIFFERENZIALE».)  
Montare il tappo superiore (1) ed i bracci. (Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».)
- D** Die Mikroschalter (2) samt O-Ring montieren. Anzugsmoment: max. 30 Nm.  
Wenn nötig, die Differentialspiele einstellen (Siehe «DIFFERENTIAL ZUSAMMENBAUEN»). Den unteren Stopfen (1) und die Arme montieren. (Für weitere Einzelheiten, siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».)
- ESP** Montar el microinterruptor (2) completo de guarnición OR; par de torsión: max. 30 Nm.  
Si necesario, registrar los juegos diferenciales. (Véase «ASEMBLAGE DIFFERENCIAL».)  
Montar la tapa superior (1) y los ejes. (Para los detalles, véase «CONTROL DESGASTE Y SOSTITUCION DISCOS FRENO».)
- F** Monter le microinterrupteur (2) équipé de garniture OR; couple de serrage: max. 30 Nm.  
Si besoin, régler les jeux du différentiel (Voir «ASSEMBLAGE DU DIFFERENTIEL»). Monter le bouchon supérieur (1) et les bras. (Pour tout détail, voir «CONTROLE DE L'USURE ET SUBSTITUTION DES DISQUES FREIN».)





HOW TO DISASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - SMONTAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER ABMONTIEREN (602) - DESMONTAJE REDUCTOR ENCORPORADO Y PINON (602) - DESMONTAJE REDUCTEUR INTEGRE (602)



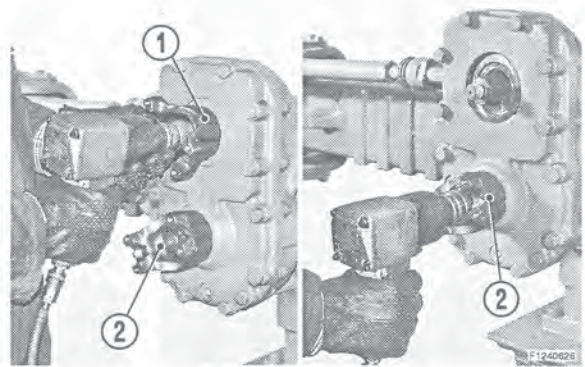
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GB

a

The figure shows the axle with incorporated reduction gear with Mechanic flanges; disassembly and assembly procedures also apply to DIN flanges.

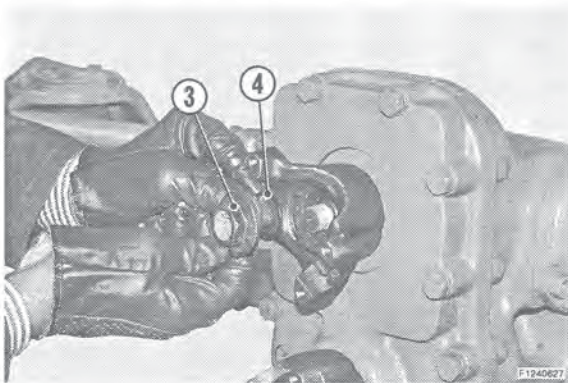


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b

Unloose the check nuts on upper (1) and lower (2) flange.



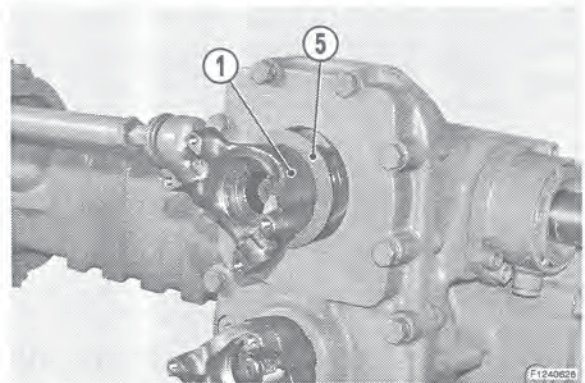
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GB

c

Draw out nuts (3) and O-rings (4).



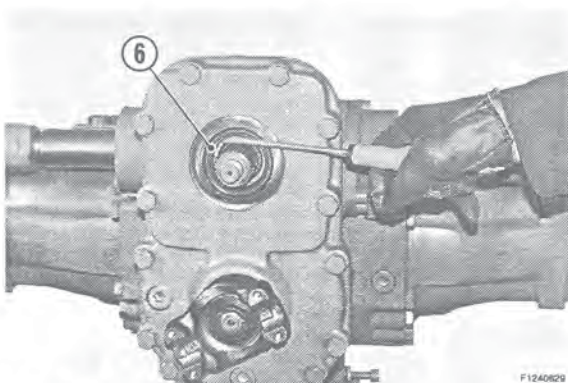
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d

Remove the upper flange (2) together with dust ring (5).



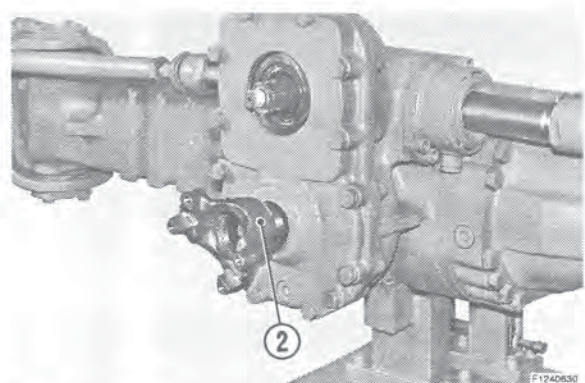
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e

Remove the snap ring (6) and discard it.



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GB

f

Remove the lower flange (2)

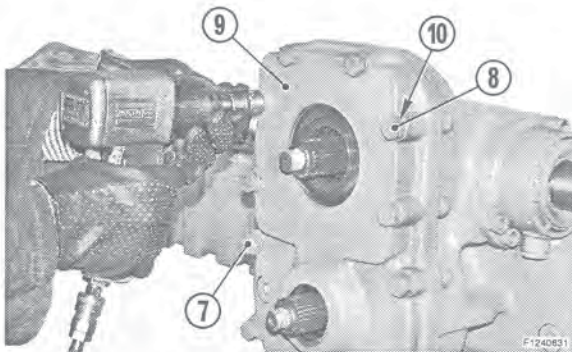


- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> La figura illustra l'assale con riduttore incorporato, con flange Mechanic; lo smontaggio e l'assemblaggio sono uguali anche per le flange DIN.</p> <p><b>D</b> Die Abbildung zeigt die Achse mit eingebautem Reduzierer und Mechanic Flanschen; das Abmontieren und Zusammenbauen erfolgt wie für die Flanschen DIN.</p> <p><b>ESP</b> La figura ilustra el eje con reductor incorporado, con bridas Mechanic; el desmontaje y el ensamblaje son iguales también por las bridas DIN.</p> <p><b>F</b> La figure illustre l'essieu à réducteur incorporé, avec Flaque Mechanic; le démontage et l'assemblage sont pareils même pour les flasques DIN.</p> | <p><b>b</b></p> <p><b>ITA</b> Allentare i dadi di ritegno delle flange superiore (1) ed inferiore (2).</p> <p><b>D</b> Befestigungsmuttern der oberen Flanschen (1) und der unteren Flanschen (2) lockern.</p> <p><b>ESP</b> Aflojar las tuercas de retención de las bridas superior (1) y inferior (2).</p> <p><b>F</b> Desserrer les écrous de fixation des flasques supérieures (1) et inférieures (2).</p> |
| <p><b>c</b></p> <p><b>ITA</b> Asportare i dadi (3) e le guarnizioni OR (4).</p> <p><b>D</b> Muttern (3) abschrauben und O-Ringe (4) abnehmen.</p> <p><b>ESP</b> Sacar las tuercas (3) y las guarniciones OR (4).</p> <p><b>F</b> Enlever les écrous (3) et les garnitures OR (4).</p>                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>d</b></p> <p><b>ITA</b> Rimuovere la flangia superiore (1) completa di anello parapolvere (5).</p> <p><b>D</b> Den oberen Flansch (1) samt Staabdichtungsring (5) abnehmen.</p> <p><b>ESP</b> Remove the brida superior (1) completa de segmento parapolveres (5).</p> <p><b>F</b> Enlever la flasque supérieure (1) équipée d'anneau anti-poussière (5).</p>                                            |
| <p><b>e</b></p> <p><b>ITA</b> Rimuovere l'anello di tenuta (6) e scartarlo.</p> <p><b>D</b> Kolbenring (6) abnehmen und entsorgen.</p> <p><b>ESP</b> Remove the segmento de compresion (6) y descartarlo.</p> <p><b>F</b> Enlever la bague d'étanchéité (6) et la jeter.</p>                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>f</b></p> <p><b>ITA</b> Rimuovere la flangia inferiore (2).</p> <p><b>D</b> Unteren Flansch abnehmen (2).</p> <p><b>ESP</b> Remove the brida inferior (2).</p> <p><b>F</b> Enlever la flasque inférieure (2).</p>                                                                                                                                                                                        |

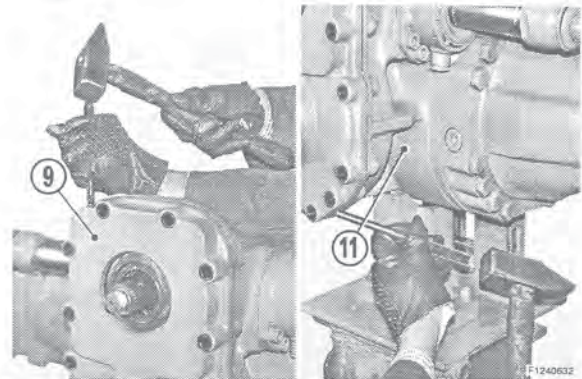




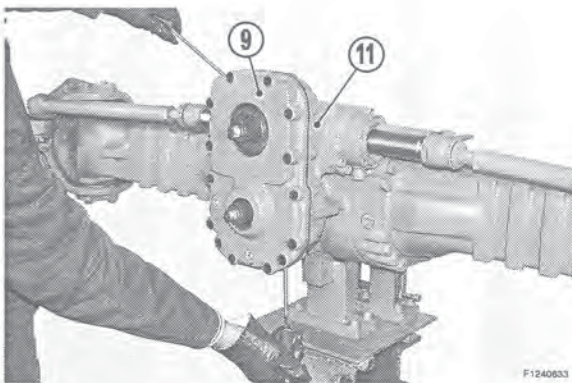
**HOW TO DISASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - SMONTAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER ABMONTIEREN (602) - DESMONTAJE REDUCTOR ENCORPORADO Y PINON - DESMONTAJE REDUCTEUR INTEGRE (602)**



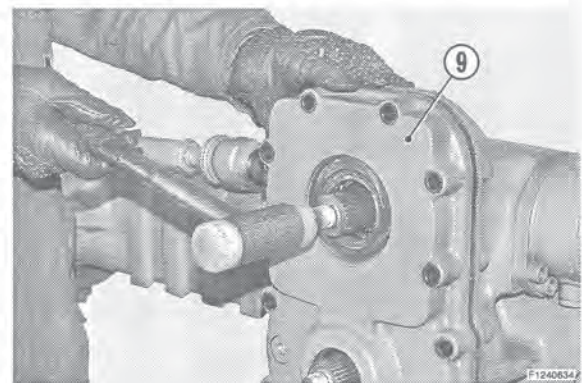
Remove check screws (7), (8) and relative washers (10) from cover (9).



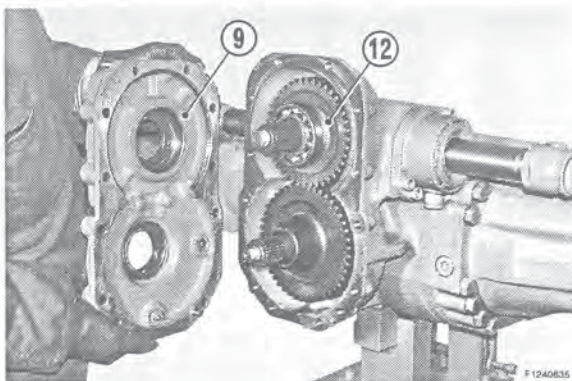
In turn, insert a punch in the slots provided and, tapping lightly with a hammer, separate the cover (9) from the body of the reduction gear (11).



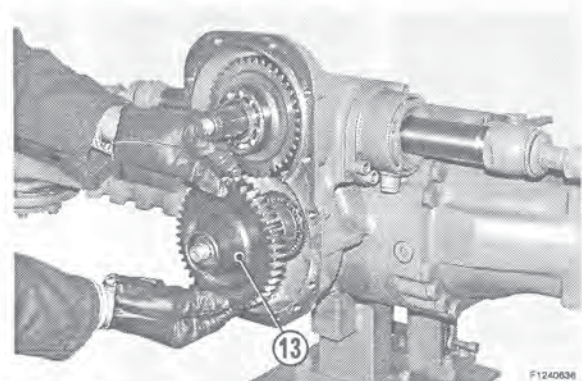
Insert two levers in the provided slots and move the cover (9) away from the body of the reduction gear (11).



Lightly tap with a hammer to disengage cover (9) from upper gear (12).



Draw out cover (9) and remove any sealant left.



Remove lower gear (13).



- a**
- ITA** Rimuovere le viti (7), (8) di ritegno del coperchio (9) e le relative rondelle (10).
- D** Befestigungsschrauben (7) und (8) des Deckels (9) mit den Unterlegscheiben (10) abschrauben.
- ESP** Remover los tornillos (7), (8) de retencion de la tapa (9) y las relativas arandelas (10).
- F** Enlever les vis (7), (8) de fixation du couvercle (9) et ses relatives rondelles (10).

- b**
- ITA** Inserire alternativamente nelle cave predisposte uno spintore **a**, con leggeri colpi di martello, separare il coperchio (9) dal corpo riduttore (11).
- D** Abwechselnd, in die Nuten einen Stößel stecken und diesen mit einem Hammer leicht schlagen, bis sich der Deckel (9) vom Reduziererkörper (11) löst.
- ESP** Introducir alternativamente en los orificios propuestas un empuje y, con ligeros golpes de martillo, separar la tapa (9) del cuerpo reductor (11).
- F** Introduire alternativement dans les creux prédisposés un poussoir et, à l'aide de légers coups de maillet, séparer le couvercle (9) du corps réducteur (11).

- c**
- ITA** Inserire due leve nelle cave predisposte ed allontanare il coperchio (9) dal corpo riduttore (11).
- D** Zwei Hebel in die Nuten stecken und den Deckel (9) vom Reduziererkörper (11) abheben.
- ESP** Introducir dos palancas en los orificios propuestas un empuje y alejar la tapa (9) del cuerpo reductor (11).
- F** introduire deux leviers dans les creux prédisposés et éloigner le couvercle (9) du corps réducteur (11).

- d**
- ITA** Battere leggeri colpi con un mazzuolo per disimpegnare il coperchio (9) dall'ingranaggio superiore (12).
- D** Mit leichten Hammerschlägen, den Deckel (9) vom oberen Zahnrad (12) trennen.
- ESP** Golpear con ligeros golpes con un martillo para desconectar la tapa (9) del engranaje superior (12).
- F** Donner de légers coups de maillet pour dégager le couvercle (9) de l'engrenage supérieur (12).

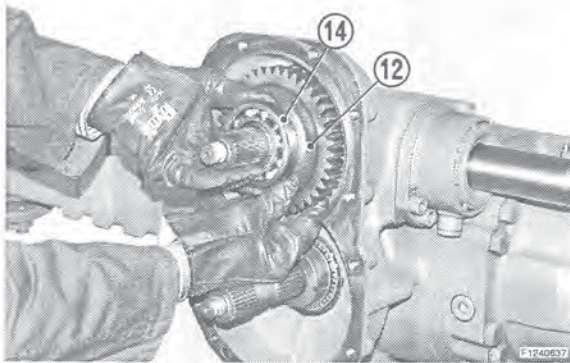
- e**
- ITA** Asportare il coperchio (9) e rimuovere ogni traccia di sigillante.
- D** Deckel (9) abnehmen und Dichtungsmaße vollständig entfernen.
- ESP** Introducir la tapa (9) y remover cada mancha de cola.
- F** Enlever le couvercle (9) et nettoyer toute trace de colle.

- f**
- ITA** Asportare l'ingranaggio inferiore (13).
- D** Das untere Zahnrad (13) entfernen.
- ESP** Sacar el engranaje inferior (13).
- F** Enlever l'engrenage inférieur (13).

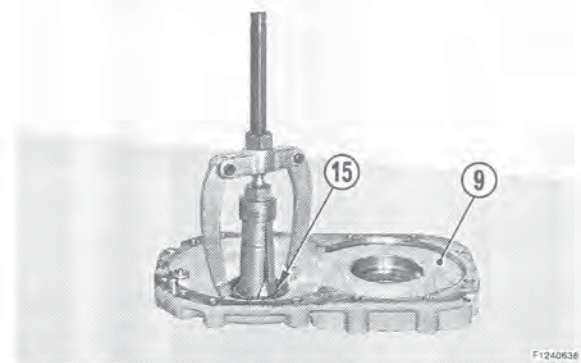




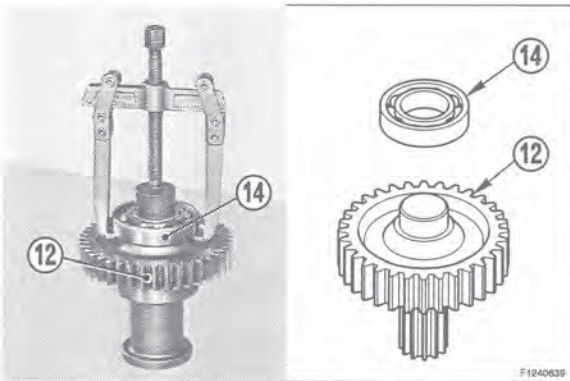
**HOW TO DISASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - SMONTAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER ABMONTIEREN (602) - DESMONTAJE REDUCTOR ENCORPORADO Y PINON - DESMONTAJE REDUCTEUR INTEGRE (602)**



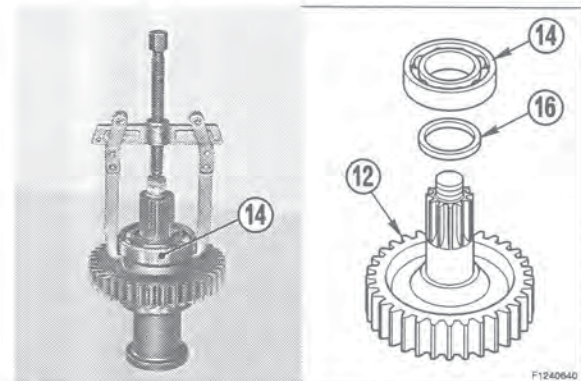
Remove upper gear assembly (12) complete with bearings (14).



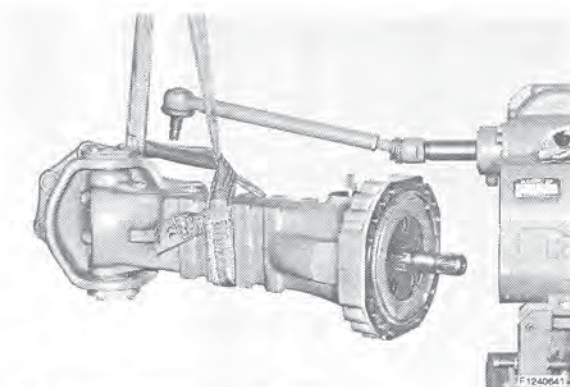
Using a puller, remove snap ring (15) from cover (9) and discard it.  
**NOTE.** Note down direction of installation.



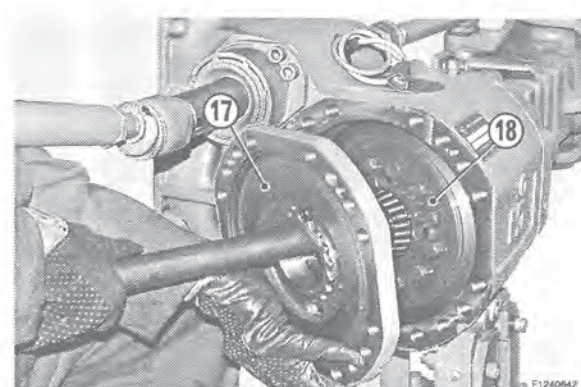
Remove inner bearing (14) from gear assembly (12).



Remove outer bearing (14) and distance piece (16).



Disjoin from the steering case the steering bar located by the side of the intermediate cover (17).  
Remove the complete arm.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISCS».



Remove the intermediate cover (17) and the whole differential unit (18).  
For details, see «HOW TO REMOVE THE DIFFERENTIAL UNIT».



- a**
- ITA** Rimuovere il gruppo ingranaggio superiore (12) completo di cuscinetti (14).
- D** Das obere Zahnradaggregat (12) samt Lager (14) entfernen.
- ESP** Remover el grupo engranaje superior (12) completo de cojinetes (14).
- F** Enlever le groupe engrenage supérieur (12) équipé des paliers (14).

- b**
- ITA** Utilizzando un estrattore, rimuovere dal coperchio (9) l'anello di tenuta (15) e scartarlo.  
**NOTA.** Annotare il senso di montaggio.
- D** Mit einem Abzieher, vom Deckel (9) den Kolbenring (15) abnehmen und entsorgen.  
**BEMERKUNG.** Auf die Montagerichtung achten.
- ESP** Utilizando un extractor, remover la tapa (9) el segmento de compresion (15) y descartarlo.  
**NOTA** Anotar el sentido de montaje.
- F** A l'aide de l'extracteur, enlever le couvercle (9) la bague d'étanchéité (15) et l'éliminer.  
**NOTE.** Prendre note du sens de montage.

- c**
- ITA** Rimuovere dal gruppo ingranaggio (12) il cuscinetto interno (14).
- D** Vom Zahnradaggregat (12) das innere Lager (14) abnehmen.
- ESP** Remover del grupo engranaje (12) el cojinete interior (14).
- F** Enlever le groupe engrenage (12) le palier interne (14).

- d**
- ITA** Rimuovere il cuscinetto esterno (14) ed il distanziale (16).
- D** Das äußere Lager (14) und das Distanzstück (16) entfernen.
- ESP** Remover el cojinete exterior (14) y el distancial (16).
- F** Enlever le palier (14) et l'entretoise (16).

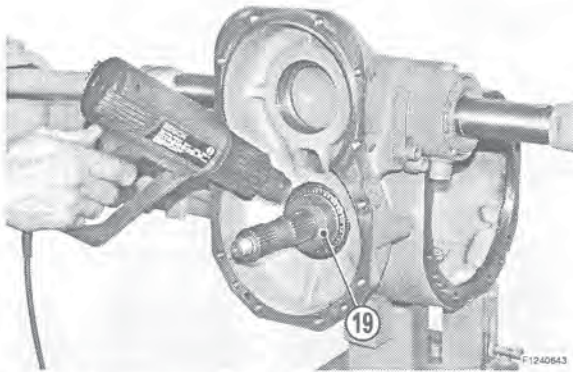
- e**
- ITA** Scollegare dalla scatola snodo la barra di sterzata del lato del coperchio intermedio (17).  
Rimuovere il braccio completo.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Vom Gelenkgehäuse die Lenkstange an der Seite des mittleren Deckels (17) abmontieren.  
Den ganzen Arm abnehmen.  
Weitere Einzelheiten im Paragraph «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Desconectar del carter de las rotulas la barra de direccion del lado de la tapa intermedia (17).  
Remover el brazo completo.  
Para los detalles, vease «CONTROL DESGASTE Y SUBSTITUCION DISCOS FRENO».
- F** Débrancher la boîte d'articulation de la barre de braquage du côté couvercle intermédiaire (17).  
Enlever le bras complet.  
Pour les détails, voir «CONTROLE USURE ET SUBSTITUTION DES DISQUES FREINS».

- f**
- ITA** Rimuovere il coperchio intermedio (17) ed il differenziale completo (18).  
Per i dettagli, vedere «RIMOZIONE GRUPPO DIFFERENZIALE».
- D** Den mittleren Deckel (17) und das ganze Differential (18) abnehmen.  
Weitere Einzelheiten im Paragraph «DIFFERENTIALLAGGREGAT ABNEHMEN».
- ESP** Remover la tapa intermedia (17) y el diferencial completo (18).  
Por los detalles, vease «REMOVER GRUPO DIFERENCIAL».
- F** Enlever le couvercle intermédiaire (17) et le différentiel complet (18).  
Pour les détails, voir «DEPOSE DU GROUPE DIFFERENTIEL».

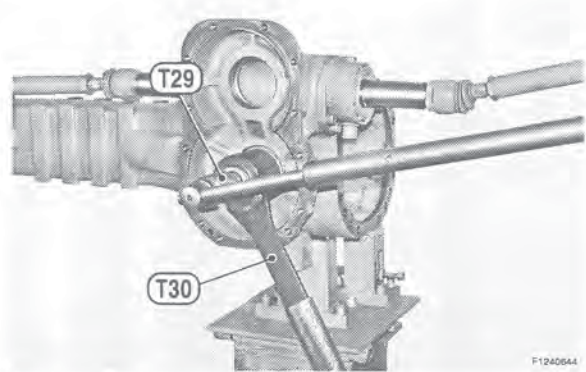




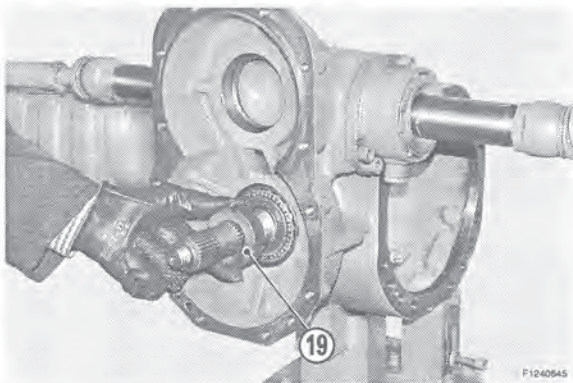
**HOW TO DISASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - SMONTAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER ABMONTIEREN (602) - DESMONTAJE REDUCTOR ENCORPORADO Y PINON - DESMONTAJE REDUCTEUR INTEGRE (602)**



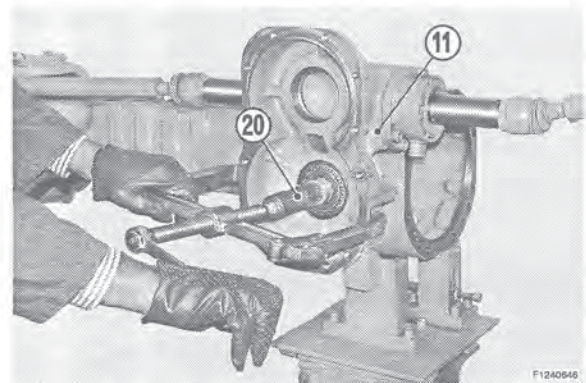
**a** **GB** Heat the ring nut (19) at approx. 80°C.



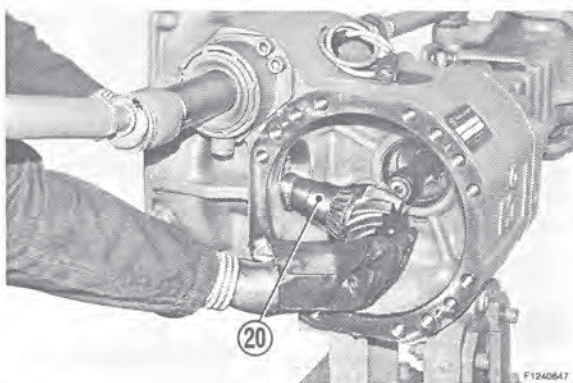
**b** **GB** Engage special wrench T30 on the ring nut (19) and apply bar-hold T29 on the pinion (20).



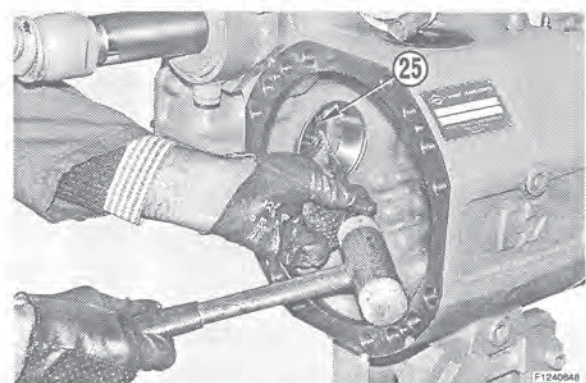
**c** **GB** Remove ring nut (19)



**d** **GB** Using a puller, extract pinion (20) complete with inner bearing (21), distance piece (22) and distance washers.  
**NOTE.** The thrust blocks of the bearings remain in the central body (11).



**e** **GB** Remove the complete pinion (20).  
**NOTE.** Carefully check and note direction of installation of distance piece.



**f** **GB** Using a punch and a hammer, extract the snap ring (25).  
**NOTE.** Note direction of installation of snap ring (24).

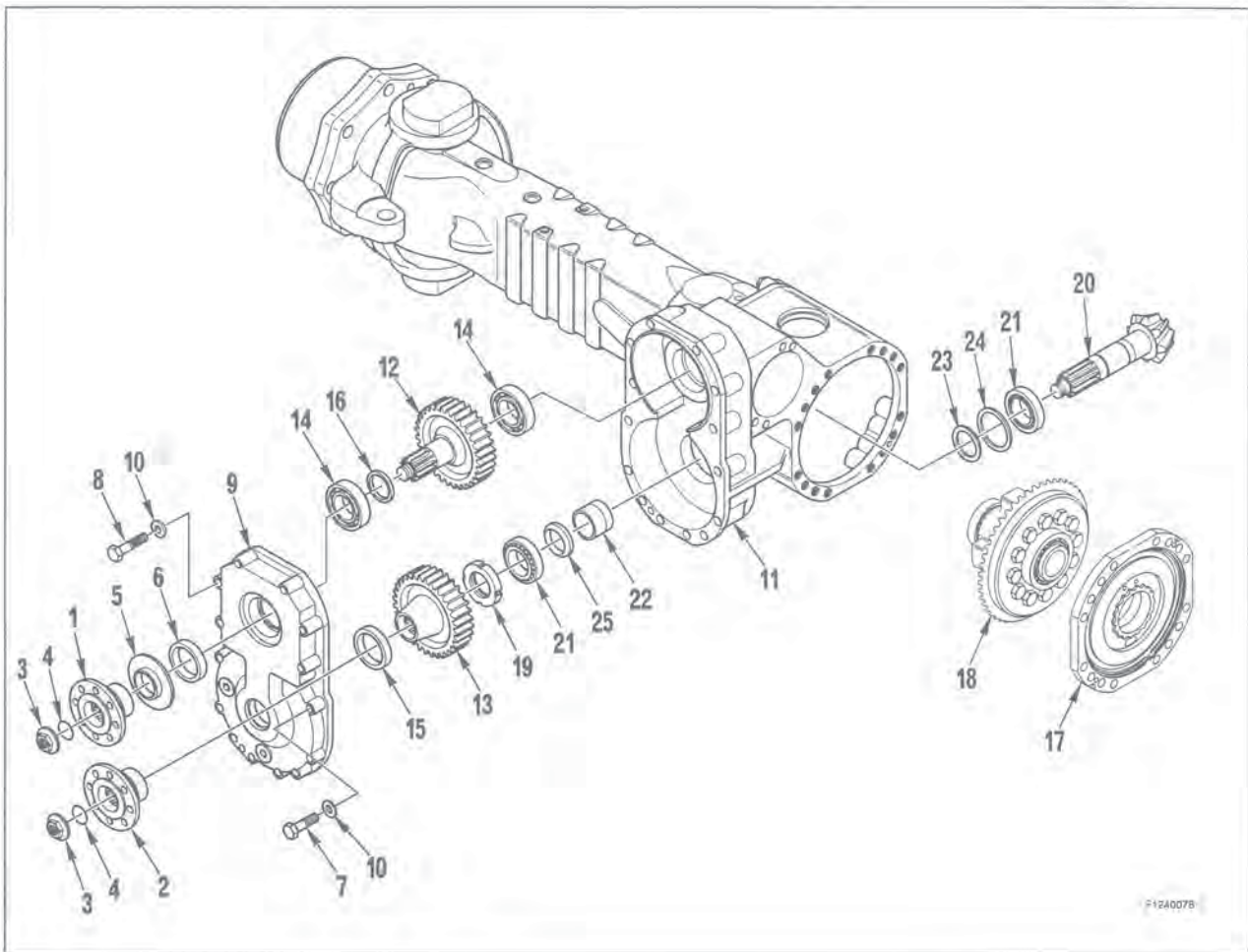




- a**
- ITA** Scaldare a circa 80°C la ghiera (19).
- D** Nutmutter (19) bis auf ca. 80°C erwärmen.
- ESP** Calentar hasta aproximadamente 80°C la virola (19).
- F** Chauffer l'anneau (19) à environ 80°C.
- b**
- ITA** Impegnare la chiave speciale T30 sulla ghiera (19) ed applicare sul pignone (20) il codolo T29. Fermare la chiave T30 e ruotare il pignone (20) per allentare la ghiera (19).
- D** Spezialschlüssel T30 in die Nutmutter (19) stecken und auf das Rad (20) den Schaft T29 anbringen. Den Schlüssel T30 festhalten und das Rad (20) drehen, um die Nutmutter (19) zu lockern.
- ESP** Empenar la llave especial T30 sobre la virola (19) y aplicar sobre el pinon (20) el mango T29. Parar la llave T30 y girar el pinon (20) para aflojar la virola (19).
- F** Engager la clé spéciale T30 sur l'anneau de fixation (19) et appliquer sur le pignon (20) l'embout T29. Arrêter la clé T30 et tourner le pignon (20) pour desserrer l'anneau de fixation (19).
- c**
- ITA** Asportare la ghiera (19).
- D** Nutmutter (19) entfernen.
- ESP** Sacar la virola (19).
- F** Enlever l'anneau (19).
- d**
- ITA** Utilizzando un estrattore, estrarre il pignone (20) completo del cuscinetto interno (21), del distanziale (22) e degli spessori (23) e (24).  
**NOTA.** Le ralle dei cuscinetti rimangono nel corpo centrale (11).
- D** Mit einem Abzieher, Rad (20) samt inneres Lager (21), Distanzstück (22) und Unterlegscheiben (23) und (24) herausnehmen.
- BEMERKUNG.** die Scheiben der Lager bleiben im Zentralkörper (11) sitzen.
- ESP** Utilizando un extractor, extraer el pinon (20) completo de cojinete interno (21), del distancial (22) y de los espesores (23) y (24).  
**NOTA.** Las ranuras de los cojinetes quedan en el cuerpo central (11).
- F** A l'aide d'un extracteur extraire le pignon (20) équipé de palier interne (21), de l'entretoise (22) et des cales (23) et (24).  
**NOTE.** Les crapaudines des paliers demeurant dans le corps central (11).
- e**
- ITA** Rimuovere il pignone completo (20).  
**NOTA.** Controllare attentamente ed annotare il senso di montaggio del distanziale (22).
- D** Das gesamte Rad (20) abnehmen.  
**BEMERKUNG.** Sorgfältig die Montagerichtung des Distanzstückes (22) kontrollieren.
- ESP** Remover el pinon completo (20).  
**NOTA.** Controlar con cuidado y anotar el sentido de montaje del distancial (22).
- F** Enlever le pignon complet (20).  
**NOTE.** Contrôler attentivement et prendre note du sens de montage de l'entretoise (22).
- f**
- ITA** Utilizzando uno spintore ed un mazzuolo, estrarre l'anello di tenuta (25).  
**NOTA.** Annotare il senso di montaggio dell'anello di tenuta (24).
- D** Mit einem Stößel und einem Hammer, den Kolbenring (25) herausnehmen.  
**BEMERKUNG.** Montagerichtung des Kolbenrings (24) beachten.
- ESP** Utilizando un empuje y un martillo, extraer el segmento de compresion (25).  
**NOTA.** Anotar el sentido de montaje del segmento de compresion (24).
- F** A l'aide d'un poussoir et d'un maillet, extraire la bague d'étanchéité (25).  
**NOTE.** Prendre note du sens du montage de la bague d'étanchéité (24).



HOW TO DISASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - SMONTAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER ABMONTIEREN (602) - DESMONTAJE REDUCTOR ENCORPORADO Y PINON - DESMONTAJE REDUCTEUR INTEGRE (602)







SPICER CLARK-HURTH

**GB**

**CAUTION!** 1- If disassembly has been carried out only as a means to replace the snap ring (24), position the new ring and reassemble the unit by keeping to the torque wrench settings indicated in the following section and using the prescribed locking products.

2- If disassembly is carried out in order to replace crown wheel and pinion, bearings, or planetary gear, break up distance washers and calculate clearances as indicated in the sections regarding removal, disassembly, assembly and installation of differential unit and bevel pinion.

**ITA**

**ATTENZIONE!** 1- Se lo smontaggio è stato eseguito solo per la sostituzione dell'anello di tenuta (24), procedere al posizionamento del nuovo anello e rimontare il gruppo rispettando le coppie di serraggio indicate nel paragrafo seguente ed utilizzando i prodotti di bloccaggio prescritti.

2- Se lo smontaggio viene eseguito per la sostituzione della coppia conica, dei cuscinetti o degli ingranaggi satelliti, procedere alla scomposizione ed alla ricerca degli spessori e dei giochi come indicato nei paragrafi riguardanti la rimozione, lo smontaggio, l'assemblaggio e l'installazione del differenziale e del pignone conico.

**D**

**ACHTUNG!** 1- Falls die Teile nur abmontiert worden sind, um den Kolbenring (24) auszuwechseln, den neuen Kolbenring einsetzen und das Aggregat wieder zusammenbauen; dabei die im nachfolgenden Paragraph angegebene Anzugsmomente beachten und die vorgeschriebenen Befestigungsprodukte verwenden.

2- Falls die Teile abmontiert worden sind, um den Kegelradtrieb, die Lager oder die Planetengetriebe auszuwechseln, die Unterlegscheiben auseinander nehmen und die Spiele beachten, die in den Paragraphen zum Entfernen, Abmontieren, Zusammenbau und zur Installation des Differentials und des Kegelrads angegeben sind.

**ESP**

**CUIDADO!** 1- Si el desmontaje ha sido efectuado solo por la sustitución del segmento de compresión (24), remontar el grupo respetando los pares de torsión indicadas en el capítulo siguiente y utilizando los productos de bloque descritos.

2- Si el desmontaje viene efectuado para la sustitución del par conico, de los cojinetes o de los engranajes satélites, proceder a la descomposición y a la búsqueda de los espesores y de los juegos como indicados en los capítulos concernientes la remoción, el desmontaje, el ensamblaje y la instalación del diferencial y del pinón conico.

**F**

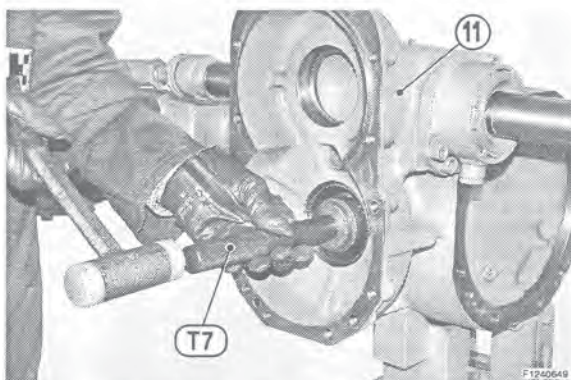
**ATTENTION!** 1- Si le démontage n'a eu lieu que pour la substitution de la bague d'étanchéité (24), positionner la bague d'étanchéité et remonter le groupe en respectant les couples de serrage indiqués dans le paragraphe suivant et en utilisant les produits de blocage préconisés.

2- Si le démontage a lieu pour substituer le couple conique, les paliers ou les engrenages satellites, désassembler et rechercher les cales et les jeux comme indiqué dans les paragraphes ayant trait à la dépose, au démontage, à l'assemblage et à l'installation du différentiel et du pignon conique.



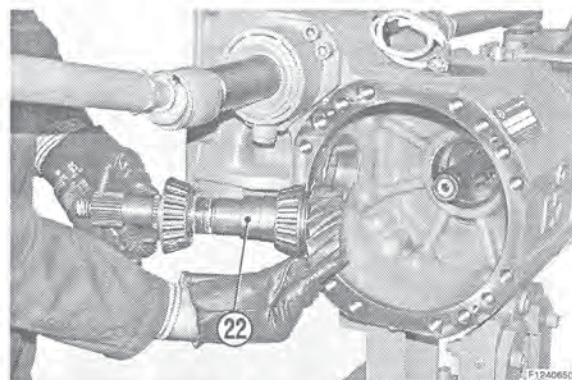


HOW TO ASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - ASSEMBLAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER MONTIEREN (602) - ASEMBLAJE REDUCTOR INCORPORADO Y PINON - MONTAJE REDUCTEUR INTEGRE (602)



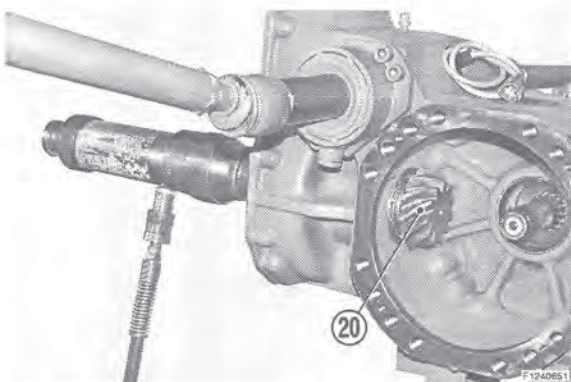
Find the value of the distance washers (23) and (24) and insert the thrust blocks of the conical bearing of the pinion into the body of the reduction gear (11) (See «HOW TO INSTALL AND ADJUST THE BEVEL PINION»).

Using tool T7 insert the snap ring (25) previously lubricated with grease.

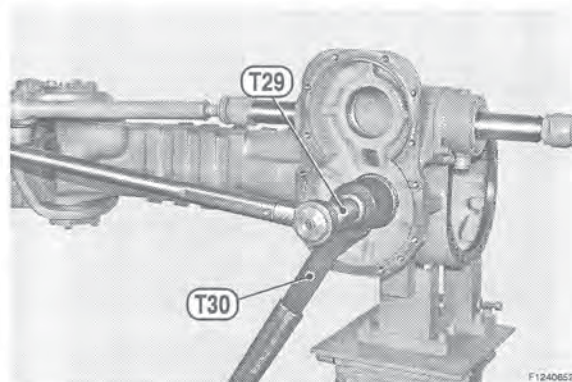


Assemble the pinion assembly as shown in the picture, checking that distance piece (22) is correctly oriented.

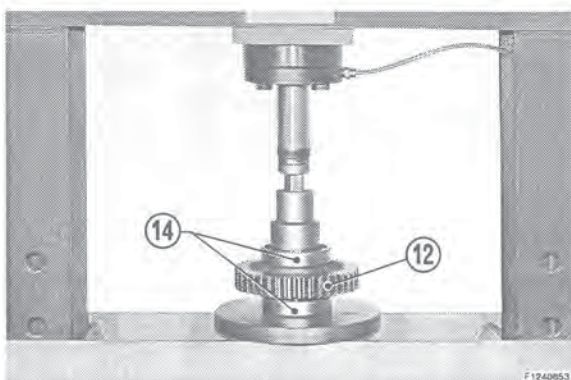
**NOTE.** Apply grease to the outer surface of the distance piece (22).



With tools T28C, T28D and T28B connected to a press, insert the complete pinion assembly (20).

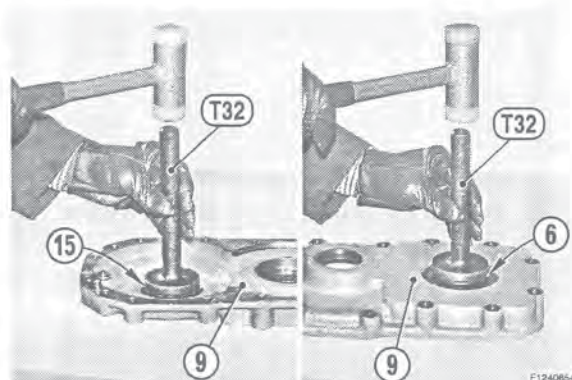


Apply Loctite 242 to the thread of the pinion and screw the ring nut (19). Engage special wrench T30 on the ring nut and apply bar T29 to the pinion (20). Tighten the ring nut (19) following the appropriate procedure (See «HOW TO INSTALL AND ADJUST THE BEVEL PINION») and check that torque is 170 – 220Ncm.



Using a press, fit the bearings (14) and the distance piece (16) on the upper gear (12).

**CAUTION!** The distance piece (16) must be positioned between the outer bearing and the gear.



Grease snap rings (15) and (6); position the snap rings in the cover (9) using tool T32.





- ITA** Ricercare il valore degli spessori (23) e (24) ed inserire nel corpo riduttore (11) le ralle dei cuscinetti conici del pignone (Vedere «INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO»).
- NE PIGNONE CONICO».**  
Utilizzando l'attrezzo T7 inserire l'anello di tenuta (25) dopo averlo lubrificato con grasso.
- D** Die Größen der Unterlegscheiben (23) und (24) kontrollieren und in den Reduziererkörper (11) die Lagerscheiben des Rades einsetzen (Siehe «INSTALLATION UND EINSTELLUNG DES KEGELRADES»).
- a** Mit Hilfe des Werkzeugs T7 den zuvor eingefetteten Kolbenring (25) einsetzen.
- ESP** Buscar el valor de los espesores (23) y (24) y introducir en el cuerpo reductor (11) las rangas de los cojinetes conicos del pinon (Vease «INSTALACION Y REGISTRACION PINON CONICO»).
- Utilizando la herramienta T7 introducir el segmento de compresion (25) despues de haberlo lubrificado con grasa.
- F** Chercher la valeur des cales (23) et (24), puis introduire dans le corps réducteur (11) les crapaudines des paliers coniques du pignon (voir «INSTALLATION ET REGLAGE DU PIGNON CONIQUE»).
- A l'aide de l'outil T7 introduire la bague d'étanchéité (25) après l'avoir lubrifiée avec du gras.

- ITA** Utilizzando gli attrezzi T28C, T28D e T28B collegati ad una pressa, inserire il gruppo pignone (20) completo.
- D** Mit Hilfe der an einer Presse angeschlossenen Werkzeuge T28C, T28D und T28B, das ganze Radaggregat (20) einsetzen.
- C**
- ESP** Utilizando las herramientas T28C, T28D y T28B conectar a un prensa, insertar el grupo pinon (20) completo.
- F** A l'aide des outils T28C, T28D et T28B reliés à une presse, introduire le groupe pignon (20) complet.

- ITA** Utilizzando una pressa, montare sull'ingranaggio superiore (12) i cuscinetti (14) ed il distanziale (16).
- ATTENZIONE!** Il distanziale (16) va posizionato tra il cuscinetto esterno e l'ingranaggio.
- D** Mit Hilfe einer Presse, die Lager (14) und das Distanzstück (16) auf das obere Zahnrad (12) montieren.
- e** **ACHTUNG!** Das Distanzstück (16) muß zwischen dem äußeren Lager und das Zahnrad liegen.
- ESP** Utilizando una prensa, montar sobre el engranaje superior (12) los cojinetes (14) y el distancial (16).
- CUIDADO.** El distancial (16) viene colocado entre el cojinete exterior y el engranaje.
- F** A l'aide d'une presse, monter sur l'engrenage supérieur (12) les paliers (14) et l'entretoise (16).
- ATTENTION!** L'entretoise doit être placée entre le palier et l'engrenage.

- ITA** Comporre il gruppo pignone come in figura, controllando che il distanziale (22) sia orientato correttamente.
- NOTA.** Lubrificare con grasso la superficie esterna del distanziale (22).
- D** Das Radaggregat wie in der Abbildung gezeigt zusammenbauen; dabei überprüfen ob das Distanzstück (22) auch richtig orientiert ist.
- b** **BEMERKUNG.** Die äußere Fläche des Distanzstückes (22) mit Fett schmieren.
- ESP** Componer el grupo pinon como en figura, controlando que el distancial (22) sea orientado correctamente.
- NOTA.** Lubrificar con grasa la superficie exterior del distancial (22).
- F** Composer le groupe pignon comme sur la figure, contrôler si l'entretoise (22) est orientée correctement.
- NOTE.** Lubrifier avec du gras la surface externe de l'entretoise (22).

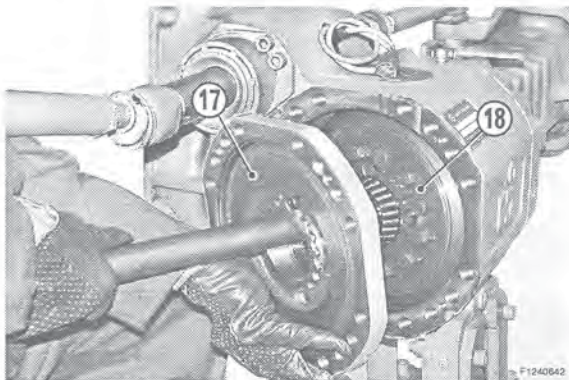
- ITA** Spalmare la filettatura del pignone con Loctite 242 ed avvitare la ghiera (19). Impegnare la chiave speciale T30 sulla ghiera ed applicare il codolo T29 sul pignone (20). Serrare la ghiera (19) con le modalità prescritte (Vedere «INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO») e controllare che la coppia di rotazione sia di 170÷220 Ncm.
- D** Radgewinde mit Loctite 242 schmieren und die Nutmutter (19) zuschrauben. Den Spezialschlüssel T30 in die Nutmutter setzen und den Schaft T29 auf das Rad (20) setzen. Nutmutter (19) laut Anweisungen fest ziehen (Siehe «INSTALLATION UND EINSTELLUNG DES KEGELRADES») und das Gegenmoment kontrollieren, das 170÷220 Ncm betragen muß.
- d**
- ESP** Pasar sobre la rosca del pinon Loctite 242 y entornillar la virola (19). Empear la llave especial T30 sobre la virola y aplicar el mango T29 sobre el pinon (20). Apretar la virola (19) con las modalidades prescritas (Vease «INSTALACION Y REGISTRACION PINON CONICO») y controlar que el par de rotacion sea de 170÷220 Ncm.
- F** Enduire le filetage du pignon avec du Loctite 242 et visser l'anneau (19). Engager la clé spéciale T30 sur l'anneau et appliquer l'embout T29 sur le pignon (20). Serrer l'anneau (19) de la façon préconisée (voir «INSTALLATION ET REGLAGE DU PIGNON CONIQUE») et contrôler que le couple de rotation est de 170÷220 Ncm.

- ITA** Lubrificare con grasso gli anelli di tenuta (15) e (16), posizionarli nel coperchio (9) utilizzando l'attrezzo T32.
- D** Die Kolbenringe (15) und (16) mit Fett schmieren; diese mit dem Werkzeug T32 auf den Deckel (9) positionieren.
- f**
- ESP** Lubrificar con grasa los segmento de compresion (15) y (16); colocarlos en la tapa (9) utilizando la herramienta T32.
- F** Lubrifier avec du gras les bagues d'étanchéité (15) et (16); placer ces dernières dans le couvercle (9) à l'aide de l'outil T32.





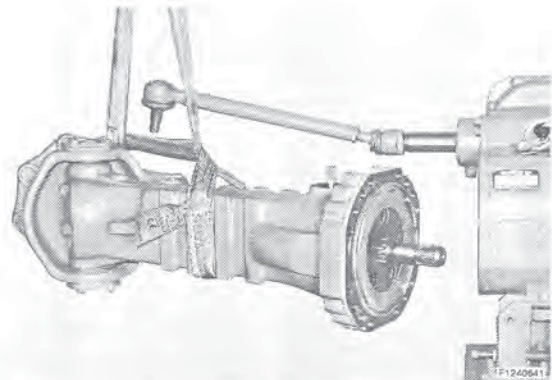
**HOW TO ASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - ASSEMBLAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER MONTIEREN (602) - ASEMBLAJE REDUCTOR INCORPORADO Y PINON - MONTAJE REDUCTEUR INTEGRE (602)**



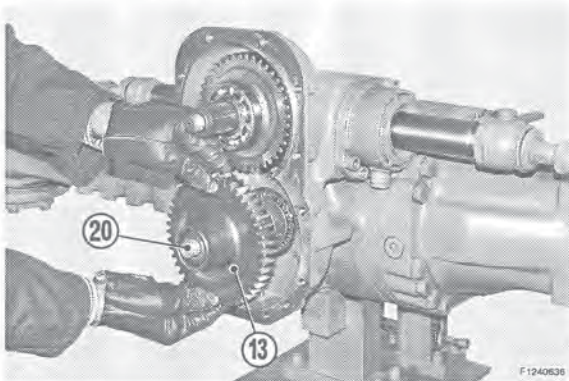
Re-install the differential unit (18) and the intermediate cover (17).

**CAUTION!** If the crown has been replaced, reinstate clearances.

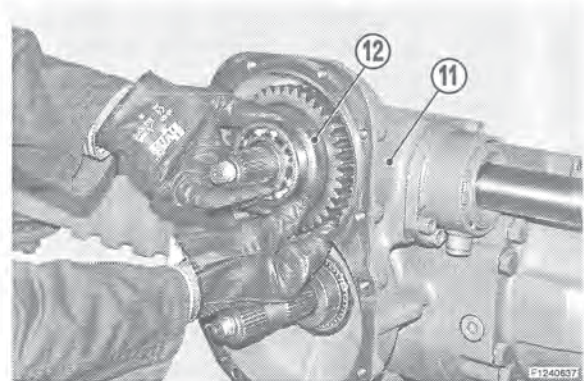
For details, see «HOW TO ASSEMBLE AND ADJUST THE DIFFERENTIAL UNIT».



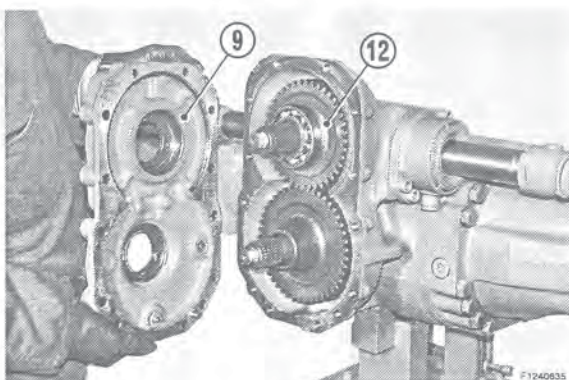
Re-install the complete arm checking flatness and blocking the arm by keeping to the appropriate procedures illustrated in section «HOW TO ASSEMBLE THE BRAKING UNITS». Also connect the steering bar.



Fit the lower gear (13) onto the pinion (20).

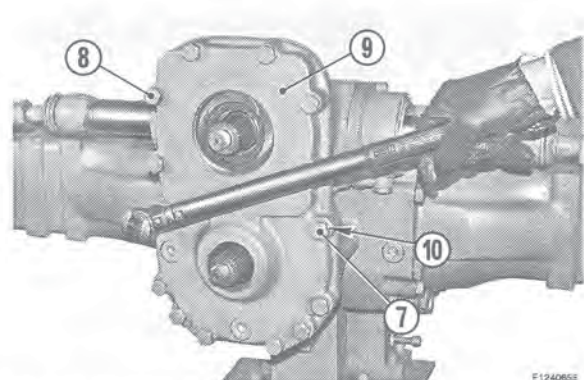


Insert the upper gear unit (12) into the body of the reduction gear (11).



Apply Loctite 510 to the locking surface of the body of the reduction gear (11).

Lubricate snap rings (6) and (15); fit cover (9) and set cover (if necessary) by lightly tapping with a plastic hammer.



Block cover (9) with screws (7) and (8) and relative washers (10). Tighten using the criss-cross method. Torque wrench setting: 82–91 Nm





- a**
- ITA** Rimontare il gruppo differenziale (18) ed il coperchio intermedio (17).  
ATTENZIONE! Se è stata sostituita la corona, ristabilire i giochi.  
Per i dettagli, vedere «ASSEMBLAGGIO ED INSTALLAZIONE GRUPPO DIFFERENZIALE».
- D** Das Differentialaggregat (18) und den mittleren Deckel (17) wieder montieren.  
ACHTUNG! Falls der Kranz ausgewechselt worden ist, Spiele wieder herstellen.  
Weitere Einzelheiten im Paragraph «ZUSAMMENBAU UND INSTALLATION DES DIFFERENTIALAGGREGATS».
- ESP** Remontar el grupo diferencial (18) y la tapa intermedia (17).  
CUIDADO! Si ha sido cambiada la corona, restabilizar los juegos.  
Para los detalles, vease «ASEMBLAJE Y INSTALACION GRUPO DIFERENCIAL».
- F** Remonter le groupe différentiel (18) et le couvercle intermédiaire (17).  
ATTENTION! Si la couronne a été substituée, rétablir les jeux.  
Pour tout détail, voir «ASSEMBLAGE ET INSTALLATION GROUPE DIFFERENTIEL».

- c**
- ITA** Montare sul pignone (20) l'ingranaggio inferiore (13).
- D** Das untere Zahnrad (13) auf das Rad (20) montieren.
- ESP** Montar sobre el pinon (20) el engranaje inferior (13).
- F** Monter sur le pignon (20) l'engrenage inférieur (13).

- e**
- ITA** Spalmare la superficie di chiusura del corpo riduttore (11) con Loctite 510.  
Lubrificare gli anelli di tenuta (6) e (15); montare il coperchio (9) assestandolo (se necessario) con leggeri colpi di un mazzuolo in materiale plastico.
- D** Die Schließfläche des Reduziererkörpers (11) mit Loctite 510 schmieren.  
Kolbenringe (6) und (15) schmieren; Deckel (9) montieren und wenn nötig, mit einem Gummihammer leicht schlagen.
- ESP** Pasar la superficie de cierre del cuerpo reductor (11) con Loctite 510.  
Lubricar los segmentos de compresion (6) y (15); montar la tapa (9) arreglando (si necesario) con ligeros golpes de martillo en material plastico.
- F** Enduire la surface de fermeture du corps réducteur (11) avec du Loctite 510.

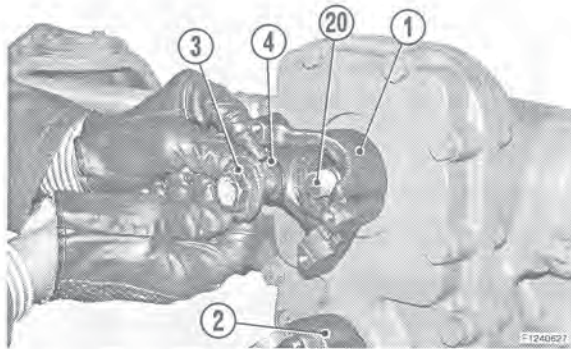
- ITA** Rimontare il braccio completo, controllando la planarità e bloccandolo con le modalità indicate nel paragrafo «ASSEMBLAGGIO DEI GRUPPI DI FRENNATURA».  
Collegare anche la barra di sterzata.
- D** Den gesamten Arm wieder montieren und Ebenheit laut Anweisungen des Paragraphs «ZUSAMMENBAU DER BREMSAGGREGATE» kontrollieren.  
Lenkstange ebenfalls anschließen.
- ESP** Remontar el brazo completo, controlando la planaridad y bloqueando con las modalidades indicadas en el capítulo «ASEMBLAJE DE LOS GRUPOS DE FRENADURA».  
Conectar también la barra de dirección.
- F** Remonter le bras complet, en contrôler l'uniformité et le bloquer suivant le mode indiqué au paragraphe «ASSEMBLAGE DES GROUPE DE FREINAGE».  
Brancher également la barre de braquage.

- d**
- ITA** Inserire nel corpo riduttore (11) il gruppo ingranaggio superiore (12).
- D** Das obere Zahnradaggregat (12) in den Reduzierkörper (11) einsetzen.
- ESP** Introducir en el cuerpo reductor (11) el grupo engranaje superior (12).
- F** Introduire dans le corps réducteur (11) le groupe engrenage supérieur (12).

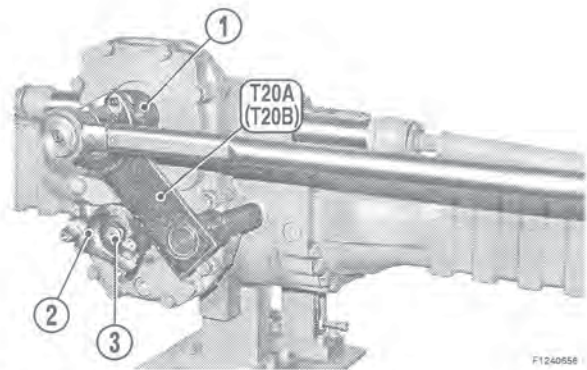
- f**
- ITA** Bloccare il coperchio (9) con le viti (7) e (8) e le relative rondelle (10) serrando con il metodo di serraggio incrociato.  
Coppia di serraggio: 82÷91 Nm.
- D** Deckel (9) mit den Schrauben (7) und (8) und den Unterlegscheiben (10) festschrauben; die Schrauben im Kreuz abwechselnd fest ziehen.  
Anzugsmoment: 82÷91 Nm.
- ESP** Bloquear la tapa (9) con los tornillos (7) y (8) y las relativas arandelas (10) apretando con el metodo de torsion cruzado.  
Par de torsion : 82÷91 Nm.
- F** Bloquer le couvercle (9) avec les vis (7) et (8) et leurs relatives rondelles (10) en serrant à l'aide du système de serrage croisé.  
Couple de serrage: 82÷91 Nm.



**HOW TO ASSEMBLE INCORPORATED REDUCTION GEAR AND PINION - ASSEMBLAGGIO RIDUTTORE INTEGRATO (602) - INTEGRIERTER REDUZIERER MONTIEREN (602) - ASEMBLAJE REDUCTOR INCORPORADO Y PINON - MONTAJE REDUCTEUR INTEGRE (602)**



Fit the upper (1) and lower (2) flanges.  
Apply Loctite 242 to the threaded portion of pinion (20) and upper gear (12). Fit O-rings (4) and nuts (3).



Apply tool **T20A** (or **T20B**) to flanges (1) and (2) and tighten nuts (3) using a dynamometric wrench.  
Torque wrench setting: 280–310 Nm

- a**
- ITA** Montare le flange superiore (1) ed inferiore (2).  
Spalmare le filettature del pignone (20) e dell'ingranaggio superiore (12) con Loctite 242.  
Montare gli anelli OR (4) ed i dadi (3).
- D** Obere (1) und untere Flanschen (2) montieren.  
Radgewinde (20) und oberes Zahnrad (12) mit Loctite 242 schmieren.  
O-Ringe (4) und Muttern (3) montieren.
- ESP** Montar las bridas superior (1) y inferior (2).  
Pasar las roscas del pinon (20) y del engranaje superior (12) Loctite 242.  
Montar los segmentos OR (4) y las tuercas (3).
- F** Monter les flasques supérieures (1) et inférieures (2).  
Enduire les filetages du pignon (20) et de l'engrenage supérieur (12) avec du Loctite 242.  
Monter les bagues OR (4) et les écrous (3).

- b**
- ITA** Applicare alle flange (1) e (2) l'attrezzo T20A (oppure T20B) e serrare i dadi (3) con una chiave dinamometrica.  
Coppia di serraggio: 280÷310 Nm
- D** An den Flanschen (1) und (2) das Werkzeug T20A (oder T20B) anbringen und Muttern (3) mit einem Momentenschlüssel fest ziehen.  
Anzugsmoment: 280÷310 Nm.
- ESP** Aplicar a las bridas (1) y (2) la herramienta T20A (o T20B) y apretar las tuercas (3) con una llave dinamométrica.  
Par de torsin : 280÷310 Nm.
- F** Appliquer aux flasques (1) et (2) l'outil T20A (ou T20B) et serrer les écrous (3) au moyen d'une clé dynamométrique.  
Couple de serrage: 280÷310 Nm.

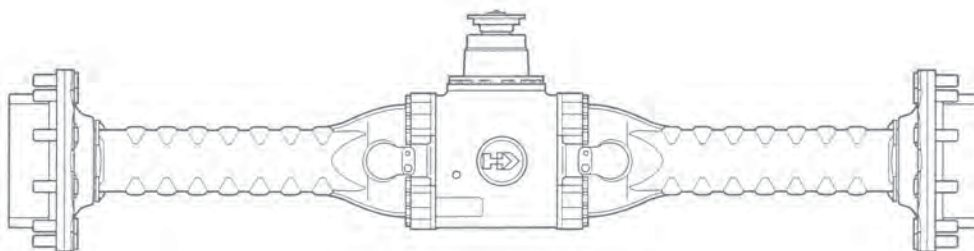




## **AXLE TYPE: 112 (REAR)**







# **maintenance and repair INSTRUCTION MANUAL**

**MANUALE D'ISTRUZIONE E RIPARAZIONE  
WARTUNG UND REPARATURANLEITUNG  
MANUAL DE MANUTENCION Y REPARACION  
MANUAL ENTRETIEN ET REPARATION**

## **DRIVE AXLE TYPE 112**



PRINTED IN ITALY

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GB

The efficiency and continued operation of mechanical units depend on constant, correct maintenance and also on efficient repair work, should there be a break-down or malfunction. The instructions contained in this manual have been based on a complete overhaul of the unit. However, it is up to the mechanic to decide whether or not it is necessary to assemble only individual components, when partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to be performed.

All the information needed for correct disassembly, checks and assembly of each individual component is set out below. In order to remove the differential unit from the vehicle, the manuals provided by the vehicle manufacturer should be consulted. In describing the following operations it is presumed that the unit has already been removed from the vehicle.

**IMPORTANT:** In order to facilitate work and protect both working surfaces and operators, it is advisable to use proper equipment such as: trestles or supporting benches, plastic or copper hammers, appropriate levers, pullers and specific spanners or wrenches.

Before going on to disassemble the parts and drain the oil, it is best to thoroughly clean the unit, removing any encrusted or accumulated grease.

**INTRODUCTORY REMARKS:** All the disassembled mechanical units should be thoroughly cleaned with appropriate products and restored or replaced if damage, wear, cracking or seizing have occurred.

In particular, thoroughly check the condition of all moving parts (bearings, gears, crown wheel and pinion, shafts) and sealing parts (O-rings, oil shields) which are subject to major stress and wear. In any case, it is advisable to replace the seals every time a component is overhauled or repaired. During assembly, the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly, the prescribed pre-loading, backlash and torque of parts must be maintained.

**CLASSIFICATION:** This manual classifies units according to part numbers. For a correct interpretation, classification is indicated as follows:

→ → [ ] = up to the part number

[ ] → → = from the part number on

When no classification is given, disassembly and assembly operations are the same for all versions.

**SPECIFIC EQUIPMENT AND SPARE PARTS:** The drawings of all specific tools required for maintenance and repair work can be found at the end of this manual; spare parts may be ordered either from the vehicle manufacturer or directly from the Service Centers or Authorised Distributors of SPICER CLARK-HURTH.

ITA

Il rendimento e la continuità degli organi meccanici dipendono oltre che da una costante e corretta manutenzione, anche dal tempestivo intervento, nell'eventualità di guasti o anomalie.

Nel proporre questo manuale si è considerata l'ipotesi di una revisione generale del gruppo ma è il meccanico a valutare la necessità di montare solo i singoli componenti nel caso di riparazione. Il manuale è una guida rapida e sicura che consente interventi precisi, tramite le fotografie ed i disegni prospettici che illustrano le varie fasi delle operazioni. Di seguito sono riportate tutte quelle informazioni ed avvertenze necessarie al corretto smontaggio, alle relative verifiche ed all'assemblaggio dei singoli componenti. Per la rimozione del ponte differenziale dal veicolo, è necessario consultare i manuali forniti dal costruttore del veicolo. Nel descrivere le operazioni seguenti, si presuppone che il ponte sia già stato rimosso dal veicolo.

**IMPORTANTE:** In tutte le operazioni, è consigliabile usare attrezzature idonee quali cavalletti o banchi di sostegno,

martelli in plastica o rame, leve appropriate estrattori e chiavi specifiche, al fine di facilitare il lavoro salvaguardando nel contempo le superfici lavorate e la sicurezza degli operatori. Prima di procedere al disassemblaggio delle parti e scaricare l'olio, è opportuno eseguire un'accurata pulizia del ponte, asportando incrostazioni ed accumuli di grasso.

**PREMESSA:** Tutti gli organi meccanici smontati, devono essere accuratamente puliti con prodotti appropriati, quindi ripristinati o sostituiti nel caso presentino danni, usura, incrinature, grippaggi, ecc. In particolare, verificare l'integrità di tutte quelle parti in movimento (cuscinetti, ingranaggi, coppia conica, alberi) e di tenuta (anelli OR, paraolio), soggette a maggiori sollecitazioni ed usura. È consigliabile, comunque, la sostituzione degli organi di tenuta ogni qualvolta si proceda alla revisione o riparazione dei componenti. Al momento del montaggio, gli anelli di tenuta devono essere lubrificati sui bordi di tenuta. Nel caso della coppia conica, la sostituzione di uno dei suoi ingranaggi comporta anche la sostituzione dell'altro. In fase di montaggio sono da rispettare scrupolosamente i giochi, i precarichi e le coppie prescritte.

**VALIDITÀ:** Il manuale fornisce le validità dei gruppi sotto forma di matricola. Al fine di una corretta interpretazione, le validità sono indicate come:

→ → [ ] = fino alla matricola

[ ] → → = dalla matricola

Se non sono indicate validità, le operazioni di smontaggio ed assemblaggio sono comuni a tutte le versioni.

**MANUTENZIONE E RIPARAZIONE:** Al fine di facilitare interventi sui gruppi ponte differenziali e cambi di velocità la SPICER CLARK-HURTH, ha ritenuto opportuno compilare queste istruzioni di manutenzione e riparazione. I disegni delle attrezzature specifiche eventualmente necessarie per l'esecuzione di interventi di manutenzione e riparazione possono essere acquistati direttamente presso il costruttore; i ricambi possono essere ordinati tramite il costruttore della macchina o direttamente presso la SPICER CLARK-HURTH.

D

Die Leistung und Lebensdauer der mechanischen Teile hängt nicht nur von einer ständigen und richtig durchgeführten Wartung sondern auch von einem sofortigen Eingriff im Störfall ab. Um dieses Handbuch zu erstellen sind wir von einer allgemeinen Überprüfung der Einheit ausgegangen, doch entscheidet der Mechaniker ob die einzelnen Teile bei Reparaturen montiert werden müssen oder nicht. Das Handbuch ist schnell und einfach nachzuschlagen und ermöglicht es anhand der Abbildungen und der Zeichnungen, die die verschiedenen Vorgänge darstellen, gezielt einzugreifen. Nachstehend sind alle Informationen und Hinweise aufgeführt, die zur Zerlegung, Prüfung und Montage der Einzelteile nötig sind. Um die Differentialachse des Fahrzeugs abzumontieren, lesen Sie bitte die Anweisungen in den Handbüchern des Fahrzeugherstellers. Die nachstehenden Beschreibungen gehen davon aus, daß die Fahrzeugachse schon abmontiert worden ist.

**WICHTIG:** Um die Arbeit zu erleichtern und gleichzeitig die verarbeiteten Flächen zu schützen und die Sicherheit der Arbeiter zu gewährleisten, empfehlen wir geeignete Werkzeuge wie Böcke, Tisch, Gummi- oder Kupferhammer, geeignete Abzieher und Schlüssel zu verwenden. Bevor mit der Zerlegung der Teile begonnen und das Öl abgelassen wird, muß die Achse sorgfältig gereinigt und Verkrustungen und Fettablagerungen abgetragen werden.

**VORAUSSSETZUNG:** Alle abmontierten mechanischen Teile müssen sorgfältig mit geeigneten Reinigungsmitteln gereinigt oder, wenn beschädigt, verschleißt, gerissen, festgefressen usw. ausgewechselt werden. Insbesondere muß der einwandfreie Zustand aller beweglichen Teile (Lager, Zahnräder, Kegelradpaare, Wellen) und der Dichtungen (O-Ringe, O-labdichtungen), die am meisten beansprucht werden und verschleßen, kontrolliert werden. Wir empfehlen auf jeden Fall die Abdichtungselemente immer auszuwechseln, wenn eine Überholung oder eine Reparatur der Teile vorgenommen wird. Bei





der Montage müssen die Ränder der Dichtringe geschmiert werden. Wenn beim Kegelradpaar ein Zahnrad ausgewechselt werden muß, muß auch das andere Zahnrad ausgewechselt werden. Bei der Montage müssen die vorgeschriebenen Spiele, Vorspannungen und Drehmomente strengstens eingehalten werden.

**GÜLTIGKEIT:** Das Handbuch gibt an zu welchen Kennnummern die Einheiten gehören. Der Einfachheit halber sind die Angehörigkeiten folgendermaßen aufgeführt:

➡➡ [ ] = bis Kennnummer

[ ] ➡➡ = ab Kennnummer

Wenn keine Angehörigkeit angegeben ist, verstehen sich die Arbeiten zur Zerlegung und Montage für alle Ausführungen gültig.

**SPEZIFISCHE WERKZEUGE UND ERSATZTEILE:** die Zeichnungen der für Wartungsarbeiten erforderlichen spezifischen Werkzeuge, sind am Ende des Handbuchs aufgeführt; Ersatzteile können beim Fahrzeughersteller oder direkt bei der Kundendienststelle oder bei einem zugelassenen Händler der SPICER CLARK-HURTH bezogen werden.

### ESP

El rendimiento y la duración de los órganos mecánicos depende, además que del constante y correcto mantenimiento, también de la intervención inmediata en caso de averías o anomalías.

Al proponer este manual, ha sido considerada la suposición de una revisión general del grupo, pero es el mecánico quien tiene que valorar la necesidad de montar cada uno de los componentes en caso de reparación. El manual es una guía rápida y segura que permite intervenciones precisas por medio de fotografías y de planos que muestran las distintas fases de las operaciones. A continuación figuran todas las informaciones y advertencias necesarias para ejecutar un montaje correcto, para las comprobaciones y el montaje de cada uno de los componentes. Para remover el puente diferencial del vehículo hay que consultar los manuales de los fabricantes del vehículo. En la descripción de las operaciones siguientes se supone que el puente ya ha sido sacado del vehículo.

**IMPORTANTE:** Para facilitar el trabajo salvaguardando al mismo tiempo las superficies mecanizadas y la seguridad de los operadores, se aconseja que se usen equipos y herramientas adecuados como caballetes y bancos de soporte, martillos de plástico o de cobre, palancas adecuadas, extractores y llaves específicas.

Antes de desmontar las partes y descargar el aceite, es conveniente que se haga una limpieza minuciosa del puente sacando las incrustaciones y acumulaciones de grasa.

**INTRODUCCION:** Todos los órganos mecánicos desmontados tienen que ser limpiados minuciosamente con productos adecuados y restaurados o sustituidos en el caso de que presenten daños, desgaste, rajaduras, agarrotamientos, etc. En particular, comprobar la integridad de todas las partes en movimiento (cojinetes, engranajes, par cónico, ejes) y de estanqueidad (anillos OR, detenedor de aceite) sujetas a mayores sollicitaciones y desgaste.

Se aconseja, de todas formas, que se sustituyan los órganos de estanqueidad cada vez que se ejecute la revisión o reparación de los componentes.

Al volver a montar, los segmentos de compresión tienen que estar lubricados en los bordes de estanqueidad. En el caso del par cónico, la sustitución de uno de sus engranajes comporta también la sustitución del otro. Al montar hay que tener en cuenta escrupulosamente los juegos, las precargas y los pares descriptos.

**VALIDEZ:** El manual suministra la validez de los grupos en forma de matrícula. Para poder tener una interpretación correcta, la validez está indicada:

➡➡ [ ] = hasta la matrícula

[ ] ➡➡ = desde la matrícula en adelante

Si no ha sido indicada validez, las operación de desmontaje y montaje son comunes a todas las versiones.

**HERRAMIENTAS ESPECIFICAS Y RECAMBIOS:** Los planos de las herramientas específicas necesarias para la ejecución de las intervenciones de mantenimiento figuran al final del manual; los recambios se pueden pedir al fabricante de la máquina o directamente al Service Center o a Distribuidores autorizados de SPICER CLARK-HURTH.

### F

Le rendement et la continuité des organes mécaniques dépendent, non seulement d'une maintenance correcte et constante, mais également de la rapidité d'intervention en cas de pannes ou d'anomalies. En vous proposant ce manuel, on envisage l'hypothèse d'une révision générale du groupe, mais c'est au mécanicien d'évaluer la nécessité de monter ou non chacun des composants en cas de réparation. Le manuel est un guide rapide et sûr consentant des interventions précises, au travers de photographies et de dessins prospectifs qui illustrent les différentes phases des opérations. Ensuite, sont reportées toutes les informations et précautions nécessaires pour un démontage correct et les vérifications et assemblage de chaque composant. En ce qui concerne le déplacement du pont d'étai du véhicule, il est nécessaire consulter les manuels fournis par le constructeur du véhicule. En décrivant les opérations suivantes, on présume que le pont ait déjà été enlevé du véhicule.

**IMPORTANT:** Pour faciliter le travail en sauvegardant en même temps les surfaces usinées et la sécurité des opérateurs, il est préconisé d'utiliser des installations appropriées telles que des étais ou banc de support, maillets en plastique ou en cuivre, leviers appropriés, extracteurs et clés spécifiques. Avant de procéder au démontage des parties et vidanger l'huile, il vaut mieux nettoyer soigneusement le pont, en enlevant incrustations et blocs de gras.

**PRELIMINAIRE:** Tous les organes mécaniques démontés doivent être soigneusement nettoyés à l'aide de produits appropriés et réparés ou remplacés dans le cas où ils seraient abîmés, usés, fêlés, grippés, etc. Vérifier, l'intégrité, en particulier, de toutes les parties en mouvement (paliers, engrenages, couple conique, arbres) et l'étanchéité des bagues (bagues OR, parahuile), qui sont sujettes à plus de sollicitations et à l'usure. Il est préconisé, de toute façon, de substituer les organes d'étanchéité, chaque fois que l'on effectue une révision ou une réparation des composants. Au moment du montage, les bagues d'étanchéité doivent être lubrifiées sur les bords étanches. Dans le cas du couple conique, la substitution de l'un de ses engrenages comporte également la substitution de l'autre. En phase de montage, il faut respecter scrupuleusement les jeux, les précharges et les couples prescrits.

**VALIDITE:** Le manuel fournit la validité des groupes sous forme de matricule. Pour une meilleure interprétation, les validités sont indiquées comme:

➡➡ [ ] = jusqu'à l'immatriculation

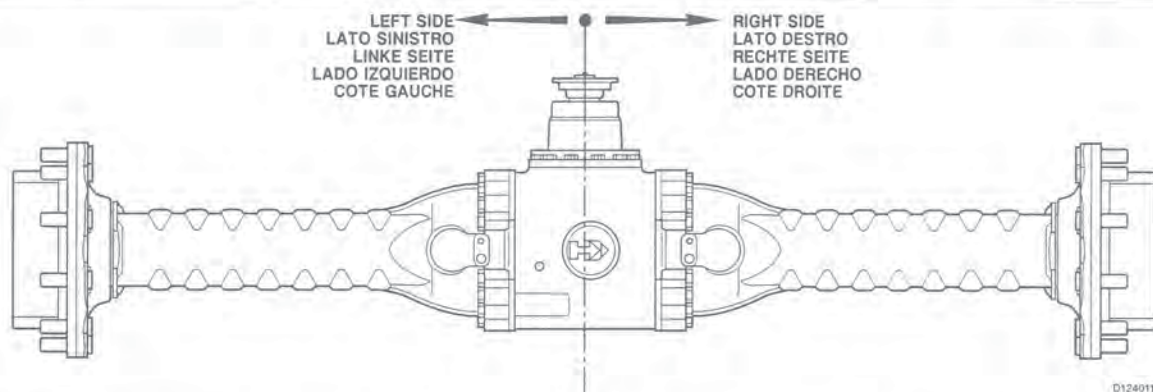
[ ] ➡➡ = à partir de l'immatriculation et après

Si les validités ne sont pas indiquées, les opérations de démontage et d'assemblage sont pareilles dans toutes les versions.

**INSTALLATIONS SPECIFIQUES ET PIECES DETACHEES:** Les dessins des installations spécifiques nécessaires pour effectuer des interventions d'entretien sont reportées à la fin du manuel, les pièces détachées peuvent être commandées au constructeur de la machine ou directement aux Centres de Services, ou Distributeurs agréés de la Société SPICER CLARK-HURTH.

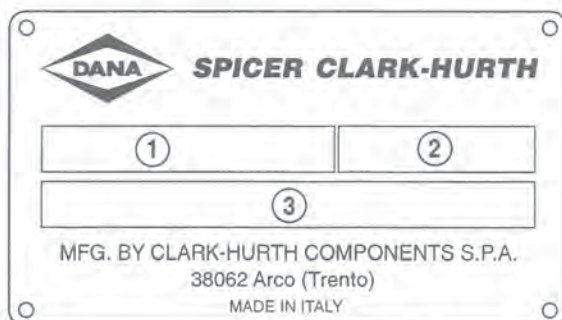


DEFINITION OF VIEWPOINTS - DEFINIZIONE VISTE - DEFINITION DER ANSICHTEN - DEFINICION VISTAS - DÉFINITION VUES



D1240111

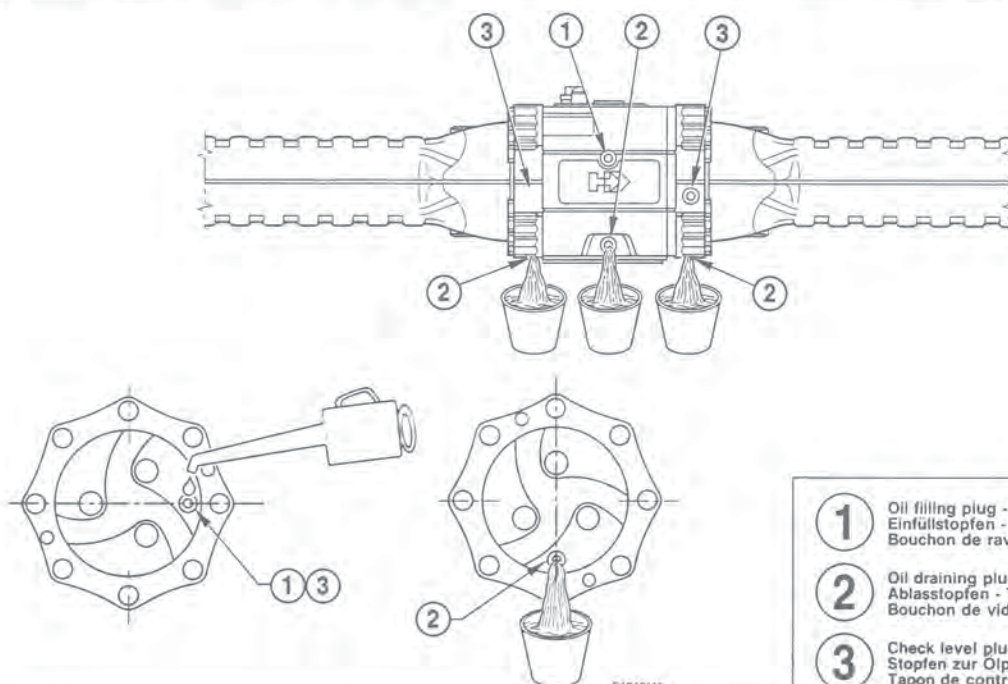
DATA PLATE - TARGA MATRICOLA - KENNUMMERNSCHILD - MATRICULA - PLAQUE D'IMMATRICULATION



D1240011

- ① Type and model unit - modification index  
Tipo e modello gruppo - indice di modifica  
Typ und Modelleles Antriebes - Änderungsverzeichnis  
Tipo y modelo grupo - índice de modificación  
Type et modèle de ensemble - tableau des modifications
- ② Serial number  
Numero di serie  
Seriennummer  
Número de serie  
Número de serie
- ③ Lubricant  
Lubrificante  
Schmieröl  
Lubrifiant  
Lubrifiant

MAINTENANCE POINTS - PUNTI DI MANUTENZIONE - WARTUNGSSTELLEN - PUNTOS DE MANUTENCION - POINTS D'ENTRETIEN



D1240112

- ① Oil filling plug - Tappo di carico  
Einfüllstopfen - Tapon de carga  
Bouchon de ravitaillement
- ② Oil draining plug - Tappo di scarico  
Ablassstopfen - Tapon de descarga  
Bouchon de vidange
- ③ Check level plug - Tappo controllo livello  
Stopfen zur Ölpegelkontrolle -  
Tapon de contri de nivel - Jauge de niveau




**MAINTENANCE INTERVALS - INTERVALLI DI MANUTENZIONE - WARTUNGSINTERVALLE - INTERVALOS DE MANUTENCIÓN - INTERVALLE DE SERVICE**

| OPERATION - OPERAZIONE - ARBEITSVORGANG - OPERACION - OPERATION                                                                                                                       |                                                                                                                                                     | FREQUENCY - PERIODICITÀ - ZEITABSTAND - FRECUENCIA - PERIODICITE                                                       | LUBRICANTS - LUBRIFICANTI - SCHMIERSTOFFE - LUBRICANTES - LUBRIFIANTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Check levels;</li> <li>• Controllo livelli;</li> <li>• Ölstandkontrolle;</li> <li>• Control niveles;</li> <li>• Contrôle niveaux;</li> </ul> | Differential<br>Differenziale<br>Im differential<br>Diferencial<br>Différentiel                                                                     | monthly<br>mensile<br>monatlich<br>cada mes<br>mensuel                                                                 | <ul style="list-style-type: none"> <li>• SAE85W90 (API GL4 - MIL L-2105)<br/>With additives for oil-bath brakes<br/>Con additivi per freni a bagno d'olio<br/>Mit Zusatzmittel für Bremsen in Ölbad<br/>Con aditivos para frenos de baño de aceite<br/>Avec adjuvants pour freins en bain d'huile</li> <li>• SAE85W90 (API GL5 - MIL 2105-B)<br/>With additives for oil-bath brakes, for units presenting hypoid crown wheel and pinion and/or self-locking differential gear<br/>Per esecuzioni con coppia conica ipoide e/o con differenziale autobloccante, con additivi per freni a bagno d'olio<br/>Bei Ausführungen mit Kegel- und Telleradpaar und/oder Selbstsperrdifferential, mit Zusatzmitteln für Bremsen in Ölbad<br/>Para ejecuciones con par cónico hipoide y/o con diferencial autobloqueante con aditivos para frenos de baño de aceite.<br/>Pour exécutions avec couple conique hypoide et/ou différentiel autobloquant, avec adjuvants pour freins en bain d'huile</li> </ul> |
|                                                                                                                                                                                       | Planetary reduction<br>Riduzione epicicloidale<br>Planetengetrieb<br>Reducción epicicloidial<br>Reduction epicycloidale                             | every 200 hours<br>ogni 200 ore<br>alle 200 Std.<br>cada 200 horas<br>toutes les 200 heures                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>• Oil change;</li> <li>• Cambio olio;</li> <li>• Ölwechsel;</li> <li>• Cambio aceite;</li> <li>• Vidange huile;</li> </ul>                     | Differential<br>Differenziale<br>Im differential<br>Diferencial<br>Différentiel                                                                     | every 800 hours *<br>ogni 800 ore<br>alle 800 Std.<br>cada 800 horas<br>toutes les 800 heures                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                                                                       | Planetary reduction<br>Riduzione epicicloidale<br>Planetengetrieb<br>Reducción epicicloidial<br>Reduction epicycloidale                             | every 1000 hours *<br>ogni 1000 ore<br>alle 1000 Std.<br>cada 1000 horas<br>toutes les 1000 heures                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                                                                       | Self-locking differential gear<br>Differenziale autobloccante<br>Selbstsperrdifferential<br>Diferencial autobloqueante<br>Différentiel autobloquant | every 700 hours * <input type="checkbox"/><br>ogni 700 ore<br>alle 700 Std.<br>cada 700 horas<br>toutes les 700 heures |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

\* Initially after 100 working hours - Inizialmente dopo 100 ore di lavoro - Erstmals nach 100 Betriebsstunden - Al principio, después de 100 horas de trabajo - Initialement après 100 heures de travail  
☐ When it starts sounding noisy - Anche ai primi cenni di rumorosità - Auch falls ungewöhnliche Geräusche zu bemerken sind - También al primer indicio de ruido - Même aux premiers signaux de bruit

| OPERATION - OPERAZIONE - ARBEITSVORGANG - OPERACION - OPERATION | MEMBER - ORGANO - ELEMENT - ORGANO - ORGANE                 | CONDITIONS - CONDIZIONI - BEDINGUNG - CONDICIONES - CONDITIONS                                 | FREQUENCY - PERIODICITÀ - ZEITABSTAND - FRECUENCIA - PERIODICITE | LUBRICANTS - LUBRIFICANTI - SCHMIERSTOFFE - LUBRICANTES - LUBRIFIANTS |
|-----------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------|
| Greasing<br>Ingrassaggio<br>Schmieren<br>Engrase<br>Graissage   | Articulations<br>Snodi<br>Gelenk<br>Rótula<br>Articulations | Normal work<br>Lavori normali<br>Normale Arbeit<br>Trabajos normales<br>Tâches ordinaires      | monthly<br>mensile<br>monatlich<br>cada mes<br>mensuel           | MOLIKOTE                                                              |
|                                                                 |                                                             | Awkward work<br>Lavori gravosi<br>Schwere Arbeit<br>Trabajos pesados<br>Tâches extraordinaires | Weekly<br>Settimanale<br>Wöchentlich<br>Semanal<br>Hebdomadaire  |                                                                       |

**ADJUSTMENT AND CHECKS - REGISTRAZIONE E CONTROLLI - EINSTELLUNGEN UND KONTROLLEN - AJUSTE Y CONTROLES - REGLAGES ET CONTROLES**

| UNIT - GRUPPO - AGGREGAT - GRUPO - GROUPE                                                     | OPERATION - OPERAZIONE - ARBEITSVORGANG - OPERACION - OPERATION | FREQUENCY - PERIODICITÀ - ZEITABSTAND - FRECUENCIA - PERIODICITE                                  | SERVICE BRAKE CIRCUIT - CIRCUITO COMANDO FRENI - BREMSKREISLAUF - CIRCUITO MANDOS FRENOS - CIRCUIT DE COMMANDE DES FREINS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Negative brake<br>Freno negativo<br>Federspeicherbremse<br>Freno negativo<br>Frein négatif    | Adjustment<br>Registrazione<br>Einstellen<br>Ajuste<br>Réglage  | every 1000 hours *<br>ogni 1000 ore<br>alle 1000 Std.<br>cada 1000 horas<br>toutes les 1000 hours | Only for mineral oil use e.g. ATF Dexron II. Make sure that master cylinder seals are suitable for mineral oil.<br>Usare esclusivamente olio minerale ATF Dexron II. Accertarsi che le guarnizioni del cilindro master siano adatte a questo olio.<br>Nur mineralisches Öl verwenden, z.B.: ATF Dexron II. Achtung: Dichtringe des Hauptbremszylinders müssen für dieses Öl geeignet sein.<br>Usar exclusivamente aceite mineral ATF Dexron II. Asegurarse de que las juntas del cilindro principal son adecuadas para este aceite.<br>Utiliser exclusivement huile minérale ATF Dexron II. Vérifier que les joints du maître-cylindre, soient compatibles avec cette huile. |
| Service brake<br>Freni di servizio<br>Hilfsbremse<br>Frenos de ejercicio<br>Freins de service | Adjustment<br>Registrazione<br>Einstellen<br>Ajuste<br>Réglage  | every 500 hours<br>ogni 500 ore<br>alle 500 Std.<br>cada 500 horas<br>toutes les 500 hours        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Wheel nuts<br>Dadi ruota<br>Radmütern<br>Tuercas rueda<br>Ecrous de roue                      | Tightening<br>Serraggio - Festziehen<br>Apriete<br>Serrage      | every 200 hours<br>ogni 200 ore<br>alle 200 Std.<br>cada 200 horas<br>toutes les 200 hours        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

\* Initially after 100 working hours - Inizialmente dopo 100 ore di lavoro - Erstmals nach 100 Betriebsstunden - Al principio, después de 100 horas de trabajo - Initialement après 100 heures de travail





SPICER CLARK-HURTH

**CONVERSION TABLES - TABELLE DI CONVERSIONE - UMRECHNUNGSTABELLEN  
TABLAS DE CONVERSION - TABLEAUX DE CONVERSION**

Units of pressure - Unità di pressione - Druckeinheiten  
Unidad de presión - Unités de pression:

$$1 \text{ Atm} \cong 1 \text{ bar} \cong 10^5 \text{ Pa} \cong 14.4 \text{ Psi}$$

Units of weight - Unità di peso - Gewichtseinheiten  
Unidad de peso - Unités de poids

|      | N    | daN   | kN      | kg    | lbs   |
|------|------|-------|---------|-------|-------|
| 1N   | 1    | 0,1   | 0,001   | 0,102 | 0,225 |
| 1daN | 10   | 1     | 0,01    | 1,02  | 2,25  |
| 1kN  | 1000 | 100   | 1       | 102   | 225   |
| 1kg  | 9,81 | 0,981 | 0,00981 | 1     | 2,205 |
|      |      |       |         |       |       |

Units of torque - Unità di coppia - Drehmomenteinheiten  
Unidad de par - Unités de couple

|        | Nm     | daNm    | kNm       | kgm     | lb-in |
|--------|--------|---------|-----------|---------|-------|
| 1Nm    | 1      | 0,1     | 0,001     | 0,102   | 8,854 |
| 1daNm  | 10     | 1       | 0,01      | 1,02    | 88,54 |
| 1kNm   | 1000   | 100     | 1         | 102     | 8854  |
| 1kgm   | 9,81   | 0,981   | 0,00981   | 1       | 86,8  |
| 1lb-in | 0,1129 | 0,01129 | 0,0001129 | 0,01152 | 1     |

**TIGHTENING TORQUES - COPPIE DI SERRAGGIO - ANZIEHDREHMOMENTE  
PARES DE TORSION - COUPLES DE SERRAGE**

Unit - Unità di misura - Maßeinheiten - Unidad de medida - Unités de mesure: Nm

| SIZE OF BOLT<br>MISURA VITE<br>SCHRAUBENMASS<br>TAMANO TORNILLO<br>MESURE VIS |            | TYPE OF BOLT - TIPO VITE - GEWINDE - TIPO DE TORNILLO - TYPE DE VIS |                          |                          |                          |                          |                          |
|-------------------------------------------------------------------------------|------------|---------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                                                               |            | 8.8                                                                 |                          | 10.9                     |                          | 12.9                     |                          |
|                                                                               |            | Normali<br>+ Loctite 242                                            | Normali<br>+ Loctite 270 | Normali<br>+ Loctite 242 | Normali<br>+ Loctite 270 | Normali<br>+ Loctite 242 | Normali<br>+ Loctite 270 |
| COARSE PITCH - PASSO GROSSO - GROßER<br>SCHRITT - PASO GRUESO - GROS PAS      | M6 x 1     | 9,5-10,5                                                            | 10,5-11,5                | 14,3-15,7                | 15,2-16,8                | 16,2-17,8                | 18,1-20,0                |
|                                                                               | M8 x 1,25  | 23,8-26,2                                                           | 25,6-28,4                | 34,2-37,8                | 36,7-40,5                | 39,0-43,0                | 43,7-48,3                |
|                                                                               | M10 x 1,5  | 48-53                                                               | 52-58                    | 68-75                    | 73-81                    | 80-88                    | 88-97                    |
|                                                                               | M12 x 1,75 | 82-91                                                               | 90-100                   | 116-128                  | 126-139                  | 139-153                  | 152-168                  |
|                                                                               | M14 x 2    | 129-143                                                             | 143-158                  | 182-202                  | 200-221                  | 221-244                  | 238-263                  |
|                                                                               | M16 x 2    | 200-221                                                             | 219-242                  | 283-312                  | 309-341                  | 337-373                  | 371-410                  |
|                                                                               | M18 x 2,5  | 276-305                                                             | 299-331                  | 390-431                  | 428-473                  | 466-515                  | 509-562                  |
|                                                                               | M20 x 2,5  | 390-431                                                             | 428-473                  | 553-611                  | 603-667                  | 660-730                  | 722-798                  |
|                                                                               | M22 x 2,5  | 523-578                                                             | 575-635                  | 746-824                  | 817-903                  | 893-987                  | 974-1076                 |
|                                                                               | M24 x 3    | 675-746                                                             | 732-809                  | 950-1050                 | 1040-1150                | 1140-1260                | 1240-1370                |
|                                                                               | M27 x 3    | 998-1103                                                            | 1088-1202                | 1411-1559                | 1539-1701                | 1710-1890                | 1838-2032                |
|                                                                               | M30 x 3,5  | 1378-1523                                                           | 1473-1628                | 1914-2115                | 2085-2305                | 2280-2520                | 2494-2757                |
| FINE PITCH - PASSO FINE - KLEINER SCHRITT<br>PASO FINO - PAS FIN              | M8 x 1     | 25,7-28,3                                                           | 27,5-30,5                | 36,2-39,8                | 40,0-44,0                | 42,8-47,2                | 47,5-52,5                |
|                                                                               | M10 x 1,25 | 49,4-54,6                                                           | 55,2-61,0                | 71,5-78,5                | 78,0-86,0                | 86,0-94,0                | 93,0-103,0               |
|                                                                               | M12 x 1,25 | 90-100                                                              | 98-109                   | 128-142                  | 139-154                  | 152-168                  | 166-184                  |
|                                                                               | M12 x 1,5  | 86-95                                                               | 94-104                   | 120-132                  | 133-147                  | 143-158                  | 159-175                  |
|                                                                               | M14 x 1,5  | 143-158                                                             | 157-173                  | 200-222                  | 219-242                  | 238-263                  | 261-289                  |
|                                                                               | M16 x 1,5  | 214-236                                                             | 233-257                  | 302-334                  | 333-368                  | 361-399                  | 394-436                  |
|                                                                               | M18 x 1,5  | 312-345                                                             | 342-378                  | 442-489                  | 485-536                  | 527-583                  | 580-641                  |
|                                                                               | M20 x 1,5  | 437-483                                                             | 475-525                  | 613-677                  | 674-745                  | 736-814                  | 808-893                  |
|                                                                               | M22 x 1,5  | 581-642                                                             | 637-704                  | 822-908                  | 903-998                  | 998-1103                 | 1078-1191                |
|                                                                               | M24 x 2    | 741-819                                                             | 808-893                  | 1045-1155                | 1140-1260                | 1235-1365                | 1363-1507                |
|                                                                               | M27 x 2    | 1083-1197                                                           | 1178-1302                | 1520-1680                | 1672-1848                | 1834-2027                | 2000-2210                |
|                                                                               | M30 x 2    | 1511-1670                                                           | 1648-1822                | 2138-2363                | 2332-2577                | 2565-2835                | 2788-3082                |





**SCREW-LOCKING, SEALING AND LUBRICATING MATERIALS - MATERIALI PER BLOCCAGGIO VITI, TENUTA E LUBRIFICAZIONE - MATERIAL ZUR BLOCKIERUNG VON SCHRAUBEN UND FÜR DICHTUNGEN UND SCHMIERMITTEL - MATERIALES PARA EL BLOQUEO, ESTANQUEIDAD Y LUBRICACION - MATERIAUX POUR LE BLOCAGE VIS, ÉTANCHEITÉ ET LUBRIFICATION**



1 - Locking, sealing and lubricating materials referred to in this manual are the same used in the shop-floor.

*I materiali per il bloccaggio, tenuta e lubrificazione specifica indicati nel manuale, sono quelli usati in fabbrica.*

Die Materialien zur Blockierung von Schrauben, für Dichtungen und Schmiermittel, die im Handbuch aufgeführt sind, sind dieselben die auch vom Hersteller verwendet werden.

*Los materiales para el bloqueo, estanqueidad y lubricación específica indicados en el manual, son los que se usan en la fábrica.*

*Les matériaux de blocage, d'étanchéité et de lubrification spécifiques indiqués dans ce manuel sont ceux employés à l'usine.*

2 - The table below gives an account of the typical applications of each single material, in order to facilitate replacement with similar products marketed by different brand names with different trade marks.

*Di questi materiali, vengono riportate le applicazioni tipiche che li distinguono, in modo da poterli sostituire con prodotti similari commercializzati da altre marche e quindi con altre sigle.*

Von diesen Materialien werden die typischen Anwendungen genannt, um sie mit ähnlichen Materialien zu ersetzen, die unter anderen Namen und Kennzeichnungen im Handel erhältlich sind.

*De estos materiales damos las aplicaciones típicas que los distinguen, de manera que se puedan sustituir con productos similares comercializados por otras marcas y por tanto con otras siglas.*

De ces matériaux ne sont reportées que les applications typiques qui les distinguent de telle sorte qu'ils puissent être substitués par des produits semblables se trouvant dans le commerce sous d'autres marques et par conséquent sous d'autres sigles.

| DENOMINATION<br>DENOMINAZIONE<br>BEZEICHNUNG<br>DENOMINACION<br>DENOMINATION | APPLICATION - APPLICAZIONE - ANWENDUNG - APLICACION - APPLICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Loctite 242                                                                  | <ul style="list-style-type: none"> <li>Anaerobic product apt to prevent the loosening of screws, nuts and plugs. Used for medium-strength locking. Before using it, completely remove any lubricant by using the specific activator.</li> <li><i>Prodotto anaerobico adatto a prevenire l'allentamento di viti, dadi e tappi. Usato per la frenatura a media resistenza. Deve essere usato dopo aver asportato ogni traccia di lubrificante con l'attivatore specifico.</i></li> <li>Anaerobes Produkt, um das Lockern von Schrauben, Muttern und Stopfen zu verhindern. Für mittlere Widerstandskräfte geeignet. Darf erst aufgetragen werden, wenn die Flächen von Schmiermittel richtig sauber sind. Dazu das entsprechende Produkt verwenden.</li> <li><i>Producto anaeróbico apto para prevenir el aflojamiento de tornillos, tuerca y tapones. Usado para el frenado de media resistencia. Tiene que ser usado sólo después de haber quitado todo residuo de lubricante con el activador específico.</i></li> <li>Produit anaérobie servant à prévenir le relâchement des vis, écrous et bouchons. Utilisé pour le freinage demi résistant. Il doit être utilisé après avoir enlevé toute trace de lubrifiant à l'aide d'un activateur spécial.</li> </ul>                                                                                                                                                                 |
| Loctite 243                                                                  | <ul style="list-style-type: none"> <li>The oleocompatible alternative to 242. Does not require the activation of lubricated surfaces.</li> <li><i>Prodotto alternativo al 242 che, essendo oleocompatibile, non richiede l'attivazione di superfici lubrificate.</i></li> <li>Alternatives Produkt zu Loctite 242. Da es ölkompatibel ist müssen die geschmierten Flächen nicht aktiviert werden.</li> <li><i>Producto alternativo al 242 que, siendo oleocompatible, no requiere la activación de superficies lubricadas.</i></li> <li>Produit en alternance avec le 242 lequel étant oléocompatible ne requiert aucune activation des surfaces lubrifiées.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Loctite 270                                                                  | <ul style="list-style-type: none"> <li>Anaerobic product for very-high strength locking of screws and nuts. Before using it, completely remove any lubricant by using the specific activator. To remove parts, it may be necessary to heat them at 80°C approx.</li> <li><i>Prodotto anaerobico adatto per la frenatura ad altissima resistenza di viti e dadi. Deve essere usato dopo aver asportato ogni traccia di lubrificante con l'attivatore specifico.</i></li> <li><i>La rimozione delle parti, può richiedere un riscaldamento a circa 80°C.</i></li> <li>Anaerobes Produkt für hohe Widerstandskräfte für Schrauben und Muttern geeignet. Zuerst die Fläche sorgfältig aktivieren. Um die Flächen zu säubern, diese auf ca. 80°C erwärmen.</li> <li><i>Producto anaeróbico apto para el frenado de alta resistencia de tornillos y tuercas. tiene que ser usado después de haber quitado todo residuo de lubricante con el activador específico.</i></li> <li><i>La remoción de las partes, puede requerir un calentamiento a unos 80°C.</i></li> <li>Produit anaérobie apte au freinage à très haute résistance des vis et des écrous. Il doit être utilisé après avoir enlevé toute trace de lubrifiant à l'aide d'un activateur spécial.</li> </ul>                                                                                                                                                                |
| Loctite 275                                                                  | <ul style="list-style-type: none"> <li>Anaerobic product suitable for high-strength locking and sealing of large threaded parts, bolts and stud bolts, for pipe sealing and for protecting parts against tampering; suitable for sealing coupling surfaces with a max. diametrical clearance of 0.25 mm.</li> <li><i>Prodotto anaerobico adatto per la frenatura e sigillatura ad alta resistenza di parti filettate, bulloni e prigionieri di grandi dimensioni, protezione antimanomissione e sigillatura di tubazioni; può sigillare accoppiamenti con gioco diametrale massimo di 0,25 mm.</i></li> <li>Anaerobes Produkt zum Bremsen und Siegeln von großen Gewinden, Muttern und Stiftschrauben, sehr widerstandsfähig, verschleierungsbeständig, und zum Siegeln von Rohrleitungen geeignet; kann Kupplungen mit einer maximalen Lagerluft von 0,25 mm siegeln.</li> <li><i>Producto anaeróbico apto para el frenado y selladura a alta resistencia de tornillos, tuercas y prisioneros de grandes dimensiones, protección anti manomisión y selladura de tubaciones; puede sellar encolcados con juego diametral.</i></li> <li>Produit anaérobie adapté au freinage et au scellage à haute résistance des parties filetées, boulons et prisonniers de grandes dimensions, protection anti-altération et scellage de tuyauteries; il peut sceller des accouplements ayant un jeu diamétral maximal de 0,25 mm.</li> </ul> |



**SCREW-LOCKING, SEALING AND LUBRICATING MATERIALS - MATERIALI PER BLOCCAGGIO VITI, TENUTA E LUBRIFICAZIONE - MATERIAL ZUR BLOCKIERUNG VON SCHRAUBEN UND FÜR DICHTUNGEN UND SCHMIERMITTEL - MATERIALES PARA EL BLOQUEO, ESTANQUEIDAD Y LUBRICACION - MATERIAUX POUR LE BLOCAGE VIS, ETANCHEITÉ ET LUBRIFICATION**

| DENOMINATION<br>DENOMINAZIONE<br>BEZEICHNUNG<br>DENOMINACION<br>DENOMINATION                                                                                                                                                                       | APPLICATION - APPLICAZIONE - ANWENDUNG - APLICACION - APPLICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Loctite 510</b>                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Anaerobic product for the hermetic sealing of flanged units and screw holes communicating with fluids. Can seal clearances between flanges up to 0.2 mm.</li> <li><i>Prodotto anaerobico adatto alla tenuta ermetica di fluidi tra assieme flangiati e di viti a foro comunicante con i fluidi. Può sigillare giochi tra le flange fino a 0,2 mm.</i></li> <li>Anaerobes Produkt zur Abdichtung von Flüssigkeiten an Flanschen und Schrauben mit Löchern, die mit Flüssigkeiten in Kontakt stehen. Kann ein Spiel zwischen Flanschen bis 0,2 mm abdichten.</li> <li><i>Producto anaeróbico apto para la estanqueidad de fluidos entre grupos bridados y de tornillos de orificio comunicante con los fluidos. Puede sellar juegos entre las bridas hasta 0,2 mm.</i></li> <li><i>Produit anaérobic apte à la tenue étanche des fluides entre les pièces à brides et des vis à trou en contact avec les fluides. Il peut sceller un jeu parmi les flasques jusqu'à 0,2 mm.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Loctite 577</b>                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Quick anaerobic sealant for sealing threaded portions of conical or cylindrical unions up to M80. Before using it, remove any lubricant with the specific activator. After polymerisation, disassembly may result rather difficult, so heating may be necessary for larger diameters.</li> <li><i>Prodotto anaerobico sigillante rapido per la tenuta di filettature di raccordi conici o cilindrici fino a M80. Deve essere usato dopo aver asportato ogni traccia di lubrificante con l'attivatore specifico. Dopo la polimerizzazione presenta una moderata difficoltà di smontaggio per cui può richiedere, per i diametri maggiori, un riscaldamento.</i></li> <li>Anaerobes Produkt zum schnellen Siegeln und Abdichten von Kegel- oder Zylinderkupplungen bis M80. Darf erst aufgetragen werden, nachdem mit einem spezifischen Wirkstoff jede Spur von Schmiermittel abgetragen worden ist. Nach der Polymerisation könnte das Abmontieren etwas schwierig sein weshalb größere Durchmesser zuerst erhitzt werden müssen.</li> <li><i>Producto anaeróbico sellante rapido para el estanqueido de tornillos de empalme conico o cilindrico hasta M80. Debe de ser utilizado despues de haber quitado cada mancha de lubricante con activador especifico. Despues de la polimeracion presenta una moderada dificultad de desmontaje por lo tanto puede necesitar, para los diametros mayores, un calentamiento.</i></li> <li><i>Produit anaérobic collage rapide assurant l'étanchéité des filetages des raccords coniques ou cylindriques jusqu'à M80. Il doit être utilisé après qu'on ait enlevé toute trace de lubrifiant à l'aide d'un activateur spécial. Une certaine difficulté de démontage se présente après la polymérisation, on peut donc avoir la nécessité de devoir chauffer préalablement pour de plus amples diamètres.</i></li> </ul> |
| <b>Loctite 638</b>                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Anaerobic adhesive for fast and high-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with clearance ranging between 0.1 and 0.25 mm.</li> <li><i>Adesivo anaerobico per l'incollaggio rapido ad alta resistenza di giunti cilindrici in metallo (mozzo su albero). Può incollare particolari con gioco tra 0,1 e 0,25 mm.</i></li> <li>Anaerobes Klebstoff für große Widerstandskräfte für Zylinderkupplungen aus Metall geeignet (Wellennaben). Kann Einzelteil mit einem Radialspiel zwischen 0,1 mm und 0,25 mm zusammenkleben.</li> <li><i>Adhesivo anaeróbico para el encolado rápido de alta resistencia de juntas cilíndricas de metal (cubo en el eje). Puede encolar piezas con juego entre 0,1 mm y 0,25 mm.</i></li> <li><i>Adhésif anaérobic servant à un collage rapide et hautement résistant des joints cylindriques en métal (moyeu sur l'arbre). Il peut servir à coller des pièces avec un jeu allant de 0,1 à 0,25 mm.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Loctite 648</b>                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Anaerobic adhesive for fast and medium-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with radial clearance below 0.1 mm.</li> <li><i>Adesivo anaerobico per l'incollaggio rapido a media resistenza di giunti cilindrici in metallo (mozzo su albero). Può incollare particolari con gioco radiale inferiore a 0,1 mm.</i></li> <li>Anaerobes Klebstoff für mittlere Widerstandskräfte für Zylinderkupplungen aus Metall geeignet (Wellennaben). Kann Einzelteil mit einem Radialspiel von weniger als 0,1 mm zusammenkleben.</li> <li><i>Adhesivo anaeróbico para encolado rápido de media resistencia juntas cilíndricas de metal (cubo en el eje). Puede encolar piezas con juego radial inferior a 0,1 mm.</i></li> <li><i>Adhésif anaérobic servant à un collage rapide moyennement résistant des joints cylindriques en métal (moyeu sur l'arbre). Il peut servir à coller des pièces avec un jeu radial inférieur à 0,1 mm.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>(AREXONS)</b><br>Repositionable jointing compound for seals<br><i>Mastice per guarnizioni riposizionabile</i><br>Klebstoff für verstellbare Dichtungen<br><i>Pasta para juntas reposicionable</i><br>Mastic pour garnitures à remettre en place | <ul style="list-style-type: none"> <li>Solvent-based sealing compound for elastic seals, drying through evaporation. Used for sealing the outer diameter of sealing rings for rotating shafts with outer metal reinforcement.</li> <li><i>Mastice sigillante per guarnizioni elastiche a base di solvente, essicante per evaporazione. Viene utilizzato per la tenuta sul diametro esterno di anelli di tenuta per alberi rotanti con armatura metallica esterna.</i></li> <li>Klebstoff für Gummidichtung auf Lösemittelbasis, trocknet durch Verdampfung. Wird am äußeren Durchmesser von Dichtungsringe bei rotierenden Wellen mit Metallmantel verwendet.</li> <li><i>Pasta para juntas de sellado para juntas elásticas a base de disolvente, deshidratante por evaporación. Se utiliza para la estanqueidad en el diametro externo de segmentos de compresión, para ejes giratorios con armadura metálica exterior.</i></li> <li><i>Mastic adhésif à base de solvants pour garnitures élastiques, séchant par évaporation. Il sert à garder étanche le diamètre extérieur des bagues d'étanchéité des arbres rotatifs ayant une armature métallique externe.</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |





**SCREW-LOCKING, SEALING AND LUBRICATING MATERIALS - MATERIALI PER BLOCCAGGIO VITI, TENUTA E LUBRIFICAZIONE - MATERIAL ZUR BLOCKIERUNG VON SCHRAUBEN UND FÜR DICHTUNGEN UND SCHMIERMITTEL - MATERIALES PARA EL BLOQUEO, ESTANQUEIDAD Y LUBRICACION - MATERIAUX POUR LE BLOCAGE VIS, ETANCHEITÉ ET LUBRIFICATION**

| DENOMINATION<br>DENOMINAZIONE<br>BEZEICHNUNG<br>DENOMINACION<br>DENOMINATION                                                                                           | APPLICATION - APPLICAZIONE - ANWENDUNG - APLICACION - APPLICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <b>Silicone</b><br><b>Silicone</b><br><b>Silikon</b><br><b>Silicona</b><br><b>Silicone</b>                                                                             | <ul style="list-style-type: none"> <li>• Semi-fluid adhesive material used for sealing and filling and to protect components from environmental and physical elements. Polymerises with non-corrosive dampness.</li> <li>• <i>Materiale adesivo semifluido usato per sigillatura, riempimenti e per la protezione di componenti dagli elementi ambientali e fisici. Polimerizza con umidità non corrosiva.</i></li> <li>• Halbflüssiger Klebstoff zum Befestigen, Füllen und zum Schutz von Bestandteilen vor äußeren Einwirkungen. Polymerisiert durch nicht korrosive Feuchtigkeit</li> <li>• <i>Material adhesivo semifluido usado para el sellado, llenado y para la protección de componentes de elementos ambientales y físicos. Polimeriza con humedad no corrosiva.</i></li> <li>• Produit adhésif semi-fluide utilisé pour le scellage, remplissage et protection des éléments ambiants et physiques. Polymérise à une humidité non corrosive.</li> </ul>                                                                                                                                                                                                                                                                                                       |
| <b>(TECNO LUPE/101)</b><br><b>Silicone-based grease</b><br><b>Grasso al silicone</b><br><b>Silikonfett</b><br><b>Grasa a la silicona</b><br><b>Graisse au silicone</b> | <ul style="list-style-type: none"> <li>• Highly adhesive synthetic grease, with silicone compounds added. Applied to adjustment screws with hole communicating with oil-type fluids. Used when frequent adjusting is required.</li> <li>• <i>Grasso sintetico con elevato grado di adesività, additivato con composti silicnici. Applicato su viti di registrazione a foro comunicante con fluidi di tipo oleoso. Usato quando si richiedono frequenti interventi di registrazione.</i></li> <li>• Synthetisches Fett mit hoher Haftfestigkeit, mit silikonhaltigen Stoffen legiert. Wird auf Stellschrauben mit Loch, die mit ölhaltigen Flüssigkeiten in Kontakt stehen, angebracht. Wird verwendet, wenn die Schraub öfters eingestellt werden muß.</li> <li>• <i>Grasa sintética con elevado grado de adhesión, aditivada con componentes silicónicos. Aplicada en tornillos de ajuste de orificio comunicante con fluidos de tipo oleoso. Se usa cuando se requieren frecuentes intervenciones de ajuste.</i></li> <li>• Graisse synthétique ayant un degré d'adhésivité élevé, adjuvé de composés au silicone. Appliqué sur les vis de réglage à trou communiquant avec des fluides du type huileux. Utilisé quand il y a besoin de réglages fréquents.</li> </ul> |
| <b>Molikote</b><br><b>(DOW CORNING)</b>                                                                                                                                | <ul style="list-style-type: none"> <li>• Lubricating compound containing molybdenum disulphide, used to lubricate articulation pins and to prevent sticking and oxidation of parts that are not lubricated on a regular basis.</li> <li>• <i>Composto lubrificante contenente bisolfuro di molibdeno, usato per la lubrificazione di perni snodo e per prevenire incollamenti ed ossidazioni di particolari non lubrificati in modo continuo.</i></li> <li>• Schmierstoff mit Molybdändisulfid; wird zum Schmieren von Gelenkstiften und gegen Ankleben und Oxydation von nicht dauergeschmierten Einzelteilen verwendet.</li> <li>• <i>Compuesto lubricante que contiene bisulfuro de molibdeno, usado para la lubricación de rótulas y para prevenir encoladuras y oxidaciones de piezas no lubricadas de manera continua.</i></li> <li>• Composé lubrifiant contenant du bisulfure de molybdène, utilisé pour lubrifier les axes d'articulation et prévenir collages et oxydations des pièces qui ne sont pas continuellement lubrifiées.</li> </ul>                                                                                                                                                                                                                  |
| <b>(Lithium-based) Grease</b><br><b>Grasso (al Litio)</b><br><b>(Lithium) Fett</b><br><b>Grasa (al Litio)</b><br><b>Graisse (au Lithium)</b>                           | <ul style="list-style-type: none"> <li>• Applied to bearings, sliding parts and used to lubricate seals or parts during assembly</li> <li>• <i>Applicato a cuscinetti, parti scorrevoli e per lubrificare guarnizioni o pezzi in fase di montaggio.</i></li> <li>• Wird auf Lager, Gleiteilen aufgetragen und zum Schmieren von Dichtungen oder von Teilen bei der Montage verwendet.</li> <li>• <i>Aplicada a cojinetes, partes deslizables o para lubricar juntas o piezas en fase de montaje.</i></li> <li>• Appliqué sur les paliers, parties coulissantes et pour lubrifier les garnitures ou pièces pendant la phase de montage.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |





## NOTES ON SAFETY PRECAUTIONS - NOTE RIGUARDANTI LA SICUREZZA - BEMERKUNGEN ZUR SICHERHEIT - NORMAS CONCERNIENTES A LA SEGURIDAD - NOTES EN MATIERE DE SECURITE

- GB**
- 1 - During all operations described in this manual, the axle should be fastened onto a trestle, while the other parts mentioned should rest on supporting benches.
  - 2 - When removing one of the arms, an anti-tilting safety trestle should be placed under the other arm.
  - 3 - When working on an arm that is fitted on the machine, make sure that the supporting trestles are correctly positioned and that the machine is locked lengthways.
  - 4 - Do not admit any other person inside the work area; mark off the area, hang warning signs and remove the ignition key from the machine.
  - 5 - Use only clean, quality tools; discard all worn, damaged, low-quality or improvised wrenches and tools. Ensure that all dynamometric wrenches have been checked and calibrated.
  - 6 - Always wear gloves and non-slip rubber shoes when performing repair work.
  - 7 - Should you stain a surface with oil, remove marks straight away.
  - 8 - Dispose of all lubricants, seals, rags and solvents once work has been completed. Treat them as special waste and dispose of them according to the relative law provisions obtaining in the country where the axles are being overhauled.
  - 9 - Make sure that only weak solvents are used for cleaning purposes; avoid using turpentine, dilutants and toluol-, xylol-based or similar solvents; use light solvents such as Kerosene, mineral spirits or water-based, environment friendly solvents.
  - 10 - For the sake of clarity, the parts that do not normally need to be removed have not been reproduced in some of the diagrams.
  - 11 - The terms RIGHT and LEFT in this manual refer to the position of the operator facing the axle from the side opposite the drive.
  - 12 - After repair work has been completed, accurately touch up any coated part that may have been damaged.

- ITA**
- 1 - Le operazioni descritte sono riferite all'assale bloccato su cavalletto ed alcuni particolari appoggiati su un banco di lavoro.
  - 2 - Quando si asporta un braccio dell'assale, sistemare sotto l'altro braccio un cavalletto di sicurezza antiribaltamento.
  - 3 - Se si opera su un'assale montato sulla macchina, assicurarsi di aver sistemato dei cavalletti di sostentamento e di aver immobilizzato longitudinalmente la macchina.
  - 4 - Non permettere che persone estranee entrino nella zona di lavoro; delimitare questa zona, appendere dei cartelli di avviso di lavori in corso ed asportare le chiavi di avviamento della macchina.
  - 5 - Usare solo ed esclusivamente attrezzi puliti e di buona qualità; scartare chiavi od attrezzi usurati o danneggiati, di bassa qualità od improvvisati. Assicurarsi che le chiavi dinamometriche siano state controllate e tarate.
  - 6 - Durante le operazioni di riparazione, indossare sempre guanti e scarpe antiscivolo.
  - 7 - Pulire immediatamente le zone eventualmente imbrattate d'olio.
  - 8 - I lubrificanti, le guarnizioni, gli eventuali stracci di pulizia ed i solventi usati devono essere smaltiti come rifiuti speciali e comunque secondo le normative vigenti nel Paese ove vengono revisionati gli assali.
  - 9 - Per la pulizia, usare solo solventi deboli escludendo categoricamente trielina, diluenti e solventi a base di toluolo, xilolo, ecc.; usare solo solventi leggeri quali cherosene, ragie minerali o solventi ecologici a base d'acqua.
  - 10 - Per chiarezza di illustrazione ed esposizione, sulle figure di alcuni gruppi mancano dei particolari che, normalmente, possono essere lasciati montati. Rimuovere solo i particolari descritti.
  - 11 - I termini DESTRA e SINISTRA usati nel manuale sono riferiti alla persona che guarda l'assale dal lato opposto alla presa di moto.
  - 12 - Al termine delle riparazioni, per evitare dannose ossidazioni, ritoccare con cura le parti verniciate eventualmente danneggiate.

- D**
- 1 - Die beschriebenen Vorgänge werden an der Achse vorgenommen, wenn diese auf einem Bock blockiert ist. Zur Bearbeitung der Einzelteile, werden diese auf die Werkbank gelegt.
  - 2 - Wenn eine Achse abgenommen wird, einen Sicherheitsbock unter den zweiten Arm legen.
  - 3 - Werden Arbeiten an der Achse vorgenommen, wenn diese noch an der Maschine montiert ist, Böcke zur Halterung unter die Achse stellen und die Maschine der Länge nach blockieren.
  - 4 - Es dürfen sich keine fremde Personen in der Nähe der Maschine während der Arbeiten aufhalten; diesen Bereich absperren und mit Schilder kennzeichnen, die auf die laufenden Arbeiten hinweisen. Zündschlüssel von der Maschine abnehmen.
  - 5 - Nur saubere Werkzeuge guter Qualität verwenden; alte, beschädigte oder improvisierte Hilfsmittel nicht verwenden. Sicherstellen, daß die Dynamometer geprüft und geeicht worden sind.
  - 6 - Bei Reparaturen, stets Handschuhe und rutschfeste Schuhe tragen.
  - 7 - Mit Öl beschmutzte Stellen, sofort reinigen.
  - 8 - Gebrauchte Schmiermittel, Dichtungen, Reinigungslappen und

- Lösemittel müssen als Sondermüll und auf jeden Fall laut den örtlich geltenden Vorschriften entsorgt werden.
- 9 - Zur Reinigung ausschließlich schwache Lösemittel wie Petroleum, Terpentin oder wasserhaltige Lösemittel verwenden. Auf keinen Fall Trichloräthylen, tuolol- oder xylolhaltige Lösemittel usw. verwenden.
  - 10 - Um die Arbeitsvorgänge verständlich abzubilden, werden in einigen Fotos die Aggregate ohne Einzelteile gezeigt, die sonst bei der Arbeit nicht abmontiert werden müssen. Nur die beschriebenen Teile abmontieren.
  - 11 - Unter RECHTS und LINKS versteht man in diesem Handbuch die Seite einer Person, die zur Achse schaut und zwar dem Antrieb entgegengesetzt.
  - 12 - Nach beendeten Arbeiten und um Rostbildungen zu vermeiden, die Teile an denen der Lack ggf. beschädigt worden ist, anstreichen.

- ESP**
- 1 - Las operaciones descritas se refieren al eje bloqueado en un caballete y a algunas partes apoyadas en el banco de trabajo.
  - 2 - Cuando se saca un brazo del eje, colocar debajo del otro un caballete de seguridad antivuelco.
  - 3 - Si se trabaja con un eje montado en la máquina, asegurarse de haber colocado caballetes soporte y de haber inmovilizado longitudinalmente la máquina.
  - 4 - No permitir que personas extrañas entren en la zona de trabajo; delimitar esta zona, colgar carteles de aviso de hombres trabajando y sacar las llaves de arranque de la máquina.
  - 5 - Usar sólo y exclusivamente herramientas limpias y de buena calidad; descartar llaves o herramientas gastadas o dañadas, de calidad mediocre o improvisadas. Asegurarse de que las llaves dinamométricas han sido controladas y calibradas.
  - 6 - Durante las operaciones de reparación, llevar siempre guantes y calzado antideslizamiento.
  - 7 - Limpiar inmediatamente las zonas que pudieran estar sucias de aceite.
  - 8 - Los lubricantes, las juntas, los trapos para la limpieza y los disolventes usados hay que eliminarlos como desechos especiales y, de todas formas, de acuerdo con las normativas vigentes en el país en el que se revisan los ejes.
  - 9 - Para limpiar, utilizar sólo disolventes débiles excluyendo en absoluto tricloroetileno, diluyentes y disolventes a base de toluol, silol, etc.; usar sólo disolventes ligeros como querosano, aguarrás minerales o disolventes ecológicos a base de agua.
  - 10 - Para que resulte clara la exposición y la ilustración, en las figuras de algunos grupos faltan algunas piezas que por lo general se pueden dejar montadas. Sacar sólo las partes descritas.
  - 11 - Las palabras DERECHA E IZQUIERDA usadas en el manual se refieren a la persona que mira el eje del lado opuesto a la toma de movimiento.
  - 12 - Al final de las reparaciones, para evitar oxidaciones, retocar cuidadosamente las partes pintadas que estuvieran dañadas.

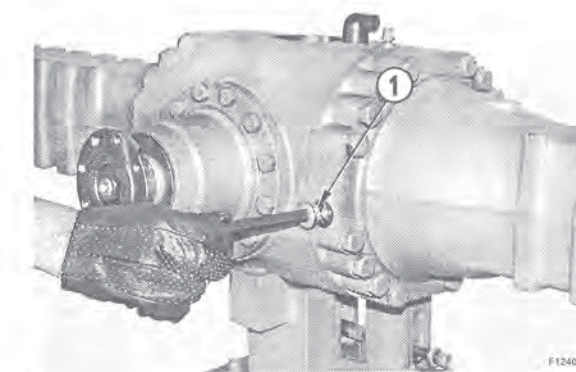
- F**
- 1 - Les opérations décrites se rapportent à l'essieu bloqué sur chevalet et de quelques pièces posées sur un établi de travail.
  - 2 - Quand on enlève un essieu monté sur la machine, ajuster sous l'autre bras un chevalet de sécurité contre tout basculement.
  - 3 - Si on œuvre sur un essieu monté sur la machine, s'assurer d'avoir aménagé des chevalets de soutien et d'avoir bloqué la machine en longueur.
  - 4 - Ne jamais permettre à des étrangers de pénétrer dans la zone de travail; délimiter cette zone, mettre des pancartes de signalisation de travaux en cours et enlever les clés de contact de la machine.
  - 5 - N'utiliser que des outils propres et de bonne qualité; éliminer clé ou autres outils usés, abîmés, de mauvaise qualité ou improvisés. Veiller à ce que les clés dynamométriques aient été contrôlées et calibrées.
  - 6 - Pendant les opérations de réparation, endosser toujours gants et chaussures antidérapantes.
  - 7 - Nettoyer tout de suite les éventuelles zones souillées d'huile.
  - 8 - Les lubrifiants, les garnitures, les éventuels chiffons servant au nettoyage et les solvants utilisés devront être récoltés et traités comme rebut spécial conformément aux lois en vigueur dans le pays où les essieux sont en révision.
  - 9 - Pour le nettoyage, n'utiliser que des solvants à base de toluol, xylol, etc.; n'utiliser que des solvants légers tels que kérosène, essences minérales, ou solvants écologiques à base d'eau.
  - 10 - En ce qui concerne la clarté en matière d'illustration et exposition, sur les figures de certains groupes, il y a des pièces manquantes qui normalement peuvent rester montées. Enlever uniquement les pièces décrites.
  - 11 - Les termes DROITE et GAUCHE utilisés dans ce manuel se rapportent à la personne regardant l'essieu du côté opposé à celui de la prise de mouvement.
  - 12 - A la fin des opérations, afin d'éviter un risque d'oxydation nuisible, retoucher soigneusement les parties vernies éventuellement abîmées.



| SYMBOLS - SIMBOLI - SYMBOLS<br>SIMBOLOS - SYMBOLES |                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                    | Disassembly of assembly groups<br>Smontaggio di sottogruppi<br>Zerlegen von Baugruppen<br>Desmontaje de subgrupos<br>Démontage des sous-groupes                                                                                                                                                           |
|                                                    | Reassemble to from assembly groups<br>Montaggio di sottogruppi<br>Zusammenbauen von Baugruppen<br>Ensamblaje de subgrupos<br>Montage des sous-groupes                                                                                                                                                     |
|                                                    | Remove obstruction parts<br>Smontaggio di particolari ingombri<br>Abbauen-Ausbauen<br>Desmontaje de componentes abultados<br>Démontage des pièces encombrantes                                                                                                                                            |
|                                                    | Reinstall-remount parts which had obstructed disassembly<br>Montaggio di particolari ingombri<br>Einbauen-Ausbauen<br>Montaje de componentes abultados<br>Montage des pièces encombrantes                                                                                                                 |
|                                                    | Attention! Important notice<br>Attenzione, indicazione importante<br>Achtung, wichtiger Hinweis<br>¡Cuidado! Indicación importante<br>Attention, indication importante                                                                                                                                    |
|                                                    | Check - adjust e.g. torque, dimensions, pressures, etc.<br>Controllare - regolare p.e. coppie, misure, pressioni ecc.<br>Prüfen - Einstellen z.B. Momente, Maße, Drucke u.s.ä.<br>Controlar y ajustar, por ej. pares, medidas, presiones, etc.<br>Controler, régler p.e. couples, mesures, pressions etc. |
|                                                    | T = Special tool<br>T = Attrezzature speciali<br>T = Spezialwerkzeug<br>T = Herramientas especiales<br>T = Outils<br>P = page<br>P = Pagina<br>P = Seite<br>P = Página<br>P = Page                                                                                                                        |
|                                                    | Note direction of installation<br>Rispettare direzione di montaggio<br>Einbaurichtung beachten<br>Respetar la dirección de ensamble<br>Respecter direction de montage                                                                                                                                     |
|                                                    | Visual inspection<br>Esaminare con controllo visuale<br>Kontrollieren - Prüfen<br>Examinar mediante inspección visual<br>Controler, examiner, contrôle visuel                                                                                                                                             |
|                                                    | Possibly still serviceable, renew if necessary<br>Eventualmente riutilizzare (sostituire se necessario)<br>Bedingt weiterverwendbar<br>Puede volver a utilizarse (reemplazar, si es preciso)<br>Eventuellement a utiliser a nouveau (remplacer si nécessaire)                                             |
|                                                    | Renew at each reassembly<br>Sostituire ad ogni montaggio<br>Beim Zusammenbau immer erneuern<br>Puede reemplazarse a cada ensamble<br>Remplacer avec chaque montage                                                                                                                                        |
|                                                    | Unlock - lock e.g. split pin, locking plate, etc.<br>Togliere-mettere la sicura<br>Entsichern-Sichern<br>Quitar-colocar el seguro<br>Enlever-mettre la sécurité                                                                                                                                           |
|                                                    | Lock-adhere (liquid sealant)<br>Mettere la sicura, incollare (mastice liquido)<br>Sichern-Kleben (flüssige Dichtung)<br>Colocar el seguro, pegar (mástique líquido)<br>Mettre la sécurité, coller (mastic liquide)                                                                                        |
|                                                    | Guard against material damage, damage to parts<br>Evitare danni materiali, danni a pezzi<br>Materialschaden verhüten<br>Evitar dañar los materiales o las piezas<br>Eviter dommages au matériaux, dommages aux pièces                                                                                     |
|                                                    | Mark before disassembly, observe marks when reassembly<br>Marchiare prima dello smontaggio (per il montaggio)<br>Vor dem Ausbau markieren (für den Zusammenbau)<br>Marcar antes de desmontar (para facilitar el ensamble)<br>Marquer avant le démontage (pour le montage)                                 |
|                                                    | Filling - topping up - refilling e.g. oil, cooling water, etc.<br>Caricare - riempire (olio - lubrificante)<br>Einfüllen - Auffüllen - Nachfüllen (Öl-Schmiermittel)<br>Cargar - llenar (aceite lubricante)<br>Charger - remplir (huile - lubrifiant)                                                     |
|                                                    | Drain off oil, lubricant<br>Scaricare olio lubrificante<br>Öl, bzw. Schmiermittel Ablassen<br>Descargar aceite lubricante<br>Vidanger, lubrifiant                                                                                                                                                         |
|                                                    | Tighten<br>Tendere<br>Spannen<br>Tenser<br>Tendre                                                                                                                                                                                                                                                         |
|                                                    | Apply pressure into hydraulic circuit<br>Inserire pressione nel circuito idraulico<br>Leitung unter Druck setzen<br>Introducir presión en el circuito hidráulico<br>Insérer pression dans le circuit hydraulique                                                                                          |
|                                                    | To clean<br>Pulire<br>Reinigen<br>Limpiar<br>Nettoyer                                                                                                                                                                                                                                                     |
|                                                    | Lubricate - grease<br>Lubrificare - ingrassare<br>Schmieren - einfetten<br>Lubrificar - engrasar<br>Lubrifier - Graisser                                                                                                                                                                                  |



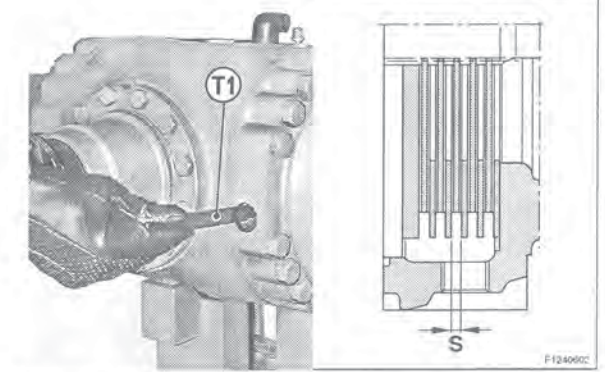
CHECKING WEAR AND REPLACING THE BRAKING DISKS - CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO - VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN - CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO - CONTROLE D'USURE ET SUBSTITUTION DES DISQUES DE FREINAGE



GB

a

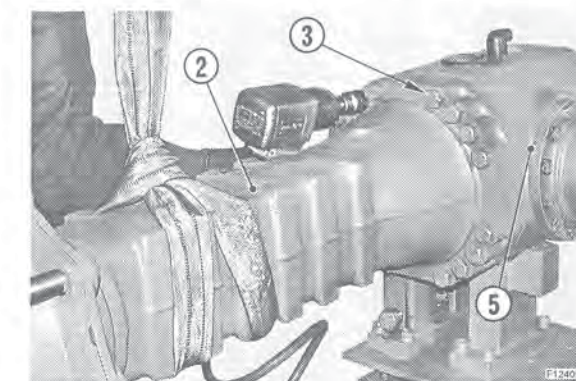
CAUTION! Perform all operations on both arms.  
Remove the oil-level plug (1).



GB

b

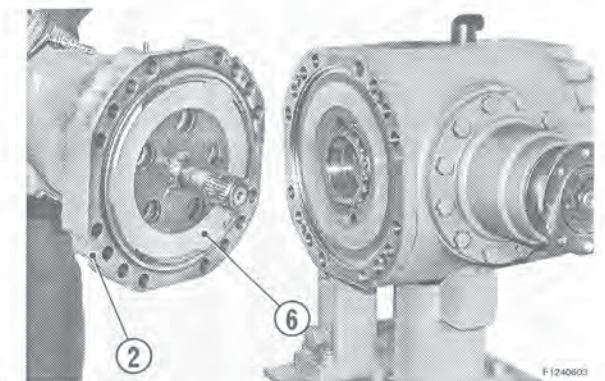
Apply the brakes and, keeping them under pressure, check the linings "S" between the disks using tool T1.  
Minimum "S": 4.5 mm.  
CAUTION! Replace the braking disks and the intermediate disks on both sides if necessary.



GB

c

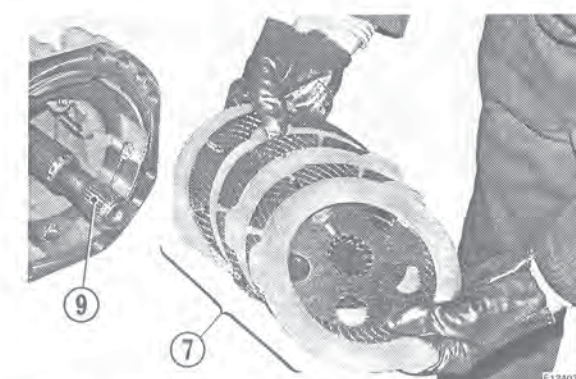
Unloose and remove the screws (3) and the washers (4) that fix the arm (2) to the central body (5).



GB

d

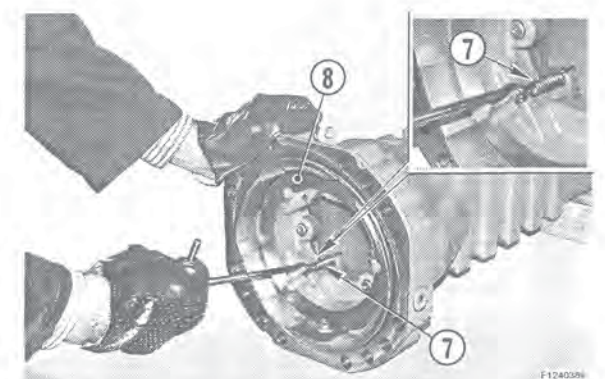
Remove the arm (2) together with the pack of the braking disks (6). Place the arm on a bench.



GB

e

Remove the braking disks (6) and note down their order of assembly.  
NOTE. 1 - If the disks do not need replacing, avoid switching their position.  
2 - Extract the axle shaft (9).



GB

f

Remove the reversal springs (7) from the piston (8).  
NOTE. If the springs (7) are weak or deformed they must be replaced.

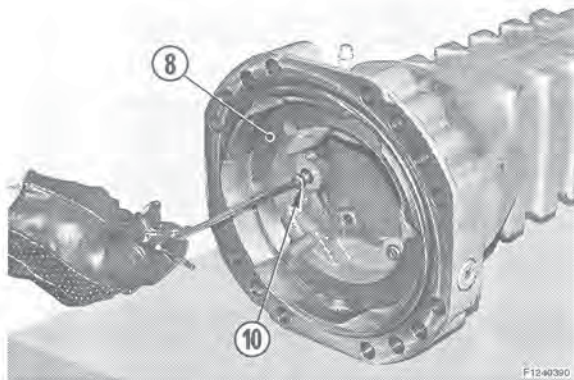


- a**
- ITA** **ATTENZIONE!** Eseguire tutte le operazioni per i due bracci.  
Asportare il tappo (1) di livello olio.
- D** **ACHTUNG!** Alle Vorgänge für beide Arme durchführen.  
Ölpegelstopfen (1) abnehmen.
- ESP** **CUIDADO!** Ejecutar todas las operaciones para los dos brazos.  
Sacar el tapón (1) de carga de nivel aceite.
- F** **ATTENTION!** Effectuer toutes les opérations sur les 2 bras.  
Enlever le bouchon de la jauge d'huile (1).
- b**
- ITA** Eseguire una frenata e, mantenendo la pressione, controllare con l'attrezzo T1 lo spessore "S" tra i dischi.  
"S" minimo: 4,5 mm  
**ATTENZIONE!** Se necessario, sostituire i dischi freno ed intermedi di ambedue i lati.
- D** Die Bremse einmal betätigen und bei betätigter Bremse mit dem T1 Werkzeug das Distanzstück "S" zwischen den Scheiben kontrollieren.  
"S" mindestens: 4,5 mm  
**ACHTUNG!** Wenn nötig, die Bremscheiben und die mittleren Scheiben auf beiden Seiten auswechseln.
- ESP** Ejecutar un frenado y, manteniendo la presión, controlar con la herramienta T1, el espesor "S" entre los discos.  
"S" mínimo: 4,5 mm  
**CUIDADO!** Si fuera necesario, sustituir los discos del freno y los intermedios a ambos lados.
- F** Effectuer un freinage, puis en tenant sous pression, contrôler à l'aide de l'outil T1 la cale "S" entre les disques.  
"S" minimum: 4,5 mm.  
**ATTENTION!** Si besoin, substituer les disques de freinage et les intermédiaires des deux côtés.
- c**
- ITA** Allentare ed asportare le viti (3) e le rondelle (4) che fissano il braccio (2) al corpo centrale (5).
- D** Schrauben (3) mit den Unterlegscheiben (4) lockern und abschrauben, die den Arm (2) am zentralen Körper (5) befestigen.
- ESP** Aflojar y extraer los tornillos (3) y las arandelas (4) que fijan el brazo (2) al cuerpo central (5).
- F** Desserrer et enlever les vis (3), les rondelles (4) qui fixent le bras (2) au corps central (5).
- d**
- ITA** Rimuovere il braccio (2) e con esso il pacco dei dischi di frenatura (6).  
Posizionare il braccio su un banco di lavoro.
- D** Arm (2) samt Bremscheiben (6) abnehmen.  
Arm auf die Werkbank legen.
- ESP** Remover el brazo (2) y con el mismo el paquete de discos de frenado (6).  
Posicionar el brazo en un banco de trabajo.
- F** Déposer le bras (2) et avec ce dernier le paquet de disques de freinage (6).  
Placer le bras sur l'établi d'usinage.
- e**
- ITA** Rimuovere i dischi di frenatura (6) annotando l'ordine di montaggio.  
**NOTA.** 1 - Se i dischi non vanno sostituiti, evitare lo scambio di posizione.  
2 - Estrarre il semiasse (9).
- D** Bremscheiben (6) abnehmen und auf die Reihenfolge der Montage achten.  
**BEMERKUNG.** 1 - Sollen die Scheiben nicht ausgetauscht werden, diese in der richtigen Reihenfolge zur Seite legen.  
2 - Halbachse (9) abnehmen.
- ESP** Remover los discos de frenado (6) anotando el orden de montaje.  
**NOTA.** 1 - Si los discos no tienen que ser sustituidos, evitar el intercambio de posición.  
2 - Extraer el semieje (9).
- F** Enlever les disques de freinage (6) en prenant note de l'ordre de montage.  
**NOTE.** 1 - Si les disques ne sont pas à remplacer, éviter le changement de position.  
2 - Extraire le demi-essieu (9).
- f**
- ITA** Rimuovere le molle (7) di dentro del pistone (8).  
**NOTA.** Se le molle (7) risultano snervate o deformate, devono essere sostituite.
- D** Rückzugsfedern (7) des Kolbens (8) abnehmen.  
**BEMERKUNG.** Wenn die Federn (7) nachgesetzt oder verformt sind, diese auswechseln.
- ESP** Remover los muelles (7) de vuelta del pistón (8).  
**NOTA.** Si los muelles (7) están desnervados o deformados, hay que sustituirlos.
- F** Enlever les ressorts (7) de rentrée du piston (8).  
**NOTE.** Si les ressorts (7) sont éternés ou déformés, il faut les remplacer.





CHECKING WEAR AND REPLACING THE BRAKING DISKS - CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO - VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN - CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO - CONTROLE D'USURE ET SUBSTITUTION DES DISQUES DE FREINAGE



GB

a

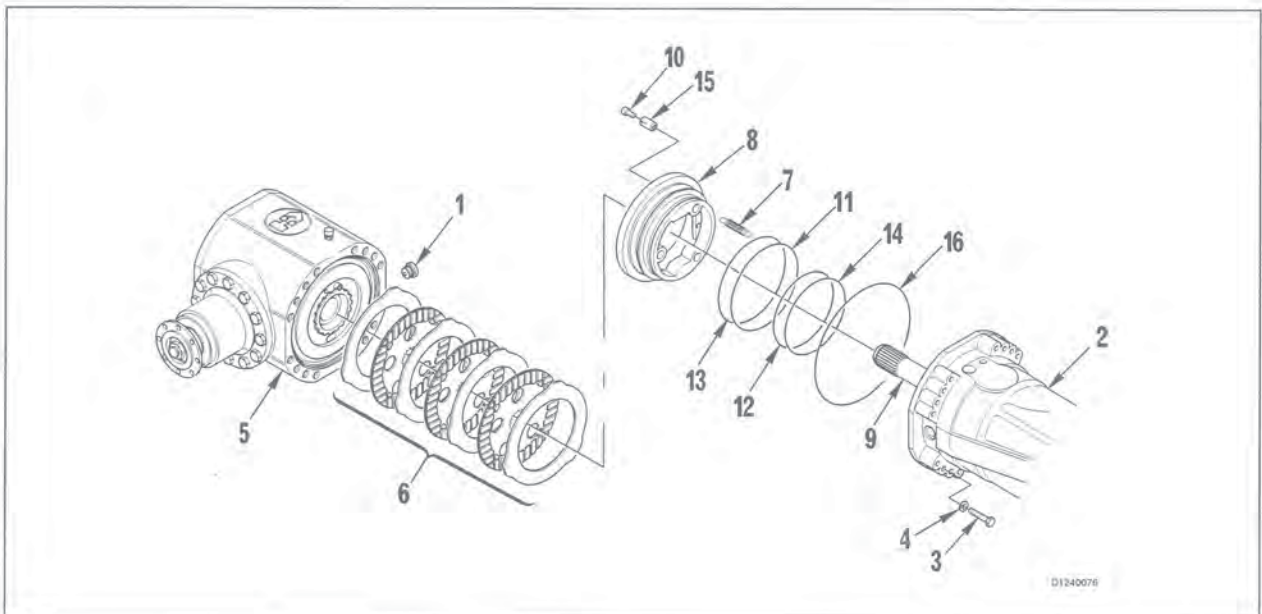
Remove the pin screws (10) guiding the piston (8).  
**CAUTION!** If the screws are to be replaced, note down the different colours for the different brake gaps.  
 (See «HOW TO ASSEMBLE THE BRAKING UNITS»)



GB

b

Slowly introduce compressed air through the connection of the braking circuit in order to extract the entire piston.  
**CAUTION!** Hold on to the piston as it may be suddenly ejected and damaged.





**ITA**

Rimuovere le viti a perno (10) di guida del pistone (8).  
**ATTENZIONE!** Se le viti devono essere sostituite, annotare la colorazione distintiva per i giochi freno (Vedere «ASSEMBLAGGIO GRUPPI DI FRENATURA»).

**D**

Die Stiftschraube (10) zur Kolbenführung (8) entfernen.  
**ACHTUNG!** Sollen die Schrauben ausgewechselt werden, auf die farbige Kennzeichnung für das Bremsenspiel achten (Siehe «ZUSAMMENBAU DER BREMSAGGREGATE»).

**ESP**

Remover los pernos roscados (10) de guía del pistón (8).  
**CUIDADO!** Si hay que sustituir los pernos, anotar el color distintivo para los juegos del freno (Véase «MONTAJE DE LOS GRUPOS DE FRENADO»).

**F**

Enlever les vis goujon (10) de guidage du piston (8).  
**ATTENTION!** Si les vis doivent être remplacées, prendre note de la couleur de distinction des jeux de frein (Voir «ASSEMBLAGE DU GROUPE DE FREINAGE»).

**a**

**ITA**

Immettere lentamente aria compressa attraverso l'attacco del circuito frenante per estrarre il pistone completo.  
**ATTENZIONE!** Trattenere il pistone che può essere espulso velocemente ed essere danneggiato.

**D**

Langsam Druckluft in den Bremskreislauf blasen, um den kompletten Kolben herauszuziehen.  
**ACHTUNG!** Den Kolben mit der Hand halten, um zu vermeiden daß er zu schnell herausgestoßen und beschädigt wird.

**ESP**

Introducir lentamente aire comprimido a través de la unión del circuito frenante para extraer el pistón completo.  
**CUIDADO!** Retener el pistón porque puede ser expulsado rápidamente y quedar dañado.

**F**

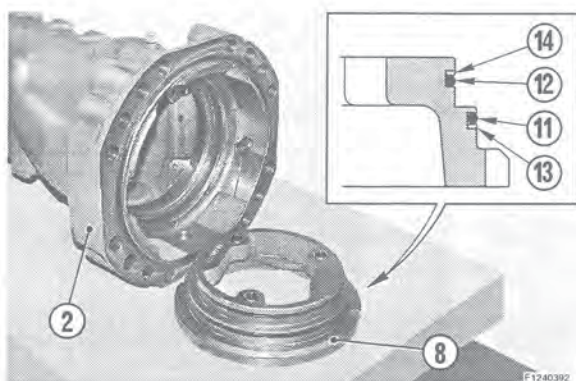
Injecter tout doucement de l'air comprimé à travers le raccord du circuit freinant pour extraire le piston complet.  
**ATTENTION!** Retenir le piston qui pourrait être éjecté fortement et s'abîmer.

**b**





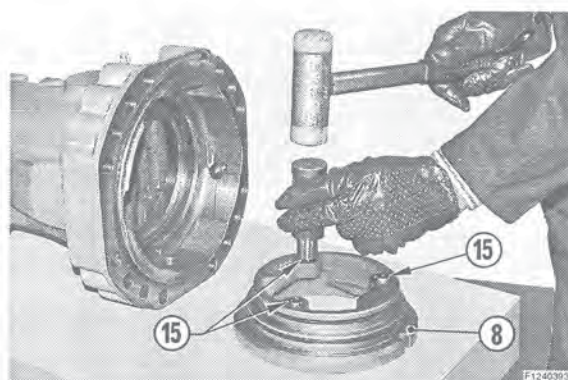
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MONTAJE DE LOS GRUPOS DE FRENADO - ASSEMBLAGE DES GROUPE DE FREINAGE



GB

a

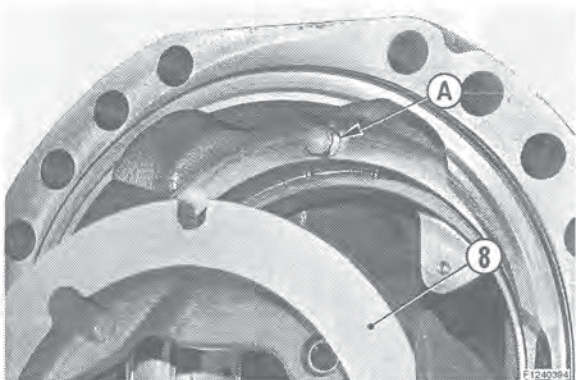
Accurately clean the piston (8) and the seats of slide and seal. Replace the O-rings (11) and (12) and the anti-extrusion rings (13) and (14); make sure that the assembly side is correct.  
**CAUTION!** Accurately check the positioning of the anti-extrusion rings (13) and (14).



GB

b

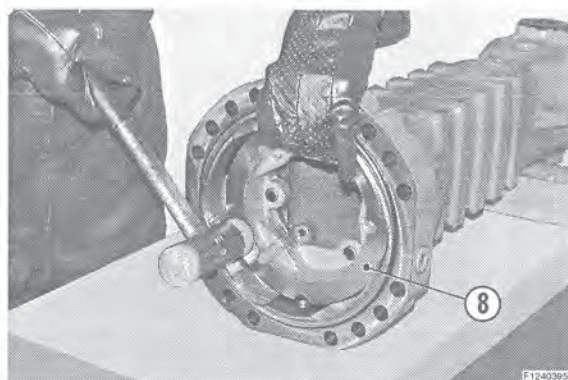
Insert the stroke automatic regulation springs (15); place them in line with the piston (8).



GB

c

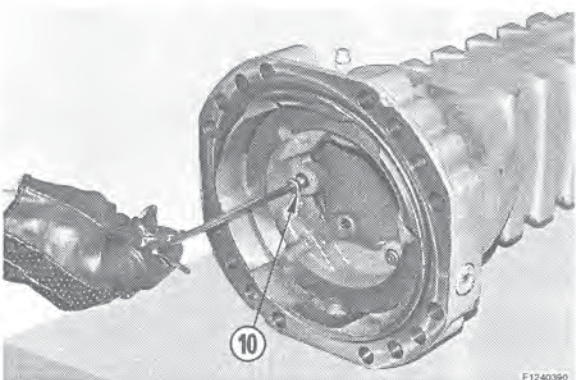
Lubricate the seals (11) and (12) and fit the piston (8) into the arm (2).  
**CAUTION!** Make sure that the piston seat fits into the stop pin "A" inside the arm.



GB

d

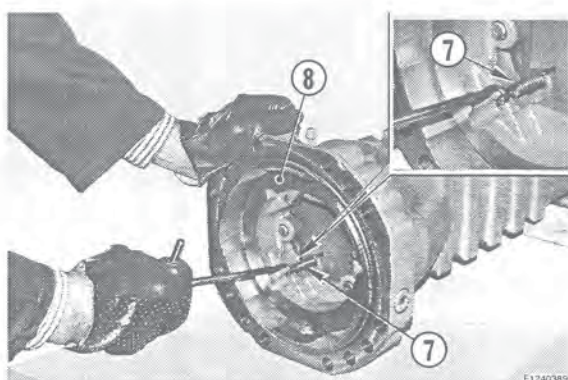
Assist the insertion of the piston (8) by lightly hammering around the edge with a plastic hammer.



GB

e

Fit the pin screws (10) making sure that they are all of the same colour. White: 1 mm gap  
Yellow: 0.75 mm gap  
Blue: 0.5 mm gap  
Apply Loctite 270 to the thread.  
Torque wrench setting: 5-7 Nm.



GB

f

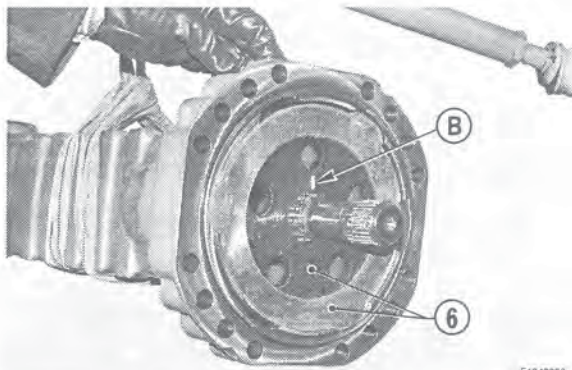
Fit the reversal springs (7) on the piston (8).  
**CAUTION!** Pay due attention not to deform the connections of the springs.



- ITA** Pulire accuratamente il pistone (8) e le sedi di scorrimento e tenuta.  
Sostituire le guarnizioni OR (11) e (12) e gli anelli antiestrusione (13) e (14), rispettando il senso di montaggio.  
**ATTENZIONE!** Controllare attentamente il posizionamento degli anelli antiestrusione (13) e (14).
- D** Kolben (8) sowie Gleit- und Dichtungssitze sorgfältig reinigen.  
O-Ringe (11) und (12) sowie die Halteringe (13) und (14) auswechseln; dabei auf die Reihenfolge der Montage achten.
- a** **ACHTUNG!** Position der Halteringe (13) und (14) sorgfältig kontrollieren.
- ESP** Limpiar minuciosamente el pistón (8) y los alojamientos de deslizamiento y estanqueidad.  
Sustituir las juntas OR (11) y (12) y los anillos antiextrusión (13) y (14) teniendo en cuenta el sentido de montaje.  
**CUIDADO!** Controlar atentamente el posicionamiento de los anillos antiextrusión (13) y (14).
- F** Nettoyer soigneusement le piston (8), les logements de coulissement et d'étanchéité.  
Remplacer les garnitures OR (11) et (12), les anneaux anti-extrusion (13) et (14) en respectant le sens du montage.  
**ATTENTION!** Contrôler soigneusement la position des anneaux anti-extrusion (13) et (14).
- ITA** Lubrificare le guarnizioni (11) e (12) e montare nel braccio (2) il pistone (8).  
**ATTENZIONE!** Controllare che la sede del pistone imbocchi la spina di arresto "A" interna al braccio.
- D** Dichtungen (11) und (12) schmieren und Arm (2) und Kolben (8) montieren.  
**ACHTUNG!** Der Kolben muß den Anhaltestift "A" im Inneren des Arms aufnehmen.
- c**
- ESP** Lubricar las juntas (11) y (12) y montar en el brazo (2) el pistón (8).  
**CUIDADO!** Controlar que el alojamiento del pistón encaje en la clavija de tope "A" dentro del brazo.
- F** Lubrifier les garnitures (11) et (12), puis monter dans le bras (2) le piston (8).  
**ATTENTION!** Contrôler que le logement du piston s'emboîte bien avec la broche d'arrêt "A" à l'intérieur du bras.
- ITA** Aiutare l'inserimento del pistone (8) con leggeri colpi di mazzuolo in materiale plastico distribuiti lungo la circonferenza.
- D** Den Kolben (8) einsetzen; diesen dazu leicht mit einem Gummihammer entlang seiner Kreislinie schlagen.
- d**
- ESP** Facilitar la inserción del pistón (8) con ligeros golpes de martillo de material plástico distribuidos en toda la circunferencia.
- F** Accompagner l'introduction du piston (8) par de légers coups de maillet en matière plastique distribués tout le long de la circonférence.
- ITA** Montare le viti a perno (10) controllando che siano tutte dello stesso colore. Bianco: gioco 1 mm  
Giallo: gioco 0,75 mm  
Azzurro: gioco 0,5 mm.  
Spalmare la filettatura con Loctite 270.  
Coppia di serraggio: 5÷7 Nm
- D** Die Stiftschrauben (10) einsetzen. Diese müssen alle gleichfarbig sein. Weiß: Spiel 1 mm  
Gelb: Spiel 0,75 mm  
Hellblau: Spiel 0,5 mm.
- e** Das Gewinde mit Loctite 270 schmieren.  
Anzugsmoment: 5÷7 Nm.
- ESP** Montar los pernos roscados (10) controlando que sean todos del mismo color. Blanco: juego 1 mm  
Amarillo: juego 0,75 mm  
Azul: juego 0,5 mm.  
Pasar en la rosca Loctite 270.  
Par de torsión: 5÷7 Nm.
- F** Monter les vis à tourillon (10) en contrôlant si elles sont toutes de la même couleur. Blanc: jeu 1 mm  
Jaune: jeu 0,75 mm  
Bleu ciel: jeu 0,5 mm.  
Enduire le filetage de Loctite 270.  
Couple de serrage: 5÷7 Nm.
- ITA** Montare le molle (7) di ritorno del pistone (8).  
**ATTENZIONE!** Usare molta cautela per non deformare gli attacchi delle molle.
- D** Die Rückzugsfedern (7) des Kolbens (8) montieren.  
**ACHTUNG!** Sehr vorsichtig vorgehen, um die Federn am Anschluß nicht zu verformen.
- f**
- ESP** Montar los muelles (7) de retorno del pistón (8).  
**CUIDADO!** Tener mucha cuidado a fin de no deformar las uniones de los muelles.
- F** Monter les ressorts (7) de retour du piston (8).  
**ATTENTION!** Faire très attention à ne pas déformer les raccords des ressorts.



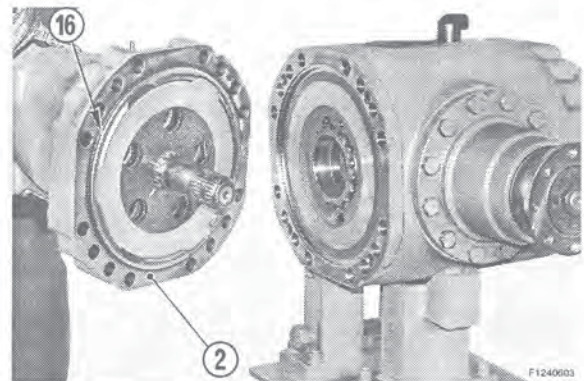
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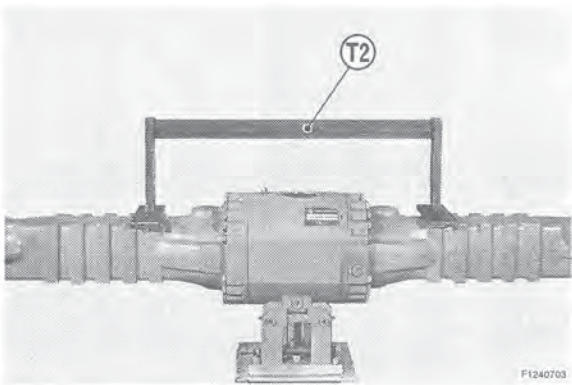
Slightly lubricate the braking disks (6) and fit them in the arm following the correct sequence; orient them so that the oil circulation holes and the marks "B" are perfectly lined up.



F1240603



Check that the positioning of the sealing ring (16) on the arm is intact; install the complete arm (2). Lock it into position using two facing screws (3) and washers (4).



F1240703



Check the flatness of the arms using tool T2 and finally lock the arms with the screws (3) and the washer (4) using the cross-tightening method.  
Torque wrench setting: 298 Nm



**ITA** Lubrificare leggermente i dischi di frenatura (6) e montarli nel braccio con la giusta sequenza, orientati in modo che i fori di circolazione dell'olio ed i contrassegni "B" siano perfettamente allineati.

**D** Die Bremsscheiben (6) leicht schmieren und in der richtigen Reihenfolge auf den Arm montieren. Dabei müssen sie so orientiert sein, daß Ölleitungslöcher genau mit den Kennzeichnungen "B" übereinstimmen.

**ESP** Lubricar ligeramente los discos de frenado (6) y montarlos en el brazo con la secuencia exacta, orientados de manera que los orificios de circulación del aceite y las marcas "B" estén perfectamente alineados.

**F** Lubrifier légèrement les disques de freinage (6), puis monter ceux-ci dans le bras à la juste séquence, orientés de telle sorte à ce que les trous de circulation de l'huile et ceux marqués "B" soient parfaitement alignés.

**ITA** Verificare l'integrità ed il posizionamento dell'anello di tenuta (16) del braccio; installare il braccio completo (2).

Fissarlo in posizione con due viti (3) e rondelle (4) contrapposte.

**D** Kontrollieren ob der Kolbenring (16) unbeschädigt und auf den Arm richtig montiert ist; den kompletten Arm (2) montieren.

In seiner Position mit zwei Schrauben (3) und den entgegengesetzten Unterlegscheiben (4) befestigen.

**ESP** Comprobar la integridad y el posicionamiento del segmento de compresión (16) del brazo; instalar el brazo completo (2).

Fijarlo en su posición con dos tornillos (3) y arandelas (4) contrapuestas.

**F** Vérifier le bon état et la position de la bague d'étanchéité (16) du bras, installer le bras complet (2). Fixer celui-ci à sa place à l'aide des deux vis (3) et des rondelles (4) superposées.

**ITA** Controllare la planarità dei bracci con l'attrezzo T2 e fissarli definitivamente con le viti (3) e le rondelle (4) con il metodo del serraggio incrociato.  
Coppia di serraggio: 298 Nm

**D** Die Ebenheit der Arme mit dem Werkzeug T2 kontrollieren und die Arme endgültig mit den Schrauben (3) und Unterlegscheiben (4) abwechselnd und gegenseitig festschrauben.  
Anzugsmoments: 298 Nm

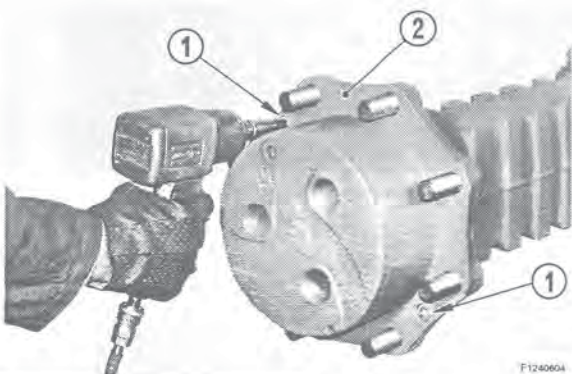
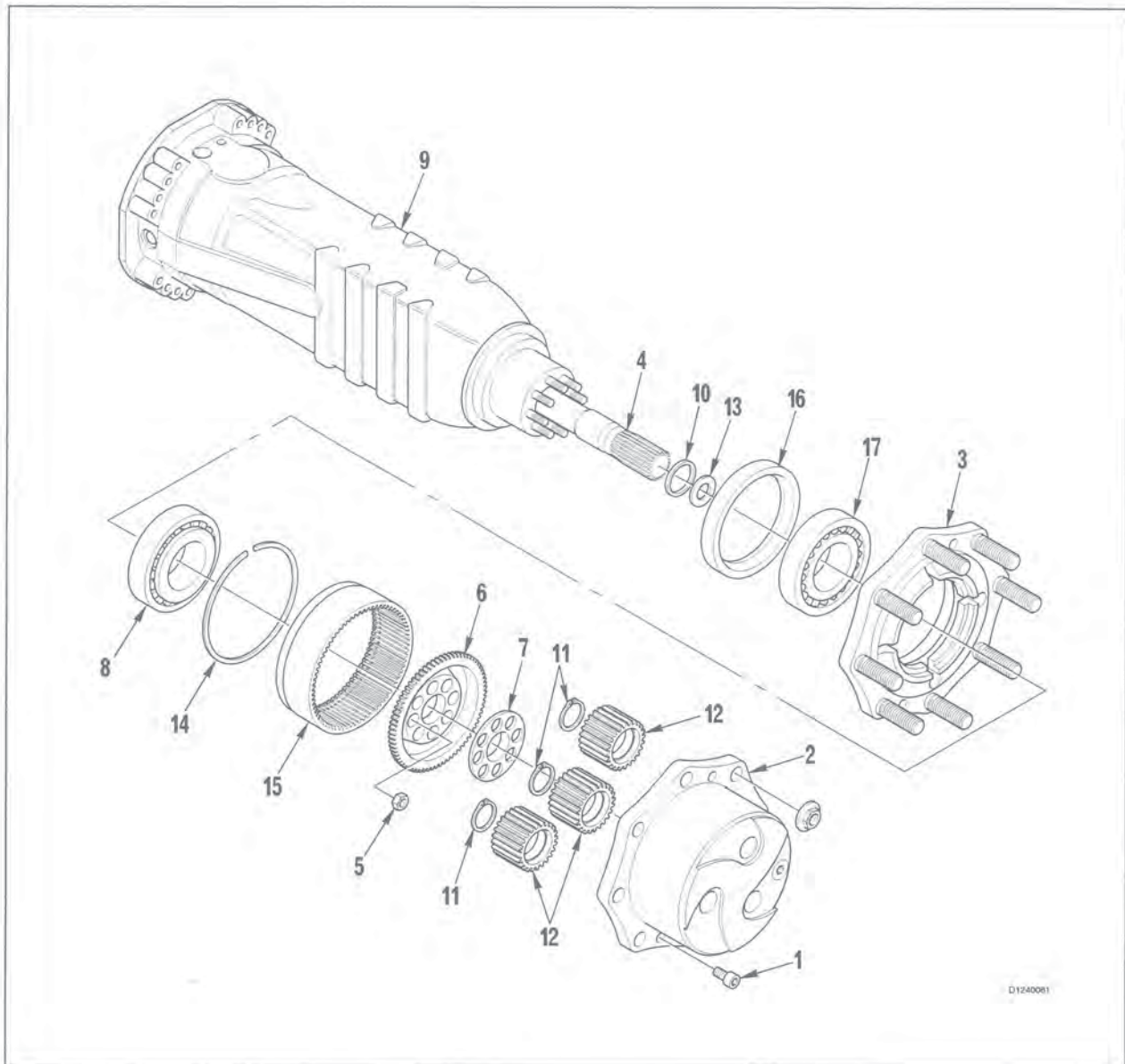
**ESP** Controlar la planaridad de los brazos utilizando la herramienta T2 y fijarlos definitivamente con los tornillos (3) y las arandelas (4) con el método de torsión cruzado.  
Par de torsión: 298 Nm

**F** Contrôler l'uniformité des bras à l'aide de l'outil T2 puis fixer définitivement ces derniers avec les vis (3) et les rondelles (4) par le biais du mode de serrage croisé.  
Couple de serrage: 298 Nm



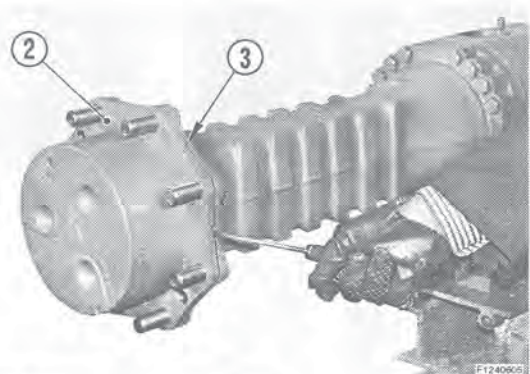


**HOW TO DISASSEMBLE THE PLANETARY REDUCTION AND AXLE SHAFT - SMONTAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE - PLANETENGETRIEB UND HALBACHSEN ABMONTIEREN - DESMONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - DESASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL ET DU DEMI-ESSEUX**



**GB** **e**

Remove the securing screws (1) from the spider cover (2).



**GB** **f**

Disjoin the spider cover (2) from the hub (3) by alternatively forcing a screwdriver into the appropriate slots.

## NOTES ON SAFETY PRECAUTIONS - NOTE RIGUARDANTI LA SICUREZZA - BEMERKUNGEN ZUR SICHERHEIT - NORMAS CONCERNIENTES A LA SEGURIDAD - NOTES EN MATIERE DE SECURITE

**GB** The axle shafts can only be removed after extraction has been performed. Different procedures need to be followed depending on the kind of repair operation needed and the type of axle:

- 1 - Axle without parking brakes: compressed air (7 bar approx.) should be introduced in the braking circuit in order to hold the braking disks in position.
- 2 - Axle with negative brake: does not require any preparation as the disks are mechanically locked in position.
- 3 - Axle with mechanical brake: requires that the external control levers are put under tension in relation to each other.
- 4 - Disassembly to be carried out with the arm resting on the bench.

The explanations reported herewith refer to removal operations carried out on the bench; the different stages of axle shaft removal also apply to all other solutions or versions.

**ITA** La rimozione dei semiassi può essere eseguita solo dopo la rimozione del coperchio portasatelliti ed in modo diversificato, in funzione del tipo di riparazione da eseguire e del tipo di assale:

- 1 - Assale senza freni di stazionamento: è necessario immettere aria compressa (circa 7 bar) nel circuito di frenatura per tenere in posizione i dischi freni.
- 2 - Assale con freno negativo: non richiede alcuna preparazione in quanto i dischi restano bloccati meccanicamente.
- 3 - Assale con freno a comando meccanico: richiede di mettere in tensione tra loro le leve esterne di comando.
- 4 - Smontaggio eseguito con il braccio appoggiato sul banco.

Le spiegazioni riportate si riferiscono alla rimozione eseguita al banco e le fasi sono comuni alle altre soluzioni o versioni.

**D** Die Halbachsen können erst abmontiert werden, wenn das Gelenkgehäuse schon abgenommen worden ist. Der Vorgang ist je nach benötigter Reparatur und je nach Achsentyp unterschiedlich:

- 1 - Achse ohne Feststellbremse: die Bremsanlage mit ca. 7 bar unter Druck setzen, um die Bremsscheiben in ihrer Position festzuhalten.
- 2 - Achse mit negativer Bremse: benötigt keinerlei Vorbereitung, da die Scheiben mechanisch blockiert bleiben.

3 - Achse mit mechanisch gesteuerten Bremsen: in diesem Fall müssen die äußeren Steuerhebel untereinander unter Spannung gesetzt werden.

4 - Zum Abmontieren, Arm auf die Werkbank legen.

Die Erläuterungen beziehen sich auf das Abmontieren an der Werkbank, wobei die Vorgänge für alle anderen Lösungen oder Ausführungen gleich sind.

**ESP** La remoción de los semiejes se puede ejecutar solamente después de la remoción y de manera diversificada en función del tipo de reparación que hay que ejecutar y del tipo de eje:

- 1 - Eje sin frenos de estacionamiento: es necesario hacer entrar aire comprimido (aproximadamente 7 bares) en el circuito de frenado para mantener en posición los discos de los frenos.
- 2 - Eje con freno negativo: no requiere ninguna preparación puesto que los discos quedan bloqueados mecánicamente.
- 3 - Eje con freno de mando mecánico: requiere la puesta en tensión entre sí de las palancas exteriores de mando.
- 4 - Desmontaje ejecutado con el brazo apoyado en el banco.

Las explicaciones que aquí figuran se refieren a la remoción ejecutada en el banco y las fases son comunes para otras soluciones o versiones.

**F** La dépose des demi-essieux ne peut être effectuée qu'après la dépose, d'une façon diversifiée, en fonction du type de réparation à effectuer et du type d'essieu:

- 1 - Essieu sans freins de stationnement: il faut introduire de l'air comprimé (environ 7 bar) dans le circuit de freinage pour maintenir les disques de freinage en place.
- 2 - Essieu à frein négatif: ne requiert aucune préparation parce que les disques mécaniquement restent bloqués.
- 3 - Essieu à frein de commande mécanique: requiert de mettre sous tension des leviers externes de commande entre-eux.
- 4 - Démontage effectué et bras déposé sur l'établi.

Les explications reportées se réfèrent à la dépose effectuée sur l'établi, les phases sont les mêmes que pour les autres solutions ou versions.

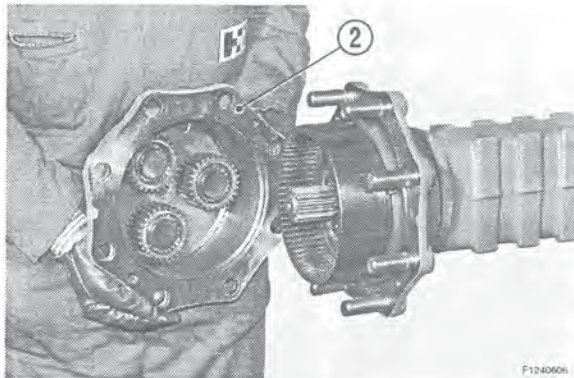
- a**
- ITA** Asportare le viti (1) di fissaggio del coperchio portasatelliti (2).
- D** Befestigungsschrauben (1) vom Planetenradhalterdeckel (2) abschrauben.
- ESP** Sacar los tornillos (1) de fijación de la tapa portasatélites (2).
- F** Enlever les vis de fixation (1) du couvercle porte-satellites (2).

- b**
- ITA** Utilizzando un cacciavite inserito alternativamente nelle cave predisposte, staccare il coperchio portasatelliti (2) dal mozzo portaruota (3).
- D** Mit einem Schraubenzieher den Planetenradhalterdeckel (2) von der Radhaltenabe (3) trennen. Dazu den Schraubenzieher abwechselnd in die vorgesehenen Nuten stecken und anheben.
- ESP** Utilizando un destornillador introducido alternativamente en las ranuras predispuestas, desprender la tapa portasatélites (2) del cubo portarruedas (3).
- F** A l'aide d'un tournevis introduit au fur et à mesure dans les creux prédisposés, décrocher le couvercle porte-satellites (2) du moyeu porte-roue (3).





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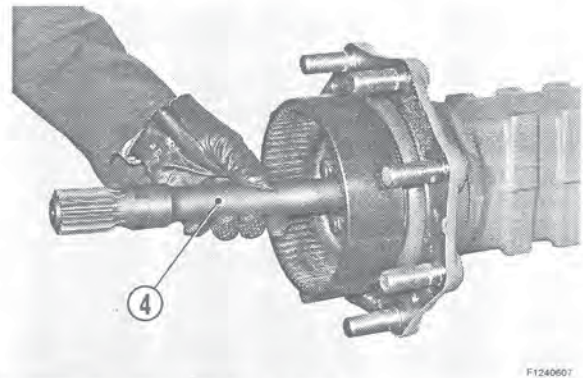
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GB

a

Remove the complete planetary carrier cover (2).



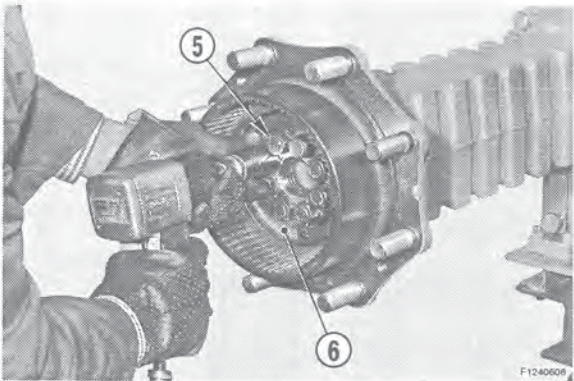
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GB

b

Remove the complete axle-shaft (4).



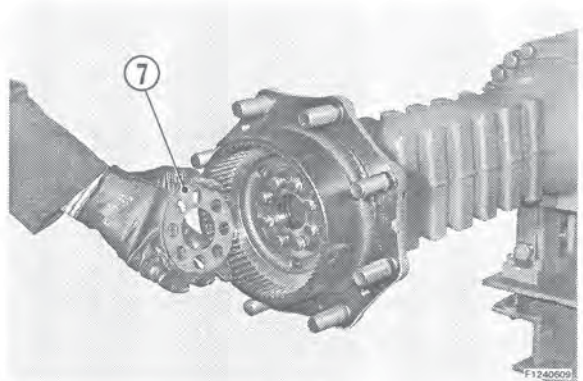
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GB

c

Unloose and remove the tightening nuts (5) from the crown flange (6).



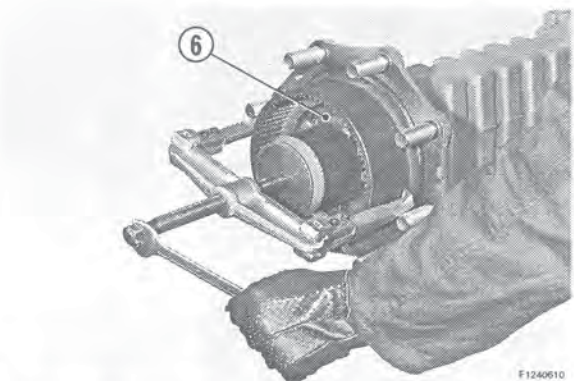
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GB

d

Remove the safety flange (7).



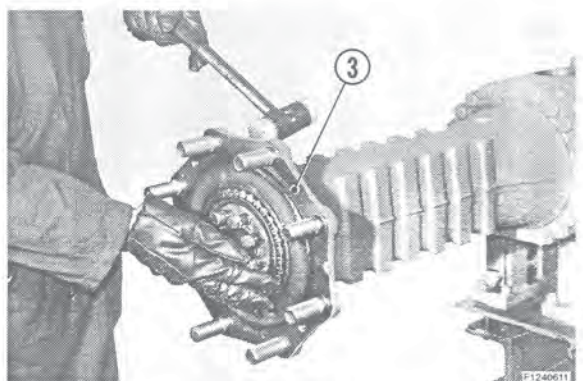
F1240610



GB

e

Using a puller, remove the complete crown flange (6) by acting on the stud bolts.



F1240611



GB

f

Partially extract the hub (3) using a plastic hammer.  
NOTE. Alternately hammer on several equidistant points.





**a**

**ITA** Asportare il coperchio portasatelliti (2) completo.

**D** Kompletter Planetenradhalterdeckel (2) abnehmen.

**ESP** Sacar la tapa portasatélites (2) completa.

**F** Enlever le couvercle porte-satellites (2) complet.

**b**

**ITA** Asportare il semiasse (4).

**D** Komplette Hallachse (4) heraus ziehen.

**ESP** Extraer el semieje (4) completo.

**F** Extraire de demi-essieu (4) complet.

**c**

**ITA** Allentare ed asportare i dadi (5) che fissano la flangia portacorona (6).

**D** Befestigungsmuttern (5) des Kranzhalterflansches (6) lockern.

**ESP** Aflojar y quitar las tuercas (5) que fijan la brida portacorona (6).

**F** Desserrer et enlever les écrous (5) de fixation de la flasque porte-couronne (6).

**d**

**ITA** Rimuovere la flangia di sicurezza (7).

**D** Sicherheitsflansch (7) abnehmen.

**ESP** Remover la brida de seguridad (7).

**F** Enlever la flasque de sécurité (7).

**e**

**ITA** Utilizzando un estrattore e, facendo reazione sui prigionieri, rimuovere la flangia portacorona (6) completa.

**D** Durch einen Abzieher über die Stiftschrauben, den kompletten Kranzhalterflansch (6) abnehmen.

**ESP** Utilizando un extractor y apalancando los prisioneros, remover la brida portacorona (6) completa.

**F** En utilisant l'extracteur et en faisant réagir les prisonniers, enlever la flasque porte-couronne (6) complète.

**f**

**ITA** Utilizzando un mazzuolo in materiale plastico, sfilare parzialmente il mozzo portaruota (3).  
**NOTA.** Battere alternativamente in più punti equidistanti.

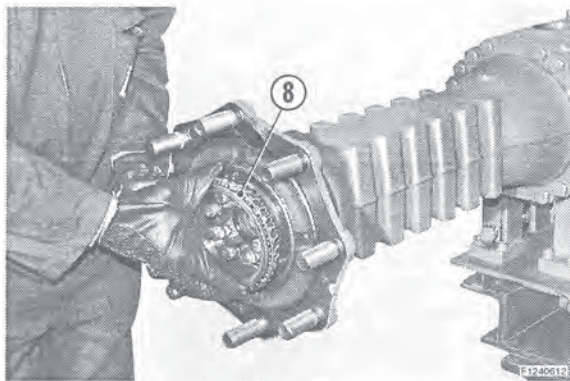
**D** Mit einem Gummihammer, die Radhalternabe (3) etwas heraus schieben.  
**BEMERKUNG.** Abwechselnd an verschiedenen, gleich entfernten Stellen schlagen.

**ESP** Utilizando un martillo de material plástico, extraer parcialmente el cubo portarruedas (3).  
**NOTA.** Golpear alternativamente en varios puntos equidistantes.

**F** A l'aide d'un maillet en matière plastique, extraire partiellement le moyeu porte-roue (3).  
**NOTE.** Frapper sur plusieurs points à la même distance.



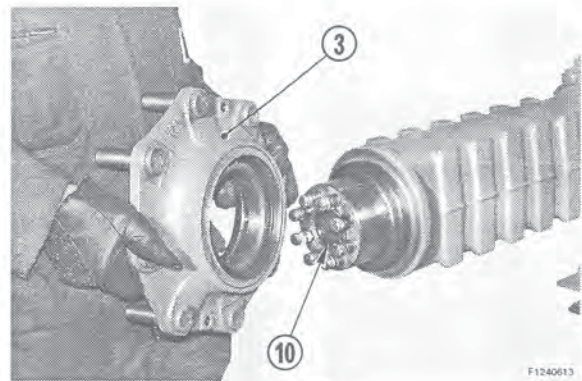
HOW TO DISASSEMBLE THE PLANETARY REDUCTION AND AXLE SHAFT - SMONTAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE - PLANETENGETRIEB UND HALBACHSEN ABMONTIEREN - DESMONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - DESASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL ET DU DEMI-ESSIEUX



GB

a

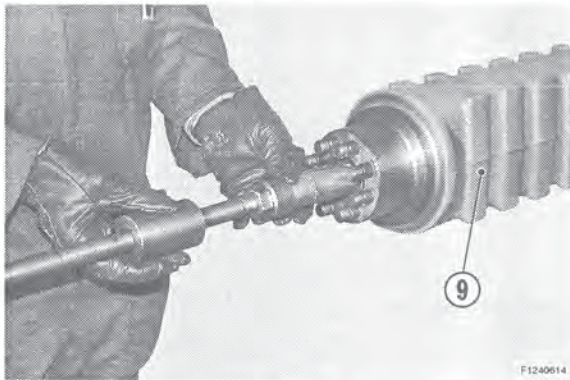
Remove the external bearing (8).



GB

b

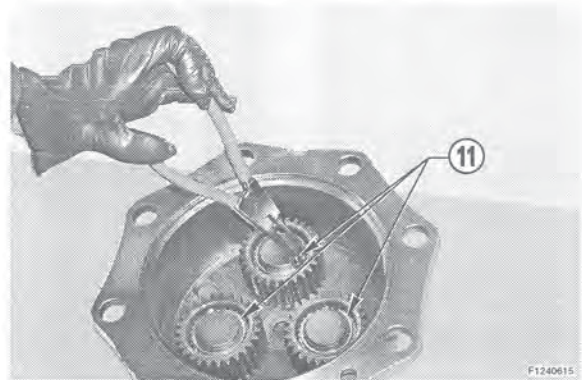
Extract the hub (3).



GB

c

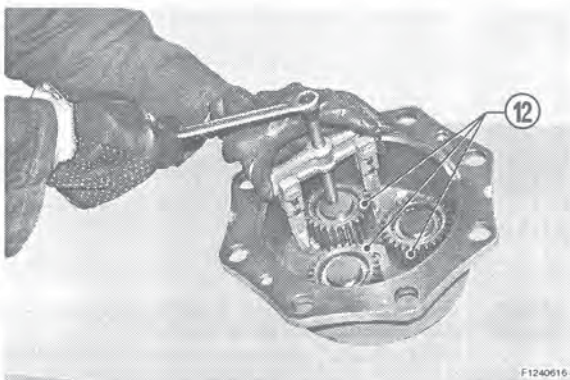
Remove snap ring (10) from the arm (9).



GB

d

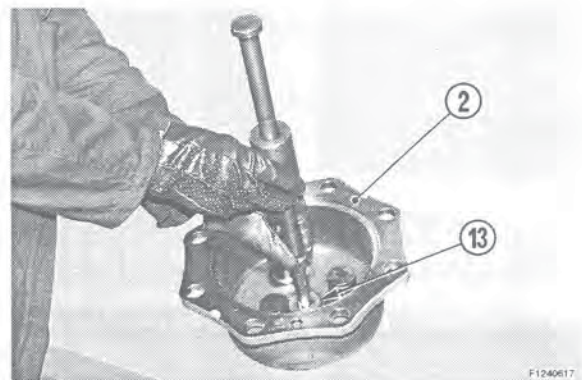
Remove the snap rings (11).



GB

e

With the help of an puller, remove the planet wheel gears (12).  
NOTE. Note down the assembly side of planet wheels.



GB

f

Using a puller for inner parts, remove shim washer (13) from planetary cover (2).



- a**
- ITA** Asportare il cuscinetto esterno (8).
  - D** Äußeres (8) Lager abnehmen.
  - ESP** Sacar el cojinete exterior (8).
  - F** Enlever le palier externe (8).

- b**
- ITA** Sfilare il mozzo portaruota (3).
  - D** Radhalternabe (3) herausziehen.
  - ESP** Extraer el cubo portarruedas (3).
  - F** Extraire le moyeu porte-roue (3).

- c**
- ITA** Rimuovere dal braccio (9) l'anello di tenuta (10).
  - D** Kolbenring (9) vom Arm (10) abnehmen.
  - ESP** Sacar el anillo de retención (9) del brazo (10).
  - F** Enlever l'anneau élastique (9) du bras (10).

- d**
- ITA** Asportare gli anelli elastici (11).
  - D** Die Kolbenringe (11) entfernen.
  - ESP** Sacar los anillos elásticos (11).
  - F** Enlever les anneaux élastiques (11).

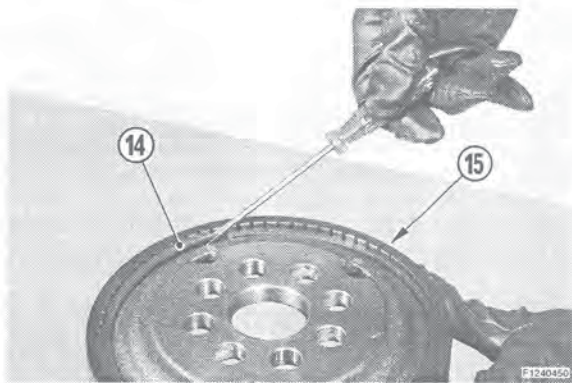
- e**
- ITA** Utilizzando un estractore, asportare gli ingranaggi satelliti (12).  
**NOTA.** Annotare il senso di montaggio dei satelliti.
  - D** Mit einem Abzieher, die Planetenräder (12) heraus nehmen.  
**BEMERKUNG.** Montagerichtung der Planetenräder beachten.
  - ESP** Utilizando un extractor, sacar los engranajes satélites (12).  
**NOTA.** Anotar el sentido de montaje de los satélites.
  - F** A l'aide d'un extracteur, extraire les engrenages satellites (12).  
**NOTE.** Prendre note du sens de montage des satellites.

- f**
- ITA** Utilizzando un estractore per interni, asportare dal coperchio portasatelliti (2) la rondella di rasamento (13).
  - D** Mit einem Abzieher den Deckel der Planetengetriebe (2) und die Zwischenlegscheibe (13) abziehen.
  - ESP** Utilizar un extractor por internos, sacar de la tapa portasatelites (2) la arandela de rasadura (13).
  - F** A l'aide d'un extracteur d'internes, extraire du couvercle porte-satellite (2) la rondelle de rasage (13).

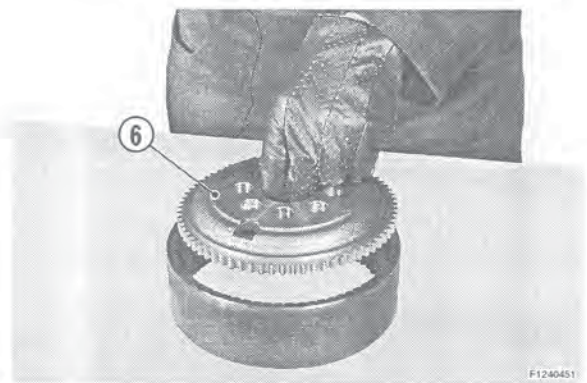




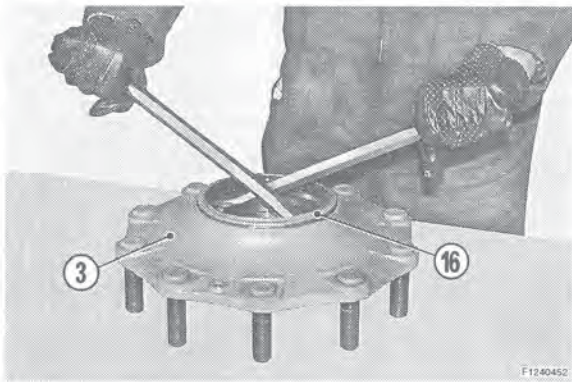
HOW TO DISASSEMBLE THE PLANETARY REDUCTION AND AXLE SHAFT - SMONTAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE - PLANETENGETRIEB UND HALBACHSEN ABMONTIEREN - DESMONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - DESASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL ET DU DEMI-ESSIEUX



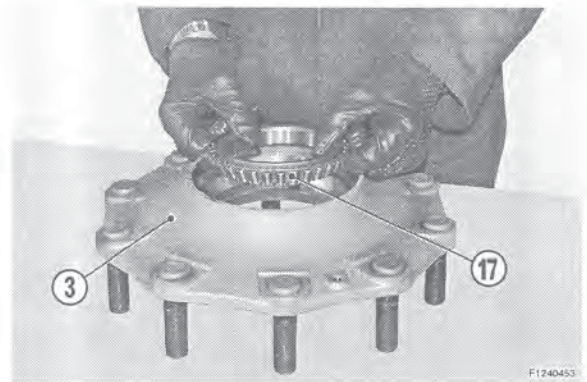
 **GB** **a**  
Remove the snap ring (14) from the crown (15).



 **GB** **b**  
Remove the crown flange (6).



 **GB** **c**  
Remove the sealing ring (16) from the hub (3).



 **GB** **d**  
Remove the internal bearing (15).



 **GB** **e**  
Remove the external thrust blocks from the bearings (8) and (17) forcing a pin-driver into the appropriate slots on the hub (3).  
**NOTE.** Hammer in an alternate way so as to avoid crawling or deformation of the thrust blocks.



- a**
- ITA** Asportare l'anello elastico (14) di ritenzo della corona (15).
- D** Den Kolbenring (14) vom Kranz (15) abnehmen.
- ESP** Sacar el anillo elástico (14) de retención de la corona (15).
- F** Enlever l'anneau élastique (14) de retenue de la couronne (15).

- b**
- ITA** Rimuovere la flangia portacorona (6).
- D** Kranzhalterflansch (6) abnehmen.
- ESP** Remover la brida portacorona (6).
- F** Déposer la flasque porte-couronne (6).

- c**
- ITA** Rimuovere dal mozzo portaruota (3) l'anello di tenuta (16).
- D** Von der Radhalternabe (3) den Kolbenring abnehmen (16).
- ESP** Remover del cubo portarruedas (3) el segmento de compresión (16).
- F** Enlever, du moyeu porte-roue (3), la bague d'étanchéité (16).

- d**
- ITA** Rimuovere il cuscinetto interno (17).
- D** Inneres Lager (17) abnehmen.
- ESP** Remover el cojinete interior (17).
- F** Enlever le palier interne (17).

- e**
- ITA** Rimuovere le ralle esterne dei cuscinetti (8) e (17) utilizzando un cacciapinne inserito nelle cave predisposte sul mozzo (3).  
**NOTA.** Battere in modo alternato per evitare impuntamenti e deformazione delle ralle.
- D** Die äußeren Scheiben der Lager (8) und (17) mit einem Dübel durch die Nabenlöcher (3) herausschlagen.  
**BEMERKUNG.** Abwechselnd herausschlagen, um Verformungen zu vermeiden.
- ESP** Remover las ranguas exteriores (8) y (17) de los cojinetes utilizando un extractor para clavijas insertado en las ranuras predispuestas en el cubo (3).  
**NOTA.** Golpear de manera alternada para evitar daños y deformaciones de las ranguas.
- F** Enlever les crapaudines externes des paliers (8) et (17) à l'aide d'une chasse-goupilles placée dans les creux spécialement conçus à cet effet sur le moyeu (3).  
**NOTE.** Taper d'une manière alternée afin d'éviter talonnage et déformation des crapaudines.

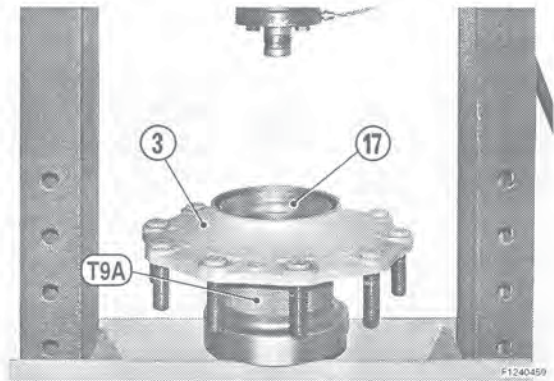




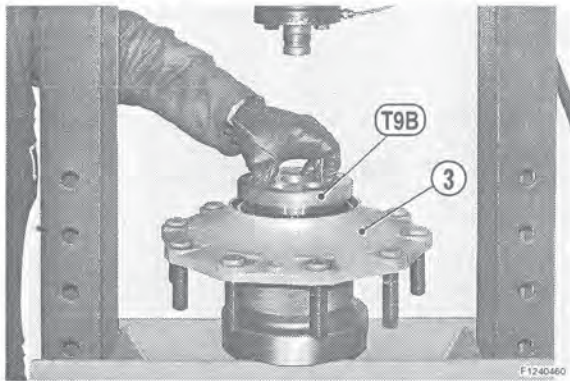
ASSEMBLING THE PLANETARY REDUCTION AND AXLE SHAFT - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE - PLANETENGETRIEB UND HALBACHSEN MONTIEREN - MONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - ASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL ET DU DEMI-ESSIEUX



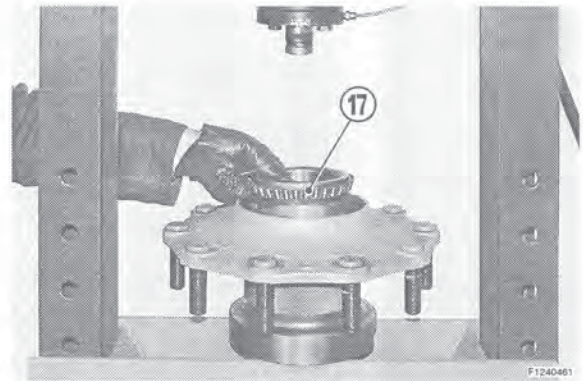
Position the lower part of tool **T9A** and the thrust block of the external bearing (8) under the press.



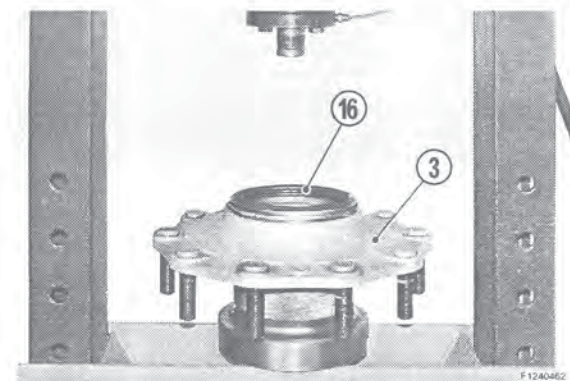
Lubricate the seats of the bearings and position the hub (3) on tool **T9A**; position the thrust block of the internal bearing (17).  
**NOTE.** Check that the thrust block is correctly oriented.



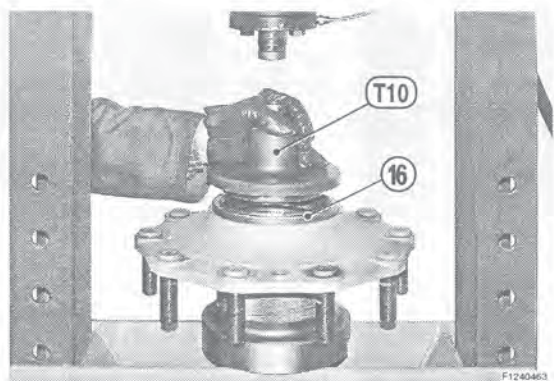
Position the upper part of tool **T9B** and press the thrust blocks into the hub (3) all the way down.



Fit the bearing (15) into the internal thrust block.



Apply a sealant for removable seals to the outer surface of the sealing ring (16). Position the sealing ring (16) in the hub (3).  
**NOTE.** Check that the ring (16) is correctly oriented.



Position tool **T10** and press the sealing ring (16) into its seat.



- a**
- ITA** Posizionare sotto la pressa la parte inferiore dell'attrezzo **T9A** e la ralla del cuscinetto esterno (8).
- D** Unter einer Presse den unteren Teil des Werkzeugs **T9A** und die Scheibe des äußeren Lagers (8) positionieren.
- ESP** Posicionar debajo de la prensa la parte inferior de la herramienta **T9A** y la rangua del cojinete exterior (8).
- F** Placer sous la presse la partie inférieure de l'outil **T9A** et la crapaudine du palier externe (8).

- ITA** Lubrificare le sedi dei cuscinetti e posizionare sull'attrezzo **T9A** il mozzo portaruota (3); posizionare la ralla del cuscinetto interno (17).
- NOTA.** Controllare l'orientamento della ralla.

- D** Die Lagersitze schmieren und am Werkzeug **T9A** die Radhalternabe (3) positionieren; die Scheibe des inneren Lagers (17) positionieren.
- BEMERKUNG.** Die Position der Scheibe beachten.

- ESP** Lubricar los alojamientos de los cojinetes y posicionar en la herramienta **T9A** el cubo portarruedas (3); posicionar la rangua del cojinete interior (17).
- NOTA.** Controlar la orientación de la rangua.

- F** Lubrifier le logement des paliers et placer sur l'outil **T9A** le moyeu porte-roue (3); placer la crapaudine du palier interne (17).
- NOTE.** Contrôler les sens de la crapaudine.

- c**
- ITA** Posizionare la parte superiore dell'attrezzo **T9B** e pressare a fondo le ralle nel mozzo portaruota (3).
- D** Das obere Teil des Werkzeugs **T9B** positionieren und die Scheiben in die Radhalternabe (3) fest eindrücken.
- ESP** Posicionar la parte superior de la herramienta **T9B** y presionar a fondo las ranguas en el cubo portarruedas (3).
- F** Placer la partie supérieure de l'outil **T9B**, puis presser à fond les crapaudines du moyeu porte-roue (3).

- ITA** Montare il cuscinetto (17) nella ralla interna.

- D** Lager (17) in die innere Scheibe montieren.

- ESP** Montar el cojinete (17) en la rangua interior.

- F** Monter le palier (17) dans la crapaudine interne.

- e**
- ITA** Spalmare la superficie esterna dell'anello di tenuta (16) con sigillante per guarnizioni removibili. Posizionare l'anello di tenuta (16) nel mozzo (3).
- NOTA.** Controllare l'orientamento dell'anello (16).

- D** Die äußere Fläche des Kolbenringes (16) mit Dichtmasse für abnehmbare Dichtungen schmieren. Den Kolbenring (16) in die Nabe (3) montieren.
- BEMERKUNG.** Richtung des Ringes (14) beachten.

- ESP** Pasar sobre la superficie exterior del anillo de compresión (16) un elemento de sellado por guarniciones removibles. Posicionar el segmento de compresión (16) en el cubo (3).
- NOTA.** Controlar la orientación del anillo (16).

- F** Enduire la surface externe de la bague d'étanchéité (16) d'enduit pour garnitures démontables. Placer la bague d'étanchéité (16) dans le moyeu (3).
- NOTE.** Contrôler le sens de la bague (16).

- ITA** Posizionare l'attrezzo **T10** e pressare in sede l'anello di tenuta (16).

- D** Das Werkzeug **T10** positionieren und den Kolbenring (16) in seinen Sitz pressen.

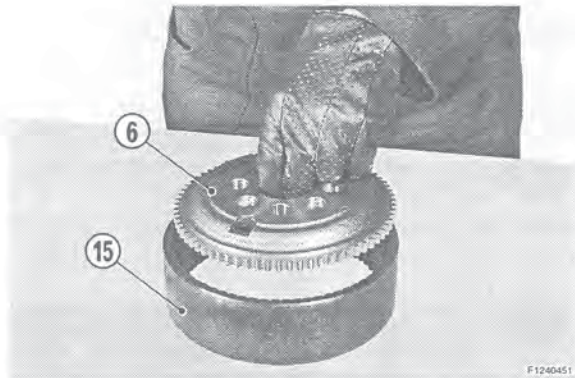
- ESP** Posicionar la herramienta **T10** y presionar en su alojamiento el segmento de compresión (16).

- F** Placer l'outil **T10** et presser dans son logement la bague d'étanchéité (16).

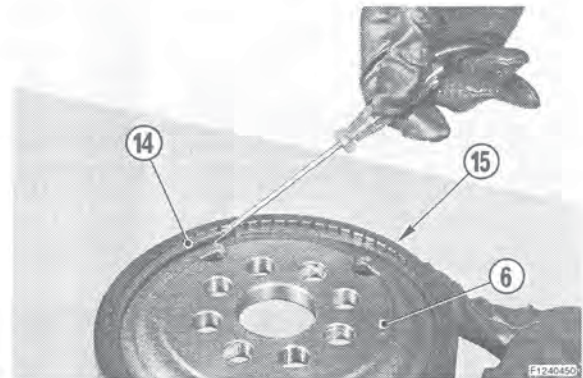




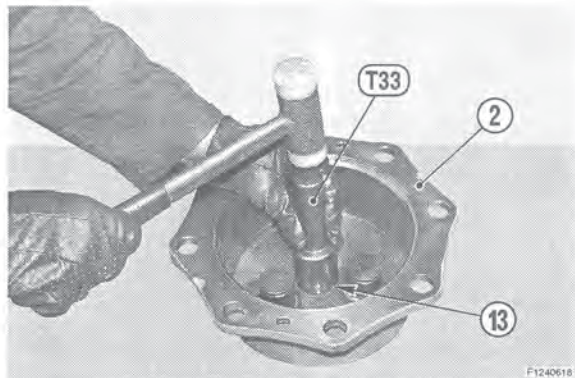
ASSEMBLING THE PLANETARY REDUCTION AND AXLE SHAFT - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE - PLANETENGETRIEB UND HALBACHSEN MONTIEREN - MONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - ASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL ET DU DEMI-ESSIEUX



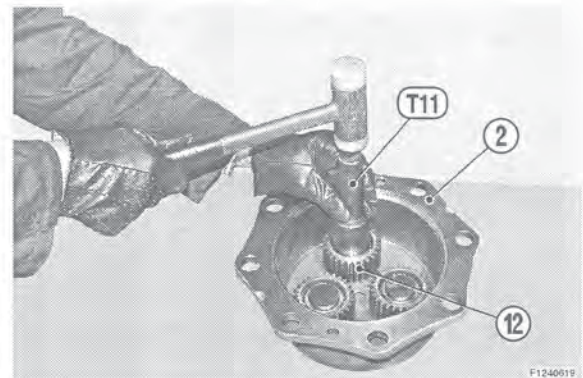
Insert the flange (6) in the crown (15).



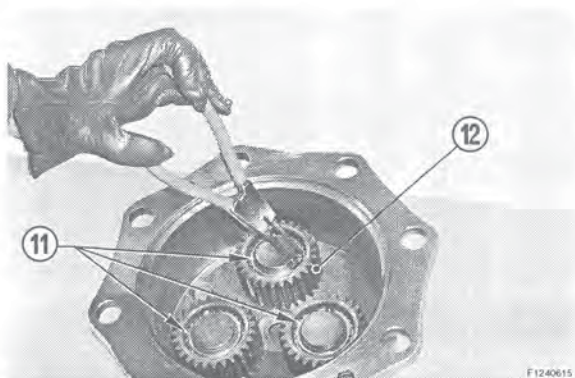
Insert the snap ring (14) in order to fix the flange (6) in the crown (15).  
**NOTE.** Carefully check that ring (14) is properly inserted in the slot of the crown (15).



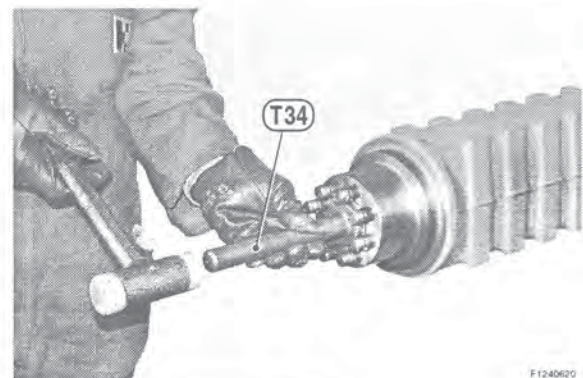
Using tool T33, fit shim washer (13) into planetary cover (2).



With the help of tool T11, insert the planet wheel gears (12) into the cover (2).  
Accurately check the orientation.



Lock the gears (12) into position by fitting the snap rings (11).



Lubricate the outer face of the sealing ring (10) and, with the help of tool T34, fit it in the arm.  
**NOTE.** Accurately check direction of assembly.

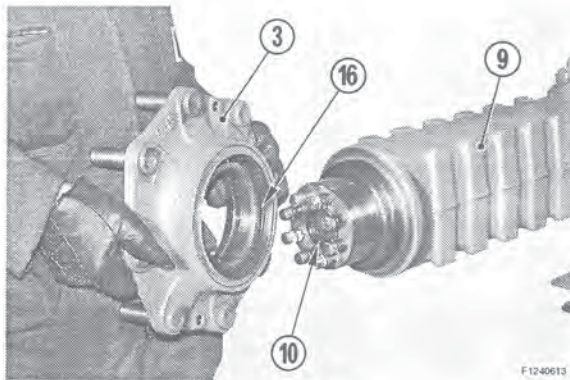


- a**
- ITA** Inserire la flangia (6) nella corona (15).
- D** Flansch (6) in den Kranz (15) montieren.
- ESP** Introducir la brida (6) en la corona (15).
- F** Introduire la flasque (6) dans la couronne (15).
- b**
- ITA** Inserire l'anello elastico (14) per fissare la posizione della flangia (6) nella corona (15).  
**NOTA.** Controllare attentamente l'inserimento dell'anello (14) nella cava della corona (15).
- D** Den Kolbenring (14) einsetzen, um die Position des Flansches (6) im Kranz (15) zu sichern.  
**BEMERKUNG.** Sorgfältig kontrollieren, ob der Ring (14) in der Nut des Kranzes (15) richtig eingesetzt ist.
- ESP** Introducir el anillo elástico (14) para fijar la posición de la brida (6) en la corona (15).  
**NOTA.** Controlar atentamente la inserción del anillo (14) en la ranura de la corona (15).
- F** Introduire l'anneau élastique (14) pour fixer la position de la flasque (6) dans la couronne (15).  
**NOTE.** Contrôler soigneusement l'introduction de la bague (14) dans le creux de la couronne (15).
- c**
- ITA** Utilizzando l'attrezzo **T33** montare nel coperchio portasatelliti (2) la rondella di rasamento (13).
- D** Mit dem Werkzeug **T33**, den Deckel der Planetengetriebe (2) und die Zwischenscheibe (13) montieren.
- ESP** Utilizando la herramienta **T33** montar en la tapa portasatelites (2) la arandela de rasadura (13).
- F** A l'aide de l'outil **T33** monter le couvercle porte-satellite (2), la rondelle de rasage (13).
- d**
- ITA** Utilizzando l'attrezzo **T11** inserire nel coperchio (2) gli ingranaggi satelliti (12).  
Controllare attentamente l'orientamento.
- D** Mit dem Werkzeug **T11** in den Deckel (2) die Planetenräder (12) einsetzen.  
Die Position sorgfältig kontrollieren.
- ESP** Utilizando la herramienta **T11** introducir en la tapa (2) los engranajes satélites (12).  
Controlar atentamente la orientación.
- F** A l'aide de l'outil **T11** introduire dans le couvercle (2) les engrenages satellites (12).  
Contrôler attentivement le sens.
- e**
- ITA** Bloccare la posizione degli ingranaggi (12) montando gli anelli elastici di ritegno (11).
- D** Die Position der Räder (12) mit den Halteringen (11) blockieren.
- ESP** Bloquear la posición de los engranajes (12) montando los anillos elásticos de retención (11).
- F** Bloquer la position des engrenages (12) en montant les anneaux élastiques de retenue (11).
- f**
- ITA** Lubrificare l'esterno dell'anello di tenuta (10) e, con l'attrezzo **T34**, montarlo nel braccio.  
**NOTA.** Controllare attentamente il senso di montaggio.
- D** Den Kolbenring (10) außen schmieren und mit dem Werkzeug **T34** in den Arm montieren.  
**BEMERKUNG.** Montage-richtung sorgfältig prüfen.
- ESP** Lubrificar el exterior del anillo de retención (10) y, con la herramienta **T34**, montarlo en el brazo.  
**NOTA.** Controlar cuidadosamente el sentido de montaje.
- F** Lubrifier l'extérieur de la bague d'étanchéité (10) et au moyen de l'outil **T34** monter cette dernière dans le bras.  
**NOTE.** Contrôler attentivement le sens du montage.





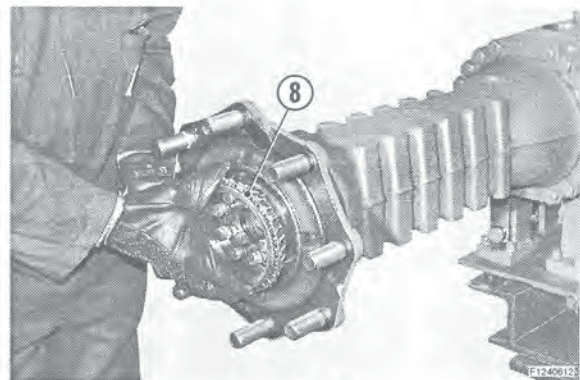
ASSEMBLING THE PLANETARY REDUCTION AND AXLE SHAFT - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE -  
PLANETENGETRIEB UND HALBACHSEN MONTIEREN - MONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - ASSEMBLAGE DU REDUCTEUR  
EPICYCLOIDAL ET DU DEMI-ESSIEUX



GB

a

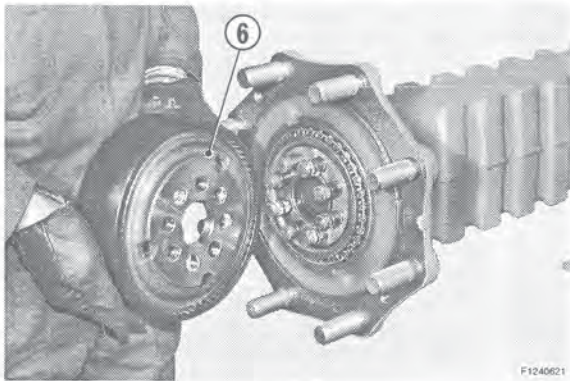
Lubricate with grease the sealing ring (16) and the hub of the arm (9).  
Install the hub (3).



GB

b

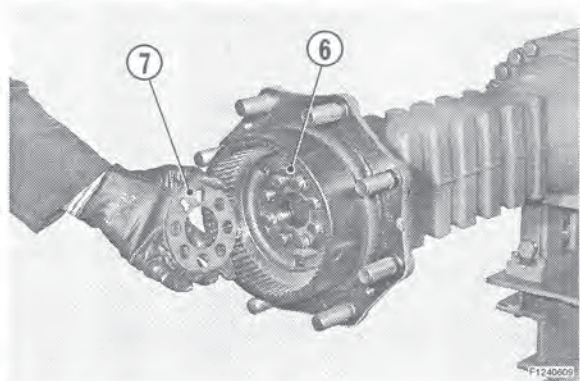
Install the external bearing (8).  
**NOTE.** Using a plastic hammer, drive the bearing to the limit stop by lightly hammering around the edge.



GB

c

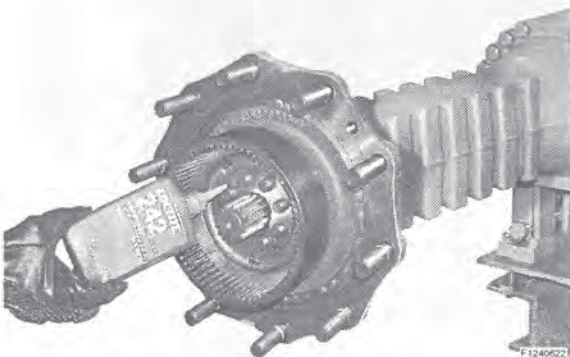
Fit the complete crown flange (6).  
**NOTE.** In order to fasten the flange (6), use a plastic hammer and alternately hammer on several equidistant points.



GB

d

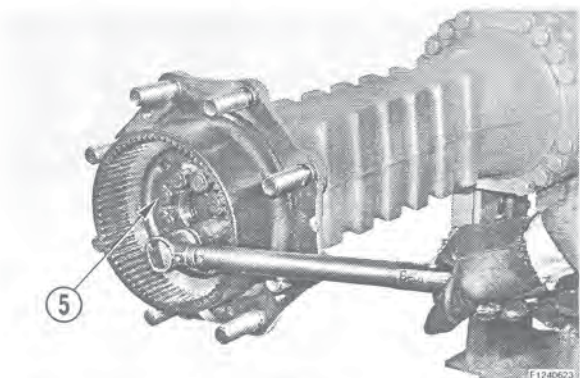
Apply Tecnolube Seal 101 grease to the surface of the safety flange (7) which touches the crown flange (6).  
Fit the safety flange (7).



GB

e

Apply Loctite 242 to the studs and fit in the nuts (5).



GB

f

Cross tighten the nuts (5) in two stages.  
Initial torque wrench setting: 130 Nm  
Final torque wrench setting: 255-285 Nm



- a**
- ITA** Lubrificare con grasso l'anello di tenuta (16) ed il mozzo del braccio (9).  
Montare il mozzo portaruota (3).
- D** Kolbenring (16) und Armnabe (9) mit Fett schmieren.  
Radhalternabe (3) montieren.
- ESP** Lubrificar con grasa el segmento de compresión (16) y el cubo del brazo (9).  
Montar el cubo portarruedas (3).
- F** Lubrifier avec de la graisse la bague d'étanchéité (16) et le moyeu du bras (9).  
Monter le moyeu porte-roue (3).

- c**
- ITA** Montare la flangia portacorona (6) completa.  
**NOTA.** Per mandare in battuta la flangia (6), usare un mazzuolo in materiale plastico battuto alternativamente in più punti equidistanti.
- D** Kompletter Kranzhalterflansch (6) montieren.  
**BEMERKUNG.** Um den Flansch (6) bis zum Anschlag einzusetzen, einen Gummihammer verwenden und abwechselnd an gleich entfernten Stellen einschlagen.
- ESP** Montar la brida portacorona (6).  
**NOTA.** Para llevar a tope la brida (6) usar un martillo de material plástico golpeándolo alternativamente en varios puntos equidistantes.
- F** Monter la flasque porte-couronne (6) complète.  
**NOTE.** Pour envoyer la flasque (6) en butée, utiliser un maillet en matière plastique en battant sur plusieurs points équidistants.

- e**
- ITA** Spalmare i prigionieri con Loctite 242 e montare i dadi (5).
- D** Die Stiftschrauben mit Loctite 242 schmieren und die Muttern (5) montieren.
- ESP** Pasar en los prisioneros Loctite 242 y montar las tuercas (5).
- F** Enduire les prisonniers avec du Loctite 242 puis monter les écrous (5).

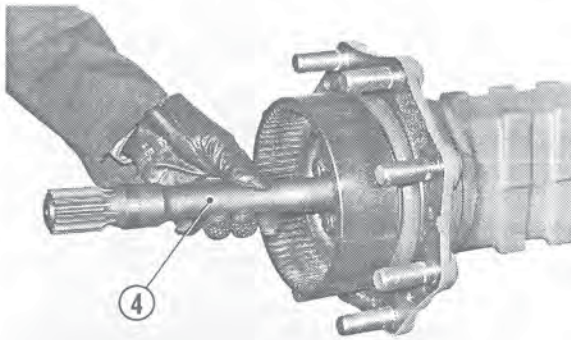
- b**
- ITA** Montare il cuscinetto esterno (8).  
**NOTA.** Mandare a fondo corsa il cuscinetto con leggeri colpi di mazzuolo distribuiti su tutta la circonferenza.
- D** Äußeres Lager (8) montieren.  
**BEMERKUNG.** Das Lager bis zum Anschlag einsetzen; dazu einen Gummihammer verwenden und entlang der Kreislinie einschlagen.
- ESP** Montar el cojinete exterior (8).  
**NOTA.** Llevar al fondo de carrera el cojinete con ligeros golpes de martillo distribuidos en toda la circunferencia.
- F** Monter le palier externe (8).  
**NOTE.** Envoyer le palier en fin de course avec des petits coups de maillet distribués sur toute la circonférence.

- d**
- ITA** Lubrificare con grasso Tec nolube Seal 101 la superficie della flangia di sicurezza (7) a contatto con la flangia portacorona (6).  
Montare la flangia di sicurezza (7).
- D** Mit Fett Typ Tec nolube Seal 101 die Oberfläche des Sicherheitsflansch (7) schmieren, der am Kranzhalterflansch (6) anliegt.  
Sicherheitsflansch (7) montieren.
- ESP** Lubricar con grasa Tec nolube Seal 101 la superficie de la brida de seguridad (7) en contacto con la brida portacorona (6).  
Montar la brida de seguridad (7).
- F** Lubrifier avec du gras Tec nolube Seal 101 la surface de la flasque de sécurité (7) en contact avec la flasque porte-couronne (6).  
Monter la flasque de sécurité (7).

- f**
- ITA** Serrare i dadi (5) in due tempi e con il metodo del serraggio incrociato.  
Coppia di serraggio iniziale: 130 Nm  
Coppia di serraggio finale 255÷285 Nm
- D** Die Mutter (5) abwechseln und entgegengesetzt festschrauben.  
Anfänglicher Anzugsmoment: 130 Nm  
Endgültiger Anzugsmoment: 255–285 Nm
- ESP** Apretar las tuercas (5) en dos tiempos y siempre con el método de torsión cruzada.  
Par de torsión inicial: 130 Nm  
Par de torsión final 255÷285 Nm
- F** Serrer les écrous (5) en deux temps par le biais du mode de serrage croisé.  
Couple de serrage initial: 130 Nm  
Couple de serrage final: 255–285 Nm



ASSEMBLING THE PLANETARY REDUCTION AND AXLE SHAFT - ASSEMBLAGGIO RIDUTTORE EPICICLOIDALE E SEMIASSE - PLANETENGETRIEB UND HALBACHSEN MONTIEREN - MONTAJE REDUCTOR EPICICLOIDAL Y SEMIEJES - ASSEMBLAGE DU REDUCTEUR EPICYCLOIDAL ET DU DEMI-ESSIEUX



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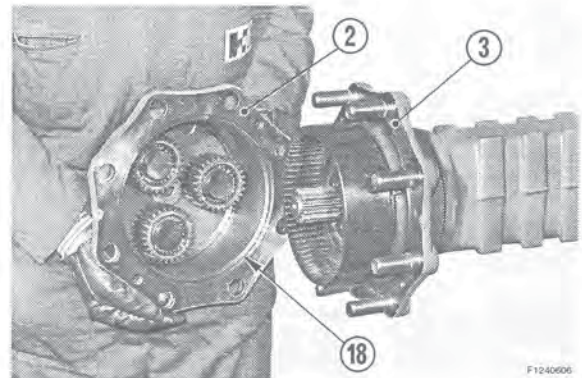


GB

a

Grease snap ring (10) and sealing face of axle-shaft (4). Install the axle shaft (4) making sure it is properly engaged in the braking disks and in the differential unit.

**NOTE.** Be very careful not to damage the snap ring (10).



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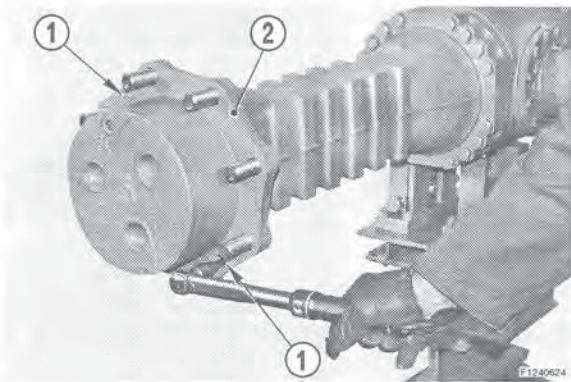


GB

b

Fit the planetary carrier cover (2) onto the hub (3).

**CAUTION!** Check that the O-ring (18) is in good condition and in position.



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GB

c

Lock the planetary carrier cover (2) by tightening the screws (1). Torque wrench setting for screws: 40-50 Nm





SPICER CLARK-HURTH

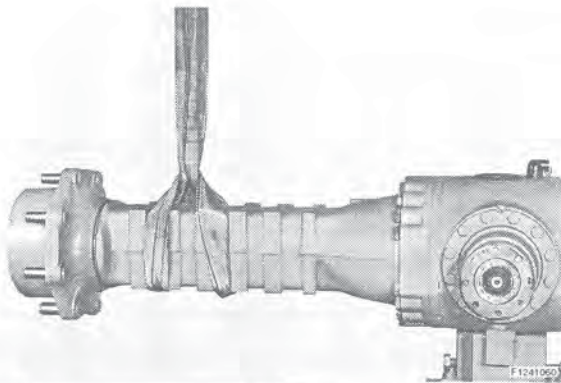
- a**
- ITA** Lubrificare l'anello di tenuta (10) la superficie di tenuta del semiasse (4).  
Montare il semiasse (4) assicurandosi che si innesti nei dischi freno e nel differenziale.  
**NOTA.** Prestare molta attenzione per non danneggiare l'anello di tenuta (10).
- D** Kolbenring (10) und Dichtungsfläche der Halbachse (4) schmieren.  
Halbachse (4) montieren und darauf achten, daß sie richtig in den Bremsscheiben und im Differential sitzt.  
**BEMERKUNG.** Sehr vorsichtig vorgehen, um den Kolbenring (10) nicht zu beschädigen.
- ESP** Lubrificar el segmento de compresión (10) la superficie de compresión del semieje (4).  
Montar el semieje (4) asegurándose que se injerte en los discos y en el diferencial.  
**NOTA.** Prestar mucha atención para no danar el segmento de compresión (10).
- F** Lubrifier la bague d'étanchéité (10), la surface étanche du demi-essieu (4).  
Monter le demi-essieu (4) en s'assurant qu'il est bien engagé dans les disques freins et dans le différentiel.  
**NOTE.** Faire très attention à ne pas abîmer la bague d'étanchéité (10).

- b**
- ITA** Montare il coperchio portasatelliti (2) sul mozzo portaruota (3).  
**ATTENZIONE!** Controllare lo stato e la posizione della guarnizione OR (18).
- D** Planetenradhalterdeckel (2) auf die Radhalternabe (3) montieren.  
**ACHTUNG!** Den Zustand und die Position des O-Ringes (18) kontrollieren.
- ESP** Montar la tapa portasatélites (2) en el cubo portarruedas (3).  
**CUIDADO!** Controlar el estado y la posición de la junta OR (18).
- F** Monter le couvercle porte-satellites (2) sur le moyeu porte-roue (3).  
**ATTENTION!** Contrôler l'état et la position de la garniture OR (18).

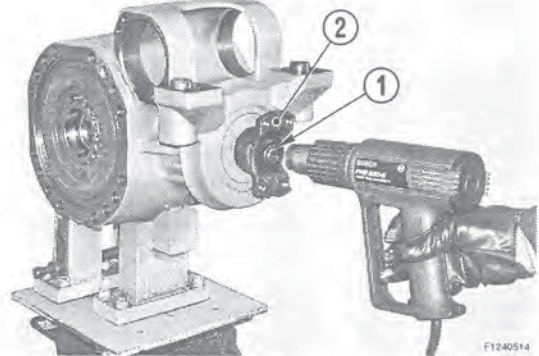
- c**
- ITA** Bloccare il coperchio portasatelliti (2) con le viti (1).  
Coppia di serraggio viti: 40÷50 Nm
- D** Planetenhalterdeckel (2) mit den Schraube (1) fest-schrauben.  
Anzugsmoment der Schrauben: 40÷50 Nm
- ESP** Bloquear la tapa portasatélites (2) con los tornillos (1).  
Par de torsión tornillos: 40÷50 Nm
- F** Bloquer le couvercle porte-satellites (2) avec les vis (1).  
Couple de serrage vis: 40÷50 Nm



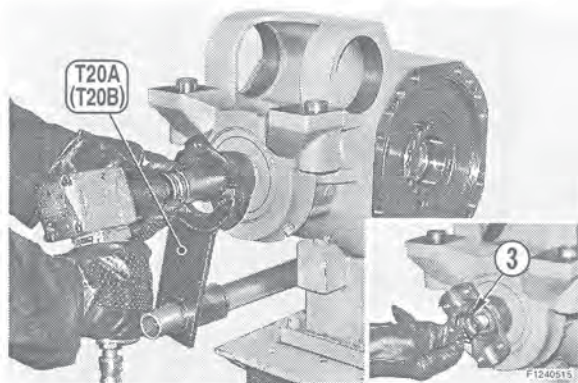
HOW TO REMOVE THE BEVEL PINION - RIMOZIONE PIGNONE CONICO - KEGELRAD ABMONTIEREN - REMOCION PIÑON CONICO - DEPOSE DU PIGNON CONIQUE



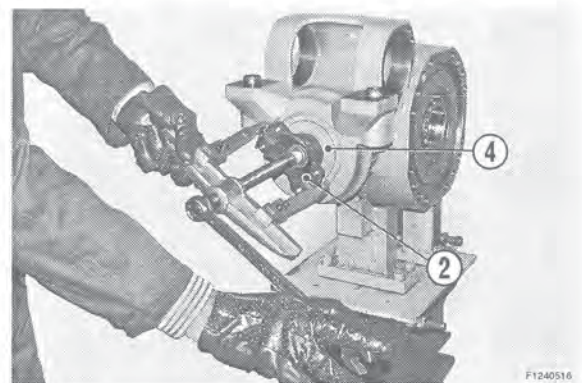
**ATTENTION!** Though the photos in this manual refer to a steering and oscillating axle, the operations described apply anyway. Remove the complete arms and the differential unit. For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS» and «REMOVING THE DIFFERENTIAL UNIT».



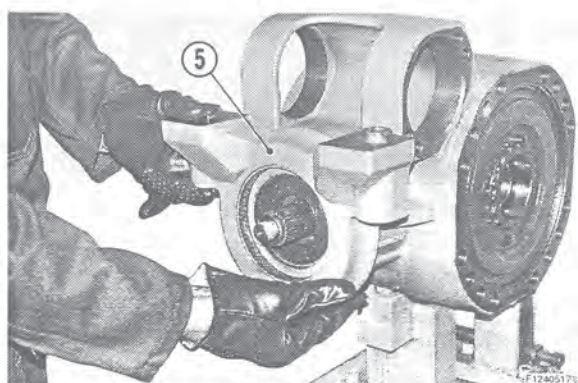
If disassembly is awkward, heat the check nut (1) of the flange (2) at 80°C.  
**NOTE.** Heating is meant to unloose the setting of Loctite on the nut (1).



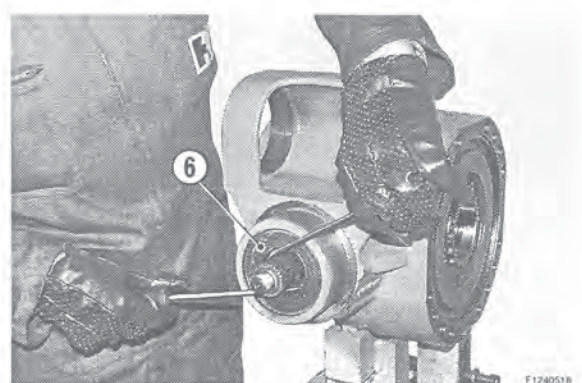
Position tool **T20A** (or **T20B**), so as to avoid pinion rotation. Unloose and remove the nut (1); also remove the O-ring (3).



Remove the flange (2) complete with guard (4) by means of a puller.



**ATTENTION!** This operation does not apply to the fixed axle. Remove the swinging support (5).



Remove the sealing ring (6).



**ITA**

**ATTENZIONE!** Le foto rsono riferite ad un assale sterzante ed oscillante, ma le operazioni descritte sono valide.

Rimuovere i bracci completi ed il differenziale.

Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO» e «RIMOZIONE GRUPPO DIFFERENZIALE».

**D**

**ACHTUNG!** Die Abbildungen beziehen sich auf eine Lenk- und Schwenkachse. Die beschriebenen Vorgänge gelten aber auch in diesem Fall.

**a**

Komplette Arme und Differential abnehmen. Siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN» und «DIFFERENTIALAGGREGAT ABMONTIEREN».

**ESP**

**ATENCION!** Las fotos se refieren a un eje desviante y oscilante, pero las operaciones descritas son validas.

Remover los brazos completos y el diferencial. Para los detalles véase «CONTROL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO» y «REMOCION GRUPO DIFERENCIAL».

**F**

**ATTENTION!** Les photos sont référées à un essieu braquant et oscillant, mais les opérations ci-décrites sont valables.

Enlever complètement les bras complets et le différentiel. Pour de plus amples détails, voir «CONTROLE USURE ET SUBSTITUTION DES DISQUES DE FREINAGE» et «DEPOSE DU GROUPE DIFFERENTIEL».

**ITA**

Se lo smontaggio risulta faticoso, scaldare a circa 80°C il dado (1) di ritegno della flangia (2).

**NOTA.** Il riscaldamento ha lo scopo di allentare la presa del Loctite di bloccaggio del dado (1).

**D**

Wenn das Abmontieren schwierig ist, die Mutter (1) zur Halterung des Flansches (2) auf ca. 80°C erwärmen.

**b**

**BEMERKUNG.** Durch das Erhitzen wird das Fett aufgeweicht, das die Mutter (1) blockiert.

**ESP**

Si el desmontaje resulta difícil, calentar a unos 80°C la tuerca (1) de retención de la brida (2).

**NOTA.** El calentamiento tiene la finalidad de aliojar la adhesión del Loctite de bloqueo de la tuerca (1).

**F**

Si démonter est difficile, chauffer l'écrou (1) de fixation de la flasque (2) à environ 80°C.

**NOTE.** Le chauffage à pour objet de ralentir la prise du Loctite de blocage de l'écrou (1).

**ITA**

Applicare l'attrezzo **T20A** (oppure **T20B**) ed impegnarlo in modo da evitare la rotazione del pignone. Allentare ed asportare il dado (1); asportare anche l'anello OR (3).

**D**

Werkzeug **T20A** (**T20B**) so anbringen, daß das Rad nicht mehr drehen kann. Mutter (1) lockern und abschrauben; O-Ring (3) ebenfalls abnehmen.

**c**

**ESP**

Aplicar la herramienta **T20A** (**T20B**) y bloquearla a fin de evitar la rotación del piñón. Aflojar y sacar la tuerca (1); sacar también el anillo OR (3).

**F**

Appliquer l'outil **T20A** (ou **T20B**) engager ce dernier de manière à éviter la rotation du pignon. Relâcher et enlever l'écrou (1) enlever également la garniture OR (3).

**ITA**

Utilizzando un estrattore, rimuovere la flangia (2) completa della protezione (4).

**D**

Mit einem Abzieher, Flansch (2) samt Schutzteil (4) abnehmen.

**d**

**ESP**

Utilizando un extractor, remover la brida (2) completa con la protección (4).

**F**

A l'aide d'un extracteur, enlever la flasque (2) complète de la protection (4).

**ITA**

**ATTENZIONE!** Questa operazione non è valida per l'assale fisso. Rimuovere il supporto oscillante (5).

**D**

**ACHTUNG!** Dieser Vorgang gilt nicht für die feste Achse. Schwenkbare Halterung (5) entfernen.

**e**

**ESP**

**ATENCION!** Esta operación no es valida para el eje fijo. Remover el soporte oscilante (5).

**F**

**ATTENTION!** Cette opération n'est pas valable en case d'essieu fixe. Enlever le support oscillant (5).

**ITA**

Rimuovere l'anello di tenuta (6).

**D**

Kolbenring (6) entfernen.

**f**

**ESP**

Remover el segmento de compresión (6).

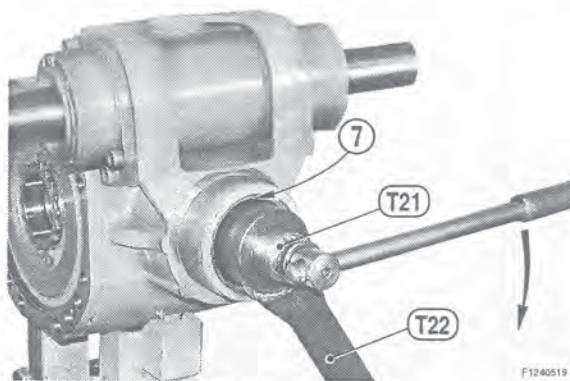
**F**

Enlever la bague d'étanchéité (6).





HOW TO REMOVE THE BEVEL PINION - RIMOZIONE PIGNONE CONICO - KEGELRAD ABMONTIEREN -  
REMOCION PIÑON CONICO - DEPOSE DU PIGNON CONIQUE

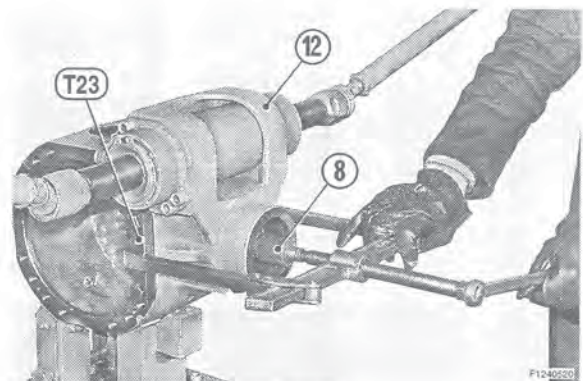


GB

a

Position wrench **T22** onto the ring nut (7) and apply bar hold **T21** to the pinion (8).  
Stop wrench **T22** and rotate the pinion so as to release and remove the ring nut (7).

**NOTE.** If disassembly proves awkward, weld the ring nut at approx. 80°C.

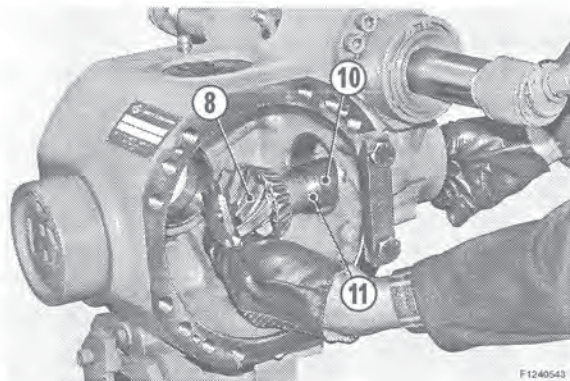


GB

b

Apply blocks **T23** and, with the help of a puller, extract the pinion (8) complete with the internal bearing (9), the distance piece (10) and shims (11).

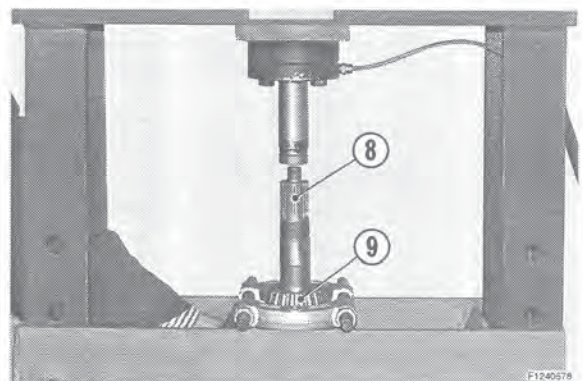
**NOTE.** The thrust blocks of the bearings remain in the central body (12).



GB

c

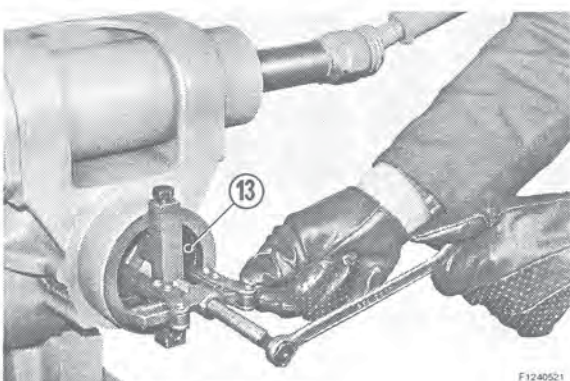
Remove the pinion (8), shims (11) and distance piece (10).



GB

d

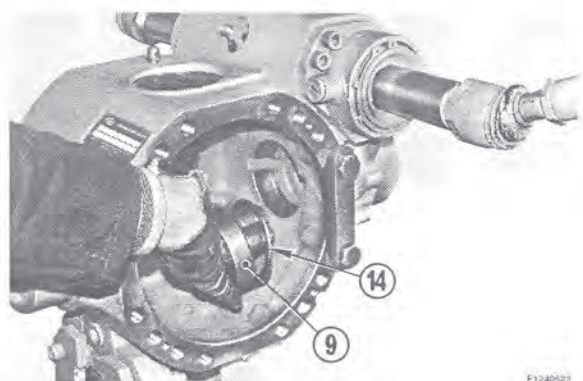
Using a puller and a press, remove the inner bearing (9) from the pinion (8).



GB

e

Remove the thrust block of the external bearing (13).



GB

f

Insert a drift in the appropriate holes and remove the thrust block of the internal bearing (9) as well as the shim washers (14).





- ITA** Impegnare la chiave speciale **T22** sulla ghiera (7) ed applicare sul pignone (8) il codolo **T21**.  
Fermare la chiave **T22** e ruotare il pignone per allentare ed asportare la ghiera (7).  
**NOTA.** Se lo smontaggio risulta faticoso, scaldare la ghiera a circa 80 °C.
- D** Den speziellen Schlüssel **T22** in die Nutmutter (7) setzen und am Rad (8) den Schaft **T21** anbringen.  
Schlüssel **T22** festhalten und das Rad drehen, um die Nutmutter (7) zu lockern und abzunehmen.
- a** **BEMERKUNG.** Falls die Nutmutter zu fest sitzt, diese auf ca. 80°C erhitzen.
- ESP** Bloquear la llave especial **T22** en la virola (7) y aplicar en el piñón (8) el mango **T21**.  
Bloquear la llave **T22** y girar el piñón para aflojar y extraer la virola (7).  
**NOTA.** Si el desmontaje resulta difícil, calentar la virola a unos 80°C.
- F** Engager la clé spéciale **T22** sur le collier de serrage (7) et appliquer sur le pignon (8) le cône **T21**.  
Bloquer la clé **T22**, tourner le pignon pour relâcher et enlever le collier de serrage (7).  
**NOTE.** Si le désassemblage est rendu difficile, chauffer la bague à une chaleur de 80°C.

- ITA** Asportare il pignone (8), gli spessori (11) ed il distanziale (10).
- D** Rad (8), Unterlegscheibe (11) und Distanzstück (10) abnehmen.
- c**
- ESP** Sacar el piñón (8), los espesores (11) y el separador (10).
- F** Enlever le pignon (8), les cales (11) et l'entretoise (10).

- ITA** Rimuovere la ralla del cuscinetto esterno (13).
- D** Scheibe vom äußeren Lager (13) abnehmen.
- e**
- ESP** Remover la rangua del cojinete exterior (13).
- F** Enlever la crapaudine du palier externe (13).

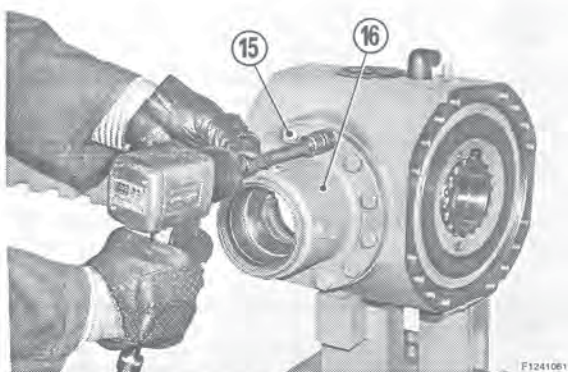
- ITA** Applicare i blocchi **T23** e con un estractore, estrarre il pignone (8) completo del cuscinetto interno (9), del distanziale (10) e degli spessori (11).  
**NOTA.** Le ralle dei cuscinetti rimangono nel corpo centrale (12).
- D** Die Blöcke **T23** anbringen und mit einem Abzieher das Rad (8) samt dem inneren Lager (9), Distanzstück (10) und der Scheiben (11) herausziehen.
- b** **BEMERKUNG.** Die Lagerscheiben bleiben im zentralen Körper (12) sitzen.
- ESP** Aplicar los bloques **T23** y con un extractor, extraer el piñón (8) con su cojinete interior (9) del separador (10) y de los posibles espesores (11).  
**NOTA.** Las ranguas de los cojinetes quedan en el cuerpo central (12).
- F** Appliquer les blocs **T23** et à l'aide d'un extracteur, extraire le pignon (8) complet du palier interne (9), du différentiel (10) et des éventuelles cales (11).  
**NOTE.** Les crapaudines des paliers demeurent dans le corps central (12).

- ITA** Utilizzando un estractore ed una pressa, rimuovere dal pignone (8) il cuscinetto interno (9).
- D** Mit einem Abzieher und einer Presse, vom Rad (8) das innere Lager (9) abnehmen.
- d**
- ESP** Utilizando un extractor y una prensa, remover del piñón (8) el cojinete interior (9).
- F** A l'aide de l'extracteur et d'une presse, ôter du pignon (8) le palier interne (9).

- ITA** Con un punzone inserito nelle cave predisposte, rimuovere la ralla del cuscinetto interno (9) e gli spessori di rasamento (14).
- D** Einen Dübel in die vorgesehenen Nuten stecken und die Scheibe des inneren Lagers (9) und die Zwischenlegscheiben (14) entfernen.
- f**
- ESP** Utilizando un punzón introducido en las ranuras predisuestas, remover la rangua del cojinete interior (9) y los espesores (14).
- F** A l'aide d'un poussoir introduit dans le creux prédisposé, enlever la crapaudine du palier interne (9) et les cales de rasage (14).



HOW TO REMOVE THE BEVEL PINION - RIMOZIONE PIGNONE CONICO - KEGELRAD ABMONTIEREN -  
REMOCION PIÑON CONICO - DEPOSE DU PIGNON CONIQUE

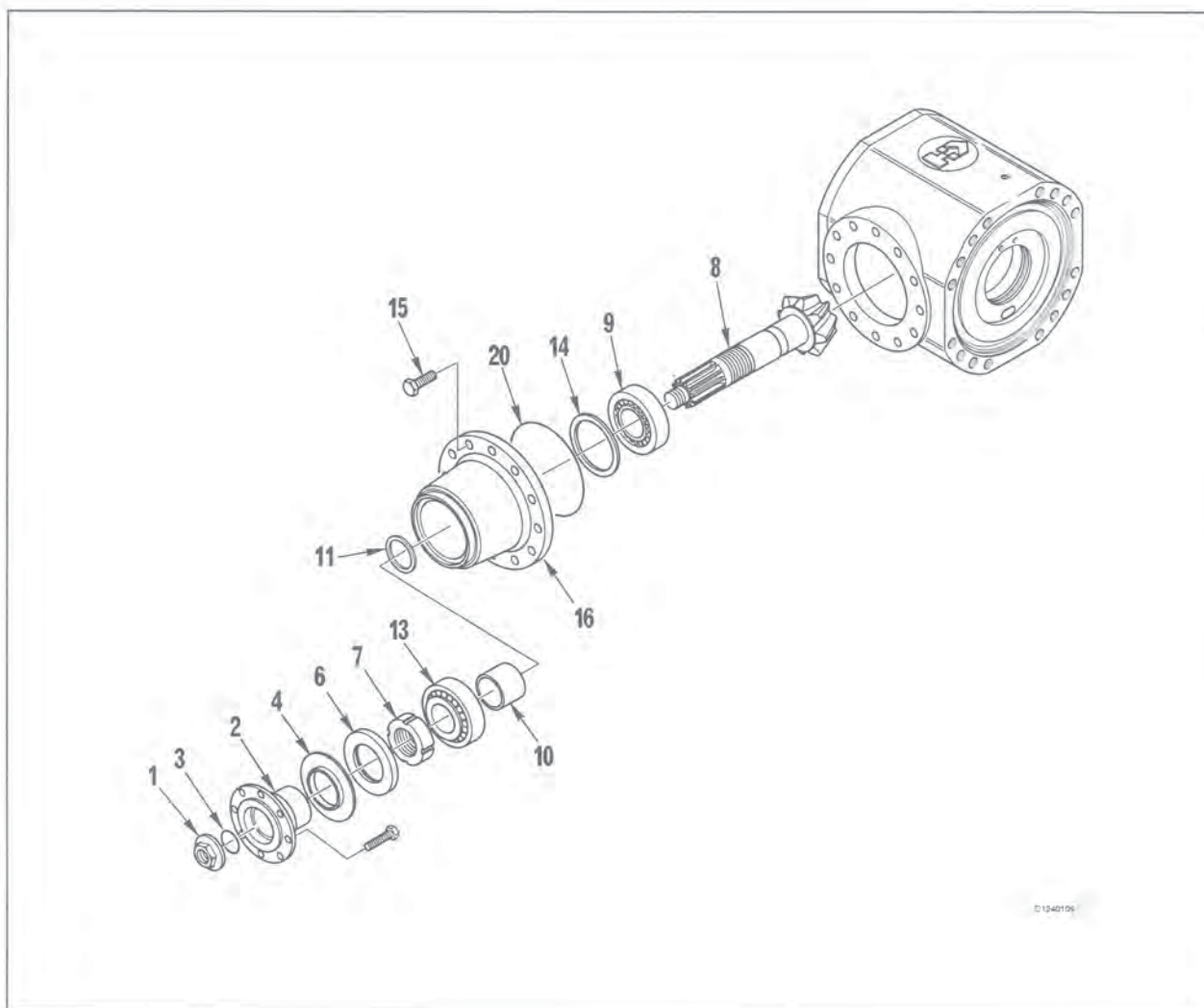


GB

a

**ONLY IF NECESSARY**

Unloose and remove the screws (15) locking the support (16);  
remove the whole support.







a

ITA

**SOLO SE NECESSARIO**

Allentare ed asportare le viti (15) di fissaggio del supporto (16); rimuovere il supporto completo.

D

**NUR WENN NOTWENDIG**

Schrauben (15) zur Befestigung der Halterung (16) abschrauben; Halterung abnehmen.

ESP

**SOLO SI NECESARIO**

Alojar y sacar los tornillos (15) de fijaje del soporte (16); remover el soporte completo.

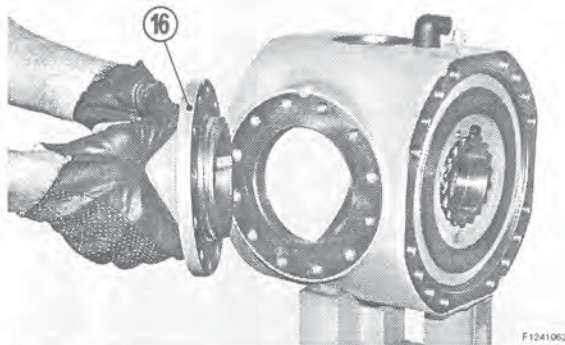
F

**SEUL SI BESOIN**

Desserrer et enlever les vis (15) de fixation du support (16); enlever le support complet.



HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PINON CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE



F1241062

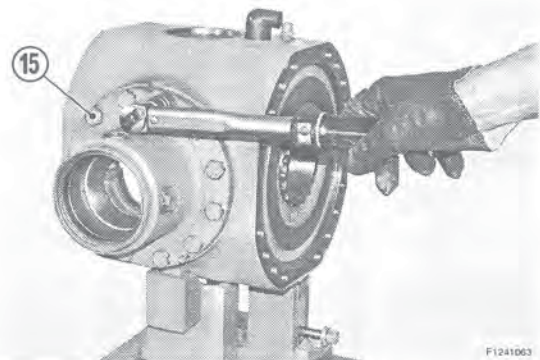
GB

a

**ONLY IF HAS BEEN REMOVED**

Fit support (16), including O-ring (20), onto the intermediate body.  
**NOTE.** 1- The cavity located on the outer diameter must face upwards.

2- Check and lubricate the O-ring (20).

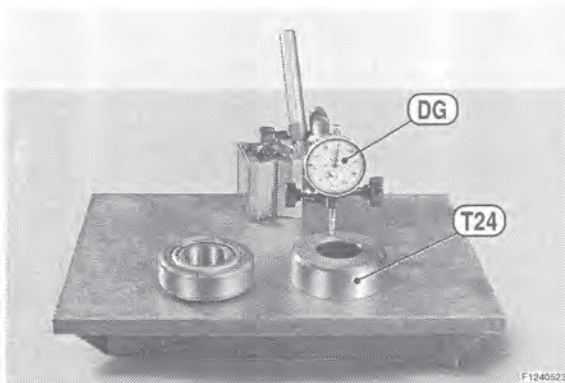


F1241063

GB

b

Fasten support with screws (15) previously coated with Loctite 270. Tighten using the criss-cross method to a tightening torque of 90 – 100 Nm.



F1240523

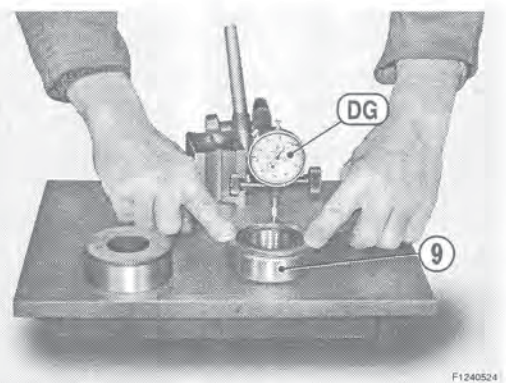


GB

c

Using a surface plate, reset a centesimal comparator "DG" and place it on the measurement ring T24 (with a thickness of 30.2 mm).

Preset the comparator to approx. 2 mm.



F1240524

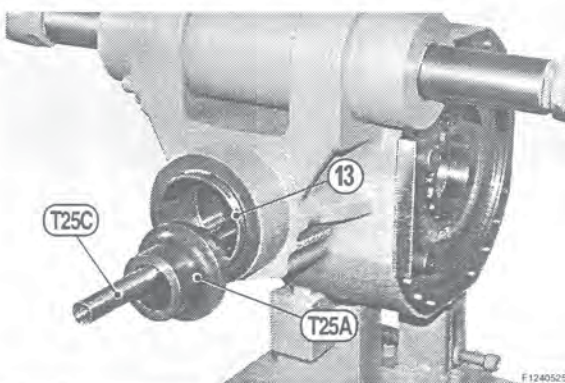
GB

d

Bring the internal bearing (9), complete with its thrust block, under the comparator "DG".

Determine overall thickness "D" of the bearing checking the discrepancy between this size and the size of the measurement ring.

**CAUTION!** Press the thrust block in the centre and take several measurements while rotating the thrust block.

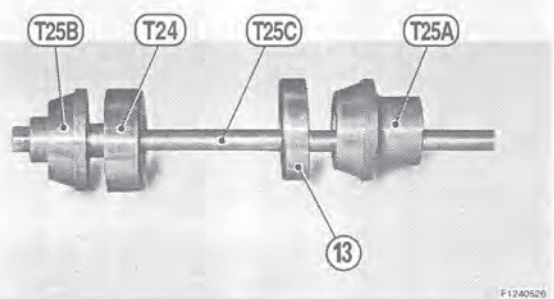


F1240525

GB

e

Partially insert the thrust block of the external bearing (13).



F1240526

GB

f

Install tension rod T25C, measurement ring T24 and front guide tool T25A on the thrust block of the external bearing (13).



**ITA**

**SOLO SE È STATO RIMOSSO**

Montare sul corpo intermedio il supporto (16) completo di guarnizione OR (20).

**NOTA.** 1- La nicchia ricavata sul diametro esterno deve essere rivolta verso l'alto.

2- Controllare e lubrificare la guarnizione OR (20).

**D**

**NUR WENN ABGENOMMEN**

Auf den mittleren Körper die Halterung (16) samt O-Ring (20) montieren.

**BEMERKUNG.** 1- Die Nische am äußeren Durchmesser muß nach oben gerichtet sein.

2- Ring (20) kontrollieren und schmieren.

**ESP**

**SOLO SI HA SIDO REMOVIDO**

Montar sobre el cuerpo intermedio el soporte (16) completo de guarnición OR (20).

**NOTA.** 1- El nicho recavado sobre el diametro externo debe de ser dirigido hacia el alto.

2- Controlar y lubrificar la guarnición OR (20).

**F**

**UNIQUEMENT S'IL A ÉTÉ ENLEVÉ**

Monter sur le corps intermédiaire le support (16) équipé de garnitures OR (20).

**NOTE.** 1- La niche obtenue sur le diamètre externe doit être tournée vers le haut.

2- Contrôler et lubrifier la garniture OR (20).

**ITA**

Utilizzando un piano di riscontro, azzerare sull'anello di misura T24 (di spessore conosciuto pari a 30,2 mm) un comparatore centesimale "DG".

Precaricare il comparatore di circa 2 mm.

**D**

Mit Hilfe eines Anschlags am Meßring T24 (bekannte Stärke 30,2 mm) eine hundertteilige Meßuhr "DG" auf Null stellen.

Meßuhr auf 2 mm vorladen.

**ESP**

Utilizando una superficie para la comparación, poner a cero en el anillo de medida T24 (del que se conoce el espesor igual a 30,2 mm) un comparador centesimal "DG".

Precargar el comparador en 2 mm aproximadamente.

**F**

A l'aide d'un plan de comparaison, mettre à zéro sur l'anneau de mesure T24 (d'une épaisseur connue égale à 30,2 mm), un comparateur centésimal "DG".

Précharger le comparateur d'environ 2 mm.

**ITA**

Inserire parzialmente nel corpo centrale (12) la ralla del cuscinetto esterno (13).

**D**

Auf den zentralen Körper (12) die Scheibe des äußeren Lagers (13).

**ESP**

Introducir parcialmente en el cuerpo central (12) la rangua el cojinete exterior (13).

**F**

Introduire, partiellement dans le corps central (12), la crapaudine du palier externe (13).

**ITA**

Fissare il supporto con le viti (15) spalmate con Loctite 270.

Serrare con il metodo incrociato ad una coppia di 90÷100 Nm.

**D**

Halterung mit den zuvor mit Loctite 270 geschmierten Schrauben (15) befestigen.

Im Kreuz abwechselnd fest ziehen. Anzugsmoment: 90÷100 Nm.

**ESP**

Fijar el soporte con los tornillos (15) pasar con Loctite 270.

Apretar con el metodo cruzado a un par de 90÷100 Nm.

**F**

Fixer le support avec les vis (15) enduire de Loctite 270.

Serrer à l'aide du système croisé à un couple de 90÷100 Nm.

**ITA**

Portare sotto il comparatore "DG" il cuscinetto interno (9) completo di ralla.

Determinare lo spessore totale "D" del cuscinetto controllando lo scostamento rispetto la misura dell'anello di misura.

**ATTENZIONE!** Premere la ralla in modo centrato ed eseguire più volte la misurazione ruotando la ralla.

**D**

Unter die Meßuhr "DG" das innere Lager (9) samt Scheibe legen.

Gesamte Stärke "D" des Lagers messen und die Abweichung im Verhältnis zum Meßring kontrollieren.

**ACHTUNG!** Die Scheibe muß zentriert sein und den Meßvorgang mehrmals bei gedrehter Scheibe wiederholen.

**ESP**

Poner debajo del comparador "DG" el cojinete interior (9) con la rangua.

Determinar el espesor total "D" del cojinete controlando la diferencia con respecto al tamaño del anillo de medida.

**CUIDADO!** Presionar la rangua de manera centrada y ejecutar varias veces la medida girando la rangua.

**F**

Amener sous le comparateur "DG" le palier interne (9) équipé de crapaudine.

Définir l'épaisseur totale "D" du palier en contrôlant l'écart par rapport à celle mesurée par l'anneau de mesure.

**ATTENTION!** Presser la crapaudine vers le centre, puis en effectuer plusieurs fois le mesurage en tournant la crapaudine.

**ITA**

Montare il tirante T25C, l'anello di misura T24, ed infine l'attrezzo anteriore T25A di guida della ralla (13) del cuscinetto esterno.

**D**

Die Spannstange T25C, den Meßring T24, und zuletzt das vordere Werkzeug T25A zur Führung der Scheibe (13) des äußeren Lagers montieren.

**ESP**

Montar el tirante T25C, el anillo de medida T24, y por último la herramienta anterior T25A guía de la rangua (13) del cojinete exterior.

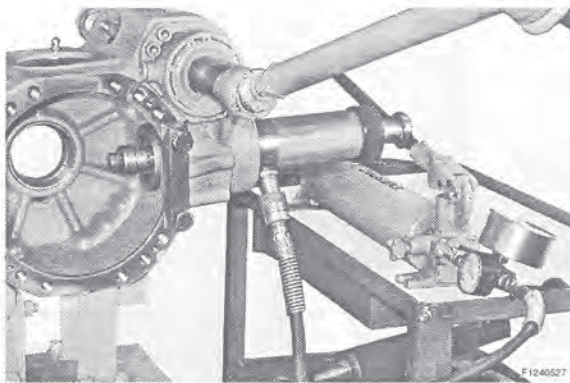
**F**

Monter la tringle T25C, l'anneau de mesure T24, et enfin l'outil antérieur T25A de guidage de la crapaudine (13) du palier externe.





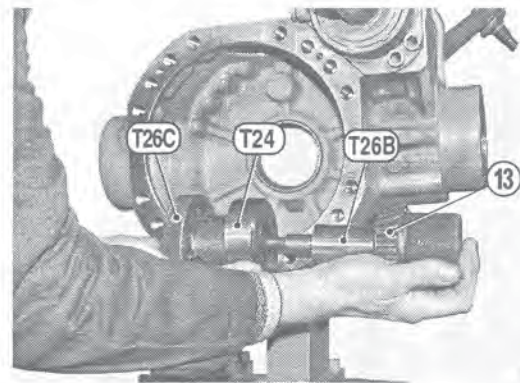
HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PIÑON CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE



GB

a

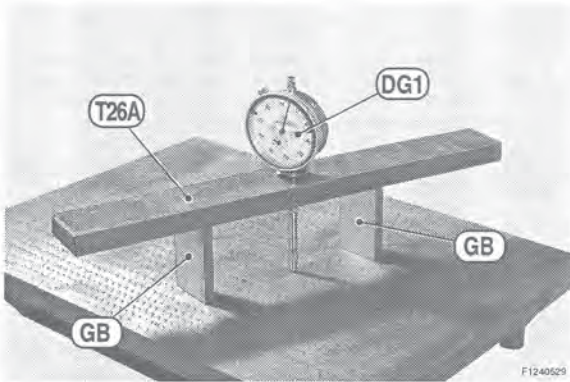
Connect the tension rod to the press and move the thrust block of the external bearing (13) into its seat. Disconnect the press and remove the tension rod.  
**NOTE.** Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.



GB

b

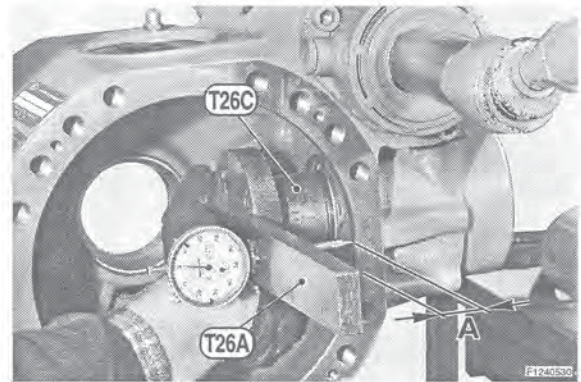
Insert tool T26B complete with external bearing (13), measurement ring T24 and gauged ring nut T26C. Manually tighten.



GB

c

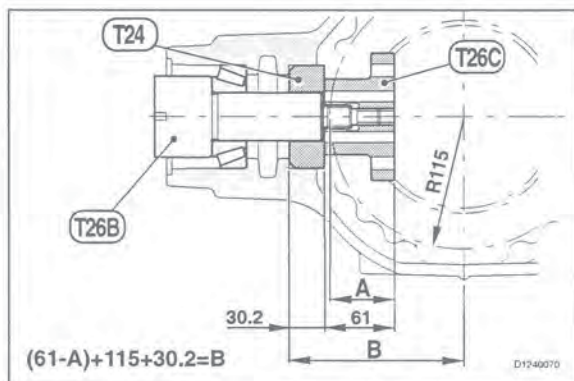
Fit a centesimal comparator "DG1" with long stem into bar T26A; when the bar rests on two size-blocks "GB" of 57 mm, reset the comparator.  
Preset the comparator to approx. 2 mm and reset.



GB

d

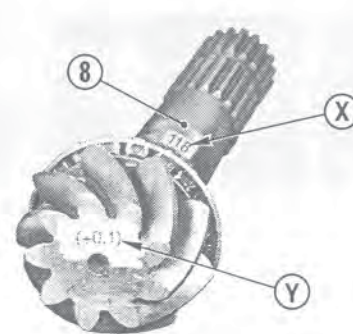
Lay bar T26A on gauged nut T26C and take the size "A" at about 57 mm corresponding to the maximum diameter of arms centring.



GB

e

Calculate size "B" which will be the first useful value for calculating the size of the shims (14) that are to be inserted under the thrust block of the internal bearing (9).



GB

f

Check the nominal size (X) marked on the pinion and add or subtract the indicated variation (Y) so as to obtain size "Z".  
e.g.:  $Z = 118 + 0.1 = 118.1$   
 $Z = 118 - 0.2 = 117.8$





ITA

Collegare il tirante alla pressa e mandare in sede la ralla del cuscinetto esterno (13).  
Scollegare la pressa e rimuovere il tirante.

**NOTA.** Prima di proseguire, assicurarsi dell'inserimento totale della ralla.

D

Spannstange mit der Presse verbinden und die Scheibe in ihren Sitz im äußeren Lager (13) einsetzen. Von der Presse abnehmen und Spannstange abnehmen.

a

**BEMERKUNG.** Sorgfältig kontrollieren, ob die Scheibe richtig eingesetzt worden ist.

ESP

Conectar el tirante a la prensa y colocar en el alojamiento la rangua del cojinete exterior (13). Sacar la prensa y remover el tirante.

**NOTA.** Antes de continuar, asegurarse de que la rangua está completamente insertada.

F

Brancher la tringle à la presse, puis envoyer dans son logement la crapaudine du palier externe (13). Débrancher la presse et enlever la tringle.

**NOTE.** Avant de continuer, s'assurer que la crapaudine est complètement insérée.

ITA

Inserire l'attrezzo **T26B** completo di cuscinetto esterno (13) anello di misura **T24** e ghiera di altezza calibrata **T26C**.

Serrare a fondo manualmente.

D

Werkzeug **T26B** mit dem äußeren Lager (13), Meßring **T24** und in der Höhe kalibrierte Nutmutter **T26C** einsetzen.

Von Hand festschrauben.

b

ESP

Introducir la herramienta **T26B** con el cojinete exterior (13), el anillo de medida **T24** y la virola de altura calibrada **T26C**.

Apretar a fondo manualmente.

F

Introduire l'outil **T26C** équipé du palier externe (13), l'anneau de mesure **T24** et le collier de serrage de hauteur tarabudé **T26C**.

Serrer à fond manuellement.

ITA

Montare un comparatore centesimale "**DG1**" con stelo prolungato, nella barra **T26A**; azzerare il comparatore quando la barra appoggia su due blocchetti "**GB**" calibrati da 57 mm.

Precaricare il comparatore di circa 2 mm ed azzerarlo.

D

Die hundertteilige Meßuhr "**DG1**" mit dem Verlängerungsstift in den Stab **T26A** montieren; die Meßuhr auf Null stellen, nachdem der Stab auf zwei kalibrierte Blöcke "**GB**" zu 57 mm gelegt worden ist.

Meßuhr auf 2 mm vorladen und auf Null stellen.

c

ESP

Montar un comparador centesimal "**DG1**" con vástago prolongado en la barra **T26A**; poner a cero el comparador cuando la barra está apoyada en dos bloques "**GB**" calibrados de 57 mm.

Precargar el comparador en 2 mm aproximadamente y ponerlo a cero.

F

Monter un comparateur centésimal "**DG1**" muni de tige de prolongation dans la barre **T26A**; mettre le comparateur à zéro lorsque la barre posée sur les deux blocs calibrés "**GB**" est à 57 mm.

Précharger le comparateur à environ 2 mm et remettre à zéro.

ITA

Appoggiare la barra **T26A** sulla ghiera calibrata **T26C** e rilevare la misura "**A**" circa 57mm in corrispondenza del diametro massimo della centratura dei bracci.

D

Stab **T26A** auf die kalibrierte Nutmutter **T26C** legen und das Maß "**A**" bei ca. 57 mm am maximalen Durchmesser der Armzentrierung messen.

d

ESP

Apoyar la barra **T26A** en la virola calibrada **T26C** y registrar la medida "**A**" unos 57 mm en correspondencia del diámetro máximo del centraje de los brazos.

F

Poser la barre **T26A** sur le collier de serrage tarabudé **T26C**, relever la mesure "**A**" à environ 57 mm en correspondance du diamètre de centrage maximal des bras.

ITA

Eseguire il calcolo per ottenere la prima misura utile "**B**", per il calcolo degli spessori (14) da inserire sotto la ralla del cuscinetto interno (9).

D

Das Maß "**B**" ausrechnen, das zur Ermittlung der Distanzstücke (14) dient, die unterhalb der Scheibe des inneren Lagers (9) eingesetzt werden sollen.

e

ESP

Ejecutar el cálculo para obtener la primera medida útil "**B**" para el cálculo de los espesores (14) que hay que insertar debajo de la rangua del cojinete interior (9).

F

Faire le calcul pour obtenir la première mesure utile "**B**" pour calculer les cales (14) à introduire au-dessous de la crapaudine du palier interne (9).

ITA

Controllare la misura nominale (X) segnata sul pignone e sommare o sottrarre ad essa la variazione indicata: (Y) per ottenere la misurazione "**Z**".

Es:  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$

D

Das Nennmaß (X), das am Rad markiert ist, kontrollieren und die Abweichung addieren oder abziehen, (Y) für das Maß "**Z**".

Beisp.:  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$

f

ESP

Controlar la medida nominal (X) marcada en el piñón y sumarle o restarle la variación indicada (Y) para obtener la medida "**Z**".

Ej.:  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$

F

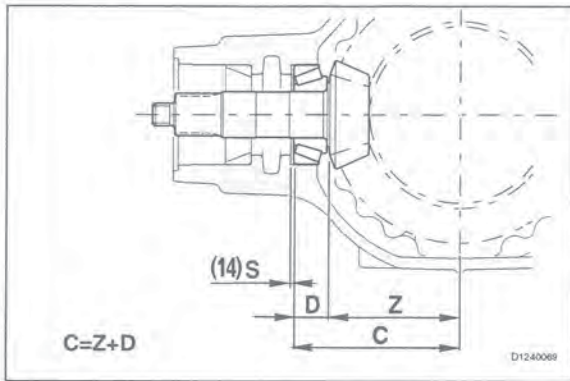
Contrôler la mesure nominale (X) marquée sur le pignon et additionner ou soustraire à celle-ci la variation indiquée (Y) pour obtenir la mesure "**Z**".

Exp.  $Z = 118 + 0,1 = 118,1$   
 $Z = 118 - 0,2 = 117,8$





HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGLRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PIÑON CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE

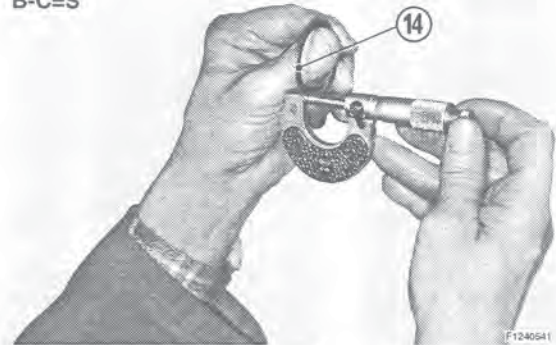


GB

a

Calculate size "C" which represents the second value for calculating the size of the shims "S" that are to be placed under the thrust block of the internal bearing (9).

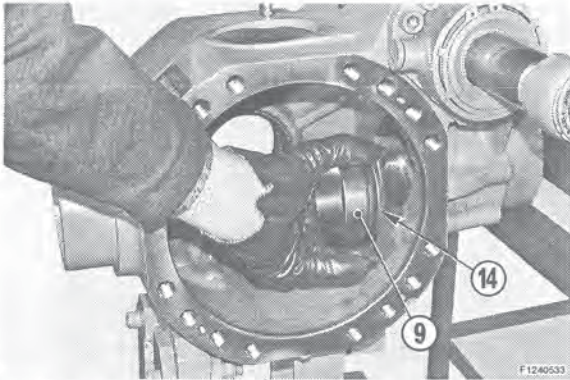
$B-C=S$



GB

b

Calculate the difference between sizes "B" and "C" so as to obtain the size "S" of the shim (14) that will go under the thrust block of the internal bearing (9).

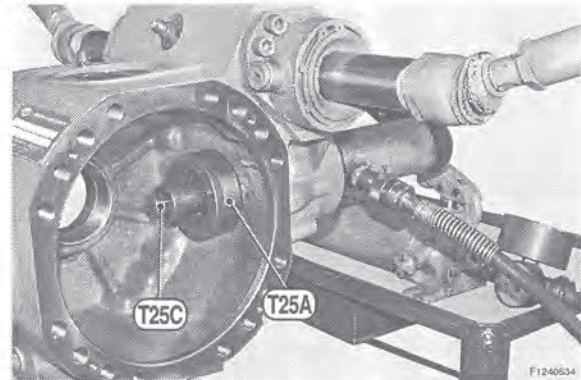


GB

c

Insert shim "S" (14) and the thrust block of the internal bearing (9) in the central body.

**NOTE.** To hold shim "S" (14) in position, apply grease.



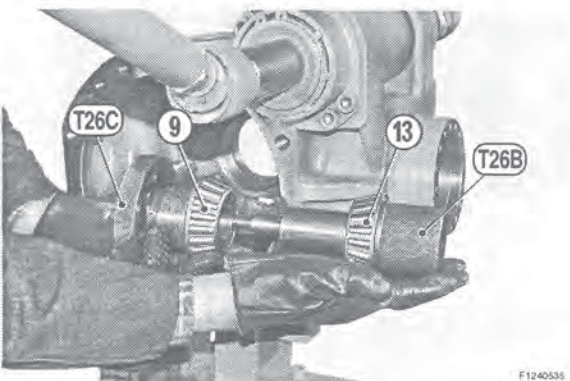
GB

d

Position tool T25A and tension rod T25C.

Connect the tension rod to the press, fasten the thrust block and then remove the tools.

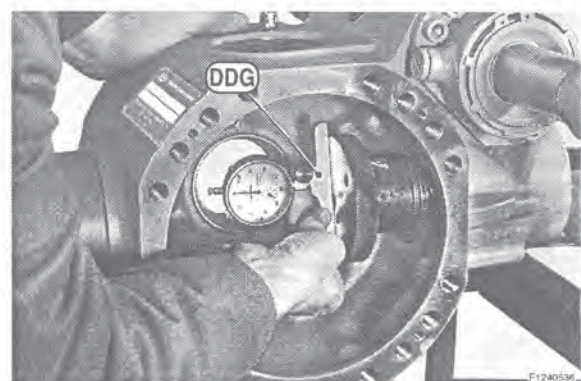
**NOTE.** Before going on to the next stage, make sure that the thrust block has been completely inserted.



GB

e

Position tools T26C and T26B complete with tapered bearings (9) and (13); manually tighten until a rolling torque has been obtained.



GB

f

Insert the stem of a depth comparator "DDG" in either side hole of tool T26C; reset the comparator with a presetting of approx. 3 mm.





SPICER CLARK-HURTH

- a**
- ITA** Calcolare la seconda misura utile "C" per il calcolo dello spessore "S" da inserire sotto la ralla del cuscinetto interno (9).
- D** Das zweite Maß "C" für das Distanzstück "S" ausrechnen, das unter die Scheibe des inneren Lagers (9) eingesetzt werden soll.
- ESP** Calcular la segunda medida útil "C" para el cálculo del espesor "S" a insertar debajo de la rangua del cojinete interior (9).
- F** Calculer la seconde mesure utile "C" pour calculer la cale "S" à introduire au-dessous de la crapaudine du palier interne (9).

- ITA** Eseguire la differenza tra le misure "B" e "C" per stabilire la misura "S" dello spessore (14) da inserire sotto la ralla del cuscinetto interno (9).
- D** Den Unterschied zwischen Maß "B" und "C" ausrechnen, um das Distanzstück "S" (14) auszurechnen, das unter die Scheibe des inneren Lagers (9) eingesetzt werden soll.
- ESP** Sacar la diferencia entre las medidas "B" y "C" para establecer la medida "S" del espesor (14) a insertar debajo de la rangua del cojinete interior (9).
- F** Effectuer la différence entre les mesures "B" et "C" pour établir la mesure "S" de la cale (14) à introduire au-dessous de la crapaudine du palier interne (9).

- c**
- ITA** Inserire nel corpo centrale lo spessore "S" (14) e la ralla del cuscinetto interno (9).  
**NOTA.** Per tenere in posizione lo spessore "S" (14), spalmarlo leggermente con grasso.
- D** In den zentralen Körper das Distanzstück "S" (14) und die Scheibe des inneren Lagers (9) einsetzen.  
**BEMERKUNG.** Um das Distanzstück "S" (14) in seiner Position festzuhalten, dieses leicht mit Fett schmieren.
- ESP** Introducir en el cuerpo central el espesor "S" (14) y la rangua del cojinete interior (9).  
**NOTA.** Para mantener en su posición el espesor "S" (14), pasarle ligeramente un poco de grasa.
- F** Introduire dans le corps central la cale "S" (14) et la cale du palier interne (9).  
**NOTE.** Enduire légèrement celle-ci de gras pour la maintenir dans sa position.

- ITA** Montare l'attrezzo T25A ed il tirante T25C. Collegare il tirante alla pressa, mandare in battuta la ralla e quindi smontare gli attrezzi.  
**NOTA.** Prima di proseguire, assicurarsi dell'inserimento totale della ralla.
- D** Werkzeug T25A und Spannstange T25C montieren. Spannstange mit der Presse verbinden und die Scheibe bis zum Anschlag einsetzen. Danach die Werkzeuge abmontieren.
- d** **BEMERKUNG.** Sorgfältig kontrollieren ob die Scheibe richtig eingesetzt worden ist.
- ESP** Montar la herramienta T25A y el tirante T25C. Conectar el tirante a la prensa, llevar a tope la rangua y luego desmontar las herramientas.  
**NOTA.** Antes de continuar, asegurarse de que la rangua ha sido totalmente introducida.
- F** Monter l'outil T25A et la tringle T25C. Relier la tringle à la presse, envoyer en butée la crapaudine, puis démonter les outils.  
**NOTE.** Avant de continuer, s'assurer que la crapaudine est entièrement insérée.

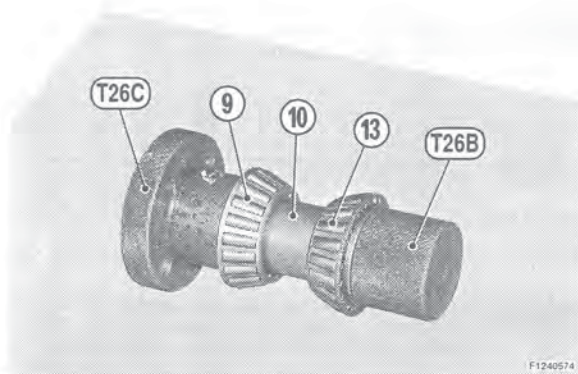
- e**
- ITA** Inserire gli attrezzi T26C e T26B completi dei cuscinetti conici (9) e (13); serrare manualmente fino ad avere sicuramente una coppia di rotolamento.
- D** Die Werkzeuge T26C und T26B samt Kegellager (9) und (13) einsetzen; von Hand zudrehen bis ein Drehmoment erreicht worden ist.
- ESP** Introducir las herramientas T26C y T26B con sus cojinetes cónicos (9) y (13); apretar manualmente hasta obtener con seguridad un par de rodamiento.
- F** Introduire les outils T26C et T26B équipés des paliers coniques (9) et (13); serrer manuellement jusqu'à être sûr d'avoir un couple de roulement.

- ITA** Inserire in uno dei due fori laterali dell'attrezzo T26C lo stelo di un comparatore di profondità "DDG"; azzerare il comparatore con un precarico di circa 3 mm.
- D** In eines der beiden seitlichen Löcher des Werkzeugs T26C den Stift der Meßuhr "DDG" stecken; die Meßuhr auf 3 mm vorladen und auf Null stellen.
- f**
- ESP** Introducir en uno de los dos orificios laterales de la herramienta T26C el vástago de un comparador de profundidad "DDG"; poner a cero el comparador con una precarga de aproximadamente 3 mm.
- F** Introduire dans l'un des deux trous latéraux de l'outil T26C, la tige d'un comparateur de profondeur "DDG", mettre le comparateur à zéro avec une précharge d'environ 3 mm.

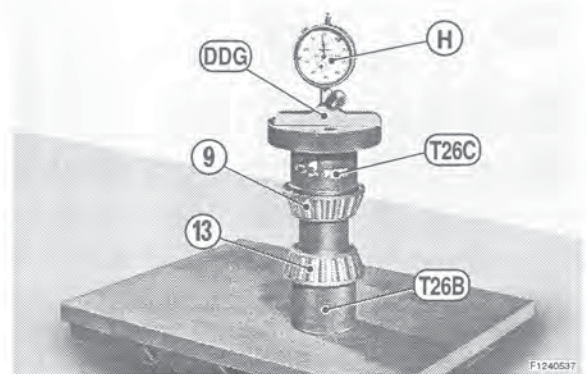




HOW TO INSTALL AND ADJUST THE BEVEL PINION - INSTALLAZIONE E REGISTRAZIONE PIGNONE CONICO - KEGELRAD INSTALLIEREN UND EINSTELLEN - INSTALACION Y AJUSTE DEL PINON CONICO - INSTALLATION ET REGLAGE DU PIGNON CONIQUE

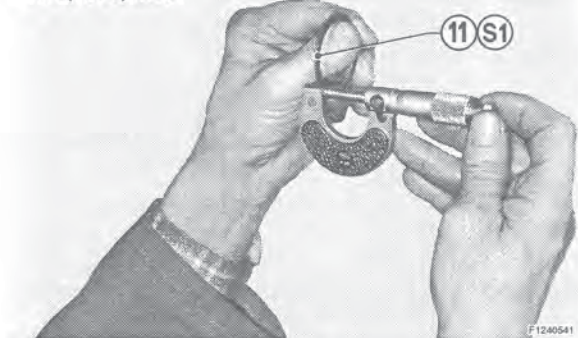


Remove the comparator and release tools and bearings from the central body.  
Re-install all and insert the distance piece (10) between bearings (9) and (13); manually tighten the whole pack.

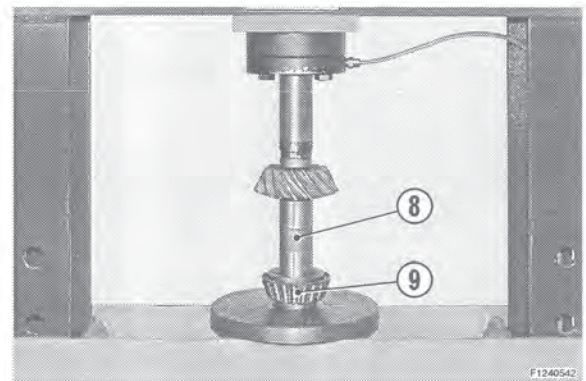


Insert depth comparator "DDG" into tool T26B-T26C and measure variation "H" in relation to the zero setting performed back at point d.

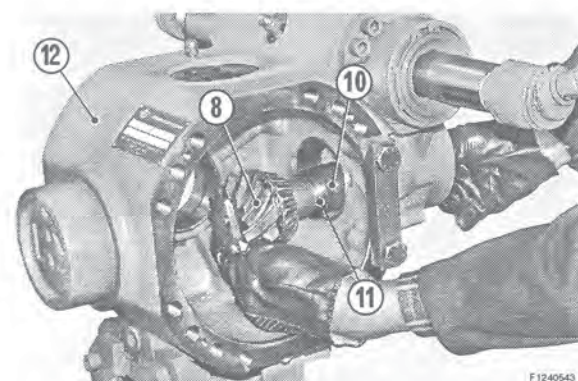
$$H + 0,12 \div 0,13 = S1$$



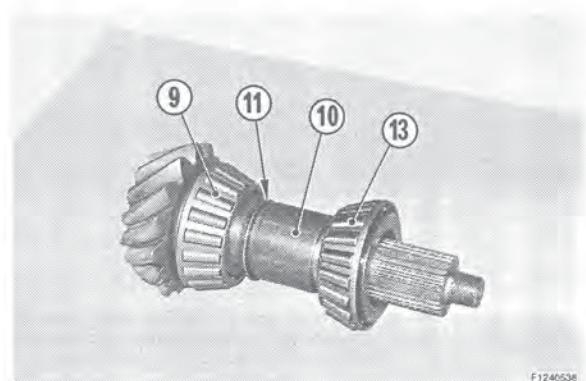
The variation is to be added to a set value of 0.12–0.13 mm., so as to obtain the size of shim "S1" (11) which will be inserted between the external bearing (13) and the distance piece (10) and subsequently, to determine the preload for the bearings.



Position the internal bearing (9) and the pinion (8) under a press; force the bearing onto the pinion.



Fit the pinion (8), shim "S1" (11) and distance piece (10) in the main body (12).  
**NOTE.** The finer shims must be placed in-between the thicker ones



Insert the external bearing (13) in the central body in order to complete the pack arranged as in the figure.





**ITA** Rimuovere il comparatore e smontare dal corpo centrale il gruppo attrezzi e cuscinetti.  
Rimontare il tutto inserendo tra i cuscinetti (9) e (13) il distanziale (10); serrare manualmente l'intero pacco.

**D** Die Meßuhr abnehmen und vom zentralen Körper die Werkzeuge und Lager abmontieren.  
Das ganze wieder montieren und dabei zwischen den Lagern (9) und (13) das Distanzstück (10) einsetzen; von Hand das Ganze festschrauben.

**ESP** Remover el comparador y desmontar del cuerpo central el grupo de las herramientas y cojinetes.  
Volver a montar todo introduciendo entre los cojinetes (9) y (13) el separador (10); apretar manualmente todo el paquete.

**F** Enlever le comparateur et démonter du corps central le groupe outils et paliers.  
Remonter le tout en insérant entre les paliers (9) et (13), l'entretoise (10); serrer tout le paquet à la main.

**ITA** Inserire nell'attrezzo T26B-T26C il comparatore di profondità "DDG" e rilevare lo scostamento "H" rispetto l'azzeramento eseguito al punto d.

**D** In das Werkzeug T26B-T26C die Meßuhr "DDG" für die Tiefe einsetzen und die Abweichung "H" im Verhältnis zur unter Punkt d vorgenommenen Nullstellung messen.

**ESP** Introducir en la herramienta T26B-T26C el comparador de profundidad "DDG" y relevar el alejamiento "H" respecto al aceramiento efectuado al punto d.

**F** Introduire l'outil T26B-T26C le comparateur de profondeur "DDG" et relever l'écart "H" par rapport à la mise à zéro effectué au point d.

**ITA** Lo scostamento rilevato è da sommare ad una misura fissa di  $0,12 \pm 0,13$  mm, per ottenere lo spessore "S1" (11) da inserire tra cuscinetto esterno (13) e distanziale (10) e quindi, determinare il precarico stabilito per i cuscinetti.

**D** Die ermittelte Abweichung wird dem festen Maß von  $0,12 \pm 0,13$  mm hinzu gerechnet, um das Distanzstück "S1" (11) zu ermitteln, das zwischen dem äußeren Lager (13) und das Distanzstück (10) eingesetzt werden soll und folglich die benötigte Vorbelastung der Lager festzulegen.

**ESP** La separación registrada hay que sumarla a una medida fija de  $0,12 \pm 0,13$  mm para obtener el espesor "S1" (11) que hay que introducir entre el cojinete exterior (13) y el separador (10) y luego, determinar la precarga establecida para los cojinetes.

**F** L'écart relevé est à additionner à une mesure fixe de  $0,12 \pm 0,13$  mm pour obtenir la cale "S1" (11) à introduire entre le palier externe (13) et entretoise (10) et par conséquent déterminer la précharge préconisée pour les paliers.

**ITA** Posizionare il cuscinetto interno (9) e pignone (8) sotto una pressa; forzare sul pignone il cuscinetto.

**D** Das innere Lager (9) und das Rad (8) unter eine Presse setzen; auf das Rad das Lager drücken.

**ESP** Posicionar el cojinete interior (9) y el piñón (8) debajo de una prensa; forzar en el piñón el cojinete.

**F** Placer le palier interne (9) et le pignon (8) sous presse; forcer sur pignon et palier.

**ITA** Montare nel corpo centrale (12), il pignone (8), gli spessori "S1" (11) e il distanziale (10).  
**NOTA.** Gli spessori più fini devono essere contenuti tra quelli più spessi.

**D** Zentralen Körper (12), Rad (8), Unterlegscheibe "S1" (11) und Distanzstück (10) montieren.  
**BEMERKUNG.** Die dünneren Unterlegscheiben müssen zwischen den stärkeren gelegt werden.

**ESP** Montar en el cuerpo central (12) el piñón (8) los espesores "S1" (11) y el separador (10).  
**NOTA.** Los espesores más delgados tienen que colocarse entre los más gruesos.

**F** Monter le corps central (12), le pignon (8), les cales "S1" (11) et l'entretoise (10).  
**NOTE.** Les cales plus minces doivent être intercalées parmi les plus épaisses.

**ITA** Inserire nel corpo centrale il cuscinetto esterno (13) in modo da completare il pacco come composto in figura.

**D** In den zentralen Körper das äußere Lager (13) einsetzen wie in der Abbildung gezeigt.

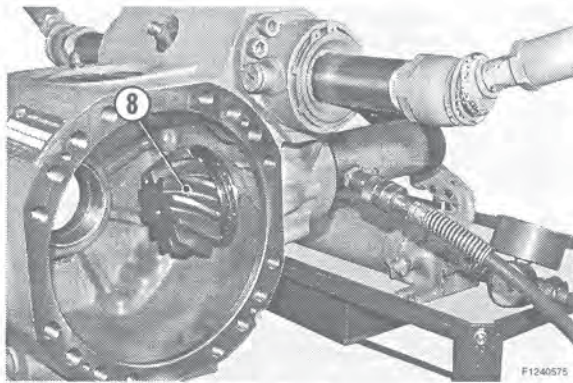
**ESP** Introducir en el cuerpo central el cojinete exterior (13) de manera que el paquete quede completo como ha sido formado en la figura.

**F** Introduire dans le corps central, le palier externe (13), de manière à compléter le paquet comme composé sur la figure.





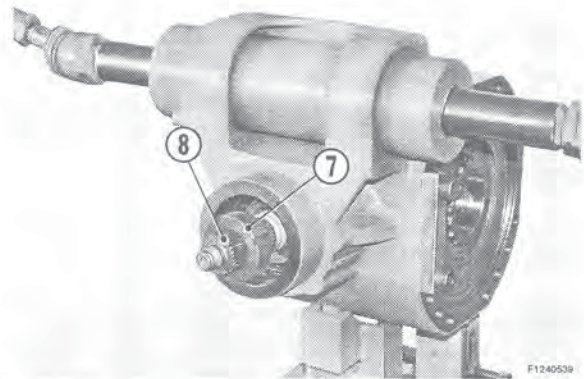
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GB

a

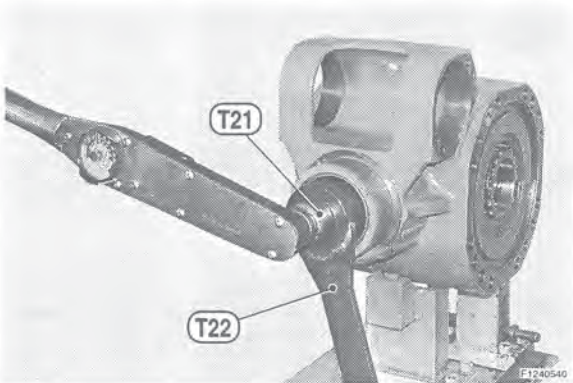
Connect the pinion (8) to the tie rod T28A and T28B; connect the tie rod T28C (see special tools) to the press and block.



GB

b

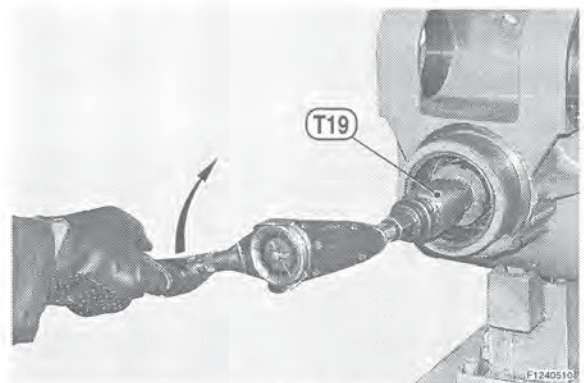
Apply Loctite 242 to the thread of the ring nut (7) and screw the nut onto the pinion (8).



GB

c

Apply special wrench T22 to the ring nut (7) and bar-hold T21 to the pinion (8). Lock the wrench T22 and rotate the pinion using a dynamometric wrench, up to a minimum required torque setting of 500 Nm.



GB

d

Apply onto the pinion (8) the bar-hold and with the help of a torque metre, check the torque of the pinion (8). Torque: 120-170 Ncm

**CAUTION!** If torque exceeds the maximum value, then the size of shim "S1" (11) between the bearing (13) and the distance piece (10) needs to be increased.

If torque does not reach the set value, increase the torque setting of the ring nut (7) in different stages to obtain a maximum value of 570 Nm.

**CAUTION!** If torque does not reach the minimum value, then the size of shim "S1" (11) needs to be reduced.

**CAUTION!** When calculating the increase or decrease in size of shim "S1", bear in mind that a variation of shim (11) of 0.01 mm corresponds to a variation of 60 Ncm in the torque of the pinion (8).



- a**
- ITA** Collegare il pignone (8) al tirante T28A e T28B; collegare il tirante T28C (Vedere attrezzature speciali) alla pressa e mandare in blocco.
- D** Ritzel (8) mit der Zugstange T28A und T28B verbinden; Zugstange T28C (siehe Spezialausrüstung) mit der Presse verbinden und blockieren.
- ESP** Conectar el pignon (8) al tirante T28A y T28B; conectar el tirante T28C (Vease herramientas especiales) a la prensa y bloquear.
- F** Brancher le pignon (8) à la tringle T28A et T28B; relier la tringle T28C (voir installations spéciales) à la presse puis envoyer en butée.

- c**
- ITA** Impegnare la chiave speciale T22 sulla ghiera (7) ed applicare il codolo T21 sul pignone (8).  
Fermare la chiave T22 e ruotare il pignone con una chiave dinamometrica fino alla coppia minima richiesta di 500 Nm.
- D** Den speziellen Schlüssel T22 auf die Nutmutter (7) setzen und den Schaft T21 auf das Rad (8) montieren. Den Schlüssel T22 festhalten und das Rad mit einem Momentenschlüssel drehen bis das mindeste Anzugsmoment von 500 Nm erreicht worden ist.
- ESP** Colocar la llave especial T22 en la virola (7) y aplicar el mango T21 en el piñón (8).  
Parar la llave T22 y girar el piñón con una llave dinamométrica hasta el par mínimo requerido de 500 Nm.
- F** Engager la clé spéciale T22 sur le collier (7) et appliquer la queue T21 sur le pignon (8).  
Bloquer la clé T22, tourner le pignon avec une clé dynamométrique jusqu'au couple minimum requis de 500 Nm.

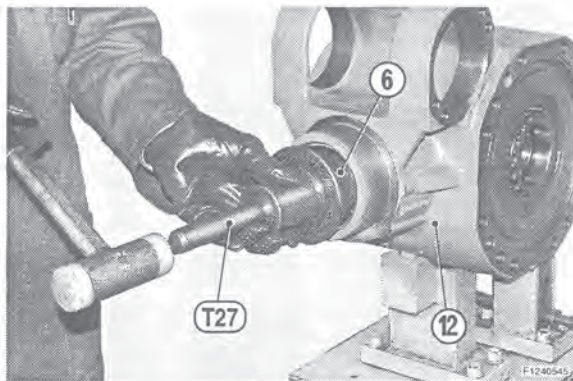
- b**
- ITA** Spalmare la filettatura della ghiera (7) con Loctite 242 ed avvitarela sul pignone (8).
- D** Das Gewinde der Nutmutter (7) mit Loctite 242 schmieren und auf das Rad (8) schrauben.
- ESP** Pasar sobre la rosca de la virola (7) Loctite 242 y atornillarla en el piñón (8).
- F** Enduire le filetage du collier de serrage (7) avec du Loctite 242, puis visser celui-ci sur le pignon (8).

- d**
- ITA** Applicare sul pignone (8) il codolo T19 e con un torsiometro, controllare la coppia di rotazione del pignone. Coppia di rotazione: 120÷170 Ncm  
**ATTENZIONE!** Se la coppia supera il valore massimo bisogna aumentare lo spessore "S1" (11) tra cuscinetto (13) e distanziale (10). Se la coppia di rotazione non raggiunge il valore stabilito, aumentare la coppia di serraggio della ghiera (7) in più tempi fino a raggiungere il valore massimo ammesso di 570 Nm.  
**ATTENZIONE!** Se la coppia di rotazione non raggiunge il valore minimo, è necessario diminuire lo spessore "S1" (11).  
**ATTENZIONE!** Al fine di poter calcolare gli incrementi o la diminuzione dello spessore "S1", è necessario considerare che la variazione dello spessore (11) di 0,01 mm, fa variare la coppia di rotazione del pignone (8) di 60 Ncm.
- D** Den Schaft T19 montieren auf das Rad (8) und mit einem Drehungsmesser das Drehmoment des Rads kontrollieren. Drehmoment: 120÷170 Ncm  
**ACHTUNG!** Falls das Drehmoment größer als der maximale Wert sein sollte, muß ein größeres Distanzstück "S1" (11) zwischen Lager (13) und Distanzstück (10) eingesetzt werden. Falls das Drehmoment den benötigten Wert nicht erreicht, muß das Drehmoment der Nutmutter (7) stufenweise erhöht werden, bis der maximal zugelassene Wert von 570 Nm erreicht worden ist.  
**ACHTUNG!** Falls das Drehmoment den minimalen Wert nicht erreicht, muß das Distanzstück "S1" (11) kleiner gewählt werden.  
**ACHTUNG!** Um die Erhöhungen oder Verringerungen des Distanzstücks "S1" ausrechnen zu können, muß beachtet werden, daß ein Unterschied von 0,01 mm des Distanzstücks (11), das Drehmoment des Rads (8) um 60 Ncm verändert.
- ESP** Aplicar el mango T19 en el piñón (8) y con un torsiómetro, controlar el par de rotación del piñón. Par de rotación: 120÷170 Ncm  
**CAUIDADO!** Si el par supera el valor máximo, hay que aumentar el espesor "S1" (11) entre el cojinete (13) y el separador (10). Si el par de rotación no alcanza el valor establecido, aumentar el par de torsión de la virola (7) varias veces hasta alcanzar el valor máximo admitido de 570 Nm.  
**CAUIDADO!** Si el par de rotación no alcanza el valor mínimo, hay que disminuir el espesor "S1" (11).  
**CAUIDADO!** A fin de poder calcular los incrementos o la disminución del espesor "S1", hay que considerar que el espesor (11) de 0,01 mm hace variar el par de rotación del piñón (8) en 60 Ncm.
- F** Appliquer la queue T19 sur le pignon (8) et l'aide d'un torsiomètre, contrôler le couple de rotation du pignon. Couple de rotation: 120÷170 Ncm  
**ATTENTION!** Si le couple dépasse la valeur maximale, il faut augmenter la cale "S1" (11) entre palier (13) et entretoise (10). Si le couple de rotation n'atteint pas la valeur établie, augmenter le couple de serrage du collier de serrage (7) en plusieurs fois jusqu'à atteindre la valeur maximale préconisée de 570 Nm.  
**ATTENTION!** Si le couple de rotation n'atteint pas la valeur minimale, il faut diminuer la cale "S1" (11).  
**ATTENTION!** Pour pouvoir calculer l'incrémentation ou la diminution de la cale "S1", il faut tenir compte que la variation de la cale (11) de 0,01 mm, modifie le couple de rotation du pignon (8) de 60 Ncm.





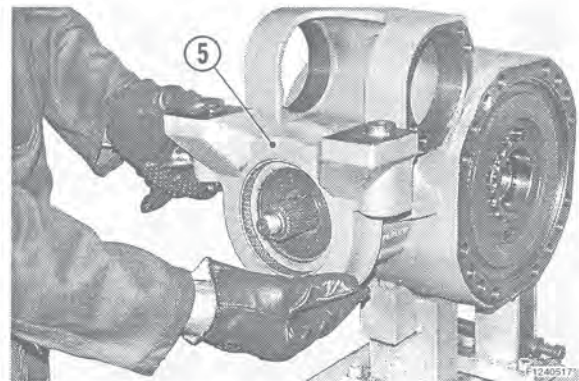
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GB

a

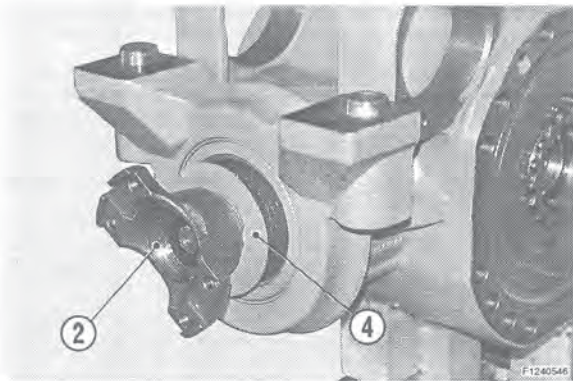
Lubricate the outer surface of the new sealing ring (6) and fit it onto the central body (12) using tool T27.



GB

b

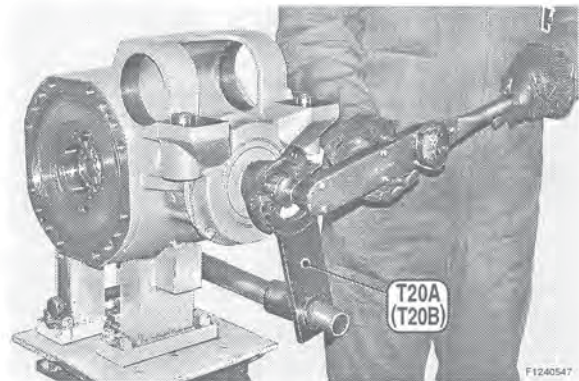
**ATTENTION!** This operation does not apply to the fixed axle.  
**NOTE.** Check that it is properly oriented.



GB

c

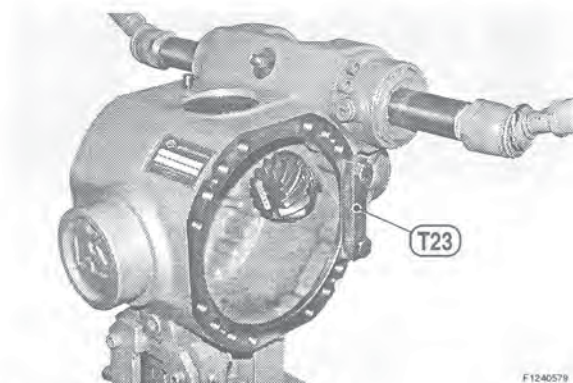
Fit the flange (2) complete with the guard (4) and fasten it.  
For keying the flange (2), use a plastic hammer if necessary.  
**NOTE.** Make sure that the guard (4) is securely fastened onto the flange and that it is not deformed.



GB

d

Apply Loctite 242 to the threaded part of the pinion (8).  
Position tool T20A (or T20B) and fasten it in order to avoid rotation.  
Insert O-ring (3) the nut (1) and tighten it using a dynamometric wrench.  
Torque wrench setting: 280-310 Nm



GB

e

Remove blocks T23 (used for extracting the pinion) and re-install the arms.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS».



- a**
- ITA** Lubrificare la superficie esterna del nuovo anello di tenuta (6) e montarlo nel corpo centrale (12) utilizzando l'attrezzo **T27**.
- D** Die äußere Fläche des neuen Ringes (6) schmieren und den zentralen Körper (12) mit Hilfe des Werkzeugs **T27** montieren.
- ESP** Lubricar la superficie exterior del nuevo segmento de compresión (6) y montarlo en el cuerpo central (12) utilizando la herramienta **T27**.
- F** Lubrifier la surface externe de la bague d'étanchéité neuve (6), puis monter celle-ci dans le corps central (12) à l'aide de l'outil **T27**.

- ITA** **ATTENZIONE!** Questa operazione non è valida per l'assale fisso.  
Montare il supporto oscillante (5).  
**NOTA:** Controllare attentamente l'orientamento.
- D** **ACHTUNG!** Dieser Vorgang gilt nicht für die feste Achse.  
Die schwenkbare Halterung (5) montieren.  
**BEMERKUNG:** Richtung sorgfältig kontrollieren.
- ESP** **ATENCION!** Esta operación no es válida para el eje fijo.  
Montar el soporte oscilante (5).  
**NOTA:** Controlar atentamente la orientación.
- F** **ATTENTION!** Cette opération n'est pas valable en cas d'essieu fixe.  
Monter le support oscillant (5).  
**NOTE:** Contrôler attentivement le sens.

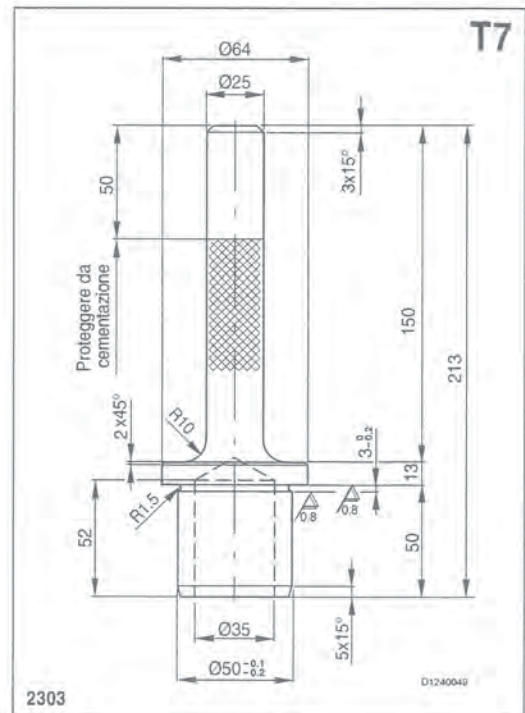
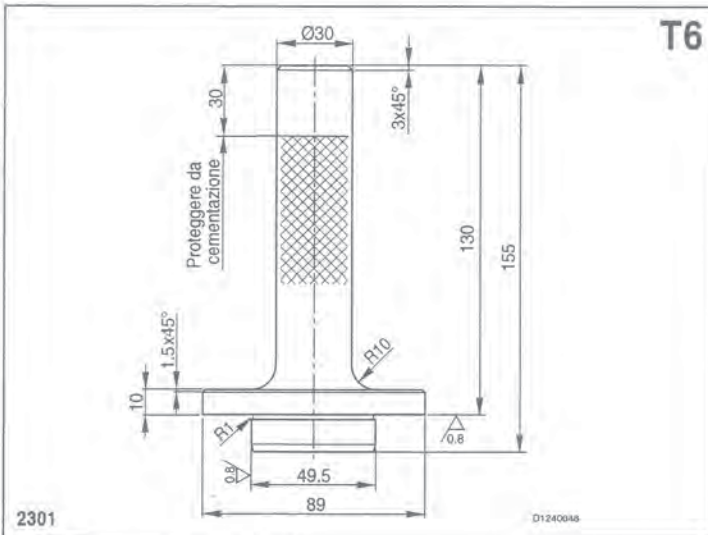
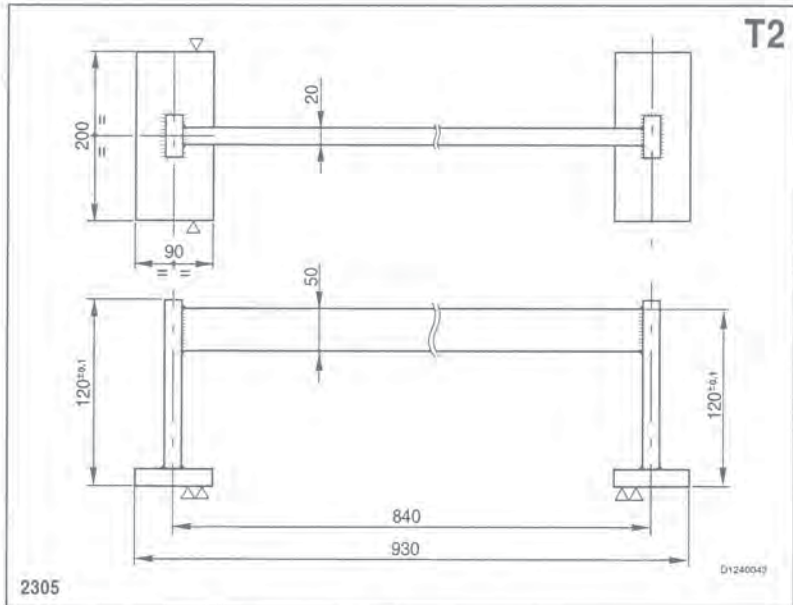
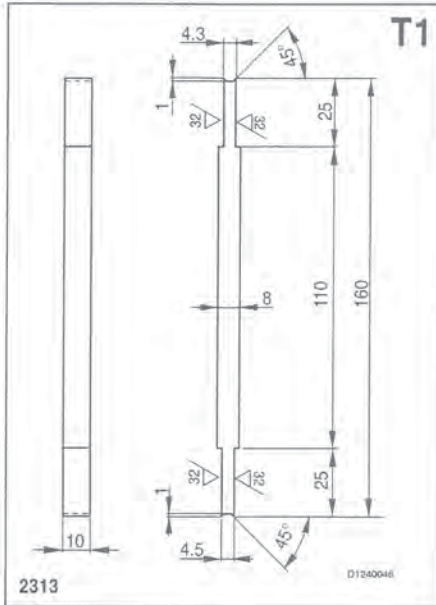
- c**
- ITA** Montare la flangia (2) completa della protezione (4) e mandarla in battuta.  
Se necessario, per il calettamento della flangia (2), usare un mazzuolo in materiale plastico.  
**NOTA:** Controllare che la protezione (4) sia ben forzata sulla flangia e che non sia deformata.
- D** Flansch (2) samt Schutzteil (4) montieren und bis zum Anschlag bringen.  
Wenn nötig, den Flansch (2) mit einem Gummihammer einschlagen.  
**BEMERKUNG:** Kontrollieren ob das Schutzteil (4) richtig auf dem Flansch sitzt und nicht verformt ist.
- ESP** Montar la brida (2) con su protección (4) y llevarla hasta el tope.  
Si fuera necesario, para ensamblar de la brida (2) usar un martillo de material plástico.  
**NOTA:** Controlar que la protección (4) está bien forzada en la brida y que no está deformada.
- F** Monter la flasque (2) équipée de protection (4), puis envoyer celle-ci en butée.  
Si besoin, pour caler la flasque (2) utiliser un maillet en matière plastique.  
**NOTE:** Veiller à ce que la protection (4) est bien forcée sur la flasque et qu'elle n'est pas déformée.

- ITA** Spalmare la porzione filettata del pignone (8) con Loctite 242.  
Montare l'attrezzo **T20A** (oppure **T20B**) ed impegnarlo per evitare la rotazione. Montare l'anello OR (3) ed il dado (1); serrare con chiave dinamometrica.  
Coppia di serraggio: 280÷310 Nm
- D** Das Gewinde des Rads (8) mit Loctite 242 schmieren. Das Werkzeug **T20A** (**T20B**) montieren und blockieren, damit es nicht drehen kann.  
O-Ring (3) und Mutter (1) montieren und mit einem Momentenschlüssel festschrauben.  
Anzugsmoment: 280÷310 Nm
- ESP** Pasar en la parte roscada del piñón (8) Loctite 242. Montar la herramienta **T20A** (o **T20B**) y bloquearla para evitar la rotación.  
Montar el anillo OR (3) y la tuerca (1) y apretarlos con llave dinamométrica.  
Par de torsión: 280÷310 Nm
- F** Enduire la partie filetée du pignon (8) avec du Loctite 242. Monter et fixer l'outil **T20A** (ou **T20B**) pour éviter la rotation.  
Monter le OR (3) et l'écrou (1), puis serrer à l'aide de la clé dynamométrique.  
Couple de serrage: 280÷310 Nm

- e**
- ITA** Asportare i blocchi **T23** montati per l'estrazione del pignone e rimontare i bracci.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Blöcke **T23** abnehmen, die zum Herausnehmen des Rads montiert wurden und Arme wieder montieren.  
Siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Sacar los bloques **T23** montados para la extracción del piñón y volver a montar los brazos.  
Para los detalles, véase «CONTROL DEL DESGASTE Y SUSTITUCION DE LOS DISCOS DEL FRENO».
- F** Enlever les blocs **T23** montés pour l'extraction des pignons, puis remonter les bras.  
Pour de plus amples détails, voir «CONTROLE DE L'USURE ET SUBSTITUTION DES FREINS».

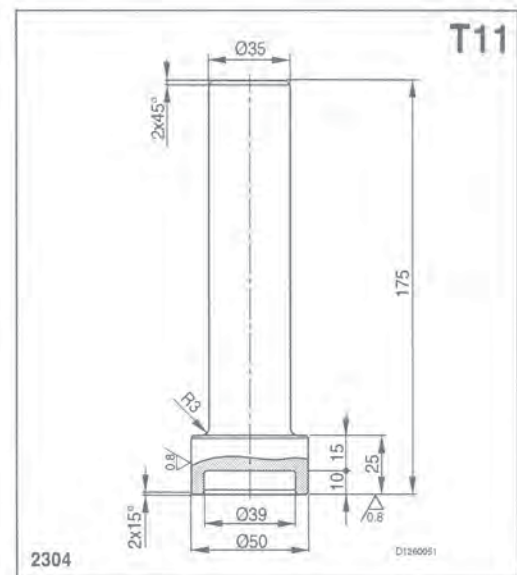
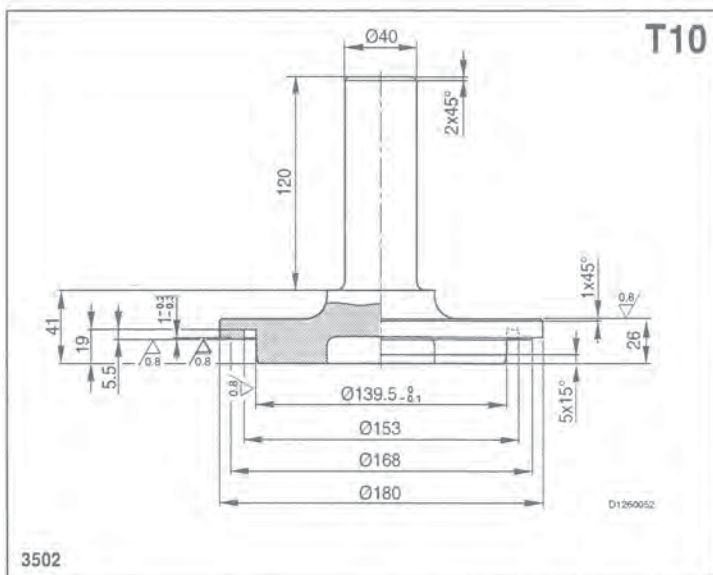
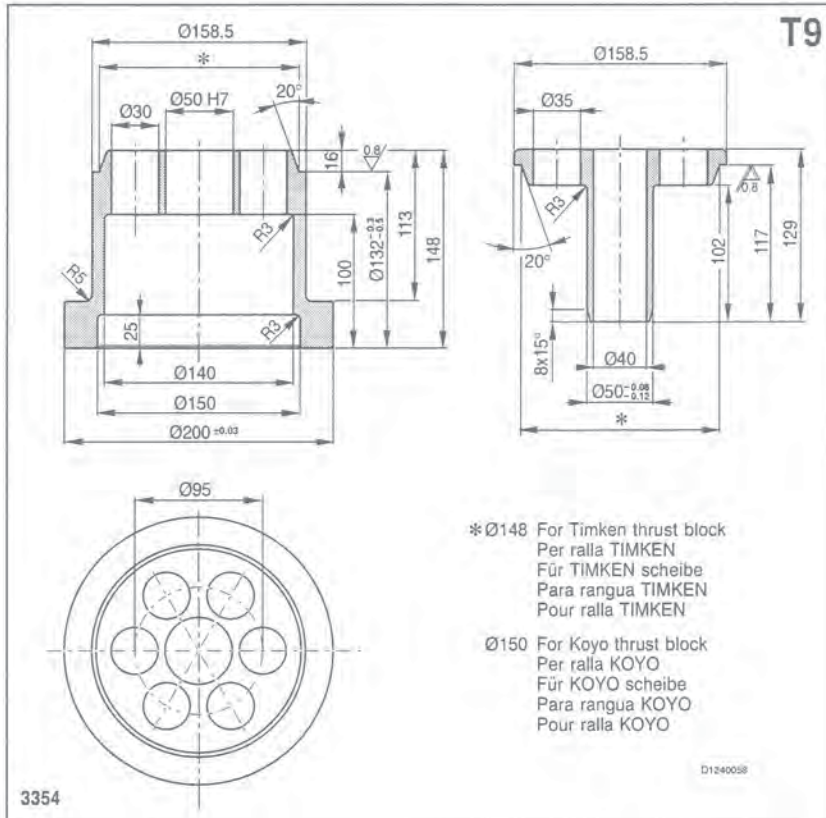


SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZZEUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL





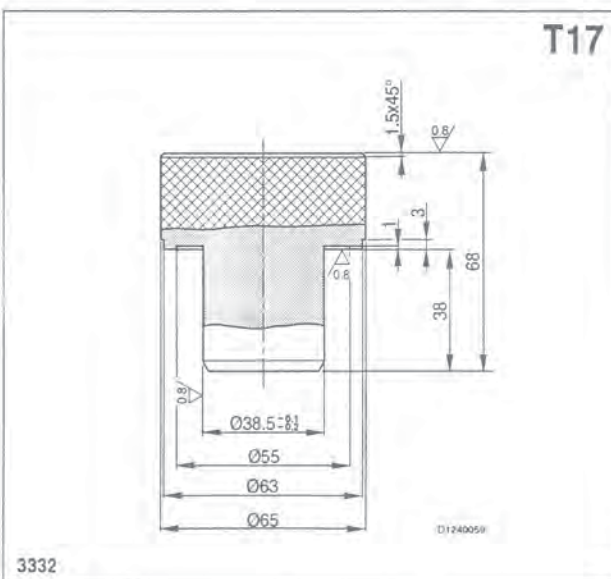
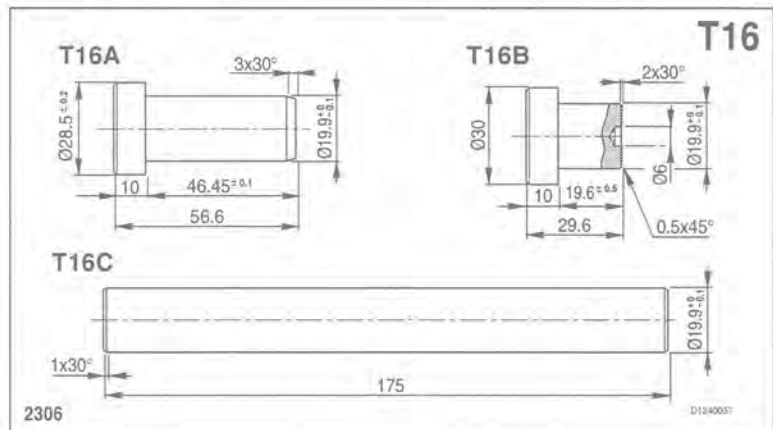
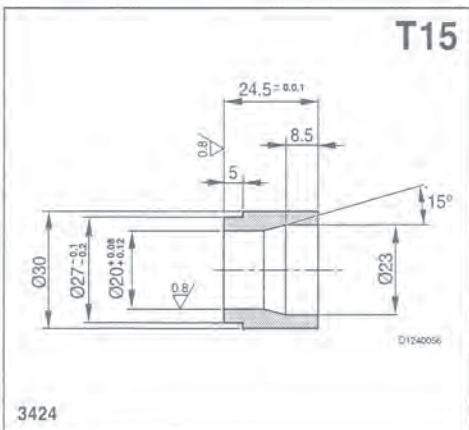
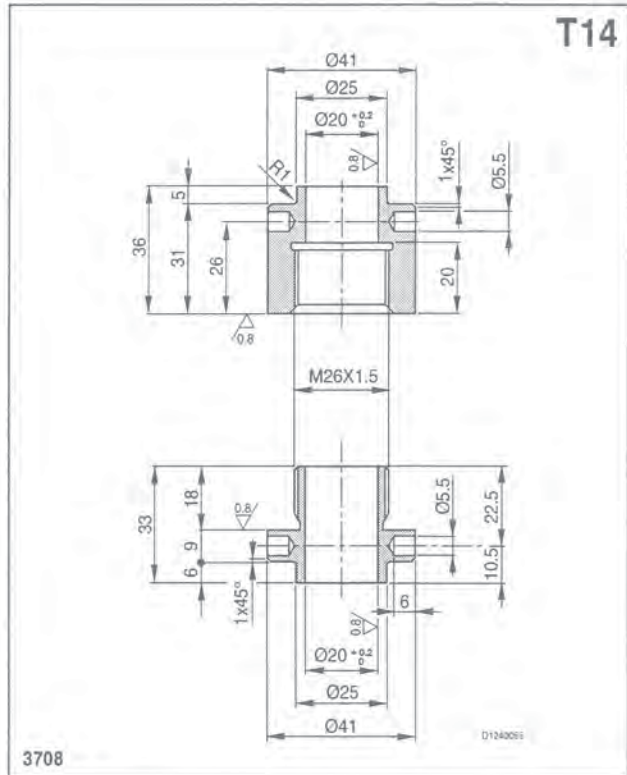
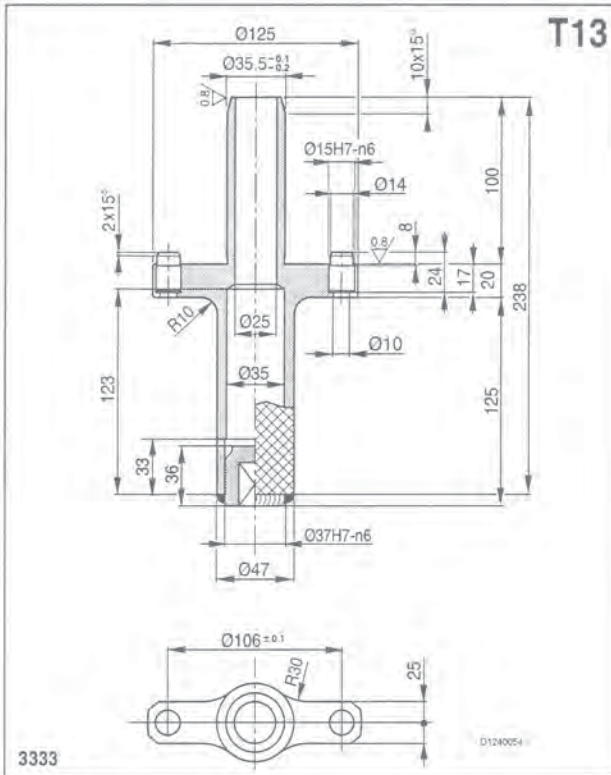
SPICER CLARK-HURTH





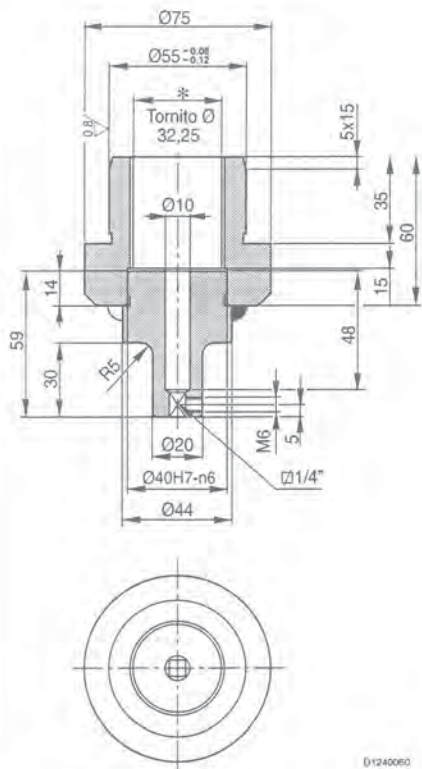


SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZZEUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL



## T19

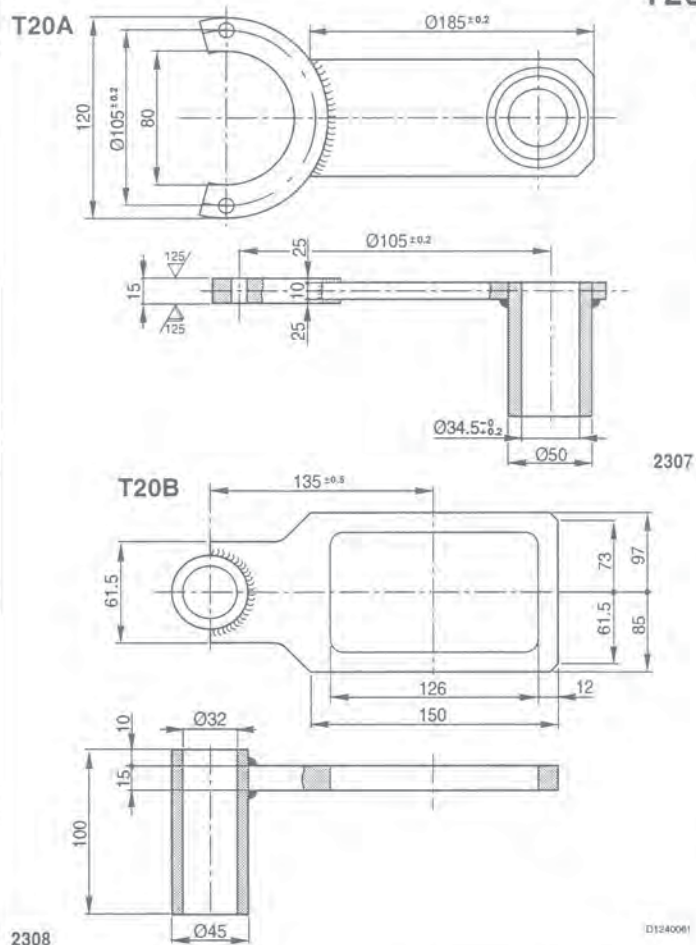
\* 38x1.25x29 DIN 5480



3317/4

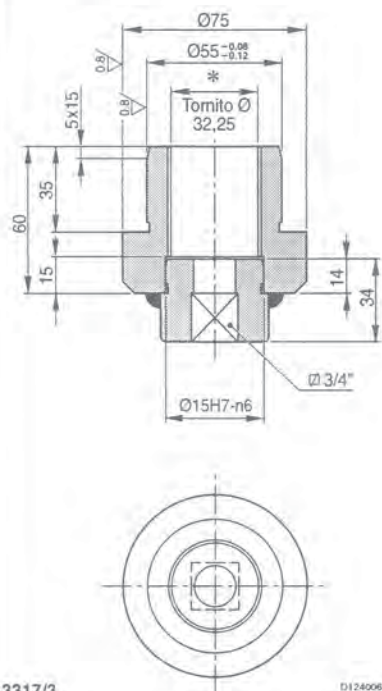
D1240050

## T20



## T21

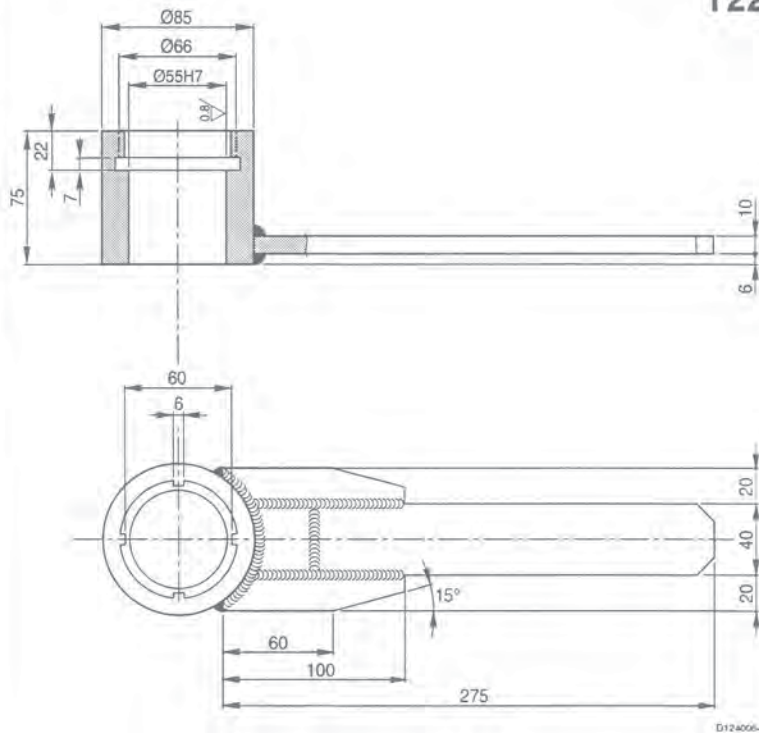
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3317/3

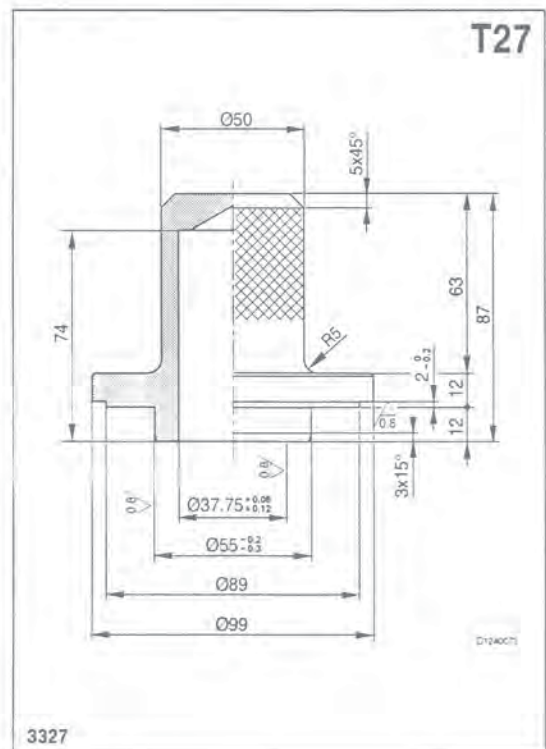
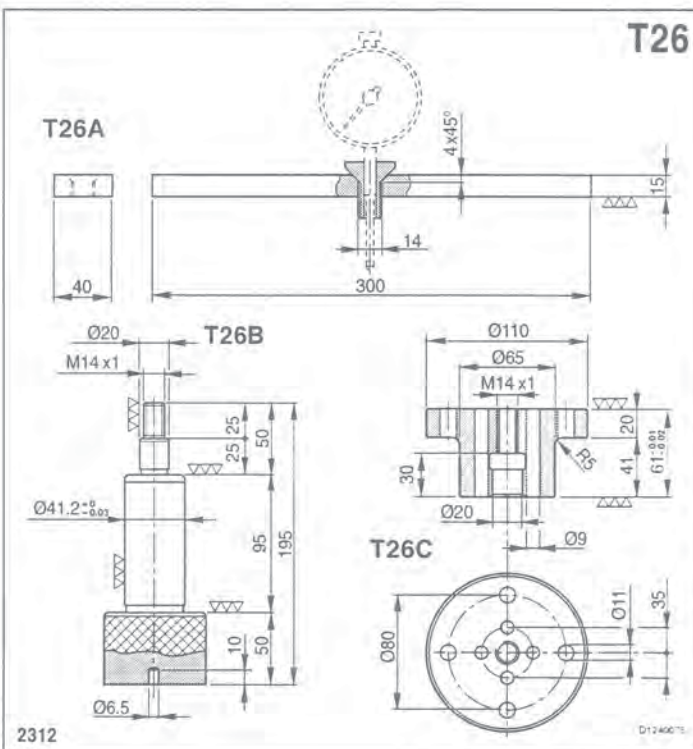
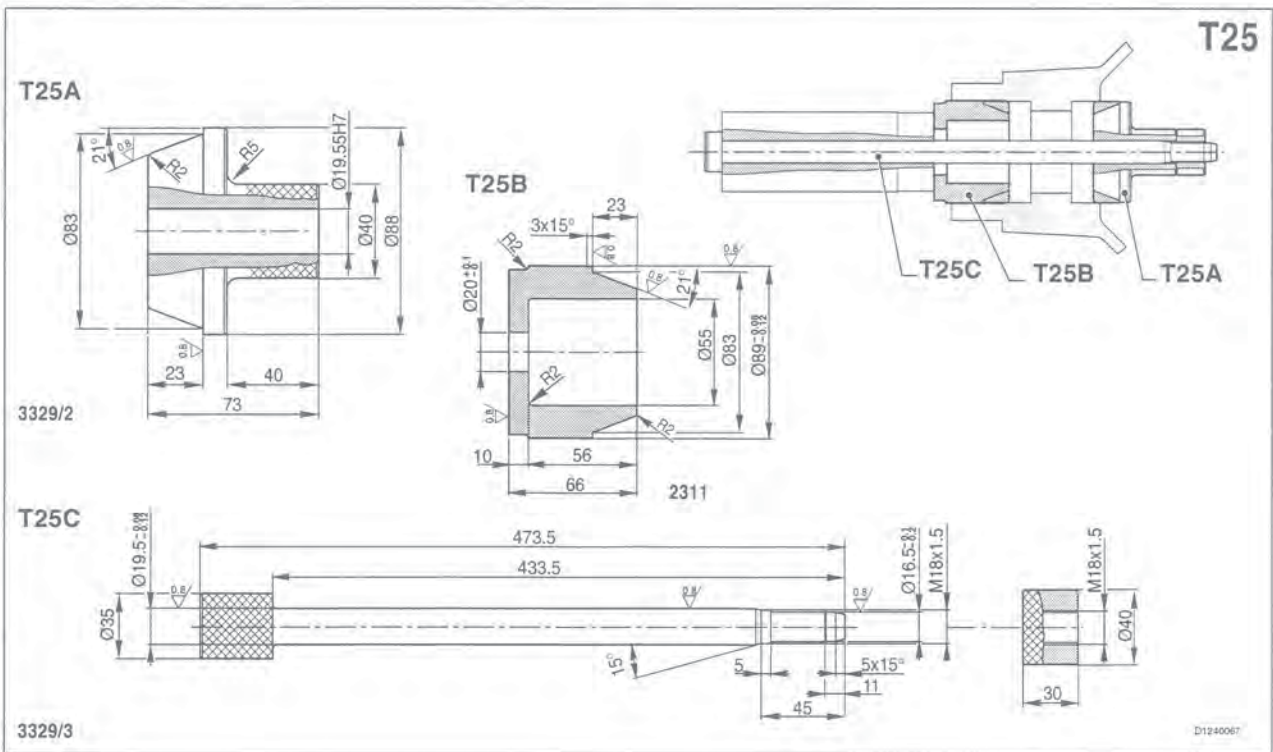
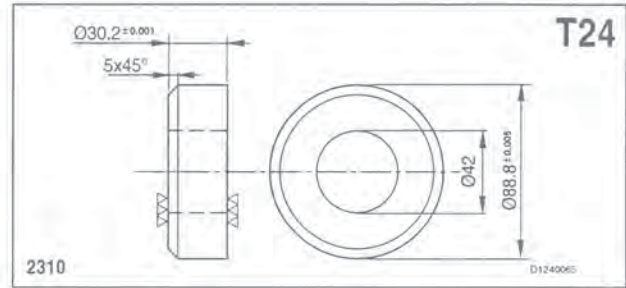
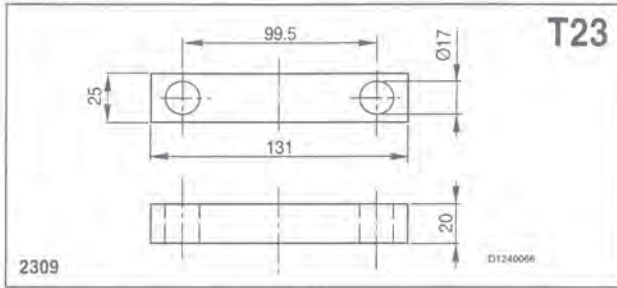
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## T22





SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL

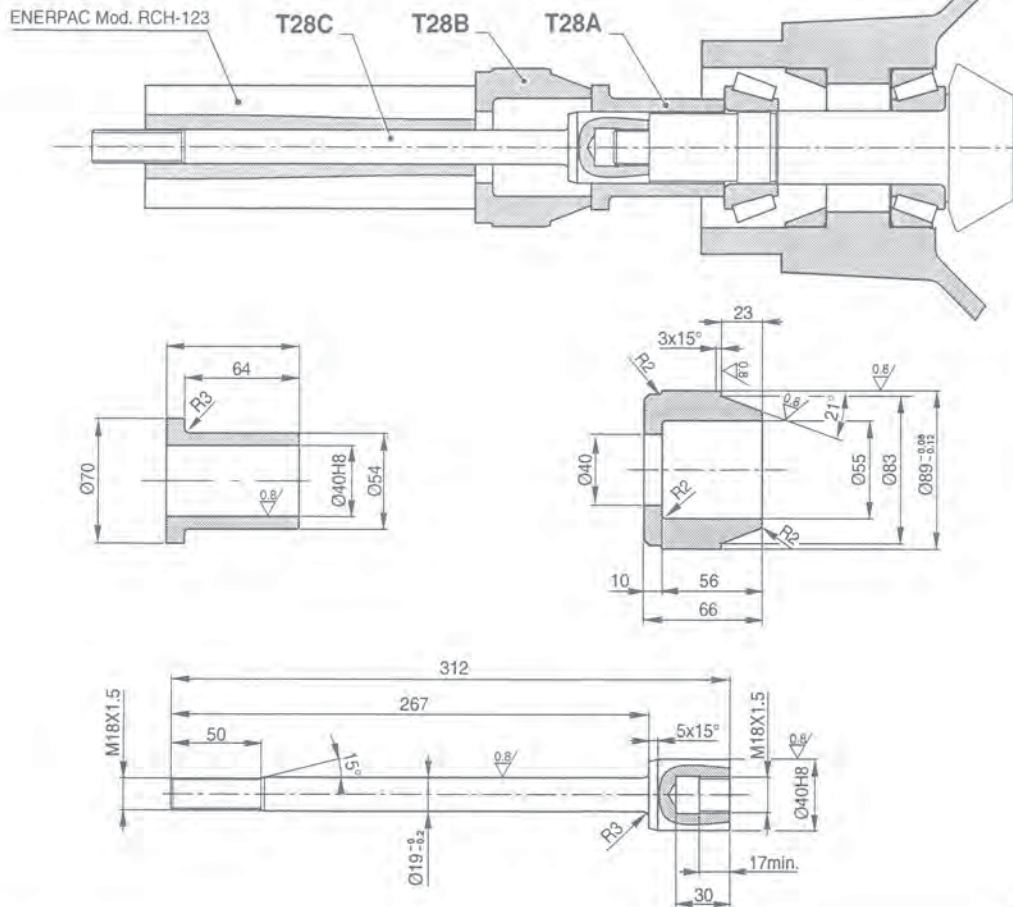






SPICER CLARK-HURTH

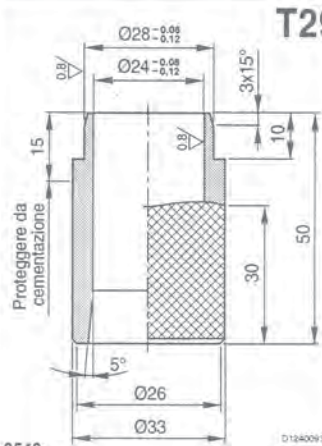
**T28**



3329

D1240074

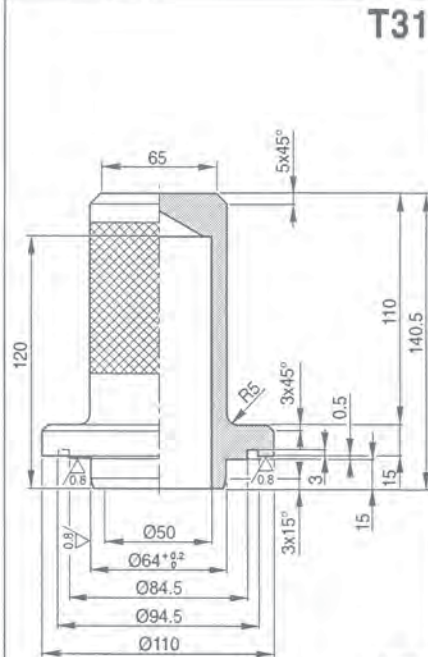
**T29**



3543

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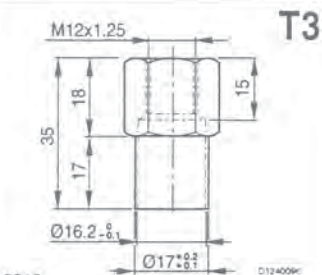
**T31**



3739

D1240091

**T30**

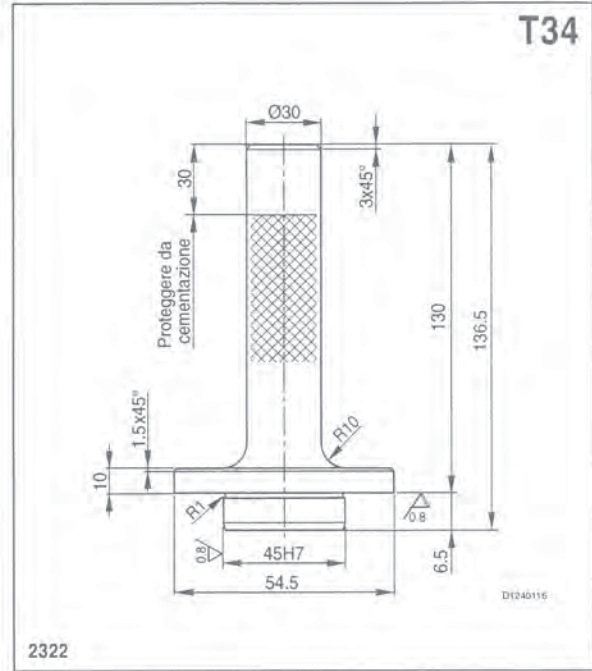
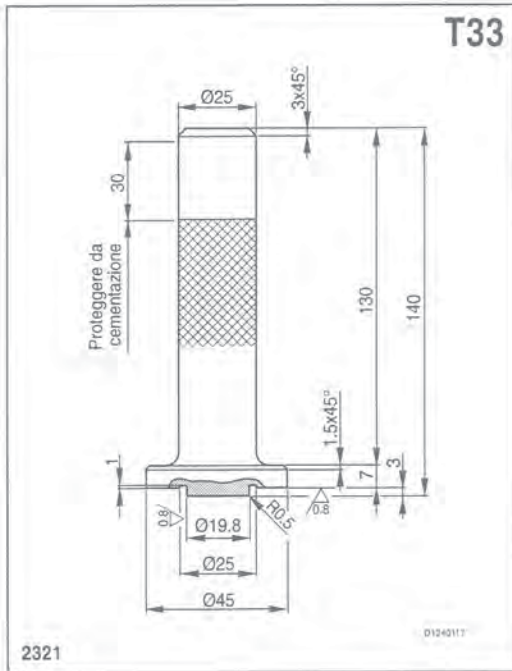


2316

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SPECIAL TOOLS - ATTREZZI SPECIALI - SONDERWERZZEUGE  
HERRAMIENTAS ESPECIALES - OUTILS SPECIAL





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                       | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE   | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insufficient braking<br>Frenatura insufficiente<br>Ungenügende Bremswirkung<br>Frenado insuficiente<br>Freinage insuffisant | 1. Incorrect adjustment                       | Inspect disc thickness and if discs are usable read-just brakes to the specifications in the vehicle's manual.                                                                                                                                                                                                                     |
|                                                                                                                             | 1. Incorretta registrazione                   | Controllare lo spessore dei dischi freno e, se i dischi freno possono essere riutilizzati, registrarli come da istruzioni del manuale del veicolo.                                                                                                                                                                                 |
|                                                                                                                             | 1. Fehlerhafte Einstellung                    | Bremsscheibenstärke überprüfen, koennen die Bremscheiben noch verwendet werden, Spiel neu einstellen gemäß Anweisungen im Handbuch des Fahrzeuges.                                                                                                                                                                                 |
|                                                                                                                             | 1. Ajuste incorrecto                          | Controlar el espesor de los discos del freno y, si los discos del freno pueden volver a utilizarse, ajustarlos de acuerdo con las instrucciones del manual del vehiculo.                                                                                                                                                           |
|                                                                                                                             | 1. Mauvais réglage                            | Inspecter l'épaisseur des disques frein et, si les disques frein sont en bon état, régler selon les instructions du manuel du véhicule.                                                                                                                                                                                            |
|                                                                                                                             | 2. Brake discs worn out                       | Inspect disc thickness and replace if necessary.                                                                                                                                                                                                                                                                                   |
|                                                                                                                             | 2. Dischi freno usurati                       | Controllare lo spessore dei dischi freno e, se necessario, sostituirli.                                                                                                                                                                                                                                                            |
|                                                                                                                             | 2. Bremsscheiben verschlissen                 | Bremsscheibenstärke überprüfen und falls erforderlich ersetzen.                                                                                                                                                                                                                                                                    |
|                                                                                                                             | 2. Discos del freno gastados                  | Controlar el espesor de los discos del freno y, si fuera necesario, sustituirlos.                                                                                                                                                                                                                                                  |
|                                                                                                                             | 2. Disques frein usés                         | Inspecter l'épaisseur des disques frein et si nécessaire remplacer les disques.                                                                                                                                                                                                                                                    |
|                                                                                                                             | 3. Incorrect brake fluid                      | Replace all seals in axle and master cylinder that have made contact with the incorrect fluid and all brake hoses. If incorrect fluid leaked into axle oil, seals and o-rings in axle must be replaced.                                                                                                                            |
|                                                                                                                             | 3. Fluido non idoneo nel circuito             | Sostituire tutti gli anelli di tenuta del ponte e del cilindro master che sono venuti a contatto con il fluido non idoneo nonché i tubi flessibili. Se il fluido non idoneo è entrato nel ponte e si è mescolato con il lubrificante devono essere sostituiti tutti gli anelli di tenuta ed gli O-rings.                           |
|                                                                                                                             | 3. Ungeeignete Flüssigkeit in der Bremsanlage | Alle Dichtringe und Gummischläuche die mit der falschen Flüssigkeit in Kontakt gekommen sind, in der Achse und im Hauptbremszylinder ersetzen. Sollte diese Flüssigkeit auch in die Achse gelaugt sein, sind auch sämtliche O-Ringe und Dichtringe der Achse zu ersetzen.                                                          |
|                                                                                                                             | 3. Fluido no adecuado para el circuito        | Sustituir todos los segmentos de compresión del puente y del cilindro principal que han estado en contacto con el fluido no adecuado como así también los tubos flexibles. Si el fluido no adecuado ha entrado en el puente y se ha mezclado con el lubricante, hay que sustituir todos los segmentos de compresión y los O-Rings. |
|                                                                                                                             | 3. Fluide inadéquat dans le circuit           | Substituer tous les joints d'étanchéité du pont et du maître-cylindre qui ont été en contact avec ce fluide mais aussi les tubes flexibles. Si le fluide incorrect est entré dans le pont et s'est mélangé avec le lubrifiant tous les joints d'étanchéité et o-ring doivent être changés.                                         |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                     | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insufficient braking<br><i>Frenatura insufficiente</i><br>Ungenügende Bremswirkung<br><i>Frenado insuficiente</i><br>Freinage insuffisant | 4. Loss of brake fluid<br><br>4. <i>Perdita del fluido del circuito freno</i><br><br>4. Verlust von Bremsflüssigkeit<br><br>4. <i>Pérdida del fluido del circuito del freno</i><br><br>4. Fluidé dans le circuit de freinage                                                                                                                                                                                                                                                                                                                                                                                                                   | Inspect for and repair any leaks in outside circuit or master cylinder.<br>If caused by incorrect brake fluid see correction N. 3.<br>If leak is to the outside replace the o-rings between the center and intermediate housings.<br>If leak is to the inside replace above o-rings and brake piston o-rings.<br><br><i>Controllare e riparare tutte le perdite del circuito esterno o del circuito master.</i><br><i>Se la causa è dovuta al fluido non idoneo vedere rimedio n. 3.</i><br><i>Se la perdita è verso l'esterno del ponte sostituire gli O-ring tra la scatola centrale ed il coperchio intermedio.</i><br><i>Se la perdita è verso l'interno del ponte, sostituire gli O-ring sopra menzionati e quelli del pistone freno.</i><br><br>Äussere Bremsanlage und Hauptbremszylinder auf Ölverluste prüfen.<br>Sollte der Verlust auf ungeeignete Bremsflüssigkeit zurückzuführen sein, siehe Abhilfe N.3.<br>Sollte der Verlust nach aussen sein, die O-Ringe zwischen dem Achsmittengehäuse und den Zwischengehäuse ersetzen.<br>Sollte der Verlust nach innen sein, oben genannte O-Ringe und jene der Bremskolben ersetzen.<br><br><i>Controlar y reparar todas las pérdidas del circuito exterior o del cilindro principal.</i><br><i>Si la causa se debe al fluido no idóneo, véase el remedio n°3.</i><br><i>Si la pérdida es hacia fuera del puente, sustituir los O-Ring entre la caja central y la tapa intermedia.</i><br><i>Si la pérdida es hacia el interior del puente, sustituir los O-Ring mencionados más arriba y los del pistón del freno.</i><br><br>Inspecter et réparer toutes les fuites du circuit externe ou du maître-cylindre.<br>Si la cause est due à l'utilisation d'un fluide non indiqué voir remède N. 3.<br>Si la fuite est vers l'extérieur du pont, substituer les o-rings entre le carter central et les carters intermédiaires.<br>Si la fuite est vers l'intérieur du pont substituer les o-rings mentionnés ci-dessus et ceux des pistons frein. |
|                                                                                                                                           | 5. Overheated axle causing brake fluid to vaporize.<br>(Brake return when axle cools)<br><br>5. <i>Surriscaldamento del ponte con vaporizzazione del fluido.</i><br><i>(I freni ritornano quando il ponte si raffredda)</i><br><br>5. Verdunstung der Bremsflüssigkeit wegen Überhitzung.<br>(Im abgekühlten Zustand ist die Bremswirkung wieder hergestellt)<br><br>5. <i>Sobrecalentamiento del puente con vaporización del fluido.</i><br><i>(Los frenos vuelven a funcionar cuando se enfría el puente)</i><br><br>5. Surchauffe du pont avec vaporisation du fluide.<br>(Les freins fonctionnent à nouveau quand le fluide se refroidit). | See «overheating» problem.<br><br><i>Vedere problema: Surriscaldamento.</i><br><br>Siehe Problem: Überhitzung.<br><br><i>Véase el problema: Sobrecalentamiento.</i><br><br>Voir probleme: Surchauffe.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                       | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                             | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Soft brake pedal<br><i>Pedale del freno non risponde</i><br>Leichtes Bremspedal<br><i>El pedal del freno no funciona</i><br>Pedale du frein ne repond pas                   | 6. Air in brake circuit<br><i>6. Aria nel circuito frenante</i><br>6. Luft in der Bremsanlage<br><i>6. Aire en el circuito frenante</i><br>6. Air dans le circuit                                                       | Bleed brakes as described in the vehicle's service manual.<br><i>Spurgare il circuito frenante come da istruzioni di spurgo del manuale del veicolo.</i><br>Bremsen entlüften gemäß Anweisungen im Handbuch des Fahrzeugs.<br><i>Purgar el circuito frenante se acuerdo con las instrucciones de purga del manual del vehículo.</i><br>Purger le circuit de frein selon «instructions de purge» du manuel du véhicule. |
| Ineffective safety brake<br><i>Freno negativo inefficiente</i><br>Federspeicherbremse ohne Funktion.<br><i>Freno negativo inefficiente</i><br>Inefficacite du frein negatif | 7. Incorrect adjustment<br><i>7. Registrazione incorretta</i><br>7. Fehlerhafte Einstellung des Bremsscheibenspieles<br><i>7. Ajuste incorrecto</i><br>7. Mauvais réglage                                               | See correction N. 1.<br><i>Vedere rimedio N. 1.</i><br>Siehe Abhilfe N. 1.<br><i>Véase remedio N.1</i><br>Voir remède N. 1.                                                                                                                                                                                                                                                                                            |
|                                                                                                                                                                             | 8. Brake disc worn out<br><i>8. Dischi freno usurati</i><br>8. Bremslamellen verschlissen<br><i>8. Discos del freno gastados</i><br>8. Usure disques frein                                                              | See correction N. 2.<br><i>Vedere rimedio N. 2.</i><br>Siehe Abhilfe N. 2.<br><i>Véase remedio N. 2.</i><br>Voir remède N. 2.                                                                                                                                                                                                                                                                                          |
| Overheating<br><i>Surriscaldamento</i><br>Überhitzung<br><i>Sobrecalentamiento</i><br>Surchauffe                                                                            | 9. Oil level wrong<br><i>9. Livello olio non corretto</i><br>9. Niedriger Ölspiegel-Falscher Ölstand<br><i>9. Nivel de aceite no correcto</i><br>9. Niveau d'huile pas incorrect                                        | Drain, flush and refill oil to proper level.<br><i>Scaricare, eseguire un lavaggio e riempire d'olio fino a livello.</i><br>Öl ablassen, reinigen und richtigen Ölstand wieder herstellen.<br><i>Descargar, ejecutar un lavado y llenar con aceite hasta el nivel.</i><br>Vidanger, rincer et refaire le niveau d'huile.                                                                                               |
|                                                                                                                                                                             | 10. Too small of a brake gap<br><i>10. Poco gioco tra i dischi freno</i><br>10. Zu wenig Spiel zwischen den Bremslamellen<br><i>10. Poco juego entre los discos del freno</i><br>10. Peu de jeu entre les disques frein | Readjust brakes to the specifications in the vehicle's service manual.<br><i>Registare il freno come istruzioni da manuale del veicolo.</i><br>Spiel gemäß Anweisungen im Handbuch des Fahrzeuges herstellen.<br><i>Ajustar el freno de acuerdo con las instrucciones del manual del vehículo</i><br>Regler le frein selon les instructions du manuel du véhicule.                                                     |
|                                                                                                                                                                             | 11. Park brake dragging<br><i>11. Freno di parcheggio in trazione</i><br>11. Feststellbremse zieht<br><i>11. Freno de estacionamiento en tracción</i><br>11. Frein de parc mal réglé                                    | Unlock the brake and adjust the correct gap.<br><i>Sbloccare il freno ripristinando il gioco corretto.</i><br>Bremsen lösen und richtiges Lamellenspiel einstellen.<br><i>Desbloquear el freno restableciendo el juego correcto.</i><br>Débloquer le frein et régler le jeu.                                                                                                                                           |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                            | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                             | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Overheating<br><i>Surriscaldamento</i><br>Überhitzung<br><i>Sobrecalentamiento</i><br>Surchauffe | 12. Incorrect brake fluid in system<br><i>12. Fluido non idoneo nel circuito</i><br>12. Ungeeignete Flüssigkeit in der Bremsanlage<br><i>12. Fluido no adecuado en el circuito</i><br>12. Fluide incorrect dans le circuit                                                                                              | See correction N. 3.<br><i>Vedere rimedio N. 3.</i><br>Siehe Abhilfe N. 3.<br><i>Véase remedio N. 3</i><br>Voir remède N. 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                  | 13. No free-pedal at master cylinder<br><i>13. Non c'è corsa a vuoto sul cilindro master</i><br>13. Kein Leerweg am Bremspedal<br><i>13. No hay carrera en vacío en el cilindro principal</i><br>13. Pas de garde sur la pédale du maître-cylindre                                                                      | Readjust brake pedal as described in the vehicle's service manual.<br><i>Registrazione il pedale del freno come istruzioni da manuale del veicolo.</i><br>Bremspedal gemäß Anweisungen im Handbuch des Fahrzeuges einstellen.<br><i>Ajustar el pedal del freno de acuerdo con las instrucciones del manual del vehículo.</i><br>Régler la pédale du frein selon les instructions du manuel du véhicule.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                  | 14. Restriction in brake lines<br><i>14. Restringimento sul circuito del freno</i><br>14. Verengung in der Bremsanlage<br><i>14. Circuito del freno restringido</i><br>14. Reglage sur circuit du frein                                                                                                                 | Inspect for and replace damage lines.<br><i>Controllare e riparare i condotti ammaccati o piegati.</i><br>Anlage überprüfen und verbeulte oder geknickte Leitungen ersetzen.<br><i>Controlar y reparar los conductos golpeados o plegados.</i><br>Inspecter et réparer les conduites endommagées.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                                                                                  | 15. Restriction in return line of brake Servo system<br><i>15. Restringimento sul condotto di ritorno del sistema servo</i><br>15. Verengung in der Rückflussleitung des Servobremssystems<br><i>15. Conducto de retorno del sistema servo restringido</i><br>15. Etranglement sur la conduite de retour du servo-frein | Inspect for and replace damaged return line. Inspect for and remove any filter, tee'd in line or any other source of back pressure from the return line.<br><i>Controllare e riparare il condotto ammaccato o piegato. Controllare e sostituire tutti i filtri e raccordi sul circuito o qualsiasi altro ostacolo nel condotto di ritorno.</i><br>Anlage überprüfen und verbeulte oder geknickte Leitungen ersetzen. Alle Filter und Abzweigungen in der Anlage überprüfen, sämtliche Hindernisse für den freien Durchfluß entfernen.<br><i>Controlar y reparar el conducto golpeado o plegado. Controlar y sustituir todos los filtros y empalmes en el circuito o cualquier otro obstáculo en el conducto de retorno.</i><br>Inspecter et réparer la conduite endommagée. Inspecter et changer tous les filtres, raccords en «T» ou autre obstacle sur le circuit de retour. |
|                                                                                                  | 16. Incorrect lubricant<br><i>16. Lubrificante non idoneo</i><br>16. Ungeeignetes Schmieröl<br><i>16. Lubricante no adecuado</i><br>16. Lubrifiant incorrect                                                                                                                                                            | Change the retaining rings of the brake circuit and brake pump.<br><i>Sostituire gli anelli di tenuta del circuito freno e della pompa freno.</i><br>Die Abdichtungsringe des Bremskreislaufts der Bremspumpe ersetzen.<br><i>Sustituir los segmentos de compresión del circuito del freno y de la bomba del freno.</i><br>Replacer les anneaux d'étanchéité du circuit et de la pompe de frein.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                        | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                       |
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| Diff-lock inoperative<br><i>Il blocco differenziale non funziona</i><br>Differentialsperre ohne Wirkung<br><i>El bloque del diferencial no funciona</i><br>Mauvais fonctionnement du blocage du différentiel | 17. If manual control, loose or misadjusted linkage<br>17. <i>Se il comando è manuale: comando scollegato o registrato male</i><br>17. Bei mechanisch betätigter Sperre, loser oder schlecht eingestellter Hebel<br>17. <i>Si el mando es manual: mando desconectado o mal ajustado</i><br>17. Si la commande est manuel: commande déconnectée ou mal réglée                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Inspect and correct linkage and readjust as indicated in vehicle's service manual.<br><i>Controllare, riparare e registrare il comando indicato nel manuale del veicolo.</i><br>Hebel überprüfen und gemäß Anweisungen im Handbuch des Fahrzeuges einstellen.<br><i>Controlar, reparar y ajustar el mando indicado en el manual del vehículo.</i><br>Inspecter, réparer et régler la commande selon le manuel du véhicule. |
|                                                                                                                                                                                                              | 18. If hydraulic control, problems in the hydraulic or electrical circuits of the vehicle<br>18. <i>Se il comando è idraulico: problemi nel circuito elettrico del veicolo</i><br>18. Bei hydraulisch betätigter Sperre, Probleme in der hydraulischen oder elektrischen Anlage des Fahrzeuges<br>18. <i>Si el mando es hidráulico: problemas en el circuito eléctrico del vehículo</i><br>18. Si la commande est hydraulique: problème dans le circuit électrique dans le véhicule                                                                                                                                                                                                                                                                                                                                     | Refer to the service manual for the vehicle.<br><i>Fare riferimento alle istruzioni nel manuale del veicolo.</i><br>Siehe Anweisungen im Handbuch des Fahrzeuges.<br><i>Consultar las instrucciones del manual del vehículo.</i><br>Voir instructions dans manuel du véhicule.                                                                                                                                             |
|                                                                                                                                                                                                              | 19. If hydraulic control: problems in actuating cylinder (noteable through loss of hydraulic oil or increase of the oillevel in axle)<br>19. <i>Se il comando è idraulico: problemi nell'attuatore (caratterizzati da perdite del fluido idraulico o da aumento del livello d'olio nel ponte)</i><br>19. Bei hydraulisch betätigter Sperre, Ölverlust im Betätigungszyylinder (erkentlich durch Verlust von hydraulisch Flüssigkeit oder Anstieg des Ölniveaus in der Achse)<br>19. <i>Si el mando es hidráulico: problemas en el actuador (caracterizados por pérdidas del fluido hidráulico o por un aumento del nivel del aceite en el puente)</i><br>19. Si la commande est hydraulique: problèmes dans le vérin (caractérisés par des fuites de fluide hydraulique ou augmentation du niveau d'huile dans le pont) | Rebuilt cylinder.<br><i>Controllare e riparare il cilindro.</i><br>Überprüfen und Zylinder reparieren.<br><i>Controlar y reparar el cilindro.</i><br>Inspecter et reparer le cylindre.                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                              | 20. If with lim. slip differential, worn discs<br>20. <i>Se il differenziale è del tipo autobloccante, dischi usurati</i><br>20. Wenn mit Selbstsperrdifferential, Scheiben verschlissen<br>20. <i>Si el diferencial es del tipo autobloqueante: discos gastados</i><br>20. Si avec différentiel à glissement limité, usure sur les disques                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Replace discs.<br><i>Sostituire i dischi.</i><br>Scheiben ersetzen.<br><i>Sustituir los discos.</i><br>Remplacer les disques.                                                                                                                                                                                                                                                                                              |



| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                                                                    | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| Oil coming out of breather<br><i>Olio fuoriesce dallo sfiato</i><br><i>Ölaustritt aus dem Entlüfter</i><br><i>El aceite sale del purgador</i><br><i>Huile sort du reniflard</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 21. Leak in internal brake system<br><i>21. Perdita di fluido idraulico dal sistema frenante</i><br>21. Verlust von hydraulisch Flüssigkeit der Bremsanlage<br><i>21. Pérdida de fluido hidráulico del sistema frenante</i><br>21. Fuite de fluide hydraulique du système de freinage                                                                                                                          | See correction N. 2 and 3.<br><i>Vedere rimedio N. 2 e 3.</i><br><br>Siehe Abhilfe N. 2 und 3.<br><br><i>Véanse remedios N. 2 y 3.</i><br><br>Voir remède N. 2 et 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 22. Leak in diff-lock actuating cylinder<br><i>22. Perdita d'olio idraulico dal circuito del blocco differenziale</i><br>22. Verlust von Hydraulisch Flüssigkeit der hydraulisch Anlage der Differentialsperre<br><i>22. Pérdida de aceite hidráulico del circuito del bloque del diferencial</i><br>22. Fuite d'huile hydraulique du circuit de blocage du différentiel                                       | See correction N. 19.<br><i>Vedere rimedio N. 19.</i><br><br>Siehe Abhilfe N. 19.<br><br><i>Véase remedio N. 19.</i><br><br>Voir remède N. 19.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| NoSpin indexing noise when driving straight<br><b>CAUTION!</b> With NoSpin, fatigue damage can occur on the side with the larger tire.<br><i>Il NoSpin è rumoroso viaggiando sul rettilineo</i><br><b>ATTENZIONE!</b> Con il NoSpin possono verificarsi avarie da fatica sul lato con il pneumatico più grande.<br><br>NoSpin macht Geräusche bei Geradeausfahrt<br><b>ACHTUNG!</b> Mit NoSpin können auf der Seite mit dem grösseren Reifenradius Ermüdungsschäden auftreten.<br><br><i>El NoSpin hace ruido andando en un rectilíneo</i><br><b>CUIDADO!</b> con el No Spin se pueden producir averías por fatiga en un lado en el neumático más grande.<br><br>Le No-Spin fait du bruit en roulant en ligne droite<br><b>ATTENTION!</b> Avec le NoSpin, des ruptures de fatigue peuvent se produire du côté des pneumatiques les plus grands. | 23. Unequal tire pressure left and right<br><i>23. Pressione disuguale nei pneumatici sui due lati</i><br>23. Ungleichmässiger Reifendruck links und rechts<br><i>23. Presión desigual en los neumáticos a ambos lados</i><br>23. Pressions différentes dans les pneumatiques sur les deux cotés du véhicule                                                                                                   | Inflate tires to the recommended pressure in the service manual, or until the rolling radius is equal.<br><i>Gonfiare i pneumatici alla pressione raccomandata nel manuale o comunque fino ad ottenere un raggio statico uguale.</i><br><br>Reifen vorschriftsgemäß aufpumpen bis ein gleichgroßer statischer Halbmesser erreicht wird.<br><i>Hinchar los neumáticos a la presión recomendada en el manual o, de todas formas, hasta obtener un rayo estático igual.</i><br><br>Gonfler les pneumatiques selon la pression recommandée dans le manuel ou jusqu'à obtenir le même rayon sous charge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 24. Different style, size or brand of tires between left and right hand side<br><i>24. Pneumatico di disegno, marca o costruttore diversi sui due lati</i><br>24. Unterschiedliche Reifen, -größen - marken, links und rechts<br><i>24. Neumáticos de diseño, marca o fabricante distintos a los dos lados</i><br>24. Pneumatiques de sculptures ou de constructeurs différents sur les deux côtes du véhicule | Change tires to make the rolling radius equal.<br>Vary the tire pressure within the specifications until the rolling radius is equal.<br><i>Cambiare pneumatici o rendere i raggi statici dei pneumatici eguali.</i><br><i>Variare la pressione dei pneumatici nei campi di tolleranza prescritti dai costruttori dei pneumatici stessi, fino ad ottenere un raggio statico uguale.</i><br><br>Reifen ersetzen sodaß ein gleich-großer Statischer Halbmesser erreicht wird.<br>Reifendruck im Bereich der Vorschriften ändern bis ein gleichgroßer Halbmesser erreicht wird.<br><i>Cambiar los neumáticos o hacer que los rayos estáticos de los neumáticos sean iguales.</i><br><i>Variar la presión de los neumáticos en los campos de tolerancia prescritos por los fabricantes de dichos neumáticos, hasta obtener un radio estático igual.</i><br><br>Changer les pneumatiques ou rendre les rayons sans charge des pneumatiques égaux.<br>Modifier la pression des pneumatiques dans les tolérances prescrites par les constructeurs de ces mêmes pneumatiques, jusqu'à obtenir un rayon sous charge identique. |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                         | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                 | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                       |
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| Noise during coast and under<br>power the same<br><i>Rumorosità uguale sia in tiro<br/>che in rilascio</i><br>Geräusch im Zug und im<br>Schub gleich stark<br><i>Ruido igual tanto en tracción<br/>como en inercia</i><br>Bruit en traction ou en retenue                     | 25. Wheel bearings damaged<br><i>25. Cuscinetti dei mozzi danneggiati</i><br>25. Lager der Radnaben beschädigt<br><i>25. Cojinetes de los cubos dañados</i><br>25. Roulements des moyeux endom-<br>magés                                                                                                                    | Replace and adjust.<br><i>Sostituire i particolari in avaria.</i><br>Beschädigte Teile gemäß Anweisungen.<br><i>Sostituire las piezas averiadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                                  |
| Noise under power greater<br>than during coast<br><i>Rumorosità più elevata in tiro<br/>piuttosto che in rilascio</i><br>Geräusch stärker im Zug als<br>im Schub<br><i>Ruido más elevado en tracción<br/>que en inercia</i><br>Bruit plus élevé en traction<br>qu'en retenue. | 26. Low oil level<br><i>26. Livello olio basso</i><br>26. Niedriger Ölstand<br><i>26. Nivel de aceite bajo</i><br>26. Niveau d'huile insuffisant<br><br>27. Incorrect lubricant<br><i>27. Olio non idoneo</i><br>27. Ungeeignetes Schmieröl<br><i>27. Aceite no adecuado</i><br>27. Huile incorrect                         | Refill oil to proper level.<br><i>Ripristinare il livello olio.</i><br>Schmieröl nachfüllen bis richtiger Ölstand wieder<br>hergestellt ist.<br><i>Restablecer el nivel del aceite.</i><br>Refaire le niveau d'huile.<br><br>See correction N. 16.<br><i>Vedere rimedio N. 16.</i><br>Siehe Abhilfe N. 16.<br><i>Véase remedio N. 16.</i><br>Voir remède N. 16.                                            |
|                                                                                                                                                                                                                                                                               | 28. Ring and pinion worn<br><i>28. Coppia conica usurata</i><br><br>28. Kegel- und Tellerrad verschlissen<br><i>28. Par cónico gastado</i><br><br>28. Usure du couple conique                                                                                                                                               | Inspect through top cover. Replace and adjust.<br><i>Controllare attraverso il coperchio superiore.</i><br><i>Sostituire la coppia conica.</i><br><br>Durch die obere Bohrung überprüfen. Kegel- und Tel-<br>lerrad ersetzen.<br><i>Controlar a través de la tapa superior.</i><br><i>Sustituir el par cónico.</i><br><br>Inspectionner au travers du couvercle supérieur.<br>Remplacer le couple conique. |
|                                                                                                                                                                                                                                                                               | 29. Worn ring and pinion bearings<br><i>29. Cuscinetti della coppia conica<br/>usurati</i><br><br>29. Kegelrollenlager des Kegel- und<br>Tellerradpaars verschlissen<br><i>29. Cojinetes del par cónico gastados</i><br>29. Usure des roulements du couple<br>conique                                                       | Replace and adjust.<br><i>Sostituire i particolari in avaria.</i><br><br>Beschädigte Teile ersetzen.<br><i>Sostituire las piezas averiadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                                       |
|                                                                                                                                                                                                                                                                               | 30. Worn planetary gears or bearings<br><i>30. Planetari o cuscinetti dell'epiciclo-<br/>dale usurati</i><br><br>30. Planetenräder oder Lager der Pla-<br>netenabtriebe verschlissen<br><i>30. Planetarios y cojinetes del epiciclo-<br/>dal gastados</i><br>30. Usure des planétaires ou roule-<br>ment de l'épicycloïdale | Replace.<br><i>Sostituire i particolari in avaria.</i><br><br>Beschädigte Teile ersetzen.<br><i>Sostituire las piezas averiadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                                                  |





| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                                                                                      | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                        | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| Noise during coast greater than under power<br><i>Rumorosità più elevata in rilascio piuttosto che in tiro</i><br>Geräusch stärker im Schub als im Zug<br><i>Ruido más elevado en inercia que en tracción</i><br>Bruit plus élevé en retenue qu'en traction                                                                                | 31. Loose pinion nut<br><i>31. Ghiera pignone allentata</i><br>31. Wellenmutter des Kegelritzels lose<br><i>31. Virola del piñón floja</i><br>31. Ecrou du pinion dévissé                                                                                                                          | Inspect ring, pinion and pinion bearings. If undamaged, retighten nut.<br><i>Controllare la coppia conica ed i rispettivi cuscinetti, se non fossero danneggiati serrare la ghiera.</i><br>Kegel- und Tellerrad und Lager überprüfen. Sollten diese nicht beschädigt sein, Wellenmutter anziehen.<br><i>Controlar el par cónico y los cojinetes correspondientes.</i><br>Inspecter le couple conique et les roulements et si rien n'est endommagé, resserrer l'écrou.                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                                                            | 32. Only pinion bearing damaged<br><i>32. Solo un cuscinetto del pignone è danneggiato</i><br>32. Nur eines der Lager des Kegelritzels ist beschädigt<br><i>32. Sólo un cojinete del piñón está dañado</i><br>32. Seulement un roulement du pignon est endommagé                                   | See correction N. 29.<br><i>Vedere rimedio N. 29.</i><br>Siehe Abhilfe N. 29.<br><i>Véase remedio N. 29.</i><br>Voir remède N. 29.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Noise during turn (without NoSpin)<br><i>Rumore sotto sterzo (senza NoSpin)</i><br>Geräusch während der Kurvenfahrt (ohne NoSpin)<br><i>Ruido en la dirección (sin NoSpin)</i><br>Bruit en braquage (sans NoSpin)                                                                                                                          | 33. Worn spider and/or side gears<br><i>33. Satelliti e/o planetari del differenziale danneggiati</i><br>33. Ausgleich kegelräder und/oder welleräder verschlissen<br><i>33. Satélites y/o planetarios del diferencial dañados</i><br>33. Satellites et/ou planétaires du différentiel endommagées | Replace.<br><i>Sostituire i particolari danneggiati.</i><br>Beschädigte Teile ersetzen.<br><i>Sostituire las piezas dañadas.</i><br>Remplacer les pièces endommagées.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A «Stick slip» noise when going from forward to reverse<br><i>Un rumore tipo «Stick slip» si manifesta durante l'inversione di marcia</i><br>«Stick slip» -Geräusch bei Änderung der Fahrtrichtung<br><i>Un ruido tipo «Stick slip» se manifiesta al invertir la marcha</i><br>Un bruit type «Stick slip» se manifeste pendant l'inversion | 34. Worn or damaged cardanshaft<br><i>34. Giunto cardanico danneggiato</i><br>34. Kardanwelle beschädigt<br><i>34. Junta cardánica dañada</i><br>34. Joint cardan endommagé                                                                                                                        | Inspect and replace as described in vehicle's service manual.<br><i>Controllare e sostituire il giunto come indicato nel manuale del veicolo.</i><br>Überprüfen und Kardanwelle gemäß Anweisungen im Handbuch des Fahrzeuges ersetzen.<br><i>Controlar y sustituir la junta como se indica en el manual del vehículo.</i><br>Inspecter et remplacer le joint cardan selon les indications du manuel du véhicule.                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                            | 35. Loose wheel<br><i>35. Ruota allentata</i><br>35. Rad lose<br><i>35. Rueda floja</i><br>35. Roue dévissée                                                                                                                                                                                       | Inspect for wheel and wheel stud damage. Replace if needed and retorque lugnuts.<br><i>Ispezionare eventuali danni al disco ed alle colonnette del mozzo ruota, se necessario sostituire i particolari danneggiati e serrare i dadi alla coppia prescritta.</i><br>Eventuelle Schäden an der Felge und an den Radbolzen überprüfen. Falls erforderlich beschädigte Teile ersetzen und Radmuttern gemäß vorgeschriebenem Drehmoment anziehen.<br><i>Inspeccionar los posibles daños al disco y a las columnas del cubo de la rueda; si fuera necesario, sustituir las piezas dañadas y apretar las tuercas al par prescrito.</i><br>Inspecter les éventuels dommages au disque et aux goujons du moyeu de rue. Si nécessaire remplace les pièces endommagées et serrer les écrous au couple prescrit. |



| PROBLEM - PROBLEMA - PROBLEM -<br>PROBLEMA - PROBLEME                                                                                                                                                                                                                                                                                                             | CAUSE - CAUSE - URSACHE -<br>CAUSAS - CAUSE                                                                                                                                                                                                                                                                                                                            | CORRECTION - RIMEDI - ABHILFE -<br>REMEDIOS - REMEDE                                                                                                                                                                                                                                                                        |
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| <p>A «Stick slip» noise when going from forward to reverse</p> <p><i>Un rumore tipo «Stick slip» si manifesta durante l'inversione di marcia</i></p> <p>«Stick slip» -Geräusch bei Änderung der Fahrtrichtung</p> <p><i>Un ruido tipo «Stick slip» se manifiesta al invertir la marcha</i></p> <p>Un bruit type «Stick slip» se manifeste pendant l'inversion</p> | <p>36. Articulation box joint and achsel shaft damaged</p> <p><i>36. Giunti della scatola snodo, semiassi o snodi di sterzata danneggiati</i></p> <p>36. Kupplung des Gelenkgehäuseg, Halbachse beschädigt</p> <p><i>36. Juntas de la caja de la rótula, semi-eje o perno de dirección dañados</i></p> <p>36. Joint boîtier d'articulation, demi-es-sieu endommagé</p> | <p>Inspect and replace.</p> <p><i>Ispezionare e sostituire i particolari danneggiati.</i></p> <p>Überprüfen und beschädigte Teile ersetzen.</p> <p><i>Inspeccionar y sustituir las piezas dañadas.</i></p> <p>Inspecter et remplacer les pièces endommagées.</p>                                                            |
|                                                                                                                                                                                                                                                                                                                                                                   | <p>37. Spider pins loose in diff-carrier</p> <p><i>37. Satelliti liberi nella scatola differenziale</i></p> <p>37. Ausgleich kegelräder im Differential lose</p> <p><i>37. Satélites libres en la caja del diferencial</i></p> <p>37. Satellites libres dans le carter central</p>                                                                                     | <p>Inspect through top cover. Replace.</p> <p><i>Controllare attraverso il coperchio superiore, sostituire i particolari danneggiati.</i></p> <p>Durch die obere Bohrung überprüfen, Beschädigte Teile ersetzen.</p> <p><i>Inspectioner au travers du couvercle supérieur.</i></p> <p>Remplacer les pièces endommagées.</p> |
|                                                                                                                                                                                                                                                                                                                                                                   | <p>38. Damaged or missing spider and/or side gear washers</p> <p><i>38. Rondelle di rasamento del differenziale usurate</i></p> <p>38. Anlaufscheiben im Differential verschlissen</p> <p><i>38. Arandelas de espesor del diferencial gastadas</i></p> <p>38. Usure des rondelles du différentiel</p>                                                                  | <p>See correction N. 33.</p> <p><i>Vedere rimedio N. 33.</i></p> <p>Siehe Abhilfe N. 33.</p> <p><i>Véase remedio N. 33.</i></p> <p>Voir remède N. 33.</p>                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                             |







SPICER CLARK-HURTH

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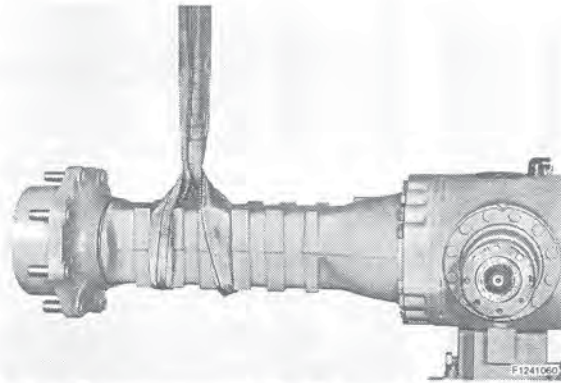
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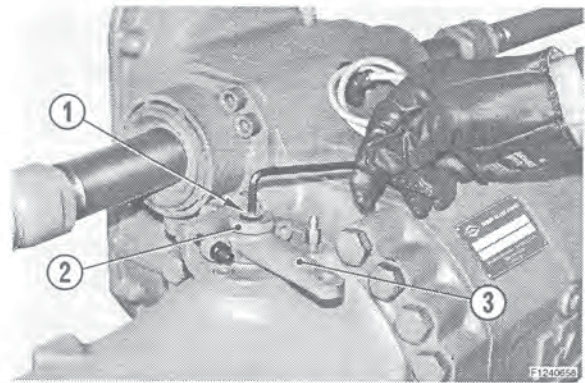
HOW TO DISASSEMBLE THE MECHANIC PARKING BRAKE UNIT - SMONTAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE ABMONTIEREN - DESMONTAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - DEMONTAGE DU FREIN DE STATIONNEMENT MECANIQUE



GB

a

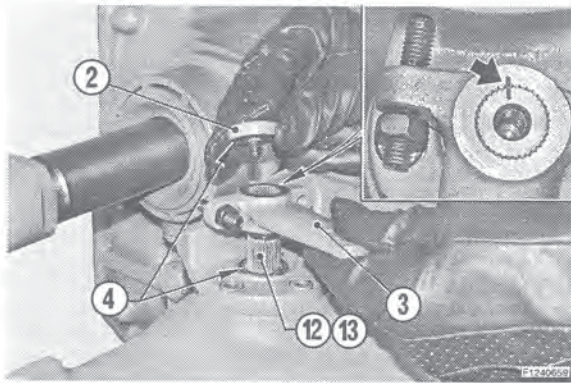
**ATTENTION!** Though the photos in this manual refer to a steering and oscillating axle, the operations described apply anyway.



GB

b

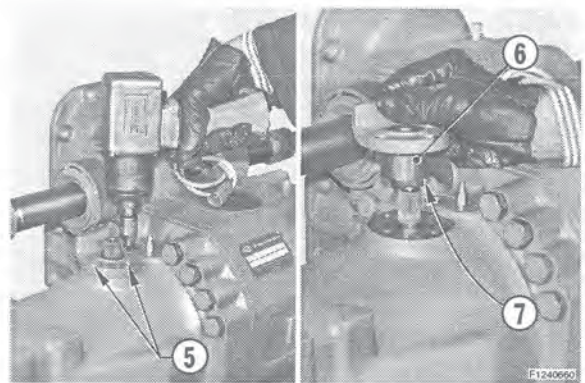
Draw out the screw (1) locking the washer (2) that stops the lever (3).



GB

c

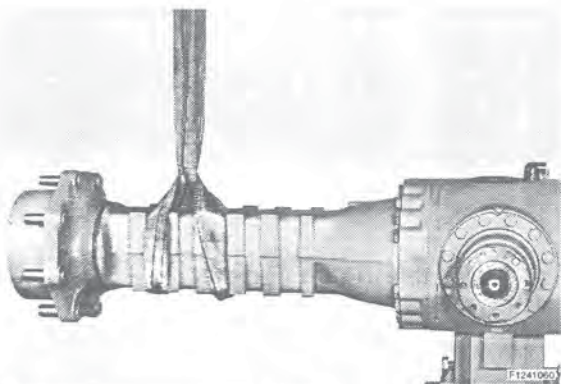
Remove washer (2), lever (3) and O-rings (4). Mark the positions of levers (3) in relation to the thrust levers (12) and (13).



GB

d

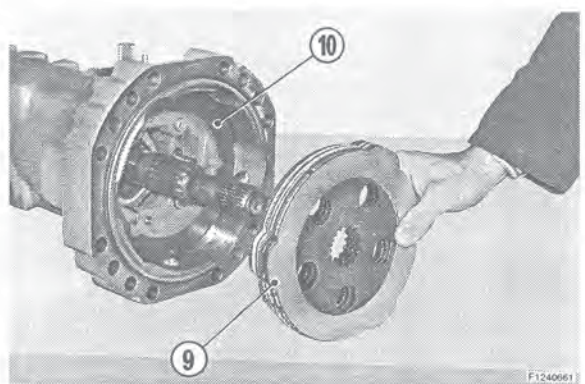
Draw out the screws (5) and remove bush (6) along with O-ring (7).



GB

e

Connect the whole arm (8) to the hoist and put the rod under light tension. Remove the whole arm; for details, see «CHECKING AND REPLACING THE BRAKING DISKS».



GB

f

Remove the braking disks (9) and the whole piston (10). For details, see «CHECKING AND REPLACING THE BRAKING DISKS».

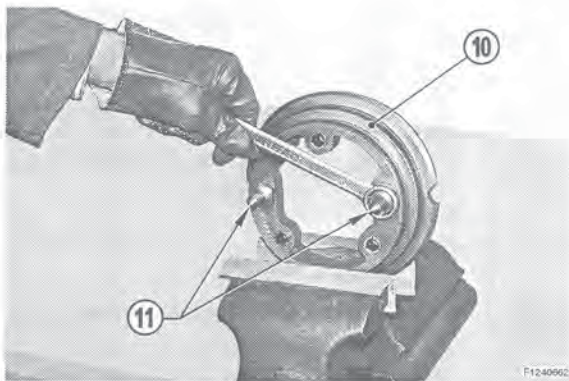


- a**
- ITA** **ATTENZIONE!** Le foto rsono riferite ad un assale sterzante ed oscillante, ma le operazioni descritte sono valide.
- D** **ACHTUNG!** Die Abbildungen beziehen sich auf eine Lenk- und Schwenkachse. Die beschriebenen Vorgänge gelten aber auch in diesem Fall.
- ESP** **ATENCIÓN!** Las fotos se refieren a un eje desviante y oscilante, pero las operaciones descritas son validas.
- F** **ATTENTION!** Les photos sont référées à un essieu braquant et oscillant, mais les opérations ci-décrites sont valables.
- b**
- ITA** Asportare la vite (1) di bloccaggio della rondella (2) di ritegno della leva (3).
- D** Die Schraube (1) zur Befestigung der Unterlegscheibe (2) des Hebels (3) abschrauben.
- ESP** Sacar el tornillo (1) de bloqueo de la arandela (2) de retencion palanca (3).
- F** Enlever la vis (1) de blocage de la rondelle (2) de fixation du levier (3).
- c**
- ITA** Rimuovere la rondella (2), la leva (3) e le guarnizioni OR (4).  
Contrassegnare le posizioni delle leve (3) rispetto le leve di spinta (12) e (13).
- D** Unterlegscheibe (2), Hebel (3) und O-Ringe (4) abnehmen.  
Die Positionen der Hebel (3) im Verhältnis zu den Druckhebeln (12) und (13) kennzeichnen.
- ESP** Remover la arandela (2), la palanca (3) y las guarniciones OR (4).  
Senalar las posiciones de las palancas (3) respecto a las palancas de empuje (12)
- F** Enlever la rondelle (2), le levier (3) et les garnitures OR (4).  
Marquer les positions des leviers (3) par rapport aux leviers (12) et (13).
- d**
- ITA** Asportare le viti (5) e rimuovere la boccia (6) completa di guarnizione OR (7).
- D** Schrauben (5) abschrauben und Buchse (6) samt O-Ring (7) abnehmen.
- ESP** Sacar los tornillos (5) y remover el casquillo (6) completo de guarniciones OR (7).
- F** Enlever les vis (5) et extraire la douille (6) équipée de garnitures OR (7).
- e**
- ITA** Agganciare il braccio completo (8) ad un mezzo di sollevamento e mettere il leggera tensione la fune.  
Rimuovere il braccio completo; per i dettagli, vedere «CONTROLLO E SOSTITUZIONE DISCHI FRENI».
- D** Vollständigen Arm (8) mit einem Hebekarren anheben bis das Seil gespannt ist.  
Vollständigen Arm abtrennen; weitere Einzelheiten im Paragraph «BREMSSCHEIBEN KONTROLLIEREN UND AUSWECHSELN».
- ESP** Enganchar el brazo completo (8) y un medio de levantamiento y poner en ligera tension el cable.  
Remover el brazo completo; por los detalles, vease «CONTROL Y SUSTITUCION DISCOS FRENOS».
- F** Accrocher le bras complet (8) à un moyen de relevage et mettre la corde légèrement en tension.  
Enlever le bras complet: pour tout détail, voir «CONTROLE ET SUBSTITUTION DES DISQUES FREINS».
- f**
- ITA** Rimuovere i dischi freni (9) ed il pistone completo (10).  
Per i dettagli, vedere «CONTROLLO E SOSTITUZIONE DISCHI FRENI».
- D** Bremsscheiben (9) und den ganzen Kolben (10) abnehmen. Weitere Einzelheiten im Paragraph «BREMSSCHEIBEN KONTROLLIEREN UND AUSWECHSELN».
- ESP** Remover los discos frenos (9) y el pistón completo (10).  
Por los detalles, vease «CONTROL Y SUSTITUCION DISCOS FRENOS».
- F** Enlever les disques freins (9) et le piston complet (10).  
Pour tout détail, voir «CONTROLE ET SUBSTITUTION DES DISQUES FREINS».





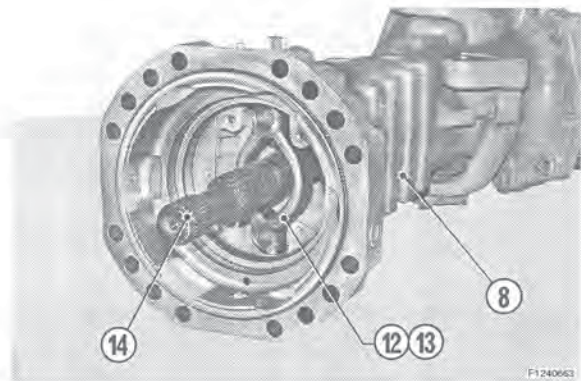
**HOW TO DISASSEMBLE THE MECHANIC PARKING BRAKE UNIT - SMONTAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE ABMONTIEREN - DESMONTAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - DEMONTAGE DU FREIN DE STATIONNEMENT MECANIQUE**



GB

a

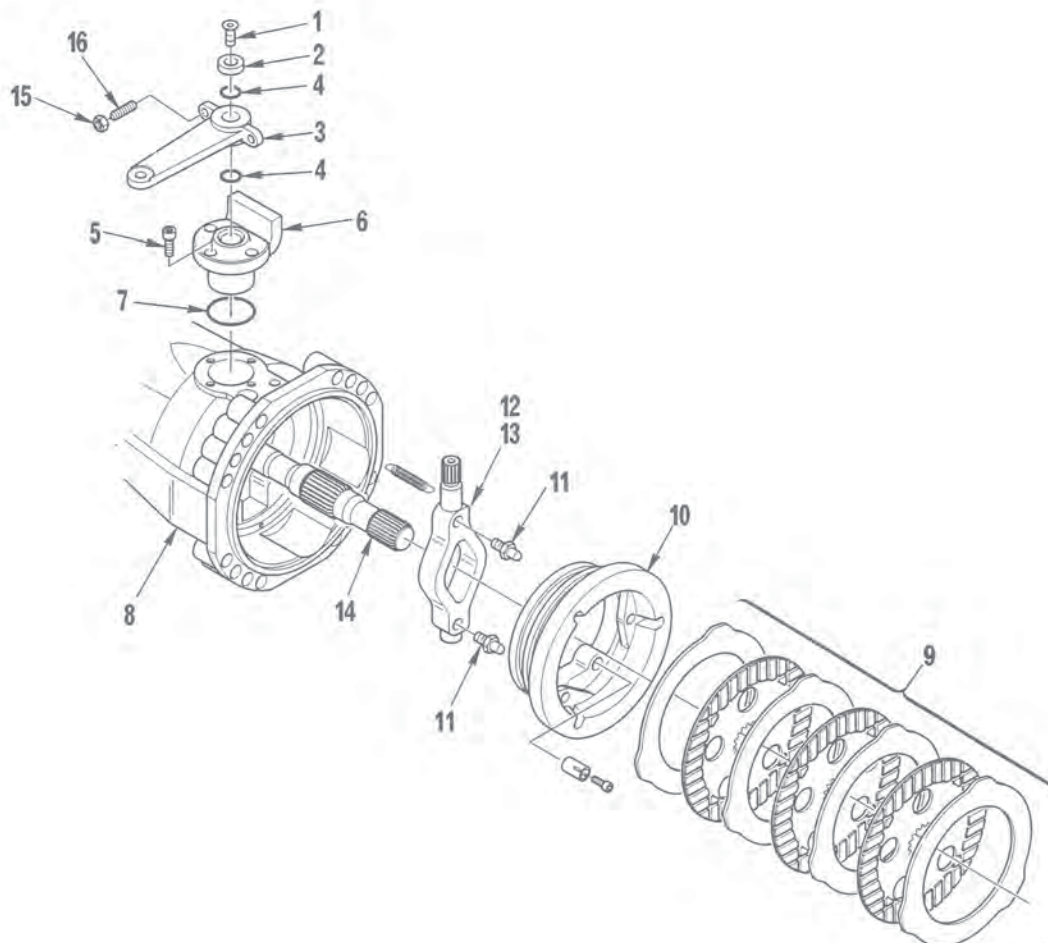
If pins (11) need replacing, block the piston (10) into a vice whose jaws are covered in smooth material and remove the pins.



GB

b

If thrust levers (12) and (13) need replacing, remove the axle shaft (14) before removing the arms (8).  
For details, see «HOW TO REMOVE THE AXLE SHAFT».



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a

ITA

Se si devono sostituire i puntali (11), bloccare il pistone (10) in una morsa con ganasce in materiale tenero e rimuovere i puntali.

D

Falls die Schäfte (11) ausgewechselt werden sollen, Kolben (10) in einem Spannbackenpaar aus weichem Material blockieren und Schäfte abnehmen.

ESP

Si se deben cambiar las puntas (11), bloquear el pistón (10) en un corchete con mordazas en material tierno y remover las puntas.

F

Si l'on doit substituer les tiges (11), bloquer le piston (10) dans un étau à mâchoire en matériel tendre, puis enlever les tiges.

b

ITA

Se si devono sostituire le leve di spinta (12) e (13), prima di rimuovere i bracci (8) rimuovere il semiasse (14).

Per i dettagli, vedere «RIMOZIONE DEL SEMIASSE».

D

Falls die Druckhebel (12) und (13) ausgewechselt werden sollen, zuerst die Halbachse (14) und dann die Arme (8) abnehmen. Weitere Einzelheiten im Paragraph «HALBACHSE INSTALLIEREN».

ESP

Si se deben cambiar las palancas de empuje (12) y (13), antes de remover los brazos (8) remover los semiejes (14).

Por los detalles, vease «REMOCION DE LOS SEMIEJES».

F

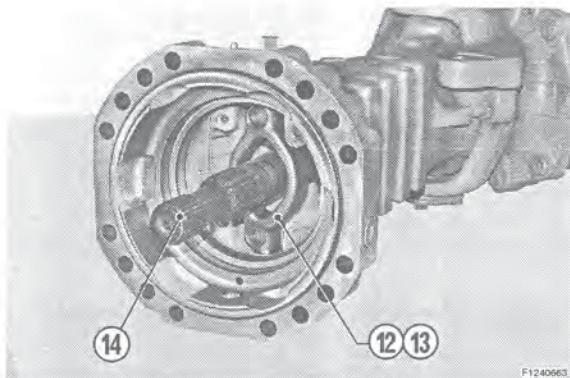
Si l'on doit substituer les leviers de poussée (12) et (13), avant d'enlever les bras (8) enlever le demi-essieu (14).

Pour tout détail, voir «DEPOSE DE DEMI-ESSIEU».





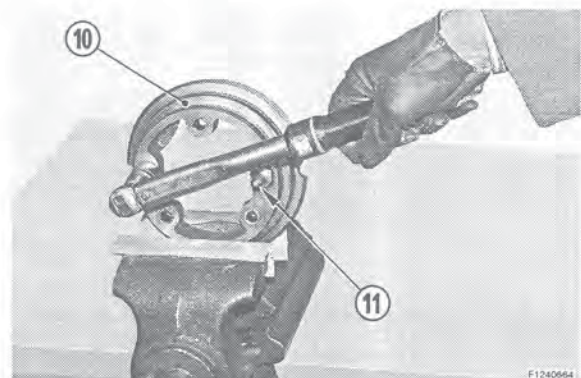
HOW TO ASSEMBLE THE MECHANIC PARKING BRAKE UNIT - ASSEMBLAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE MONTIEREN - ASEMBLAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - ASSEMBLAGE DU FREIN DE STATIONNEMENT MECANIQUE



GB

a

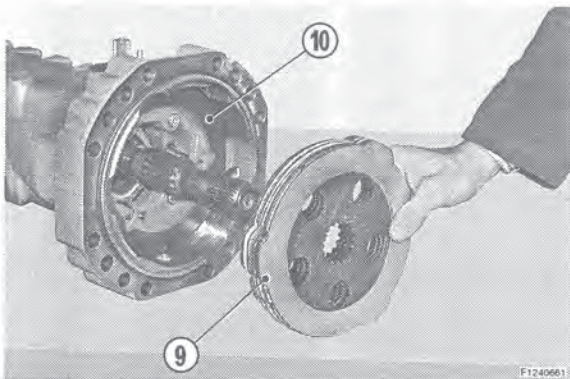
Install thrust levers (12) and (13), then install the axle shaft (14). For details, see «HOW TO INSTALL THE AXLE SHAFT».



GB

b

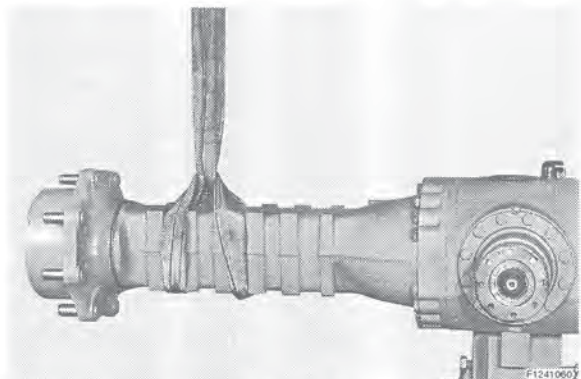
Apply Loctite 270 to the threaded portion of the pins (11) and fit them onto the piston (10). Block them: torque wrench setting 30 – 35 Nm.



GB

c

Re-install the piston (10) and the braking disks (9). For details, see «HOW TO ASSEMBLE THE BRAKING UNITS».



GB

d

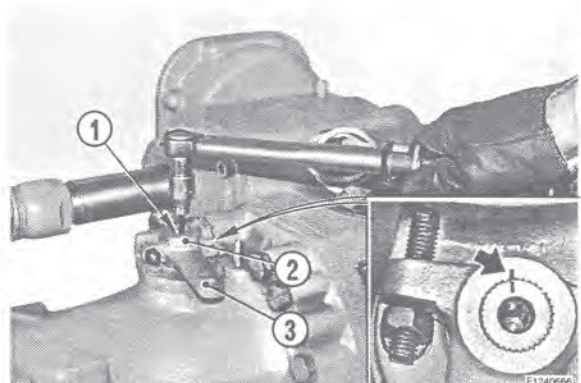
Install the arms (8) into the main body; check flatness and block arms following the appropriate procedures illustrated in section «HOW TO ASSEMBLE THE BRAKING UNITS».



GB

e

Install the bush (6) complete with O-ring (7) and block it with screws (5). Tighten screws with a torque wrench setting of 23.8 – 26.2 Nm.



GB

f

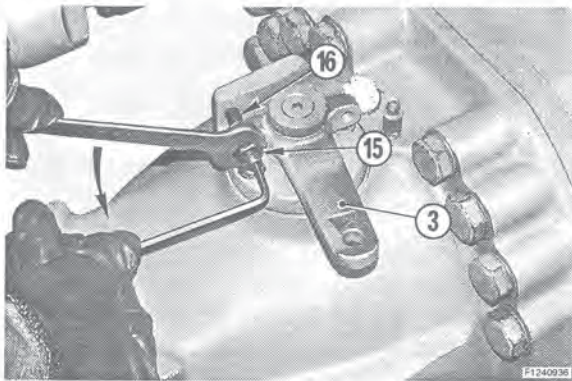
Install in sequence the lower O-ring (4), the lever (3) and the washer (2) with the relative O-ring (4). Block with screw (1) and tighten using a torque wrench setting of 23.8 – 26.2 Nm.  
**CAUTION!** Refer and keep to the positions marked during disassembly.



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Montare le leve di spinta (12) e (13) e successivamente il semiasse (14).<br/>Per i dettagli di montaggio del semiasse, vedere «INSTALLAZIONE DEL SEMIASSE».</p> <p><b>D</b> Druckhebel (12) und (13) montieren; danach Halb-achse (14) montieren.<br/>Weitere Einzelheiten im Paragraph «HALBACHSE INSTALLIEREN».</p> <p><b>ESP</b> Montar la palancas de empuje (12) y (13) y al final los semiejes (14).<br/>Por los detalles de montaje de los semiejes, vease «INSTALACION DE LOS SEMIEJES».</p> <p><b>F</b> Monter les leviers de poussée (12) et (13) et ensuite le demi-essieu (14).<br/>Pour tout détail, voir «DEPOSE DE DEMI-ESSIEU».</p> | <p><b>ITA</b> Spalmare la filettatura dei puntali (11) con Loctite 270 e montarli sul pistone (10).<br/>Bloccarli con una coppia di serraggio di 30÷35 Nm.</p> <p><b>D</b> Schäfte (11) mit Loctite 270 schmieren und auf den Kolben (10) montieren.<br/>Anzugsmoment: 30÷35 Nm.</p> <p><b>ESP</b> Pasar la rosca de las puntales (11) con Loctite 270 y montarlas sobre los pistones (10).<br/>Bloquearlos con un par de torsion de 30÷35 Nm.</p> <p><b>F</b> Enduire le filetage des tiges (11) avec du Loctite 270 puis les monter sur le piston (10).<br/>Bloquer à un couple de serrage de 30÷35 Nm.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p><b>c</b></p> <p><b>ITA</b> Rimontare il pistone (10) ed i dischi freno (9).<br/>Per i dettagli, vedere «ASSEMBLAGGIO DEI GRUPPI DI FRENATURA».</p> <p><b>D</b> Kolben (10) und Bremsscheiben (9) wieder montieren.<br/>Weitere Einzelheiten im Paragraph «ZUSAMMENBAU DER BREMSAGGREGATE».</p> <p><b>ESP</b> Remontar los pistones (10) y los discos frenos (9).<br/>Por los detalles, vease «ASEMBLAJE DE LOS GRUPOS DE FRENADURA».</p> <p><b>F</b> Remonter le piston (10) et les disques freins (9).<br/>Pour tout détail, voir «ASSEMBLAGE DES GROUPES DE FREINAGE».</p>                                                                                                    | <p><b>ITA</b> Montare i bracci (8) sul corpo centrale; controllare il livellamento e quindi bloccarli con le modalità descritte per l'«ASSEMBLAGGIO DEI GRUPPI DI FRENATURA».</p> <p><b>D</b> Die Arme (8) auf den zentralen Körper montieren; danach abrichten und laut Anweisungen des Paragraphs «ZUSAMMENBAU DER BREMSAGGREGAT» blockieren.</p> <p><b>ESP</b> Montar los brazos (8) sobre el cuerpo central, controlar el nivelamiento y entonces bloquearlos con las modalidades descritas por «ASEMBLAJE DE LOS GRUPOS DE FRENADURA».</p> <p><b>F</b> Monter les bras (8) sur le corps central; contrôler le niveau, puis bloquer en suivant le mode décrit dans l'«ASSEMBLAGE DES GROUPES DE FREINAGE».</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p><b>e</b></p> <p><b>ITA</b> Montare la boccia (6) completa di guarnizione OR (7) e bloccarla con le viti (5).<br/>Serrare le viti con una coppia di 23,8÷26,2 Nm.</p> <p><b>D</b> Buchse (6) samt O-Ring (7) montieren und mit den Schrauben (5) festschrauben.<br/>Anzugsmoment der Schrauben: 23,8÷26,2 Nm.</p> <p><b>ESP</b> Montar el casquillo (6) completa de guarnición OR (7) y bloquearla con tornillos (5).<br/>Apretar los tornillos con un par de 23,8÷26,2 Nm.</p> <p><b>F</b> Monter la douille (6) équipée de garniture OR (7) et bloquer cette dernière avec les vis (5).<br/>Serrer les vis à un couple de serrage de 23,8÷26,2 Nm.</p>                         | <p><b>ITA</b> Montare nell'ordine la guarnizione OR inferiore (4), la leva (3) e la rondella (2) completa della relativa guarnizione OR (4).<br/>Bloccarla con la vite (1) serrata ad una coppia di 23,8÷26,2 Nm.<br/><b>ATTENZIONE!</b> Rispettare le posizioni contrassegnate in fase di smontaggio.</p> <p><b>D</b> Der Reihenfolge nach den unteren O-Ring (4), Hebel (3) und Unterlegscheibe (2) samt O-Ring (4) montieren.<br/>Mit der Schraube (1) festschrauben. Anzugsmoment der Schraube: 23,8÷26,2 Nm.<br/><b>ACHTUNG!</b> Die beim Abmontieren markierten Positionen einhalten.</p> <p><b>ESP</b> Montar en el orden la guarnición OR inferior (4), la palanca (3) y la arandela (2) completa de la relativa guarnición OR (4).<br/>Bloquearla con el tornillo (1) apretada a un par de 23,8÷26,2 Nm.<br/><b>ATENCIÓN!</b> Respetar las posiciones señaladas en fase de montaje.</p> <p><b>F</b> Monter dans l'ordre la garniture OR inférieure (4), le levier (3) et la rondelle (2) équipée de sa relative garniture OR (4).<br/>Bloquer celle-ci avec la vis (1) serrer à un couple de 23,8÷26,2 Nm.<br/><b>ATTENTION!</b> Respecter les positions notées en phase de démontage.</p> |



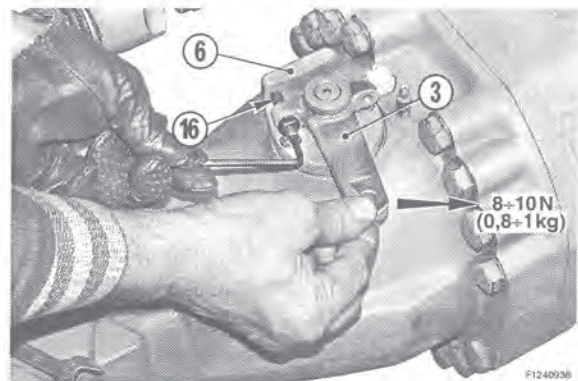
HOW TO ASSEMBLE THE MECHANIC PARKING BRAKE UNIT - ASSEMBLAGGIO GRUPPO FRENO DI STAZIONAMENTO A COMANDO MECCANICO - MECHANISQUE HANDBREMSE MONTIEREN - ASEMBLAJE GRUPO FRENO ESTACIONAMIENTO MECANICO - ASSEMBLAGE DU FREIN DE STATIONNEMENT MECANIQUE



GB

a

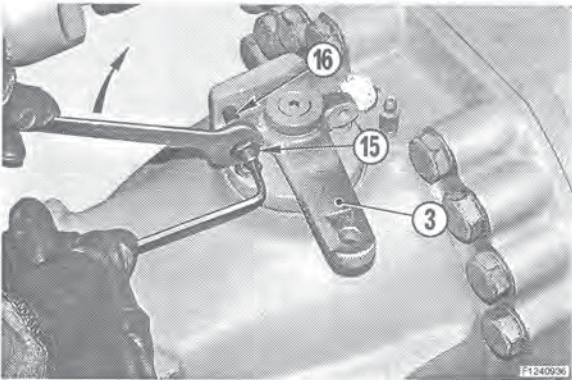
Connect the braking circuit and apply maximum working pressure to set the disks.  
Release the pressure, loosen nut (15) and unscrew dowel (16) by a few turns.



GB

b

Apply a force of 8 – 10 N (0.8 – 1 kg) to lever (3). Direct the force towards the braking direction in order to eliminate the idle stroke. While the force is being applied, tighten dowel (16) until it is caused to rest onto bush (6).



GB

c

Lock dowel (16) in this position with nut (15).  
Torque wrench setting: 20 – 25 Nm.  
**CAUTION!** The idle stroke should be eliminated without preloading thrust levers (12) and (13).



GB

d

**CAUTION!** After connecting the control cable, check that when brakes are released both dowels (16) do lean against bush (6).

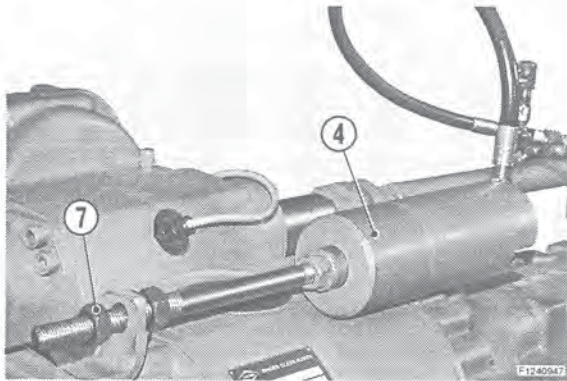


- a**
- ITA** Collegare il circuito frenante ed inserire la massima pressione di lavoro per assestare i dischi. Rilasciare la pressione, allentare il dado (15) e svitare di qualche giro il grano (16).
- D** Den Bremskreislauf anschließen und den maximale Arbeitsdruck einlassen, um die Scheiben zu setzen. Den Druck ablassen, die Mutter (15) lockern und den Stift (16), um einige Umdrehungen aufschrauben.
- ESP** Conectar el circuito frenante y introducir la máxima presión de trabajo para ajustar los discos. Soltar la presión, aflojar las tuercas (15) y destornillar de algun giro la espiga (16).
- F** Brancher le circuit freinant et insérer le maximum de pression d'usinage pour ajuster les disques. Relâcher la pression, desserrer l'écrou (15) et dévisser le grain (16) de quelques tours.
- b**
- ITA** Applicare alla leva (3) una forza di 8÷10 N (0,8÷1 kg), diretta nel senso di frenatura per eliminare la corsa a vuoto. Mantenendo la forza, avvitare il grano (16) fino all'appoggio sulla boccia (6).
- D** Auf den Hebel (3) eine Kraft von 8÷10 N (0,8÷1 kg) in die Bremsrichtung anbringen, um den leeren Lauf auszuschließen. Bei angebrachter Kraft, Stift (16) aufschrauben, bis er an der Buchse (6) anliegt.
- ESP** Aplicar a la palanca (3) una fuerza de 8÷10 N (0,8÷1 kg), directa en el sentido de frenadura para eliminar la carrera a vacío. Manteniendo la fuerza, atornillar la espiga (16) hasta el apoyo sobre el casquillo (6).
- F** Appliquer au levier (3) une contrainte de 8÷10 N (0,8÷1 kg), orientée dans le sens du freinage pour éliminer la course à vide. En maintenant la contrainte, visser le grain (16) jusqu'à ce qu'il se pose sur le fourreau (6).
- c**
- ITA** Bloccare il grano (16) in questa posizione con il dado (15). Coppia di serraggio: 20÷25 Nm. **ATTENZIONE!** La corsa a vuoto va eliminata senza precaricare le leve di spinta (12) e (13).
- D** Stift (16) in dieser Position mit der Mutter (15) blockieren. Anzugsmoment: 20÷25 Nm. **ACHTUNG!** Der leere Lauf muß beseitigt werden ohne die Druckhebel (12) und (13) vorzuladen.
- ESP** Bloquear la espiga (16) en esta colocación con la tuerca (15). Par de torsión: 20÷25 Nm. **ATENCIÓN!** La carrera a vacío debe de ser eliminada sin precargar las palancas de impulso (12) y (13).
- F** Bloquer le grain (16) dans cette position à l'aide de l'écrou (15). Couple de serrage: 20÷25 Nm. **ATTENTION!** La course à vide doit être éliminée sans précharger les leviers d'appui (12) et (13).
- d**
- ITA** **ATTENZIONE!** Dopo il collegamento del cavo di comando, controllare che in fase di rilascio dei freni, ambedue i grani (16) vadano in appoggio sulla boccia (6).
- D** **ACHTUNG!** Nach dem Anschluß des Steuerkabels, kontrollieren, ob beim Loslassen der Bremsen, beide Stifte (16) an der Buchse anliegen (6).
- ESP** **ATENCIÓN!** Después de la conexión del cable de mando, controlar que en fase de suelte de los frenos, las dos espigas (16) vayan en apoyo sobre el casquillo (6).
- F** **ATTENTION!** Après avoir branché le câble de commande, contrôler que pendant la phase de relâchement des freins, les deux grains (16) aillent se poser sur l'embout (6).





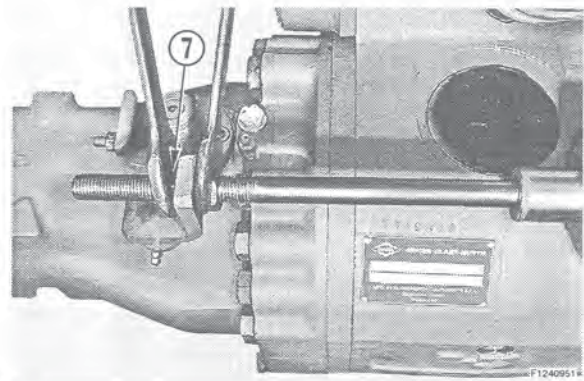
**HOW TO REMOVE AND DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - RIMOZIONE E SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO - AUßERE HYDRAULISCHE NEGATIVBREMSE ABMONTIEREN - REMOCION Y DESMONTAJE FRENO NEGATIVO IDRAULICO EXTERIOR - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE**



GB

a

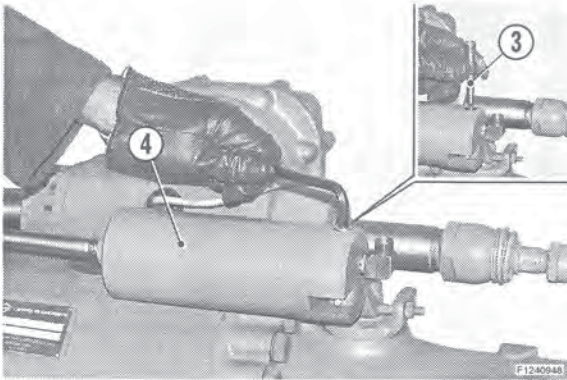
Insert pressure into cylinder (4) in order to release the brakes.  
**NOTE.** If the machine hydraulic system cannot be used, use an external manual pump.



GB

b

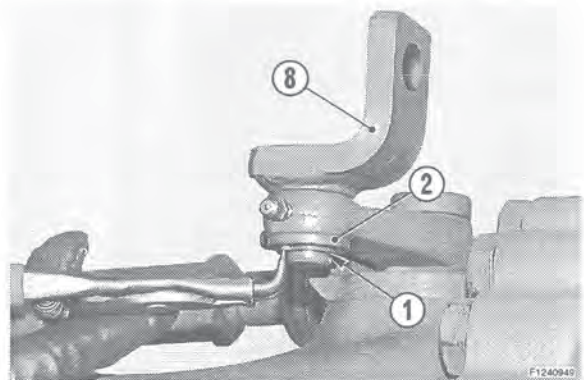
Loosen and remove the external nut (7).



GB

c

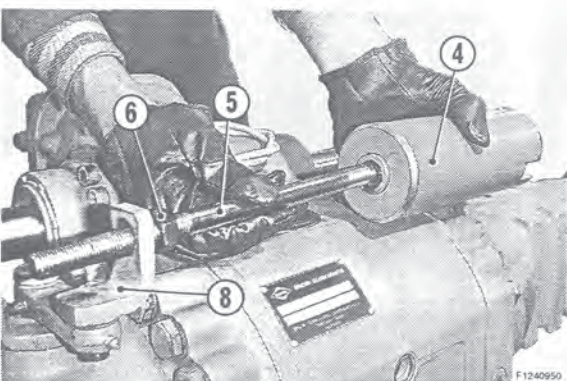
Release the pressure in the cylinder and disconnect the pressure delivery tube.  
Remove the fulcrum pin (3) from the cylinder (4).



GB

d

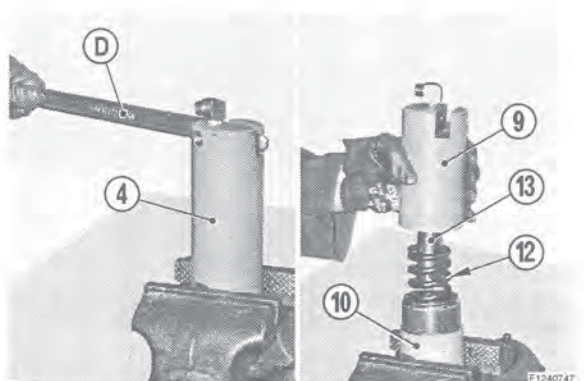
Remove the snap ring (1) that checks the support (8) and remove the distance piece (2).



GB

e

Remove the cylinder assembly (4) complete with rod (5), internal nut (6) and support (8).



GB

f

Place cylinder (4) into a vice with the spring seat side (10) engaged in it and, using a bar "D", loosen and remove the cylinder unit (9) complete with piston (13) and spring (12).

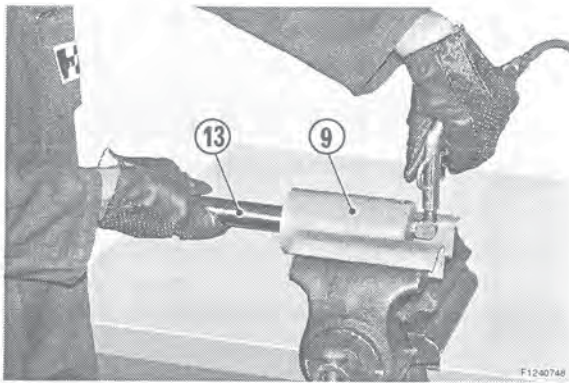




|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Immettere pressione nel cilindro (4) per sbloccare i freni.<br/><b>NOTA.</b> Se non è possibile utilizzare l'impianto idraulico macchina, utilizzare una pompa manuale esterna.</p> <p><b>D</b> Den Druck in den Zylinder (4) lassen, um die Bremsen frei zu machen.<br/><b>BEMERKUNG:</b> Falls die hydraulische Anlage der Maschine nicht verwendet werden kann, eine manuelle getrennte Pumpe verwenden.</p> <p><b>ESP</b> Meter presión en el cilindro (4) para bloquear los frenos.<br/><b>NOTA.</b> Si no es posible utilizar el equipo hidráulico máquina, utilizar una bomba manual exterior.</p> <p><b>F</b> Envoyer de la pression dans le cylindre (4) pour débloquer les freins.<br/><b>NOTE.</b> Si utiliser l'installation hydraulique de la machine n'est pas possible, utiliser une pompe manuelle externe.</p> | <p><b>ITA</b> Allentare ed asportare il dado esterno (7).</p> <p><b>D</b> Die äußere Mutter (7) abschrauben.</p> <p><b>ESP</b> Aflojar y sacar la tuerca externa (7).</p> <p><b>F</b> Desserrer et enlever l'écrou externe (7).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p><b>c</b></p> <p><b>ITA</b> Rilasciare la pressione del cilindro e scollegare il tubo di mandata della pressione.<br/>Rimuovere il perno di fulcro (3) del cilindro (4).</p> <p><b>D</b> Den Druck vom Zylinder ablassen und die Druckleitung abtrennen.<br/>Den Zentrierstift (3) des Zylinders (4) abnehmen.</p> <p><b>ESP</b> Solter la presión del cilindro y desconectar el tubo de ida de la presión.<br/>Remover la rotula (3) del cilindro (4).</p> <p><b>F</b> Relâcher la pression du cylindre et débrancher le tube de refoulement de pression. Enlever l'axe du point d'appui (3) du cylindre (4).</p>                                                                                                                                                                                                                                          | <p><b>ITA</b> Rimuovere l'anello elastico (1) di ritengo supporto (8) ed asportare il distanziale (2).</p> <p><b>D</b> Den Kolbenring (1) der Halterung (8) abnehmen und das Distanzstück (2) abnehmen.</p> <p><b>ESP</b> Remover el anillo elastico (1) de retencion soporte (8) y sacar el distancial (2).</p> <p><b>F</b> Enlever l'anneau à ressort (1) de retenue au support (8), puis enlever l'entretoise (2).</p>                                                                                                                                                                                                                                                                                                                                                                       |
| <p><b>e</b></p> <p><b>ITA</b> Rimuovere il gruppo cilindro (4), completo di asta (5), dado interno (6) e supporto (8).</p> <p><b>D</b> Das Zylinderaggregat (4) samt Stab (5), innere Mutter (6) und Halterung (8) abnehmen.</p> <p><b>ESP</b> Remover el grupo cilindro (4), completo de varilla (5), tuerca interna (6) y soporte (8).</p> <p><b>F</b> Enlever le groupe cylindre (4), complet de tige (5), écrou interne (6) et support (8).</p>                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>ITA</b> Fissare il cilindro (4) in una morsa dal lato sede molla (10) e, utilizzando una barra "D", allentare ed asportare il corpo cilindro (9) completo di pistone (13) e la molla (12).</p> <p><b>D</b> Den Zylinder (4) in einem Spannstock an der Federseite (10) einklemmen und mit dem Stab "D" den Zylinderkörper (9) lockern und samt Kolben (13) und Feder (12) abnehmen.</p> <p><b>ESP</b> Fijar el cilindro (4) en un corchete del lado muelle (10) y, utilizando un varilla "D", aflojar y sacar el cuerpo cilindro (9) completo de pistón (13) y el muelle (12).</p> <p><b>F</b> Fixer le cylindre (4) dans un étau du côté du siège ressort (10), puis à l'aide d'une barre "D", desserrer et enlever le corps cylindre (9) complet du piston (13) et du ressort (12).</p> |



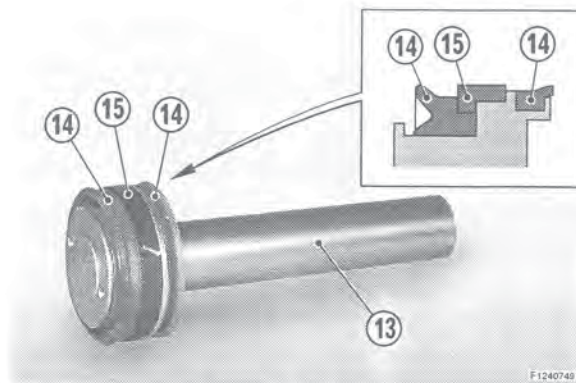
**HOW TO REMOVE AND DISASSEMBLE THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - RIMOZIONE E SMONTAGGIO FRENO NEGATIVO IDRAULICO ESTERNO - ÄußERE HYDRAULISCHE NEGATIVBREMSE ABMONTIEREN - REMOCION Y DESMONTAJE FRENO NEGATIVO IDRAULICO EXTERIOR - ENLEVER ET DEMONTER DU FREIN NEGATIF HYDRAULIQUE EXTERNE**



GB

a

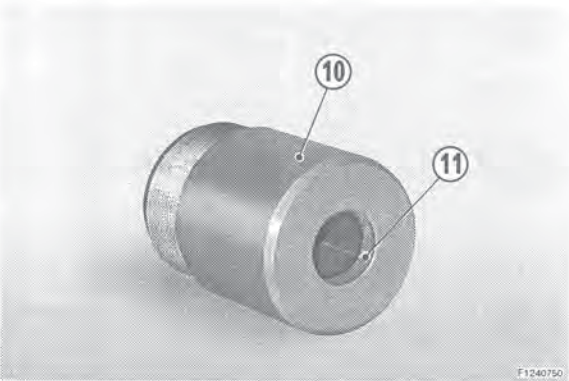
Gently introduce the union piece of the cylinder unit (9) so as to eject the piston (13).  
**CAUTION!** Hold the piston as it may be forced out rapidly and be damaged.



GB

b

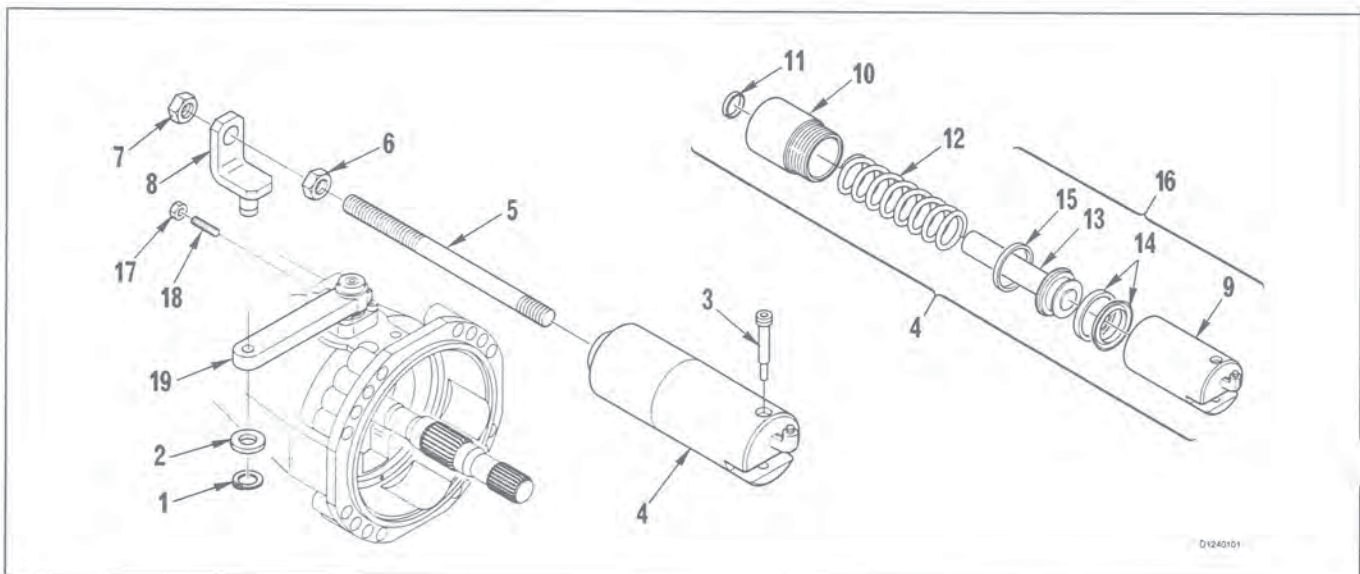
Remove seals (14) and guide ring (15) from the piston (13).  
**NOTE.** Note down seals direction of assembly.



GB

c

**ONLY IF NECESSARY**  
Remove the guide ring (11) from the spring seat (10).  
**CAUTION!** If the guide ring (11) is removed, it must be replaced.







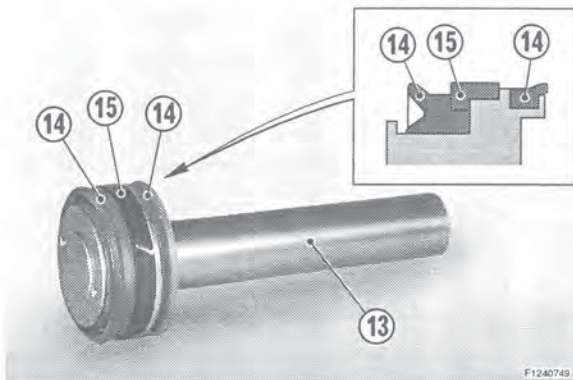
- a**
- ITA** Immettere lentamente il raccordo del corpo cilindro (9) per espellere il pistone (13).  
**ATTENZIONE!** Trattenere il pistone che può essere espulso velocemente ed essere danneggiato.
- D** Langsam das Anschlußstück des Zylinderkörpers (9) einsetzen, um den Kolben (13) auszustoßen.  
**ACHTUNG!** Den Kolben halten, denn er könnte plötzlich herausspringen und beschädigt werden.
- ESP** Meter lentamente el empalme del cuerpo cilindro (9) para la expulsión del pistón (13).  
**ATENCIÓN!** Tener el pistón que puede ser expulsado rápidamente y danarse.
- F** Introduire lentement le raccord du corps cylindre (9) et expulser le piston (13).  
**ATTENTION!** Retenir le piston qui expulsé rapidement peut par conséquent s'endommager.

- b**
- ITA** Rimuovere dal pistone (13) le guarnizioni (14) e l'anello di guida (15).  
**NOTA.** Annotare il senso di montaggio delle guarnizioni.
- D** Den Kolben (13), die Dichtungen (14) und den Führungsring (15) abnehmen.  
**BEMERKUNG.** Montagerichtung der Dichtungen bemerken.
- ESP** Remover del pistón (13) las guarniciones (14) y el anillo de guía (15).  
**NOTA.** Anotar el sentido de desmontaje de las guarniciones.
- F** Enlever du piston (13) les garnitures (14) et la bague de guidage (15).  
**NOTE.** Prendre note du sens de montage des garnitures.

- c**
- ITA** **SOLO SE NECESSARIO**  
Rimuovere dalla sede molla (10) l'anello di guida (11).  
**ATTENZIONE!** Se l'anello di guida (11) viene smontato, deve essere sostituito.
- D** **NUR WENN NOTWENDIG**  
Aus dem Federsitz (10) den Führungsring (11) nehmen.  
**ACHTUNG!** Falls der Führungsring (11) abmontiert wird, muß er ausgewechselt werden.
- ESP** **SOLO SI NECESARIO**  
Remover de la sede muelle (10) el anillo de guía (11).  
**ATENCIÓN!** Si el anillo de guía (11) viene desmontado, debe de ser substituido.
- F** **SEUL SI BESOIN**  
Enlever du siège ressort (10), la bague de guidage (11).  
**ATTENTION!** Si la bague de guidage (11) est démontée, il faut la substituer.



**HOW TO ASSEMBLE AND INSTALL THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - ASSEMBLAGGIO ED INSTALLAZIONE FRENO NEGATIVO IDRAULICO ESTERNO - ÄUßERE HYDRAULISCHE NEGATIVBREMSE MONTIEREN - ASEMBLAJE Y INSTALACION FRENO NEGATIVO IDRAULICO EXTERIOR - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE**

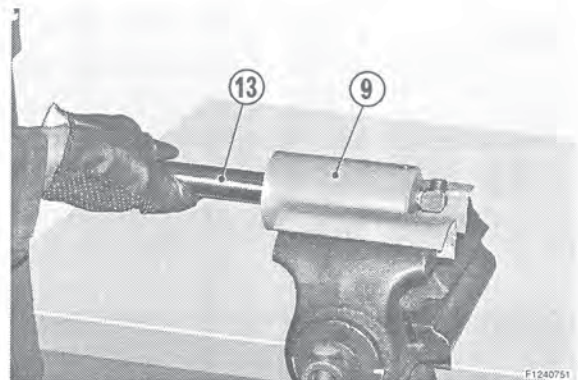


F1240749



**a**

Install guide ring (15) and seals (14) onto the piston (13).  
**CAUTION!** Carefully check seals assembly direction.

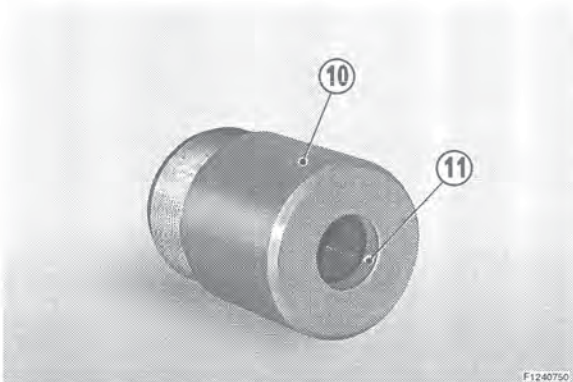


F1240751



**b**

Lubricate the seals (14) and the inside of the cylinder (9); introduce the whole piston and move it to end of stroke.

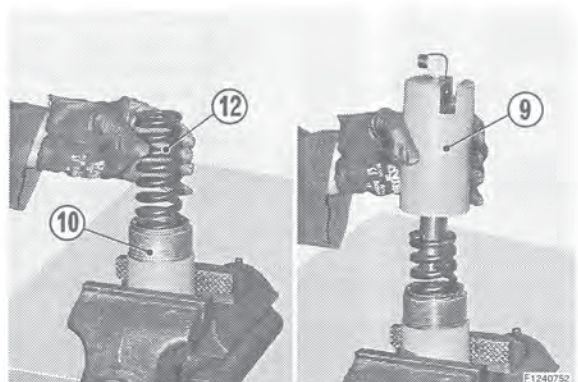


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**c**

If guide ring has been removed, insert a new one (11) into the seat of the spring.  
Lubricate the guide ring.

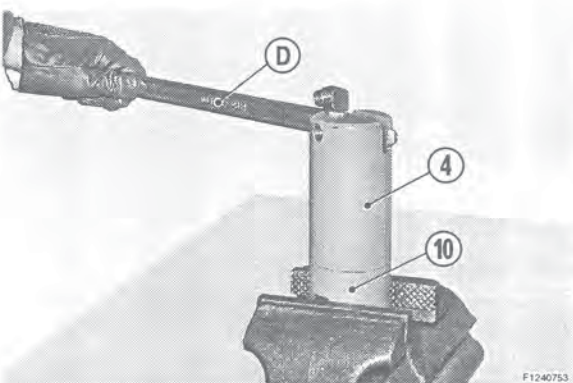


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**d**

Position the spring seat (10) in a vice and insert spring (12).  
Lubricate the thread. Assemble the whole cylinder (9).

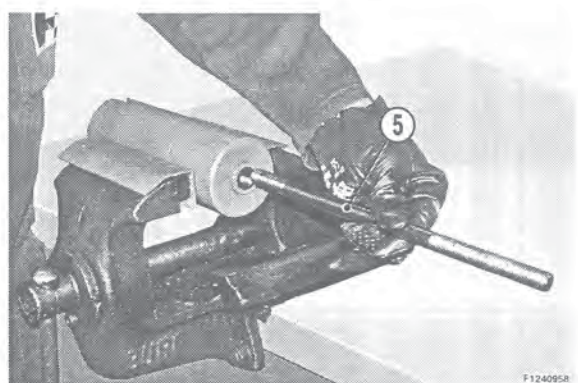


F1240753



**e**

Screw the cylinder (9) into the spring seat (10) and lock it using a bar "D".



F1240958



**f**

Apply Loctite 270 to the rod (5) and screw it in the piston (13) as far as it will go.





- a**
- ITA** Montare sul pistone (13) l'anello di guida (15) e le guarnizioni (14).  
**ATTENZIONE!** Controllare attentamente il senso di montaggio delle guarnizioni.
- D** Auf den Kolben (13) den Führungsring (15) und die Dichtungen (14) montieren.  
**ACHTUNG!** Auf die Montagerichtung der Dichtungen sorgfältig achten.
- ESP** Montar sobre el piston (13) el anillo de guía (15) y las guarniciones (14).  
**ATENCIÓN!** Controlar atentamente el sentido de montaje de las guarniciones.
- F** Monter sur le piston (13) la bague de guidage (15) et les garnitures (14).  
**ATTENTION!** Contrôler attentivement le sens du montage des garnitures.

- ITA** Lubrificare le guarnizioni (14) e l'interno del cilindro (9); inserire il pistone completo e mandarlo a fine corsa.
- D** Dichtungen (14) und das Zylinderinnere (9) schmieren; den vollständigen Kolben einsetzen und bis zum Anschlag einschieben.
- ESP** Lubrificar las guarniciones (14) y el interior del cilindro (9); introducir el piston completo y mandarlo a final de carrera.
- F** Lubrifier les garnitures (14) à l'intérieur du cylindre (9); y introduire le piston complet et l'envoyer en fin de course.

- c**
- ITA** Se è stato smontato, inserire il nuovo anello di guida (11) nella sede molla (10).  
Lubrificare l'anello di guida.
- D** Falls der Führungsring (11) abmontiert worden ist, diesen in den Federsitz (10) einsetzen.  
Den Führungsring schmieren.
- ESP** Si ha sido desmontado, introducir el nuevo anillo de guía (11) en la sede muelle (10).  
Lubricar el anillo de guía.
- F** Si elle a été démontée, introduire la bague de guidage neuve (11) dans le siège ressort (10).  
Lubrifier la bague de guidage.

- ITA** Posizionare la sede molla (10) in una morsa ed inserire la molla (12).  
Lubrificare la filettatura. Montare il cilindro completo (9).
- D** Federsitz (10) in einen Spannbock einklemmen und die Feder (12) einsetzen.  
Gewinde schmieren. Den vollständigen Zylinder (9) montieren.
- ESP** Colocar la sede muelle (10) en un corchete y introducir un muelle (12).  
Lubricar la rosca. Montar el cilindro completo (9).
- F** Placer le siège ressort (10) dans un étau et y introduire le ressort (12).  
Lubrifier le filetage. Monter le cylindre complet (9).

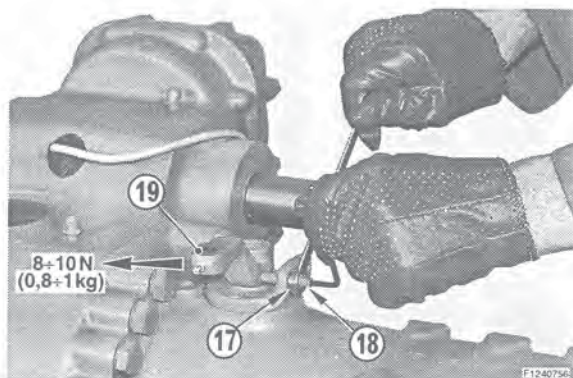
- e**
- ITA** Avvitare il cilindro (9) nella sede molla (10) e bloccarlo utilizzando una barra "D".
- D** Den Zylinder (9) in den Sitze der Feder (10) schrauben und mit Hilfe des Stabs "D" blockieren.
- ESP** Atornillar el cilindro (9) en la sede muelle (10) y bloquearlo utilizando una varilla "D".
- F** Visser le cylindre (9) dans le siège ressort (10), puis bloquer celui-ci à l'aide d'une barre "D".

- ITA** Spalmare l'asta (5) con Loctite 270 ed avvitare a fondo nel pistone (13).
- D** Den Stab (5) mit Loctite 270 schmieren und in den Kolben (13) festschrauben.
- ESP** Pasar la varilla (5) con Loctite 270 y atornillarla a fondo en el piston (13).
- F** Enduire la tige (5) avec du Loctite 270 et visser celle-ci à fond dans le piston (13).





**HOW TO ASSEMBLE AND INSTALL THE EXTERNAL HYDRAULIC NEGATIVE BRAKE - ASSEMBLAGGIO ED INSTALLAZIONE FRENO NEGATIVO IDRAULICO ESTERNO - AUßERE HYDRAULISCHE NEGATIVBREMSE MONTIEREN - ASEMBLAJE Y INSTALACION FRENO NEGATIVO IDRAULICO EXTERIOR - ASSEMBLAGE ET INSTALLATION DU FREIN NEGATIF HYDRAULIQUE EXTERNE**

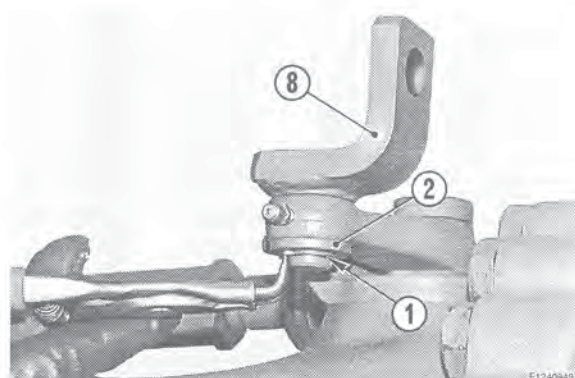


GB

a

Loosen nuts (17) and set braking levers (19) clearances to zero by turning dowels (18); lock nuts (17) with a torque wrench setting of 20 – 25 Nm.

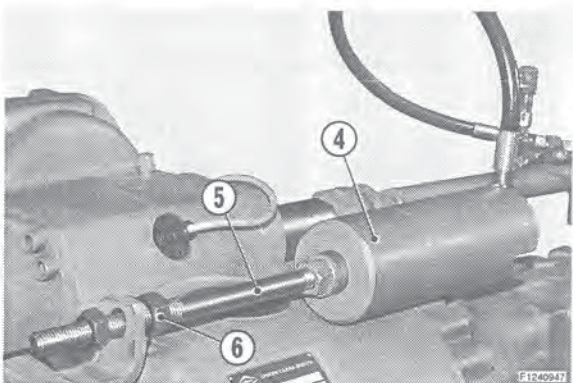
**CAUTION!** Clearances should be set to zero without causing any preloading.



GB

b

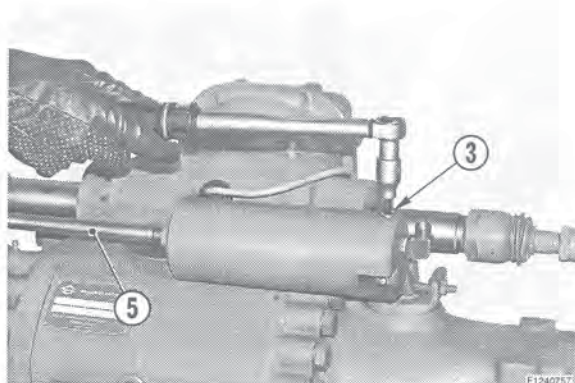
Install distance piece (2) and insert the pin of support (10) into the right-hand braking lever. Fit the second distance piece (2) and snap ring (1).



GB

c

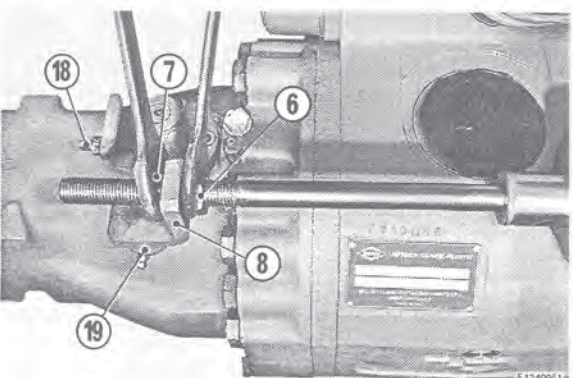
Install cylinder (4) complete with rod (5) and internal nut (6).



GB

d

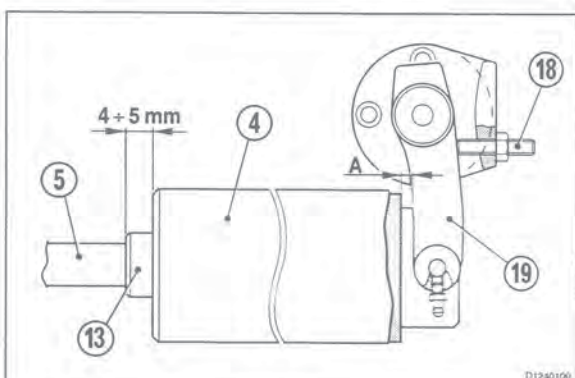
Centre the hole of fulcrum pin (3). Apply Loctite 242 to the pin thread, screw and tighten pin with a dynamometric wrench set at 25 – 30 Nm.



GB

e

Introduce pressure into the cylinder (4) and whilst holding both levers (19) back against the adjusting screws (18), move nuts (6) and (7) so that they are made to rest against support (8); lock the nuts with a torque wrench setting of 50 – 60 Nm.



GB

f

Check that, when the brakes are released (pressure inserted), levers (19) do lean against the screws (18) without prestressing them and make sure that a clearance "A" is left between cylinder (4) and lever (19). Also check that when pressure is released, piston (13) projects out by 4 – 5 mm.



**ITA**

Allentare i dadi (17) ed azzerare i giochi delle leve di frenatura (19) con i grani (18); bloccare i dadi (17) ad una coppia di 20÷25 Nm.

**ATTENZIONE!** I giochi devono risultare azzerati senza provocare precarico.

**D**

Muttern (17) lockern und die Spiele der Bremshebel (19) mit den Stiften (18) zurückstellen; die Mutter (17) bei einem Anzugsmoment von 20÷25 Nm blockieren.

**a**

**ACHTUNG!** Die Spiele müssen zurückgestellt werden, ohne das Teil vorzuladen.

**ESP**

Alojar las tuercas (17) y poner a zero los juegos de las palancas de frenadura (19) con las espigas (18); bloquear las tuercas (17) a un par de 20÷25 Nm.

**ATENCION!** Los juegos deben de resultar a zero sin provocar precarga.

**F**

Desserrer les écrous (17) et mettre à zéro les jeux des leviers de freinage (19) avec les grains (18); bloquer les écrous (17) à un couple de 20÷25 Nm.

**ATTENTION!** Les jeux doivent être mis à zéro sans provoquer de précharge.

**ITA**

Montare il distanziale (2) ed infilare il perno del supporto (10) nella leva di frenatura destra. Montare il secondo distanziale (2) e l'anello elastico (1).

**D**

Das Distanzstück (2) montieren und den Halterungsstift (10) in den rechten Bremshebel einsetzen. Das zweite Distanzstück (2) in den Kolbenring (1) montieren.

**b****ESP**

Montar el distancial (2) y insertar el perno del soporte (10) en la palanca de frenadura derecha. Montar el segundo distancial (2) y el anillo elastico.

**F**

Monter l'entretoise (2), puis introduire l'axe du support (10) dans le levier de freinage droit. Monter la deuxième entretoise (2) et l'anneau à ressort (1).

**ITA**

Montare il cilindro (4) completo di asta (5) e del dado interno (6).

**D**

Den Zylinder (4) samt Stab (5) und innere Mutter (6) montieren.

**c****ESP**

Montar el cilindro (4) completo de varilla (5) y de la tuerca interna (6).

**F**

Monter le cylindre (4) équipé de la tige (5) et de l'écrou interne (6).

**ITA**

Centrare il foro del perno di fulcro (3). Spalmare la filettatura del perno (3) con Loctite 242, avvitarlo e serrarlo con chiave dinamometrica tarata a 25÷30 Nm.

**D**

Das Loch des Zentrierstiftes (3) zentrieren. Das Stiftgewinde (3) mit Loctite 242 schmieren und mit einem Momentenschlüssel bei 25÷30 Nm fest ziehen.

**d****ESP**

Centrar el agujero de la rotula del fulcro (3). Pasar la rosca de la rotula (3) con Loctite 242, atornillarlo y apretarlo con llave dinamometrica tarada a 25÷30 Nm.

**F**

Centrer le trou de l'axe du fourreau (3). Enduire le filetage de l'axe (3) avec du Loctite 242, visser et serrer celui-ci à l'aide d'une clé dynamométrique calibrée à 25÷30 Nm.

**ITA**

Immettere pressione nel cilindro (4) e, mantenendo entrambe le leve (19) appoggiate alle viti di registro (18), mandare in appoggio i dadi (6) e (7) sul supporto (8); bloccare i dadi con una coppia di 50÷60 Nm.

**D**

Den Druck in den Zylinder (4) einlassen. Beide Hebel (19) an den Stellschrauben (18) anliegen lassen und die Muttern (6) und (7) bis zum Anschlag der Halterung (8) bringen; die Muttern mit einem Anzugsmoment von 50÷60 Nm fest ziehen.

**e****ESP**

Meter presión en el cilindro (4), manteniendo las dos palancas (19) en apoyo a las tuercas de registro (18), mandar en apoyo las tuercas (6) y (7) sobre el soporte (8); bloquear las tuercas con un par de 50÷60 Nm.

**F**

Emettre de la pression dans le cylindre (4), puis en maintenant les deux leviers (19) posés sur les vis de réglage (18), envoyer les écrous (6) et (7) en appui sur le support (8); bloquer les écrous à un couple de 50÷60 Nm.

**ITA**

Controllare che a freni sbloccati (pressione inserita), le leve (19) vadano in appoggio sulle viti (18) senza precaricarle e che tra cilindro (4) e leva (19) rimanga un gioco "A". Controllare anche che a pressione rilasciata, il pistone (13) abbia una sporgenza di 4÷5 mm.

**D**

Kontrollieren, ob bei freien Bremsen (eingelassener Druck), die Hebel (19) an den Schrauben (18) anliegen, ohne sie vorzuladen und ob zwischen Zylinder (4) und Hebel (19) ein Spiel "A" besteht. Kontrollieren, ob bei abgelassenem Druck, der Kolben (13) um 4÷5 mm herausragt.

**f****ESP**

Controlar que a frenos bloqueados (presión insertada), las palancas (19) vayan en apoyo sobre los tornillos (18) sin precargarlas y que entre el cilindro (4) y la palanca (19) haya un juego "A". Controlar también que a presión soltada el pistón (13) tenga una resalte de 4÷5 mm.

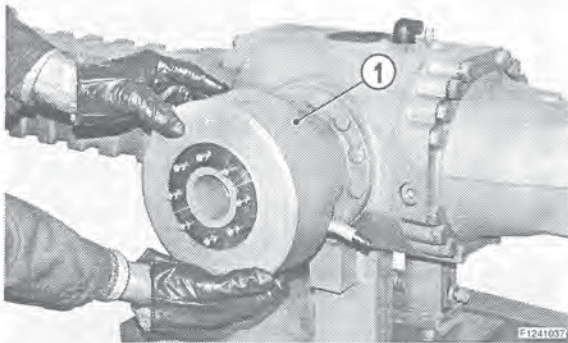
**F**

Contrôler que lorsque les freins sont débloqués (pression introduite), les leviers (19) aillent se poser sur les vis (18) sans précharger ces dernières, et qu'entre cylindre (4) et levier (19) il y ait un jeu "A". Contrôler également que lorsque la pression est relâchée, le piston (13) ait une saillie de 4÷5 mm.

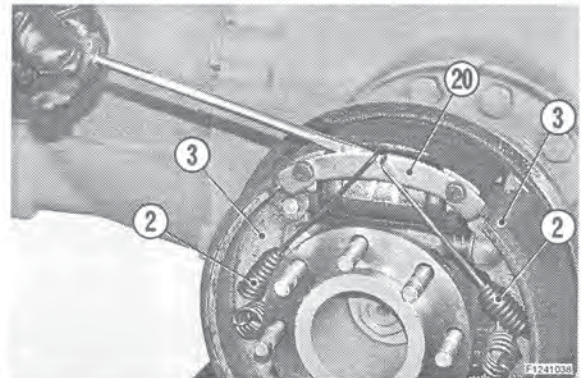




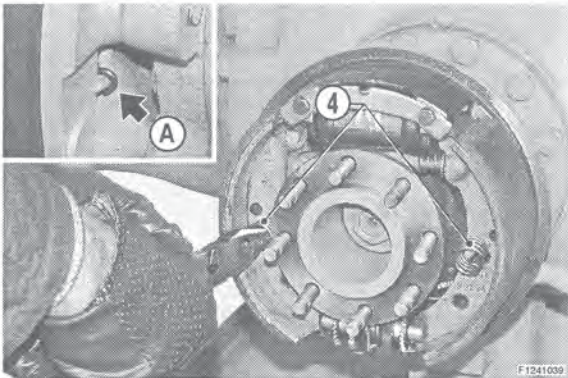
DISASSEMBLING THE HYDRAULIC DRUM BRAKE - SMONTAGGIO FRENO A TAMBURO COMANDO IDRAULICO -  
TROMMELBREMSE MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE FRENO A TAMBOR MANDO HIDRAULICO -  
DESASSEMBLAGE DU FREIN A TAMBOUR DE COMMANDE HYDRAULIQUE



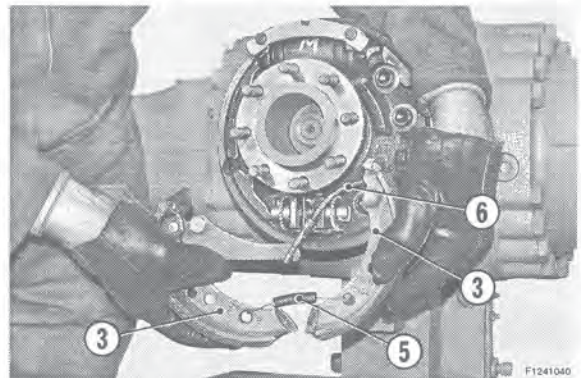
Move away the drum (1) and remove dust from the friction seals.  
**CAUTION!** Use only an aspirator and a brush.



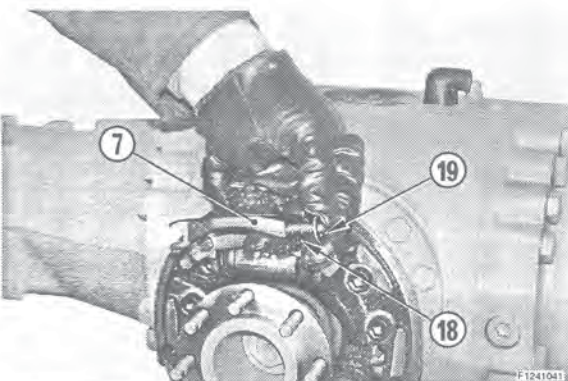
With a screwdriver, disengage the return springs (2) of shoes (3) from the stopper (20) and extract them.



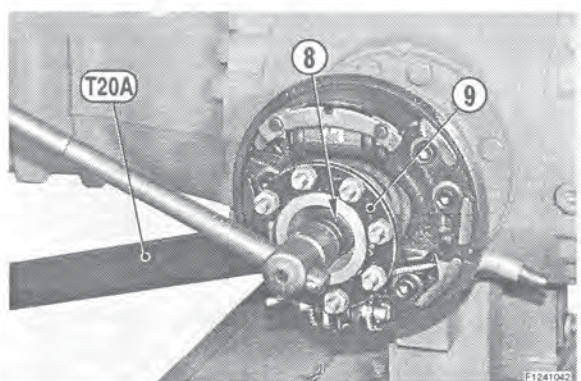
Remove the axial check springs (4) of shoes (3).  
**NOTE.** To remove springs, give a push and rotate so as to disengage the catch in the rear seat "A".



Remove the shoes (3) complete with the positioning spring (5).  
Release the cable (6) for the parking brake function as well as the spring (5).



Remove the elastic compression bar set (7) (compression bar 7, spring 18, washer 19).



Fit tool T20A (or T20B) and loosen the check nut (8) of the in-flange (9).



- a**
- ITA** Rimuovere il tamburo (1) ed asportare la polvere delle guarnizioni d'attrito.  
**ATTENZIONE!** Usare solo aspiratore e pennello.
- D** Trommel (1) abnehmen und den Staub von den Reibungsdichtungen entfernen.  
**ACHTUNG!** Dazu nur einen Sauger und einen Pinsel verwenden.
- ESP** Remover el tambor (1) y sacar el polvo de las guarniciones de atrito.  
**ATENCIÓN!** Usar solo spirador y brocha.
- F** Enlever le tambour (1) et enlever la poussière des garnitures de friction.  
**ATTENTION!** Utiliser uniquement aspirateur et pinceau.

- b**
- ITA** Utilizzando un cacciavite, sganciare dalla bozza (20) ed asportare le molle (2) di ritorno delle ganasce (3).
- D** Mit einem Schraubenzieher vom Block (20) die Rückzugsfedern (2) der Backen (3) abnehmen.
- ESP** Utilizando un destornillador, desganchar del relieve (20) y sacar los muelles (2) de vuelta de las mordazas (3).
- F** A l'aide d'un tournevis, décrocher du bossage (20), puis enlever les ressorts (2) de retour des mâchoires (3).

- c**
- ITA** Rimuovere le molle (4) di ritegno assiale delle ganasce (3).  
**NOTA.** Per la rimozione, esercitare una spinta ed una rotazione per disimpegnare il gancio nella sede posteriore "A".
- D** Die Haltefedern (4) der Achse von den Backen (3) abnehmen.  
**BEMERKUNG.** Um diese abzunehmen, die Feder drücken und drehen, um den Haken im hinteren Sitz "A" auszurasten.
- ESP** Remover los muelles (4) de retencion axial de las mordazas (3).  
**NOTA.** Por la remocion, efectuar un empuje u una rotacion para desempeñar el gancho de la sed posterior "A".
- F** Enlever les ressorts (4) de retenue axiaux des mâchoires (3).  
**REMARQUE.** Pour enlever, exercer une pression puis une rotation pour dégager le crochet de son siège postérieur "A".

- d**
- ITA** Rimuovere le ganasce (3) complete della molla di posizionamento (5).  
Sganciare il cavo (6) per la funzione di freno di stazionamento e la molla (5).
- D** Die Backen (3) samt Stellfeder (5) abnehmen.  
Die Leitung (6) für die Handbremse und die Feder (5) ausrasten.
- ESP** Remover las mordazas (3) completas de muelles, de colocacion (5).  
Desganchar el cable (6) para las funciones de freno de estacionamiento y el muelle (5).
- F** Enlever les mâchoires (3) complètes du ressort de positionnement (5).  
Décrocher le câble (6) servant à la fonction de frein de stationnement, puis le ressort (5).

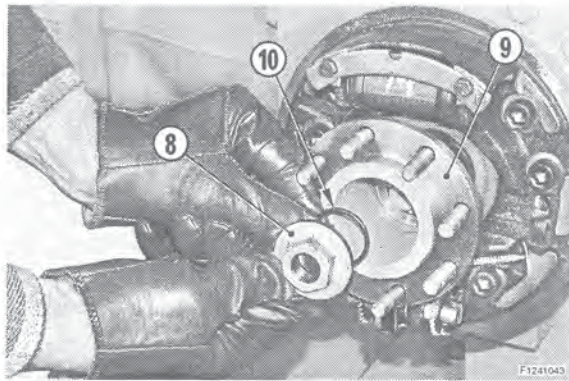
- e**
- ITA** Rimuovere il gruppo puntone elastico (7) (puntone 7, molla 18, rondella 19).
- D** Das elastische Druckstabaggregat (7) (Druckstab 7, Feder 18, Scheibe 19) abnehmen.
- ESP** Remover el grupo puliston elastico (7) (liston 7, muelle 18, arandela 19).
- F** -Enlever le groupe barre de compression élastique (7). (butée 7, ressort 18, rondelle 19).

- f**
- ITA** Montare l'attrezzo T20A (oppure T20B) ed allentare il dado (8) di ritegno della flangia di entrata (9).
- D** Das Werkzeug T20A (oder T20B) montieren und die Mutter (8) zur Halterung des Eingangsflansches (9) lockern.
- ESP** Montar la herramienta T20A (o T20B) y aflojar el dado (8) de retencion de la brida de entrada (9).
- F** Monter l'outil T20A (ou T20B) et desserrer l'écrou (8) de butée de la flasque d'entrée (9).

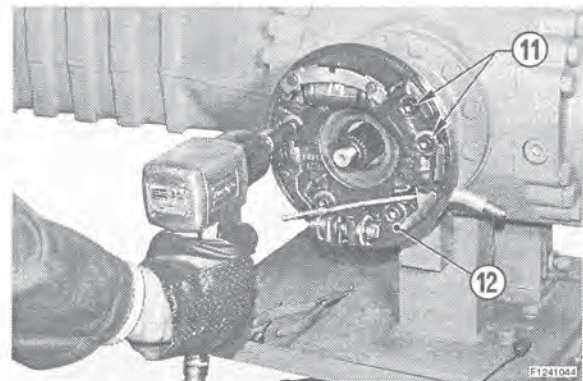




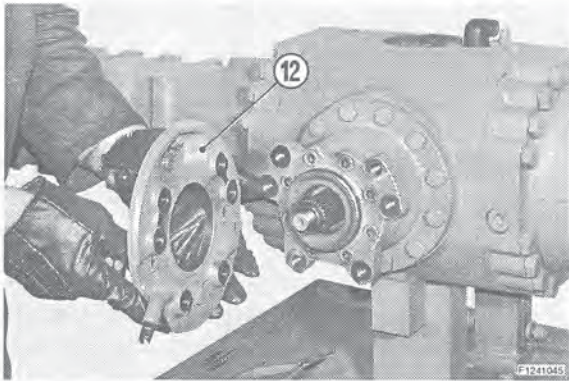
DISASSEMBLING THE HYDRAULIC DRUM BRAKE - SMONTAGGIO FRENO A TAMBURO COMANDO IDRAULICO -  
TROMMELBREMSE MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE FRENO A TAMBOR MANDO HIDRAULICO -  
DESASSEMBLAGE DU FREIN A TAMBOUR DE COMMANDE HYDRAULIQUE



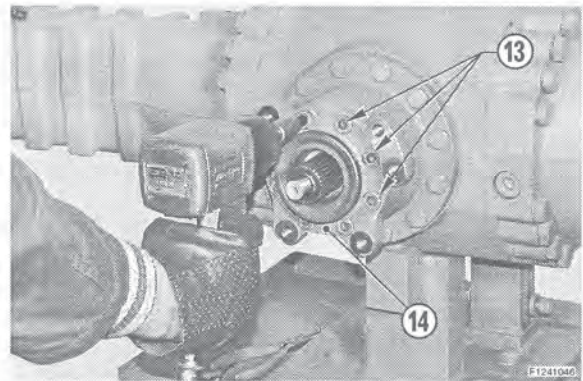
Remove parts in the following order: nut (8), O-ring (10), and whole flange (9).



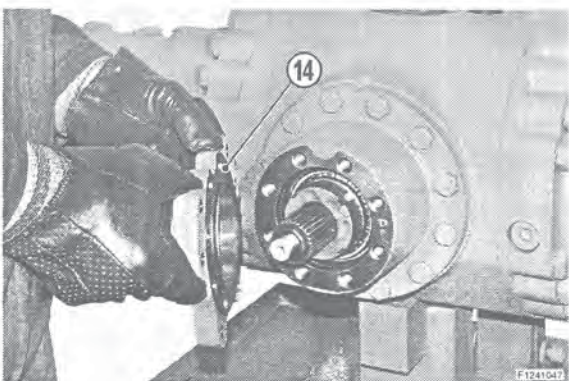
Loosen the securing screws (11) of the brake unit flange (12).



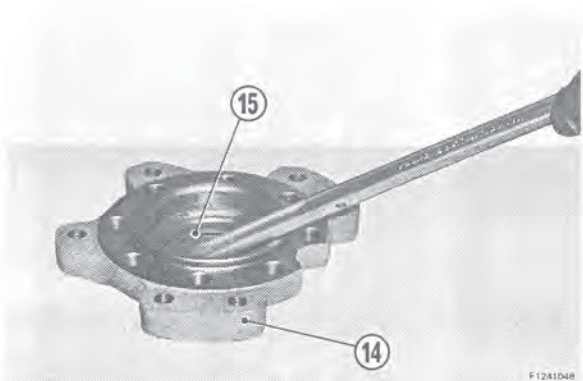
Remove the flange (12) complete with braking cylinder, clearance regulation unit, and parking function cable.



Loosen the securing screws (13) of brake support (14).



Remove the brake support (14).



Remove the sealing ring (15) from the brake support (14).  
NOTE. Note down direction of assembly.

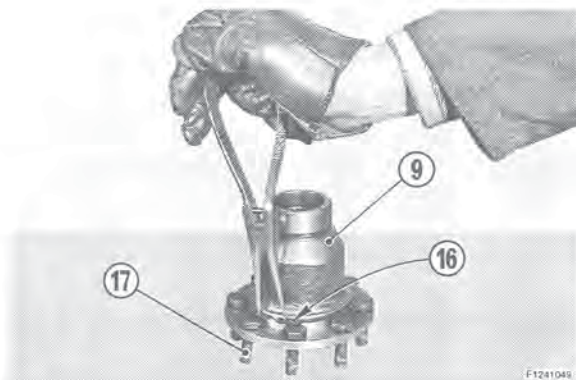


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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Asportare nell'ordine, il dado (8), la guarnizione OR (10) e la flangia (9) completa.</p> <p><b>D</b> Der Reihenfolge nach die Mutter (8), den O-Ring (10) und den gesamten Flansch (9) abnehmen.</p> <p><b>ESP</b> Sacar en el orden, el dado (8), la guarnición OR (10) y la brida (9) completa.</p> <p><b>F</b> Enlever dans l'ordre, l'écrou (8), la garniture OR (10) et le flasque (9) complète.</p>                                                                                                                                                | <p><b>b</b></p> <p><b>ITA</b> Allentare le viti (11) di fissaggio della flangia gruppo freno (12).</p> <p><b>D</b> Die Schrauben (11) zur Befestigung des Flanschs des Bremsaggregats (12) lockern.</p> <p><b>ESP</b> Aflojar lo tornillos (11) de fijaje de la brida grupo freno (12).</p> <p><b>F</b> Desserrer les vis (11) de fixation du flasque du groupe frein (12).</p>                                                                                                                                              |
| <p><b>c</b></p> <p><b>ITA</b> Rimuovere la flangia (12) completa di cilindro di frenatura, gruppo di regolazione gioco e cavo per l'azione di stazionamento.</p> <p><b>D</b> Den Flansch (12) samt Bremszylinder, Spielregelungsaggregat und Leitung der Handbremse abnehmen.</p> <p><b>ESP</b> Remover la brida (12) completa de cilindro de frenadura, grupo de regulación juego y cable por la acción de estacionamiento.</p> <p><b>F</b> Enlever le flasque (12) complète de cylindre de freinage, groupe de réglage de jeu et le câble servant à la fonction de stationnement.</p> | <p><b>d</b></p> <p><b>ITA</b> Allentare le viti (13) di fissaggio del supporto freno (14).</p> <p><b>D</b> Die Schrauben (13) zur Befestigung des Bremsenhalters (14) lockern.</p> <p><b>ESP</b> Aflojar los tornillos (13) de fijaje del soporte freno (14).</p> <p><b>F</b> Desserrer les vis (13) de fixation du support frein (14).</p>                                                                                                                                                                                  |
| <p><b>e</b></p> <p><b>ITA</b> Rimuovere il supporto freno (14).</p> <p><b>D</b> Bremsenhalter (14) abnehmen.</p> <p><b>ESP</b> Remover el soporte freno (14).</p> <p><b>F</b> Enlever le support frein (14).</p>                                                                                                                                                                                                                                                                                                                                                                        | <p><b>f</b></p> <p><b>ITA</b> Rimuovere l'anello di tenuta (15) dal supporto freno (14).<br/><b>NOTA.</b> Annotare il senso di montaggio.</p> <p><b>D</b> Dichtungsring (15) vom Bremsenhalter (14) entfernen.<br/><b>BEMERKUNG.</b> Drehrichtung notieren.</p> <p><b>ESP</b> Remover el anillo de tenuta (15) del soporte freno (14).<br/><b>NOTA.</b> Anotar el sentido de desmontaje.</p> <p><b>F</b> Enlever la bague d'étanchéité (15) du support frein (14).<br/><b>REMARQUE.</b> Prendre note du sens de montage.</p> |





DISASSEMBLING THE HYDRAULIC DRUM BRAKE - SMONTAGGIO FRENO A TAMBURO COMANDO IDRAULICO -  
TROMMELBREMSE MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE FRENO A TAMBOR MANDO HIDRAULICO -  
DESASSEMBLAGE DU FREIN A TAMBOUR DE COMMANDE HYDRAULIQUE



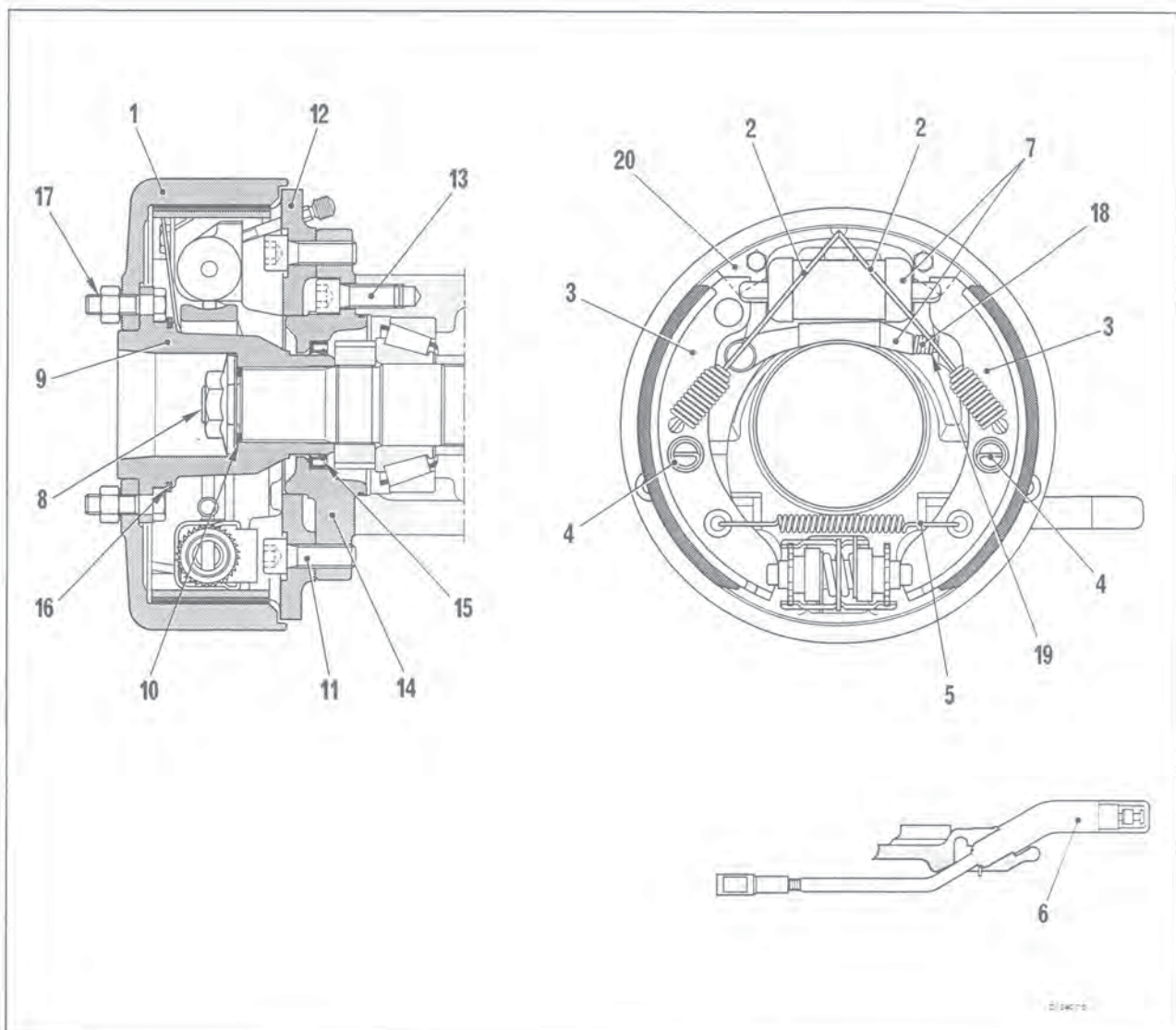
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a

**ONLY IF NECESSARY**

Remove snap ring (16) and screws (17) from the in-flange (9).





a

ITA

**SOLO SE NECESSARIO**

Asportare dalla flangia di entrata (9) l'anello elastico (16) e le viti (17).

D

**NUR WENN NÖTIG**

Vom Eingangsflansch (9) den Kolbenring (16) und die Schrauben (17) abmontieren.

ESP

**SOLO SI NECESARIO**

Sacar de la brida de entrada (9) el anillo elastico (16) y los tornillos (17).

F

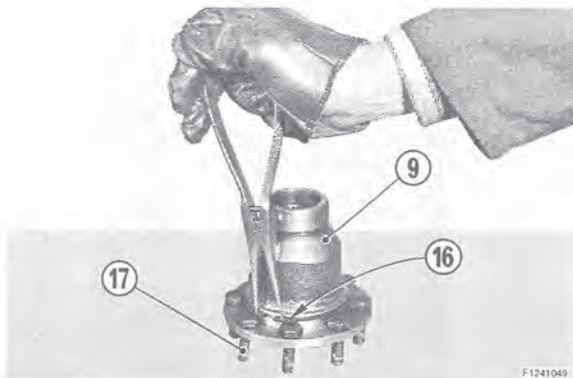
**UNIQUEMENT SI BESOIN**

Enlever du flasque d'entrée (9) l'anneau élastique (16) et les vis (17).





ASSEMBLING THE HYDRAULIC DRUM BRAKE - ASSEMBLAGGIO FRENO A TAMBURO COMANDO IDRAULICO -  
TROMMELBREMSE MIT HYDRAULISCHER STEUERUNG ZUSAMMENBAUEN - ASEMBLAJE FRENO A TAMBOR MANDO HIDRAULICO -  
ASSEMBLAGE DU FREIN A TAMBOUR DE COMMANDE HYDRAULIQUE



F1241049

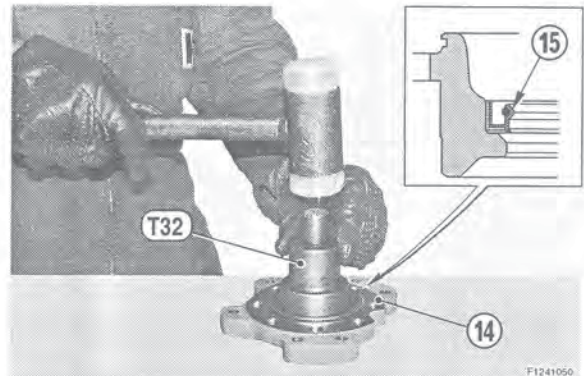


GB

a

**ONLY IF PREVIOUSLY REMOVED**

Insert the screws (17) into the flange (9) and hold them in position with the snap ring (16).



F1241050

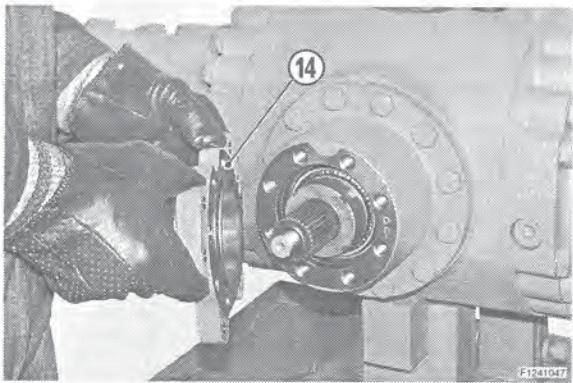


GB

b

Lubricate the sealing ring (15) and, with the help of tool T32, fit it into the brake support (14).

**NOTE.** Carefully check direction of assembly.



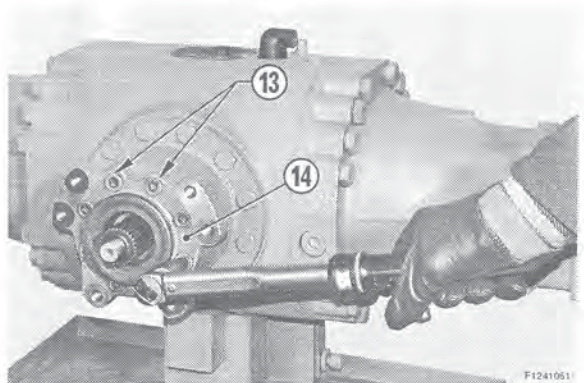
F1241047



GB

c

Lubricate the coupling surfaces and position the brake support (14).



F1241051

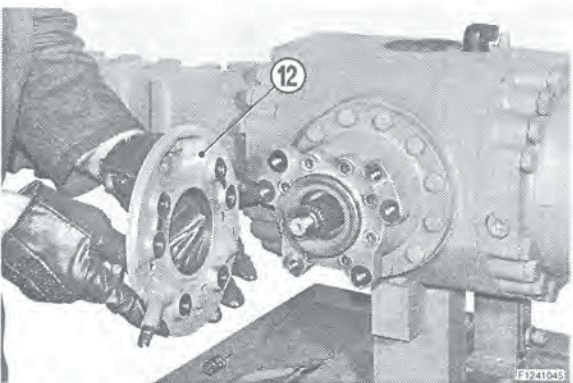


GB

d

Apply Loctite 242 to the screws (13) and tighten using the criss-cross method.

Torque wrench setting: 116 – 128 Nm



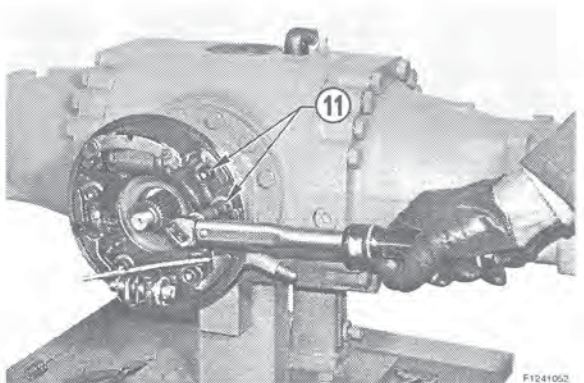
F1241045



GB

e

Lubricate the coupling surfaces and fit the flange of the brake unit (12).



F1241052



GB

f

Apply Loctite 242 to the screws (11) and tighten using the criss-cross method.



- a**
- ITA** **SOLO SE SMONTATO**  
Inserire nella flangia (9) le viti (17) e trattenerle in posizione con l'anello elastico (16).
- D** **NUR WENN ABMONTIERT**  
In den Flansch (9) die Schrauben (17) einsetzen und mit dem Kolbenring (16) festhalten.
- ESP** **SOLO SI DESMONTADO**  
Introducir en la brida (9) los tornillos (17) y tenerlos en posición con el anillo elastico (16).
- F** **SEULEMENT SI DEMONTE**  
Introduire dans le flasque (9) les vis (17), tenir celles-ci à leur place au moyen de l'anneau élastique (16).

- b**
- ITA** Lubrificare l'anello di tenuta (15) e, utilizzando l'attrezzo T32, montarlo nel supporto freno (14).  
**NOTA.** Controllare attentamente il senso di montaggio.
- D** Den Dichtungsring (15) schmieren und mit dem Werkzeug T32 in den Bremsenhalter (14) montieren.  
**BEMERKUNG.** Montagerichtung sorgfältig kontrollieren.
- ESP** Lubrificar el anillo de tenuta (15) y, utilizando la herramienta T32, montarlo en el soporte freno (14).  
**NOTA.** Controlar con cuidado el sentido de montaje.
- F** Lubrifier la bague d'étanchéité (15) puis à l'aide de l'outil T32, remonter celle-ci dans le support frein (14).  
**REMARQUE.** Contrôler attentivement le sens du montage.

- c**
- ITA** Lubrificare le superfici di accoppiamento e posizionare il supporto freno (14).
- D** Die Kupplungsflächen schmieren und den Bremsenhalter (14) positionieren.
- ESP** Lubrificar las superficies de acoplamiento y colocar el soporte freno (14).
- F** Lubrifier les surfaces d'accouplement, puis positionner le support frein (14).

- d**
- ITA** Spalmare le viti (13) con Loctite 242 ed avvitarle serrandole con il metodo incrociato.  
Coppia di serraggio: 116÷128 Nm
- D** Die Schrauben (13) mit Loctite 242 schmieren und im Kreuz festziehen.  
Anzugsmoment: 116÷128 Nm
- ESP** Pasar los tornillos (13) con Loctite 242 y atornillarlos apretandolos con el metodo cruzado.  
Par de serraje: 116÷128 Nm
- F** Enduire les vis (13) de Loctite 242, puis visser et serrer ces dernières avec la méthode croisée.  
Couple de serrage: 116÷128 Nm.

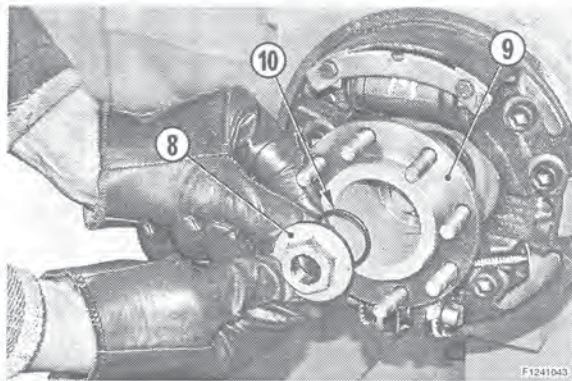
- e**
- ITA** Lubrificare le superfici di accoppiamento e montare la flangia gruppo freno (12).
- D** Die Kupplungsflächen schmieren und den Flansch des Bremsaggregats (12) montieren.
- ESP** Lubrificar la superficies de acoplamiento y montar la brida grupo freno (12).
- F** Lubrifier les surfaces d'accouplement, puis monter le flasque du groupe frein (12).

- f**
- ITA** Spalmare le viti (11) con Loctite 242 ed avvitarle serrandole con il metodo alternato.
- D** Die Schrauben (11) mit Loctite 242 schmieren und abwechselnd festziehen.
- ESP** Pasar los tornillos (11) con Loctite 242 y atornillarlos apretandolos con el metodo alternado.
- F** Enduire les vis (11) de Loctite 242, puis visser celle-ci en les serrant avec la méthode alternée.





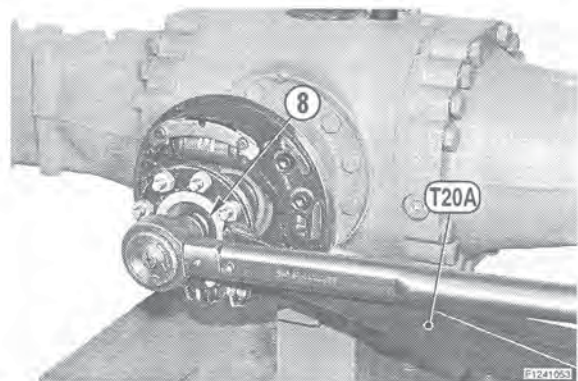
ASSEMBLING THE HYDRAULIC DRUM BRAKE - ASSEMBLAGGIO FRENO A TAMBURO COMANDO IDRAULICO -  
TROMMELBREMSE MIT HYDRAULISCHER STEUERUNG ZUSAMMENBAUEN - ASEMBLAJE FRENO A TAMBOR MANDO HIDRAULICO -  
ASSEMBLAGE DU FREIN A TAMBOUR DE COMMANDE HYDRAULIQUE



GB

a

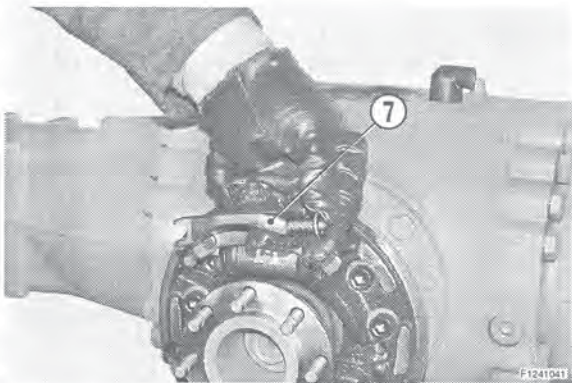
Keeping to the following sequence, install the flange (9), the O-ring (10) and the nut (8).  
Apply Loctite 242 to the threaded portion of the pinion.



GB

b

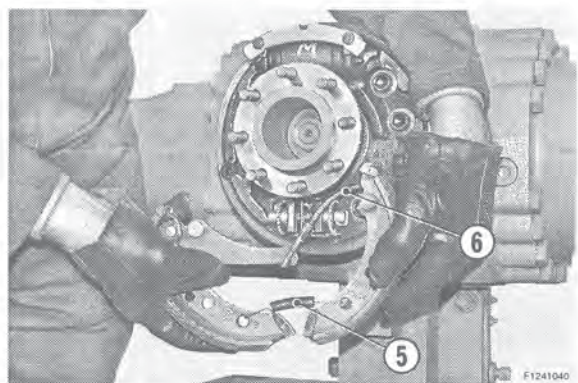
Install tool T20A (or T20B) and tighten the nut (8).  
Torque wrench setting : 280 – 310 Nm



GB

c

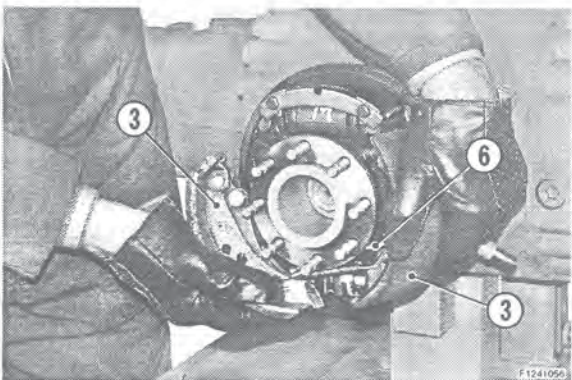
Position the elastic compression bar set (7).  
**NOTE.** Spring (18) and washer (19), which are part of the punch set, must be installed at a later stage.



GB

d

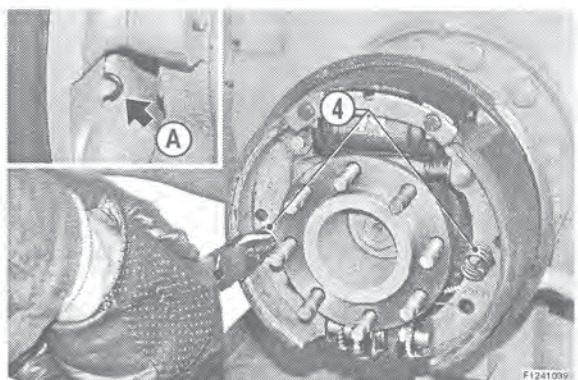
Fix the positioning spring (5) and the cable (6) to the cam of the parking function.



GB

e

Let the cable (6) slide into the guide and position the shoe set (3) by engaging the terminals in the regulation unit and in the cylinder.



GB

f

Insert the check springs (4), give a push and a torsion at the same time to engage hook "A" in the rear seat.





- a**
- ITA** Montare nell'ordine la flangia (9), l'anello OR (10) ed il dado (8).  
Spalmare il filetto del pignone con Loctite 242.
- D** Der Reihenfolge nach den Flansch (9), den O-Ring (10) und die Mutter (8) montieren.  
Das Radgewinde mit Loctite 242 schmieren.
- ESP** Montar en el orden la brida (9), el anillo OR (10) y la tuerca (8).  
Pasar la rosca del pinon con Loctite 242.
- F** Monter dans l'ordre le flange (9), la bague OR (10) et l'écrou (8).  
Enduire le filet du pignon de Loctite 242.

- b**
- ITA** Montare l'attrezzo T20A (oppure T20B) e serrare il dado (8).  
Coppia di serraggio: 280÷310 Nm
- D** Das Werkzeug T20A (oder T20B) montieren und die Mutter (8) festziehen.  
Anzugsmoment: 280÷310 Nm
- ESP** Montar la herramienta T20A (o T20B) y apretar la tuerca (8).  
Par de serraje: 280÷310 Nm
- F** Monter l'outil T20A (ou T20B), puis serrer l'écrou (8).  
Couple de serrage: 280÷310 Nm.

- c**
- ITA** Posizionare il gruppo puntone elastico (7).  
**NOTA.** La molla (18) e la rondella (19) che formano il gruppo puntone, devono essere montati in una fase successiva.
- D** Druckstabaggregat (7) positionieren.  
**BEMERKUNG.** Die Feder (18) und die Scheibe (19), die das Druckstabaggregat bilden, werden später montiert.
- ESP** Colocar el grupo liston elastico (7).  
**NOTA.** El muelle (18) y la arandela (19) que forman el grupo liston, deben de ser montados en una fase sucesiva.
- F** Positionner le groupe barre de compression élastique (7).  
**REMARQUE.** Le ressort (18) et la rondelle (19) formant le groupe barre de compression doivent être montés dans une phase successive.

- d**
- ITA** Agganciare la molla di posizionamento (5) e il cavo (6) alla camma della funzione di stazionamento.
- D** Die Stelfeder (5) und die Leitung (6) am Nocken der Handbremse einrasten.
- ESP** Enganchar el muelle de colocacion (5) y el cable (6) a la camara de funcion de estacionamiento.
- F** Accrocher le ressort de positionnement (5) et le câble (6) à la came de la fonction de stationnement.

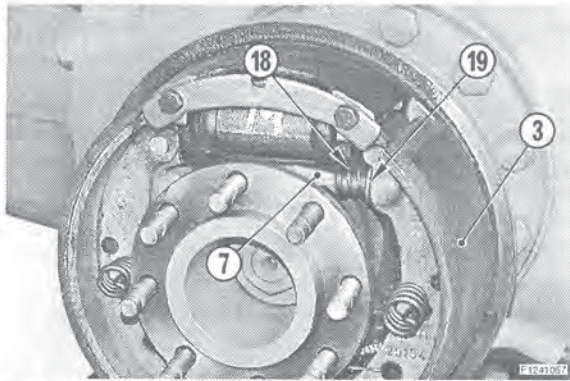
- e**
- ITA** Far scorrere il cavo (6) nella guida e posizionare il gruppo ganasce (3) impegnando i terminali nel gruppo di regolazione e nel cilindro.
- D** Die Leitung (6) in die Führung setzen und das Backenaggregat (3) positionieren; dabei die Endstücke im Regelungsaggregat und im Zylinder einrasten.
- ESP** Hacer pasar el cable (6) en la guía y colocar el grupo mordazas (3) empleando los terminos del grupo de regulacion en el cilindro.
- F** Faire coulisser le câble (6) dans son guide et positionner le groupe mâchoire (3) en engageant ses bornes dans le groupe de réglage et dans le cylindre.

- f**
- ITA** Inserire le molle di ritegno (4), applicare una spinta e contemporaneamente una torsione per impegnare il gancio "A" nella sede posteriore.
- D** Die Haltefedern (4) einsetzen und durch Drücken und gleichzeitiges Drehen, den Hacken "A" im hinteren Sitz einrasten.
- ESP** Introducir los muelles de retencion (4), dar un empuje y al mismo tiempo una torsion para emplear al gancho "A" en la sed posterior.
- F** Introduire le ressort de retenue (4), effectuer une poussée et en même temps une torsion pour engager le crochet "A" dans son siège postérieur.

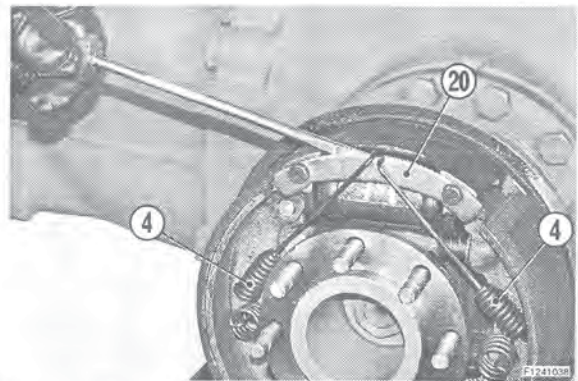




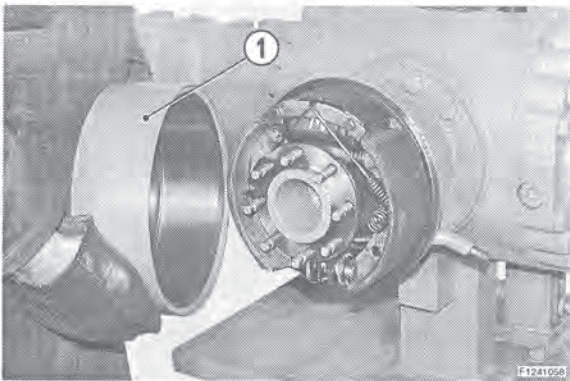
ASSEMBLING THE HYDRAULIC DRUM BRAKE - ASSEMBLAGGIO FRENO A TAMBURO COMANDO IDRAULICO -  
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Move away the right shoe (3) and position the spring (18) and washer (19) of the elastic compression bar set (7).  
**NOTE.** Check that the compression bar (7) is correctly inserted in the seats of the shoes (3).



Engage the return springs (4) of the shoes (3) and hook them onto the upper bar (20).



Install the drum (1).



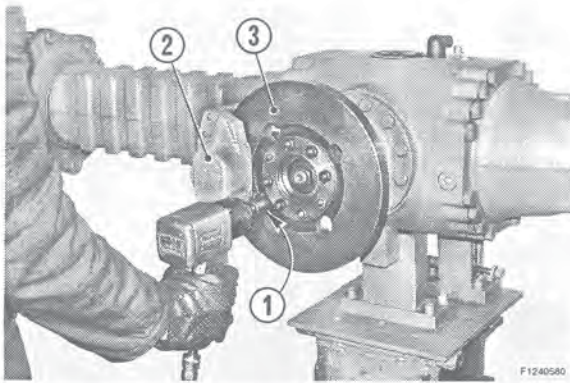
**CAUTION!** When reassembling the unit, bleed the braking circuit and apply the brakes several times when the machine is not in motion, so as to obtain the automatic adjustment of shoes (3) clearance.

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Allontanare la ganasca destra (3) e posizionare la molla (18) e la rondella (19) del gruppo puntone elastico (7).<br/><b>NOTA.</b> Controllare l'inserimento corretto del puntone (7) nelle sedi delle ganasce (3).</p> <p><b>D</b> Die rechte Backe (3) entfernen und die Feder (18) und die Scheibe (19) des Druckstabaggregats (7) positionieren.</p> <p><b>BEMERKUNG.</b> Kontrollieren, ob der Druckstab (7) richtig in den Backensitz (3) eingesetzt worden ist.</p> <p><b>ESP</b> Alejar la mordaza derecha (3) y colocar el muelle (18) y la arandela (19) de grupo liston elastico (7).<br/><b>NOTA.</b> Controlar la introduccion correcta del liston (7) en los alojamientos de las mordazas (3).</p> <p><b>F</b> Eloigner la mâchoire droite (3), puis positionner le ressort (18) et la rondelle (19) du groupe barre de compression élastique (7).<br/><b>REMARQUE.</b> Contrôler l'introduction correcte de la barre de compression (7) dans les sièges des mâchoires (3).</p> | <p><b>ITA</b> Impegnare le molle (4) di ritorno delle ganasce (3) ed agganciarle alla barra superiore (20).</p> <p><b>D</b> Die Rückzugsfedern (4) der Backen (3) einsetzen und sie in den oberen Stab (20) einrasten.</p> <p><b>ESP</b> Emplear los muelles (4) de vuelta de las mordazas (3) y engancharlas a la varilla superior (20).</p> <p><b>F</b> Engager le ressort (4) de retour des mâchoires (3) puis les accrocher à la barre supérieure (20).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>c</b></p> <p><b>ITA</b> Installare il tamburo (1).</p> <p><b>D</b> Die Trommel (1) anbringen.</p> <p><b>ESP</b> Instalar el tambor (1).</p> <p><b>F</b> Installer le tambour (1).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p><b>d</b></p> <p><b>ITA</b> <b>ATTENZIONE!</b> Quando viene rimontato il gruppo, eseguire lo spurgo dell'aria del circuito frenante ed eseguire, a <b>macchina ferma</b>, più frenate per ottenere la registrazione automatica del gioco delle ganasce (3).</p> <p><b>D</b> <b>ACHTUNG!</b> Wenn das Aggregat wieder montiert worden ist, die Luft aus dem Bremskreislauf ablassen und bei stillstehender Maschine mehrmals bremsen, um das Backenspiel (3) automatisch einzustellen.</p> <p><b>ESP</b> <b>ATENCION!</b> Cuando viene remontado el grupo, efectuar el expurgo del aire del circuito frenante y efectuar, a <b>maquina parada</b>, mas frenadas para obtener la registracion automatica del juego de las mordazas (3).</p> <p><b>F</b> <b>ATTENTION!</b> Lorsque le groupe est remonté, éventer le circuit freinant puis effectuer, machine au repos, plusieurs freinages afin d'obtenir automatiquement l'enregistrement du jeu de mâchoires (3).</p> |





HOW TO DISASSEMBLE BEVEL PINION SUPPORT WITH BRAKING DISK - SMONTAGGIO SUPPORTAZIONE PIGNONE CONICO CON FRENO A DISCO - HALTERUNG DES KOLBENS MIT BREMSSCHEIBE ABMONTIEREN - DESMONTAJE SUPORTE PINON CONICO CON FRENO A DISCO - DEMONTAGE DU SUPPORT PIGNON A FREIN A DISQUE

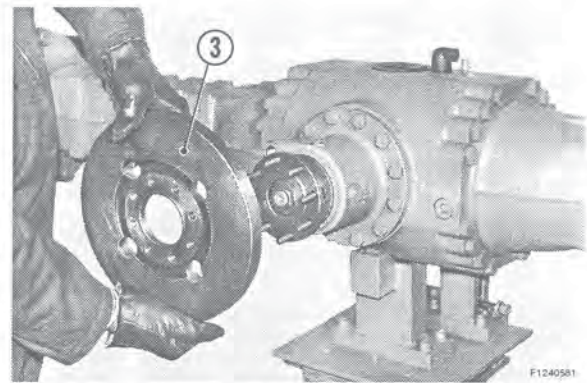


GB

a

Draw out screws (1) and remove caliper unit (2).

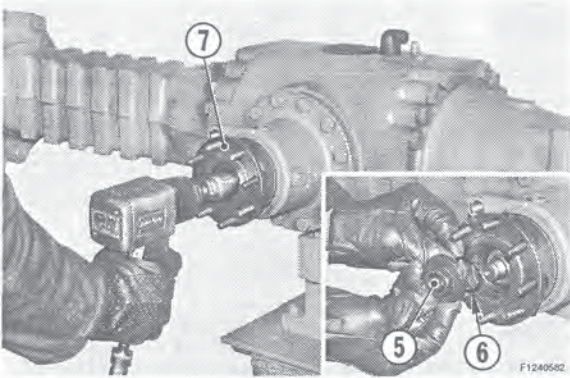
**NOTE.** Access to screws (1) is gained through the holes on the disk (3).



GB

b

Draw out the nuts (4) and remove the disk (3). Remove the screws (19).

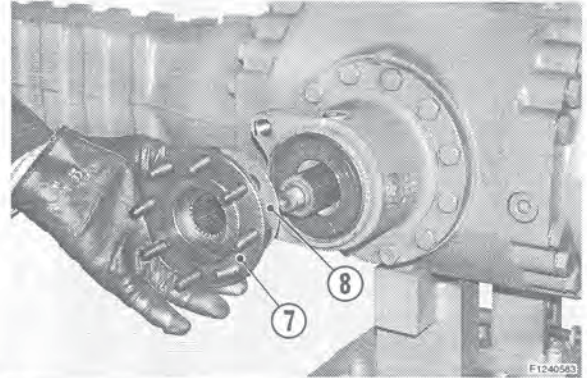


GB

c

Unloose and remove the nut (5) and the O-ring (6).

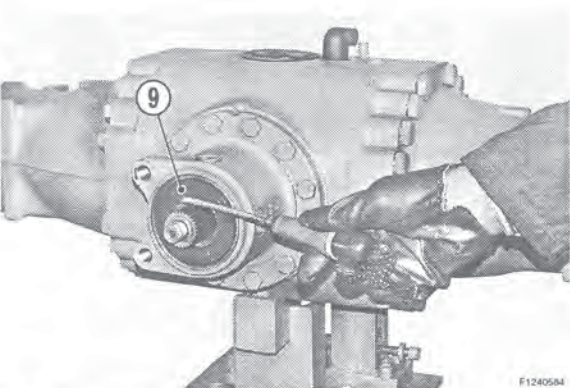
**NOTE.** If necessary, apply tool T20A (or tool T20B) to the flange (7), so as to prevent pinion rotation.



GB

d

Remove the flange (7) complete with protection (8).



GB

e

Remove the snap ring (9).





- a**
- ITA** Asportare le viti (1) e rimuovere il gruppo pinza (2).  
**NOTA.** Le viti (1) sono accessibili attraverso i fori del disco (3).
- D** Schrauben (1) abschrauben und das Zangenaggregat (2) abnehmen.  
**BEMERKUNG.** Die Schrauben (1) sind durch die Löcher in der Scheibe (3) zu erreichen.
- ESP** Sacar los tornillos (1) y remover el grupo tenazas (2).  
**NOTA.** Los tornillos (1) son accesibles a través de orificios del disco (3).
- F** Enlever les vis (1) et extraire le groupe pince (2).  
**NOTE.** Les vis (1) sont accessibles à travers les trous du disque (3).

- b**
- ITA** Asportare i dadi (4) e rimuovere il disco (3).  
Asportare le viti (19).
- D** Muttern (4) und Scheibe (3) abnehmen. Schrauben (19) abnehmen.
- ESP** Sacar las tuercas (4) y remover el disco (3).  
Sacar los tornillos (19).
- F** Enlever les écrous (4) et extraire le disque (3).  
Enlever les vis (19).

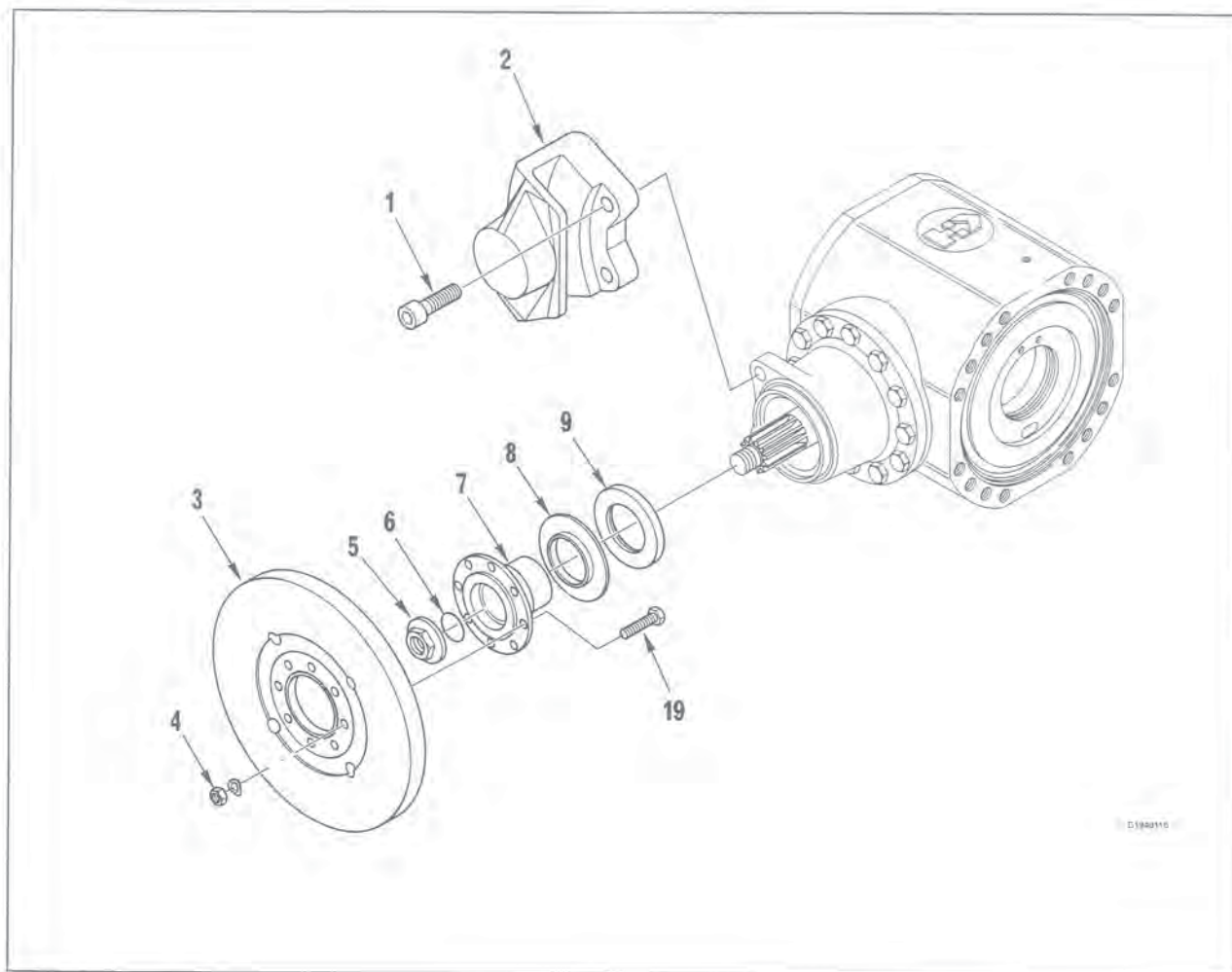
- c**
- ITA** Allentare ed asportare il dado (5) e la guarnizione OR (6).  
**NOTA.** Se si rende necessario, applicare alla flangia (7) l'attrezzo **T20A** (oppure **T20B**) in modo da evitare la rotazione del pignone.
- D** Mutter (5) und O-Ring (6) abnehmen.  
**BEMERKUNG.** An den Flansch (7) das Werkzeug **T20A** (oder **T20B**) anbringen, so daß der Kolben nicht drehen kann.
- ESP** Aflojar y sacar la tuerca (5) y la guarnición OR (6).  
**NOTA.** Si es necesario, aplicar a la brida (7) la herramienta **T20A** (o **T20B**) de manera de evitar la rotación del pinón.
- F** Desserrer et enlever l'écrou (5) et la garniture OR (6).  
**NOTE.** Si c'est nécessaire, appliquer sur la flasque (7) l'outil **T20A** (ou bien **T20B**) de telle manière à éviter la rotation du pignon.

- d**
- ITA** Rimuovere la flangia (7) completa della protezione (8).
- D** Flansch (7) samt Schutz (8) entfernen.
- ESP** Remover la brida (7) completa de la protección (8).
- F** Enlever la flasque (7) équipée de protection (8).

- e**
- ITA** Asportare l'anello di tenuta (9).
- D** Kolbenring (9) abnehmen.
- ESP** Sacar el segmento de compresión (9).
- F** Enlever la bague d'étanchéité (9).



HOW TO DISASSEMBLE BEVEL PINION SUPPORT WITH BRAKING DISK - SMONTAGGIO SUPPORTAZIONE PIGNONE CONICO CON FRENO A DISCO - HALTERUNG DES KOLBENS MIT BREMSSCHEIBE ABMONTIEREN - DESMONTAJE SUPORTE PINON CONICO CON FRENO A DISCO - DEMONTAGE DU SUPPORT PIGNON A FREIN A DISQUE

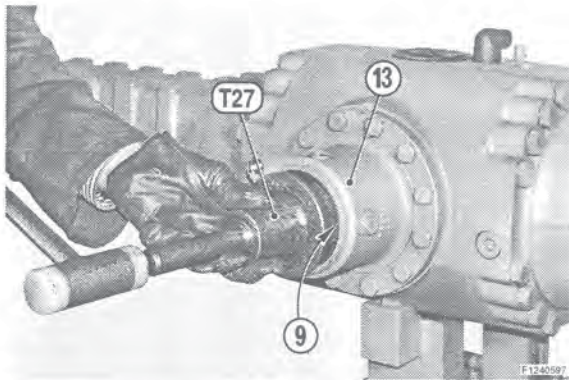




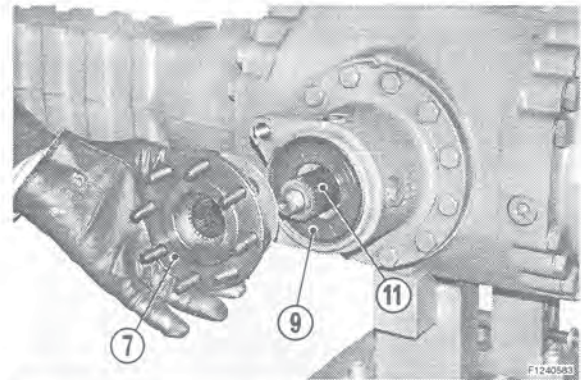




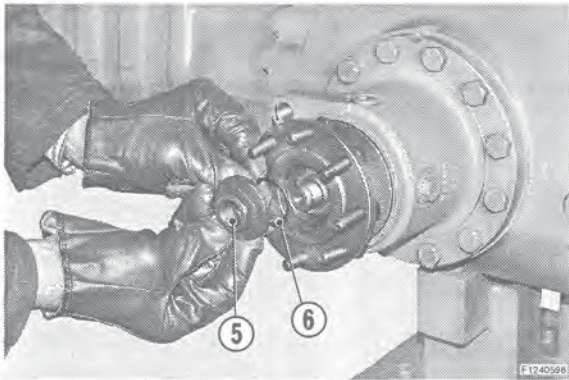
**HOW TO ASSEMBLE BEVEL PINION SUPPORT WITH BRAKING DISK - ASSEMBLAGGIO SUPPORTAZIONE PIGNONE CONICO CON FRENO A DISCO - HALTERUNG DES KOLBENS MIT BREMSSCHEIBE MONTIEREN - MONTAJE SUPORTE PINON CONICO CON FRENO A DISCO - ASSEMBLAGE DU SUPPORT PIGNON A FREIN A DISQUE**



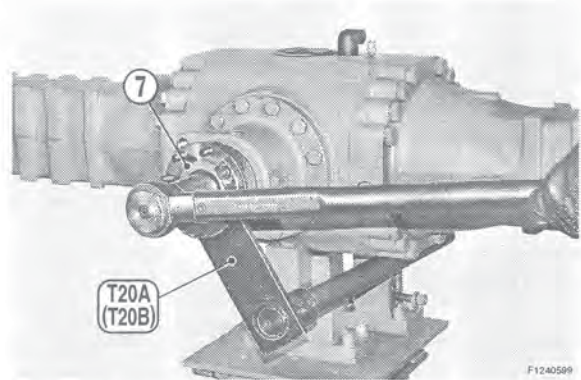
After tightening the ring nut (10), lubricate the outer surface and, using tool T27, fit the snap ring (9) into the support (13).



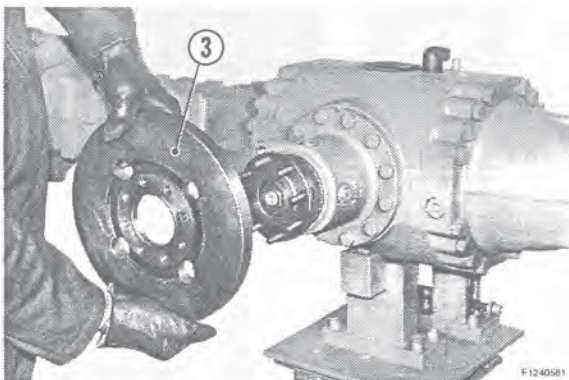
Lubricate the sealing surface of the flange (7) and fit it onto the pinion (11).



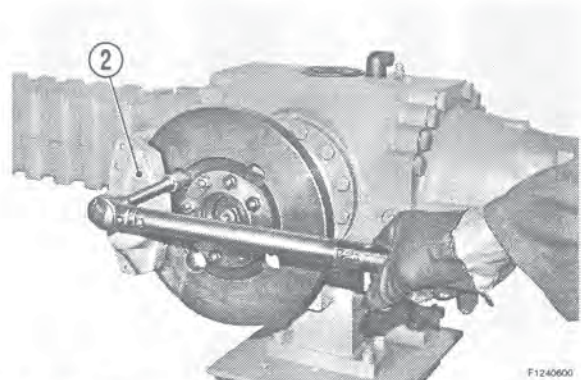
Apply Loctite 242 to pinion thread. Fit O-ring (6) and nut (5).



Apply tool T20A (or T20B) to the flange (7); tighten nut with a dynamometric wrench. Torque wrench setting: 280–310 Nm



Install disk (3) and keep it into position with screws (19) and nuts (4).



Install the caliper unit (2) and block with screws (1) coated with Loctite 242. Tighten using a dynamometric wrench to a tightening torque of 302–334 Nm



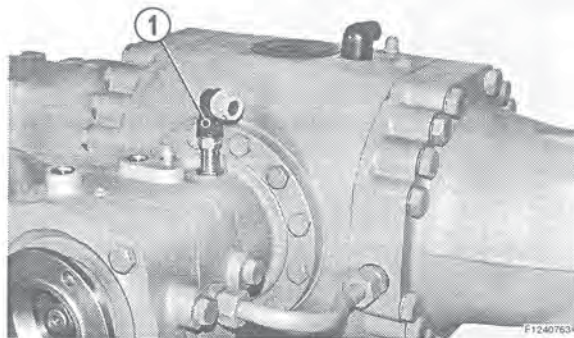


- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>a</b></p> <p><b>ITA</b> Dopo il serraggio della ghiera (10), lubrificare la superficie esterna ed utilizzando l'attrezzo T27, montare nel supporto (13) l'anello di tenuta (9).</p> <p><b>D</b> Nachdem die Nutmutter (10) festgezogen worden ist, äußere Fläche schmieren und mit dem Werkzeug T27, den Kolbenring (9) in die Halterung (13) montieren.</p> <p><b>ESP</b> Después de apretar la virola (10), lubricar la superficie externa y utilizando la herramienta T27, montar en el soporte (13) el segmento de compresión.</p> <p><b>F</b> Après le serrage de l'anneau (10), lubrifier la surface externe et à l'aide de l'outil T27 monter dans le support (13) la bague d'étanchéité (9).</p> | <p><b>b</b></p> <p><b>ITA</b> Lubrificare la superficie di tenuta della flangia (7) ed inserirla sul pignone (11).</p> <p><b>D</b> Dichtungsfläche des Flansches (7) schmieren und auf das Rad (11) montieren.</p> <p><b>ESP</b> Lubricar la superficie de compresión de la brida (7) y introducirla sobre el pínón (11).</p> <p><b>F</b> Lubrifier la surface étanche de la flasque (7) puis l'introduire sur le pignon (11).</p>                                                                                                                                                                                                                                                                                                 |
| <p><b>c</b></p> <p><b>ITA</b> Spalmare la filettatura del pignone con Loctite 242. Montare l'anello OR (6) ed il dado (5).</p> <p><b>D</b> Radgewinde mit Loctite 242 schmieren. O-Ring (6) und Mutter (5) montieren.</p> <p><b>ESP</b> Pasar la rosca del pínón con Loctite 242. Montar el segmento OR (6) y el lado (5).</p> <p><b>F</b> Enduire le filetage du pignon de Loctite 242. Monter la garniture OR (6) et l'écrou (5).</p>                                                                                                                                                                                                                                                                        | <p><b>d</b></p> <p><b>ITA</b> Applicare alla flangia (7) l'attrezzo T20A (oppure T20B); serrare il dado con una chiave dinamometrica. Coppia di serraggio: 280÷310 Nm</p> <p><b>D</b> Am Flansch (7) das Werkzeug T20A (oder T20B) anbringen; Mutter mit einem Momentenschlüssel fest ziehen. Anzugsmoment: 280÷310 Nm.</p> <p><b>ESP</b> Aplicar a la brida (7) la herramienta T20A (o T20B); apretar la tuerca con una llave dinamométrica. Par de torsión: 280÷310 Nm.</p> <p><b>F</b> Appliquer à la flasque (7) l'outil T20A (ou bien T20B); serrer l'écrou au moyen d'une clé dynamométrique. Couple de serrage: 28010 Nm.</p>                                                                                               |
| <p><b>e</b></p> <p><b>ITA</b> Montare il disco (3) e mantenerlo in posizione con le viti (19) ed i dadi (4).</p> <p><b>D</b> Scheibe (3) montieren und mit den Schrauben (19) und Muttern (4) befestigen.</p> <p><b>ESP</b> Montar el disco (3) y mantenerlo en posición con los tornillos (19) y las tuercas (4).</p> <p><b>F</b> Monter le disque (3) et le maintenir en position au moyen des vis (19) et des écrous (4).</p>                                                                                                                                                                                                                                                                               | <p><b>f</b></p> <p><b>ITA</b> Montare il gruppo pinza (2) e bloccarlo con le viti (1) spalmate con Loctite 242. Serrare con una chiave dinamometrica ad una coppia di 302÷334 Nm.</p> <p><b>D</b> Zangenaggregat (2) montieren und mit den Schrauben (1) blockieren; mit Loctite 242 schmieren. Mit einem Momentenschlüssel fest ziehen. Anzugsmoment: 302÷334 Nm.</p> <p><b>ESP</b> Pasar los tornillos (1) con Loctite 242. Montar el grupo tenazas (2) y bloquearlo con los tornillos. Apretar con una llave dinamométrica con un par de 302÷334 Nm.</p> <p><b>F</b> Monter le groupe pince (2) et bloquer au moyen des vis (1) enduire de Loctite 242. serrer au moyen d'une clé dynamométrique à un couple de 302÷334 Nm.</p> |





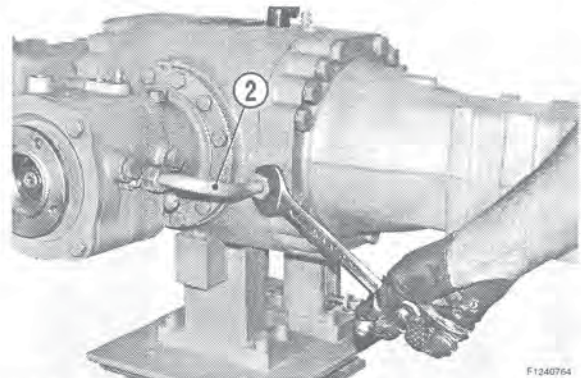
**HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



GB

a

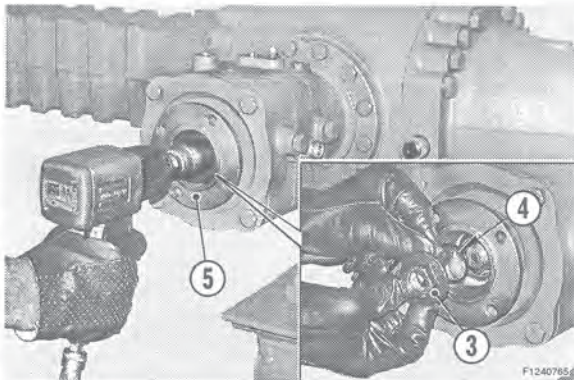
Remove movement sensor (1), if fitted.



GB

b

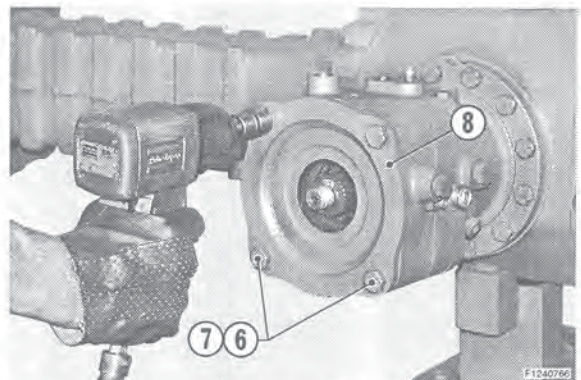
Loosen the two nuts and remove lubrication tube (2).



GB

c

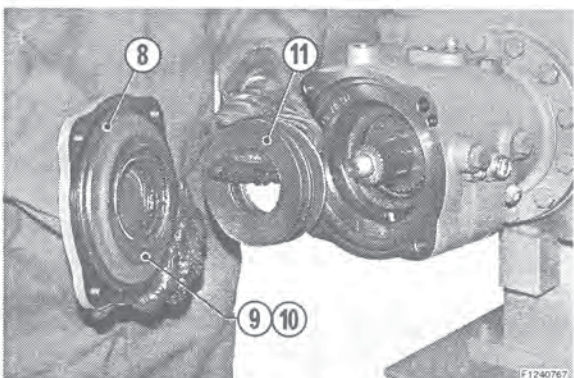
Remove nut (3), O-ring (4) and flange (5).  
**NOTE.** If disassembly is awkward, heat nut (3) at about 80°C.



GB

d

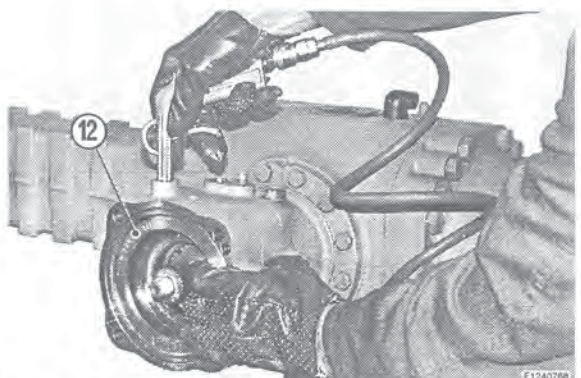
Loosen screws (6) in an alternate and criss-cross manner until the action of Belleville washers (11) becomes null.  
Remove screws (6) and spring washers of cover (8).



GB

e

Pull out cover (8), shims (9) separating ring (10) and Belleville washers (11).  
**NOTE.** Take note of the assembly direction of: shims (9) and Belleville washers (11).



GB

f

Slowly introduce compressed air through the negative brake connection point in order to extract the piston (12).  
**CAUTION!** Hold piston (12) as it may be rapidly ejected and damaged.

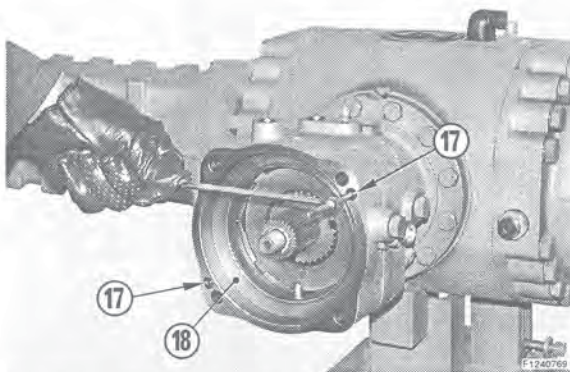


- a**
- ITA** Se è montato, rimuovere il sensore di movimento (1).
- D** Wenn montiert, den Bewegungsgeber (1) abnehmen.
- ESP** Si ha sido montado, remover el sensor de movimiento (1).
- F** S'il'est monté, enlever le capteur de déplacement (1).
- b**
- ITA** Allentare i due dadi e rimuovere il tubo (2) della lubrificazione.
- D** Die beiden Muttern lockern und die Schmierleitung (2) abnehmen.
- ESP** Aflojar las dos tuercas y remover el tubo (2) de la lubricación.
- F** Dévisser le deux écrous et enlever le tuyau (2) pour la lubrification.
- c**
- ITA** Rimuovere il dado (3), la guarnizione OR (4) e la flangia (5).  
**NOTA.** Se lo smontaggio risulta difficoltoso, scaldare il dado (3) a circa 80°C.
- D** Die Mutter (3), den O-Ring (4) und den Flansch (5) abnehmen.  
**BEMERKUNG.** Falls das Abmontieren schwer sein sollte, die Mutter (3) bis auf ca. 80°C erwärmen.
- ESP** Remover la tuerca (3), la guarnición OR (4) y la brida (5).  
**NOTA.** Si el desmontaje resulta difícil, calentar la tuerca (3) a 80°C approx.
- F** Enlever l'écrou (3), la garniture OR (4) et la flasque (5).  
**NOTE.** Si le démontage est difficile, chauffer l'écrou (3) à environ 80°C.
- d**
- ITA** Allentare in modo alternato ed incrociato le viti (6) fino ad annullare l'azione delle molle a tazza (11). Rimuovere le viti (6) e le rondelle elastiche di ritengo coperchio (8).
- D** Abwechselnd und im Kreuz die Schrauben (6) lockern, bis die Wirkung der Tellerfeder (11) gleich Null ist. Schrauben (6) und Federscheiben des Deckels (8) abnehmen.
- ESP** Aflojar de manera alterna y cruzada los tornillos (6) hasta anular la acción de los muelles a taza (11). Remover los tornillos (6) y las arandelas elasticas de retención tapa (8).
- F** Dévisser alternativement et de façon croisée les vis (6) jusqu'à annuler l'action des ressorts belleville (11). Enlever les vis (6) et les rondelles à segment de fixation du couvercle (8).
- e**
- ITA** Asportare il coperchio (8), i rasamenti (9), l'anello di battuta (10) e le molle a tazza (11).  
**NOTA.** Annotare il senso di montaggio dei rasamenti (9) e delle molle (11).
- D** Deckel (8), Scheiben (9), Anschlagring (10) und Tellerfedern (11) abnehmen.  
**BEMERKUNG.** Montagerichtung der Scheiben (9) und der Federn (11) bemerken.
- ESP** Quitar la tapa (8), las raspaduras (9), el anillo de tope (10) y los muelles a taza (11).  
**NOTA.** Anotar el sentido de las raspaduras (9) y de los muelles (11).
- F** Enlever le couvercle (8), les rasages (9), l'anneau de butée (10) et les ressorts belleville (11).  
**NOTE.** Noter le sens de montage des rasages (9) et des ressorts (11).
- f**
- ITA** Immettere lentamente aria compressa attraverso l'attacco per il freno negativo per estrarre il pistone (12).  
**ATTENZIONE!** Trattenere il pistone (12) che può essere espulso velocemente ed essere danneggiato.
- D** Langsam Druckluft durch den Anschluß für die Negativbremse einlassen, um den Kolben (12) auszu stoßen.
- ACHTUNG!** Den Kolben (12) halten, denn er könnte plötzlich herausspringen und beschädigt werden.
- ESP** Introducir lentamente aire comprimida a través el ataque para el freno negativo para extraer el piston (12).  
**ATENCIÓN!** Tener el piston (12) que puede ser expulsado rápidamente y ser danado.
- F** Emettre lentement de l'air comprimé à travers le point d'enclenchement du frein négatif pour en extraire le piston (12).  
**ATTENTION!** Retenir le piston (12) qui être expulsé rapidement peut par conséquent s'endommager.

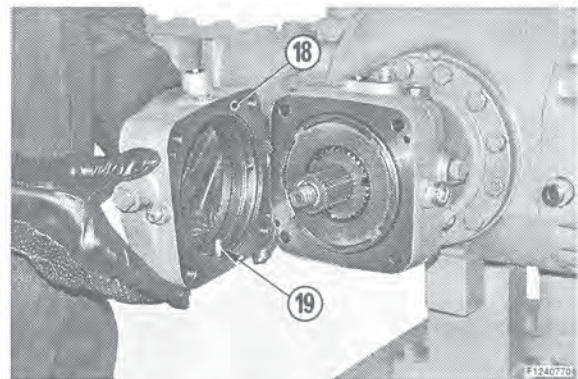




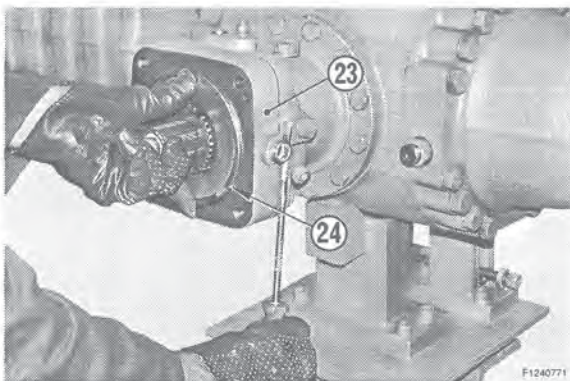
**HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



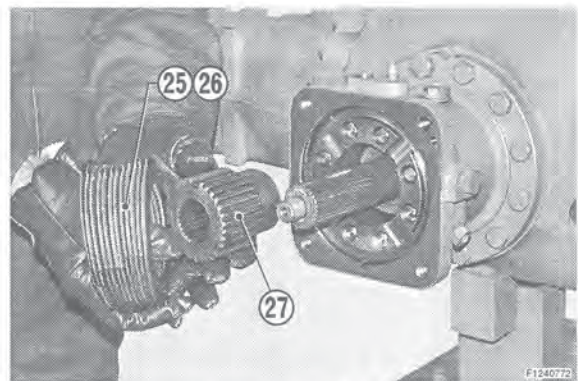
Remove check screws (17) from cylinder (18).



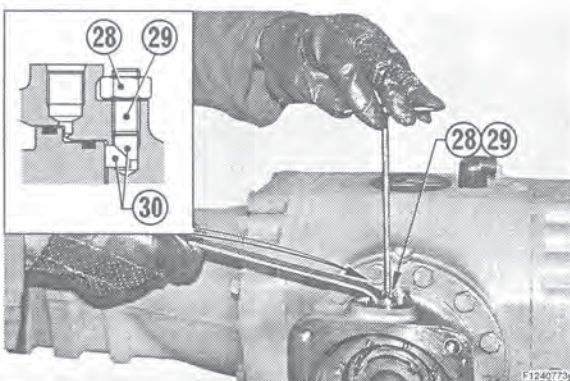
Remove cylinder (18) complete with guide pin (19) of piston (12).  
**NOTE.** Take note of direction of assembly.



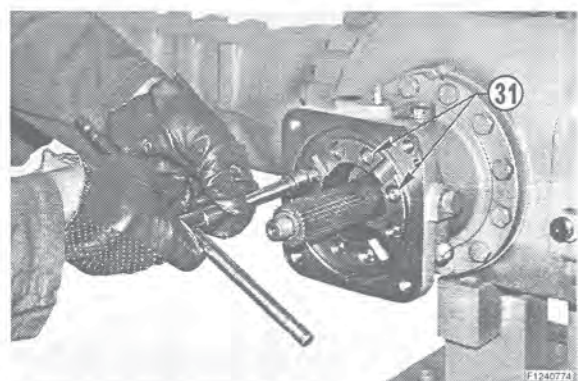
With the help of a lever, prize off the distance piece (23) complete with O-ring (24).  
**NOTE.** Thoroughly clean the face of bevel pinion support where the hub rests, check the O-ring (24) and replace it if necessary.



Remove friction discs (25), (26) and hub (27).



**3-FUNCTION VERSION ONLY**  
Loosen nuts (28) (no. 3) and unscrew dowels (29) (no. 3) to retract the adjustment points (30).  
**NOTE.** Loosen dowels (29) in an alternate manner until the piston comes to end of backstroke.  
**ONLY IF NECESSARY.** Remove points (30).



**3-FUNCTION VERSION ONLY**  
Loosen and remove the pin-type screws (31).  
**NOTE.** Loosen screws (31) in an alternate and criss-cross manner.





SPICER CLARK-HURTH

ITA

Rimuovere le viti (17) di ritegno del cilindro (18).

D

Die Schrauben (17) zur Halterung des Zylinders (18) abnehmen.

ESP

Sacar los tornillos (17) de retención del cilindro (18).

F

Enlever les vis (17) de fixation du cylindre (18).

ITA

Rimuovere il cilindro (18) completo della spina (19) di guida del pistone (12).  
**NOTA.** Annotare il senso di montaggio.

D

Den Zylinder (18) samt Stift (19) zur Führung des Kolbens (12) abnehmen.  
**BEMERKUNG.** Montagerichtung bemerken.

ESP

Sacar el cilindro (18) completo de espina (19) de guía del pistón (12).  
**NOTA.** Anotar el sentido de montaje.

F

Enlever le cylindre (18) complet de broche (19) de guidage du piston (12).  
**NOTE.** Prendre note du sens de montage.

ITA

Forzando con una leva, rimuovere il distanziale (23) completo di OR (24).  
**NOTA.** Pulire accuratamente la superficie di appoggio al mozzo di supporto pignone conico, controllare l'OR (24) e, se necessario, sostituirlo.

D

Mit Hilfe eines Hebels, das Distanzstück (23) samt O-Ring (24) entfernen.  
**BEMERKUNG.** Sorgfältig die Auflagefläche an der Nabe des kegeligen Kolbenhalters reinigen und O-Ring (24) kontrollieren. Wenn nötig, auswechseln.

ESP

Haciendo fuerza con una palanca, sacar el distancial (23) completo de OR (24).  
**NOTA.** Limpiar con atención la superficie de apoyo al cubo de soporte pín conico, controlar el OR (24) y, si necesario, substituirlo.

F

En forçant sur le levier, enlever l'entretoise (23) complet de OR (24).  
**NOTE.** Nettoyer soigneusement la surface d'appui du moyeu de support du pignon conique, contrôler la OR (24) et si besoin, la remplacer.

ITA

Asportare i dischi di frizione (25), (26) ed il mozzo (27).

D

Kupplungsscheiben (25), (26) und Nabe (27) abnehmen.

ESP

Sacar los discos de frición (25), (26) y el cubo (27).

F

Enlever les disques de friction (25), (26) et le moyeu (27).

ITA

**SOLO PER VERSIONE A 3 FUNZIONI**  
Allentare i dadi (28) (n° 3) e svitare i grani (29) (n° 3) per far rientrare i puntali di registro (30).  
**NOTA.** Allentare i grani (29) in modo alternato fino a fine corsa di ritorno del pistone.  
**SOLO SE NECESSARIO.** Asportare i puntali (30).

D

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**  
Muttern (28) (3 St.) lockern und Stifte (29) (3 St.) abschrauben. Stellschäfte (30) zurück zu fahren.  
**BEMERKUNG.** Stifte (29) abwechselnd bis zum Rücklaufende des Kolbens lockern.  
**NUR WENN NOTIG.** Schäfte (30) abnehmen.

ESP

**SOLO POR VERSION A 3 FUNCIONES**  
Aflojar los dados (28) (n°3) y destornillar las espigas (29) (n°3) para hacer entrar los puntales de registro (30).  
**NOTA.** Aflojar las espigas (29) de manera alternada hasta final carrera de vuelta del pistón.  
**SOLO SI NECESARIO.** Sacar los puntales (30).

F

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
Desserrer les écrous (28) (n°3) et dévisser les grains (29) (n°3) pour faire rentrer les tringles de réglage (30).  
**NOTE.** Desserrer les grains (29) de façon alternée jusqu'au retour de fin de course du piston.  
**SEULEMENT SI BESOIN.** Enlever les tringles (30).

ITA

**SOLO PER VERSIONE A 3 FUNZIONI**  
Allentare ed asportare le viti a perno (31).  
**NOTA.** Allentare le viti (31) in modo alternato ed incrociato.

D

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**  
Stiftschrauben (31) abschrauben.  
**BEMERKUNG.** Schrauben (31) abwechselnd und im Kreuz abschrauben.

ESP

**SOLO POR VERSION A 3 FUNCIONES**  
Aflojar y sacar los tornillos a rotula (31).  
**NOTA.** Aflojar los tornillos (31) de manera alternada y cruzada.

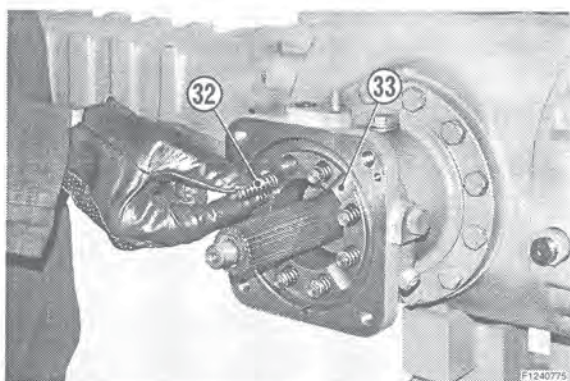
F

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
Desserrer et enlever les vis à cheville (31).  
**NOTE.** Desserrer les vis (31) de façon alternée et croisée.





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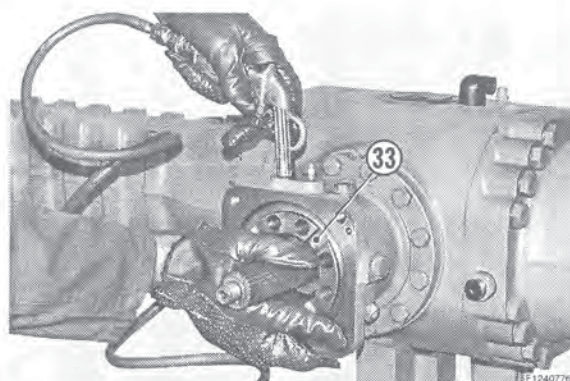


GB

a

**3-FUNCTION VERSION ONLY**

Remove springs (32) of piston (33) backward movement.



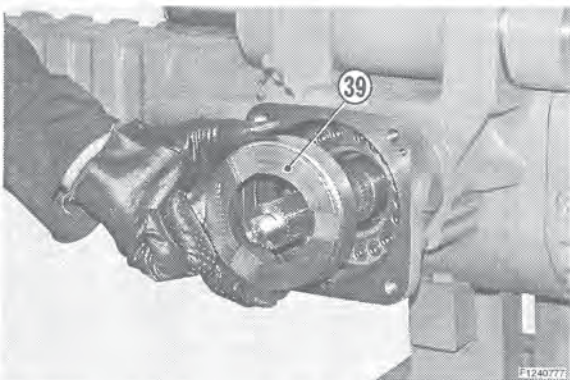
GB

b

**3-FUNCTION VERSION ONLY**

Slowly introduce compressed air through the connection point of the service brake to extract the piston (33).

**CAUTION!** Hold piston (33) as it may be rapidly ejected and damaged.

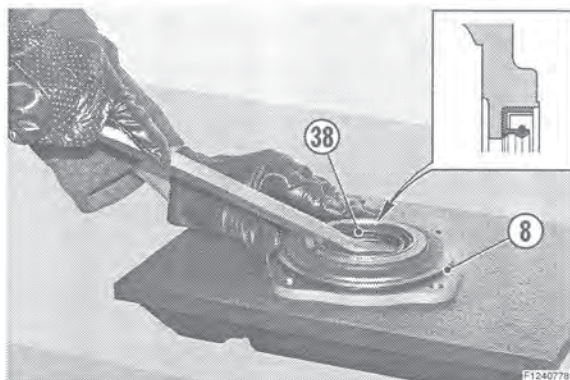


GB

c

**2-FUNCTION VERSION ONLY**

Remove the distance piece (39).

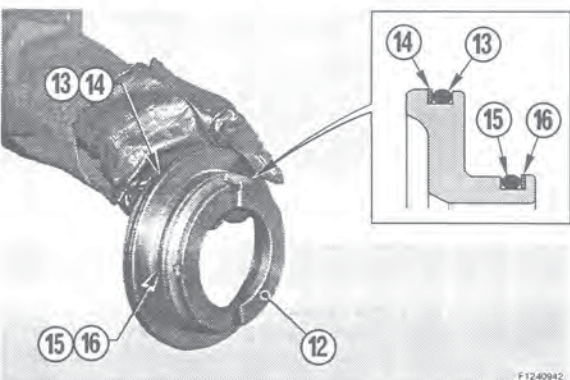


GB

d

Remove sealing ring (38) from cover (8).

**NOTE.** Take note of direction of assembly of ring (38) and replace ring every time the unit is disassembled.

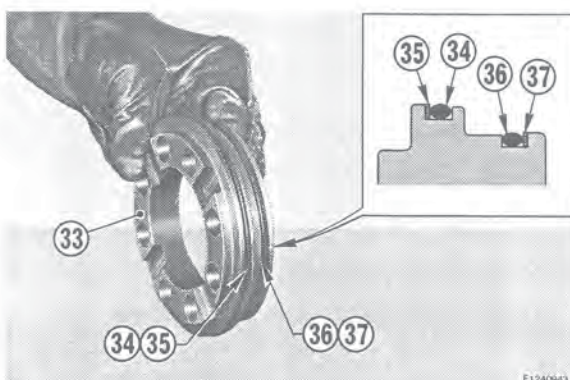


GB

e

Remove sealing rings (13) and (15) and anti-extrusion rings (14) and (16) from the piston (12).

**NOTE.** Sealing rings (13) and (15) and anti-extrusion rings (14) and (16) must be replaced each time the unit is disassembled.



GB

f

**3-FUNCTION VERSION ONLY**

Remove sealing rings (34) and (36) and anti-extrusion rings (35) and (37) from piston (33).

**NOTE.** Sealing rings (34), (36) and anti-extrusion rings (35), (37) must be replaced each time the unit is disassembled.





ITA

**SOLO PER VERSIONE A 3 FUNZIONI**

Rimuovere le molle (32) di ritorno del pistone (33).

D

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Rückzugsfeder (32) des Kolbens (33) abnehmen.

ESP

**SOLO POR VERSION A 3 FUNCIONES**

Sacar los muelles (32) de vuelta del piston (33).

F

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Enlever les ressorts (32) de retour du piston (33).

ITA

**SOLO PER VERSIONE A 3 FUNZIONI**

Immettere lentamente aria compressa attraverso l'attacco del freno di servizio per estrarre il pistone (33).

**ATTENZIONE!** Trattenere il pistone (33) che può essere espulso velocemente ed essere danneggiato.

D

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Langsam Druckluft durch den Anschluß der Hillsbremse einlassen, um den Kolben (33) auszustoßen.

**ACHTUNG!** Den Kolben (33) halten, denn er könnte plötzlich herausgestoßen und beschädigt werden.

ESP

**SOLO POR VERSION A 3 FUNCIONES**

Introducir lentamente aire comprimida a través el ataque del freno de servicio para sacar el piston (33).

**ATENCIÓN.** Tener el piston (33) que puede ser expulsado rápidamente y ser danado.

F

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Emettre lentement de l'air comprimé à travers le point de montage du frein de service pour en extraire le piston (33).

**ATTENTION!** Retenir le piston (33) qui expulsé rapidement peut être par conséquent endommagé.

ITA

**SOLO PER VERSIONE A 2 FUNZIONI**

Asportare il distanziale (39).

D

**NUR FÜR AUSFÜHRUNG MIT 2 FUNKTIONEN**

Distanzstück (39) abnehmen.

ESP

**SOLO POR VERSION A 3 FUNCIONES**

Sacar el distancial (39).

F

**SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**

Enlever l'entretoise (39).

ITA

Rimuovere dal coperchio (8) l'anello di tenuta (38).

**NOTA.** Annotare il senso di montaggio dell'anello (38) e sostituirlo ad ogni smontaggio.

D

Vom Deckel (8) den Dichtring (38) abnehmen.

**BEMERKUNG.** Montagerichtung des Ringes (38) bemerken und beim Abmontieren jedesmal auswechseln.

ESP

Remover de la tapa (8) el segmento de compresión (38).

**NOTA.** Anotar el sentido de montaje del segmento (38) y substituirlo cada desmontaje.

F

Enlever du couvercle (8) la bague d'étanchéité (38).

**NOTE.** Prendre note du sens de montage de la bague (38), la remplacer à chaque démontage.

ITA

Rimuovere dal pistone (12) gli anelli di tenuta (13) e (15) e gli anelli antiestrusione (14) e (16).

**NOTA.** Gli anelli di tenuta (13), (15) ed antiestrusione (14), (16) devono essere sostituiti ad ogni smontaggio.

D

Vom Kolben (12) Dichtringe (13) und (15) sowie die Halteringe (14) und (16) abnehmen.

**BEMERKUNG.** Die Dichtringe (13), (15) und Halteringe (14), (16) müssen bei jedem Abmontieren ausgewechselt werden.

ESP

Sacar el piston (12) los segmentos de compresión (13) y (15) y los segmentos anti-extrusión (14) y (16).

**NOTA.** Los segmentos de compresión (13) y (15) y anti-extrusión (14), (16) deben de ser cambiados cada desmontaje.

F

Enlever le piston (12) les bagues d'étanchéité (13) et (15) et les anneaux anti-extrusion (14), et (16).

**NOTE.** Les bagues d'étanchéité (13), (15) et anti-extrusion (14), (16) doivent être remplacées à chaque démontage.

ITA

**SOLO PER VERSIONE A 3 FUNZIONI**

Rimuovere dal pistone (33) gli anelli di tenuta (34) e (36) e gli anelli antiestrusione (35) e (37).

**NOTA.** Gli anelli di tenuta (34), (36) ed antiestrusione (35), (37) devono essere sostituiti ad ogni smontaggio.

D

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Vom Kolben (33) die Dichtringe (34) und (36) sowie die Halteringe (35) und (37) abnehmen.

**BEMERKUNG.** Die Dichtringe (34), (36) und Halteringe (35), (37) jedesmal auswechseln, wenn sie abmontiert werden.

ESP

**SOLO POR VERSION DE 3 FUNCIONES**

Remover del piston (33) los segmentos de compresión (34) y (36) y los segmentos anti-extrusión (35) y (37).

**NOTA.** Los segmentos de compresión (34), (36) y anti-extrusión (35), (37) deben de ser substituidos a cada desmontaje.

F

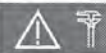
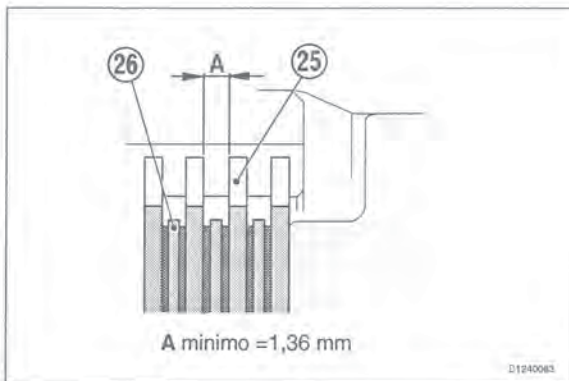
**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Enlever du piston (33) les bagues d'étanchéité (34) et (36) et les anneaux anti-extrusion (35) et (37).

**NOTE.** Les bagues d'étanchéité (34), (36) et anti-extrusion (35), (37) doivent être remplacées à chaque démontage.



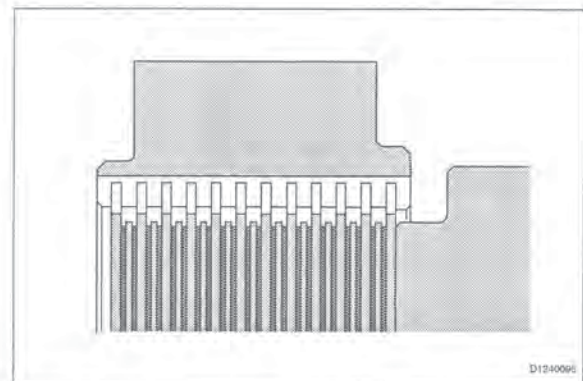
**HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



GB

a

**CAUTION!** Always check the thickness of braking discs (26), even if the braking unit is being disassembled for other reasons than this.  
If thickness "A" of one of the discs (26) is close to the minimum admissible size of 1.36 mm, replace the whole pack.

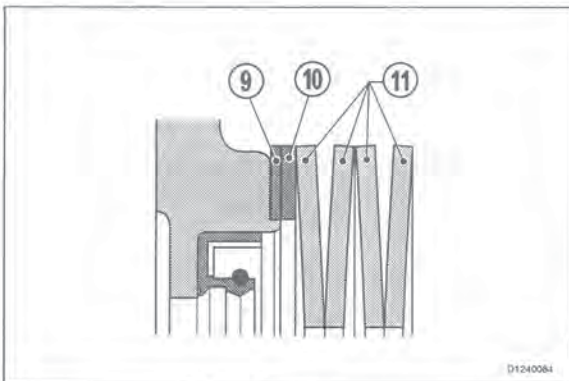


GB

b

**BRAKING DISCS PACK CONTENTS**

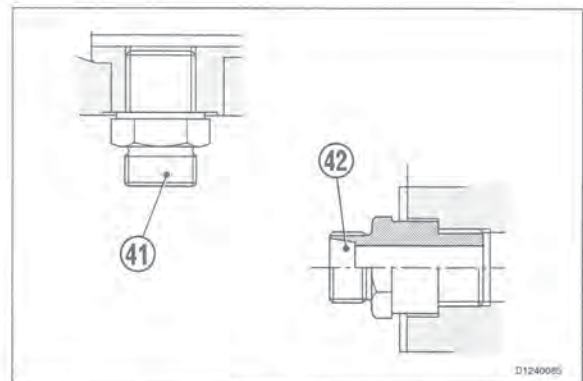
The braking discs pack is comprised of: 11 braking discs and 12 steel counterdiscs.



GB

c

**CAUTION!** If the braking discs unit is replaced, shims (9) - which determine the preloading of Belleville washers (11) - must be restored.



GB

d

**ONLY WHEN REPLACEMENT IS NECESSARY**

Remove the union pieces (41) and (42) connecting the lubrication tube (2).

**NOTE.** During the assembly stage, union pieces (41) and (42) must be coated with Loctite 577 and tightened to a torque wrench setting of 35 - 50 Nm.





**ITA**

**ATTENZIONE!** Anche se il gruppo freno viene smontato solo per motivi diversi, controllare lo spessore dei dischi di frenatura (26).

Se lo spessore "A" di un solo disco (26) si avvicina alla misura minima ammessa di 1,36 mm, sostituire l'intero pacco.

**D**

**ACHTUNG!** Jedesmal wenn das Bremsaggregat aus irgend einem Grund abmontiert wird, die Stärke der Bremsscheiben (26) kontrollieren.

Falls die Stärke "A" auch nur einer Scheibe (26) dem Mindestmaß nah liegt, den ganzen Satz auswechseln.

**ESP**

**ATENCIÓN!** También si el grupo freno viene desmontado solo por motivos diferentes, controlar el espesor de los discos de frenadura (26).

Si el espesor "A" de un solo disco (26) se acerca a la medida mínima admisible de 1,36 mm, substituir el entero paquete.

**F**

**ATTENTION!** Même si le groupe frein est démonté pour des raisons diverses, contrôler les cales des disques de freinage (26).

Si la cale "A" d'un seul disque (26) se rapproche de la mesure minimum consentie de 1,36 mm, substituer tout le paquet.

**ITA**

**ATTENZIONE!** Nel caso venga sostituito il gruppo dei dischi di frenatura, è necessario ripristinare gli spessori (9) determinanti il precarico delle molle a

tazza (11).

**D**

**ACHTUNG!** Falls das Bremschenaggregat ausgewechselt wird, die Distanzstück wieder (9) wieder einsetzen, die die Tellerfedern (11) vorladen.

**ESP**

**ATENCIÓN!** En el caso venga substituido el grupo de los discos de frenadura, es necesario restablecer los espesores (9) determinados la precarga de los muelles

a taza (11).

**F**

**ATTENTION!** Dans le cas où le groupe des disques de freinage est substitué, remettre les cales (9) qui déterminent la précharge des ressorts belleville (11).

**ITA**

**COMPOSIZIONE PACCO DISCHI DI FRENATURA**

Il pacco dei dischi di frenatura comprende: n° 11 dischi di frenatura e n° 12 controdismi in acciaio.

**D**

**DER SATZ DER BREMSSCHEIBEN BESTEHT AUS**

11 Bremsscheiben und 12 Gegenschleiben aus Stahl.

**ESP**

**COMPOSICION PAQUETE DISCOS DE FRENADURA**

El paquete de los discos de frenadura se compone de: n°11 discos de frenadura y n°12 contra-discos en acero.

**F**

**COMPOSITION DU PAQUET DE DISQUES DE FREINAGE**

Le paquet de disques de freinage comprend: n° 11 disques de freinage et n° 12 contre-disques en acier.

**ITA**

**SOLO SE È NECESSARIA LA SOSTITUZIONE**

Rimuovere i raccordi (41), (42) di attacco del tubo di lubrificazione (2).

**NOTA.** In fase di montaggio, i raccordi (41), (42) devono essere spalmati con Loctite 577 e serrati con una coppia di 35÷50 Nm.

**D**

**NUR WENN DAS AUSWECHSELN NÖTIG IST**

Anschlüsse (41), (42) der Schmierleitung (2) abnehmen.

**BEMERKUNG.** Bei der Montage, die Anschlüsse (41), (42) mit Loctite 577 schmieren und mit einem Anzugsmoment von 35÷50 Nm fest ziehen.

**ESP**

**SOLO SI NECESARIA LA SUBSTITUCION**

Remover los empalmes (41), (42) de ataque del tubo de lubricación (2).

**NOTA.** En fase de montaje, los empalmes (41), (42) deben de ser pasados con Loctite 577 y cerrados con un par de 35÷50 Nm.

**F**

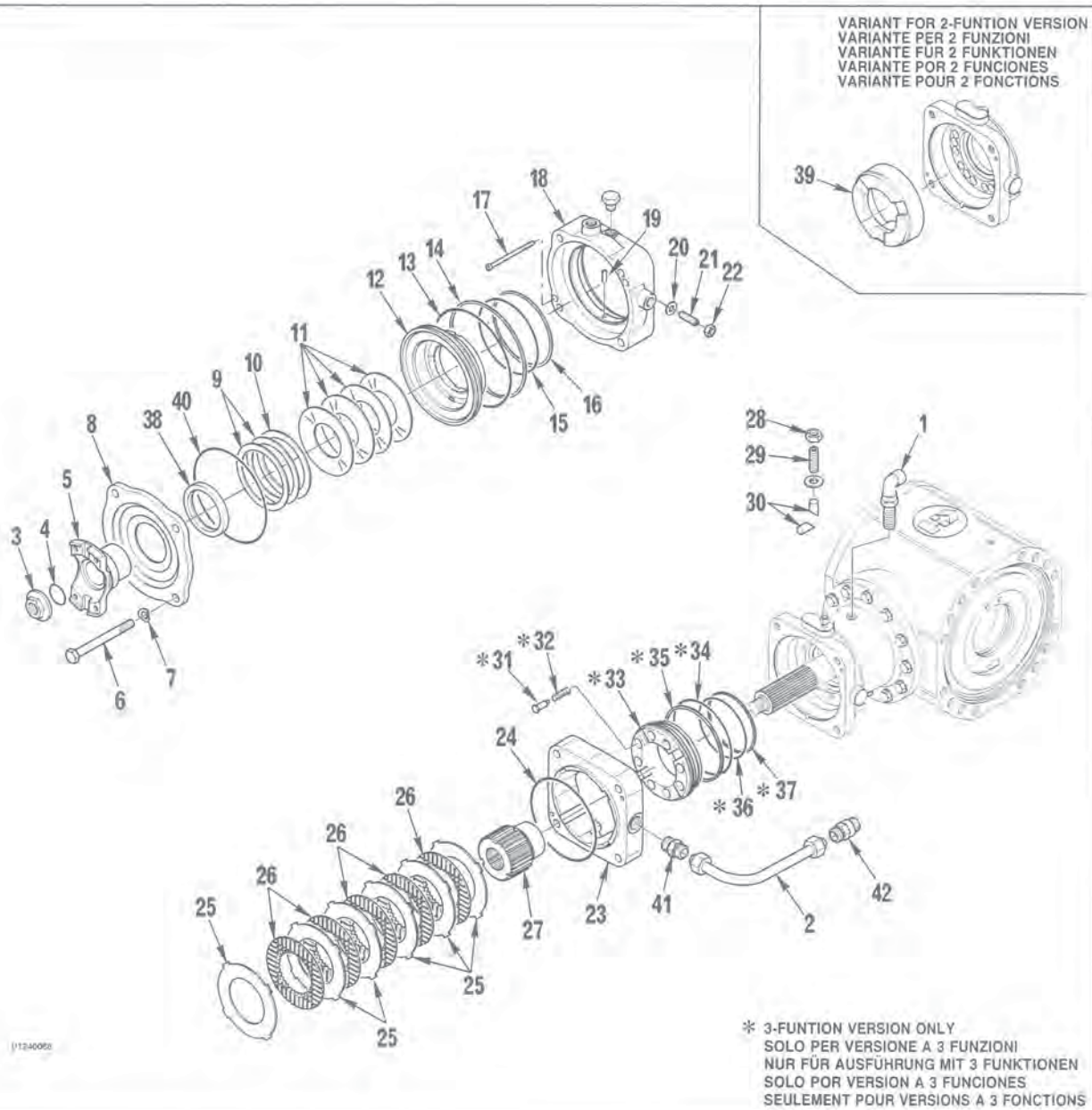
**SEULEMENT QUAND LA SUBSTITUTION EST NECESSAIRE**

Enlever les raccords (41), (42) de branchement du tube de lubrification (2).

**NOTE.** En phase de montage, les raccords (41), (42) doivent être enduits avec du Loctite 577 et serrés à un couple de 35÷50 Nm.



HOW TO DISASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - SMONTAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) ABMONTIEREN - DESMONTAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - DESMONTAJE FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)

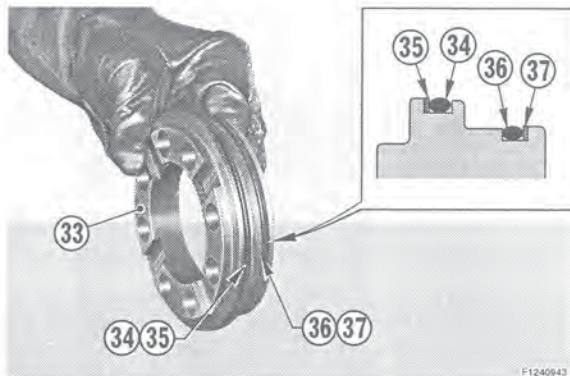








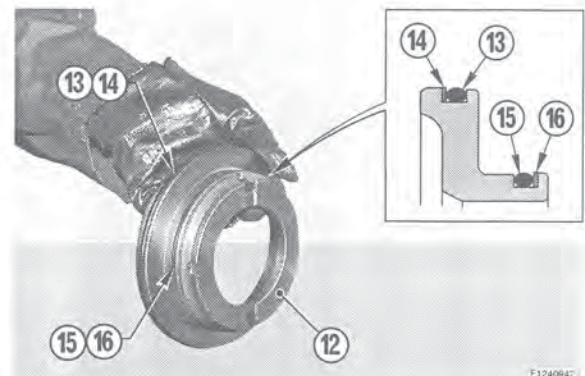
**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



**3-FUNCTION VERSION ONLY**

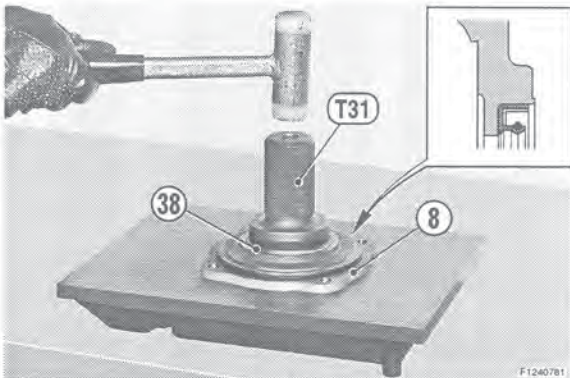
Fit the sealing rings (34), (36) and the anti-extrusion rings (35), (37) onto the piston (33) of the service brake.

**NOTE.** Carefully check the assembly position of anti-extrusion rings.



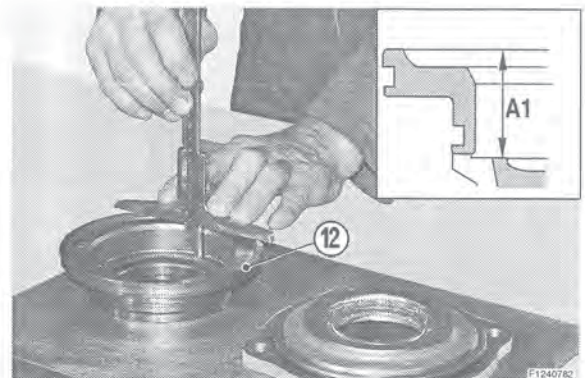
Fit the sealing rings (13), (15) and the anti-extrusion rings (14), (16) onto the piston (12) of the negative brake.

**NOTE.** Carefully check the assembly position of the anti-extrusion rings.



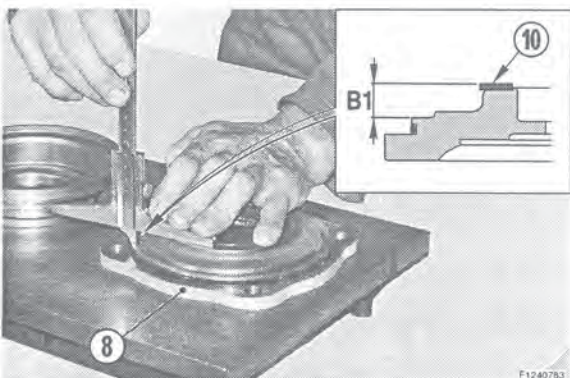
Lubricate sealing ring (38) and, using tool T31, fit it into the cover (8).

**NOTE.** Carefully check the direction of ring (38).



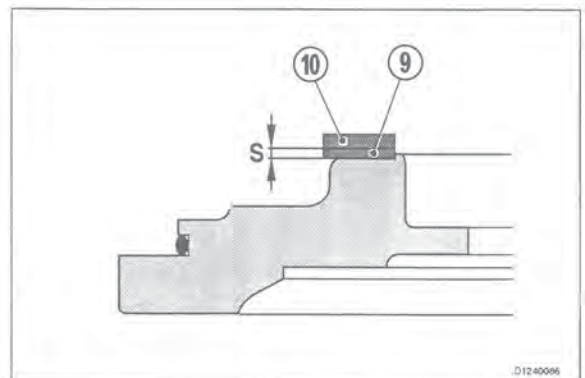
**3-FUNCTION VERSION ONLY**

Measure size "A1" of piston (12) and note it down.



**3-FUNCTION VERSION ONLY**

Fit the separating ring (10) of Belleville washers onto the cover (8), measure size "B1" and note it down.



**3-FUNCTION VERSION ONLY**

Using the measurements just taken, calculate thickness "S" of shims (9) as follows:  $S = (A1 + 1.5) - (B1 + 18.4)$  where:  
S=Shim thickness - 1.5 mm=fixed measure of braking discs clearance - 18.4 mm=fixed measure of Belleville washers.



**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Montare sul pistone (33) del freno di servizio gli anelli di tenuta (34), (36) e gli anelli antiestrusione (35), (37).  
**NOTA.** Controllare attentamente la posizione di montaggio degli anelli antiestrusione.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Auf den Kolben (33) der Hilfsbremse die Dichtringe (34), (36) und die Halteringe (35), (37) montieren.  
**BEMERKUNG.** Sorgfältig die Montagerichtung der Halteringe prüfen.

**a****ESP****SOLO POR VERSION A 3 FUNCIONES**

Montar sobre el piston (33) del freno de servicio los segmentos de compresión (34), (36) y los segmentos de anti-extrusión (35), (37).  
**NOTA.** Controlar con cuidado la colocación de montaje de los segmentos anti-extrusión.

**F****SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Monter sur le piston (33) du frein de service les bagues d'étanchéité (34), (36) et les anneaux anti-extrusion (35), (37).  
**NOTE.** Contrôler attentivement la position du montage des anneaux anti-extrusion.

**ITA**

Montare sul pistone (12) del freno negativo gli anelli di tenuta (13), (15) e gli anelli antiestrusione (14), (16).

**NOTA.** Controllare attentamente la posizione di montaggio degli anelli antiestrusione.

**D**

Auf den Kolben (12) der Negativbremse die Dichtringe (13), (15) und die Halteringe (14), (16) montieren.

**BEMERKUNG.** Sorgfältig die Montagerichtung der Halteringe prüfen.

**b****ESP**

Monter sobre el piston (12) del freno negativo los segmentos de compresión (13), (15) y los segmentos anti-extrusión (14), (16).

**NOTA.** Controlar con cuidado la colocación de montaje de los segmentos anti-extrusión.

**F**

Monter sur le piston (12) du frein négatif les bagues d'étanchéité (13), (15) et les anneaux anti-extrusion (14), (16).

**NOTE.** Contrôler attentivement la position du montage des anneaux anti-extrusion.

**ITA**

Lubrificare l'anello di tenuta (38) e, utilizzando l'attrezzo T31, montarlo nel coperchio (8).  
**NOTA.** Controllare attentamente l'orientamento dell'anello (38).

**D**

Dichtring (38) schmieren und mit Hilfe des Werkzeugs T31 den Deckel (8) montieren.  
**BEMERKUNG.** Sorgfältig die Montagerichtung des Ringes (38) prüfen.

**c****ESP**

Lubricar el segmento de compresión (38) y utilizando la herramienta T31, montarlo sobre la tapa (8).  
**NOTA.** Controlar con cuidado la dirección del segmento (38).

**F**

Lubrifier la bague d'étanchéité (38), puis à l'aide de l'outil T31, monter celle-ci dans le couvercle (8).  
**NOTE.** Contrôler attentivement l'orientation de la bague (38).

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Rilevare la misura "A1" del pistone (12) e trascriverla.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Maß "A1" des Kolbens (12) messen und anmerken.

**d****ESP****SOLO POR VERSION A 3 FUNCIONES**

Relevar la medida "A1" del piston (12) y registrarla.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**  
 Relever la mesure "A1" du piston (12) et enregistrer cette dernière.

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Montare sul coperchio (8) l'anello di battuta (10) delle molle a tazza, rilevare la misura "B1" e trascriverla.

**D****FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Auf den Deckel (8) den Anschlagring (10) der Tellerfedern montieren. Das Maß "B1" messen und anmerken.

**e****ESP****POR VERSION A 3 FUNCIONES**

Montar sobre la tapa (8) el segmento a tope (10) de los muelles a taza, relevar la medida "B1" y registrarla.

**F****DANS LES VERSIONS A 3 FONCTIONS.**

Monter sur le couvercle (8) l'anneau de butée (10) des ressorts Belleville, relever la mesure "B1" et enregistrer cette dernière.

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Utilizzando le misure rilevate, determinare lo spessore "S" dei rasamenti (9) con il seguente calcolo:

$S = (A1 + 1,5) - (B1 + 18,4)$  ove:  
 S = Spessori rasamenti - 1,5 mm = misura fissa del gioco dischi freno - 18,4 mm = misura fissa delle molle a tazza.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Anhand der ermittelten Maße die Stärke "S" der Scheiben (9) folgendermaßen ausrechnen:

$S = (A1 + 1,5) - (B1 + 18,4)$  wo:  
 S = Scheibenstärke - 1,5 mm = feste Maß für das Spiel der Brems-scheiben - 18,4 mm = feste Maß für Tellerfedern.

**f****ESP****SOLO POR VERSION A 3 FUNCIONES**

Utilizando las medidas relevadas, determinar el espesor "S" de las raspaduras (9) con el siguiente calculo:

$S = (A1 + 1,5) - (B1 + 18,4)$  donde:  
 S = espesor raspaduras - 1,5 mm = medida fija del juego discos freno - 18,4 mm = medida fija de los muelles a taza.

**F****SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**

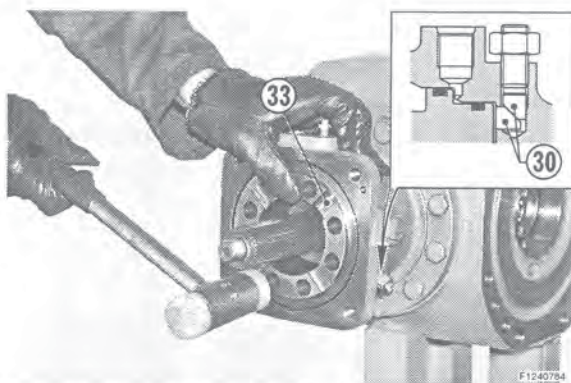
A l'aide de la mesure relevée, définir la cale "S" des rasages (9) par le calcul suivant:

$S = (A1 + 1,5) - (B1 + 18,4)$  ou:  
 S = Cales rasages - 1,5 mm = mesure fixe du jeu des disques frein - 18,4 mm = mesure fixe des ressorts Belleville.





HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)

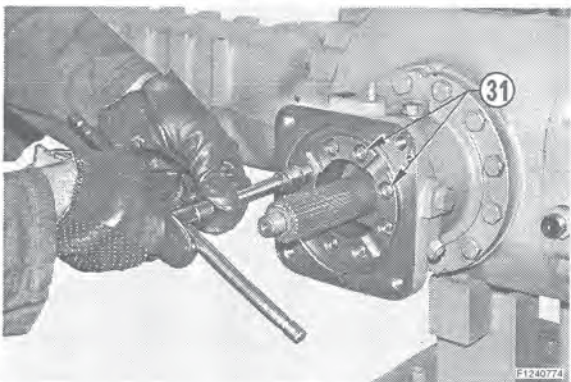


a

**3-FUNCTION VERSION ONLY**

Lubricate the O-rings and install the whole piston (33). Orient the piston with the help of a lever and push it to end of stroke with a plastic hammer.

**CAUTION!** Check that the adjusting stakes (30) are thoroughly inserted and make sure they perform a sliding motion in relation to each other.

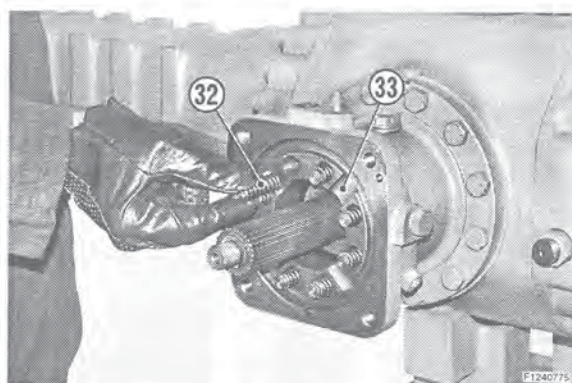


c

**3-FUNCTION VERSION ONLY**

Apply Loctite 242 to the thread of screws (31) and tighten.

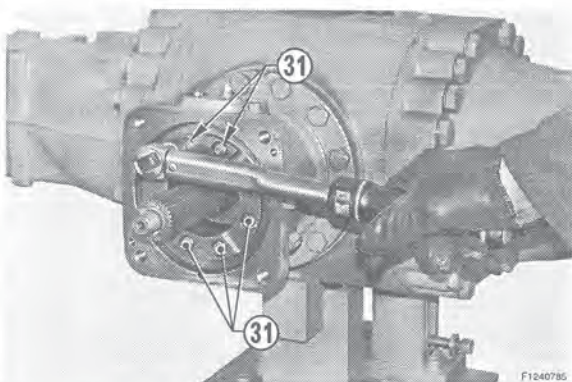
**NOTE.** Tighten the screws with a normal wrench in an alternate and criss-cross manner.



b

**3-FUNCTION VERSION ONLY**

Insert springs (32) for piston (33) backward movement.

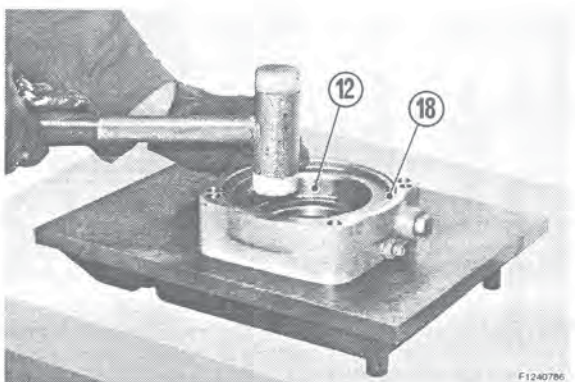


d

**3-FUNCTION VERSION ONLY**

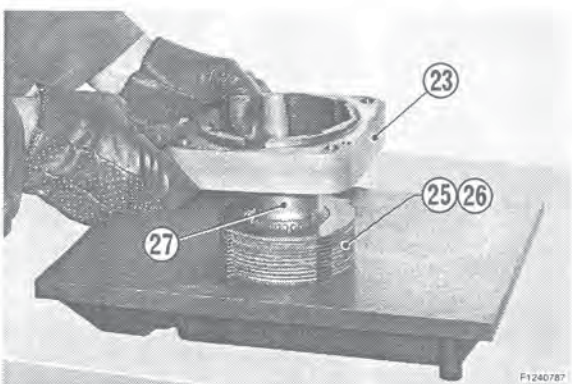
Lock screws (31) in a criss-cross manner by using a dynamometric wrench set to a max. torque of 10 Nm.

**CAUTION!** Do not exceed the specified torque setting.



e

Lubricate seals (13), (15) and fit the piston (12) into the cylinder (18). Engage piston on the pin (19). For the assembly, use a plastic hammer and push the piston (12) to end of stroke.



f

Lightly lubricate the braking discs (25), (26) and fit them onto the hub (27).

Align discs (25) and fit the distance piece (23).

**NOTE.** The braking discs pack starts and ends with steel discs (25).





SPICER CLARK-HURTH

**ITA**

**SOLO PER VERSIONE A 3 FUNZIONI**

Lubrificare le guarnizioni OR e montare il pistone (33) completo. Orientare il pistone con una leva e mandarlo a fondo corsa con un mazzuolo in materiale plastico.

**ATTENZIONE!** Controllare che i pioli di registro (30) siano inseriti a fondo e che scorrano tra loro.

**D**

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

O-Ringe schmieren und den vollständigen Kolben (33) montieren. Den Kolben mit einem Hebel orientieren und bis zum Hubende mit einem Gummihammer schlagen.

**ACHTUNG!** Kontrollieren, ob die Regelungspole (30) bis zum Anschlag eingesetzt sind und verschiebt werden können.

**ESP**

**SOLO POR VERSION A 3 FUNCIONES**

Lubricar las guarniciones OR y montar el piston (33) completo. Orientar el piston con una palanca y mandarlo a final carrera con un martillo en material plastico.

**ATENCION!** Controlar que las extremidades de registro (30) sean introducidas a fondo y que deslizen entre ellas.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Lubrifier les garnitures OR et monter le piston (33) complet. Orienter le piston à l'aide d'un levier puis l'envoyer en fin de course à l'aide d'un maillet en matière plastique.

**ATTENTION!** Contrôler, que les pôles de régistration (30) soient insérés à fond et qu'ils puissent glisser.

**ITA**

**SOLO PER VERSIONE A 3 FUNZIONI**

Inserire le molle (32) di ritorno del pistone (33).

**D**

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Rückzugsfedern (32) in den Kolben (33) einsetzen.

**ESP**

**SOLO POR VERSION A 3 FUNCIONES**

Introducir los muelles (32) de vuelta del piston (33).

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Introduire les ressorts (32) de retour du piston (33).

**ITA**

**SOLO PER VERSIONE A 3 FUNZIONI**

Spalmare il filetto delle viti (31) con Loctite 242 ed avvitare.

**NOTA.** Mandare in battuta le viti con una chiave normale con il metodo alternato ed incrociato.

**D**

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Schraubengewinde (31) mit Loctite 242 schmieren und Schrauben fest schrauben.

**ESP**

**SOLO POR VERSION A 3 FUNCIONES**

Pasar la rosca de los tornillos (31) con Loctite 242 y atornillarlas.

**NOTA.** Mandar a tope los tornillos con una llave normal de manera alternada y cruzada.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Enduire le filet des vis (31) avec du Loctite 242, puis visser.

**NOTE.** Envoyer en butée les vis à l'aide d'une clé normale avec la méthode alternée, croisée.

**ITA**

**SOLO PER VERSIONE A 3 FUNZIONI**

Bloccare le viti (31) in modo incrociato utilizzando una chiave dinamometrica tarata ad una coppia massima di 10 Nm.

**ATTENZIONE!** Non superare la coppia di serraggio indicata.

**D**

**NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Die Schrauben (31) im Kreuz mit einem Momentenschlüssel und einem Anzugsmoment von 10 Nm fest schrauben.

**ACHTUNG!** Das angegebene Moment nicht überschreiten.

**ESP**

**SOLO POR VERSION A 3 FUNCIONES**

Bloquear los tornillos (31) de manera cruzada utilizando una llave dinamometrica tarada a un par maximo de 10 Nm.

**ATENCION!** No superar el par de torsion indicado.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Bloquer les vis (31) de manière croisée à l'aide d'une clé dynamométrique calibrée à un couple max. de 10 Nm.

**ATTENTION!** Ne jamais dépasser le couple de serrage indiqué.

**ITA**

Lubrificare le guarnizioni (13), (15) e montare nel cilindro (18) il pistone (12) orientandolo sulla spina (19). Per il montaggio, utilizzare un mazzuolo in materiale plastico e mandare il pistone (12) a fondo corsa.

**D**

Dichtungen (13), (15) schmieren und in den Zylinder (18) den Kolben (12) montieren und auf den Stift (19) orientieren. Zur Montage einen Gummihammer verwenden, um den Kolben (12) bis zum Hubende zu schlagen.

**ESP**

Lubricar las guarniciones (13), (15) y montar en el cilindro (18) el piston (12) dirigiendolo sobre la espina (19).

Para el montaje, utilizar un martillo en material plastico y mandar el piston (12) a final carrera.

**F**

Lubrifier les garnitures (13), (15) puis monter dans cylindre (18) le piston (12) en l'orientant sur la broche (19).

Pour le montage, utiliser un maillet en matière plastique et envoyer le piston (12) en fin de course.

**ITA**

Lubrificare leggermente i dischi di frenatura (25), (26) e montarli sul mozzo (27).

Allineare i dischi (25) e montare il distanziale (23).

**NOTA.** La composizione del pacco dei dischi di frenatura inizia e termina con i dischi di acciaio (25).

**D**

Bremsscheiben (25), (26) leicht schmieren und auf die Nabe (27) montieren.

Scheiben (25) ausrichten und Distanzstück (23) montieren.

**BEMERKUNG.** Der Satz der Bremsscheiben beginnt und endet mit den Stahlscheiben (25).

**ESP**

Lubricar ligeramente los discos de frenadura (25), (26) y montarlos sobre el cubo (27).

Alinear los discos (25) y montar el distancial (23).

**NOTA.** La composición del paquete de los discos de frenadura empieza y termina con los discos en acero (25).

**F**

Lubrifier légèrement les disques de freinage (25), (26) et monter ceux-ci sur le moyeu (27).

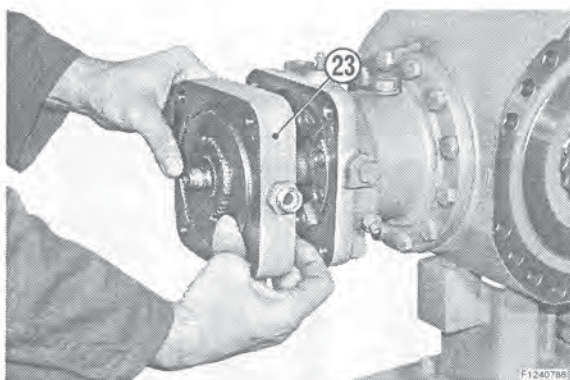
Aligner les disques (25) et monter l'entretoise (23).

**NOTE.** La composition du paquet des disques de freinage commence et s'achève par des disques en acier (25).





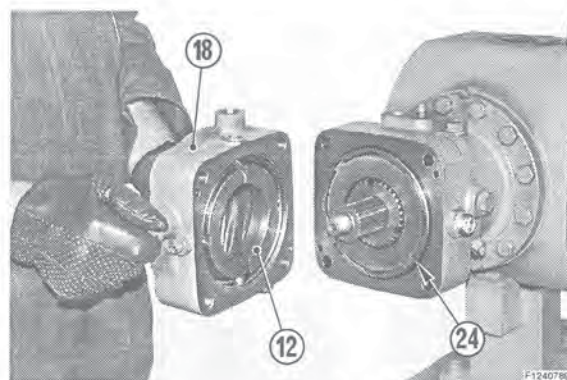
**HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)**



GB

a

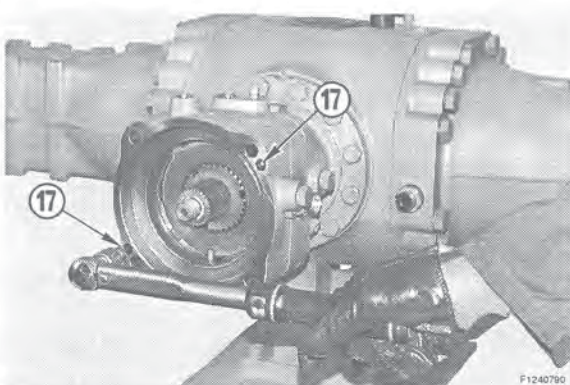
Apply Loctite 510 on the face of the distance piece (23).  
Fit the discs-hub-distance piece assembly prepared in the previous stages onto the pinion and engage it.



GB

b

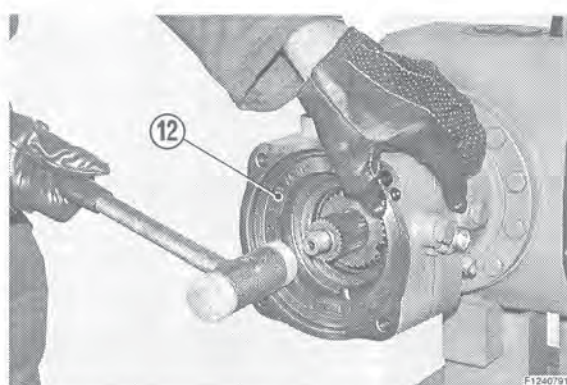
Lubricate the O-ring (24) and fit cylinder (18) complete with piston (12).



GB

c

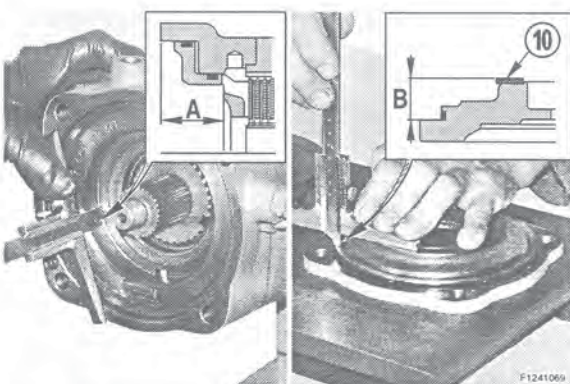
Introduce screws (17) and tighten in a criss-cross manner: use a torque wrench setting of 9.5 – 10.5 Nm.  
**NOTE.** Before giving the final tightening, align the external surfaces of the components.



GB

d

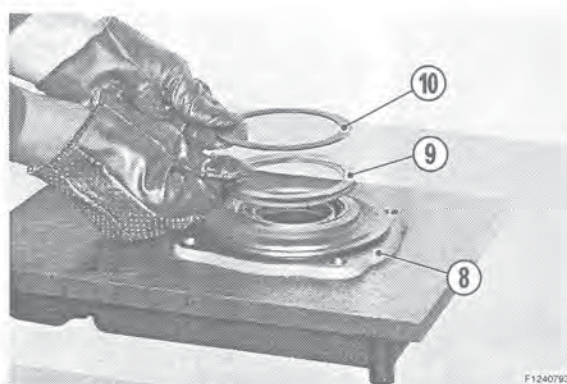
**3-FUNCTION VERSION ONLY**  
Using a plastic hammer, push the piston (12) to the end of stroke.



GB

e

**2-FUNCTION VERSION ONLY**  
Fit the separating ring (10) of Belleville washers onto the cover (8), measure size "B" and note it down.  
Measure size "A" which you will need for calculating the shims (9) according to the following:  
 $S = A - (B + 18.4)$  where: S = Shim thickness - 18.4 mm = fixed measure of Belleville washers.



GB

f

Lightly lubricate the shims (9) required according to calculations and the separating ring (10) of the Belleville washers.  
Fit shims and ring on the cover (8).  
**NOTE.** Position the larger shim so that it leans against the cover.



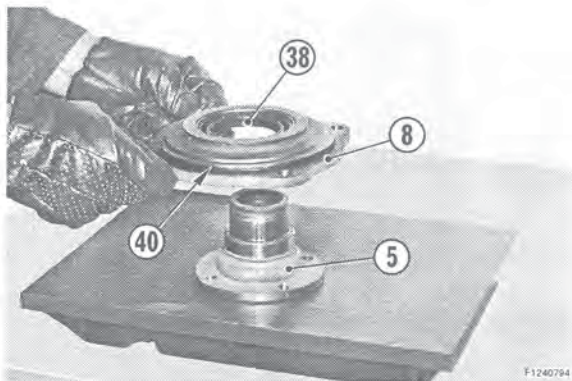


- ITA** Spalmare il piano di appoggio del distanziale (23) con Loctite 510.  
Montare sul pignone il gruppo dischi-mozzo-distanziale preparato nelle fasi precedenti e mandarlo in battuta.
- D** Die Auflagefläche des Distanzstückes (23) mit Loctite 510 schmieren.  
Auf den Kolben das Aggregat Scheiben-Nabe-Distanzstück montieren, das zuvor vorbereitet wurden und bis zum Anschlag einsetzen.
- ESP** Pasar la superficie de apoyo del distancial (23) con Loctite 510.  
Montar sobre el pinón el grupo discos-cubo-distancial preparado en la fase precedente y mandarlo a tope.
- F** Enduire le plan d'appui de l'entretoise (23) avec du Loctite 510.  
Monter sur le pignon le groupe disques-moyeu-entretoise préparé lors des phases précédentes et l'envoyer en butée.
- ITA** Lubrificare la guarnizione OR (24) e montare il cilindro (18) completo di pistone (12).
- D** O-Ring (24) schmieren und den Zylinder (18) samt Kolben (12) montieren.
- ESP** Lubrificar la guarnición OR (24) y montar el cilindro (18) completo de pistón (12).
- F** Lubrifier la garniture OR (24) et monter le cylindre (18) équipé du piston (12).
- ITA** Inserire le viti (17) ed avvitarle a fondo in modo incrociato; serrarle con una coppia di 9,5÷10,5 Nm.  
**NOTA.** Prima del serraggio finale, allineare le superfici esterne dei componenti.
- D** Schrauben (17) einsetzen und bis zum Anschlag im Kreuz mit einem Anzugsmoment von 9,5÷10,5 Nm fest schrauben.
- BEMERKUNG.** Bevor die Teile endgültig festgezogen werden, die äußeren Flächen ausrichten.
- ESP** Introducir los tornillos (17) y atornillarlos a tope de manera cruzada; apretarlos con un par de 9,5÷10,5 Nm.  
**NOTA.** Antes de apretarlos definitivamente, alinear las superficies exteriores de los componentes.
- F** Introduire les vis (17) et visser à fond de façon croisée; serrer celles-ci à un couple de 9,5÷10,5 Nm.  
**NOTE.** Avant le serrage final, aligner les surfaces externes des composants.
- ITA** **SOLO PER VERSIONE A 2 FUNZIONI**  
Utilizzando un mazzuolo in materiale plastico, mandare a fondo corsa il pistone (12).
- D** **NUR FÜR AUSFÜHRUNG MIT 2 FUNKTIONEN**  
Mit einem Gummihammer den Kolben (12) bis zum Anschlag schlagen.
- ESP** **SOLO POR VERSION A 2 FUNCIONES**  
Utilizando un martillo en material plastico, mandar a final carrera el pistón (12).
- F** **SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**  
A l'aide du maillet en matière plastique, envoyer le piston (12) en fin de course.
- ITA** **SOLO PER VERSIONE A 2 FUNZIONI**  
Montare sul coperchio (8) l'anello di battuta (10) delle molle a tazza, rilevare la misura "B" e trascriverla.  
Rilevare la misura "A" necessaria al calcolo dei rasamenti (9) con la formula:  $S = A - (B + 18,4)$  ove: S = Spessori rasamenti - 18,4 mm = misura fissa delle molle a tazza.
- D** **NUR FÜR AUSFÜHRUNG MIT 2 FUNKTIONEN**  
Auf den Deckel (8) den Anschlagring (10) der Tellerfedern montieren. Das Maß "B" messen und anmerken. Das Maß "A" messen, das zur Rechnung der Scheiben (9) mit nachstehender Formel nötig ist:  $S = A - (B + 18,4)$  wo: S = Scheibenstärke - 18,4 mm = feste Maß für Tellerfedern.
- ESP** **SOLO POR VERSION A 2 FUNCIONES**  
Montar sobre la tapa (8) el segmento a tope (10) de los muelles a taza, relevar la medida "B" y registrarla.  
Relevar la medida "A" necesaria al calculo de las raspaduras (9) con la formula:  $S = A - (B + 18,4)$  donde: S = espesor raspaduras - 18,4 mm = medida fija de los muelles a taza.
- F** **SEULEMENT DANS LES VERSIONS A 2 FONCTIONS.**  
Monter sur le couvercle (8) l'anneau de butée (10) des ressorts Belleville, relever la mesure "B" et enregistrer cette dernière. Relever la mesure "A" nécessaire pour calculer les rasages (9) avec la formule:  $S = A - (B + 18,4)$  ou: S = Cales rasages - 18,4 mm = mesure fixe des ressorts Belleville.
- ITA** Lubrificare leggermente gli spessori (9) calcolati e l'anello (10) di battuta delle molle a tazza.  
Montare spessori ed anello sul coperchio (8).  
**NOTA.** Posizionare lo spessore maggiore a ridosso del coperchio.
- D** Die Scheiben (9) und den Anschlagring (10) der Tellerfedern leicht schmieren.  
Scheiben und Ring auf den Deckel (8) montieren.  
**BEMERKUNG.** Die größere Scheibe sollte am Deckel anliegen.
- ESP** Lubrificar ligeramente los espesores (9) calculados y el segmento (10) a tope de los muelles a taza.  
Montar el espesor mayor detras de la tapa.  
**NOTA.** Colocar el espesor mayor detras de la tapa.
- F** Lubrifier légèrement les cales (9) calculées et l'anneau (10) de butée des ressorts Belleville.  
Monter cales et anneau sur le couvercle (8).  
**NOTE.** Placer la cale la plus grande au-dessus du couvercle.





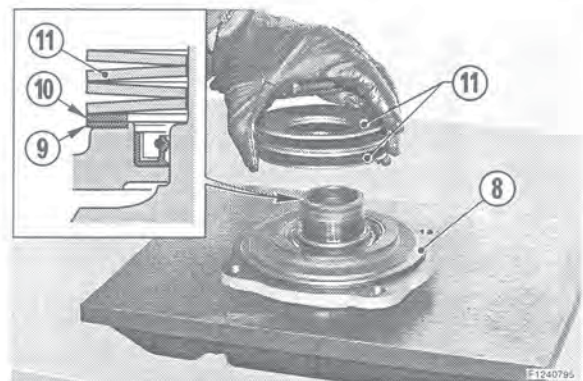
HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)



GB

a

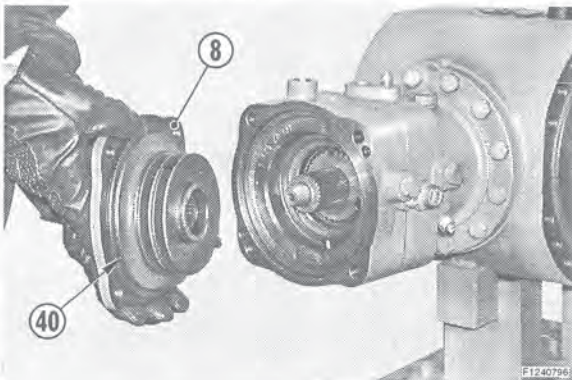
Check the state of the O-ring (40).  
Lubricate sealing ring (38) and fit flange (5) into the cover (8).



GB

b

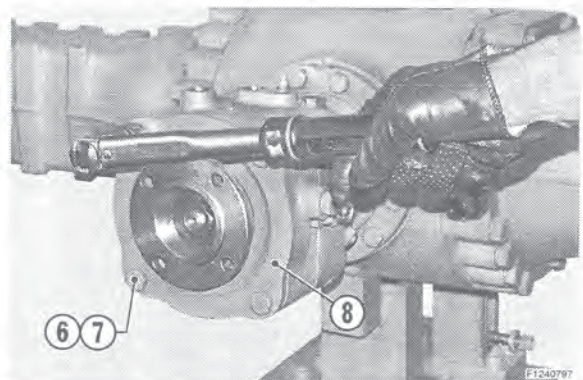
Fit the Belleville washers (11) onto the cover (8), thoroughly checking washers orientation.



GB

c

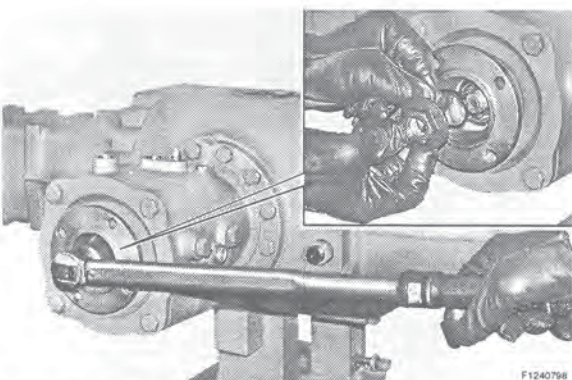
Lubricate the O-ring (40) and install the cover assembly (8).



GB

d

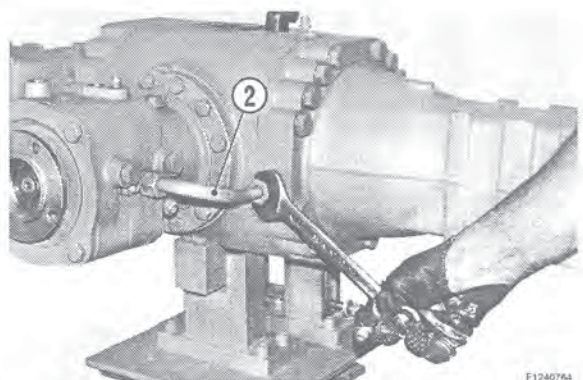
Fit screws (6) and washers (7); lock the cover with a torque wrench setting of 116 – 128 Nm.  
**NOTE.** Tighten in an alternate and criss-cross manner.



GB

e

Apply Loctite 242 to the threaded portion of the pinion, fit O-ring (4) and nut (3); tighten the nut with a dynamometric wrench set to 280 – 310 Nm.  
**NOTE.** Use tools T21-T22.



GB

f

Install the lubrication tube (2).





- a**
- ITA** Controllare lo stato dell'anello OR (40).  
Lubrificare l'anello di tenuta (38) e montare la flangia (5) nel coperchio (8).
- D** Zustand des O-Rings (40) kontrollieren.  
Dichtring (38) schmieren und Flansch (5) in den Deckel (8) montieren.
- ESP** Controlar el estado del anillo OR (40).  
Lubricar el anillo de compresión (38) y montar la brida (5) sobre la tapa (8).
- F** Contrôler l'état de la garniture OR (40).  
Lubrifier la bague d'étanchéité (38) et monter la flasque (5) dans le couvercle (8).

- b**
- ITA** Montare sul coperchio (8) le molle a tazza (11) controllandone attentamente l'orientamento.
- D** Auf den Deckel (8) die Tellerfeder (11) montieren und sorgfältig auf die Montagerichtung achten.
- ESP** Montar sobre la tapa (8) los muelles a taza (11) controlando con cuidado la dirección.
- F** Monter sur le couvercle (8) les ressorts belleville (11) en contrôlant attentivement leur orientation.

- c**
- ITA** Lubrificare l'anello OR (40) ed installare il gruppo coperchio (8).
- D** O-Ring (40) schmieren und Deckelaggregat (8) installieren.
- ESP** Lubricar el anillo OR (40) y montar el grupo tapa (8).
- F** Lubrifier la garniture OR (40) et installer le groupe couvercle (8).

- d**
- ITA** Montare le viti (6) e le rondelle (7); bloccare il coperchio con una coppia di 116÷128 Nm.  
**NOTA.** Eseguire il serraggio in modo alternato ed incrociato.
- D** Schrauben (6) und Unterlegscheiben (7) montieren; den Deckel mit einem Anzugsmoment von 116÷128 Nm blockieren.
- BEMERKUNG.** Schrauben abwechselnd und im Kreuz fest schrauben.
- ESP** Montar los tornillos (6) y las arandelas (7); bloquear la tapa con un par de 116÷128 Nm.  
**NOTA.** Apretar de manera alternada y cruzada.
- F** Monter les vis (6) et les rondelles (7); bloquer le couvercle à un couple de 116÷128 Nm.  
**NOTE.** Effectuer le serrage de façon alternée et croisée.

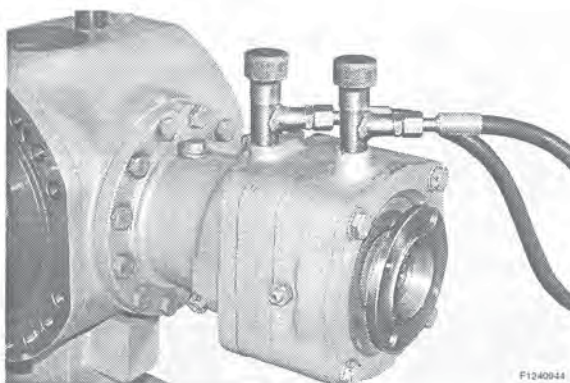
- e**
- ITA** Spalmare la porzione filettata del pignone con Loctite 242, montare l'anello OR (4) ed il dado (3); serrare il dado con chiave dinamometrica tarata a 280÷310 Nm.  
**NOTA.** Utilizzare gli attrezzi T21-T22.
- D** Das Gewinde des Kolbens mit Loctite 242 schmieren und den O-Ring (4) und die Mutter (3) montieren; die Mutter mit einem Anzugsmoment von 280÷310 Nm fest schrauben.
- BEMERKUNG.** Werkzeuge T21-T22 verwenden.
- ESP** Pasar la parte roscada del pinón con Loctite 242, montar el segmento OR (4) y la tuerca (3); apretar la tuerca con llave dinamométrica tarada a 280÷310 Nm.  
**NOTA.** Utilizar las herramientas T21-T22.
- F** Enduire la partie filetée du pignon avec du Loctite 242, monter la garniture OR (4) et l'écrou (3); serrer l'écrou à l'aide d'une clé dynamométrique calibrée à 280÷310 Nm.  
**NOTE.** Utiliser les outils T21-T22.

- f**
- ITA** Montare il tubo (2) della lubrificazione.
- D** Schmierleitung (2) montieren.
- ESP** Montar el tubo (2) de la lubricación.
- F** Monter le tube (2) de lubrification.





HOW TO ASSEMBLE THE 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS) - ASSEMBLAGGIO FRENO IN ENTRATA DA 4" (A 2 E 3 FUNZIONI) - BREMSE AM EINGANG ZU 4" (MIT 2 UND 3 FUNKTIONEN) MONTIEREN - ASEMBLAJE FRENO EN ENTRADA DE 4" (A 2 Y 3 FUNCIONES) - MONTAJE DEL FREIN EN ENTREE 4" (A 2 ET 3 FONCTIONS)



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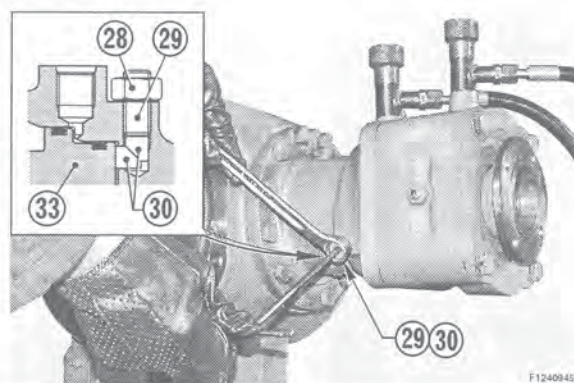
GB

a

**3-FUNCTION VERSION ONLY**

Connect the service and negative brakes to an external pump; introduce pressure up to a value of 20–25 Nm.

**NOTE.** Check that pressure is kept stable for at least 5 minutes and make sure there are no leaks.



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GB

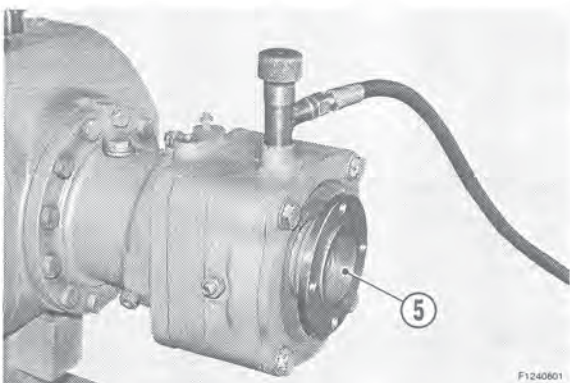
b

**3-FUNCTION VERSION ONLY**

Screw dowels (29) until pins (30) position themselves against the piston (33), then unscrew dowels by one turn to obtain a 1.5 mm stroke.

Lock dowels (29) into position with the nuts (28) tightened at 15 Nm.

Release pressure.



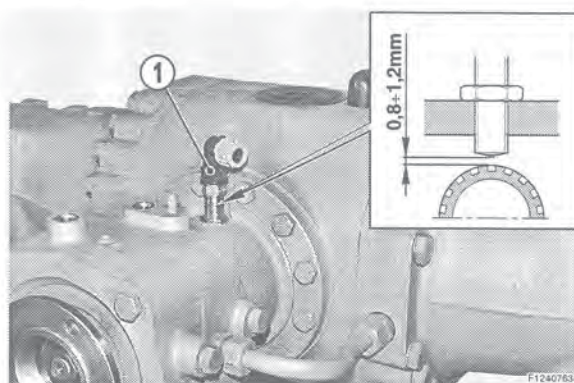
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GB

c

Check negative brake release by introducing a pressure of 16–35 bar and by manually rotating the flange (5). Release pressure.



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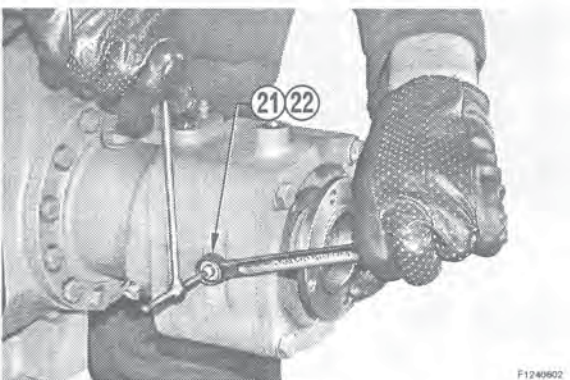


GB

d

Fit the movement sensor (1) and screw it up to the limit stop. Unscrew sensor by 3/4 turn and lock into position with nut. Locking torque: MAX 30 Nm.

**CAUTION!** Do not exceed the specified torque setting.



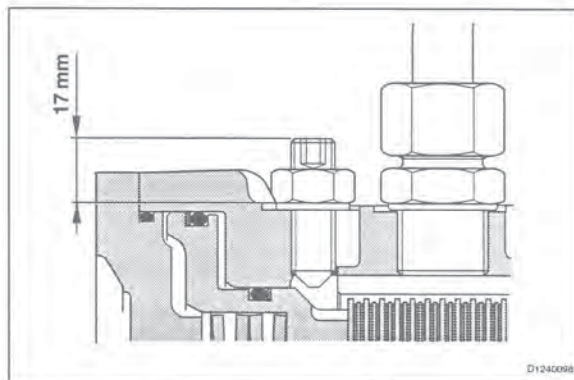
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GB

e

**CAUTION!** To release the negative brake during an emergency, (lack of pressure due to vehicle breakdown), loosen nuts (22) and screw dowels (21) in an alternate and gradual manner until you notice some preloading; continue by giving another 1.5 turns.



D1240098



GB

f

When the emergency is over, loosen the dowels in an alternate manner until a 17 mm projection is obtained; lock into position with the nuts (22) tightened to 15 Nm.



**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Collegare i freni di servizio e negativo ad una pompa esterna; immettere pressione fino ad un valore di 20÷25 Nm.

**NOTA.** Controllare che la pressione rimanga stabile per almeno 5 minuti e quindi non vi siano perdite.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Die Hilfsbremse und Negativbremse an eine getrennte Pumpe schließen; Druck bis zu einem Wert von 20÷25 Nm einlassen.

**a**

**BEMERKUNG.** Kontrollieren, ob der Druck mindestens 5 Minuten lang stabil bleibt und nirgends austritt.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Conectar los frenos de servicio y negativo a una pompa externa; introducir hasta un valor de 20÷25 Nm.

**NOTA.** Controlar que la presión quede estable por lo menos por 5 minutos y que no hayan pérdidas.

**F**

**SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.** Brancher les freins de service et négatif à une pompe externe; émettre de la pression jusqu'à une valeur de 20÷25 Nm.

**NOTE.** Contrôler que la pression soit stable pendant 5 minutes au moins et qu'il n'y ait pas de fuites.

**ITA****SOLO PER VERSIONE A 3 FUNZIONI**

Avvitare i grani (29) fino all'appoggio dei pioli (30) sul pistone (33) e quindi svitarli di 1 giro per creare una corsa del pistone di 1,5 mm.

Bloccare la posizione dei grani (29) con i dadi (28) serrati a 15 Nm. Rilasciare la pressione.

**D****NUR FÜR AUSFÜHRUNG MIT 3 FUNKTIONEN**

Stifte (29) bis zum Anschlag der Sprossen (30) am Kolben (33) schrauben und dann um 1 Umdrehung aufdrehen, um einen Hub von 1,5 mm herzustellen.

**b**

Die Position der Stifte (29) mit den Muttern (28) bei einem Anzugsmoment von 15 Nm blockieren. Druck ablassen.

**ESP****SOLO POR VERSION A 3 FUNCIONES**

Atornillar las espigas (29) hasta el apoyo de las extremidades (30) sobre el pistón (33) y ahora destornillarlos de 1 giro para averiguar una carrera del pistón de 1,5 mm.

Bloquear la posición de las espigas (29) con las tuercas (28) apretadas a 15 Nm. Dejar la presión.

**F****SEULEMENT DANS LES VERSIONS A 3 FONCTIONS.**

Visser les grains (29) jusqu'à la dépose des chevilles (30) sur le piston (33), puis dévisser ceux-ci d'un tour pour créer une course du piston de 1,5 mm.

Bloquer la position des grains (29) avec les écrous (28) serrés à 15 Nm. Relâcher la pression.

**ITA**

Controllare lo sblocco del freno negativo immettendo una pressione di 16÷35 bar e ruotando manualmente la flangia (5).

Rilasciare la pressione.

**D**

Kontrollieren ob, beim einlassen von einem Druck von 16÷35 bar die Negativbremse entschert und von Hand den Flansch (5) drehen.

Druck ablassen.

**c****ESP**

Controlar el bloqueo del frenonegativo introduciendo una presión de 16÷35 bar y ruotando manualmente la brida (5).

Dejar la presión.

**F**

Contrôler le débrayage du frein négatif en émettant de la pression à 16÷35 bar et en tournant la flasque (5) manuellement.

Relâcher la pression.

**ITA**

Montare il sensore di movimento (1) ed avvitarlo manualmente a fondo corsa. Svitarlo di 3/4 di giro e bloccare la posizione con il dado. Coppia di bloccaggio: MAX 30 Nm.

**ATTENZIONE!** Non superare la coppia indicata.

**D**

Den Bewegungsgeber (1) montieren und von Hand bis zum Anschlag montieren. Dann um 3/4 Umdrehung aufdrehen und die Position mit der Mutter blockieren.

Anzugsmoment: max. 30 Nm.

**d**

**ACHTUNG!** Das Anzugsmoment nicht überschreiten.

**ESP**

Montar el sensor de movimiento (1) y atornillarlo manualmente a final carrera. Destornillarlo de 3/4 de vuelta y bloquear la posición con la tuerca.

Par de bloqueo: Max 30 Nm.

**ATENCIÓN!** No superar la medida indicada.

**F**

Monter le capteur de déplacement (1) et visser celui-ci à la main en fin de course. Dévisser encore celui-ci de 3/4 de tour et bloquer sa position avec l'écrou. Couple de blocage: MAX. 30 Nm.

**ATTENTION!** Ne jamais dépasser le couple indiqué.

**ITA**

**ATTENZIONE!** Per sbloccare il freno negativo in fase di emergenza (mancanza di pressione per avaria del veicolo), allentare i dadi (22) ed avvitare in modo progressivo alternato, i grani (21) fino ad avvertire un precarico; proseguire ulteriormente per 1,5 giri.

**D**

**ACHTUNG!** Um die Negativbremse im Notfall zu entsichern (Druck bleibt wegen einer Störung am Fahrzeug aus), die Muttern (22) lockern und abwechseln die Stifte (21) fest schrauben bis sie vorgeladen sind; um weitere 1,5 Umdrehungen fest drehen.

**e****ESP**

**ATENCIÓN!** Para sbloquear el freno negativo en fase de emergencia (falta de presión por gaste del vehículo), aflojar las tuercas (22) y atornillar de manera progresiva alternada, las espigas (21) hasta averiguar una precarga, seguir ulteriormente por 1,5 giros.

**F**

**ATTENTION!** Pour dégager le frein négatif en cas d'urgence (manque de pression en cas de panne du véhicule) desserrer les écrous (22) et visser de façon progressive alternée, les grains (21) jusqu'à avvertir une précharge; faire encore 1,5 tour.

**ITA**

Dopo l'emergenza svitare i grani in modo alternato fino ad ottenere una sporgenza di 17 mm; bloccare la posizione con i dadi (22) serrati a 15 Nm.

**D**

Nach dem Notfall, die Stifte abwechselnd aufschrauben, bis ein Vorsprung von 17 mm erreicht wird; die Position mit den Muttern (22) bei einem Anzugsmoment von 15 Nm blockieren.

**f****ESP**

Después de una emergencia destornillar las espigas de manera alternada hasta obtener una parte saliente de 17 mm, bloquear la posición con las tuercas (22) apretadas a 15 Nm.

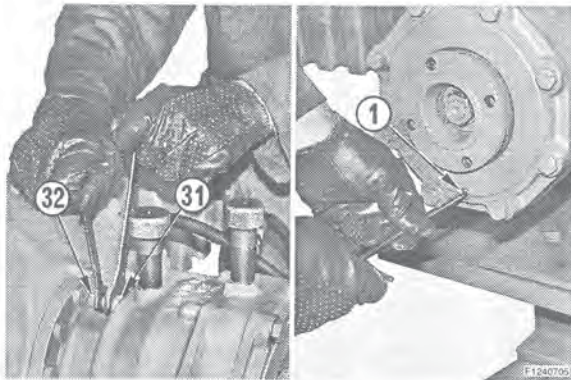
**F**

Après l'urgence dévisser les grains de façon alternée jusqu'à obtenir une saillie de 17 mm; bloquer la position à l'aide des écrous (22) serrés à 15 Nm.

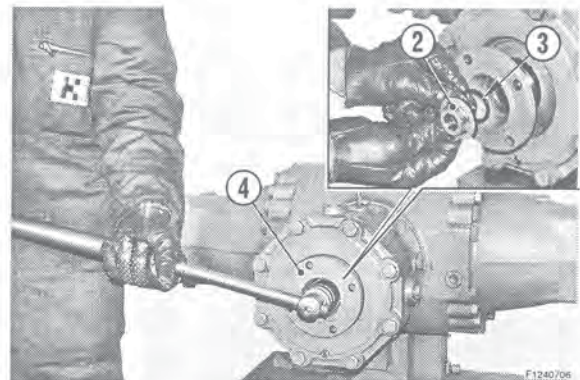




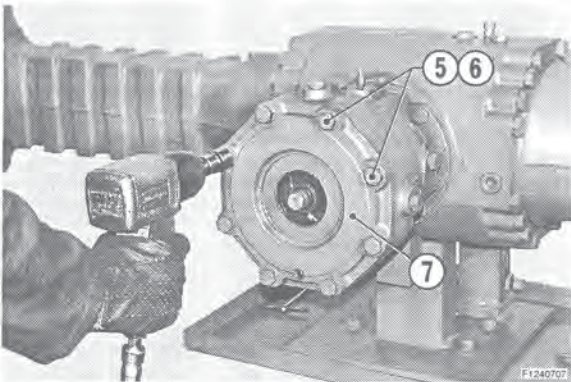
DISASSEMBLING THE 7" COMBINED BRAKE - SMONTAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ABMONTIEREN - DESMONTAJE FRENO COMBINADO DE 7" - DESASSEMBLAGE DU FREIN COMBINE PAR 7"



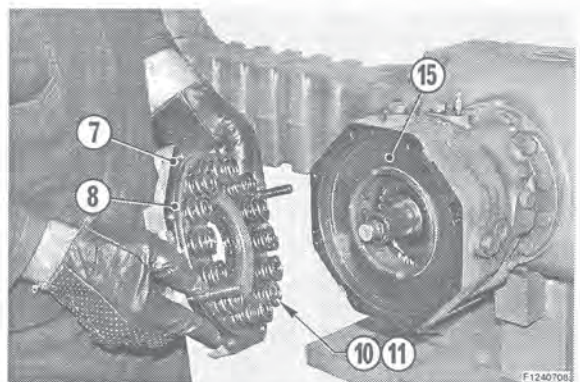
Loosen nuts (31) and unfasten screws (32) in sequence. Remove the front plug (1) to drain the residual lubricating oil.  
**CAUTION!** Apply oil recovery tubes to the hydraulic connection points.



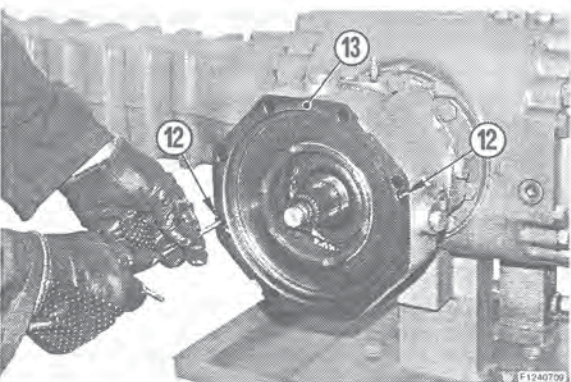
Loosen and remove nut (2), O-ring (3) and flange (4). If disassembly proves to be awkward, heat the nut (2) at about 80° C. If necessary, use one of the T20 tools.



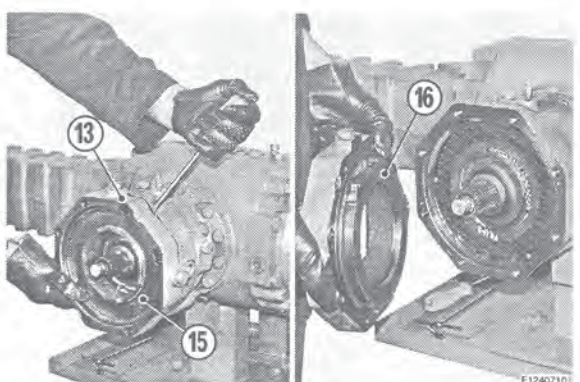
Loosen and remove screws (5) and spring washers (6).  
**CAUTION!** Gradually loosen screws in a criss-cross manner.  
**NOTE.** For the sake of safety, leave two of the screws in place.



Remove the cover (7), complete with piston (15) reversal springs (10), (11), and O-ring (8).  
**NOTE.** Check the O-ring (8) and, if necessary, replace it.



Loosen and remove the check screws (12) of cylinder (13).



By prising with a lever, remove the cylinder (13) complete with: the piston (15) of the negative brake and the intermediate disc (16).





SPICER CLARK-HURTH

**ITA**

Allentare i dadi (31) e svitare in sequenza le viti (32). Asportare il tappo anteriore (1) per scaricare l'olio di lubrificazione residuo.

**ATTENZIONE!** Applicare dei tubi di recupero olio agli attacchi idraulici.

**D**

Die Muttern (31) lockern und der Reihenfolge nach die Schrauben (32) abschrauben. Den vorderen Stopfen (1) abnehmen und das restliche Schmieröl ablassen.

**ACHTUNG!** An den hydraulischen Anschlüssen Ölsammelleitungen anbringen.

**ESP**

Alojar las tuerca (31) y destornillar en secuencia los tornillos (32). Sacar el tapon anterior (1) para descargar el aceite de lubricación residuo.

**ATENCION!** Aplicar algunos tubos de recuperación aceite a los ataques hidráulicos.

**F**

Desserrer les écrous (31), puis dévisser successivement les vis (32). Enlever le bouchon antérieur (1) pour vidanger l'huile de lubrification résidue.

**ATTENTION!** Appliquer des tuyaux pour la récolte de l'huile aux raccords hydrauliques.

**ITA**

Allentare ed asportare il dado (2), la guarnizione OR (3) e la flangia (4).

Se lo smontaggio risulta difficoltoso, scaldare il dado (2) a circa 80°C.

Se necessario, usare uno degli attrezzi T20.

**D**

Die Mutter (2) lockern und diese mit dem O-Ring (3) und dem Flansch (4) abnehmen.

Falls das Abmontieren schwer fallen sollten, die Mutter (2) bis auf ca. 80°C erhitzen.

Wenn nötig, eines der Werkzeuge T20 verwenden.

**ESP**

Alojar y sacar la tuerca (2), la guarnición OR (3) y la brida (4).

Si el desmontaje resulta dificultoso, calentar la tuerca (2) aprox. A 80 °C.

Si necesario, usar una herramienta T20.

**F**

Desserrer et enlever l'écrou (2), la garniture OR (3) et le flasque (4).

Si le démontage se fait difficile, chauffer l'écrou (2) à 80°C environ.

Si besoin, utiliser l'un des outils T20.

**ITA**

Allentare ed asportare le viti (5) e le rondelle elastiche (6).

**ATTENZIONE!** Allentare le viti progressivamente ed in modo incrociato.

**NOTA.** Per sicurezza, lasciare in posizione due viti.

**D**

Die Schrauben (5) lockern und mit den Federscheiben (6) abnehmen.

**ACHTUNG!** Die Schrauben abwechselnd und im Kreuz lockern.

**BEMERKUNG.** Zur Sicherheit zwei Schrauben in ihrem Sitz lassen.

**ESP**

Alojar y sacar los tornillos (5) y las arandelas elasticas (6).

**ATENCION!** Alojar los tornillos progresivamente y de manera cruzada.

**NOTA.** Por seguridad, dejar colocados dos tornillos.

**F**

Desserrer et enlever les vis (5), puis les rondelles élastiques (6).

**ATTENTION!** Desserrer progressivement les vis de manière croisée.

**REMARQUE.** Pour toute sécurité, laisser deux vis à leur place.

**ITA**

Rimuovere il coperchio (7) completo delle molle (10), (11) di ritorno pistone (15) e dell'anello OR (8).

**NOTA.** Controllare l'anello OR (8) e, se necessario, sostituirlo.

**D**

Den Deckel (7) samt Rückzugsfedern (10), (11) des Kolbens (15) und O-Ring (8) abnehmen.

**BEMERKUNG.** O-Ring (8) kontrollieren und, wenn nötig, auswechseln.

**ESP**

Remover la tapa (7) completo de los muelles (10) y (11) de vuelta piston (15) y del anillo OR (8).

**NOTA.** Controlar el anillo OR (8) y, si necesario, substituirlo.

**F**

Enlever le couvercle (7), complet des ressorts (10), (11) de retour piston (15) et de la bague OR (8).

**REMARQUE.** Contrôler la bague OR (8), la substituer si besoin en est.

**ITA**

Allentare ed asportare le viti (12) di ritegno del cilindro (13).

**D**

Halteschrauben (12) des Zylinders (13) lockern und abnehmen.

**ESP**

Alojar y sacar los tornillos (12) de retención del cilindro (13).

**F**

Desserrer et enlever les vis (12) de butée du cylindre (13).

**ITA**

Forzando con una leva, rimuovere il cilindro (13) completo del pistone (15) del freno negativo e del disco intermedio (16).

**D**

Mit einem Hebel den Zylinder (13) samt Kolben (15) der Federspeicherbremse und Zwischenscheibe (16) abnehmen.

**ESP**

Forzando con una palanca, remover el cilindro (13) completo del pistón (15) del freno negativo y del disco intermedio (16).

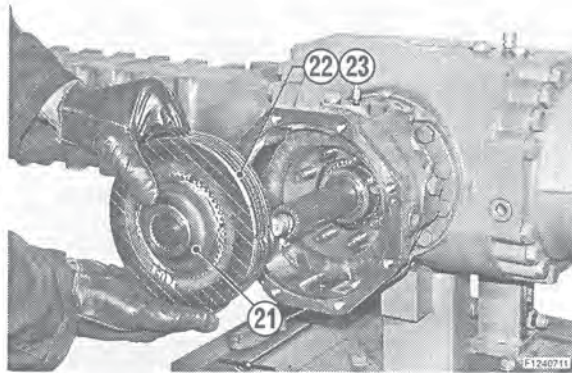
**F**

En forçant à l'aide d'un levier, enlever le cylindre (13) complet du piston (15) du frein négatif et du disque intermédiaire (16).

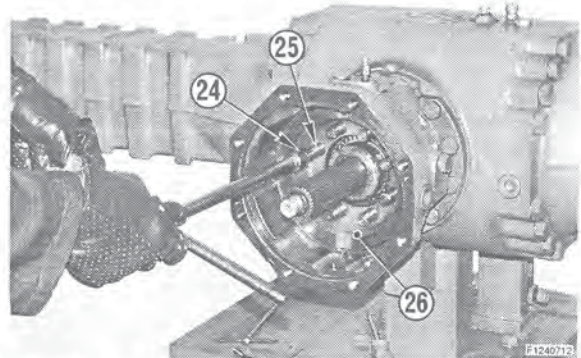




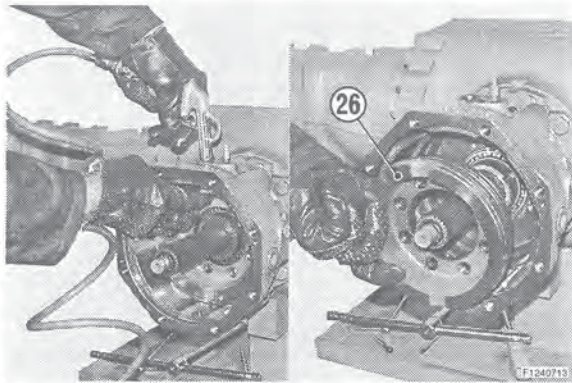
DISASSEMBLING THE 7" COMBINED BRAKE - SMONTAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ABMONTIEREN - DESMONTAJE FRENO COMBINADO DE 7" - DESASSEMBLAGE DU FREIN COMBINE PAR 7"



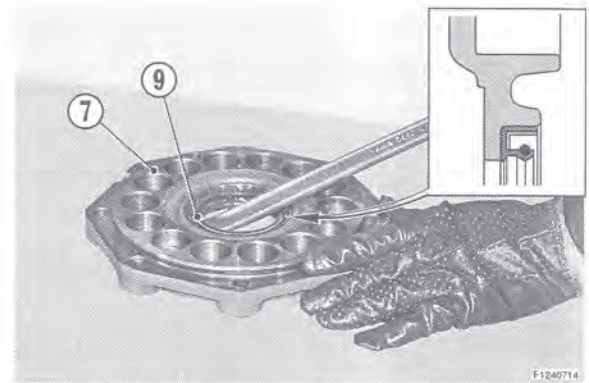
Remove the coupling (21) and the braking discs (22), (23).



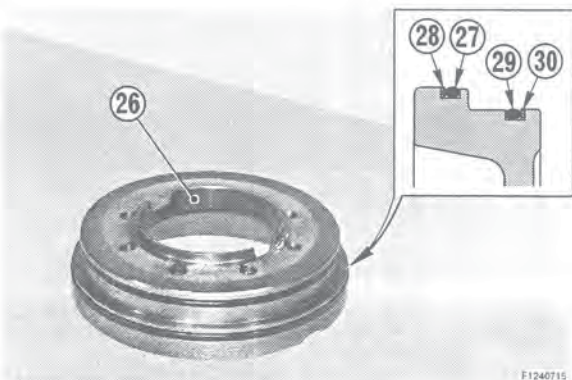
Loosen and remove the pin-type screws (24) and the piston (26) reversal springs (25).



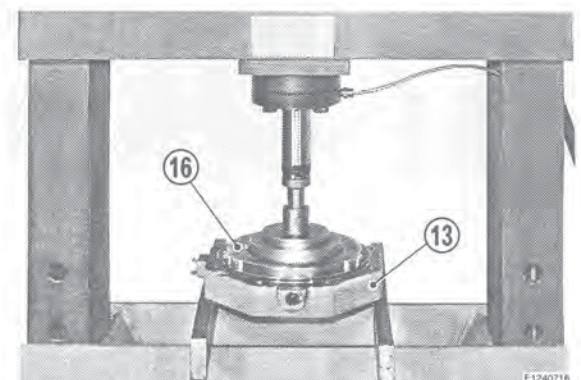
Gently introduce compressed air through the service brake connection point to extract the piston (26).



Remove the snap ring (9) from the cover (7).  
**NOTE.** Note down the direction of assembly and replace the ring (9) each time the unit is disassembled.



Remove O-rings (27), (29) and anti-extrusion rings (28), (30), from the piston (26) of the service brake.  
**NOTE.** The snap rings (17), (19) and anti-extrusion rings (28), (30) must be replaced each time the unit is disassembled.



Place the negative brake cylinder unit (13) under a press and extract the intermediate disc (16) by applying pressure to the internal collar of the piston.





- a**
- ITA** Rimuovere il manicotto (21) ed i dischi di frenatura (22), (23).
- D** Die Muffe (21) und die Bremsscheiben (22), (23) abnehmen.
- ESP** Remover el manghito (21) y los discos de frenadura (22), (23).
- F** Enlever le manchon (21) et les disques de freinage (22) et (23).

- ITA** Allentare ed asportare le viti a perno (24) e le molle (25) di ritorno pistone (26).
- D** Die Stiftschrauben (24) lockern und mit den Rückzugsfedern (25) des Kolbens (26) abnehmen.
- ESP** Allojar y sacar los tornillos a rotula (24) y los muelles (25) de vuelta piston (26).
- F** Desserrer et enlever les vis à pivot (24) et les ressorts (25) de butée piston (26).

- c**
- ITA** Immettere lentamente aria compressa attraverso l'attacco per il freno di servizio per estrarre il pistone (26).
- D** Langsam Druckluft durch den Anschluß der Hilfsbremse lassen, um den Kolben (26) heraus zu drücken.
- ESP** Introducir lentamente aire comprimida a través del ataque para el freno de servicio para el piston (26).
- F** Emettre tout doucement de l'air comprimé à travers le raccordement du frein de service pour extraire le piston (26).

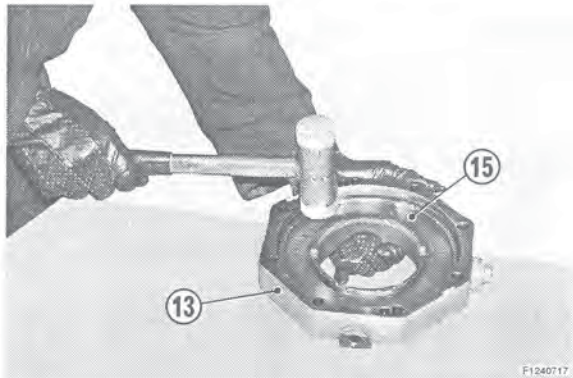
- ITA** Rimuovere dal coperchio (7) l'anello di tenuta (9).  
**NOTA.** Annotare il senso di montaggio e sostituire l'anello (9) ad ogni smontaggio.
- D** Vom Deckel (7) den Dichtungsring (9) abnehmen.  
**BEMERKUNG.** Montagerichtung notieren und bei jeder Abmontage den Dichtungsring (9) auswechseln.
- ESP** Remover de la tapa (7) el anillo de retención (9).  
**NOTA.** Anotar el sentido de montaje y substituir el anillo (9) a cada desmontaje.
- F** Enlever du couvercle (7) la bague d'étanchéité (9).  
**REMARQUE.** Prendre note du sens de monta.

- e**
- ITA** Rimuovere dal pistone (26) del freno di servizio le guarnizioni OR (27), (29) e gli anelli antiestrusione (28), (30).  
**NOTA.** Gli anelli di tenuta (17), (19) ed antiestrusione (28), (30) devono essere sostituiti ad ogni smontaggio.
- D** Vom Kolben (26) der Hilfsbremse die O-Ringe (27), (29) und die Halteringe (28), (30) abnehmen.  
**BEMERKUNG.** Die Dichtungsringe (17), (19) und die Halteringe (28), (30) müssen bei jeder Abmontage ausgewechselt werden.
- ESP** Remover del piston (26) del freno de servicio las guarniciones OR (27), (29) y los anillos antiextrusion (28), (30).  
**NOTA.** Los anillos de retención (17), (19) y antiextrusion (28), (30) deber de ser substituidos a cada desmontaje.
- F** Enlever du piston (26) du frein de service les garnitures OR (27), (29) et les anneaux anti-extrusion (28), (30).  
**REMARQUE.** Les bagues d'étanchéité (17), (19) et anti-extrusion (28), (30) doivent être substituées à chaque démontage.

- ITA** Sistemare il gruppo cilindro (13) freno negativo sotto una pressa ed estrarre il disco intermedio (16) esercitando la pressione sul collare interno del pistone.
- D** Das Zylinderaggregat (13) der Federspeicherbremse unter eine Presse bringen und die Zwischenscheibe (16) heraus drücken; dazu den Druck auf den inneren Kolbenbund ausüben.
- ESP** Colocar el grupo cilindro (13) freno negativo debajo una prensa y sacar el disco intermedio (16) efectuando una presión sobre el collar interno del piston.
- F** Ajuster le groupe cylindre (13) frein négatif sous une presse et extraire le disque intermédiaire (16) en exerçant une pression sur le collier interne du piston.



DISASSEMBLING THE 7" COMBINED BRAKE - SMONTAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ABMONTIEREN - DESMONTAJE FRENO COMBINADO DE 7" - DESASSEMBLAGE DU FREIN COMBINE PAR 7"



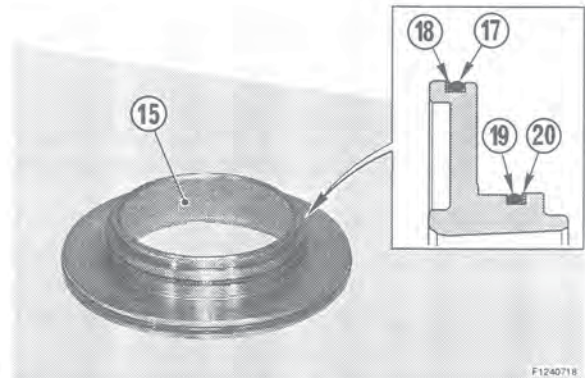
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GB

a

Using a plastic hammer, extract the piston (15) from the cylinder (13).



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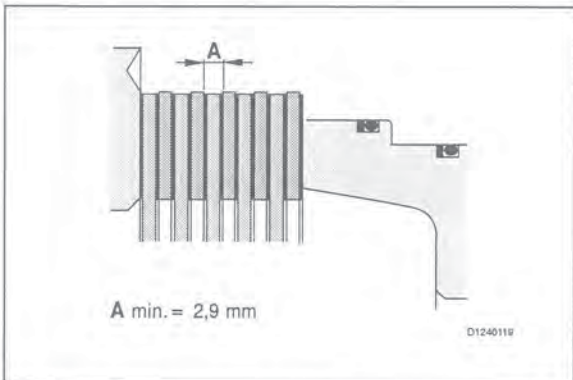


GB

b

Remove O-rings (17), (19) and anti-extrusion rings (18), (20) from the piston (15).

**NOTE.** The snap rings (17), (19) and anti-extrusion rings (18), (20), must be replaced each time the unit is disassembled.



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GB

c

**CAUTION!** Whatever the reasons for disassembling the brake unit, always check the thickness of the braking discs (23). If shim "A" of just one disc (23) is close to the minimum admissible size of 2.9 mm, replace the entire pack.



- a**
- ITA** Utilizzando un mazzuolo in materiale plastico, estrarre dal cilindro (13) il pistone (15).
- D** Mit einem Gummihammer, aus dem Zylinder (13) den Kolben (15) heraus schlagen.
- ESP** Utilizando un martillo de material plastico, sacar el cilindro (13) y el piston (15).
- F** A l'aide d'un maillet en matière plastique, extraire du cylindre (13) le piston (15).

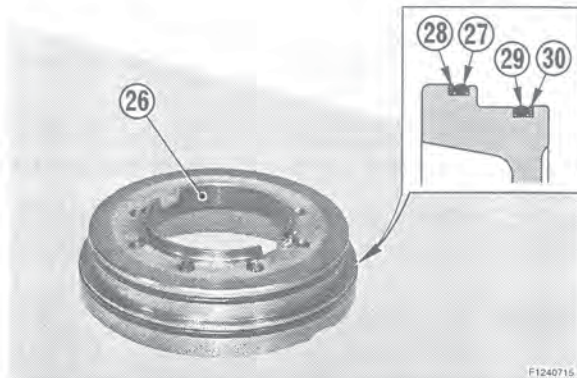
- b**
- ITA** Rimuovere dal pistone (15) le guarnizioni OR (17), (19) e gli anelli antiestrusione (18), (20).  
**NOTA.** Gli anelli di tenuta (17), (19) ed antiestrusione (18), (20) devono essere sostituiti ad ogni smontaggio.
- D** Vom Kolben (15) die O-Ringe (17), (19) und die Halteringe (18), (20) abnehmen.  
**BEMERKUNG.** Die Dichtungsringe (17), (19) und die Halteringe (18), (20) müssen bei jeder Abmontage ausgewechselt werden.
- ESP** Remover del piston (15) las guarniciones OR (17), (19) y los anillos antiextrusion (18), (20).  
**NOTA.** Los anillos de retención (17), (19) y antiextrusion (18), (20) deber de ser substituidos a cada desmontaje.
- F** Enlever du piston (15) les garnitures OR (17), (19) et les bagues anti-extrusion (18), (20).  
**REMARQUE.** Les bagues d'étanchéité (17), (19) et anti-extrusion (18), (20) doivent être substituées à chaque démontage.

- c**
- ITA** **ATTENZIONE!** Anche se il gruppo freno viene smontato per motivi diversi, controllare lo spessore dei dischi di frenatura (23).  
Se lo spessore "A" di un solo disco (23) si avvicina alla misura minima ammessa di 2,9 mm, sostituire l'intero pacco.
- D** **ACHTUNG!** Auch wenn das Bremsaggregat aus anderen Gründen abmontiert wird, die Stärke der Brems Scheiben (23) kontrollieren.  
Wenn die Stärke "A" einer einzigen Scheibe (23) fast das Mindestmaß von 2,9 mm erreicht, muß der gesamte Satz ausgetauscht werden.
- ESP** **ATENCION!** Tambien si el grupo freno viene desmontado por motivos diferentes, controlar el espesor de los discos de frenadura (23).  
Si el espesor "A" de un solo disco (23) se acerca a la medida mínima admitida de 2,9 mm, substituir el entero paquete.
- F** **ATTENTION!** Même si, pour des raisons diverses, le groupe frein est démonté, contrôler les cales des disques de freinage (23).  
Si la cale "A" d'un seul disque (23) est proche à la mesure minimale admise 2,9 mm, substituer le paquet tout entier.

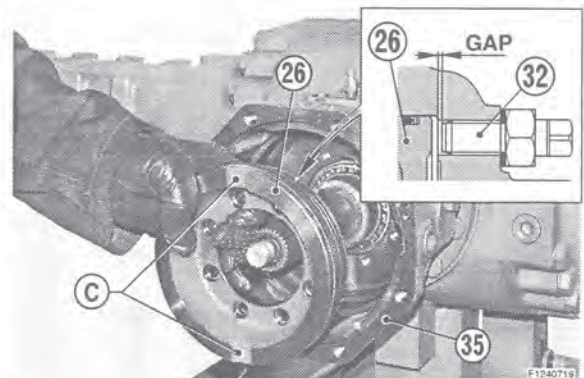




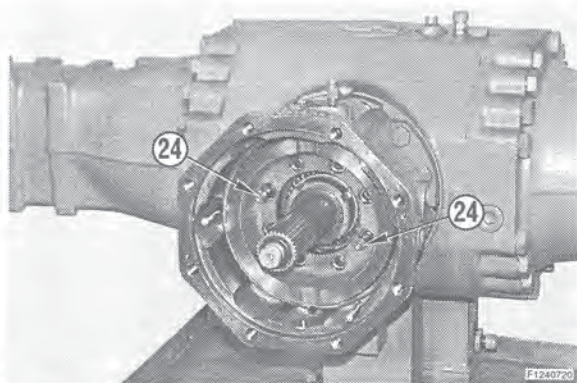
ASSEMBLING THE 7" COMBINED BRAKE - ASSEMBLAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ZUSAMMENBAUEN - ASEMBLAJE FRENO COMBINADO DE 7" - ASSEMBLAGE DU FREIN COMBINE PAR 7"



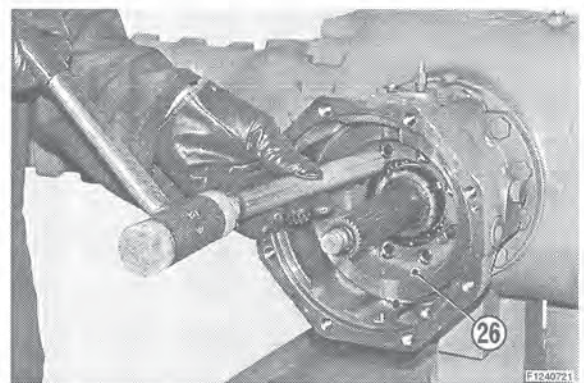
Fit the o-rings (27), (29) and the anti-extrusion rings (28), (30) onto the piston (26).  
**NOTE.** Carefully check the assembly position of rings (28), (30).



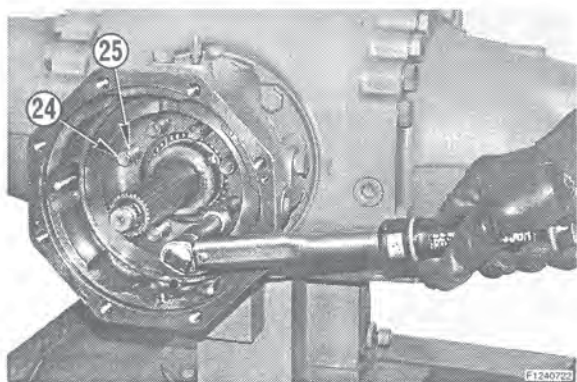
Lubricate the seals and fit the piston (26) into the braking unit (35).  
**NOTES.** 1 - Keep the oil throughways "C" vertical.  
2 - Ensure that the adjusting screws (32) are recessed in relation to the piston (26) touch down plane.



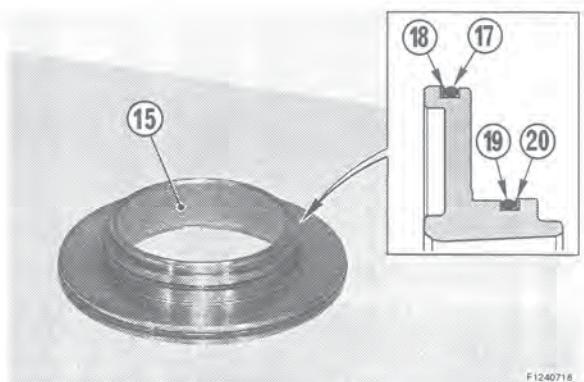
Insert two opposing screws (24) as guides.



Using a pushing device of supple material, push the piston (26) to the end of its stroke.



Remove the two screws (24) used as guides.  
Apply Loctite 242 to the thread of screws (24), fit the springs (25) and screw them in an alternate and criss-cross manner.  
Tighten with a torque of 10 – 15 Nm



Fit the O-rings (17), (19) and the anti-extrusion rings (18), (20) on the piston (15).  
**NOTE.** Carefully check the assembly position of rings (18), (20).





**ITA** Montare sul pistone (26) le guarnizioni OR (27), (29) e gli anelli antiestrusione (28), (30).  
**NOTA.** Controllare attentamente la posizione di montaggio degli anelli (28), (30).

**D** Den Kolben (26), die O-Ringe (27), (29) und die Halteringe (28), (30) montieren.  
**BEMERKUNG.** Sorgfältig die Position der Ringe (28), (30) kontrollieren.

**ESP** Montar sobre el piston (26) las guarniciones OR (27), (29) y los anillos antiextrusion (28), (30).  
**NOTA.** Controlar con cuidado la posición de montaje de los anillos (28), (30).

**F** Monter sur le piston (26) les garnitures OR (27), (29) et les bagues anti-extrusion (28), (30).  
**REMARQUE.** Contrôler attentivement la position de montage des bagues (28), (30).

**ITA** Lubrificare le guarnizioni e montare il pistone (26) nel corpo freno (35).  
**NOTE.** 1 - Tenere verticali i passaggi olio "C".  
2 - Assicurarsi che le viti di registro (32) siano arretrate rispetto al piano di battuta del pistone (26).

**D** Die Dichtungen schmieren und den Kolben (26) in den Bremsenkörper (35) montieren.  
**BEMERKUNGEN.** 1 - Die Öldurchgänge "C" senkrecht halten.  
2 - Kontrollieren, ob die Stellschrauben (32) im Verhältnis zur Anschlagfläche des Kolbens (26) zurück versetzt sind.

**ESP** Lubrificar las guarniciones y montar el piston (26) en el cuerpo freno (35).  
**NOTAS.** 1 - Tener verticales los pasajes aceite "C".  
2 - Asegurarse que los tornillos de registro (32) sean paradas respecto a plan de tope del piston (26).

**F** Lubrifier les garnitures et monter le piston (26) dans le corps frein (35).  
**REMARQUE.** 1 - Tenir en vertical les passages d'huile "C".  
2 - S'assurer que les vis de registre (32) sont en recul par rapport au plan de butée du piston (26).

**ITA** Inserire due viti (24) contrapposte di guida.

**D** Zwei entgegen gesetzte Führungsschrauben (24) einsetzen.

**ESP** Introducir dos tornillos (24) contrapuestos de guía.

**F** Introduire deux vis (24) de guidage opposées.

**ITA** Utilizzando uno spintore in materiale tenero, mandare a fondo corsa il pistone (26).

**D** Mit einem Stößel aus weichem Material, den Kolben (26) den ganzen Hub entlang zurück schieben.

**ESP** Utilizando un empuja en material tierno, mandar a tope el piston (26).

**F** A l'aide d'un poussoir en matériel tendre, envoyer le piston (26) en fin de course.

**ITA** Rimuovere le due viti (24) utilizzate come guida. Spalmare il filetto delle viti (24) con Loctite 242, montare le molle (25) ed avvitarle in modo alternato ed incrociato. Serrarle con una coppia di 10÷15 Nm.

**D** Die zwei Schrauben (24), die als Führung dienen, abnehmen. Das Gewinde der Schrauben (24) mit Loctite 242 schmieren, die Federn (25) montieren und abwechselnd und im Kreuz festziehen. Anzugsmoment: 10÷15 Nm.

**ESP** Remover los dos tornillos (24) utilizados como guía. Pasar la rosca de los tornillos (24) con Loctite 242, montar los muelles (25) y atornillarlos de manera alternada y cruzada. Apretarlos con un par de 10÷15 Nm.

**F** Enlever les deux vis (24) utilisées comme guide. Enduire le filet des vis (24) de Loctite 242, monter le ressort (25) et les visser de manière alternée et croisée. Serrer celles-ci à un couple de 10÷15 Nm.

**ITA** Montare sul pistone (15) le guarnizioni OR (17), (19) e gli anelli antiestrusione (18), (20).  
**NOTA.** Controllare attentamente la posizione di montaggio degli anelli (18), (20).

**D** Auf den Kolben (15) die O-Ringe (17), (19) und die Halteringe (18), (20) montieren.  
**BEMERKUNG.** Sorgfältig die Montageposition der Ringe (18), (20) kontrollieren.

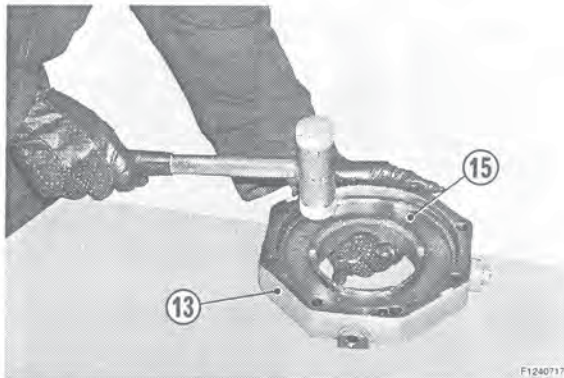
**ESP** Montar sobre el piston (15) las guarniciones OR (17), (19) y los anillos antiextrusion (18), (20).  
**NOTA.** Controlar con cuidado la posición de montaje de los anillos (18), (20).

**F** Monter sur le piston (15) les garnitures OR (17), (19) et les bagues anti-extrusions (18), (20).  
**REMARQUE.** Contrôler attentivement la position de montage des bagues (18), (20).





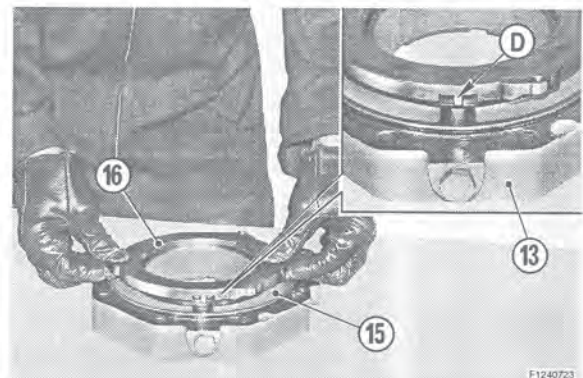
ASSEMBLING THE 7" COMBINED BRAKE - ASSEMBLAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ZUSAMMENBAUEN - ASEMBLAJEE FRENO COMBINADO DE 7" - ASSEMBLAGE DU FREIN COMBINE PAR 7"



GB

a

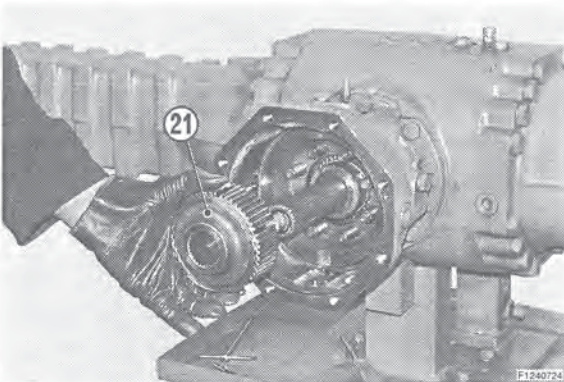
Lubricate the seals and fit the piston (15) in the cylinder (13). Push it to the end of its stroke with the help of a plastic hammer.



GB

b

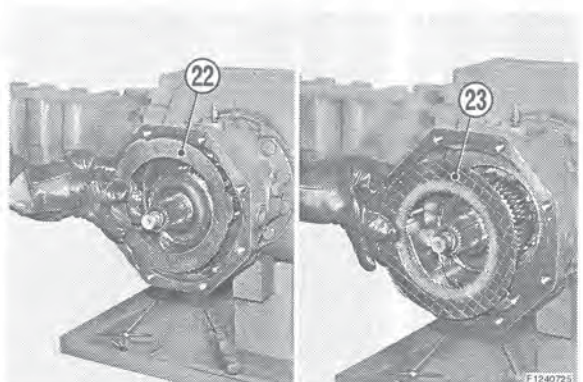
Heat the intermediate disc (16) at about 120° C and install it on the piston (15) by centring tooth "D" in the slot of the cylinder (13).



GB

c

Fit the coupling (21) onto the pinion.

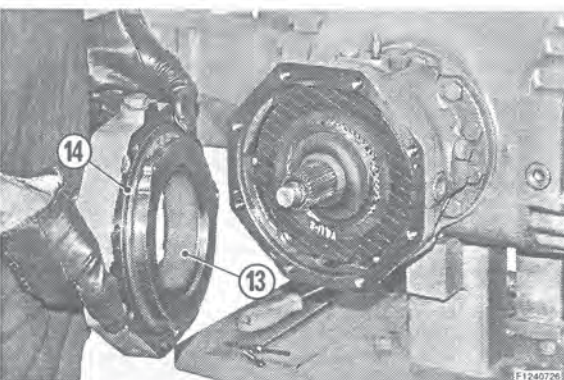


GB

d

Install the braking discs (22), (23) on the coupling (21) by starting with a steel disc (22).

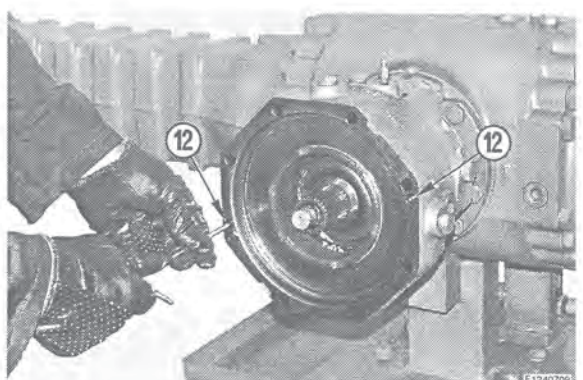
**NOTE.** Before assembling, lubricate the friction discs (23) with oil.



GB

e

Lubricate the O-ring (14) and install the cylinder (13).



GB

f

Fix the cylinder (13) with the screws (12), tightening to a torque of 9.5 – 10.5 Nm.



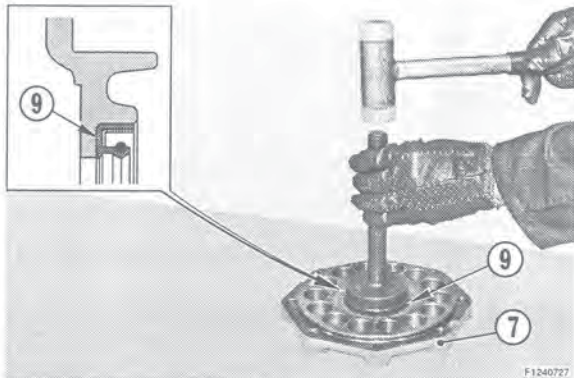


- a**
- ITA** Lubrificare le guarnizioni e montare il pistone (15) nel cilindro (13) mandandolo a fine corsa con un mazzuolo in materiale plastico.
- D** Die Backen schmieren und den Kolben (15) in den Zylinder (13) montieren; diesen mit dem Gummihammer bis zum Anschlag hinein schlagen.
- ESP** Lubrificar las guarniciones y montar el pistón (15) en el cilindro (13) mandándolo a tope con un martillo en material plástico.
- F** Lubrifier les garnitures et monter le piston (15) dans le cylindre (13) en l'envoyant en fin de course à l'aide d'un maillet en matière plastique.
- b**
- ITA** Scaldare il disco intermedio (16) a circa 120°C e montarlo sul pistone (15) centrando il nasello "D" nella cava del cilindro (13).
- D** Die Zwischenscheiben (16) bis auf ca. 120°C erhitzen und auf den Kolben (15) montieren; dabei die Nase "D" in die Zylindernut (13) einsetzen.
- ESP** Calentar el disco intermedio (16) a aprox. 120 °C y montarlo sobre el pistón (15) centrando el codillo "D" en la ranura del cilindro (13).
- F** Chauffer le disque intermédiaire (16) à 120°C environ, puis monter celui-ci sur le piston (15) en centrant bien le mentonnet "D" dans le creux du cylindre (13).
- c**
- ITA** Montare il manicotto (21) sul pignone.
- D** Die Muffe (21) auf den Kolben montieren.
- ESP** Montar el manghito (21) sobre el pistón.
- F** Monter le manchon (21) sur le pignon.
- d**
- ITA** Montare sul manicotto (21) i dischi di frenatura (22), (23) iniziando con un disco in acciaio (22).  
**NOTA.** Prima del montaggio lubrificare con olio i dischi di attrito (23).
- D** Auf die Muffe (21) die Bremsscheiben (22), (23) montieren; dazu mit der Stahlscheibe (22) beginnen.  
**BEMERKUNG.** Vor der Montage die Scheiben (23) mit Öl schmieren.
- ESP** Montar sobre el manghito (21) los discos de frenadura (22), (23) empezando con un disco en acero (22).  
**NOTA.** Antes del montaje lubricar con aceite los discos de atrito (23).
- F** Monter sur le manchon (21) les disques de freinage (22), (23) en commençant par un disque en acier (22).  
**REMARQUE.** Avant de monter, lubrifier avec l'huile les disques de friction (23).
- e**
- ITA** Lubrificare la guarnizione OR (14) e montare il cilindro (13).
- D** Den O-Ring (14) schmieren und den Zylinder (13) montieren.
- ESP** Lubrificar la guarnición OR (14) y montar el cilindro (13).
- F** Lubrifier la garniture OR (14) et monter le cylindre (13).
- f**
- ITA** Fissare il cilindro (13) con le viti (12) serrate con una coppia di 9,5÷10,5 Nm.
- D** Den Zylinder (13) mit den Schrauben (12) befestigen. Anzugsmoment 9,5÷10,5 Nm.
- ESP** Fijar el cilindro (13) con los tornillos (12) apretados con un par de 9,5÷10,5 Nm.
- F** Fixer le cylindre (13) à l'aide des vis (12) serrer celles-ci à un couple de 9,5÷10,5 Nm.





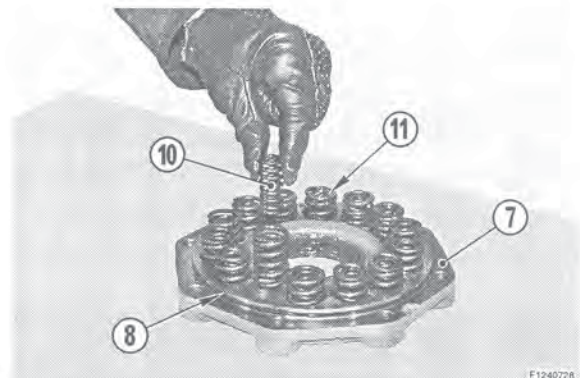
ASSEMBLING THE 7" COMBINED BRAKE - ASSEMBLAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ZUSAMMENBAUEN - ASEMBLAJE FRENO COMBINADO DE 7" - ASSEMBLAGE DU FREIN COMBINE PAR 7"



GB

a

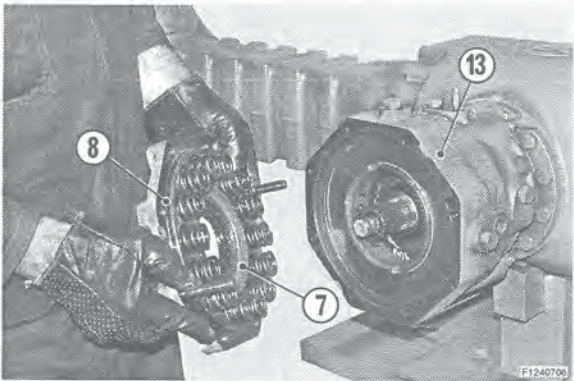
With the help of a punch, fit the snap ring (9) into the cover (7).  
**NOTE.** Carefully check the orientation of the snap ring (9).



GB

b

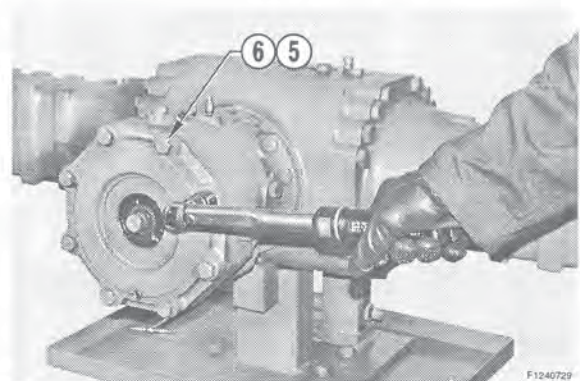
Fit the external (11) and internal (10) reversal springs of piston (15) into the seats of the cover (7).



GB

c

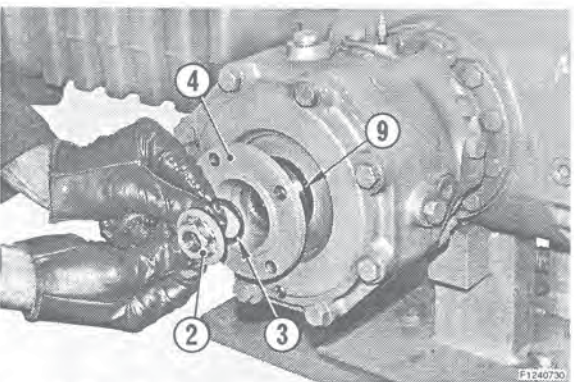
Lubricate the seal (8) and fit the cover unit (7) onto the cylinder (13), as well as the snap washers (6) and the screws (5).



GB

d

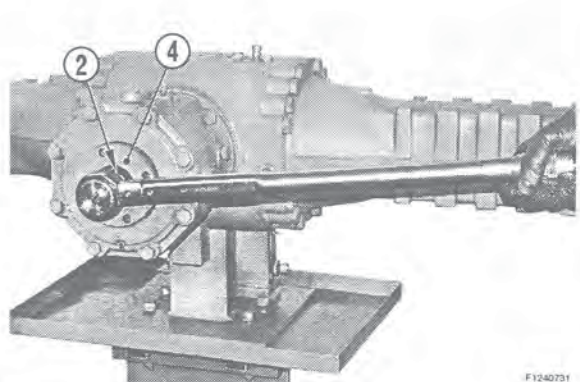
Lock the unit with a dynamometric wrench set to 82-91 Nm.  
**CAUTION!** Tighten the gap by tightening the screws gradually and in a criss-cross manner.



GB

e

Lubricate the snap ring (9) and fit the flange (4) and the O-ring (3). Apply Loctite 242 to the tang of the pinion and fit the nut (2).



GB

f

Tighten the check nut (2) of the flange (4) with a dynamometric wrench set to 280-310 Nm.  
**NOTE.** Use tool T21.





**ITA** Utilizzando un punzone, montare nel coperchio (7) l'anello di tenuta (9).  
**NOTA.** Controllare attentamente l'orientamento dell'anello di tenuta (9).

**D** Mit einem Stößel den Dichtungsring (9) in den Deckel (7) montieren.  
**BEMERKUNG.** Sorgfältig die Montagerichtung des Dichtungsringes (9) kontrollieren.

**ESP** Utilizando un punzon, montar en la tapa (7) el anillo de retención (9).  
**NOTA.** Controlar con cuidado la dirección del anillo de retención (9).

**F** A l'aide d'un poussoir, monter dans le couvercle (7) la bague d'étanchéité (9).  
**REMARQUE.** Contrôler attentivement l'orientation de la bague d'étanchéité (9).

a

**ITA** Montare nelle sedi del coperchio (7) le molle esterne (11) ed interne (10) per il ritorno del pistone (15).

**D** In die Sitze des Deckels (7) die äußere Feder (11) und die innere Rückzugsfeder (10) des Kolbens (15) montieren.

**ESP** Montar en los alojamientos de la tapa (7) los muelles exteriores (11) y interiores (10) para la vuelta del pistón (15).

**F** Monter dans les sièges du couvercle (7), le ressort externe (11) et interne (10) de retour du piston (15).

b

**ITA** Lubrificare la guarnizione (8) e montare sul cilindro (13) il gruppo coperchio (7), le rondelle elastiche (6) e le viti (5).

**D** Die Dichtung (8) schmieren und auf den Zylinder (13) das Deckelaggregat (7), die Federscheiben (6) und die Schrauben (5) montieren.

**ESP** Lubrificar la guarnición (8) y montar sobre el cilindro (13) el grupo tapa (7); las arandelas elasticas (6) y los tornillos (5).

**F** Lubrifier la garniture (8) et monter sur le cylindre (13) le groupe couvercle (7), les rondelles élastiques (6), puis les vis (5).

c

**ITA** Bloccare il gruppo con una chiave dinamometrica tarata a 82÷91 Nm.  
**ATTENZIONE!** Eseguire l'avvicinamento serrando le viti in modo progressivo ed incrociato.

**D** Das Aggregat mit einem auf 82÷91 Nm eingestellten Momentenschlüssel blockieren.  
**ACHTUNG!** Die Schrauben abwechselnd im Kreuz festziehen.

**ESP** Bloquear el grupo con una llave dinamometrica tarada a 82÷91 Nm.  
**ATENCION!** Efectuar el acercamiento apretando los tornillos de manera progresiva y cruzada.

**F** Bloquer le groupe avec une clé dynamométrique tarée à 82÷91 Nm.  
**ATTENTION!** Effectuer le rapprochement en serrant les vis progressivement de manière croisée.

d

**ITA** Lubrificare l'anello di tenuta (9) e montare la flangia (4) e l'anello OR (3).  
Spalmare il codolo del pignone con Loctite 242 e montare il dado (2).

**D** Den Dichtungsring (9) schmieren und den Flansch (4) und den O-Ring (3) montieren.  
Den Kolbenschaft mit Loctite 242 schmieren und die Mutter (2) montieren.

**ESP** Lubrificar el anillo de retención (9) y montar la brida (4) y el anillo OR (3).  
Pasar la punta de pinon con Loctite 242 y montar la tuerca (2).

**F** Lubrifier la bague d'étanchéité (9), puis monter le flasque (4) et la bague OR (3).  
Enduire la queue du pignon au Loctite 242, puis monter l'écrou (2).

e

**ITA** Serrare il dado (2) di ritegno flangia (4) con chiave dinamometrica tarata a 280÷310 Nm.  
**NOTA.** Utilizzare l'attrezzo T21.

**D** Die Mutter (2) zur Halterung des Flansch (4) mit einem Momentenschlüssel bei einem Anzugsmoment von 280÷310 Nm festziehen.  
**BEMERKUNG.** Das Werkzeug T21 verwenden.

**ESP** Apretar la tuerca (2) de retención brida (4) con una llave dinamometrica tarada a 280÷310 Nm.  
**NOTA.** Utilizar la herramienta T21.

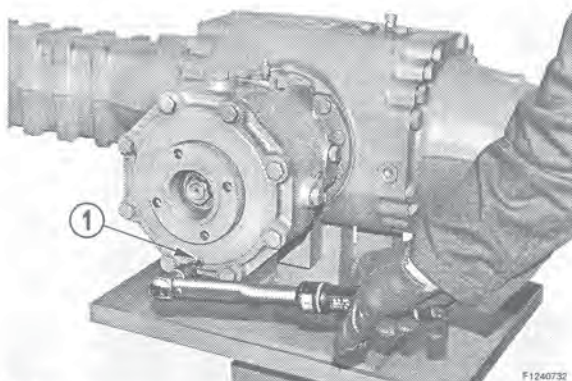
**F** Serrer l'écrou (2) de retenue flasque (4) à l'aide d'une clé dynamométrique tarée à 280÷310 Nm.  
**REMARQUE.** Utiliser l'outil T21.

f





ASSEMBLING THE 7" COMBINED BRAKE - ASSEMBLAGGIO FRENO COMBINATO DA 7" - KOMBINIERTE BREMSE ZU 7" ZUSAMMENBAUEN - ASEMBLAJE FRENO FRENO COMBINADO DE 7" - ASSEMBLAGE DU FREIN COMBINE PAR 7"

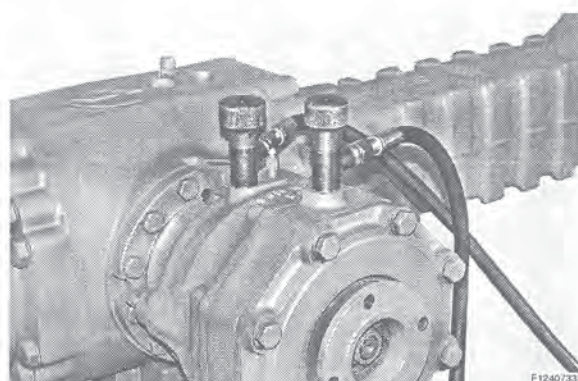


GB

a

Fit the drain plug (1) and, with a dynamometric wrench, tighten to a max. torque of 15 Nm.

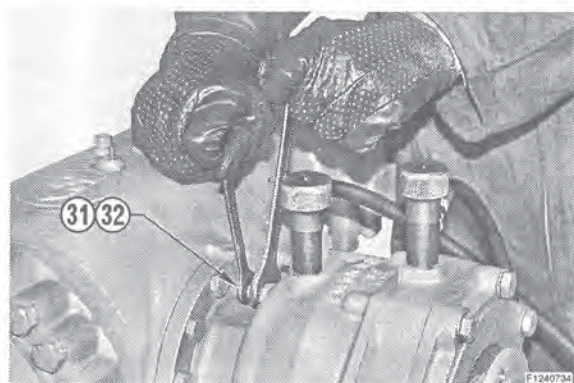
**CAUTION!** Do not exceed the specified torque.



GB

b

Connect the connection points of the service brake and negative brake to an external pump and introduce a pressure of 20 – 30 bar.



GB

c

Adjust the service brake stroke by tightening the screws (32) up to a max. torque of 10 Nm, until they are fixed to the piston (26). Unscrew by 7 faces of the hexagon (equivalent to 2 mm) and secure with the nuts (31), tightening to a torque of 15 Nm.

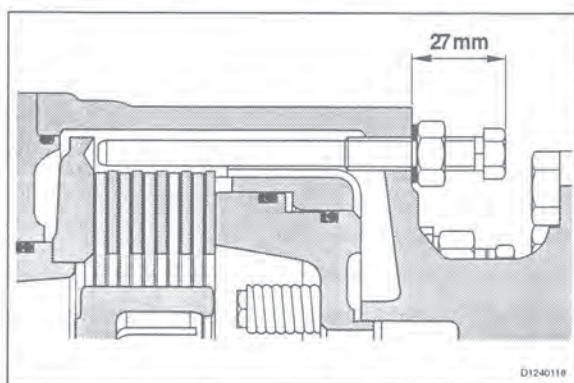


GB

d

**MECHANICAL RELEASE OF THE NEGATIVE BRAKE**

**CAUTION!** To release the negative brake in an emergency, loosen the 3 check nuts (33). Tighten the screws (34) until they are fixed to the piston; tighten further, in a gradual and alternate manner, by a max. of 1.5 turns.



GB

e

When emergency is over, loosen the screws (34) in a gradual and alternate manner until the value of 27 mm is restored. Lock screws in position with the nuts (33) tightened to a torque of 15 Nm.

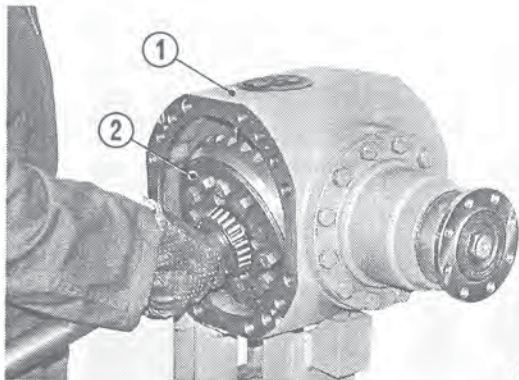


- a**
- ITA** Montare il tappo di scarico (1) e, con chiave dinamometrica, serrarlo con una coppia massima di 15 Nm.  
**ATTENZIONE!** Non superare la coppia prescritta.
- D** Den Ablassstopfen (1) montieren und mit einem Momentenschlüssel bei maximal 15 Nm festziehen.  
**ACHTUNG!** Das vorgeschriebene Anzugsmoment nicht überschreiten.
- ESP** Motar la tapa de descarga (1) y, con llave dinamométrica apretarla con un par máximo de 15 Nm.  
**ATENCIÓN!** No pasar el par prescrito.
- F** Monter le bouchon de vidange (1), puis à l'aide d'une clé dynamométrique serrer celui-ci à un couple maximum de 15 Nm.  
**ATTENTION!** Ne pas dépasser le couple prescrit.
- b**
- ITA** Collegare gli attacchi del freno di servizio e del freno negativo ad una pompa esterna ed immettere una pressione di 20÷30 bar.
- D** Die Anschlüsse der Hilfsbremse und der Federspeicherbremse an eine äußere Pumpe anschließen und einen Druck von 20÷30 bar einlassen.
- ESP** Conectar los ataques del freno de servicio y del freno negativo a una bomba externa y sumergir una presión de 20÷30 bar.
- F** Brancher les raccords du frein de service et du frein négatif à une pompe externe et émettre une pression de 20÷30 bar.
- c**
- ITA** Registrare la corsa del freno di servizio avvitando le viti (32) fino a mandarle in battuta sul pistone (26) fino alla coppia max. di 10 Nm.  
Svitare di 7 facce dell'esagono (pari a 2 mm) e bloccarle con i dadi (31) serrati a 15 Nm.
- D** Den Hub der Hilfsbremse einstellen; dazu die Schrauben (32) bis zum Anschlag am Kolben (26) bei max. 10 Nm zuschrauben.  
Die Sechskantschraube um 7 Kanten (gleich 2 mm) lockern und mit den Muttern (31) bei 15 Nm festziehen.
- ESP** Registrar la carrera del freno de servicio atornillando los tornillos (32) hasta llegar a tope el pistón (26) hasta el par máximo de 10 Nm.  
Destornillar de 7 caras del exágono (igual a 2 mm) y bloquearlas con las tuercas (31) apretados a 15 Nm.
- F** Enregistrer la course du frein de service en vissant les vis (32) jusqu'à les envoyer en butée sur le piston (26) jusqu'à un couple max. de 10 Nm.  
Dévisser de 7 faces l'hexagone (égal à 2 mm), puis bloquer celles-ci à l'aide d'écrous (31) serrés à 15 Nm.
- d**
- ITA** **SBLOCCAGGIO MECCANICO DEL FRENO NEGATIVO**  
**ATTENZIONE!** Per sbloccare il freno negativo in fase di emergenza, allentare i 3 dadi di bloccaggio (33).  
Avvitare le viti (34) fino alla battuta sul pistone; avvitare ulteriormente in modo progressivo alternato fino a far compiere un MAX. di 1,5 giri.
- D** **MECHANISCHE ENTSICHERUNG DER FEDERSPEICHERBREMSE**  
**ACHTUNG!** Um die Federspeicherbremse im Notfall zu entsichern, die 3 Befestigungsmuttern (33) lockern.  
Die Schrauben (34) bis zum Anschlag an den Kolben zuschrauben; die Schrauben um max. 1,5 Drehungen abwechselnd weiter zuschrauben.
- ESP** **BLOQUEO MECANICO DEL FRENO NEGATIVO**  
**ATENCIÓN!** Para sbloquear el freno negativo en fase de emergencia, aflojar las 3 tuercas de bloqueo (33).  
Atornillar los tornillos (34) hasta el tope sobre el pistón; atornillarlos ulteriormente de manera progresiva alternado hasta llevar al Max. de 1,5 giros.
- F** **DEBLOCAGE MECANIQUE DU FREIN NEGATIF**  
**ATTENTION!** Pour débloquer le frein négatif en phase d'urgence, desserrer les 3 écrous de blocage (33).  
Visser les vis (34) jusqu'à ce que le piston aille en butée; visser ensuite celles-ci progressivement et de manière alternée jusqu'à faire accomplir 1,5 tour max.
- e**
- ITA** Dopo l'emergenza, svitare le viti (34) in modo progressivo alternato fino a ripristinare la quota di 27 mm.  
Bloccare la posizione delle viti con i dadi (33) serrati a una coppia di 15 Nm.
- D** Nach dem Notfall, die Schrauben (34) abwechselnd bis auf 27 mm lockern.  
Die Position der Schrauben mit den Muttern (33) bei 15 Nm Anzugsmoment blockieren.
- ESP** Después de la emergencia, destornillar los tornillos (34) de manera progresiva alternada hasta llegar a la cuota de 27 mm.  
Bloquear la posición de los tornillos con las tuercas (33) apretadas a un par de 15 Nm.
- F** Après l'urgence, dévisser les vis (34) progressivement de manière alternée jusqu'à rétablir la cote de 27 mm.  
Bloquer la position des vis au moyen des écrous (33) serrés à un couple de 15 Nm.





**HOW TO DISASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - SMONTAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMOGEN (25% UND 45%) ABMONTIEREN - DESMONTAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - DESMONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



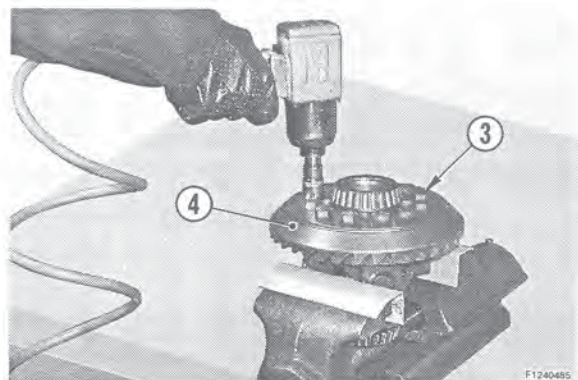
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GB

a

Remove the whole differential unit (2) from the central axle unit (1). For details, see «REMOVING THE DIFFERENTIAL UNIT».



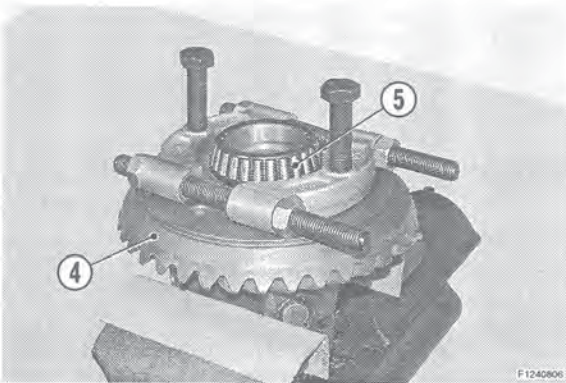
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GB

b

Remove the check screws (3) of the crown (4).  
**NOTE.** Note down the position of the niches of the central hole in relation to the protrusions of the friction unit steel discs.



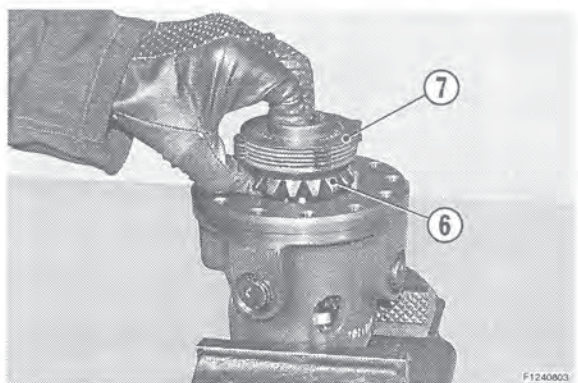
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GB

c

If bearing (5) needs replacing, remove it; remove crown (4).



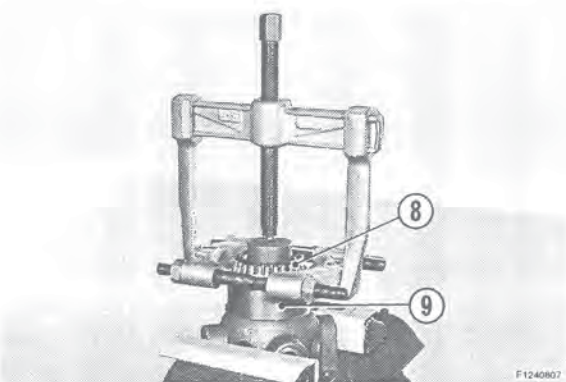
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GB

d

Remove the planetary gear (6) and the whole friction unit (7).



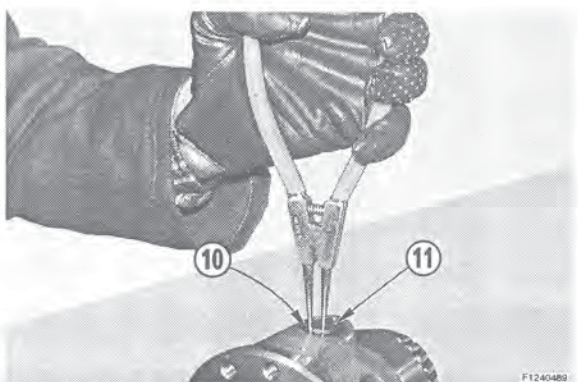
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GB

e

If bearing (8) needs replacing, extract it from the differential unit (9).



F1240489



GB

f

Remove the snap rings (10) from the pins (11) of the planet gears (12).



**ITA** Asportare dal corpo centrale assale (1) il gruppo differenziale (2) completo.  
Per i dettagli, vedere «RIMOZIONE GRUPPO DIFFERENZIALE».

**D** Vom zentralen Achsenkörper (1) das vollständige Differentialaggregat (2) abnehmen.  
Weitere Einzelheiten, siehe «DIFFERENTIALAGGREGAT ABNEHMEN».

**ESP** Sacar del cuerpo central axial (1) el grupo diferencial (2) completo.  
Por los detalles, vease «REMOCION GRUPO DIFERENCIAL».

**F** Enlever le corps central essieu (1) le groupe différentiel (2) complet.  
Pour tout détail, voir «DEPOSE DU GROUPE DIFFERENTIEL».

**a**

**ITA** Rimuovere le viti (3) di ritegno della corona (4).  
**NOTA.** Annotare la posizione delle nicchie del foro centrale rispetto alle sporgenze dei dischi d'acciaio dei gruppi di frizione.

**D** Die Schrauben (3) zur Halterung des Kranzes (4) abnehmen.  
**BEMERKUNG.** Die Position der Nischen des zentralen Lochs im Verhältnis zu den Stahlscheiben der Kupplungsaggregate anmerken.

**ESP** Remover los tornillos (3) de retención de la corona (4).  
**NOTA.** Anotar la colocación de los nichos del agujero central respecto a las partes salientes de los discos de acero de los grupos de frición.

**F** Enlever les vis (3) de fixation de la couronne (4).  
**NOTE.** Prendre note de la position des logements du trou central par rapport à la saillie des disques d'acier des groupes de friction.

**b**

**ITA** Se si deve sostituire, estrarre il cuscinetto (5); rimuovere la corona (4).

**D** Wenn es ausgewechselt werden muß, das Lager (5) heraus nehmen; Kranz (4) abnehmen.

**ESP** Si se debe de substituir, extraer el cojinete (5); remover la corona (4).

**F** Si on doit substituer, extraire le palier (5); enlever la couronne (4).

**c**

**ITA** Rimuovere l'ingranaggio planetario (6) ed il gruppo frizione (7) completo.

**D** Das Planetengetriebe (6) und das vollständige Kupplungsaggregat (7) abnehmen.

**ESP** Remover el engranaje planetario (6) y el grupo frición (7) completo.

**F** Enlever l'engrenage planétaire (6) et le groupe de friction (7) complet.

**d**

**ITA** Se si deve sostituire, estrarre il cuscinetto (8) dal corpo differenziale (9).

**D** Wenn es ausgewechselt werden muß, das Lager (8) vom Differentialkörper (9) heraus nehmen.

**ESP** Si se debe de substituir, extraer el cojinete (8) del cuerpo diferencial (9).

**F** Si on doit substituer, extraire le palier (8) du corps différentiel (9).

**e**

**ITA** Rimuovere gli anelli elastici (10) dai perni (11) degli ingranaggi satelliti (12).

**D** Die Kolbenringe (10) von den Stiften (11) der Planetengetriebe (12) abnehmen.

**ESP** Remover los segmentos elásticos (10) de los pernos (11) de los engranajes satélites (12).

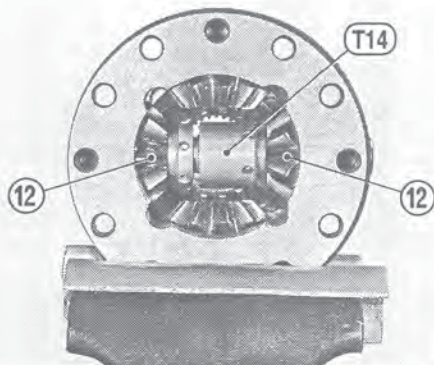
**F** Enlever les anneaux à ressort (10) des axes (11) des engrenages satellites (12).

**f**





**HOW TO DISASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - SMONTAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMOGEN (25% UND 45%) ABMONTIEREN - DESMONTAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - DESMONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



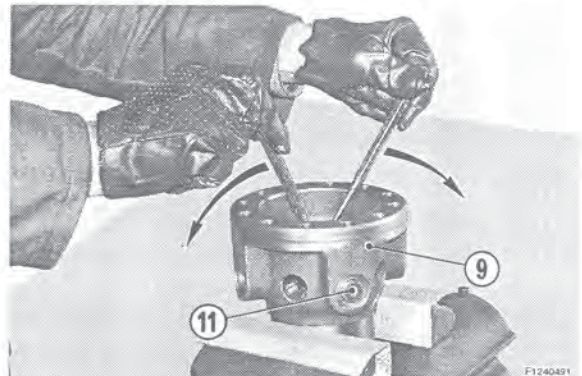
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GB

a

Introduce tool T14 in-between the planet gears (12).



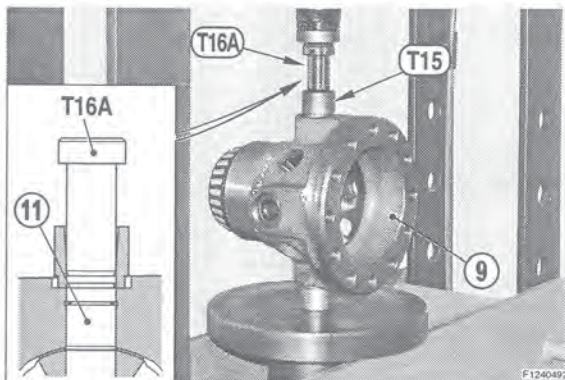
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GB

b

Using two pin-drivers, engage tool T14 in-between the planet gears (12).  
**CAUTION!** Carefully check that tool T14 keeps in an aligned position with the pins (11) when locked.



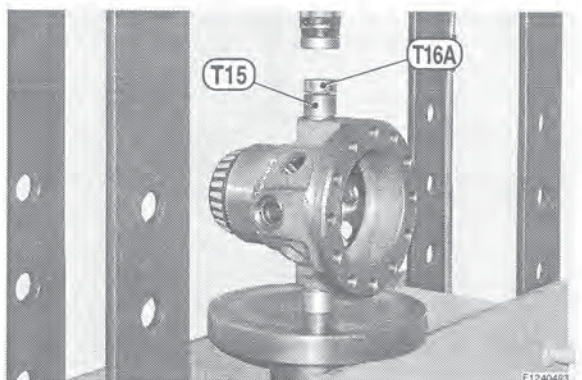
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GB

c

Place the differential unit (9) under a press, position bush T15 and insert gudgeon T16A. Press gudgeon T16A to end of stroke.



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GB

d

Remove gudgeon T16A and bush T15.  
**NOTE.** In this state, the pin (11) is contained within tool T14.



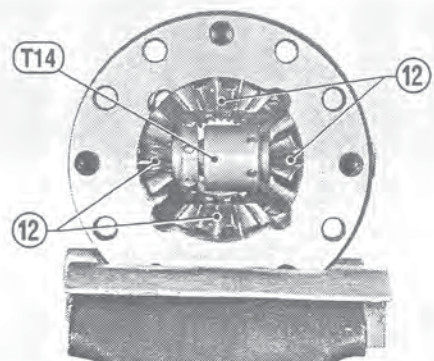
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GB

e

Remove tool T14 and planet pin (11) with it.



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GB

f

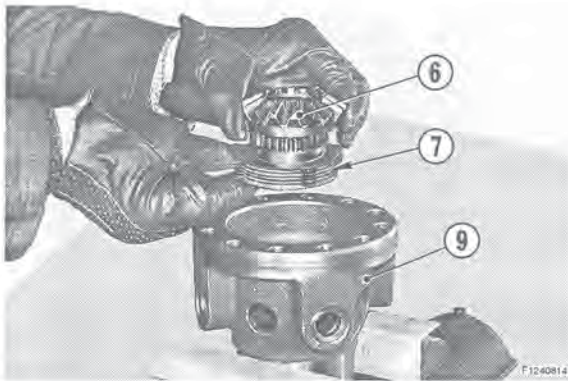
Leaving the released planet in its position, lock again tool T14. Repeat pin extraction operation on the second planet pin (11). Repeat the same operations on the remaining pins.



- a**
- ITA** Inserire tra gli ingranaggi satelliti (12) l'attrezzo T14.
- D** Zwischen den Planetengetriebe (12) das Werkzeug T14 stecken.
- ESP** Introducir entre los engranajes satélites (12) la herramienta T14.
- F** Introduire entre les engrenages satellites (12) l'outil T14.
- b**
- ITA** Operando con due cacciaspine, forzare l'attrezzo T14 tra gli ingranaggi satelliti (12).  
**ATTENZIONE!** Controllare attentamente che l'attrezzo T14 rimanga allineato ai perni (11) quando è bloccato.
- D** Mit zwei Dübeln das Werkzeug T14 zwischen den Zahnradern des Planetengetriebes (12) forcieren.  
**ACHTUNG!** Sorgfältig kontrollieren, ob das Werkzeug T14 mit den Stiften (11) ausgerichtet ist, nachdem es blockiert worden ist.
- ESP** Obrando con dos extractores de clavijas, hacer fuerza sobre la herramienta T14 entre los engranajes satélites (12).  
**ATENCIÓN!** Controlar con cuidado que la herramienta T14 quede en línea a los pernos (11) cuando esta bloqueado.
- F** En oeuvrant avec deux dispositifs arrache-broches, forcer l'outil T14 entre les engrenages satellites (12).  
**ATTENTION!** Contrôler attentivement que l'outil T14 demeure aligné aux axes (11) quand il est bloqué.
- c**
- ITA** Sistemare il corpo differenziale (9) sotto una pressa, posizionare la boccola T15 ed inserire lo spinotto T16A. Pressare lo spinotto T16A fino a fondo corsa.
- D** Den Differentialkörper (9) unter eine Presse legen, die Buchse T15 positionieren und den Bolzen T16A einsetzen. Den Bolzen T16A bis zum Anschlag einpressen.
- ESP** Sistamar el cuerpo diferencial (9) bajo una presa, colocar el carquillo T15 y introducir la cruceta T16A. Empujar la cruceta T16A a tope.
- F** Ajuster le corps différentiel (9) sous une presse, placer l'embout T15 et introduire la cheville T16A. Presser la cheville T16A jusqu'en fin de course.
- d**
- ITA** Asportare lo spinotto T16A e la bussola T15.  
**NOTA.** In questa condizione, il perno (11) è contenuto nell'attrezzo T14.
- D** Den Bolzen T16A und die Buchse T15 abnehmen.  
**BEMERKUNG.** In diesem Zustand befindet sich der Stift (11) im Werkzeug T14.
- ESP** Sacar la cruceta T16A y el manguito T15.  
**NOTA.** En esta condición, el perno (11) esta contenido en la herramineta T14.
- F** Enlever la cheville T16A et la bague T15.  
**NOTE.** Dans ces conditions, l'axe (11) est contenu dans l'outil T14.
- e**
- ITA** Rimuovere l'attrezzo T14 e con esso il perno (11) del satellite.
- D** Das Werkzeug T14 und damit auch den Stift (11) des Planetengetriebes abnehmen.
- ESP** Remover la herramienta T14 y con esta el perno (11) del satélite.
- F** Enlever l'outil T14 et avec celui-ci l'axe (11) du satellite.
- f**
- ITA** Lasciando in posizione l'ingranaggio satellite che si è liberato, bloccare nuovamente l'attrezzo T14. Ripetere le operazioni di estrazione del perno del secondo perno satellite (11).  
Ripetere le operazioni per gli altri perni.
- D** Das Planetengetriebe, das sich freigesetzt hat, in seiner Position lassen, und Werkzeug T14 wieder blockieren.  
Die Vorgänge zum Abnehmen des zweiten Stiftes des Planetengetriebes (11) wiederholen.  
Die Vorgänge für alle anderen Stifte wiederholen.
- ESP** Dejando en posición el engranaje satélite que se ha librado, bloquear de nuevo la herramienta T14. Repetir las operaciones de extracción del perno de segundo perno satélite (11).  
Repetir las operaciones para los otros pernos.
- F** En laissant dans sa position l'engrenage satellite qui s'est dégagé, bloquer de nouveau l'outil T14. Répéter les opérations pour extraire l'axe du deuxième axe satellite (11).  
Répéter les opérations pour les autres axes.



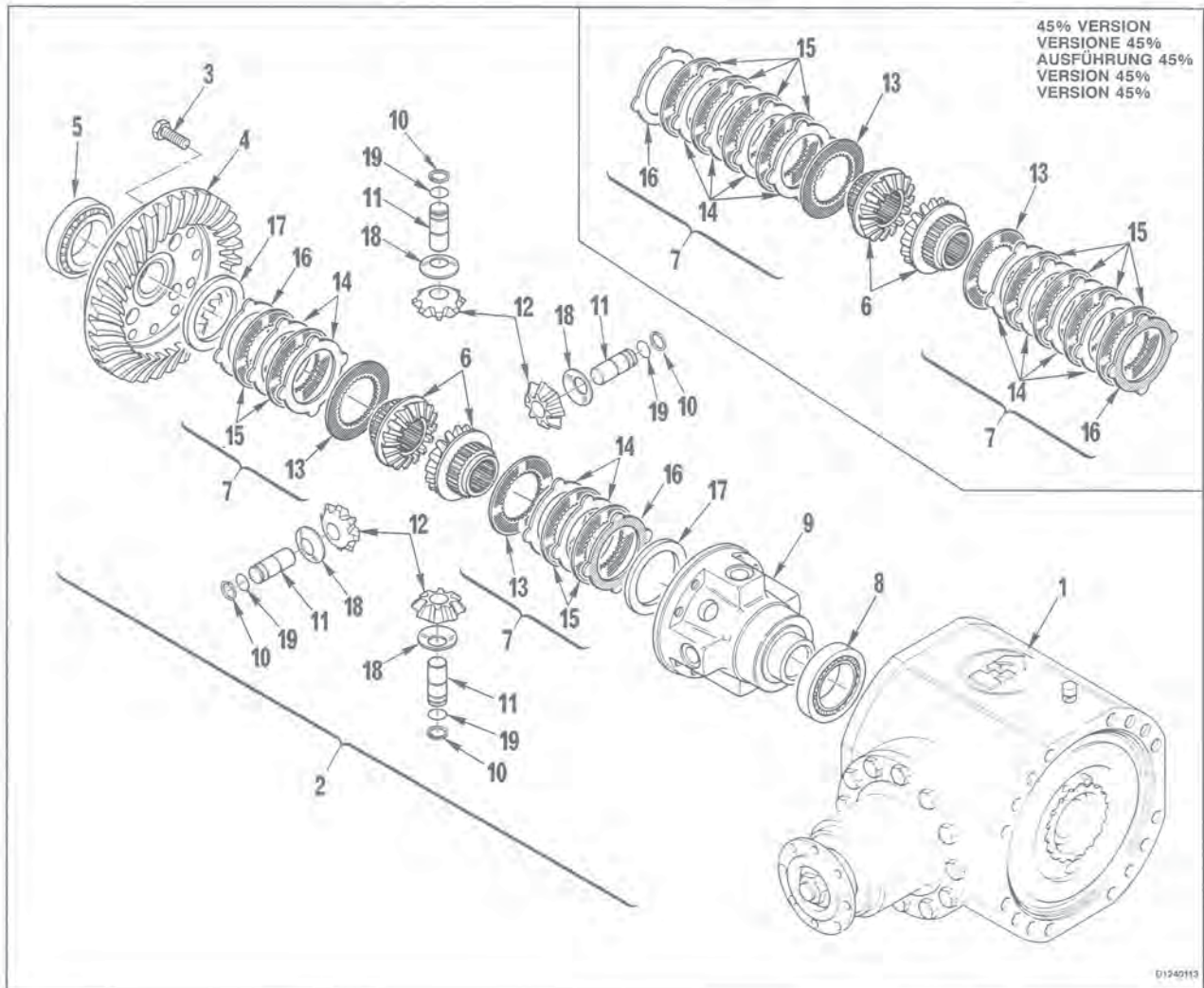
**HOW TO DISASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - SMONTAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) ABMONTIEREN - DESMONTAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - DESMONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



GB

a

Remove tool T14 and extract from the differential unit (9) the two final planet gears (12), the 2<sup>nd</sup> planet gear (6) and the whole friction assembly concerned (7).





a

**ITA** Rimuovere l'attrezzo **T14** ed asportare dal corpo differenziale (9) gli ultimi due ingranaggi satelliti (12), il 2° ingranaggio planetario (6) ed il relativo gruppo di frizione (7) completo.

**D** Das Werkzeug **T14** abnehmen und vom Differentialkörper (9) die letzten beiden Zahnräder des Planetengetriebes (12), das 2. Planetengetriebe und das entsprechende Kupplungsaggregat (7) abnehmen.

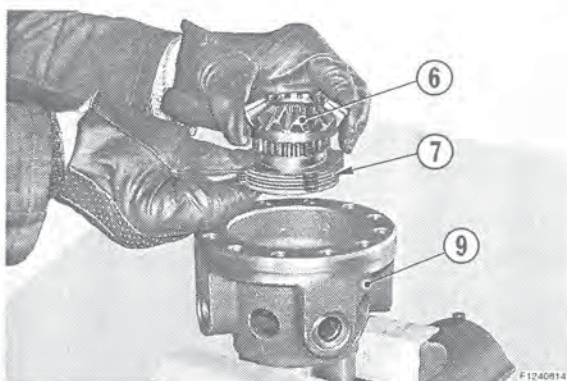
**ESP** Remover la herramienta **T14** y sacar del cuerpo diferencial (9) los últimos dos engranajes satélites (12), el 2º engranaje planetario (6) y el relativo grupo de fricción (7) completo.

**F** Enlever l'outil **T14** puis extraire du corps différentiel (9) les deux derniers engrenages satellites (12), le 2° engrenage planétaire (6) et le groupe de friction relatif (7) complet.





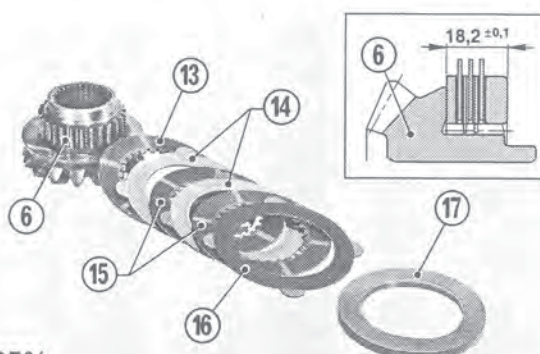
**HOW TO ASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - ASSEMBLAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) MONTIEREN - ASEMBLAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - MONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



GB

a

Place a friction unit (7) - suitable for the specific type of slipping - and planetary gear (6) into the differential unit (9).  
The composition of the unit is illustrated in the points below.



25%

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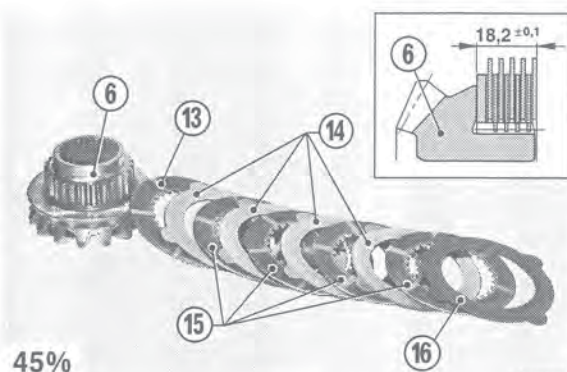
GB

b

**25% FRICTION UNIT COMPOSITION**

Friction ring with increased shim (13), steel rings (14) and friction rings (15) alternated, end ring (16) and distance piece (17).

**CAUTION!** As to rings (13) and (16), the side without notches must face outwards.



45%

F1240816



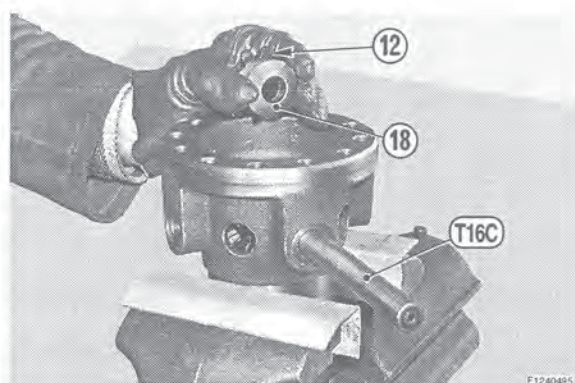
GB

c

**45% FRICTION UNIT COMPOSITION**

Friction ring with increased shim (13), steel rings (14) and friction rings (15) alternated, end ring (16) and distance piece (17).

**CAUTION!** As to rings (13) and (16), the side without notches must face outwards.



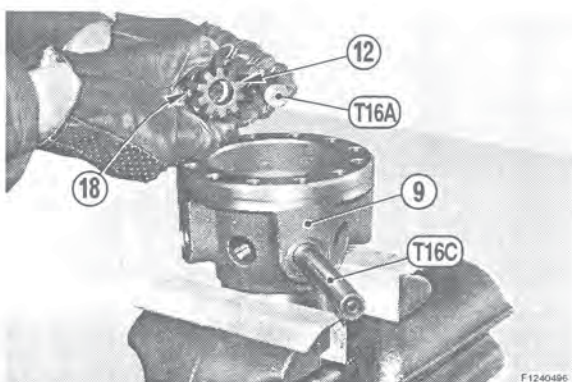
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GB

d

Position shim washer (18) and the first planet gear (12).  
Hold them in position with bar T16C.



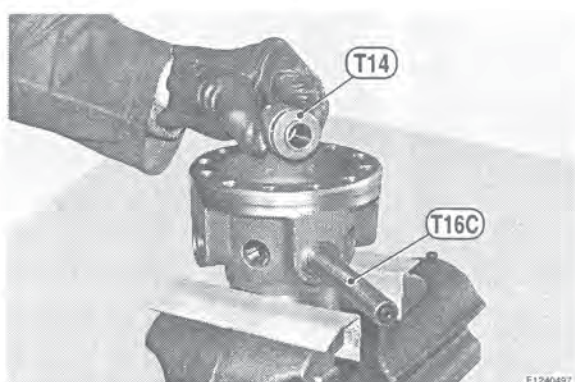
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GB

e

Using gudgeon T16A, position the second planet gear (12) and relative shim washer (18).



F1240497



GB

f

Insert too: T14 in-between the two planet gears (12). Align the whole unit, pushing bar T16C in as far as it will go, until gudgeon T16A is expelled.



- ITA** Inserire nel corpo differenziale (9), il gruppo di frizione (7) specifico per il tipo di slittamento e l'ingranaggio planetario (6).  
La composizione del gruppo di frizione è indicata in seguito.
- D** In den Differentialkörper (9) das für die Gleitungsart und das Planetengetriebe (6) geeignete Kupplungsaggregat (7) einsetzen.  
Die Zusammensetzung des Kupplungsaggregats ist nachstehend beschrieben.
- ESP** Introducir en el cuerpo diferencial (9), el grupo de frición (7) específico por el tipo de deslizamiento y el engranaje planetario (6).  
La composición del grupo de frición es indicada a seguir.
- F** Introduire dans le corps différentiel (9), le groupe de friction (7) spécifique pour le type de patinage et l'engrenage planétaire (6).  
La composition du groupe de friction est indiquée ci-dessous.

- ITA** **COMPOSIZIONE GRUPPO DI FRIZIONE 45%**  
Anello di frizione con spessore maggiorato (13), anelli d'acciaio (14) ed anelli di frizione (15) alternati, anello terminale (16).  
**ATTENZIONE!** Gli anelli (13) e (16) devono avere la parte senza intagli rivolta verso l'esterno.
- D** **ZUSAMMENBAU DES KUPPLUNGSAGGREGATS 45%**  
Kupplungsringe mit größerer Stärke (13), Stahlringe (14) und Kupplungsringe (15), Abschlußring (16).  
**ACHTUNG!** Die Ringe (13) und (16) müssen die glatte Seite nach außen gerichtet haben.
- ESP** **COMPOSICION GRUPO DE FRICION 45%**  
Segmento de frición con espesor mayor (13), segmento de acero (14) y anillo de frición (15) alternados, segmento terminal (16).  
**ATENCION!** Los segmentos (13) y (16) deben tener la parte sin ranaduras hacia el externo.
- F** **COMPOSITION DU GROUPE DE FRICTION 45%**  
Garniture de la friction avec cale majorée (13), anneaux d'acier (14) et garniture de friction (15) alternés, anneau terminal (16).  
**ATTENTION!** Les garnitures (13) et (16) doivent avoir la partie sans entailles tournée vers l'extérieur.

- ITA** Utilizzando lo spinotto **T16A**, posizionare il secondo ingranaggio satellite (12) e la relativa rondella di rasamento (18).
- D** Mit einem Bolzen **T16A** das zweite Planetengetriebe (12) und die Zwischenlegscheibe (18) positionieren.
- ESP** Utilizando la cruceta **T16A**, colocar el segundo engranaje satélite (12) y la relativa arandela de raspadura (18).
- F** A l'aide de la cheville **T16C**, mettre en place le deuxième engrenage satellite (12) et sa rondelle de rasage (18).

- ITA** **COMPOSIZIONE GRUPPO DI FRIZIONE 25%**  
Anello di frizione con spessore maggiorato (13), anelli d'acciaio (14) ed anelli di frizione (15) alternati, anello terminale (16), anello distanziatore (17).  
**ATTENZIONE!** Gli anelli (13) e (16) devono avere la parte senza intagli rivolta verso l'esterno.
- D** **ZUSAMMENBAU DES KUPPLUNGSAGGREGATS 25%**  
Kupplungsringe mit größerer Stärke (13), Stahlringe (14) und Kupplungsringe (15), Abschlußring (16), Distanzscheibe (17).  
**ACHTUNG!** Die Ringe (13) und (16) müssen die glatte Seite nach außen gerichtet haben.
- ESP** **COMPOSICION GRUPO DE FRICION 25%**  
Segmento de frición con espesor mayor (13), segmento de acero (14) y segmento de frición (15) alternados, segmento terminal (16), segmento distancial (17).  
**ATENCION!** Los segmentos (13) y (16) deben de tener la parte sin ranaduras hacia el externo.
- F** **COMPOSITION DU GROUPE DE FRICTION 25%**  
Garniture de friction avec cale majorée (13), anneaux d'acier (14) et garniture de friction (15) alternés, anneau terminal (16), bague entretoise (17).  
**ATTENTION!** Les garnitures (13) et (16) doivent avoir la partie sans entailles tournée vers l'extérieur.

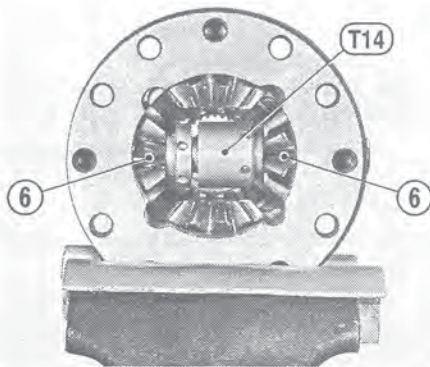
- ITA** Posizionare la rondella di rasamento (18), il primo ingranaggio satellite (12).  
Tenerli in posizione con la barra **T16C**.
- D** Die Zwischenlegscheibe (18) und das erste Planetengetriebe (12) positionieren.  
In dieser Position mit dem Stab **T16C** halten.
- ESP** Colocar la arandela de raspadura (18), el primer engranaje satélite (12).  
Tenerlos en posición con la barra **T16C**.
- F** Mettre la rondelle de rasage (18) en place, puis le premier engrenage satellite (12).  
Maintenir ceux-ci en place avec la barre **T16C**.

- ITA** Inserire tra i due ingranaggi satelliti (12) l'attrezzo **T14**. Allineare tutto il gruppo inserendo a fondo la barra **T16C** fino ad espellere lo spinotto **T16A**.
- D** Die beiden Planetengetriebe (12) mit dem Werkzeug **T14** einsetzen. Das ganze Aggregat ausrichten indem der Stab **T16C** eingesetzt wird, bis der Bolzen **T16A** ausgestoßen wird.
- ESP** Introducir entre los dos engranajes satélites (12) la herramienta **T14**.  
Alinear todo el grupo introduciendo a tope la barra **T16C** hasta sacar la cruceta **T16A**.
- F** Introduire entre les deux engrenages satellites (12) l'outil **T14**.  
Aligner tout le groupe en introduisant la barre **T16C** à fond jusqu'à expulser la cheville **T16A**.





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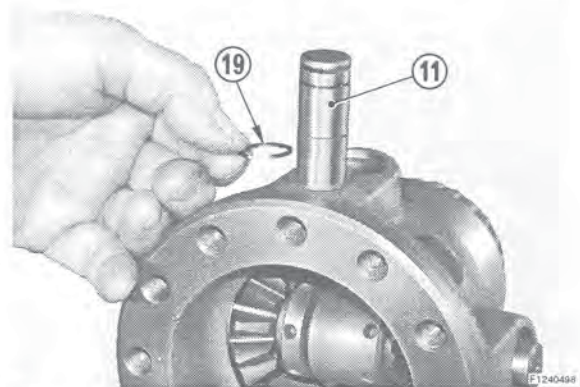
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GB

a

Lock tool **T14** behind the planet gears (12). After locking the tool, remove bar **T16C**.



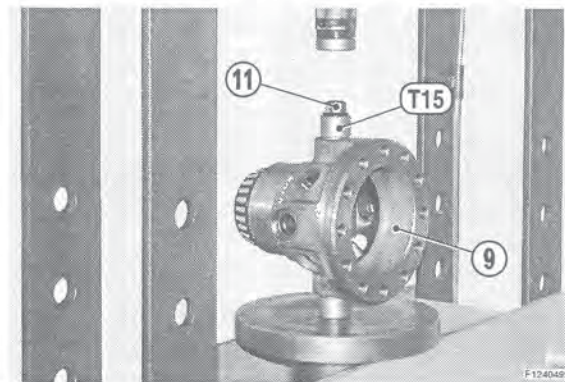
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GB

b

Fit snap rings (19) onto the pins (11).



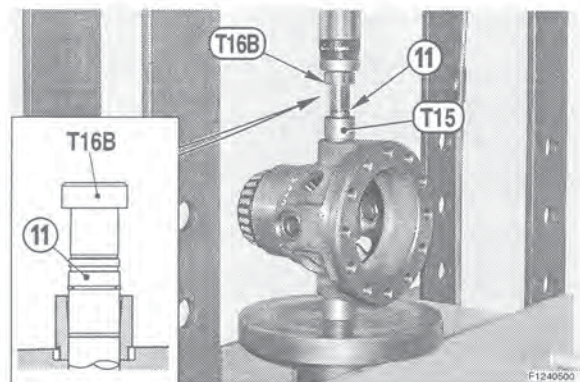
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GB

c

Position the differential unit (9) under the press, position bush **T15** and insert the planet pin (11).



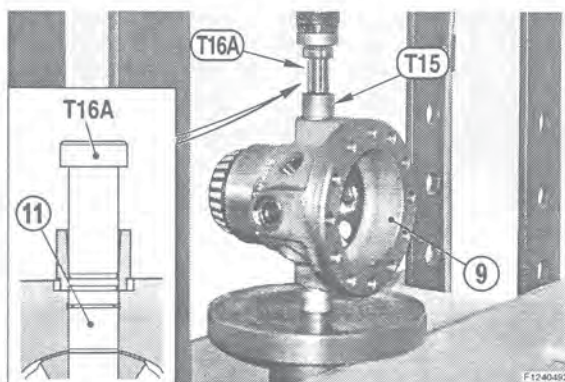
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d

Place gudgeon **T16B** on top of the planet pin (11).



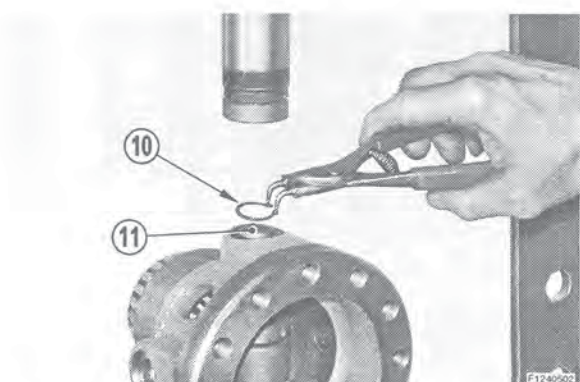
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GB

e

Press gudgeon **T16B** as far down as it will go.



F1240502



GB

f

Remove gudgeon **T16B**, bush **T15**, and fit the snap ring (10) onto the pin (11).  
**CAUTION!** Make sure that the snap ring centers the seat and positions itself on the differential unit face.  
Repeat the operations on the other planet pin and on the other planet unit.





- a**
- ITA** Bloccare l'attrezzo **T14** a ridosso degli ingranaggi satelliti (12).  
Dopo il bloccaggio, rimuovere la barra **T16C**.
- D** Das Werkzeug **T14** am Anschlag der Planetengetriebe (12) blockieren.  
Danach Stab **T16C** abnehmen.
- ESP** Bloquear la herramienta **T14** detras de los engranajes satélites (12).  
Después del bloqueo, remover la barra **T16C**.
- F** Bloquer l'outil **T14** au-dessus des engrenages satellites (12).  
Après le blocage, enlever la barre **T16C**.

- c**
- ITA** Posizionare sotto la pressa il corpo differenziale (9), sistemare la boccia **T15** ed inserire il perno satellite (11).
- D** Unter einer Presse den Differentialkörper (9) positionieren, die Buchse **T15** einlegen und den Planetenstift (11) einsetzen.
- ESP** Colocar bajo la prensa el cuerpo diferencial (9), colocar el casquillo **T15** y introducir el perno satélite (11).
- F** Placer le corps différentiel (9) sous la presse, ajuster l'embout **T15** et insérer l'axe satellite (11).

- e**
- ITA** Pressare lo spinotto **T16B** a fondo.
- D** Den Bolzen **T16B** fest einpressen.
- ESP** Apretar la cruceta **T16B** a tope.
- F** Presser la cheville **T16B** à fond.

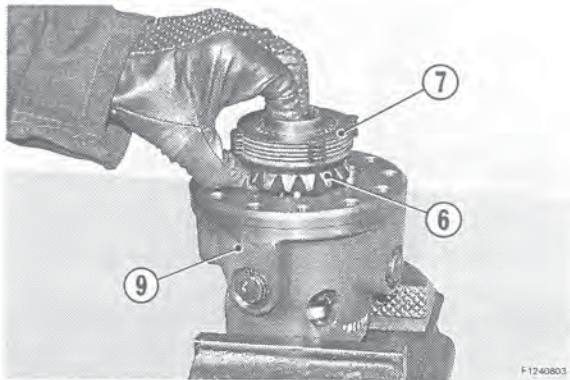
- b**
- ITA** Montare sui perni (11) gli anelli elastici (19).
- D** Auf die Stifte (11) die Kolbenringe (19) montieren.
- ESP** Montar sobre los pernos (11) los segmentos elásticos (19).
- F** Monter sur les axes (11) les anneaux à ressort (19).

- d**
- ITA** Sovrapporre al perno satellite (11) lo spinotto **T16B**.
- D** Auf den Planetenstift (11) den Bolzen **T16B** legen.
- ESP** Sobreponer al perno satélite (11) la cruceta **T16B**.
- F** Poser sur l'axe satellite (11) la cheville **T16B**.

- f**
- ITA** Rimuovere lo spinotto **T16B**, la boccia **T15** e montare sul perno (11) l'anello elastico (10).  
**ATTENZIONE!** Assicurarsi che l'anello elastico centri la sede e che appoggi sul piano del corpo differenziale. Ripetere le operazioni per l'altro perno satellite e per l'altro asse satelliti.
- D** Den Bolzen **T16B**, die Buchse **T15** abnehmen und auf den Stift (11) den Kolbenring (10) montieren.  
**ACHTUNG!** Kontrollieren, ob der Kolbenring im Sitz zentriert ist und auf der Fläche der Fläche des Differentialkörpers liegt. Die Vorgänge für den anderen Planetenstift und die andere Planetenachse wiederholen.
- ESP** Remover la cruceta **T16B**, el casquillo **T15** y montar sobre el perno (11) el segmento elastico (10).  
**ATENCIÓN!** Averiguar que el segmento elastico sea centrado en su alojamiento y que apoye sobre la superficie del cuerpo diferencial. Repetir las operaciones para el otro perno satélite y para el otro eje satélite.
- F** Enlever la cheville **T16B**, l'embout **T15** et monter sur l'axe (11) l'anneau à ressort (10).  
**ATTENTION!** S'assurer que l'anneau à ressort soit bien centré sur le siège et posé sur la surface du corps différentiel. Répéter les opérations pour l'autre axe satellite et l'autre essieu satellite.



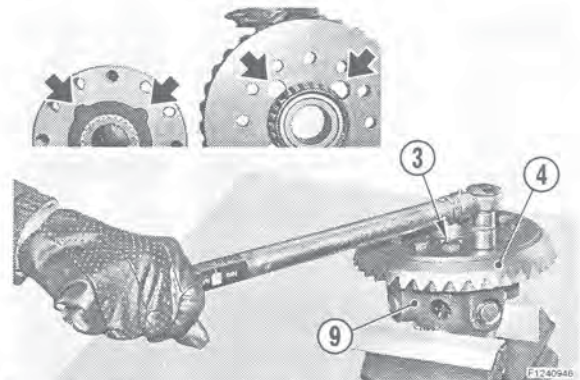
**HOW TO ASSEMBLE THE LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%) - ASSEMBLAGGIO DIFFERENZIALE A SLITTAMENTO LIMITATO (25% E 45%) - DIFFERENTIAL MIT BEGRENZTEM GLEITVERMÖGEN (25% UND 45%) MONTIEREN - ASEMBLAJE DIFERENCIAL A DESLIZAMIENTO LIMITADO (25% Y 45%) - MONTAJE DIFFERENTIEL A GLISSEMENT REDUIT (25% ET 45%)**



GB

a

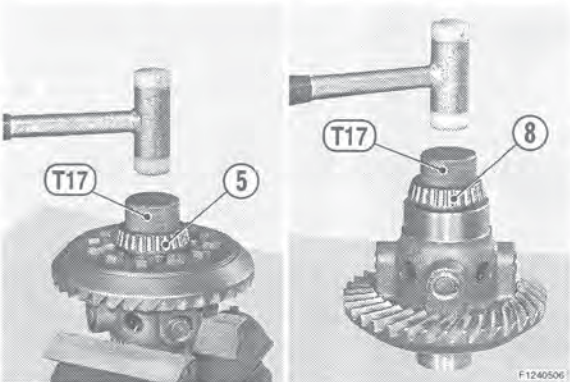
Check that planets have a light clearance in relation to the first planet gear.  
Position the second planetary gear (6) and the second friction unit (7) into the differential unit (9).



GB

b

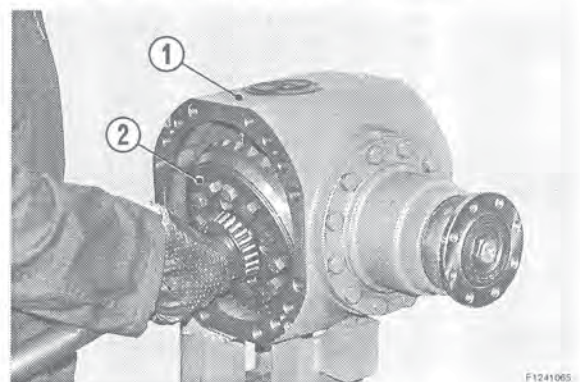
Line the lubrication holes up with the slots in the differential carrier. Orient the holes of the crown (4) towards the protrusions of the braking unit.  
Position the crown (4) on the differential unit (9) and lock it with the screws (3) previously coated with Loctite 242.  
Torque wrench setting for screws: 128 – 142 Nm.  
**NOTE.** Tighten screws using the criss-cross method.



GB

c

If bearings (5) and (8) have been removed, install them using tool T17.



GB

d

Install the whole differential assembly (2) into the central body (1).  
For details, see «INSTALLING THE DIFFERENTIAL UNIT».



**ITA** Controllare che i satelliti abbiano un leggero gioco rispetto il primo ingranaggio planetario.  
Posizionare il secondo ingranaggio planetario (6) ed il secondo gruppo di frizione (7) nel corpo differenziale (9).

**D** Kontrollieren, ob die Planetengetriebe etwas Spiel im Verhältnis zum ersten Planetengetriebe haben.  
Das zweite Planetengetriebe (6) und das zweite Kupplungsaggregat (7) in den Differentialkörper (9) einsetzen.

**ESP** Controlar que los satélites tengan un ligero juego respecto al primero engranaje planetario.  
Colocar el segundo engranaje planetario (6) y el segundo grupo de frición (7) en el cuerpo diferencial (9).

**F** Contrôler que les satellites aient un peu de jeu par rapport au premier engrenage planétaire.  
Mettre le deuxième engrenage planétaire (6) en place ainsi que le second groupe de friction (7) du corps différentiel (9).

**ITA** Se sono stati rimossi, montare i cuscinetti (5) e (8) utilizzando l'attrezzo T17.

**D** Falls sie abmontiert wurden, die Lager (5) und (8) mit dem Werkzeug T17 montieren.

**ESP** Si han sido removidos, montar los cojinetes (5) y (8) utilizando la herramienta T17.

**F** S'ils ont été enlevés, remonter les paliers (5) et (8) à l'aide de l'outil T17.

**ITA** Allineare i fori di lubrificazione della corona (4) con le cave della scatola differenziale sulle sporgenze del gruppo di frenatura. Posizionare la corona (4) sul corpo differenziale (9) e bloccarla con le viti (3) spalmate con Loctite 242. Coppia di serraggio viti: 128÷142 Nm.

**NOTA.** Serrare le viti con il metodo del serraggio incrociato.

**D** Die Schmierlöcher des Kranzes (4) der Differential-schachtel mit den Vorsprüngen des Bremsaggregats ausrichten. Den Kranz (4) auf den Differentialkörper (9) positionieren und mit den Schrauben (3), die zuvor mit Loctite 242 geschmiert wurden, blockieren. Anzugsmoment der Schrauben: 128÷142 Nm.  
**BEMERKUNG.** Sie Schrauben im Kreuz fest schrauben.

**ESP** Alinear los agujeros de lubricar de la corona con los nichos de la caja diferencial (4) sobre las partes salientes del grupo de frenadura.  
Colocar la corona (4) sobre el cuerpo diferencial (9) y bloquearla con los tornillos: 128÷142 Nm.

**NOTA.** Apretar los tornillos de manera cruzada.

**F** Aligner les trous de lubrification de la couronne (4) avec les creux du carter différentiel sur les saillies du groupe de freinage. Placer la couronne (4) sur le corps différentiel (9) et bloquer celle-ci avec les vis (3) enduites de Loctite 242.  
Couple de serrage des vis: 128÷142 Nm.

**NOTE.** Serrer les vis avec la méthode de serrage croisée.

**ITA** Installare nel corpo centrale (1) il gruppo differenziale (2) completo.  
Per i dettagli, vedere «INSTALLAZIONE GRUPPO DIFFERENZIALE».

**D** In den zentralen Körper (1) das vollständige Differentialaggregat (2) installieren.  
Für weitere Einzelheiten, siehe «INSTALLATION DES DIFFERENTIALAGGREGATS».

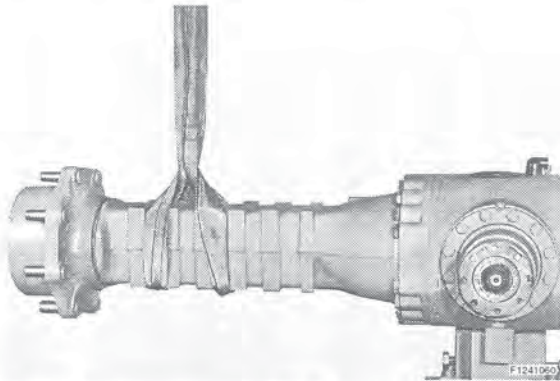
**ESP** Introducir en el cuerpo central (1) el grupo diferencial (2) completo.  
Para los detalles, vease «INSTALACION GRUPO DIFERENCIAL».

**F** Installer dans le corps central (1) le groupe différentiel (2) complet.  
Pour tout détail, voir «INSTALLATION DU GROUPE DIFFERENTIEL».



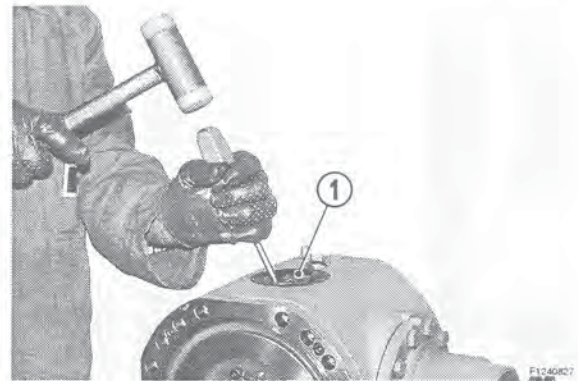


**HOW TO DISASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - SMONTAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - DESMONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



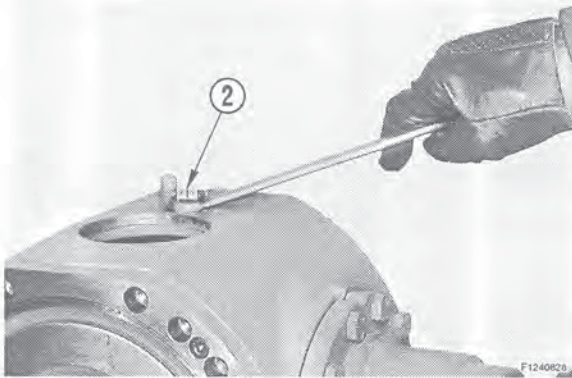
**GB** **a**

Remove the arms.  
For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISCS».



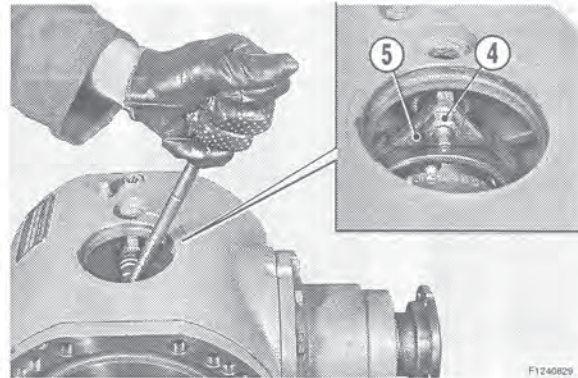
**GB** **b**

Remove the top cap (1).  
**NOTE.** The cap must be replaced each time the unit is disassembled.



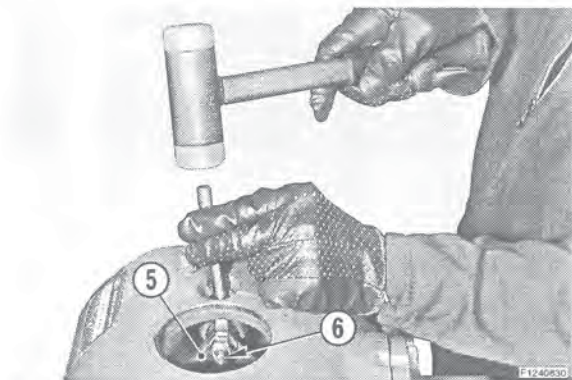
**GB** **c**

Remove the microswitch (2), signalling differential lock operation.  
**NOTE.** Check the state of the O-ring (3).



**GB** **d**

Loosen the lock nut (4) of fork (5) by about 2 turns.



**GB** **e**

Using a metal punch and a hammer, disengage fork (5) from piston cone (6).



**GB** **f**

Using two wrenches, lock piston (6) and remove nut (4).

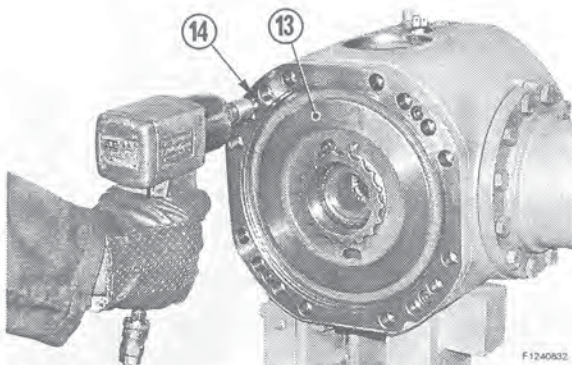


- a**
- ITA** Asportare i bracci.  
Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».
- D** Die Arme abnehmen.  
Für weitere Einzelheiten, siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».
- ESP** Sacar los brazos.  
Para los detalles, vease «CONTROL DESGASTE Y SOSTITUCION DISCOS FRENO».
- F** Enlever les bras.  
Pour tout détail, voir «CONTROLE DE L'USURE ET SUBSTITUTION DES DISQUES FREIN».
- b**
- ITA** Rimuovere il tappo superiore (1).  
**NOTA.** Il tappo deve essere sostituito ad ogni smontaggio.
- D** Unterer Stopfen (1) abnehmen.  
**BEMERKUNG.** Der Stopfen muß jedesmal ausgetauscht werden, wenn er abmontiert wird.
- ESP** Remover la tapa superior (1).  
**NOTA.** La tapa debe de ser substituida a cada desmontaje.
- F** Enlever le bouchon supérieur (1).  
**NOTE.** Le bouchon doit être remplacé à chaque démontage.
- c**
- ITA** Rimuovere il microinterruttore (2) di segnalazione inserimento bloccaggio differenziale.  
**NOTA.** Controllare lo stato della guarnizione OR (3).
- D** Den Mikroschalter (2) abnehmen, der den Einsatz der Differentialblockierung meldet.  
**BEMERKUNG.** Zustand des O-Rings (3) kontrollieren.
- ESP** Remover el microinterruptor (2) de señalación introducción bloqueo diferencial.  
**NOTA.** Controlar el estado de la guarnición OR (3).
- F** Enlever le microinterrupteur (2) qui signale l'insertion du blocage différentiel.  
**NOTE.** Contrôler l'état des garnitures OR (3).
- d**
- ITA** Allentare il dado (4) di bloccaggio della forcella (5) di circa 2 giri.
- D** Mutter (4) zur Blockierung der Gabel (5) um ca. 2 Umdrehungen lockern.
- ESP** Aflojar la tuerca (4) de bloqueo de la horquilla (5) de 2 giros approx.
- F** Desserrer l'écrou (4) de blocage de la fourchette (5) d'environ 2 tours.
- e**
- ITA** Utilizzando un punzone metallico ed un mazzuolo, sbloccare la forcella (5) dal cono del pistone (6).
- D** Mit einem Metallstift und einem Hammer die Gabel (5) von dem Kolbentrichter (6) freisetzen.
- ESP** Utilizando un punzon metalico y un martillo, bloquear l'horquilla (5) del cono del pistón (6).
- F** A l'aide d'un poussoir métallique et d'un mallet, débloquent la fourchette (5) du cône du piston (6).
- f**
- ITA** Utilizzando due chiavi, bloccare il pistone (6) ed asportare il dado (4).
- D** Mit Hilfe von zwei Schlüsseln, den Kolben (6) blockieren und die Mutter (4) abnehmen.
- ESP** Utilizando dos llaves, bloquear el pistón (6) y sacar la tuerca (4).
- F** A l'aide de deux clés, bloquer le piston (6) et enlever l'écrou (4).





**HOW TO DISASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - SMONTAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - DESMONTAJE BLOQUEO DIFFERENCIAL A COMMANDE HYDRAULIQUE**



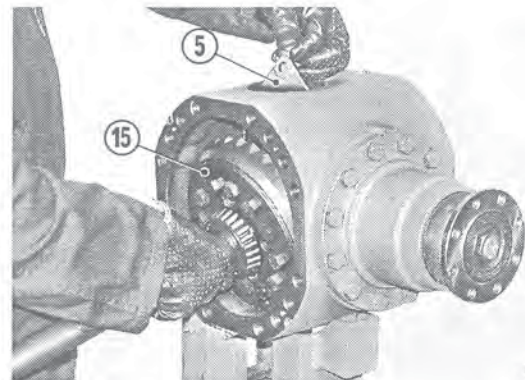
F1240632



GB

a

Remove screws (14) and remove the intermediate cover (13).  
**NOTE.** Support the differential unit with a lever.



F1240633



GB

b

Disconnect fork (5) from piston (6). While holding the fork up, remove the differential unit (15).



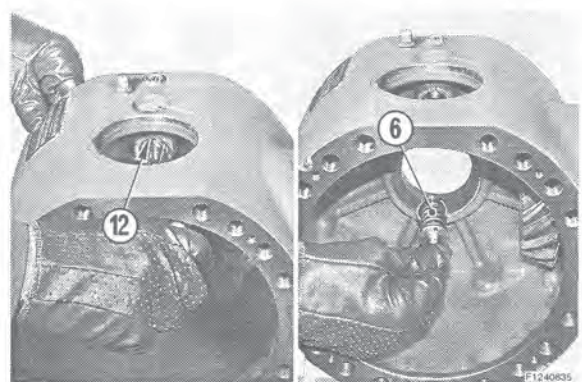
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GB

c

Extract fork (5).



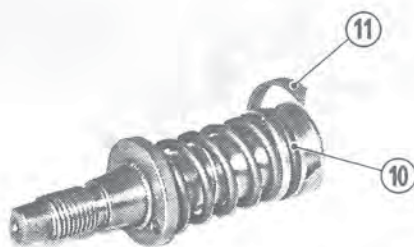
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GB

d

Remove snap ring (12) and whole piston (6).



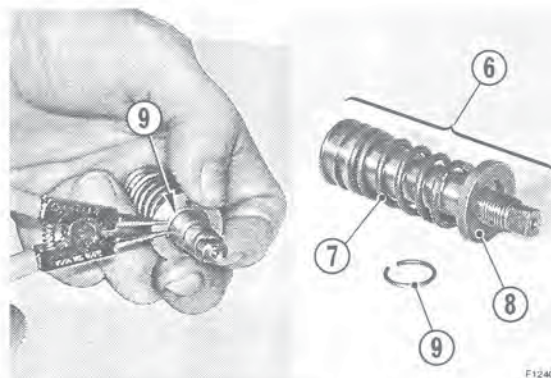
F1240636



GB

e

Remove guide ring (11) and O-ring (10).  
**NOTE.** The guide ring (11) and O-ring (10) must be replaced each time the unit is disassembled.



F1240637



GB

f

Remove snap ring (9) and take piston unit (6) apart. Remove all component parts.





- a**
- ITA** Rimuovere le viti (14) e rimuovere il coperchio intermedio (13).  
**NOTA.** Sostenere il gruppo differenziale con una leva.
- D** Die Schrauben (14) abnehmen und den mittleren Deckel (13) entfernen.  
**BEMERKUNG.** Das Differentialaggregat mit einem Hebel stützen.
- ESP** Remover los tornillos (14) y remover la tapa intermedia (13).  
**NOTA.** Sostener el grupo diferencial con una palanca.
- F** Enlever les vis (14) puis enlever le couvercle intermédiaire (13).  
**NOTE.** Soutenir le groupe différentiel à l'aide d'un levier.

- c**
- ITA** Estrarre la forcella (5).
- D** Die Gabel (5) heraus nehmen.
- ESP** Extraer la horquilla (5).
- F** Extraire la fourchette (5).

- e**
- ITA** Asportare l'anello di guida (11) e la guarnizione OR (10).  
**NOTA.** L'anello di guida (11) e la guarnizione (10) devono essere sostituiti ad ogni smontaggio.
- D** Den Führungsring (11) und den O-Ring (10) abnehmen.  
**BEMERKUNG.** Der Führungsring (11) und die Dichtung (10) müssen jedesmal ausgewechselt werden, wenn sie abmontiert werden.
- ESP** Sacar el segmento de guía (11) y la guarnición OR (10).  
**NOTA.** El segmento de guía (11) y la guarnición (10) deben de ser substituidos a cada desmontaje.
- F** Enlever la bague de guidage (11) et la garniture OR (10).  
**NOTE.** La bague de guidage (11) et la garniture (10) doivent être substituées à chaque démontage.

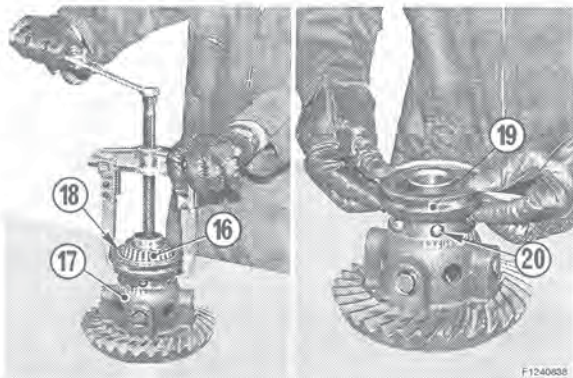
- b**
- ITA** Scollegare dal pistone (6) la forcella (5) e, tenendola sollevata, rimuovere il gruppo differenziale (15).
- D** Vom Kolben (6) die Gabel (5) abtrennen. Die anheben und des Differentialaggregat (15) entfernen.
- ESP** Desconectar del pistón (6) la horquilla y, teniendola levantada, remover el grupo diferencial (15).
- F** Débrancher du piston (6) la fourchette (5) et en tenant cette dernière soulevée, enlever le groupe différentiel (15).

- d**
- ITA** Rimuovere l'anello elastico (12) ed il pistone completo (6).
- D** Den Kolbenring (12) und den vollständigen Kolben (6) abnehmen.
- ESP** Remover el segmento elastico (12) y el pistón completo (6).
- F** Enlever l'anneau à ressort (12) et le piston complet (6).

- f**
- ITA** Rimuovere l'anello elastico (9) e scomporre il gruppo pistone (6) in tutti i suoi componenti (7), (8).
- D** Den Kolbenring (9) abnehmen und das Kolbenaggregat (6) auseinander nehmen, um die Teile (7) und (8) frei zu setzen.
- ESP** Remover el segmento elastico (9) y descomponer el grupo pistón (6) en todos sus componentes (7) y (8).
- F** Enlever l'anneau à ressort (9) et désassembler le groupe piston (6) de tous ses composants (7), (8).



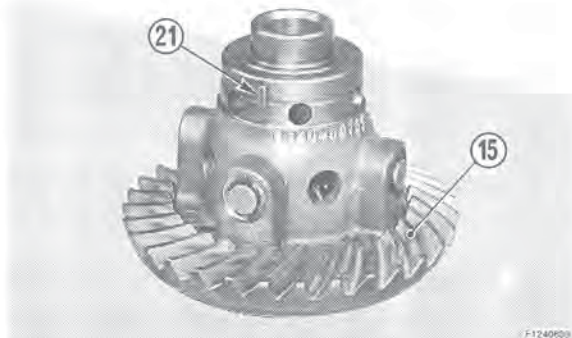
**HOW TO DISASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - SMONTAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG ABMONTIEREN - DESMONTAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - DESMONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



GB

a

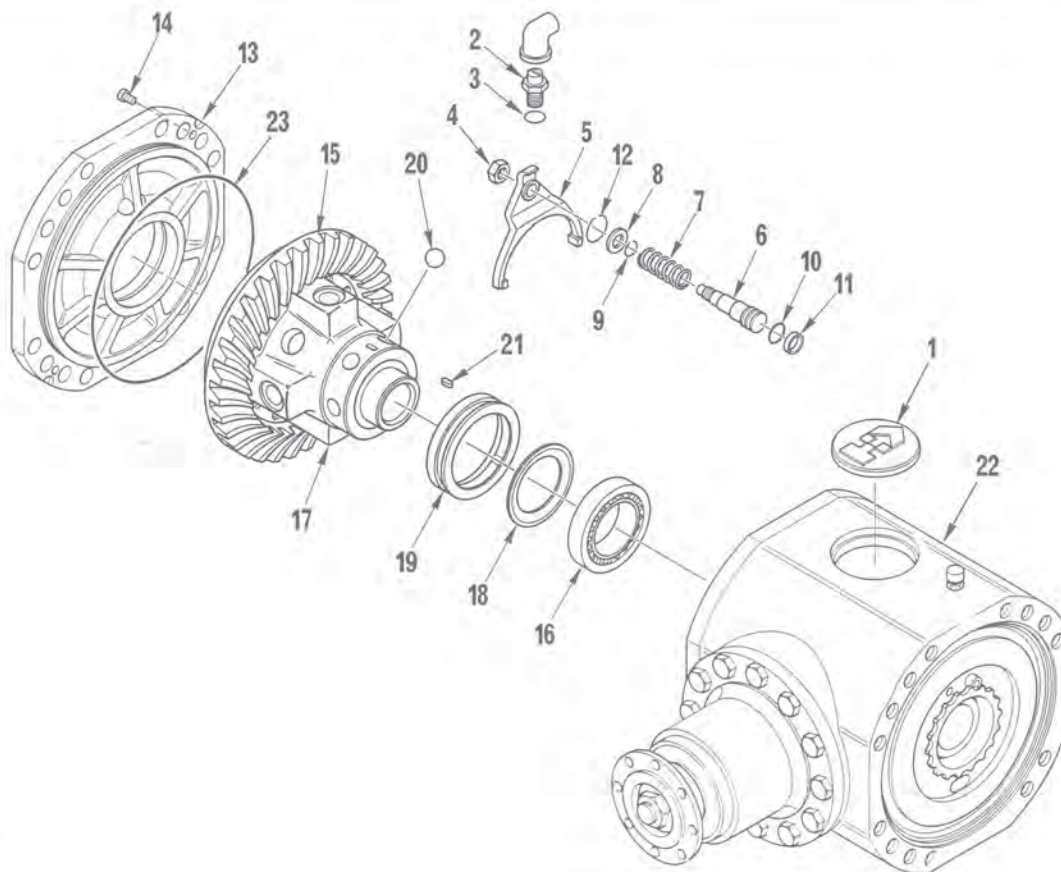
Remove bearing (16) from the differential carrier (17) as well as the stop ring (18), the coupling (19) and the spheres (20).  
**NOTE.** Note down the direction of assembly of the stop ring (18).



GB

b

**ONLY IF NECESSARY**  
Remove the coupling guide key (21) and disassemble the differential unit (15).  
(For details, see «HOW TO DISASSEMBLE THE DIFFERENTIAL UNIT».





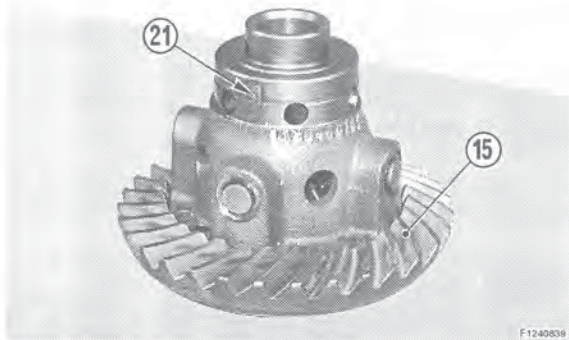
- a**
- ITA** Rimuovere il cuscinetto (16) dalla scatola differenziale (17), l'anello di arresto (18), il manicotto (19) e le sfere (20).  
**NOTA.** Annotare il senso di montaggio dell'anello di arresto (18).
- D** Lager (16) von der Differentialschachtel (17), den Sperring (18), die Hülse (19) und die Kugeln (20) entfernen.  
**BEMERKUNG.** Montagerichtung des Sperrings (18) bemerken.
- ESP** Remover los cojinetes (16) de la caja diferencial (17), el segmento de paro (18) el manguito (19) y las esferas (20).  
**NOTA.** Anotar el sentido de montaje del segmento de paro (18).
- F** Enlever le palier (16) du carter différentiel (17), la bague de butée (18), le manchon (19) et les sphères (20).  
**NOTE.** Prendre note du sens de montage de la bague de butée (18).

- b**
- ITA** **SOLO SE NECESSARIO**  
 Rimuovere la chiavetta (21) di guida del manicotto e smontare il gruppo differenziale (15).  
 (Per i dettagli, vedere «SMONTAGGIO GRUPPO DIFFERENZIALE»).
- D** **NUR FALLS NOTWENDIG**  
 Den Keil (21) zur Führung der Hülse entfernen und das Differentialaggregat (15) abmontieren.  
 (Für weitere Einzelheiten, siehe «DIFFERENTIALAGGREGAT ABMONTIEREN»).
- ESP** **SOLO SI NECESARIO**  
 Remover la Laave (21) de guía del manguito y desmontar el grupo diferencial (15).  
 Para los detalles, vease «DESMONTAJE GRUPO DIFERENCIAL».
- F** **SEULEMENT SI BESOIN**  
 Enlever la clavette (21) de guidage du manchon et démonter le groupe différentiel (15).  
 (Pour tout détail, voir «DÉMONTAGE DU GROUPE DIFFERENTIEL»).



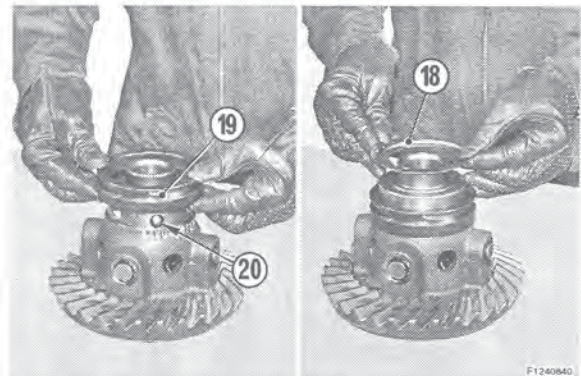


**HOW TO ASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - ASSEMBLAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG MONTIEREN - ASEMBLAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - MONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



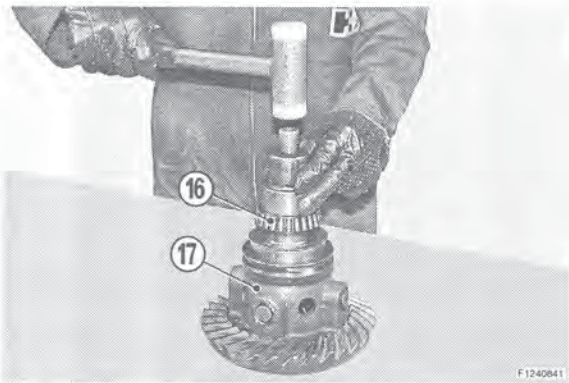
**GB** **a**

**ONLY IF PREVIOUSLY DISASSEMBLED**  
 Assemble the differential unit (15).  
 (For details, see «HOW TO ASSEMBLE THE DIFFERENTIAL UNIT».)  
 Position the guide key (21) of coupling (19).



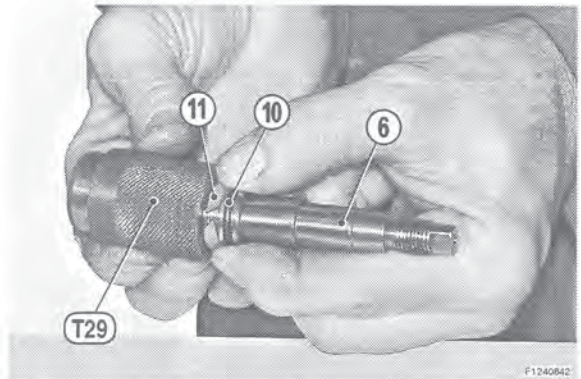
**GB** **b**

Install spheres (20), coupling (19) and stop ring (18).  
**NOTE.** Pay great attention to ring orientation (18).



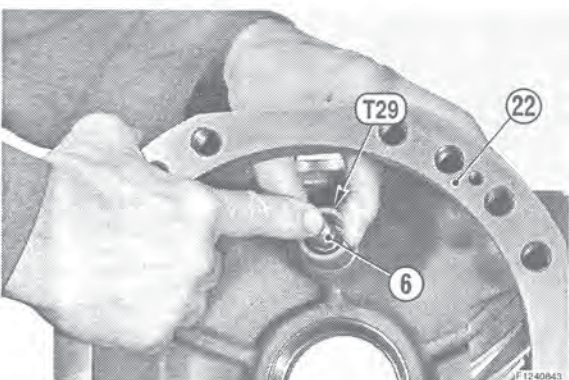
**GB** **c**

Fit bearing (16) onto the differential carrier (17).  
**NOTE.** Make sure that the bearing is well set in the differential carrier.



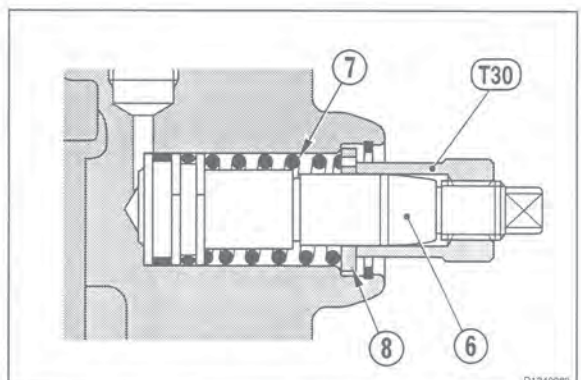
**GB** **d**

Fit O-ring (10) and guide ring (11) onto the piston (6). Lubricate seals and insert the assembly into tool T29.



**GB** **e**

Insert tool T29 in the central unit (22) and push the piston (6) into the seat.  
 Remove tool T29.



**GB** **f**

Fit spring (7) and washer (8) on the piston (6) and install tool T30.





SPICER CLARK-HURTH

- a**
- ITA** **SOLO SE È STATO SMONTATO**  
Assemblare il gruppo differenziale (15).  
(Per i dettagli, vedere «ASSEMBLAGGIO GRUPPO DIFFERENZIALE».)  
Posizionare la chiave (21) di guida del manicotto (19).
- D** **NUR WENN ES ABMONTIERT WURDE**  
Differentialaggregat (15) zusammenbauen.  
(Für weitere Einzelheiten, siehe «DIFFERENTIALAGGREGAT ZUSAMMENBAUEN».)  
Den Keil (21) auf die Führung der Hülse (19) positionieren.
- ESP** **SOLO SI ESTA DESMONTADO**  
Assemblar el grupo diferencial (15).  
(Para los detalles, vease «ASEMBLAJE GRUPO DIFERENCIAL».)  
Colocar la llave (21) de guía del manguito (19).
- F** **SEULEMENT SI DEMONTE**  
Assembler le groupe différentiel (15).  
(Pour tout détail, voir «ASSEMBLAGE DU GROUPE DIFFERENTIEL».)  
Mettre la clavette (21) de guidage du manchon (19) en place.

- ITA** Montare le sfere (20), il manicotto (19) e l'anello di arresto (18).  
**NOTA.** Controllare attentamente l'orientamento dell'anello (18).
- D** Die Kugeln (20), die Hülse (19) und den Sperring (18) montieren.
- ESP** Montar las esferas (20), el manguito (19) y el segmento de paro (18).  
**NOTA.** Controlar atentamente la dirección del segmento (18).
- F** Monter les sphères (20), le manchon (19) et l'anneau de butée (18).  
**NOTE.** Contrôler attentivement l'orientation de l'anneau (18).

- c**
- ITA** Montare sulla scatola differenziale (17) il cuscinetto (16).  
**NOTA.** Assicurarsi che il cuscinetto vada in sicura battuta sulla scatola differenziale.
- D** Auf die Differentialschachtel (17) das Lager (16) montieren.  
**BEMERKUNG.** Sicherstellen, daß das Lager richtig in der Differentialschachtel anschlägt.
- ESP** Montar sobre la caja diferencial (17) el cojinete (16).  
**NOTA.** Asegurarse que el cojinete vaya seguramente a tope sobre la caja diferencial.
- F** Monter sur le carter du différentiel (17) le palier (16).  
**NOTE.** S'assurer que le palier aille en butée sur le carter du différentiel.

- ITA** Montare sul pistone (6) l'anello OR (10) e l'anello di guida (11). Lubrificare le guarnizioni ed inserire il gruppo nell'attrezzo T29.
- D** Auf den Kolben (6) den O-Ring (10) und den Führungsring (11) montieren. Die Dichtungen schmieren und das Aggregat in das Werkzeug T29 setzen.
- ESP** Montar sobre el pistón (6) el segmento OR (10) y el segmento de guía (11). Lubrificar las guarniciones y insertar el grupo en la herramienta T29.
- F** Monter sur le piston (6) la garniture OR (10) et la bague de guidage (11). Lubrifier les garnitures et introduire le groupe dans l'outil T29.

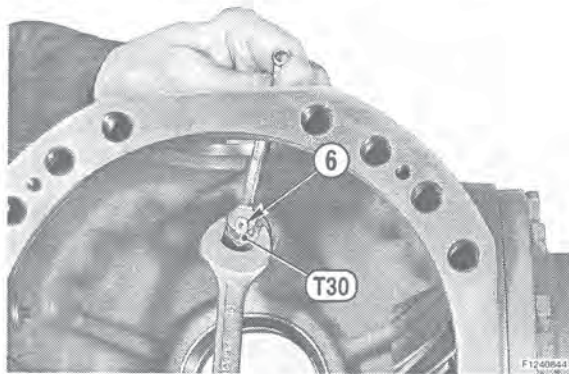
- e**
- ITA** Inserire l'attrezzo T29 nel corpo centrale (22) e spingere il pistone (6) nella sede.  
Rimuovere l'attrezzo T29.
- D** Das Werkzeug T19 in den zentralen Körper (22) setzen und den Kolben (6) in den Sitz drücken.  
Das Werkzeug T29 entfernen.
- ESP** Introducir la herramienta T29 en el cuerpo central (22) y empujar el pistón (6) en su alojamiento.  
Remover la herramienta T29.
- F** Introduire l'outil T29 dans le corps central (22) et pousser le piston (6) dans son siège.  
Enlever l'outil T29.

- ITA** Montare sul pistone (6) la molla (7) e la rondella (8) e montare l'attrezzo T30.
- D** Auf den Kolben (6) die Feder (7) und die Scheibe (8) montieren und das Werkzeug T30 montieren.
- ESP** Montar sobre el pistón (6) el muelle (7) y la arandela (8) y montar la herramienta T30.
- F** Monter sur le piston (6) le ressort (7) et la rondelle (8) puis monter l'outil T30.





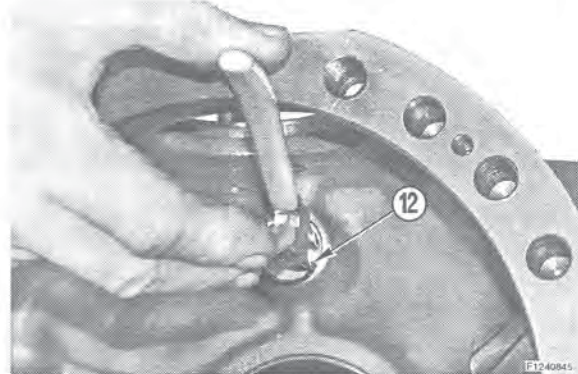
**HOW TO ASSEMBLE THE HYDRAULIC DIFFERENTIAL LOCK - ASSEMBLAGGIO BLOCCAGGIO DIFFERENZIALE A COMANDO IDRAULICO - DIFFERENTIALBLOCKIERUNG MIT HYDRAULISCHER STEUERUNG MONTIEREN - ASEMBLAJE BLOQUEO DIFERENCIAL A MANDO HYDRAULICO - MONTAJE BLOCAGE DIFFERENTIEL A COMMANDE HYDRAULIQUE**



GB

a

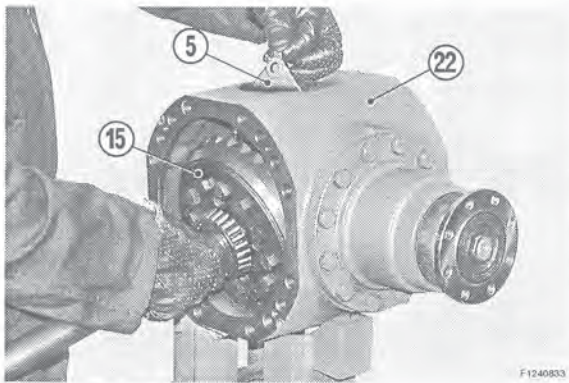
Screw tool **T30** on the thread of the piston (6) to compress spring (7) and vacate the seat for introducing the snap ring (12).



GB

b

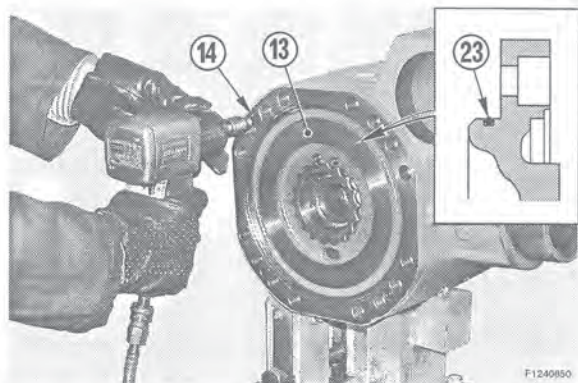
Fit the snap ring (12) of the unit.  
Remove tool **T30** and fit the snap ring (9) of spring (7).



GB

c

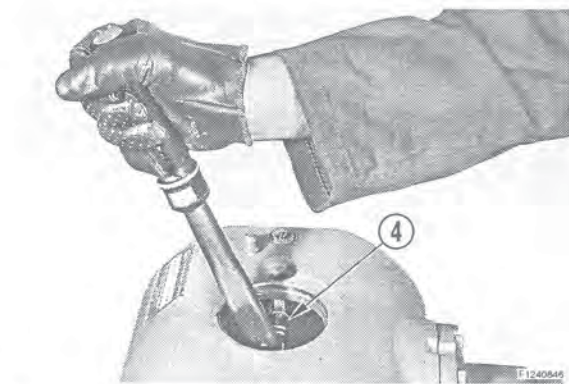
Insert the fork (5) and the differential unit (15) into the central unit (22).  
Engage the fork (5) in the coupling (19) and on the piston (6).



GB

d

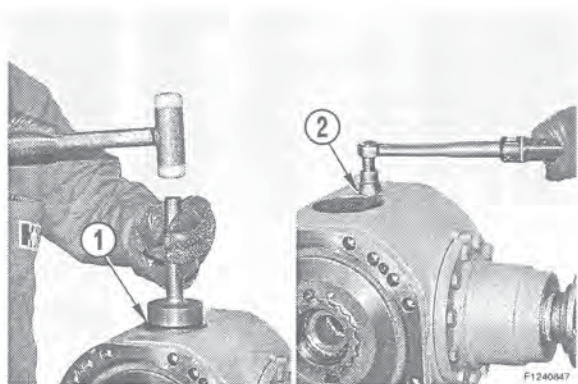
Fit the intermediate cover (13) and lock it with screws (14). Tighten screws using a torque wrench setting of 23.8 – 26.2 Nm.  
**NOTE.** Carefully check the state of the O-ring (23).



GB

e

Fit the lock nut (4) of the fork (5) and lock it with a dynamometric wrench set to a torque of 70 – 75 Nm.



GB

f

Fit the microswitch (2) complete with O-ring; torque wrench setting: max. 30 Nm.  
If necessary, adjust differential unit clearances. (see «DIFFERENTIAL UNIT ASSEMBLY».)  
Fit the top cap (1) and the arms. (For details, see «CHECKING WEAR AND REPLACING THE BRAKING DISKS».)



- a**
- ITA** Avvitare l'attrezzo **T30** sul filetto del pistone (6) per comprimere la molla (7) e liberare la sede per l'anello elastico (12).
- D** Das Werkzeug **T30** auf das Kolbengewinde (6) schrauben, um die Feder (7) zu komprimieren und den Sitz für den Kolbenring (12) freizusetzen.
- ESP** Atornillar la herramienta **T30** sobre la rosca del pistón (6) para comprimir el muelle (7) y dejar libre el alojamiento para el anillo elastico(12).
- F** Visser l'outil **T30** sur le filet du piston (6) pour comprimer le ressort (7) et dégager le siège pour l'anneau à ressort (12).
- b**
- ITA** Montare l'anello elastico (12) di ritegno del gruppo. Rimuovere l'attrezzo **T30** e montare l'anello elastico (9) di ritegno molla (7).
- D** Den Kolbenring (12) zur Halterung des Aggregats montieren.  
Das Werkzeug **T30** abnehmen und den Kolbenring (9) zur Halterung der Feder (7) montieren.
- ESP** IMontar el segmento elastico (12) de compresión del grupo.  
Removerla herramienta **T30** y montar el segmento elastico (9) de compresion muelle (7).
- F** Monter l'anneau à ressort (12) de retenue du groupe. Enlever l'outil **T30** et monter l'anneau à ressort (9) de retenue ressort (7).
- c**
- ITA** Inserire nel corpo centrale (22) la forcella (5) ed il gruppo differenziale (15). Impegnare la forcella (5) nel manicotto (19) e sul pistone (6).
- D** In den zentralen Körper (22) die Gabel (5) und das Differentialaggregat (15) einsetzen.  
Die Gabel (5) in der Hülse (19) und auf den Kolben (6) einsetzen.
- ESP** ntroducir en el cuerpo (22) la horquilla (5) y el grupo diferencial (15).  
Insertar la horquilla (5) en el manguito (19) y sobre el pistión (6).
- F** Introduire dans le corps central (22) la fourchette (5) et le groupe différentiel (15).  
Engager la fourchette (5) dans le manchon (19) puis sur le piston (6).
- d**
- ITA** Montare il coperchio intermedio (13) e bloccarlo con le viti (14) serrate con una coppia di 23,8÷26,2 Nm.  
**NOTA.** Controllare attentamente la condizione dell'anello OR (23).
- D** Den mittleren Deckel (13) montieren und mit den Schrauben (14) mit einem Anzugsmoment von 23,8÷26,2 Nm blockieren.  
**BEMERKUNG.** Zustand des O-Ringes (23) sorgfältig kontrollieren.
- ESP** Montar la tapa intermedia (13) y bloquearla con tornillos (14) apretadas con un par de 23,8÷26,2 Nm.  
**NOTA.** Controlar con cuidado la condición del segmento OR (23).
- F** Monter le couvercle intermédiaire (13) et bloquer celui-ci avec les vis (14) serrées à un couple de 23,8÷26,2 Nm.  
**NOTE.** Contrôler attentivement l'état de la garniture OR (23).
- e**
- ITA** Montare il dado (4) di ritegno forcella (5) e bloccarlo con una chiave dinamometrica tarata ad una coppia di 70÷75 Nm.
- D** Die Mutter (4) zur Halterung der Gabel (5) montieren und mit einem Momentenschlüssel und einem Anzugsmoment von 70÷75 Nm blockieren.
- ESP** Montar la tuerca (4) de compresión horquilla (5) y bloquearla con un llave dinamometrica tarada a un par de 70÷75 Nm.
- F** Monter l'écrou (4) de fixation fourchette (5) et bloquer celui-ci à l'aide d'une clé dynamométrique calibrée à un couple de 70÷75 Nm.
- f**
- ITA** Montare il microinterruttore (2) completo di guarnizione OR; coppia di serraggio: max. 30 Nm.  
Se necessario, registrare i giochi differenziale. (Vedere «ASSEMBLAGGIO DIFFERENZIALE».)  
Montare il tappo superiore (1) ed i bracci. (Per i dettagli, vedere «CONTROLLO USURA E SOSTITUZIONE DISCHI FRENO».)
- D** Die Mikroschalter (2) samt O-Ring montieren. Anzugsmoment: max. 30 Nm.  
Wenn nötig, die Differentialspiele einstellen (Siehe «DIFFERENTIAL ZUSAMMENBAUEN»). Den unteren Stopfen (1) und die Arme montieren. (Für weitere Einzelheiten, siehe «VERSCHLEISS KONTROLLIEREN UND BREMSSCHEIBEN AUSWECHSELN».)
- ESP** Montar el microinterruptor (2) completo de guarnición OR; par de torsión: max. 30 Nm.  
Si necesario, registrar los juegos diferenciales. (Vease «ASEMBLAJE DIFERENCIAL».)  
Montar la tapa superior (1) y los ejes. (Para los detalles, vease «CONTROL DESGASTE Y SOSTITUCION DISCOS FRENO».)
- F** Monter le microinterrupteur (2) équipé de garniture OR; couple de serrage: max. 30 Nm.  
Si besoin, régler les jeux du différentiel (Voir «ASSEMBLAGE DU DIFFERENTIEL»). Monter le bouchon supérieur (1) et les bras. (Pour tout détail, voir «CONTROLE DE L'USURE ET SUBSTITUTION DES DISQUES FREIN».)

# **TRAVEL MOTOR TYPE: A6VM**



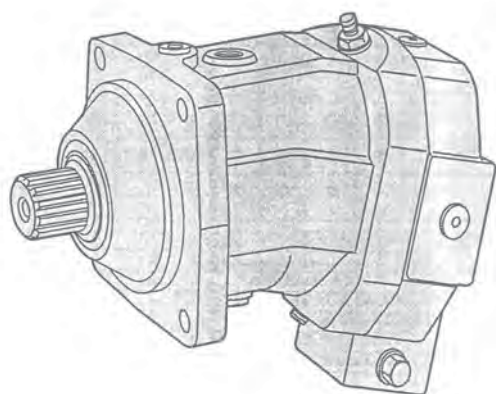


**MANNESMANN  
REXROTH**

Brueninghaus Hydromatik

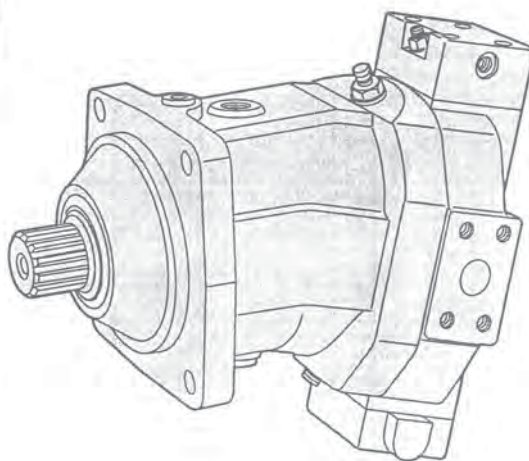
**R**

**Reparaturanleitung  
Repair Instructions**



**A6VM 28 ... 200**

**Baureihe / Series 63**



RDE 91604-01-R  
08.95

**Typschlüssel** **A6V M** / **6 3 W**

**Axialkolbenmaschine**  
 Schrägscheibenbauart, verstellbar **A6V**

**Betriebsart**  
 Motor **M**

**Nenngröße**  
 $\cong$  Schluckvolumen  $V_g \text{ max}$  in  $\text{cm}^3$

NG 250 - 1000 siehe RD 91603

**Regel- und Verstelleinrichtung**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |     | 28 | 55 | 80 | 107 | 140 | 160 | 200 |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|----|----|----|-----|-----|-----|-----|------|---------------|-----|-----|-----|-----------------------------------|---|---|---|---------------------------------|---|---|---|--------------------------------------|---|---|---|--------------------------------------|---|---|---|--------------------------------------------------|---|---|---|--------------------------------------------------|---|---|---|
| Hydraulische Verstellung, steuerdruckabhängig                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | HD  | 1   |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | HD1  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HD  | 2   |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | HD2  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HD  | 1   | D   | ●  | ●  | ●  | ●   | ●   | ●   | ●   | HD1D |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HD  | 2   | D   | ●  | ●  | ●  | ●   | ●   | ●   | ●   | HD2D |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Steuerdruckanstieg $\Delta p = 10 \text{ bar}$ mit Druckregelung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Steuerdruckanstieg $\Delta p = 25 \text{ bar}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Hydraulische Zweipunktverstellung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | HZ1 |     |     | ●  | -  | -  | -   | ●   | ●   | ●   | HZ1  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HZ3 |     |     | -  | ●  | ●  | ●   | -   | -   | -   | HZ2  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Elektrische Verstellung mit Proportionalmagnet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EP  | 1   |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | EP1  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EP  | 2   |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | EP2  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EP  | 1   | D   | ●  | ●  | ●  | ●   | ●   | ●   | ●   | EP1D |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EP  | 2   | D   | ●  | ●  | ●  | ●   | ●   | ●   | ●   | EP2D |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Steuerspannung 12 V mit Druckregelung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Steuerspannung 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Elektr. Zweipunktverstellung mit Schaltmagnet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EZ  | 1   |     | ●  | -  | -  | -   | ●   | ●   | ●   | EZ1  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EZ  | 2   |     | ●  | -  | -  | -   | ●   | ●   | ●   | EZ2  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EZ  | 3   |     | -  | ●  | ●  | ●   | -   | -   | -   | EP3  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EZ  | 4   |     | -  | ●  | ●  | ●   | -   | -   | -   | EP4  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Steuerspannung 12 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Steuerspannung 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Automatische Verstellung, hochdruckabhängig                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | HA  | 1   |     | ●  | ○  | ○  | ○   | ●   | ●   | ●   | HA1  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HA  | 2   |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | HA2  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HA  | 3   |     | -  | ●  | ●  | ●   | -   | -   | -   | HA3  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Ausführung ohne Druckanstieg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Ausführung mit Druckanstieg $\Delta p = 100 \text{ bar}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| <table border="1"> <thead> <tr> <th>Übersteuerung</th> <th>HA1</th> <th>HA2</th> <th>HA3</th> </tr> </thead> <tbody> <tr> <td>ohne Übersteuerung (kein Zeichen)</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>mit hydraulischer Übersteuerung</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>mit elektrischer Übersteuerung, 12 V</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>mit elektrischer Übersteuerung, 24 V</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>mit el. Überst. + el. Fahrtrichtungsventil, 12 V</td> <td>○</td> <td>○</td> <td>-</td> </tr> <tr> <td>mit el. Überst. + el. Fahrtrichtungsventil, 24 V</td> <td>○</td> <td>○</td> <td>-</td> </tr> </tbody> </table> |     |     |     |    |    |    |     |     |     |     |      | Übersteuerung | HA1 | HA2 | HA3 | ohne Übersteuerung (kein Zeichen) | ● | ● | ● | mit hydraulischer Übersteuerung | ● | ● | ● | mit elektrischer Übersteuerung, 12 V | ● | ● | ● | mit elektrischer Übersteuerung, 24 V | ● | ● | ● | mit el. Überst. + el. Fahrtrichtungsventil, 12 V | ○ | ○ | - | mit el. Überst. + el. Fahrtrichtungsventil, 24 V | ○ | ○ | - |
| Übersteuerung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | HA1 | HA2 | HA3 |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| ohne Übersteuerung (kein Zeichen)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ●   | ●   | ●   |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| mit hydraulischer Übersteuerung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ●   | ●   | ●   |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| mit elektrischer Übersteuerung, 12 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ●   | ●   | ●   |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| mit elektrischer Übersteuerung, 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ●   | ●   | ●   |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| mit el. Überst. + el. Fahrtrichtungsventil, 12 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ○   | ○   | -   |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| mit el. Überst. + el. Fahrtrichtungsventil, 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ○   | ○   | -   |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| Hydraulische Verstellung, drehzahlabhängig                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |     |    |    |    |     |     |     |     |      |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| $p_{ST}/p_{HD} = 5/100$ , hydraulisches Fahrtrichtungsventil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | DA1  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| el. Fahrtrichtungsventil (12 V) + el. $Q_{max}$ Schaltung (12 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | DA2  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| el. Fahrtrichtungsventil (24 V) + el. $Q_{max}$ Schaltung (24 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | DA3  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| $p_{ST}/p_{HD} = 8/100$ , hydraulisches Fahrtrichtungsventil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | DA4  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| el. Fahrtrichtungsventil (12 V) + el. $Q_{max}$ Schaltung (12 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | DA5  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |
| el. Fahrtrichtungsventil (24 V) + el. $Q_{max}$ Schaltung (24 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |     | ●  | ●  | ●  | ●   | ●   | ●   | ●   | DA6  |               |     |     |     |                                   |   |   |   |                                 |   |   |   |                                      |   |   |   |                                      |   |   |   |                                                  |   |   |   |                                                  |   |   |   |

Gleichgang-  
kolben



Differential-  
kolben





Typschlüssel  
Type code

Reparaturanleitung A6VM  
Repair Instructions A6VM

Type code **A6V M** / **6 3 W**

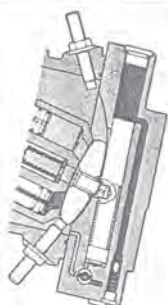
**Axial piston unit**  
Bent axis design, variable displacement **A6V**

**Mode of operation**  
Motor **M**

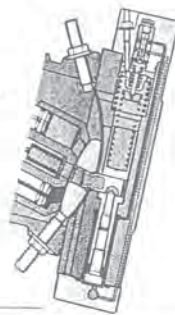
**Size**  
≡ Displacement  $V_g \text{ max}$  in  $\text{cm}^3$  **28 55 80 107 140 160 200**  
Size 250 - 1000 see RE 91603

**Control and regulating device**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |     |     | 28                             | 55 | 80 | 107 | 140 | 160 | 200 |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|--------------------------------|----|----|-----|-----|-----|-----|----------|-----|-----|-----|----------------------------|---|---|---|--------------------|---|---|---|---------------------------|---|---|---|---------------------------|---|---|---|-----------------------------------------------------|---|---|---|-----------------------------------------------------|---|---|---|
| Hydraulic control, pilot pressure related                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | HD                      | 1   |     | •                              | •  | •  | •   | •   | •   | •   | HD1      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | HD                      | 2   |     | •                              | •  | •  | •   | •   | •   | •   | HD2      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | HD                      | 1   | D   | •                              | •  | •  | •   | •   | •   | •   | HD1D     |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | HD                      | 2   | D   | •                              | •  | •  | •   | •   | •   | •   | HD2D     |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Pilot pressure increase $\Delta p = 10 \text{ bar}$<br>Pilot pressure increase $\Delta p = 25 \text{ bar}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |     |     | with constant pressure control |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Hydraulic two-position control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | HZ1                     |     |     | •                              | -  | -  | -   | •   | •   | •   | HZ1      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | HZ3                     |     |     | -                              | •  | •  | •   | -   | -   | -   | HZ2      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Electrical control, with proportional solenoid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | EP                      | 1   |     | •                              | •  | •  | •   | •   | •   | •   | EP1      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EP                      | 2   |     | •                              | •  | •  | •   | •   | •   | •   | EP2      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EP                      | 1   | D   | •                              | •  | •  | •   | •   | •   | •   | EP1D     |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EP                      | 2   | D   | •                              | •  | •  | •   | •   | •   | •   | EP2D     |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Control voltage 12 V<br>Control voltage 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |     |     | with constant pressure control |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Electr. two-position control, w. switching solenoid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EZ                      | 1   |     | •                              | -  | -  | -   | •   | •   | •   | EZ1      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EZ                      | 2   |     | •                              | -  | -  | -   | •   | •   | •   | EZ2      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EZ                      | 3   |     | -                              | •  | •  | •   | -   | -   | -   | EP3      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EZ                      | 4   |     | -                              | •  | •  | •   | -   | -   | -   | EP4      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Control voltage 12 V<br>Control voltage 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Automatic control, high pressure related                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | HA                      | 1   |     | •                              | ○  | ○  | ○   | •   | •   | •   | HA1      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | HA                      | 2   |     | •                              | •  | •  | •   | •   | •   | •   | HA2      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | HA                      | 3   |     | -                              | •  | •  | •   | -   | -   | -   | HA3      |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Model without pressure increase<br>Model with pressure increase $\Delta p = 100 \text{ bar}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| <table border="1"> <thead> <tr> <th>Override</th> <th>HA1</th> <th>HA2</th> <th>HA3</th> </tr> </thead> <tbody> <tr> <td>without override (no code)</td> <td>•</td> <td>•</td> <td>•</td> </tr> <tr> <td>hydraulic override</td> <td>•</td> <td>•</td> <td>•</td> </tr> <tr> <td>electrical override, 12 V</td> <td>•</td> <td>•</td> <td>•</td> </tr> <tr> <td>electrical override, 24 V</td> <td>•</td> <td>•</td> <td>•</td> </tr> <tr> <td>el. override + el. valve for travel direction, 12 V</td> <td>○</td> <td>○</td> <td>-</td> </tr> <tr> <td>el. override + el. valve for travel direction, 24 V</td> <td>○</td> <td>○</td> <td>-</td> </tr> </tbody> </table> |                         |     |     |                                |    |    |     |     |     |     | Override | HA1 | HA2 | HA3 | without override (no code) | • | • | • | hydraulic override | • | • | • | electrical override, 12 V | • | • | • | electrical override, 24 V | • | • | • | el. override + el. valve for travel direction, 12 V | ○ | ○ | - | el. override + el. valve for travel direction, 24 V | ○ | ○ | - |
| Override                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | HA1                     | HA2 | HA3 |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| without override (no code)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | •                       | •   | •   |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| hydraulic override                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | •                       | •   | •   |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| electrical override, 12 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | •                       | •   | •   |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| electrical override, 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | •                       | •   | •   |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| el. override + el. valve for travel direction, 12 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ○                       | ○   | -   |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| el. override + el. valve for travel direction, 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ○                       | ○   | -   |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| Hydraulic control, speed related                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| $p_{ST}/p_{HD} = 5/100$ , hydraulic valve for travel direction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | • • • • • • • • • • DA1 |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| el. valve for travel direction (12 V) + el. $Q_{max}$ switch (12 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | • • • • • • • • • • DA2 |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| el. valve for travel direction (24 V) + el. $Q_{max}$ switch (24 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | • • • • • • • • • • DA3 |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| $p_{ST}/p_{HD} = 8/100$ , hydraulic valve for travel direction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | • • • • • • • • • • DA4 |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| el. valve for travel direction (12 V) + el. $Q_{max}$ switch (12 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | • • • • • • • • • • DA5 |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |
| el. valve for travel direction (24 V) + el. $Q_{max}$ switch (24 V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | • • • • • • • • • • DA6 |     |     |                                |    |    |     |     |     |     |          |     |     |     |                            |   |   |   |                    |   |   |   |                           |   |   |   |                           |   |   |   |                                                     |   |   |   |                                                     |   |   |   |



Synchronizing piston



Differential piston



## HINWEIS

Bezeichnungen, Beschreibungen und Darstellungen entsprechen dem Informationsstand zum Zeitpunkt der Drucklegung dieser Unterlage.

Änderungen können den Service am Produkt beeinflussen, Verpflichtungen entstehen uns daraus nicht.

Methoden und Vorrichtungen sind Empfehlungen, für deren Resultat wir keine Haftung übernehmen können.

HYDROMATIK- Baugruppen, mit Angabe der Fabrik-Nr. bestellt, sind die Basis guter Reparaturen.

Einstell- und Prüfarbeiten sind bei Betriebstemperatur auf dem Teststand vorzunehmen.

Schutz von Personen und Eigentum ist durch Vorkehrungen sicherzustellen.

Sachkenntnis, die Voraussetzung für jede Servicearbeit, vermitteln wir in unseren Schulungskursen.

## NOTICE

Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing.

HYDROMATIK reserves the right to discontinue models or options at any time or to change specifications, materials, or design without notice and without incurring obligation.

Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options.

For the available combinations refer to the relevant data sheet for the basic unit and the desired option.

Adjustment and tests have to be carried out on the test bench under operating temperatures.

Protection of personnel and property has to be guaranteed by appropriate measures.

Expert knowledge, the precondition of any service work, can be obtained in our training courses.

## INHALT

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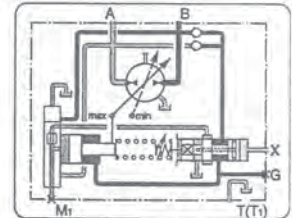
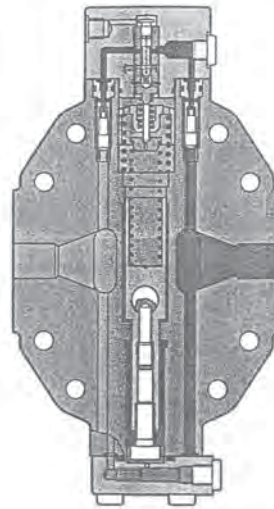
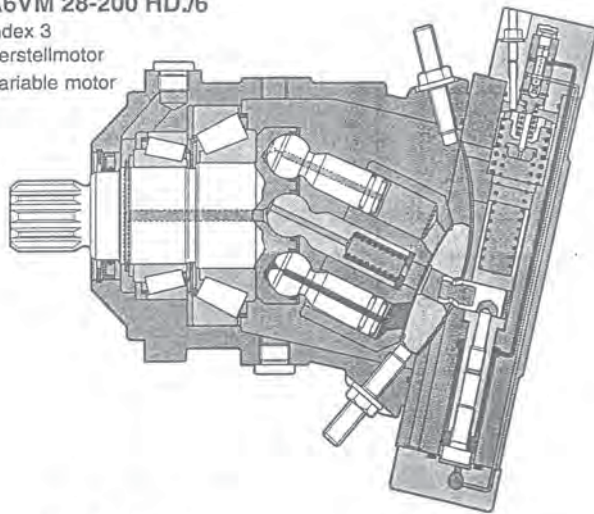
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| Replace seal nut                      |
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Schnittbild  
Sectional drawing

Reparaturanleitung A6VM  
Repair Instructions A6VM

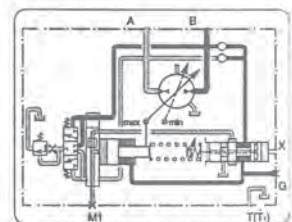
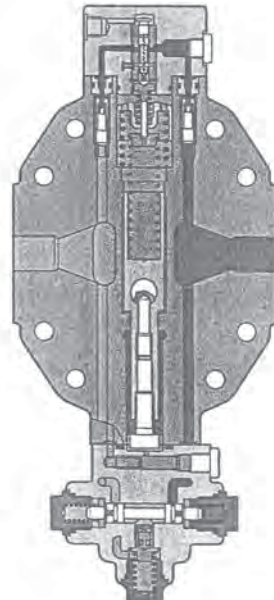
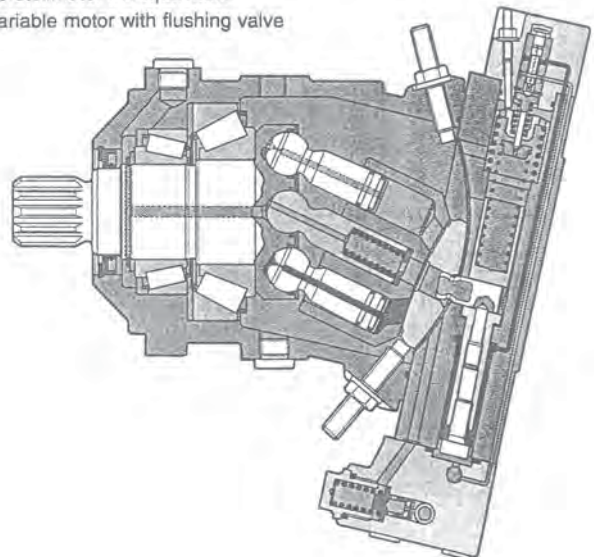
**A6VM 28-200 HD/6**

Index 3  
Verstellmotor  
Variable motor



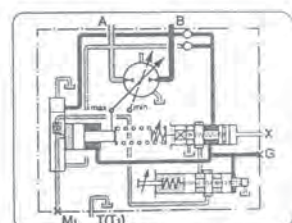
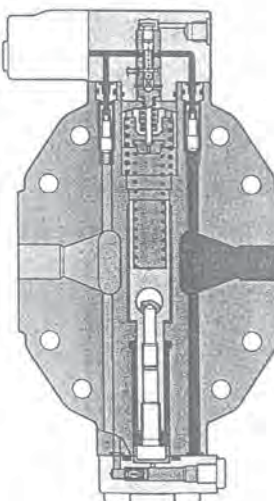
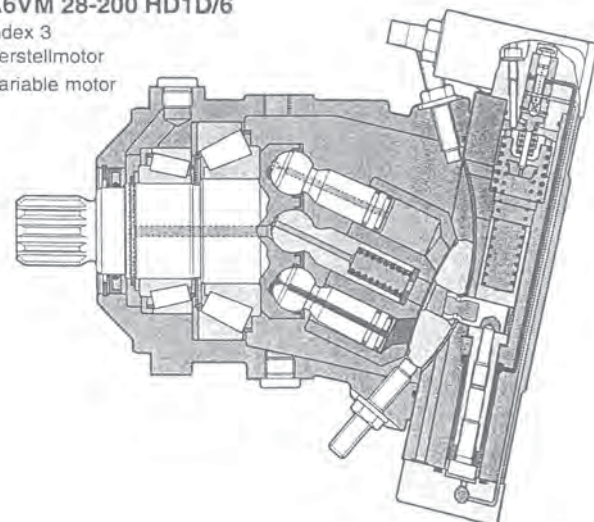
**A6VM 28-200 HD/6**

Index 3  
Verstellmotor mit Spülventil  
Variable motor with flushing valve



**A6VM 28-200 HD1D/6**

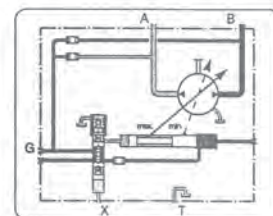
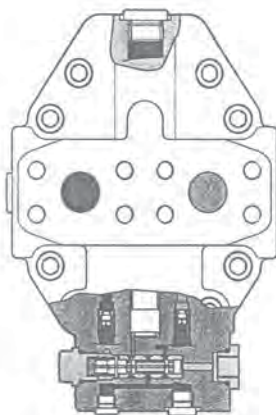
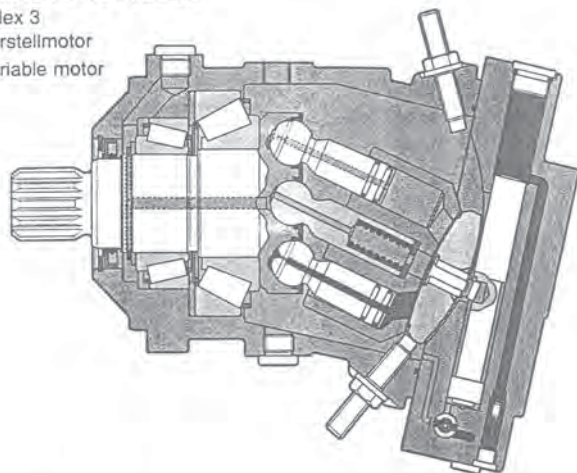
Index 3  
Verstellmotor  
Variable motor





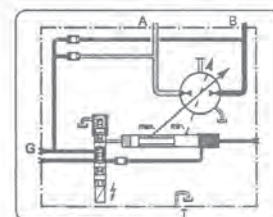
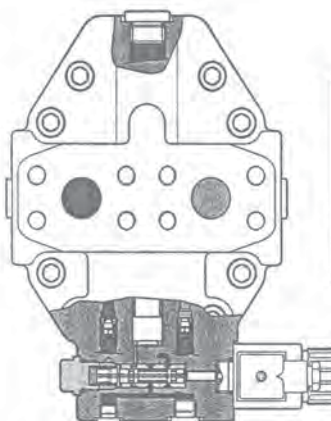
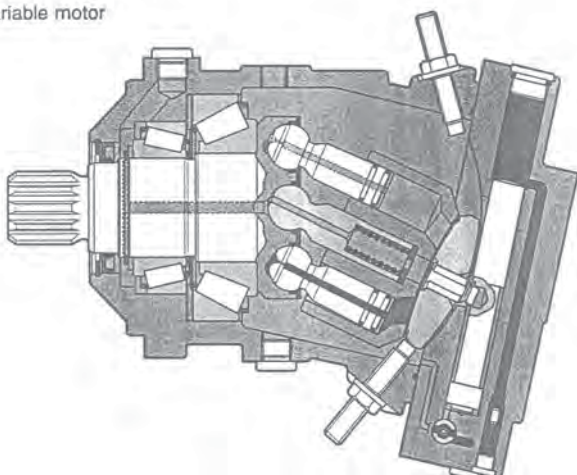
**A6VM 55-107 HZ3/6**

Index 3  
Verstellmotor  
Variable motor



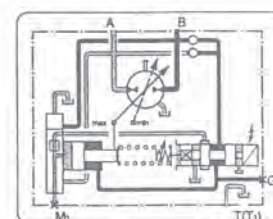
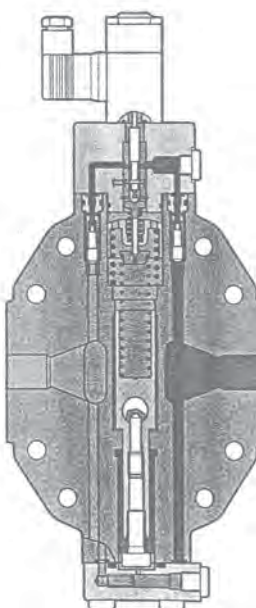
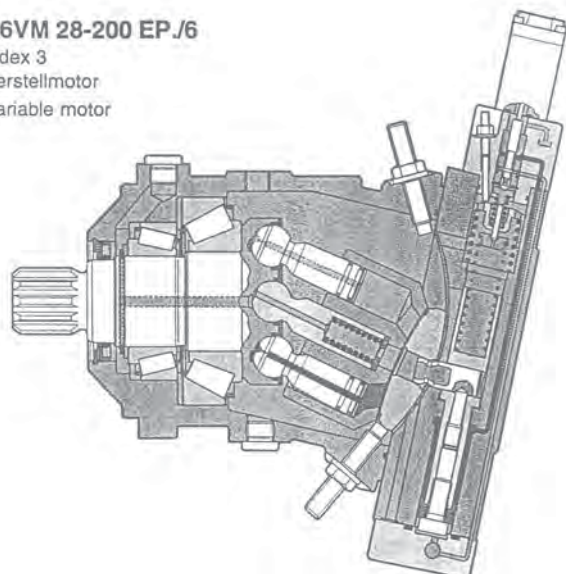
**A6VM 55-107 EZ3/6**

Index 3  
Verstellmotor  
Variable motor



**A6VM 28-200 EP./6**

Index 3  
Verstellmotor  
Variable motor



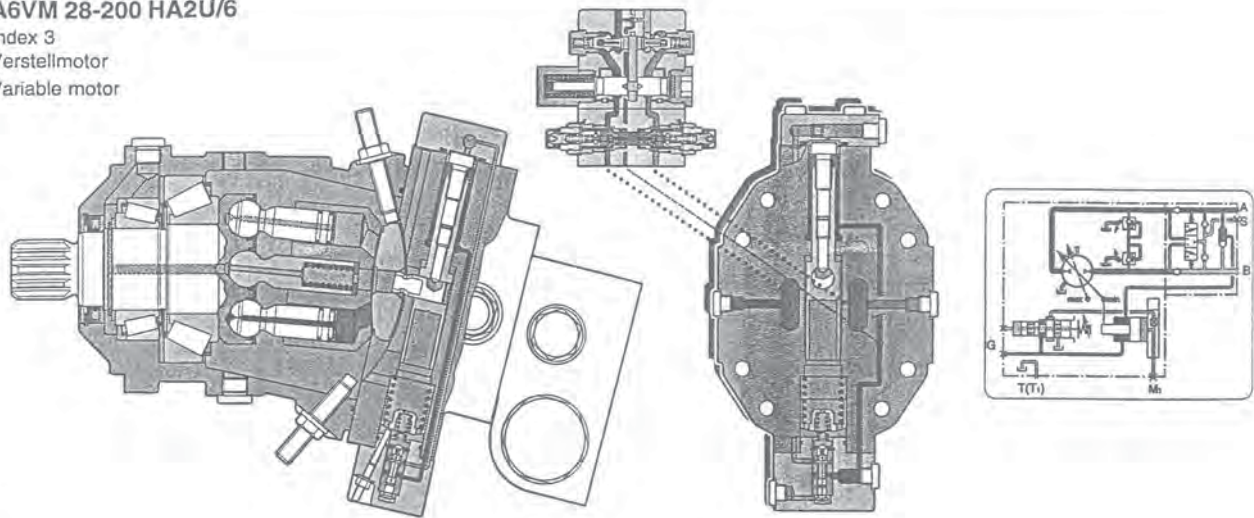


Schnittbild  
Sectional drawing

Reparaturanleitung A6VM  
Repair Instructions A6VM

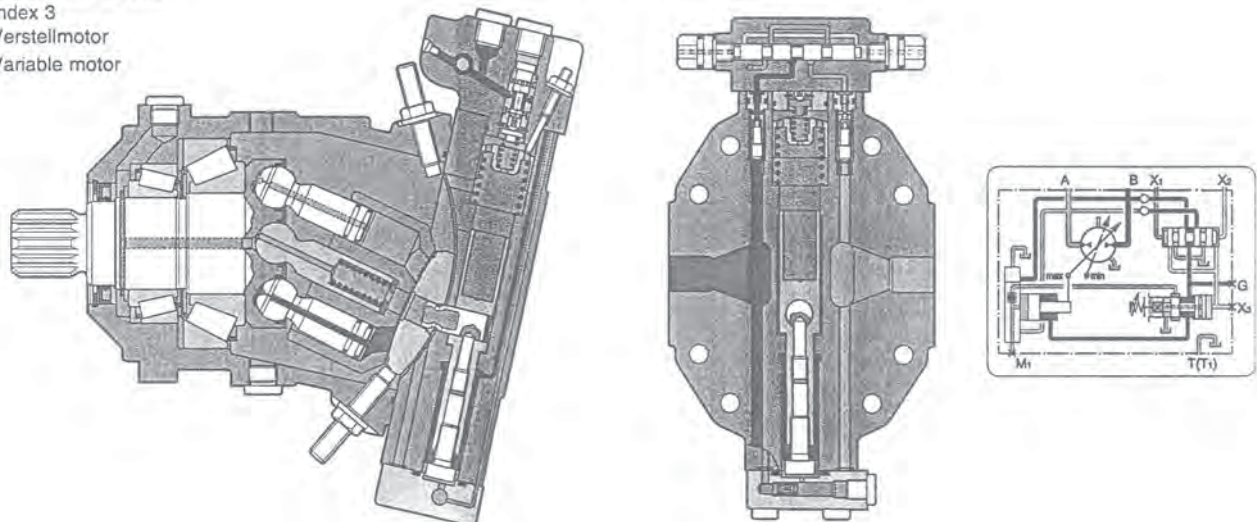
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Index 3  
Verstellmotor  
Variable motor



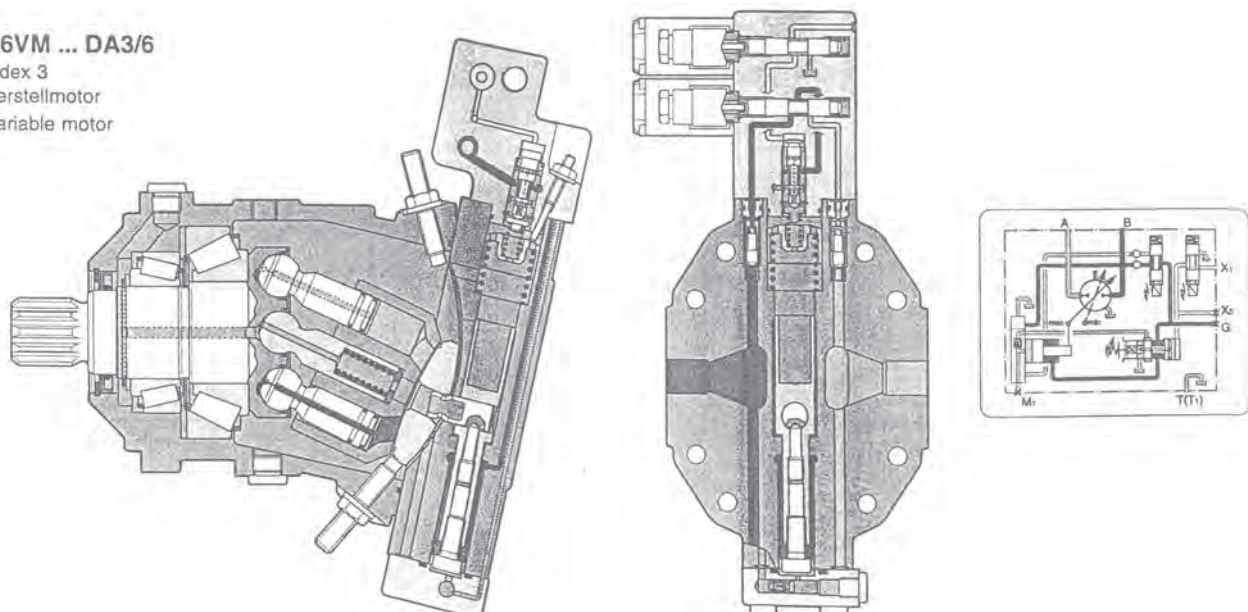
**A6VM ... DA1/6**

Index 3  
Verstellmotor  
Variable motor



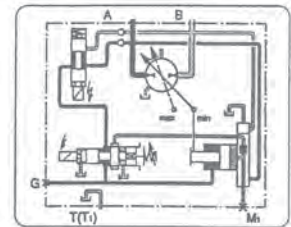
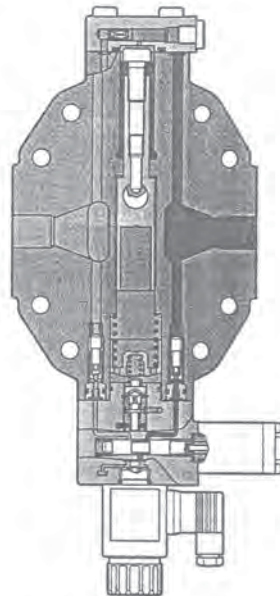
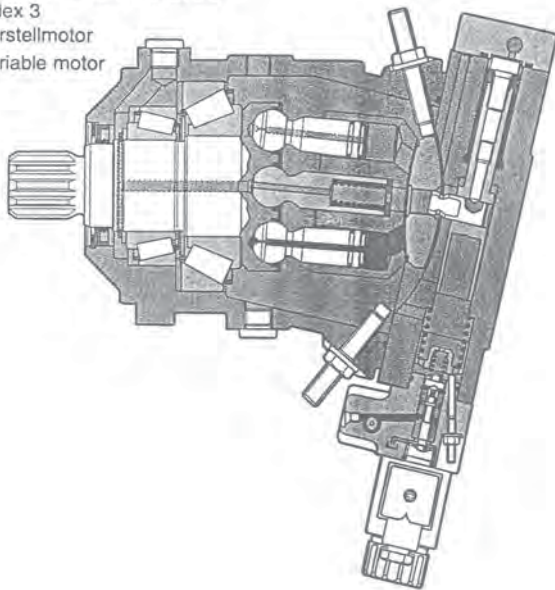
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Index 3  
Verstellmotor  
Variable motor



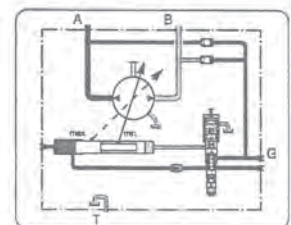
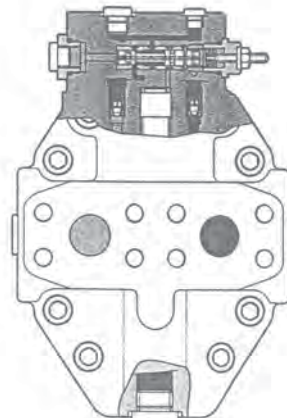
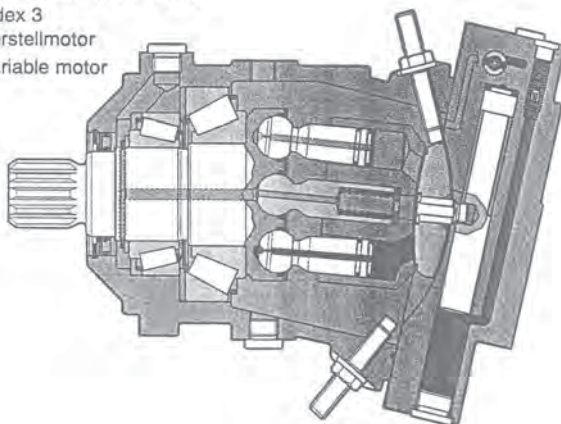
**A6VM 28-200 HA2R/6**

Index 3  
Verstellmotor  
Variable motor



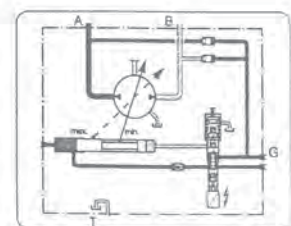
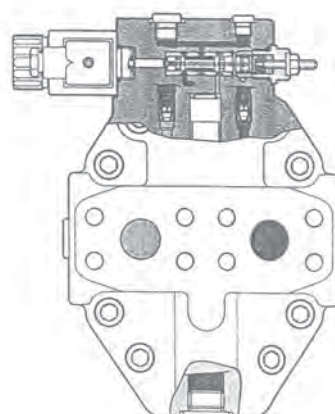
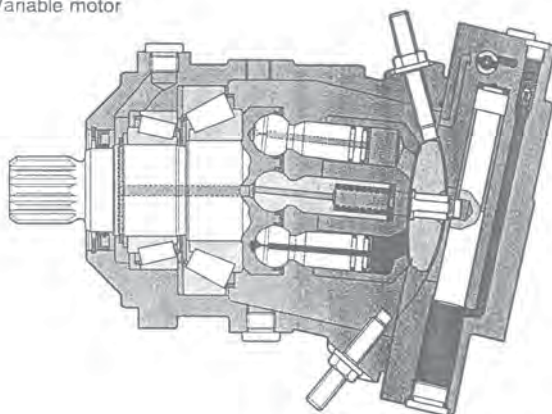
**A6VM 55-107 HA3/6**

Index 3  
Verstellmotor  
Variable motor

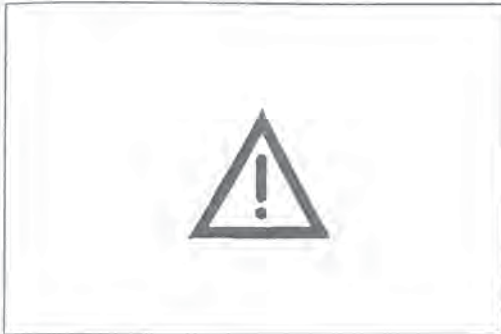


**A6VM 55-107 HA3U/6**

Index 3  
Verstellmotor  
Variable motor

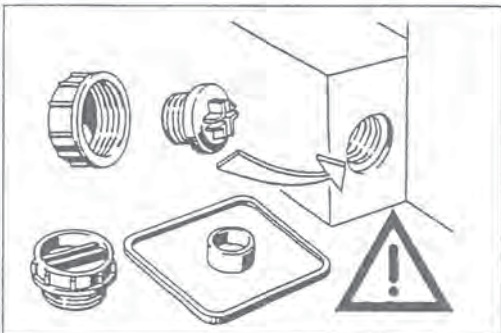




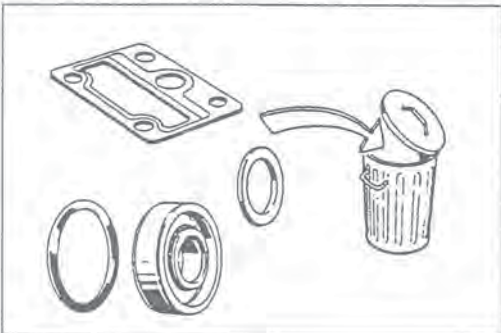


**Achtung!**  
Nachfolgend Hinweise bei allen Reparaturarbeiten an Hydraulikaggregaten beachten!

**Attention!**  
Observe the following notices when carrying out repair work at hydraulic aggregates!

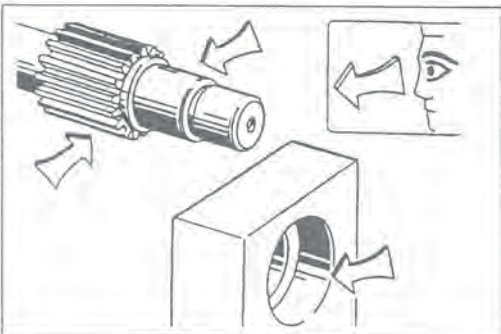


Alle Öffnungen der Hydraulikaggregate verschließen.  
Close all ports of the hydraulic aggregates.



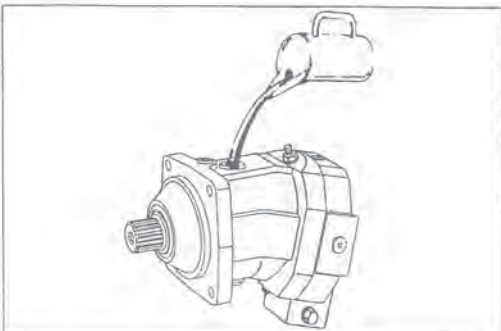
Alle Dichtungen erneuern.  
Nur original HYDROMATIK-Ersatzteile verwenden.

Replace all seals.  
Use only original HYDROMATIK spare parts.



Alle Dicht- und Gleitflächen auf Verschleiß prüfen.  
Achtung: Nacharbeiten an Dichtflächen z.B. durch Schleifpapier kann die Oberfläche beschädigen.

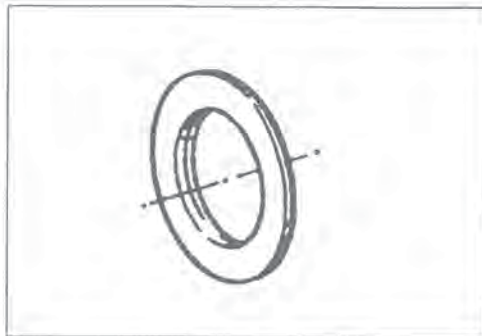
Check all seal and sliding surfaces for wear.  
Attention: Rework of sealing area f. ex. with abrasive paper can damage surface.



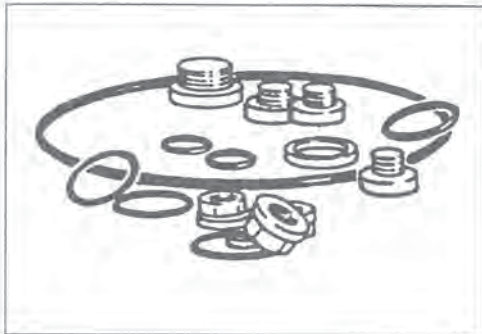
Hydraulikaggregate vor Inbetriebnahme mit Betriebsmedium befüllen.

Fill up hydraulic aggregates with medium before start-up.

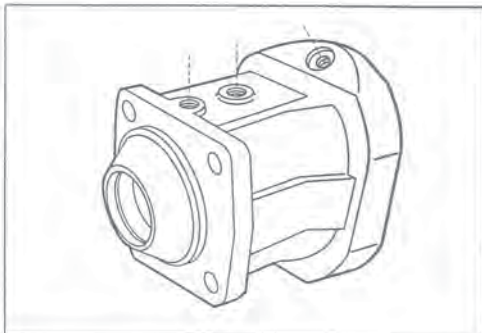




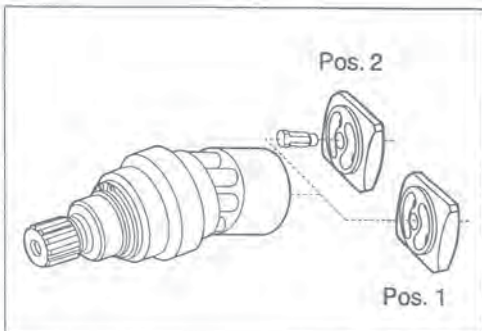
- 1 Dichtsatz für Triebwelle.  
Seal kit for drive shaft.



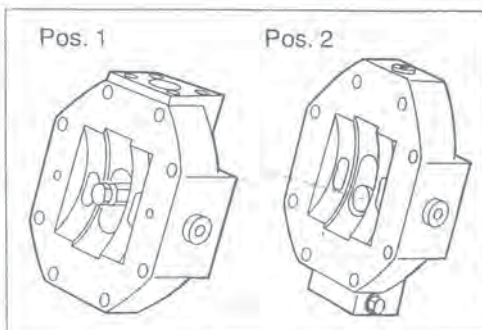
- 2 Äußerer Dichtsatz.  
External seal kit.



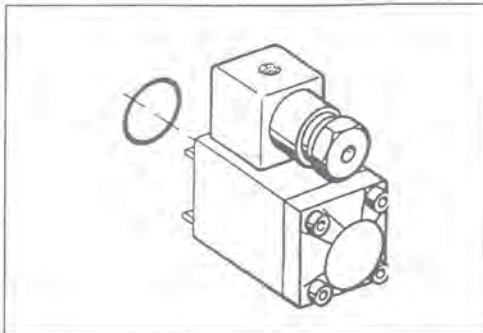
- 3 Gehäuse  
Housing



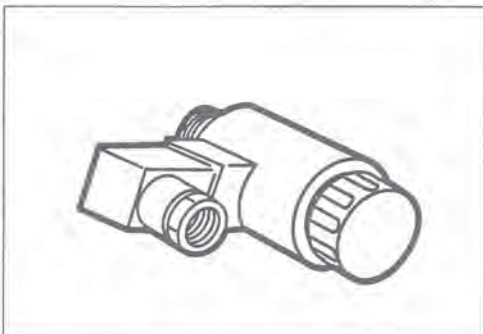
- 4 Triebwerk komplett  
Hinweis: Pos. 1 - Für Anschlußplatte mit Differentialkolben  
Pos. 2 - Für Anschlußplatte mit Gleichgangkolben  
Complete rotary group  
Note: Pos. 1 - For port plate with differential piston  
Pos. 2 - For port plate with synchronizing piston



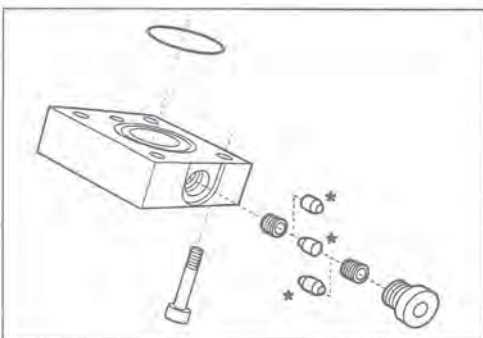
- 5 Anschlußplatte mit Stellkolben  
Hinweis: Pos. 1 - Für Anschlußplatte mit Differentialkolben  
Pos. 2 - Für Anschlußplatte mit Gleichgangkolben  
Port plate with control piston  
Note: Pos. 1 - For port plate with differential piston  
Pos. 2 - For port plate with synchronizing piston



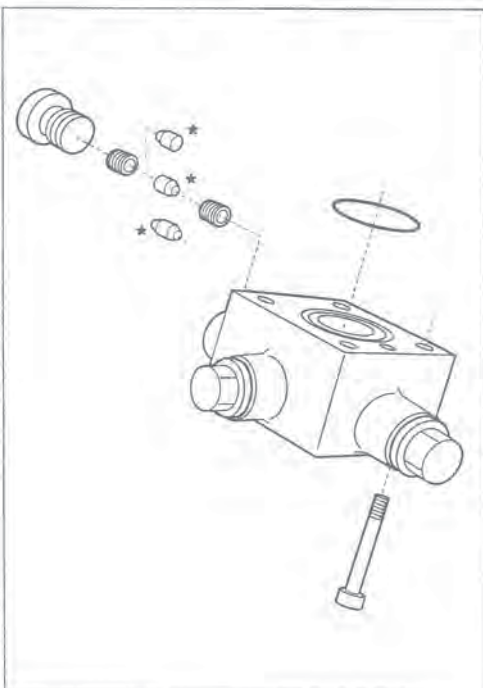
- 6 Proportionalmagnet (EP)  
Proportional solenoid (EP)



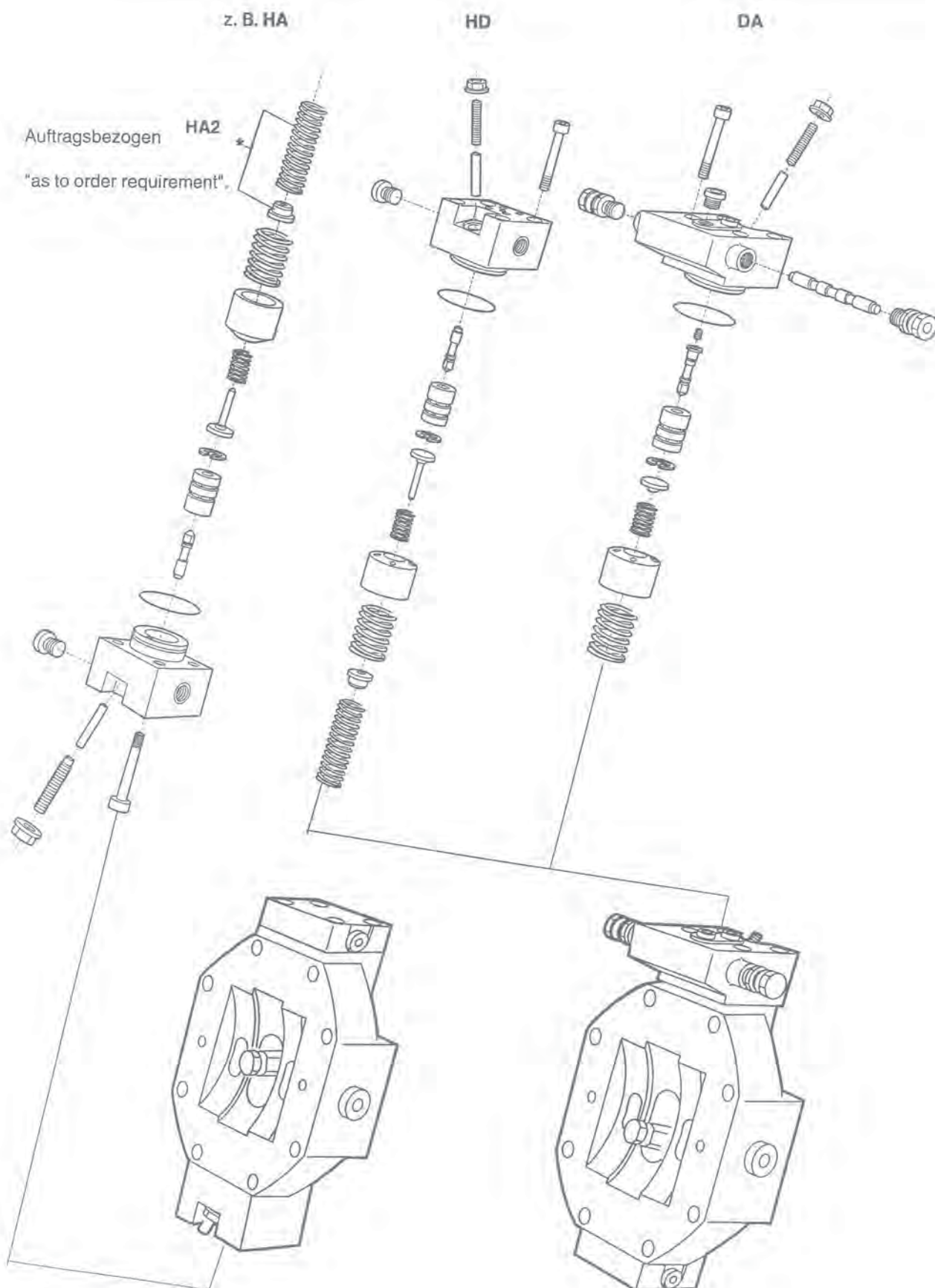
- 7 Schaltmagnet  
Solenoid



- 8 Deckel mit \* Drosselstift.  
\* Drosselstift "Auftragsbezogen".  
  
Cover with \* throttle pin.  
\* Throttle pin "as to order requirement".

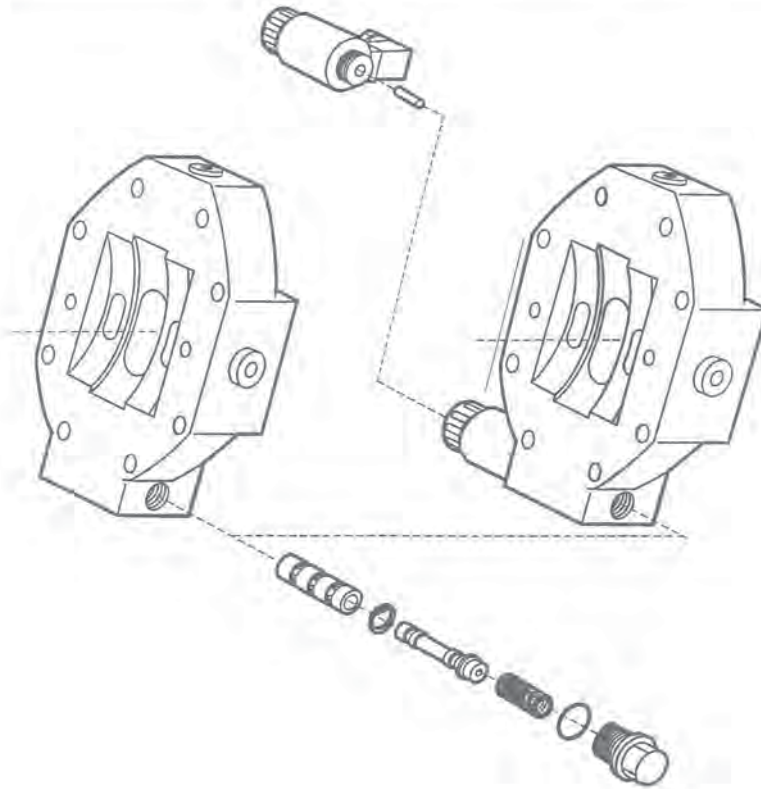


- 9 Deckel mit Spül- und Speisedruckventil und \* Drosselstift  
\* Drosselstift "Auftragsbezogen".  
  
Cover with flushing and boost pressure valve and  
\* throttle pin.  
\* Throttle pin "as to order requirement".

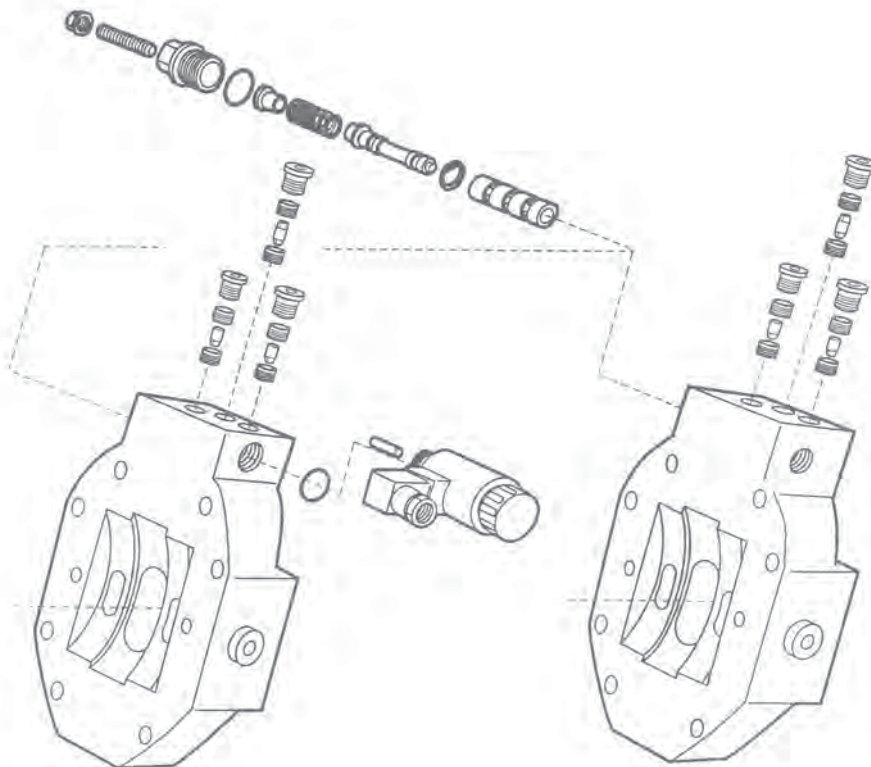


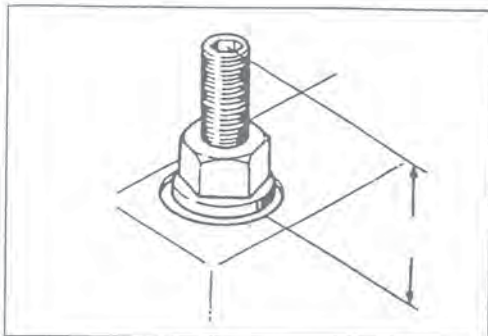


z. B. HZ3 / EZ3



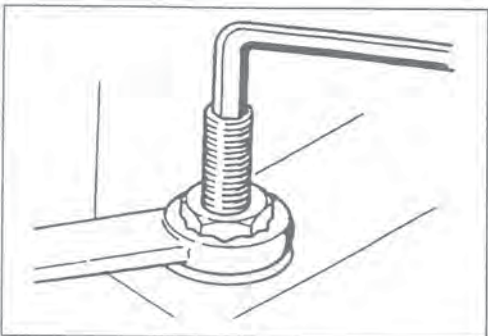
HA3 / HA3U





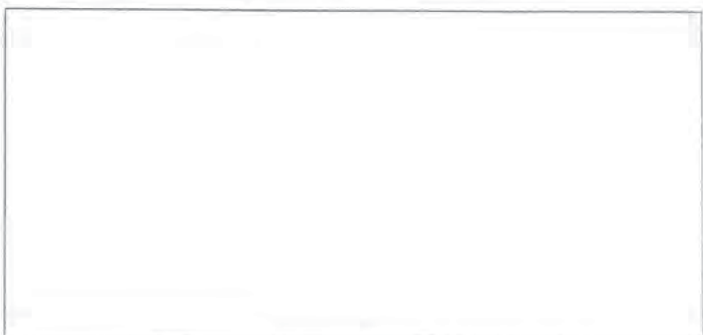
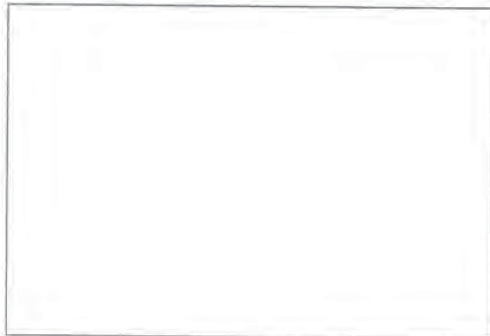
- 10 Dichtmutter austauschen.  
Zuerst Einstellhöhe messen und festhalten.

Replace seal nut.  
First measure and record setting height.



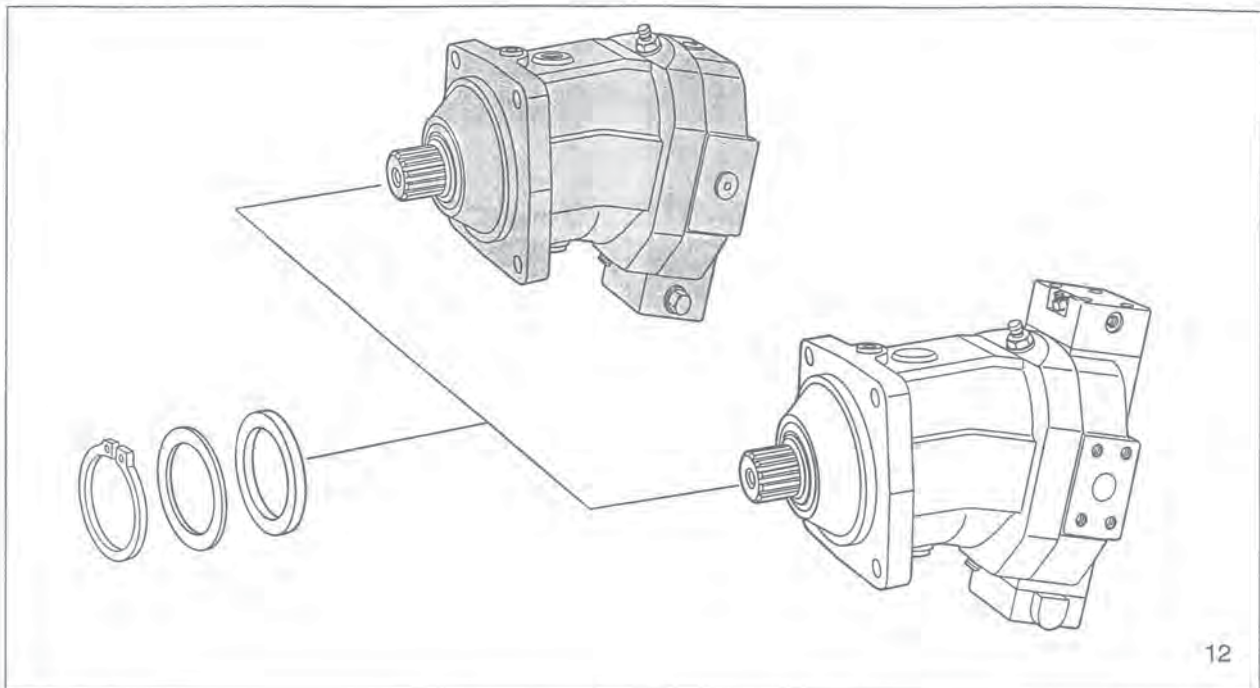
- 11 Beim Anziehen Einstellschraube gegenhalten,  
anschließend Einstellhöhe kontrollieren.

When tightening, counterhold setting screw, then  
check setting height.

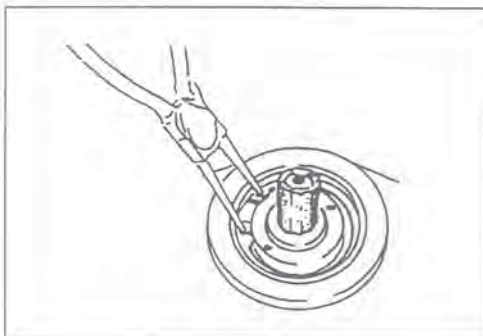


Triebwelle abdichten  
Sealing the drive shaft

Reparaturanleitung A6VM  
Repair Instructions A6VM

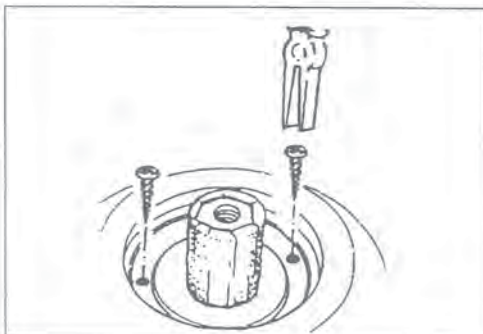


12



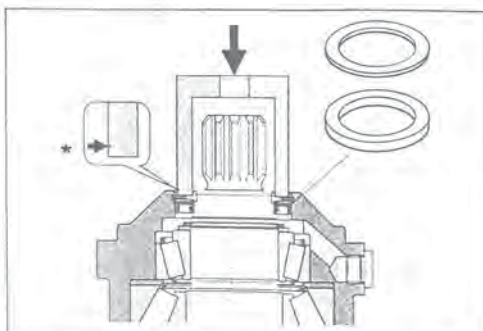
- 13 Triebwelle abkleben.  
Sicherungsring und Scheibe ausbauen.

Protecting the drive shaft.  
Remove retaining ring and shim.



- 14 Blechschraube in die mit Gummi gefüllten  
Löcher eindrehen.  
Mit Zange WDR herausziehen.

Screw in sheet metal screw into the holes  
fitted with rubber.  
Pull out seal with pliers.

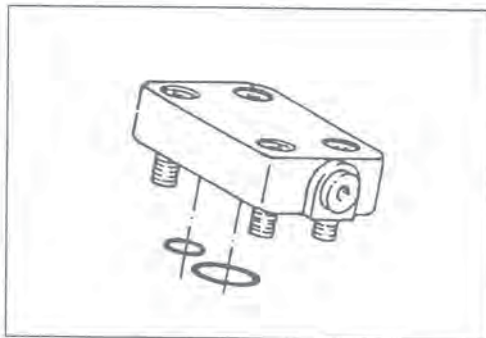
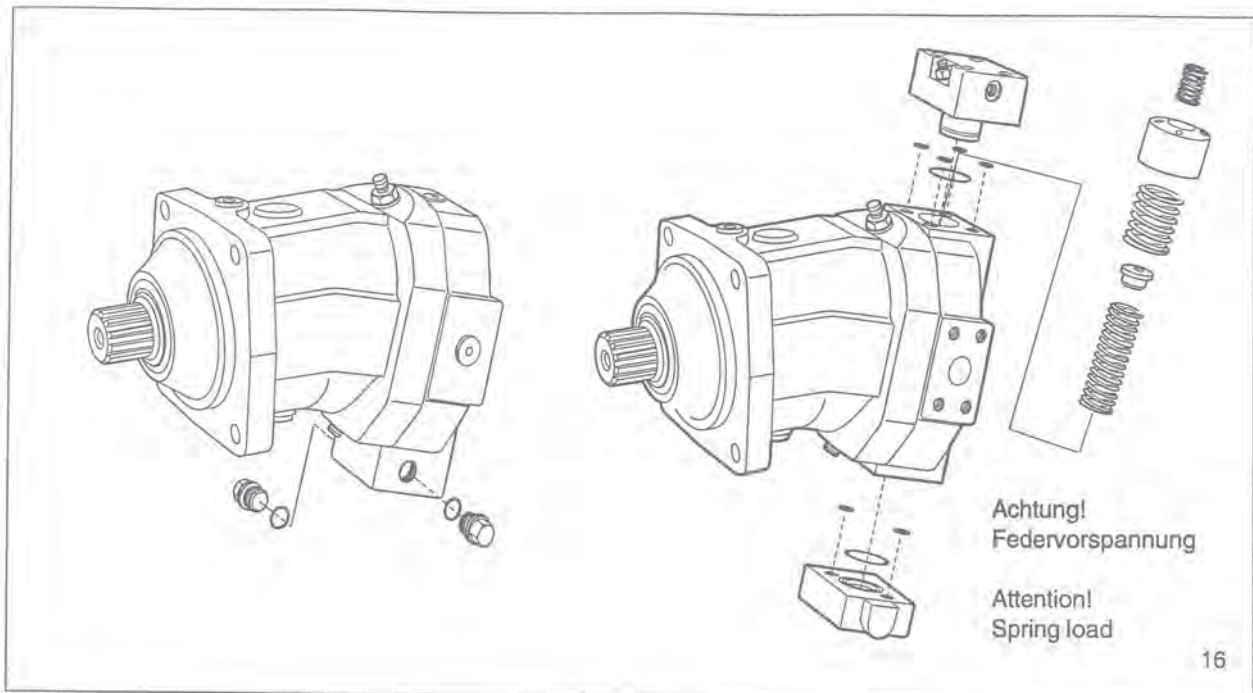


- 15 Wellendichtring und Scheibe mit Montagehülse einpressen.

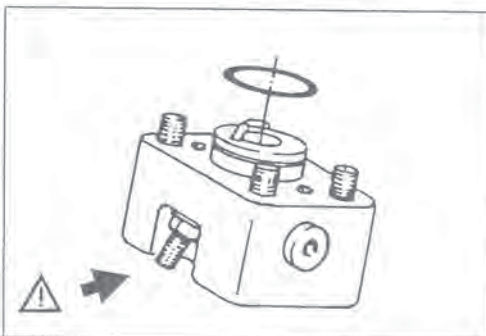
⚠ Einpresstiefe beachten! \* Marke für Einpresstiefe.  
Sicherungsring einbauen.

Press in shaft seal ring and shim with bush to stop.  
Take note of press-in depth!  
⚠ Install mark for press-in depth of safety ring.

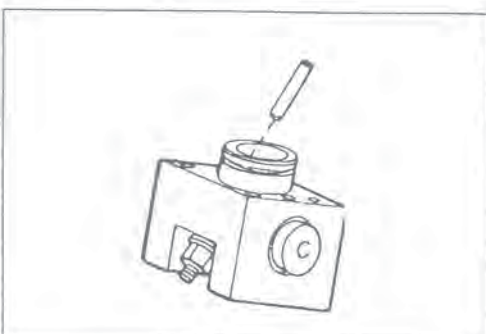




- 17 Kontrolle  
Bohrung im Gehäuse, O-Ring, Nut.
- Inspect  
Drilling in housing, O-ring, groove.



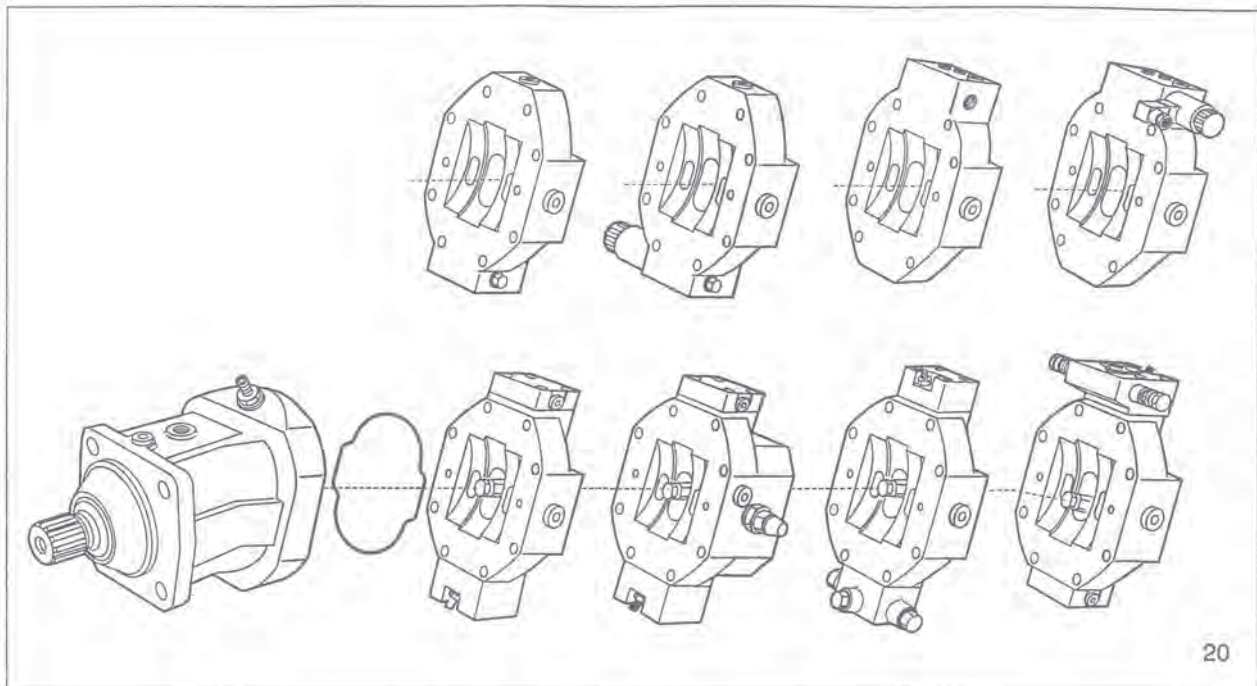
- 18 ⚠ Einstellschraube nicht ausbauen.  
Kontrolle  
O-Ring, O-Ring-Nut, Gehäuse
- ⚠ Do not remove adjustment screw.  
Inspect  
O-ring, O-ring groove, housing



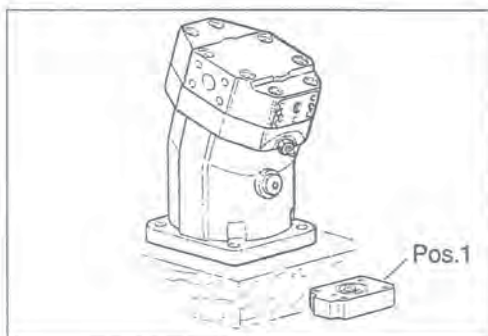
- 19 Montagehilfe  
Stift mit Fett einkleben.
- Assembly aid  
Insert pin with grease.

Verstellung abdichten  
Sealing the hydraulic control

Reparaturanleitung A6VM  
Repair Instructions A6VM

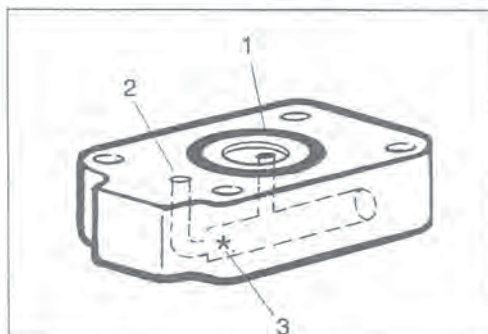


20



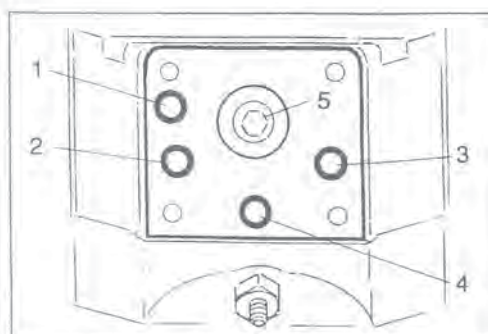
- 21 Beispiel: A6VM ... HD Verstellung  
Dermontageposition:  
Deckel Pos. 1 abbauen.

Example: A6VM ... HD control  
Disassembly position:  
Remove cover pos. 1



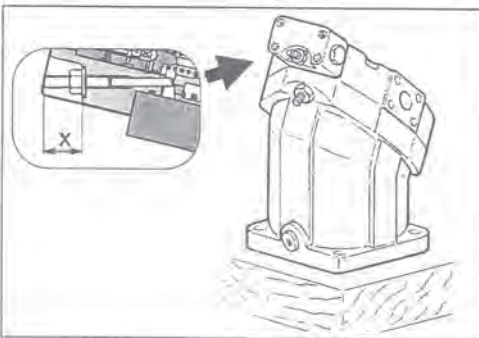
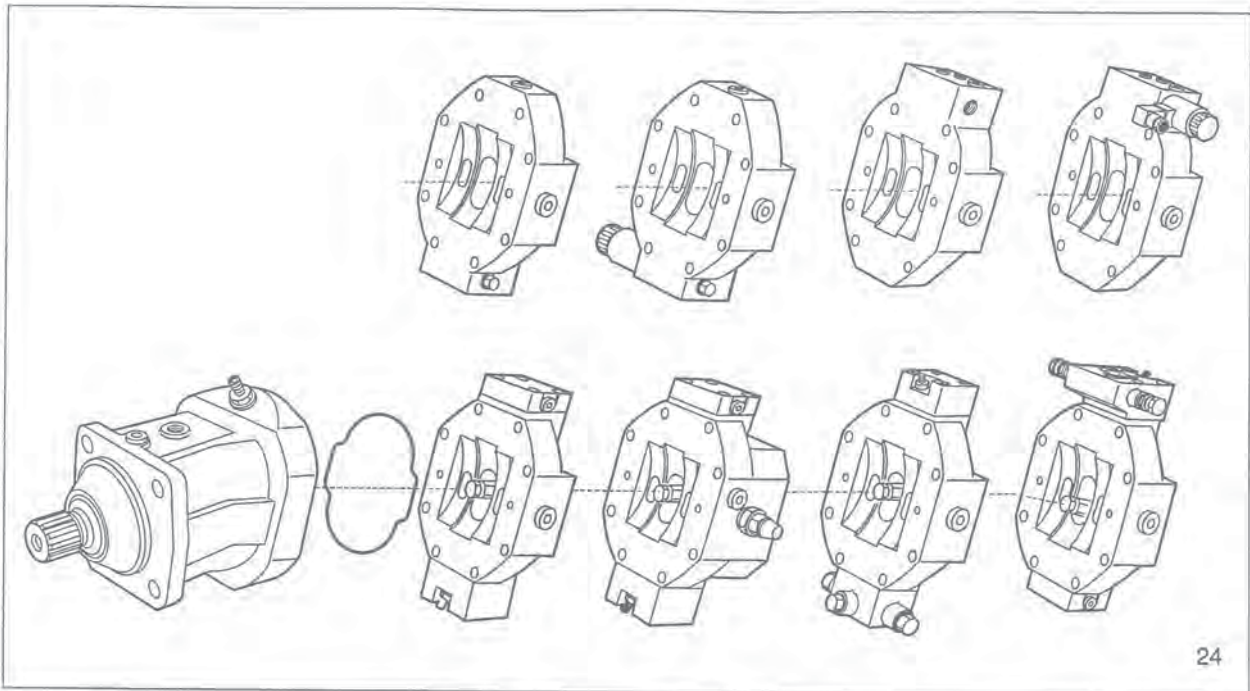
- 22 1. O-Ring  
2. Stellölzulauf  
3. Drosselstift  
⚠ Einbaulage je nach Steuerteil verschieden.

1. O-ring  
2. Input flow of oil control  
3. Throttle pin  
⚠ Installation position differs according to the control components

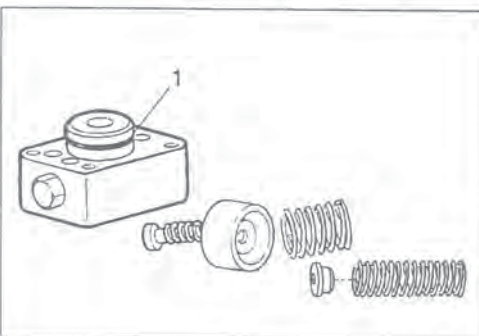


- 23 1. Stellölzulauf  
2. Hochdruck bzw. Niederdruck  
3. Hochdruck bzw. Niederdruck  
4. Lecköl  
5. Stellkolben
1. Input flow of oil control  
2. High pressure / low pressure  
3. High pressure / low pressure  
4. Leakage oil  
5. Control piston

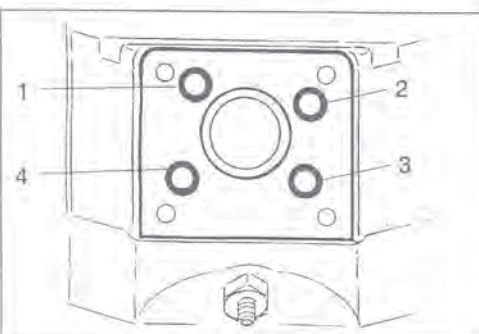




- 25 Beispiel: A6VM ... Verstellung - **Differentialkolben**  
Demontageposition: Deckel Pos. 2 abbauen.  
Achtung! Federvorspannung.  
Maß x: Maß festhalten (Regelbeginn).
- Example: A6VM... control - **differential piston**  
Disassembly position: Remove cover pos. 2.  
Attention! Spring load.  
Dimension x: Note dimension (begin of regulation).



- 26 1. O-Ring Kontrolle  
1. Check of O-ring

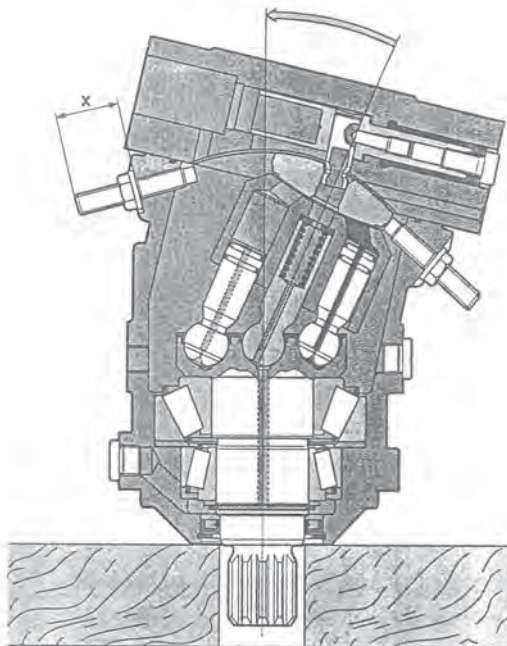


- 27 1. Hochdruck - kleine Stellkolbenseite  
2. Stelldruck  
3. Hochdruck - Rückschlagventil  
4. Hochdruck - Rückschlagventil
1. High pressure - small control piston side  
2. Control pressure  
3. High pressure - check valve  
4. High pressure - check valve



Verstellung abdichten  
Sealing the hydraulic control

Reparaturanleitung A6VM  
Repair Instructions A6VM



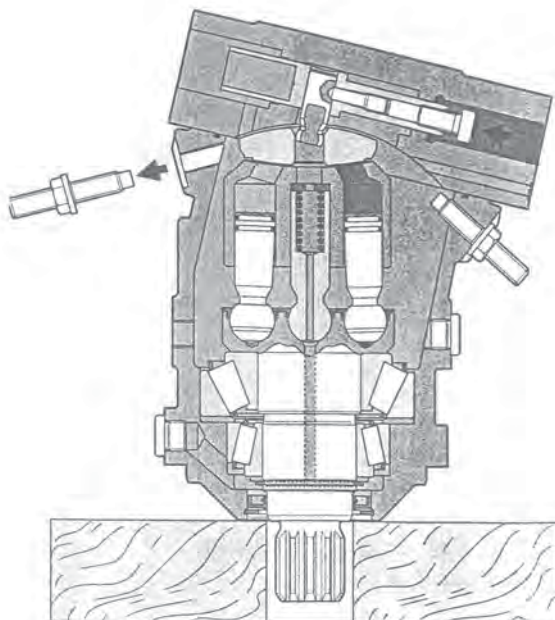
**Differentialkolben:**  
Maß X festhalten.

**Differential piston:**  
Note dimension x



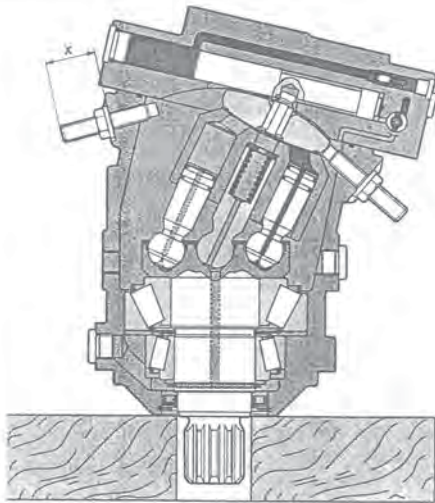
Bei "Demontage" der Anschlußplatte  
"Triebwerk" immer auf Null schwenken.  
Kolbenringe hängen aus der Zylinder-  
bohrung aus.

For disassembly of the port plate, swivel  
always rotary group to zero position.  
Piston rings to hang out of the cylinder  
boring.



$Q_{min}$ -Schraube ausbauen.  
Triebwerk auf 0° schwenken.

Remove  $Q_{min}$ -screw.  
Swivel rotary group to 0°.



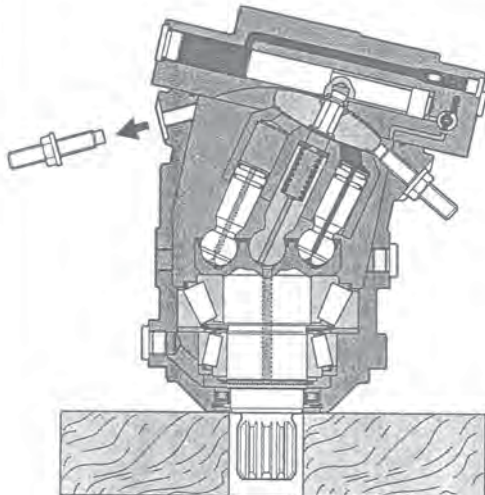
**Gleichgangkolben:**  
Maß X festhalten.

**Synchronizing piston:**  
Note dimension x.



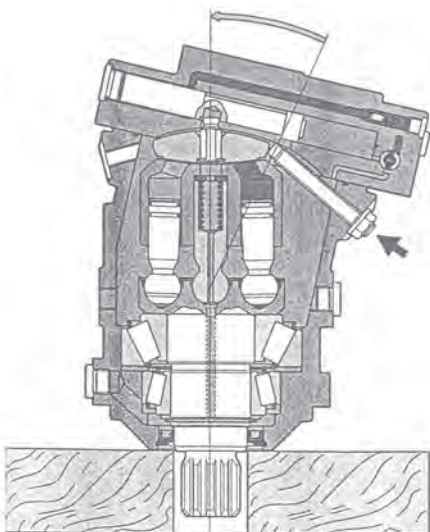
Bei "Demontage" der Anschlußplatte  
"Triebwerk" immer auf Null schwenken.  
Kolbenringe hängen aus der Zylinder-  
bohrung aus.

For disassembly of the port plate, swivel  
always rotary group to zero position.  
Piston rings to hang out of the cylinder  
boring.



$Q_{min}$ -Schraube ausbauen.

Remove  $Q_{min}$ -screw.

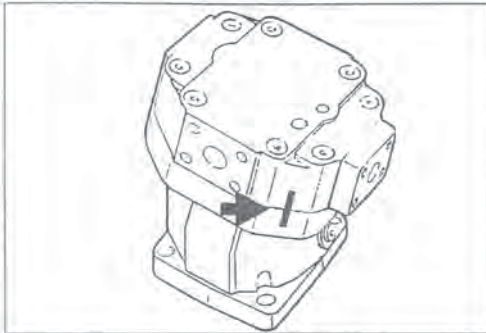


Mit Schraube  $Q_{max}$  Triebwerk auf 0°  
schwenken.

Swivel rotary group to zero position  
with screw  $Q_{max}$ .

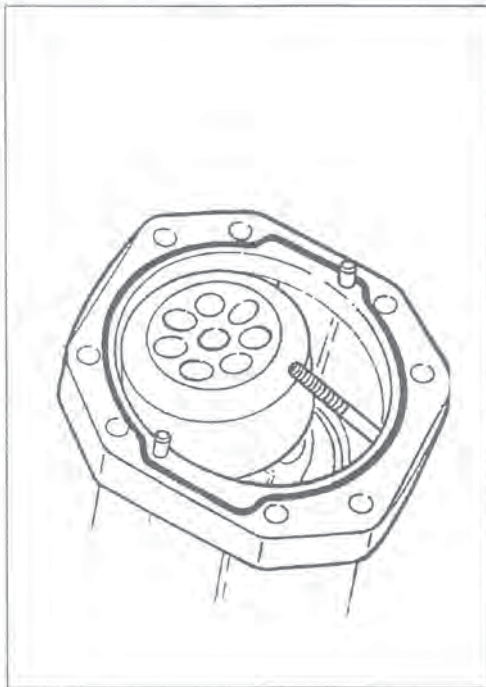
Anschlußplatte demontieren  
Disassembly of the port plate

Reparaturanleitung A6VM  
Repair Instructions A6VM



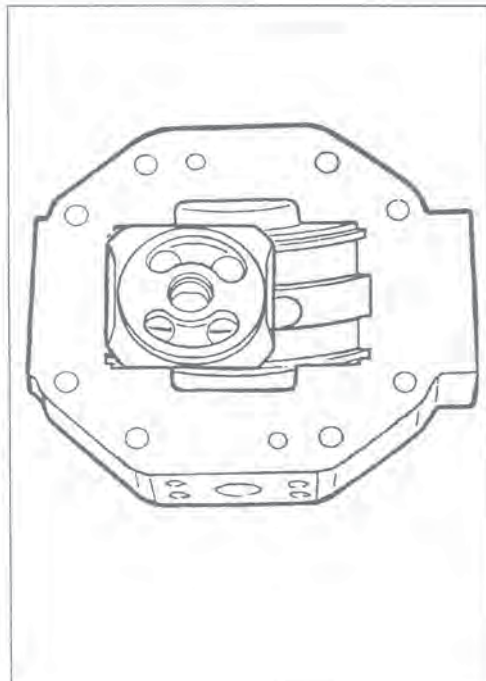
- 28 Anschlußplatte  
Lage markieren. Schrauben lösen.  
Abbauen

Port plate  
Mark position. Loosen screws.  
Removal



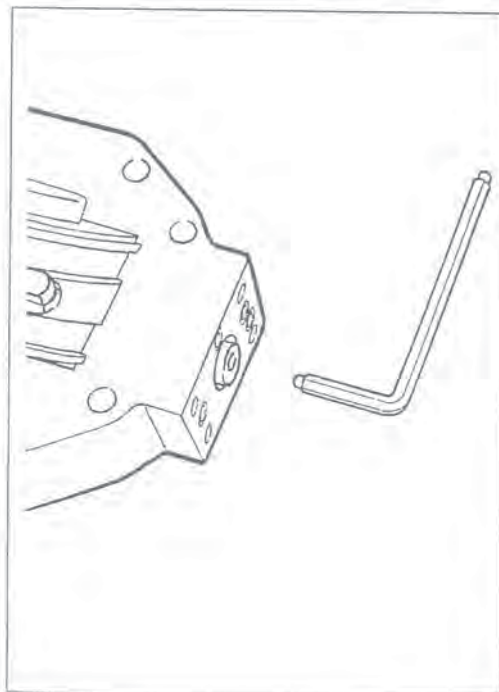
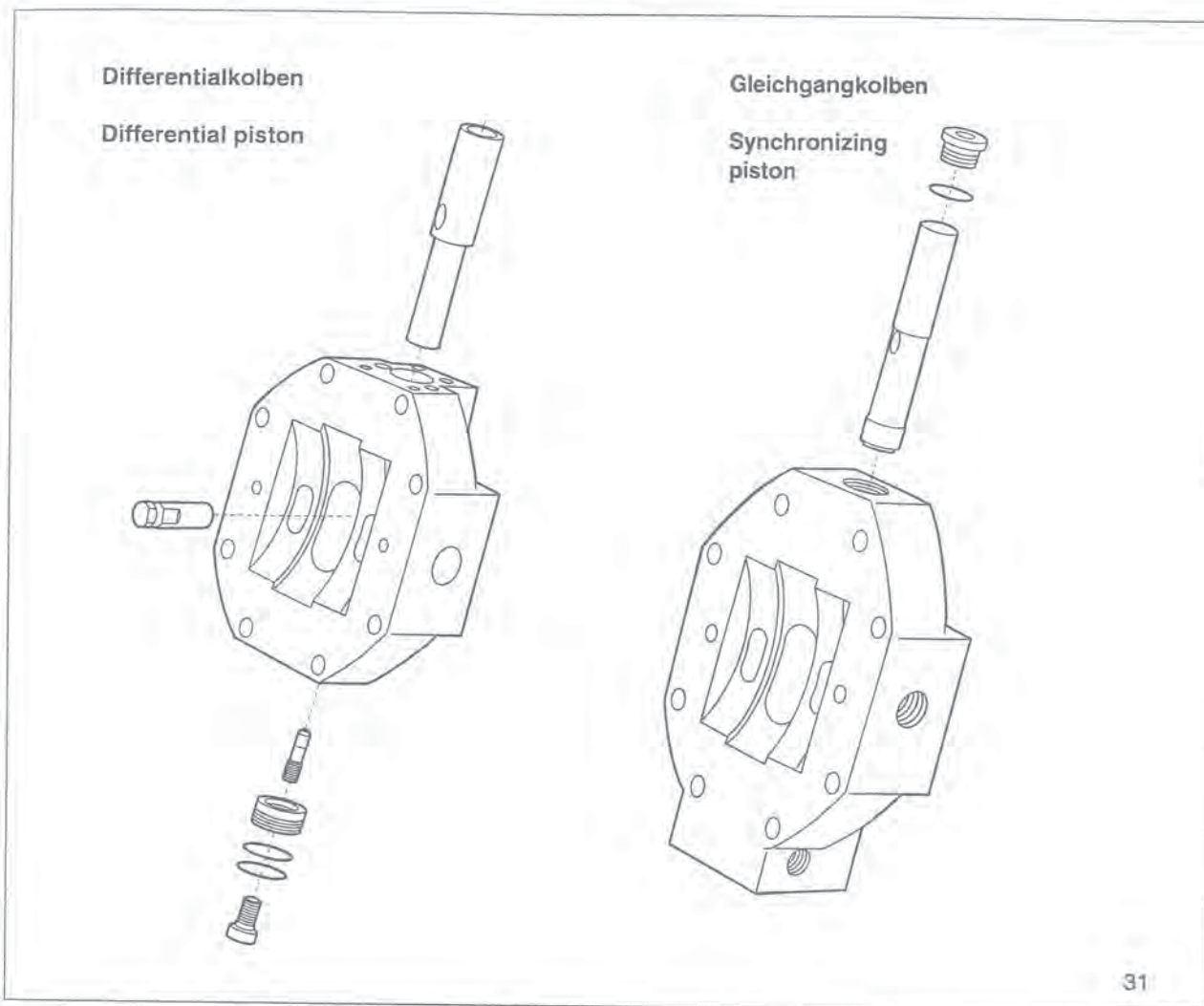
- 29 O-Ring austauschen.  
Neuer O-Ring mit etwas Fett einkleben.  
⚠ Treibwerk nicht ausschwenken.  
⚠ Kolbenringe hängen aus der Zylinderbohrung aus.

Check O-ring.  
Stick new O-ring with some grease.  
⚠ Do not swivel rotary group.  
⚠ Piston rings to hang out from the cylinder boring.



- 30 ⚠ Steuerlinse in Gleitbahn mit Fett einkleben.  
Fertigmontage in umgekehrter Reihenfolge.  
Anschlußplatte aufsetzen.  
⚠ Triebwerk senkrecht.  
⚠ Stick control lens in sliding surface with grease.  
Assembly in reversal order.  
Mount port plate.  
⚠ Rotary group vertical.



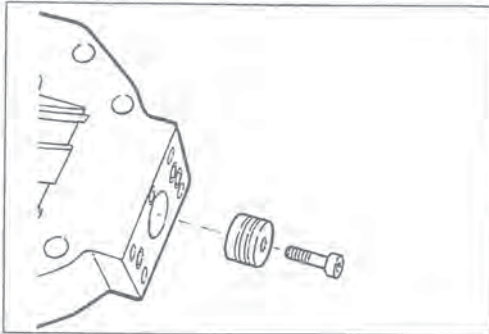


32 Befestigungsschraube lösen.  
Nur Zapfenschlüssel verwenden.

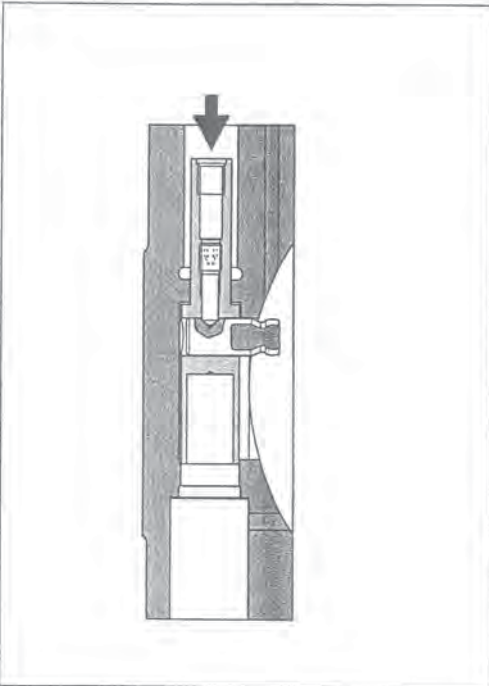
Loosen fixing screw.  
Use only socket wrench.

Stellkolben ausbauen  
Remove of the positioning piston

Reparaturanleitung A6VM  
Repair Instructions A6VM



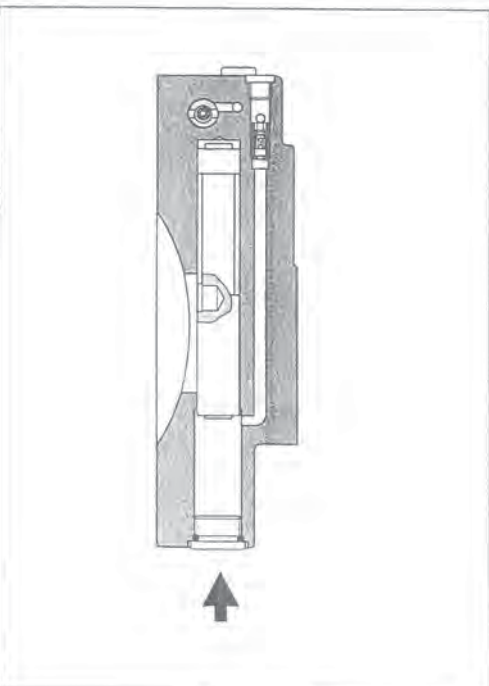
- 33 Kolben mit Kolbenring ausbauen.  
Remove piston with piston ring



- 34 **Differentialkolben**  
Befestigungsschraube für Stellzapfen über  
Bohrung erwärmen. (Schraube geklebt - herausdrehen)  
Neue Schraube verwenden  
! Precote Beschichtung  
Anziehdrehmomente beachten!

**Differential piston**

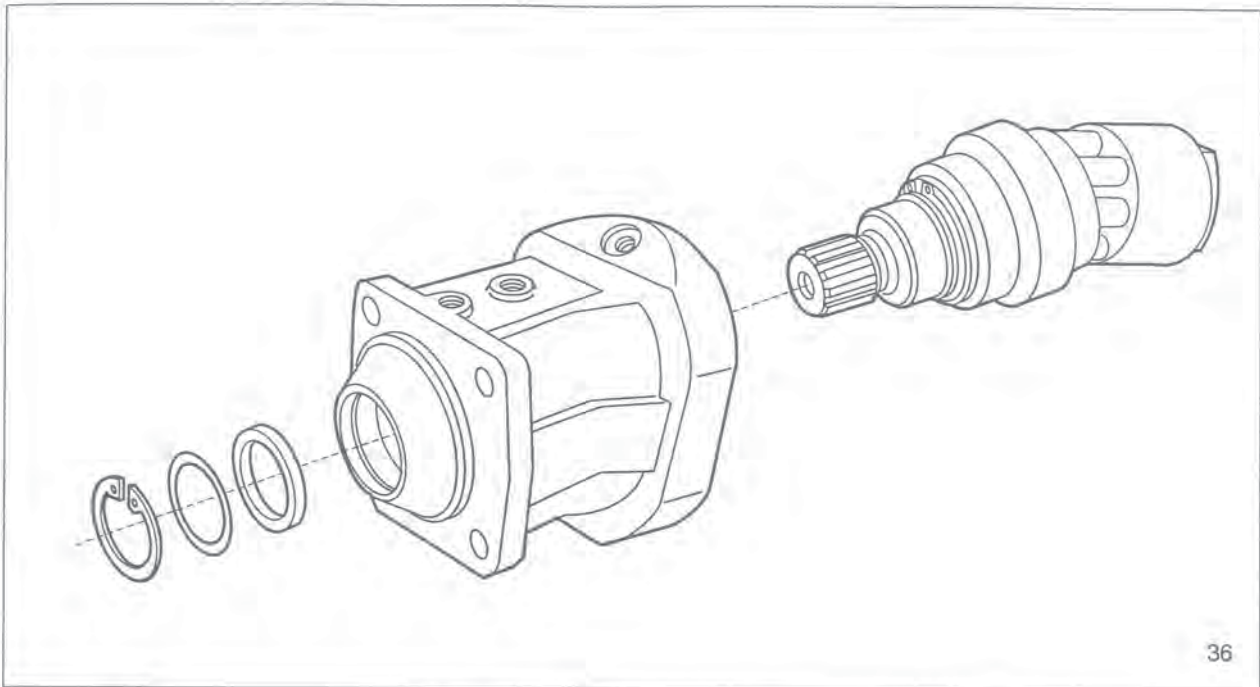
Warm up fixation screw for positioning plug  
via boring (screw glued - to turn out).  
Use new screw.  
! Precote coating.  
Note tightening torque!



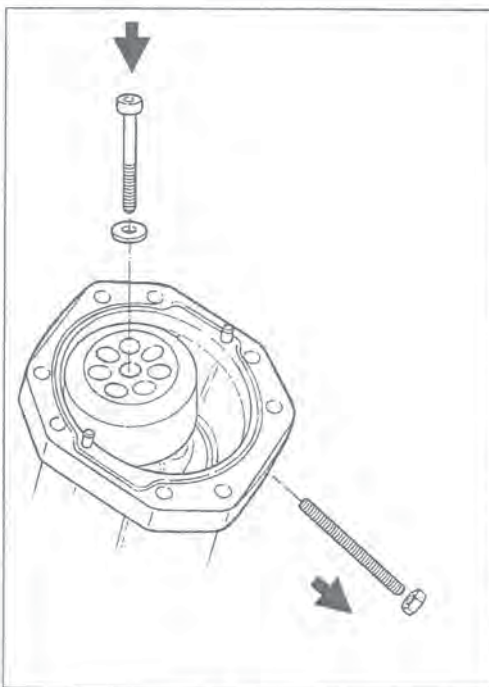
- 35 **Gleichgangkolben**  
Schraube ausbauen.  
Kolben ausbauen.  
! Einbaulage beachten.

**Synchronizing piston**

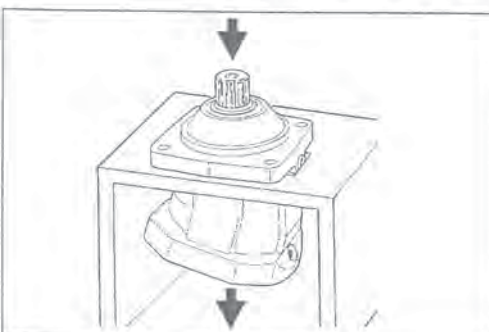
Remove screw.  
Remove piston.  
! Note installation position.



36



- 37 Mit Schraube M5 und Scheibe Zylinder am Mittelzapfen befestigen.  
 $Q_{max}$  - Anschlagschrauben ausbauen.
- Fix with screw M5 and disc cylinder at the center pin.  
Remove  $Q_{max}$  stop screw.

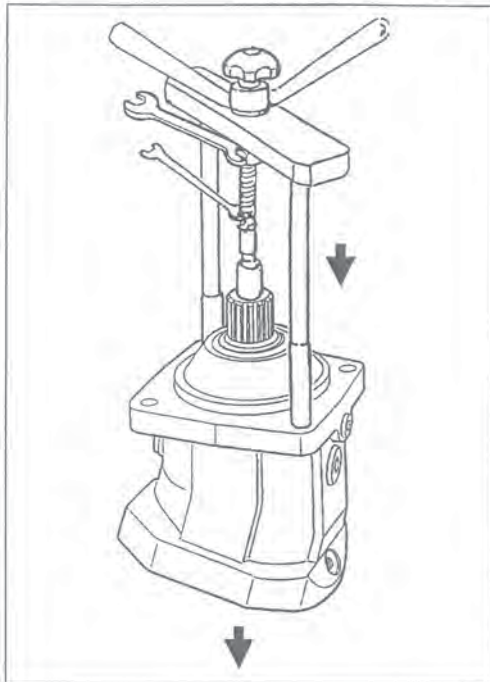


- 38 Triebwerk auspressen!  
⚠ Bei Wiederverwendung der Lager nicht schlagen.
- Press out rotary group!  
⚠ If the bearings are used again do not hit on the drive shaft.



Triebwerk ausbauen  
Remove rotary group

Reparaturanleitung A6VM  
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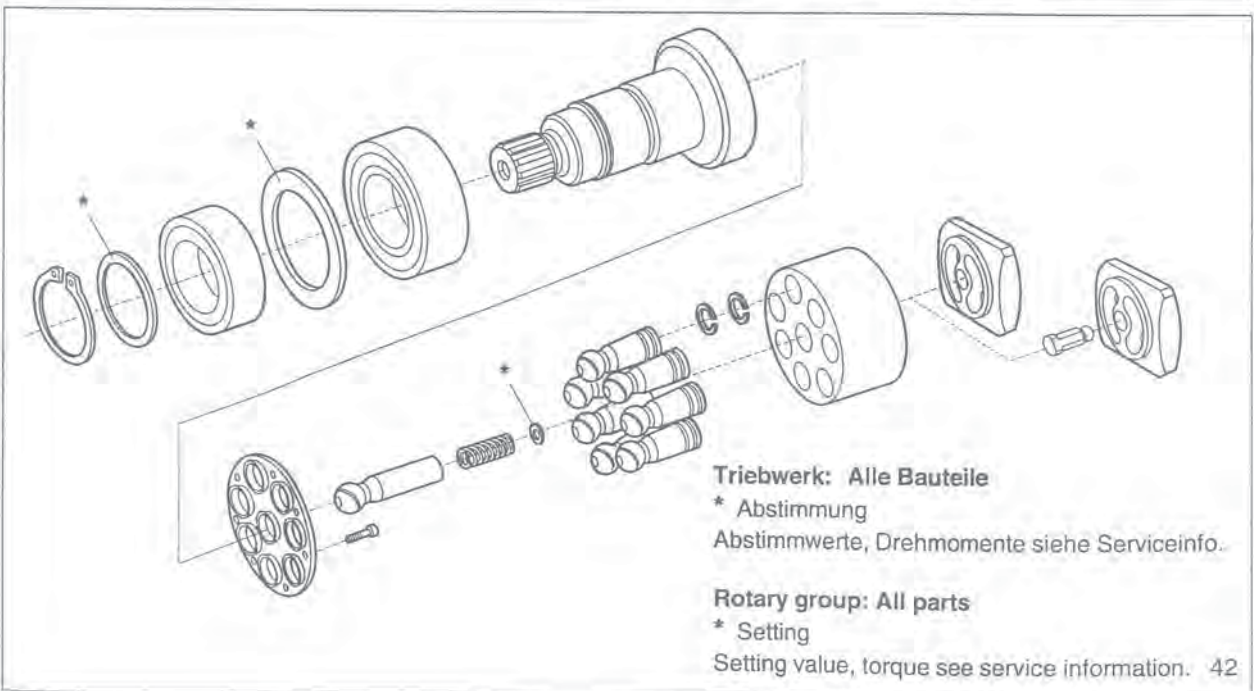
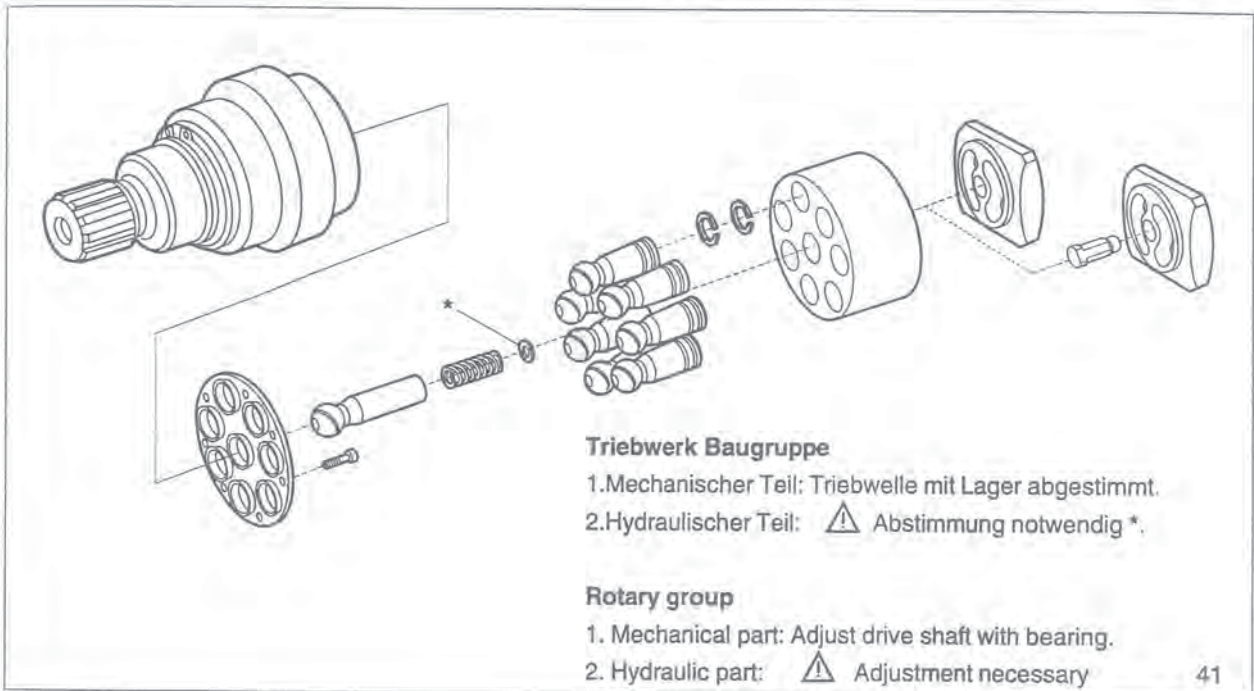
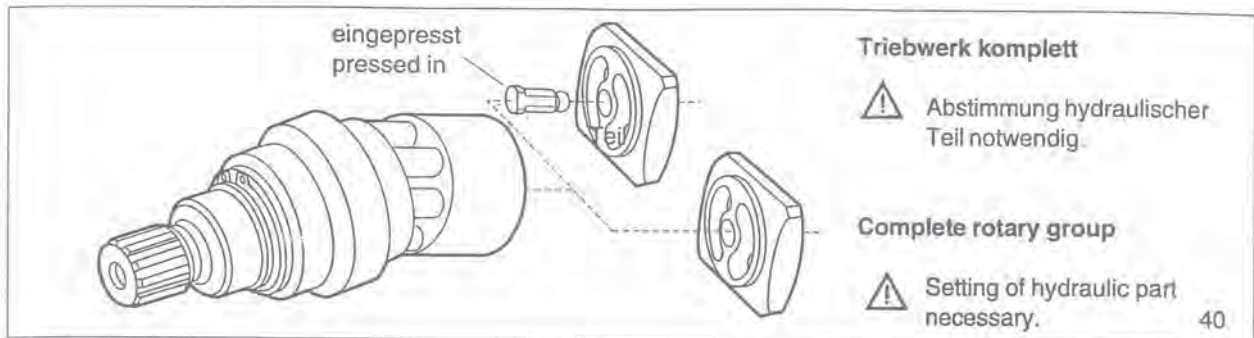


39

Oder mit Abziehvorrichtung ausdrücken.

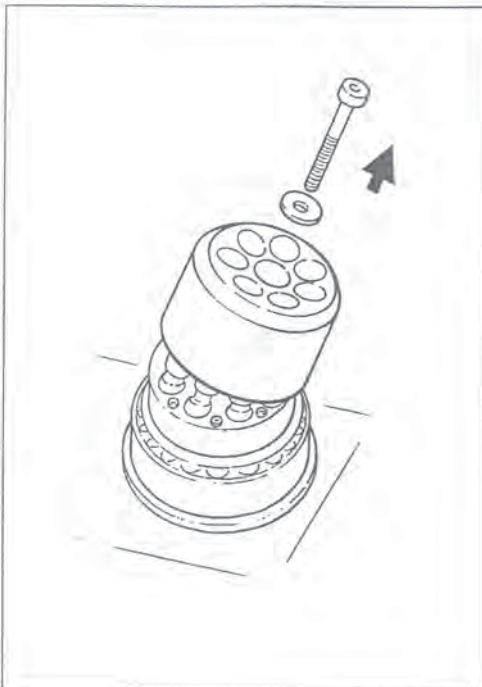
Or press-out with extraction device.





Triebwerk austauschen  
Exchanging of the rotary group

Reparaturanleitung A6VM  
Repair Instructions A6VM



43 Befestigungsschraube (Zylinder) ausbauen.  
Zylinder abheben.

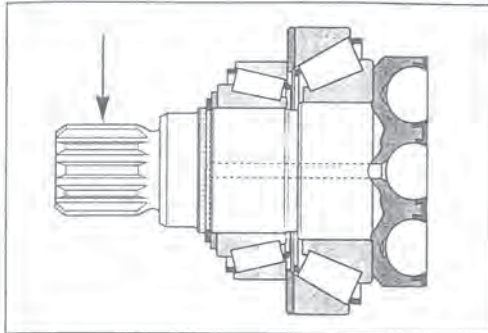
Remove fixing screw (cylinder).  
Remove cylinder.



44 Rückzugplatte demontieren.  
⚠ Schrauben sind eingeklebt.  
Torx-Werkzeug verwenden.

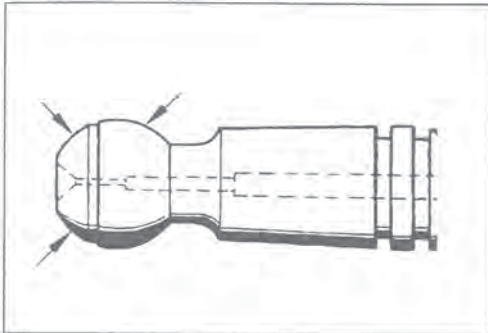
Disassemble retaining plate.  
⚠ Screws are glued.  
Use Torx-tools.





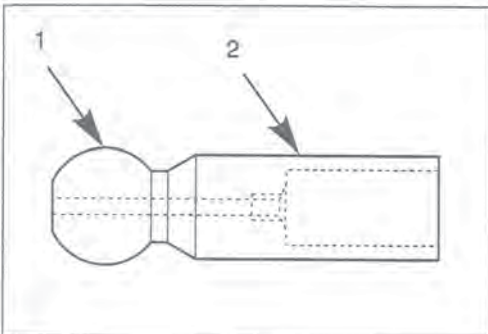
45 Kein Passungsrost, nicht ausgeschlagen.

Free of corrosion, erosion or fretting; no damage to splines or keyways.



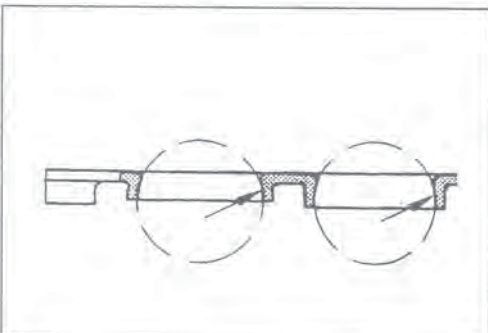
46 Kolben  
Riefenfrei und keine Pittings.

Pistons  
No scoring and no pittings.



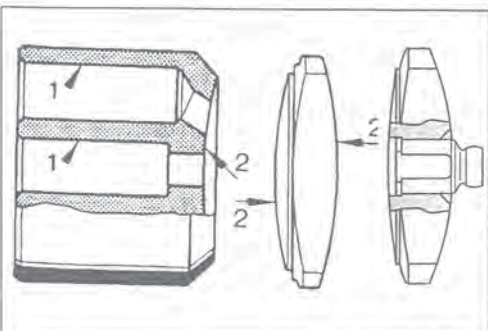
47 Mittelzapfen  
Riefenfrei und keine Pittings.

Center pin  
No scoring and no pittings.



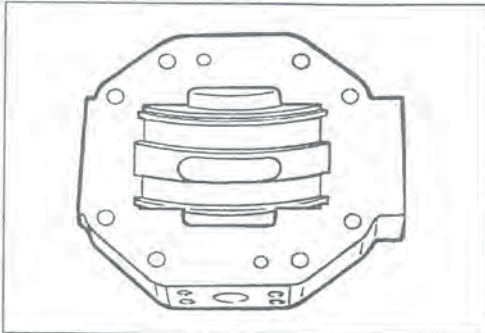
48 Rückzugplatte  
Riefenfrei und keine Ausbrüche.

Retaining plate  
No scoring and no evidence of wear

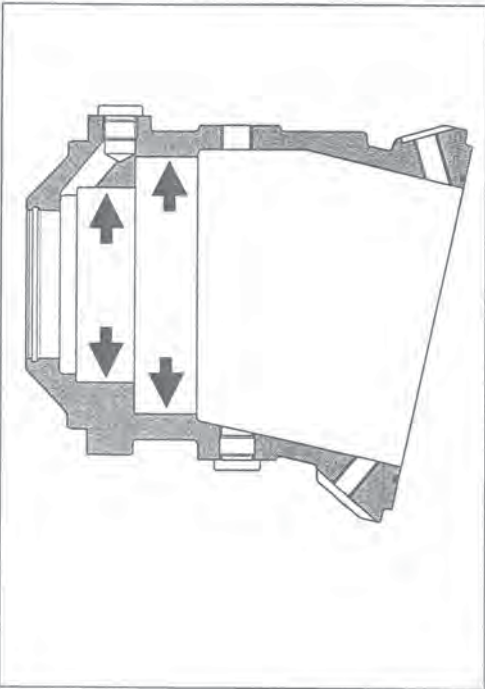


49 Zylinder / Steuerlinse  
1 Bohrungen riefenfrei, nicht ausgelaufen.  
2 Gleichmäßiges Tragbild, riß- und riefenfrei.

Cylinder block / control lens  
1 Bores free of scoring, no evidence of wear.  
2 Faces smooth and even, free of cracks and scoring.



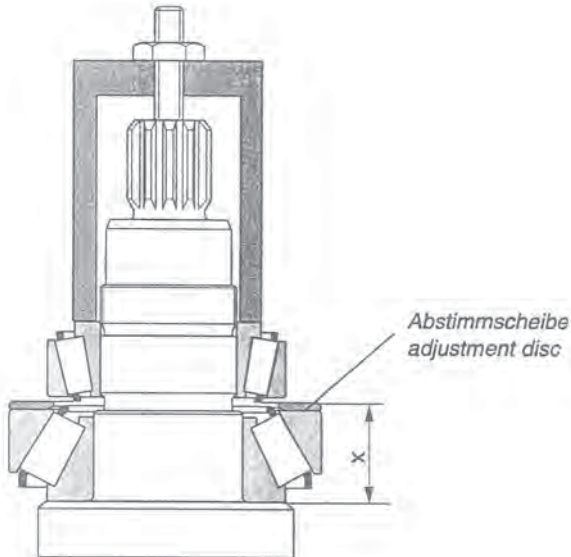
- 50 Reglergehäuse  
Gleitbahn und Seitenführung riefenfrei,  
nicht ausgelaufen.
- Control housing  
Sliding surface and side guides free of scoring  
and no wear.



- 51 Sichtkontrolle:  
Im Lagerbereich riefenfrei und keine Einlaufspuren.
- Visual check:  
Bearing areas free of scoring and no evidence of wear.



**Triebwelle: mechanischer Teil**  
**Rotary group: mechanical part**



Abstimmung Maß \*  
und Lagerdrehmomente  
siehe Serviceinfo.

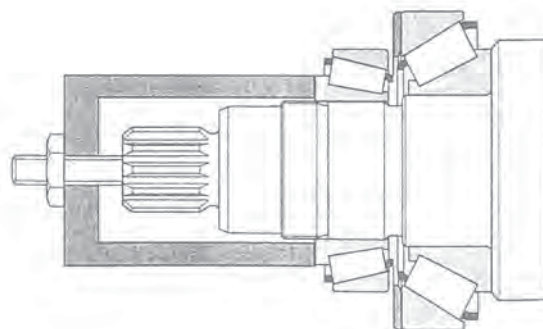
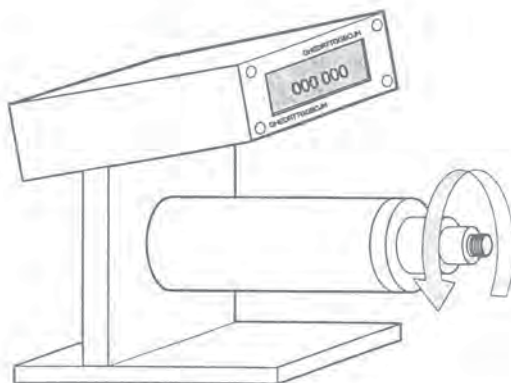
Adjustment dimension \*  
and bearing torque  
see service information.

Lager aufpressen.  
Beim Aufpressen Lager-  
drehmoment nicht überschreiten.

Press on bearing.  
Do not exceed bearing torque  
during press-on.

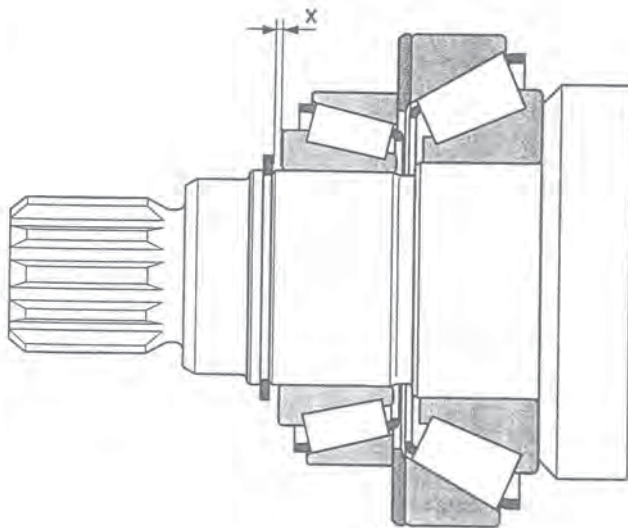
Lager mit Montagehülse vorspannen  
und laufende Drehmomentenkontrolle.

Preload bearing with assembly sleeve  
and steady control of the torque.



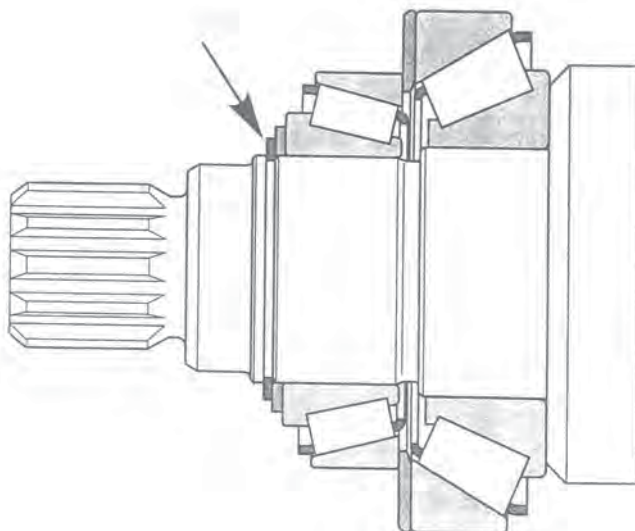


Triebwelle: mechanischer Teil  
Rotary group: mechanical part



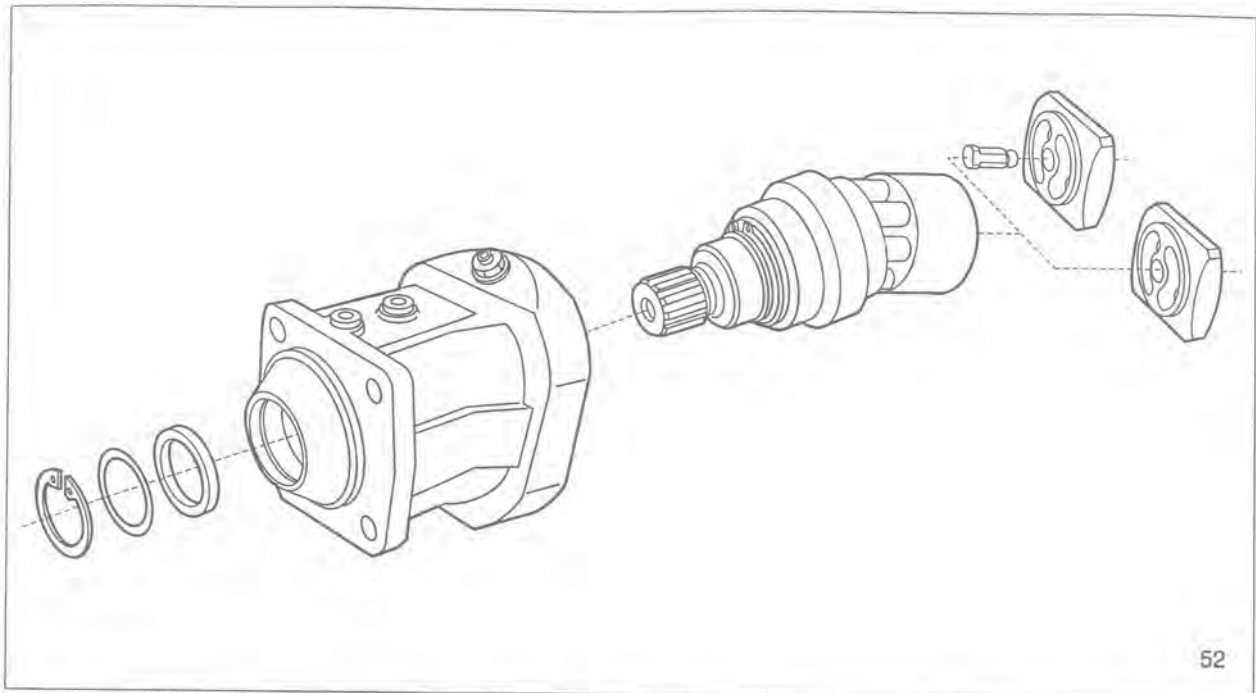
Sicherungsring montieren.  
Maß x für Abstimmungscheibe mit  
Endmaßen ermitteln (überkreuz).

Assemble safety ring.  
Determine dimension for  
adjustment disc with final  
dimensions (crossover).

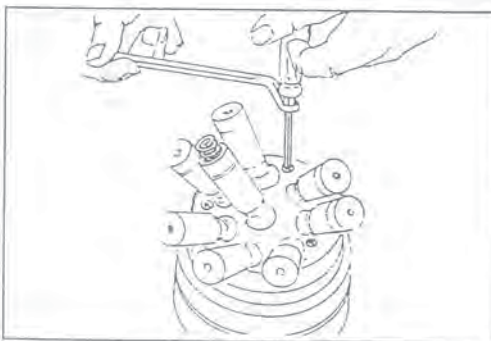


Abstimmungscheibe einbauen.  
Sicherungsring montieren.  
Triebwelle einbaufertig.

Install adjustment disc.  
Assemble safety ring.  
Drive shaft ready for assembly.

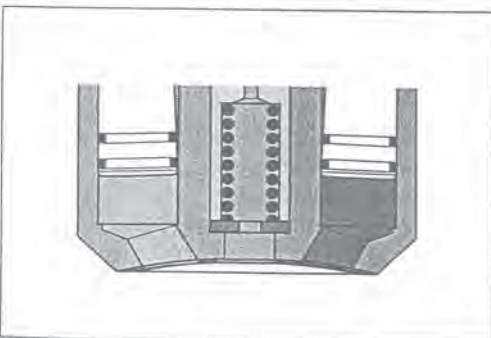


52



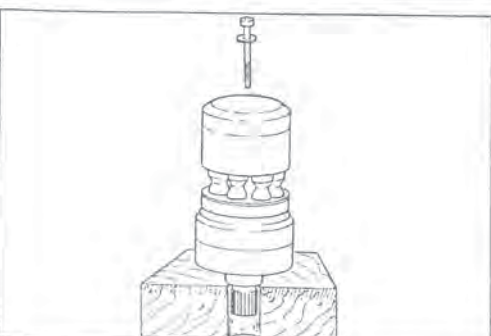
- 53 Rückzugplatte mit Kolben und Mittelzapfen einsetzen.  
Schrauben mit Precote-Beschichtung verwenden.

Insert retaining plate with piston and center pin.  
Use screw with Precote-coating.



- 54 Auf richtige Schichtung aller Teile achten.

Make sure all parts are fitted in correctly.

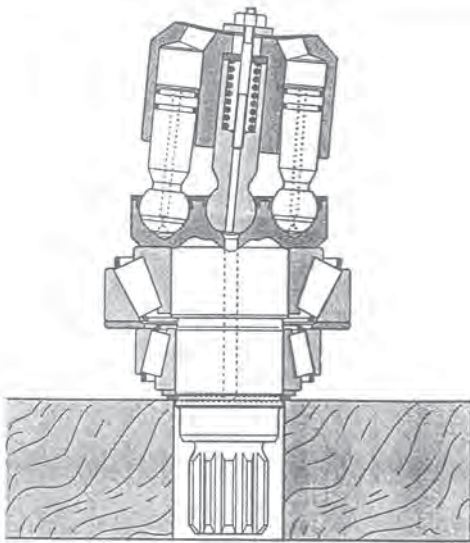


- 55 Triebwerk min. zurückschwenken und Zylinder befestigen.

Swivel cylinder block to min. and fix the cylinder.

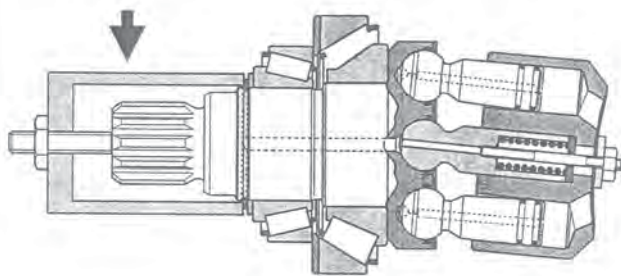
Triebwerk montieren  
Rotary group assembly

Reparaturanleitung A6VM  
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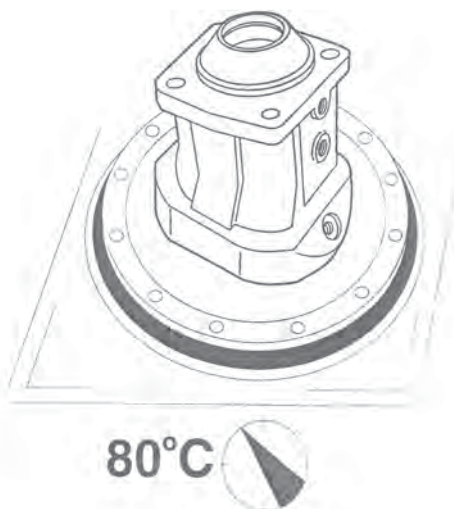
Triebwerk komplett zum  
Einbau fertig.

Rotary group completely assembled  
ready for assembly.



Montagehülse montieren.

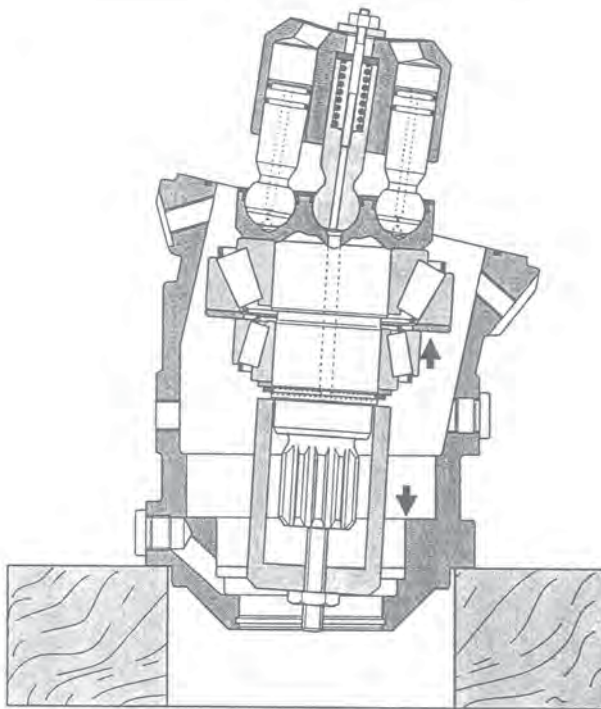
Place assembly sleeve.



Gehäuse auf 80°C erwärmen.

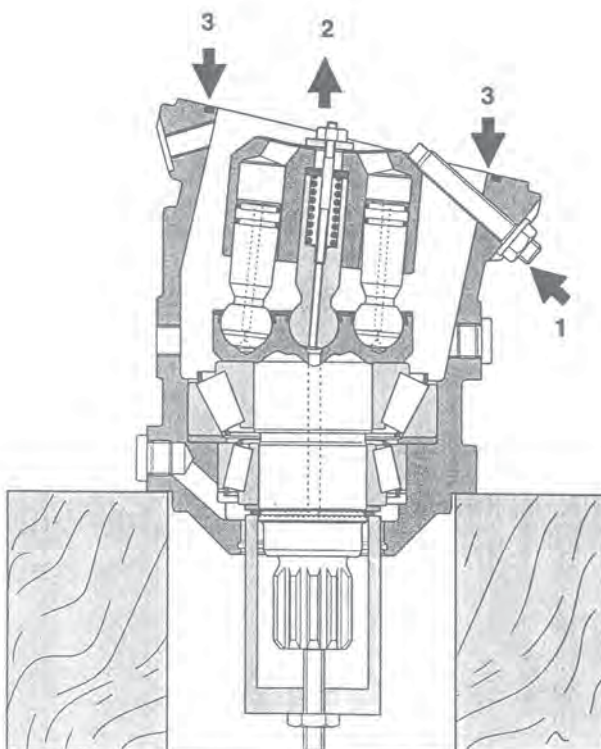
Warm up housing to 80°C.





Triebwerk ins Gehäuse auf  
Anschlag einsetzen.

Insert rotary group into housing  
to seat position.

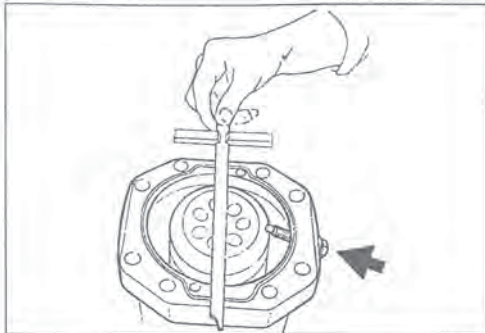


1. Mit  $Q_{max}$ -Schraube Zylinder  
in Nullposition ausrichten.
2. Zylinderbefestigungsschraube  
demonstrieren.
3. O-Ring einsetzen.

1. Fix zero position of cylinder  
with  $Q_{max}$ -screw.
2. Disassemble cylinder  
fixing screw.
3. Insert O-ring.

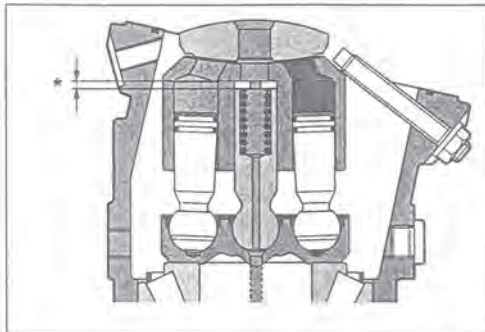
Triebwerksabstimmung (siehe Serviceinfo)  
Rotary group adjustment (see service information)

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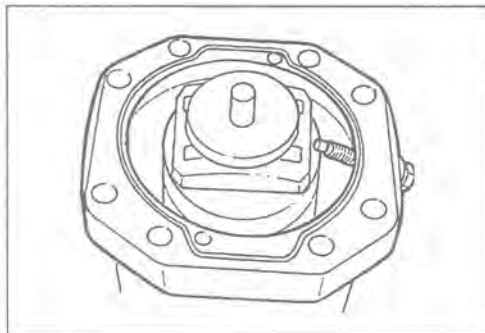
56 Mit Schraube Zylinderausschwenkung vermitteln.

Determine cylinder swivel range to max. angle with screw.



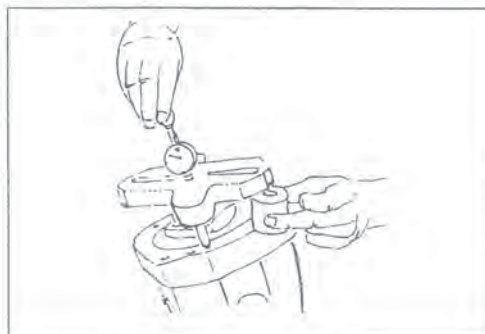
57 \* Scheibe

\* Disc



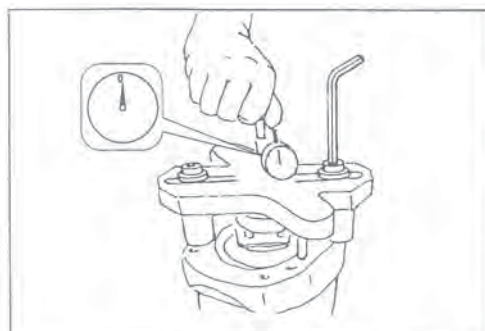
58 Zentrierscheibe aufsetzen.

Place centering disc.



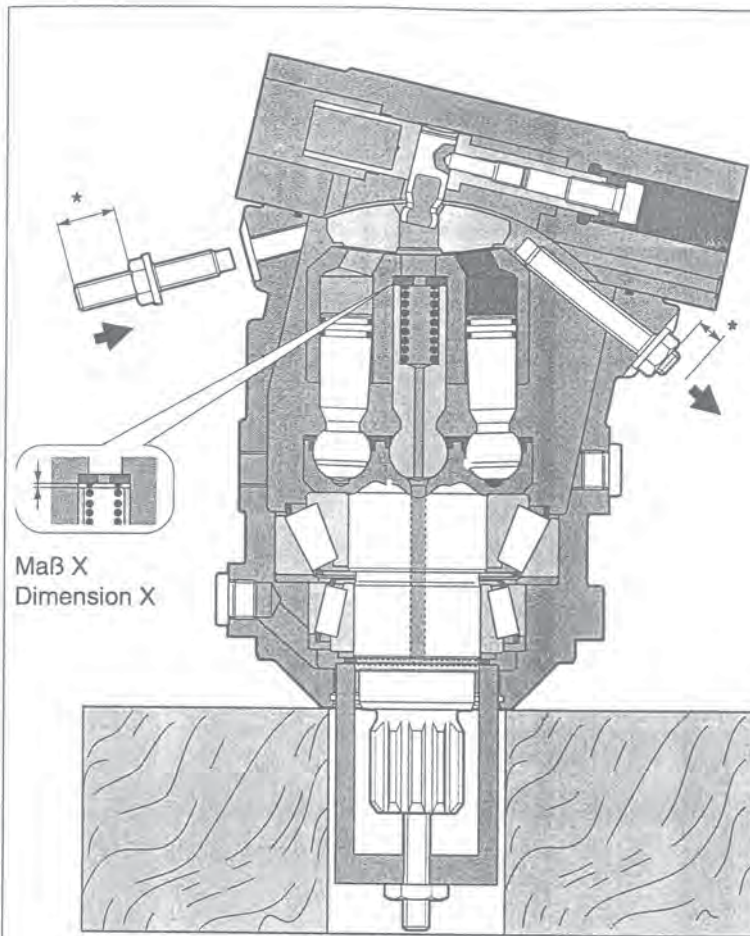
59 Meßvorrichtung aufbauen.

Mount measuring device.



60 Maß X überprüfen.

Check dimension X.

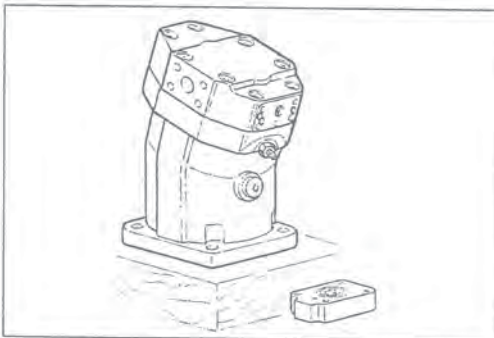


Maß X  
Dimension X

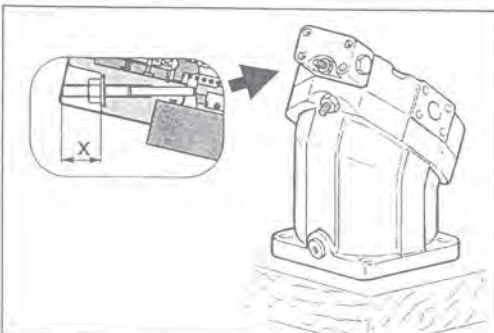
1. Anschlußplatte mit Differentialkolben montieren.  
⚠ Montageausführung beachten!  
⚠ Befestigungsschrauben mit Drehmoment anziehen.
2. Triebwerk in "Ausgangsstellung" schwenken.
3.  $Q_{max} - Q_{min}$  Schraube auf Maß \* einstellen.
4. Montagehülse demontieren.

1. Assemble port plate with differential piston.  
⚠ Take care of assembly design!  
⚠ Tighten fixing screws with torque.
2. Swivel rotary group to "starting position".
3. Set  $Q_{max} - Q_{min}$  screws to dimension\*.
4. Remove assembly sleeve.

61



- 62 Deckel montieren.  
Assemble cover.

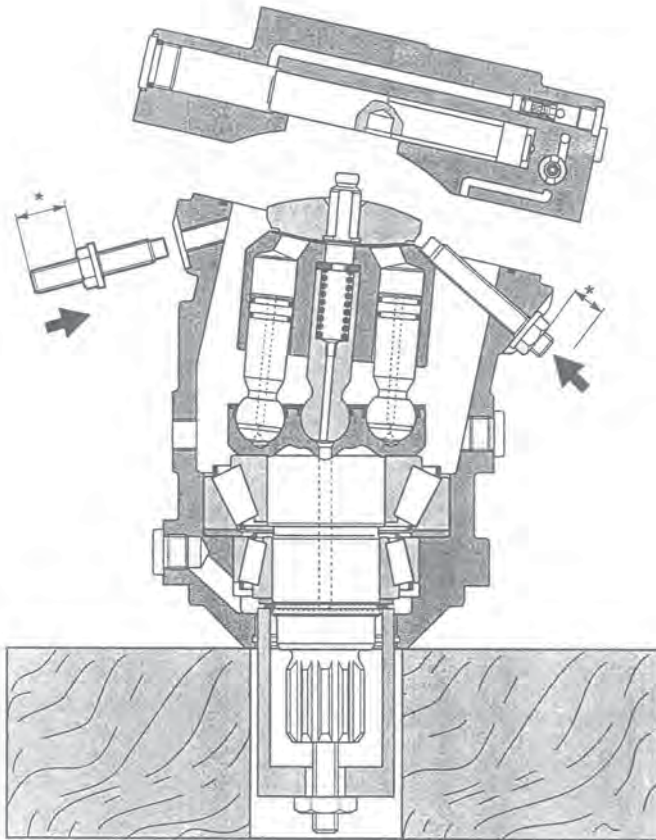


- 63 Steuerteil montieren.  
Assemble control components.



Anschlußplatte montieren  
Assembly of the port plate

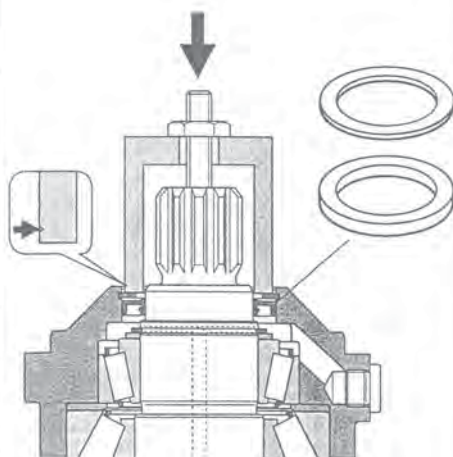
Reparaturanleitung A6VM  
Repair Instructions A6VM



1. Anschlußplatte mit Gleichgangkolben montieren.  
⚠ Montageausführung beachten!  
⚠ Befestigungsschrauben mit Drehmoment anziehen.
2. Triebwerk in "Ausgangsstellung" schwenken.
3.  $Q_{max} - Q_{min}$  Schraube auf Maß \* einstellen.
4. Montagehülse demontieren.

1. Assemble port plate with synchronizing piston.  
⚠ Take care of assembly design!  
⚠ Tighten fixing screws with torque.
2. Swivel rotary group to "starting position".
3. Set  $Q_{max} - Q_{min}$  screws to dimension\*.
4. Remove assembly sleeve.

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- 65 Wellendichtring, Scheiben und Sicherungsring montieren.  
Mit Montagehülse einpressen.

⚠ Einpresstiefe beachten!

Assemble shaft seal, disc and safety ring.  
Press-in with assembly sleeve.

⚠ Take care of press-in depth.

**Anziehdrehmomente für Schachtschrauben  
(Metrisches ISO-Regelgewinde)**

| Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Schachtschrauben mit metrischem ISO-Regelgewinde und Kopfaufmaß nach DIN 912, DIN 931 und DIN 933. Außerdem gelten diese Werte nur für leicht oder nicht geölte, unbehandelte Oberflächen, sowie nur bei Verwendung von Drehmoment- und Kraftbegrenzungsschlüsseln. | Gewindegröße | Festigkeitsklassen   |      |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|------|------|
|                                                                                                                                                                                                                                                                                                                                   |              | 8.8                  | 10.9 | 12.9 |
|                                                                                                                                                                                                                                                                                                                                   |              | Anziehdrehmoment(Nm) |      |      |
|                                                                                                                                                                                                                                                                                                                                   | M 3          | 1,1                  | 1,6  | 1,9  |
|                                                                                                                                                                                                                                                                                                                                   | M 4          | 2,9                  | 4,1  | 4,9  |
|                                                                                                                                                                                                                                                                                                                                   | M 5          | 6                    | 8,5  | 10   |
|                                                                                                                                                                                                                                                                                                                                   | M 6          | 10                   | 14   | 17   |
|                                                                                                                                                                                                                                                                                                                                   | M 8          | 25                   | 36   | 41   |
|                                                                                                                                                                                                                                                                                                                                   | M10          | 49                   | 69   | 83   |
|                                                                                                                                                                                                                                                                                                                                   | M12          | 86                   | 120  | 145  |
|                                                                                                                                                                                                                                                                                                                                   | M14          | 135                  | 190  | 230  |
|                                                                                                                                                                                                                                                                                                                                   | M16          | 210                  | 295  | 355  |
|                                                                                                                                                                                                                                                                                                                                   | M18          | 290                  | 405  | 485  |
|                                                                                                                                                                                                                                                                                                                                   | M 20         | 410                  | 580  | 690  |
|                                                                                                                                                                                                                                                                                                                                   | M 22         | 550                  | 780  | 930  |
|                                                                                                                                                                                                                                                                                                                                   | M 24         | 710                  | 1000 | 1200 |
|                                                                                                                                                                                                                                                                                                                                   | M 27         | 1050                 | 1500 | 1800 |
|                                                                                                                                                                                                                                                                                                                                   | M 30         | 1450                 | 2000 | 2400 |

**Tightening torques for shaft bolts  
(Metric ISO Standard Thread)**

| The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO-standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or uncoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools. | Thread size | Strength Classes          |        |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------|--------|--------|
|                                                                                                                                                                                                                                                                                                                                                                       |             | 8.8                       | 10.9   | 12.9   |
|                                                                                                                                                                                                                                                                                                                                                                       |             | Tightening Torque (lb.ft) |        |        |
|                                                                                                                                                                                                                                                                                                                                                                       | M 3         | 0,8                       | 1,2    | 1,4    |
|                                                                                                                                                                                                                                                                                                                                                                       | M 4         | 2,1                       | 3,0    | 3,6    |
|                                                                                                                                                                                                                                                                                                                                                                       | M 5         | 4,4                       | 6,3    | 7,4    |
|                                                                                                                                                                                                                                                                                                                                                                       | M 6         | 7,4                       | 10,3   | 12,5   |
|                                                                                                                                                                                                                                                                                                                                                                       | M 8         | 18,4                      | 25,8   | 30,2   |
|                                                                                                                                                                                                                                                                                                                                                                       | M10         | 36,1                      | 50,9   | 61,2   |
|                                                                                                                                                                                                                                                                                                                                                                       | M12         | 63,4                      | 88,4   | 106,9  |
|                                                                                                                                                                                                                                                                                                                                                                       | M14         | 99,5                      | 140,0  | 169,5  |
|                                                                                                                                                                                                                                                                                                                                                                       | M16         | 154,8                     | 217,4  | 261,6  |
|                                                                                                                                                                                                                                                                                                                                                                       | M18         | 213,7                     | 298,5  | 357,4  |
|                                                                                                                                                                                                                                                                                                                                                                       | M 20        | 302,2                     | 427,5  | 508,5  |
|                                                                                                                                                                                                                                                                                                                                                                       | M 22        | 405,4                     | 574,9  | 685,4  |
|                                                                                                                                                                                                                                                                                                                                                                       | M 24        | 523,5                     | 737,0  | 884,4  |
|                                                                                                                                                                                                                                                                                                                                                                       | M 27        | 773,9                     | 1105,5 | 1326,6 |
|                                                                                                                                                                                                                                                                                                                                                                       | M 30        | 1068,7                    | 1474,0 | 1768,8 |

**Anziehdrehmomente für Verschlussschrauben VSTI  
(Metrisches Feingewinde)**

| Gewindegröße | Bezeichnung          | Anziehdrehmoment(Nm) |
|--------------|----------------------|----------------------|
| M 8 x 1      | VSTI 8 x 1 -ED/SA    | = 5                  |
| M 10 x 1     | VSTI 10 x 1 -ED      | = 10                 |
| M 12 x 1,5   | VSTI 12 x 1,5 -ED    | = 20                 |
| M 14 x 1,5   | VSTI 14 x 1,5 -ED    | = 30                 |
| M 16 x 1,5   | VSTI 16 x 1,5 -ED/SA | = 30                 |
| M 18 x 1,5   | VSTI 18 x 1,5 -ED/SA | = 40                 |
| M 20 x 1,5   | VSTI 20 x 1,5 -ED/SA | = 50                 |
| M 22 x 1,5   | VSTI 22 x 1,5 -ED    | = 60                 |
| M 26 x 1,5   | VSTI 16 x 1,5 -ED/SA | = 70                 |
| M 27 x 2     | VSTI 27 x 2 -ED      | = 90                 |
| M 30 x 1,5   | VSTI 30 x 1,5 -ED/SA | = 100                |
| M 33 x 2     | VSTI 33 x 2 -ED/SA   | = 120                |
| M 42 x 2     | VSTI 42 x 2 -ED/SA   | = 200                |
| M 48 x 2     | VSTI 48 x 2 -ED      | = 300                |

**Tightening torques for locking screws VSTI  
(Metric ISO fine thread)**

| Thread size | Designation          | Tightening torques (lb.ft) |
|-------------|----------------------|----------------------------|
| M 8 x 1     | VSTI 8 x 1 -ED/SA    | = 4                        |
| M 10 x 1    | VSTI 10 x 1 -ED      | = 7                        |
| M 12 x 1,5  | VSTI 12 x 1,5 -ED    | = 15                       |
| M 14 x 1,5  | VSTI 14 x 1,5 -ED    | = 22                       |
| M 16 x 1,5  | VSTI 16 x 1,5 -ED/SA | = 22                       |
| M 18 x 1,5  | VSTI 18 x 1,5 -ED/SA | = 29                       |
| M 20 x 1,5  | VSTI 20 x 1,5 -ED/SA | = 37                       |
| M 22 x 1,5  | VSTI 22 x 1,5 -ED    | = 44                       |
| M 26 x 1,5  | VSTI 16 x 1,5 -ED/SA | = 51                       |
| M 27 x 2    | VSTI 27 x 2 -ED      | = 66                       |
| M 30 x 1,5  | VSTI 30 x 1,5 -ED/SA | = 74                       |
| M 33 x 2    | VSTI 33 x 2 -ED/SA   | = 88                       |
| M 42 x 2    | VSTI 42 x 2 -ED/SA   | = 147                      |
| M 48 x 2    | VSTI 48 x 2 -ED      | = 220                      |

**Anziehdrehmomente für Seal-Lock Bundmuttern  
(Metrisches ISO-Regelgewinde)**

| Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Seal-Lock Bundmuttern der Festigkeitsklasse 8.8 mit metrischem ISO-Regelgewinde. | Gewindegröße | Festigkeitsklassen   |      |      |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|------|------|
|                                                                                                                                                |              | 8.8                  | 10.9 | 12.9 |
|                                                                                                                                                |              | Anziehdrehmoment(Nm) |      |      |
|                                                                                                                                                | M 6          | 10                   |      |      |
|                                                                                                                                                | M 8          | 22                   |      |      |
|                                                                                                                                                | M 10         | 40                   |      |      |
|                                                                                                                                                | M 12         | 69                   |      |      |
|                                                                                                                                                | M 14         | 110                  |      |      |
|                                                                                                                                                | M 16         | 170                  |      |      |

**Tightening torques for seal-lock nuts  
(Metric ISO-Standard Thread)**

| The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread. | Thread size | Strength classes          |      |      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------|------|------|
|                                                                                                                                                       |             | 8.8                       | 10.9 | 12.9 |
|                                                                                                                                                       |             | Tightening torque (lb.ft) |      |      |
|                                                                                                                                                       | M 6         | 7,4                       |      |      |
|                                                                                                                                                       | M 8         | 16,2                      |      |      |
|                                                                                                                                                       | M 10        | 29,5                      |      |      |
|                                                                                                                                                       | M 12        | 50,9                      |      |      |
|                                                                                                                                                       | M 14        | 81,1                      |      |      |
|                                                                                                                                                       | M 16        | 125,3                     |      |      |

**Anziehdrehmomente für Linsenschrauben mit Kreuzschlitz DIN 7985  
(Metrisches ISO-Regelgewinde)**

| Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Linsenschrauben mit Kreuzschlitz DIN 7985 der Festigkeitsklasse 8.8 mit metrischem ISO-Regelgewinde | Gewindegröße | Festigkeitsklassen   |      |      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|------|------|
|                                                                                                                                                                   |              | 8.8                  | 10.9 | 12.9 |
|                                                                                                                                                                   |              | Anziehdrehmoment(Nm) |      |      |
|                                                                                                                                                                   | M 3          | 1,1                  |      |      |
|                                                                                                                                                                   | M 4          | 2,9                  |      |      |
|                                                                                                                                                                   | M 5          | 6                    |      |      |
|                                                                                                                                                                   | M 6          | 10                   |      |      |
|                                                                                                                                                                   | M 8          | 25                   |      |      |
|                                                                                                                                                                   | M10          | 49                   |      |      |

**Tightening torques for cross-slotted lens head screws  
DIN 7985  
(Metric ISO-Standard Thread)**

| The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread. | Thread size | Strength classes           |      |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------|------|------|
|                                                                                                                                                                                |             | 8.8                        | 10.9 | 12.9 |
|                                                                                                                                                                                |             | Tightening torques (lb.ft) |      |      |
|                                                                                                                                                                                | M 3         | 0,8                        |      |      |
|                                                                                                                                                                                | M 4         | 2,1                        |      |      |
|                                                                                                                                                                                | M 5         | 4,4                        |      |      |
|                                                                                                                                                                                | M 6         | 7,4                        |      |      |
|                                                                                                                                                                                | M 8         | 18,4                       |      |      |
|                                                                                                                                                                                | M10         | 36,1                       |      |      |



### Allgemein

- Machen Sie sich mit der Ausstattung der Maschine vertraut.
- Fahren Sie die Maschine nur, wenn Sie sich völlig mit den Bedien- und Steuerelementen sowie der Arbeitsweise der Maschine vertraut gemacht haben.
- Benutzen Sie Ihre Schutzausrüstung wie Schutzhelm, Sicherheitsschuhe und Gehörschutz.
- Machen Sie sich mit Ihrem Arbeitsgebiet vertraut.
- Benutzen Sie die Maschine nur für den ihr zugedachten Zweck.

**Beachten Sie bitte die Richtlinien der Berufsgenossenschaft und des Maschinenherstellers**



### Vor dem Start

- Beachten Sie die Bedienungshinweise vor dem Starten.
- Prüfen Sie die Maschine auf auffällige Fehler.
- Fahren Sie die Maschine nicht mit defekten Instrumenten, Kontrolleuchten oder Steuerorganen.
- Alle Schutzvorrichtungen müssen fest auf ihrem Platz sein.
- Nehmen Sie keine losen Gegenstände mit bzw. befestigen Sie diese an der Maschine.
- Halten Sie die Maschine von öligem und zündfähigem Material frei.
- Prüfen Sie vor dem Besteigen der Maschine, ob sich Personen oder Hindernisse neben oder unter der Maschine befinden.
- Vorsicht beim Besteigen der Maschine, benutzen Sie Treppen und Griffe.
- Stellen Sie vor dem Start Ihren Sitz ein.

### Starten

- Beim Starten müssen alle Bedienhebel in "Neutralstellung" stehen.
- Die Maschine nur vom Fahrersitz aus starten.
- Prüfen Sie die Anzeigeeinstrumente nach dem Start, um sicher zu gehen, daß alles ordnungsgemäß funktioniert.
- Lassen Sie die Maschine nicht unbewacht, während der Motor läuft.
- Beim Start mit Batterieverbindingskabeln verbinden Sie Plus mit Plus und Minus mit Minus. Massekabel (Minus) immer zuletzt anschließen und zuerst abtrennen.

### Vorsicht

- Auspuffgase sind lebensgefährlich. Bei Start in geschlossenen Räumen für ausreichende Luftzufuhr sorgen!

### General advice

- Make yourself familiar with the equipment of the machine.
- Only operate the machine if you are completely familiar with the operating and control elements as well as the functioning of the machine.
- Use your safety equipment like helmet, safety shoes and hearing protection.
- Make yourself familiar with your working field.
- Only operate the machine for its intended purpose.

**Please observe the guidelines of the Professional Association and the machine manufacturer.**



### Before starting

- Observe the operating instructions before starting.
- Check the machine for remarkable faults.
- Do not operate the machine with defective instruments, warning lights or control elements.
- All safety devices must be in a secure position.
- Do not carry with you movable objects or secure them to the machine.
- Keep oily and inflammable material away from the machine.
- Before entering the driver's cabin, check if persons or obstacles are beside or beneath the machine.
- Be careful when entering the driver's cabin, use stairs and handles.
- Adjust your seat before starting.

### Start

- When starting all operating levers must be in "neutral position".
- Only start the machine from the driver's seat.
- Check the indicating instruments after start to assure that all functions are in order.
- Do not leave the machine unobserved when the motor is running.
- When starting with battery connection cables connect plus with plus and minus with minus. Always connect mass cable (minus) at last and cut off at first.

### Attention

- Exhaust gas is dangerous. Assure sufficient fresh air when starting in closed rooms!



### Hydraulikanlage

1. Hydraulikanlage steht unter hohem Druck!  
Unter hohem Druck austretende Hochdruck-Flüssigkeiten (Kraftstoff, Hydrauliköl) können die Haut durchdringen und schwere Verletzungen verursachen. Daher sofort einen Arzt aufsuchen, da anderenfalls schwere Infektionen entstehen können!
  2. Bei der Suche nach Leckstellen wegen Verletzungsgefahr geeignete Hilfsmittel verwenden!
  3. Vor Arbeiten an der Hydraulikanlage diese unbedingt drucklos machen und angebaute Geräte absenken!
  4. Bei Arbeiten an der Hydraulikanlage unbedingt Motor abstellen und Traktor gegen Wegrollen sichern (Feststellbremse, Unterlegkeil)!
  5. Beim Anschließen von Hydraulikzylindern und -motoren ist auf vorgeschriebenen Anschluß der Hydraulikschläuche zu achten!
  6. Bei Vertauschen der Anschlüsse umgekehrte Funktionen (z.B. Heben/Senken) - Unfallgefahr!
  7. Hydraulikschlauchleitungen regelmäßig kontrollieren und bei Beschädigung und Alterung austauschen! Die Austauschschlauchleitungen müssen den technischen Anforderungen des Geräteherstellers entsprechen!
- ⚠ Öle, Kraftstoffe und Filter ordnungsgemäß entsorgen!

### Hinweis!

Um eine ordnungsgemäße Abwicklung von Ersatzteil-Aufträgen sicherzustellen, muß die Bestellung folgende Angaben enthalten:

Typenschlüssel  
Typ-Nr.  
Fabrikations-Nr.  
Baugruppe  
Position  
Benennung

Zur Reparatur des Gerätes empfehlen wir die Verwendung von vormontierten und teilgeprüften Baugruppen.

### Hydraulic equipment

1. Hydraulic equipment is standing under high pressure.  
⚠ High pressure fluids (fuel, hydraulic oil) which escape under high pressure can penetrate the skin and cause heavy injuries.  
Therefore immediately consult a doctor as otherwise heavy infections can be caused.
  2. When searching leakages use appropriate auxiliary devices because of the danger of accidents.
  3. Before working at the hydraulic equipment, lower pressure to zero and lower working arms of the machine.
  4. When working at the hydraulic equipment, absolutely stop motor and secure tractor against rolling away (parking brake, shim)!
  5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
  6. In case of exchanging the ports, the functions are vice versa (f. ex. lift-up/lower) - danger of accidents!
  7. Check hydraulic flexible hoses regularly and replace them in case of damage or wear! The new hose pipes must comply with the technical requirements of the machine manufacturer!
- ⚠ Orderly disposal or recycling of oil, fuel and filters!

### Note!

In order to supply proper spare parts, please provide following specifications when ordering spares:

Type Code  
Type Number  
Serial Number  
Assembly Group  
Item  
Designation

In repairing the unit, we recommend the use of pre-assembled partially tested assembly groups.

# **GEAR BOX TYPE: 357**







**SPICER®**

*Off-Highway Products*

# Service Manual

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Gear Box  
357A10

GSM-0012  
January 1998

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**GB**

The efficiency and continued operation of mechanical units depend on constant, correct maintenance and also on efficient repair work, should there be a break-down or malfunction. The instructions contained in this manual have been based on a complete overhaul of the unit. However, it is up to the mechanic to decide whether or not it is necessary to assemble only individual components, when partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to be performed.

All the information needed for correct disassembly, checks and assembly of each individual component is set out below. In order to remove the differential unit from the vehicle, the manuals provided by the vehicle manufacturer should be consulted. In describing the following operations it is presumed that the unit has already been removed from the vehicle.

**IMPORTANT:** In order to facilitate work and protect both working surfaces and operators, it is advisable to use proper equipment such as: trestles or supporting benches, plastic or copper hammers, appropriate levers, extractors and specific spanners or wrenches.

Before going on to disassemble the parts and drain the oil, it is best to thoroughly clean the unit, removing any encrusted or accumulated grease.

**INTRODUCTORY REMARKS:** All the disassembled mechanical units should be thoroughly cleaned with appropriate products and restored or replaced if damage, wear, cracking or seizing have occurred.

In particular, thoroughly check the condition of all moving parts (bearings, gears, crown wheel and pinion, shafts) and sealing parts (O-rings, oil shields) which are subject to major stress and wear. In any case, it is advisable to replace the seals every time a component is overhauled or repaired. During assembly, the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly, the prescribed pre-loading, backlash and torque of parts must be maintained.

**CLASSIFICATION:** This manual classifies units according to part numbers. For a correct interpretation, classification is indicated as follows:

→ → [ ] = up to the part number

[ ] → → = from the part number on

When no classification is given, disassembly and assembly operations are the same for all versions.

**SPECIFIC EQUIPMENT AND SPARE PARTS:** The drawings of all specific tools required for maintenance and repair work can be found at the end of this manual; spare parts may be ordered either from the vehicle manufacturer or directly from the Service Centers or Authorised Distributors of SPICER CLARK-HURTH.

**ITA**

Il rendimento e la continuità degli organi meccanici dipendono oltre che da una costante e corretta manutenzione, anche dal tempestivo intervento, nell'eventualità di guasti o anomalie.

Nel proporre questo manuale si è considerata l'ipotesi di una revisione generale del gruppo ma è il meccanico a valutare la necessità di montare solo i singoli componenti nel caso di riparazione. Il manuale è una guida rapida e sicura che consente interventi precisi, tramite le fotografie ed i disegni prospettici che illustrano le varie fasi delle operazioni. Di seguito sono riportate tutte quelle informazioni ed avvertenze necessarie al corretto disassemblaggio, alle relative verifiche ed all'assemblaggio dei singoli componenti. Per la rimozione del ponte differenziale dal veicolo, è necessario consultare i manuali forniti dal costruttore del veicolo. Nel descrivere le operazioni seguenti, si presuppone che il ponte sia già stato rimosso dal veicolo.

**IMPORTANTE:** In tutte le operazioni, è consigliabile usare attrezzature idonee quali cavalletti o banchi di sostegno,

martelli in plastica o rame, leve appropriate estrattori e chiavi specifiche, al fine di facilitare il lavoro salvaguardando nel contempo le superfici lavorate e la sicurezza degli operatori. Prima di procedere al disassemblaggio delle parti e scaricare l'olio, è opportuno eseguire un'accurata pulizia del ponte, asportando incrostazioni ed accumuli di grasso.

**PREMESSA:** Tutti gli organi meccanici smontati, devono essere accuratamente puliti con prodotti appropriati, quindi ripristinati o sostituiti nel caso presentino danni, usura, incrinature, grippaggi, ecc. In particolare, verificare l'integrità di tutte quelle parti in movimento (cuscinetti, ingranaggi, coppia conica, alberi) e di tenuta (anelli OR, paraolio), soggette a maggiori sollecitazioni ed usura. È consigliabile, comunque, la sostituzione degli organi di tenuta ogni qualvolta si proceda alla revisione o riparazione dei componenti. Al momento del montaggio, gli anelli di tenuta devono essere lubrificati sui bordi di tenuta. Nel caso della coppia conica, la sostituzione di uno dei suoi ingranaggi comporta anche la sostituzione dell'altro. In fase di montaggio sono da rispettare scrupolosamente i giochi, i precarichi e le coppie prescritte.

**VALIDITÀ:** Il manuale fornisce le validità dei gruppi sotto forma di matricola. Al fine di una corretta interpretazione, le validità sono indicate come:

→ → [ ] = fino alla matricola

[ ] → → = dalla matricola

Se non sono indicate validità, le operazioni di smontaggio ed assemblaggio sono comuni a tutte le versioni.

**MANUTENZIONE E RIPARAZIONE:** Al fine di facilitare interventi sui gruppi ponte differenziali e cambi di velocità la SPICER CLARK-HURTH, ha ritenuto opportuno compilare queste istruzioni di manutenzione e riparazione. I disegni delle attrezzature specifiche eventualmente necessarie per l'esecuzione di interventi di manutenzione e riparazione possono essere acquistati direttamente presso il costruttore; i ricambi possono essere ordinati tramite il costruttore della macchina o direttamente presso la SPICER CLARK-HURTH.

**D**

Die Leistung und Lebensdauer der mechanischen Teile hängt nicht nur von einer ständigen und richtig durchgeführten Wartung sondern auch von einem sofortigen Eingriff im Störfall ab. Um dieses Handbuch zu erstellen sind wir von einer allgemeinen Überprüfung der Einheit ausgegangen, doch entscheidet der Mechaniker ob die einzelnen Teile bei Reparaturen montiert werden müssen oder nicht. Das Handbuch ist schnell und einfach nachzuschlagen und ermöglicht es anhand der Abbildungen und der Zeichnungen, die die verschiedenen Vorgänge darstellen, gezielt einzugreifen. Nachstehend sind alle Informationen und Hinweise aufgeführt, die zur Zerlegung, Prüfung und Montage der Einzelteile nötig sind. Um die Differentialachse des Fahrzeugs abzumontieren, lesen Sie bitte die Anweisungen in den Handbüchern des Fahrzeugherstellers. Die nachstehenden Beschreibungen gehen davon aus, daß die Fahrzeugachse schon abmontiert worden ist.

**WICHTIG:** Um die Arbeit zu erleichtern und gleichzeitig die verarbeiteten Flächen zu schützen und die Sicherheit der Arbeiter zu gewährleisten, empfehlen wir geeignete Werkzeuge wie Böcke, Tisch, Gummi- oder Kupferhammer, geeignete Auszieher und Schlüssel zu verwenden. Bevor mit der Zerlegung der Teile begonnen und das Öl abgelassen wird, muß die Achse sorgfältig gereinigt und Verkrustungen und Fettablagen abgetragen werden.

**VORAUSSETZUNG:** Alle abmontierten mechanischen Teile müssen sorgfältig mit geeigneten Reinigungsmitteln gereinigt oder, wenn beschädigt, verschleißt, gerissen, festgefressen usw. ausgewechselt werden. Insbesondere muß der einwandfreie Zustand aller beweglichen Teile (Lager, Zahnräder, Kegelradpaare, Wellen) und der Dichtungen (O-Ringe, Ölabdichtungen), die am meisten beansprucht werden und verschleßen, kontrolliert werden. Wir empfehlen auf jeden Fall die Abdichtungselemente immer auszuwechseln, wenn eine Überholung oder eine Reparatur der Teile vorgenommen wird. Bei



der Montage müssen die Ränder der Dichtringe geschmiert werden. Wenn beim Kegelradpaar ein Zahnrad ausgewechselt werden muß, muß auch das andere Zahnrad ausgewechselt werden. Bei der Montage müssen die vorgeschriebenen Spiele, Vorspannungen und Drehmomente strengstens eingehalten werden.

**GÜLTIGKEIT:** Das Handbuch gibt an zu welchen Kennnummern die Einheiten gehören. Der Einfachheit halber sind die Angehörigkeiten folgendermaßen aufgeführt:

➡➡ [ ] = bis Kennnummer

[ ] ➡➡ = ab Kennnummer

Wenn keine Angehörigkeit angegeben ist, verstehen sich die Arbeiten zur Zerlegung und Montage für alle Ausführungen gültig.

**Spezifische Werkzeuge und Ersatzteile:** die Zeichnungen der für Wartungsarbeiten erforderlichen spezifischen Werkzeuge, sind am Ende des Handbuchs aufgeführt; Ersatzteile können beim Fahrzeughersteller oder direkt bei der Kundendienststelle oder bei einem zugelassenen Händler der SPICER CLARK-HURTH bezogen werden.

**ESP**

El rendimiento y la duración de los órganos mecánicos depende, además que del constante y correcto mantenimiento, también de la intervención inmediata en caso de averías o anomalías.

Al proponer este manual, ha sido considerada la suposición de una revisión general del grupo, pero es el mecánico quien tiene que valorar la necesidad de montar cada uno de los componentes en caso de reparación. El manual es una guía rápida y segura que permite intervenciones precisas por medio de fotografías y de planos que muestran las distintas fases de las operaciones. A continuación figuran todas las informaciones y advertencias necesarias para ejecutar un montaje correcto, para las comprobaciones y el montaje de cada uno de los componentes. Para remover el puente diferencial del vehículo hay que consultar los manuales de los fabricantes del vehículo. En la descripción de las operaciones siguientes se supone que el puente ya ha sido sacado del vehículo.

**IMPORTANTE:** Para facilitar el trabajo salvaguardando al mismo tiempo las superficies mecanizadas y la seguridad de los operadores, se aconseja que se usen equipos y herramientas adecuados como caballetes y bancos de soporte, martillos de plástico o de cobre, palancas adecuadas, extractores y llaves específicas.

Antes de desmontar las partes y descargar el aceite, es conveniente que se haga una limpieza minuciosa del puente sacando las incrustaciones y acumulaciones de grasa.

**INTRODUCCION:** Todos los órganos mecánicos desmontados tienen que ser limpiados minuciosamente con productos adecuados y restaurados o sustituidos en el caso de que presenten daños, desgaste, rajaduras, agrietamientos, etc. En particular, comprobar la integridad de todas las partes en movimiento (cojinetes, engranajes, par cónico, ejes) y de estanqueidad (anillos OR, detenedor de aceite) sujetas a mayores sollicitaciones y desgaste.

Se aconseja, de todas formas, que se sustituyan los órganos de estanqueidad cada vez que se ejecute la revisión o reparación de los componentes.

Al volver a montar, los segmentos de compresión tienen que estar lubricados en los bordes de estanqueidad. En el caso del par cónico, la sustitución de uno de sus engranajes comporta también la sustitución del otro. Al montar hay que tener en cuenta escrupulosamente los juegos, las precargas y los pares descriptos.

**VALIDEZ:** El manual suministra la validez de los grupos en forma de matrícula. Para poder tener una interpretación correcta, la validez está indicada:

➡➡ [ ] = hasta la matrícula

[ ] ➡➡ = desde la matrícula en adelante

Si no ha sido indicada validez, las operación de desmontaje y montaje son comunes a todas las versiones.

**HERRAMIENTAS ESPECIFICAS Y RECAMBIOS:** Los planos de las herramientas específicas necesarias para la ejecución de las intervenciones de mantenimiento figuran al final del manual; los recambios se pueden pedir al fabricante de la máquina o directamente al Service Center o a Distribuidores autorizados de SPICER CLARK-HURTH.

**F**

Le rendement et la continuité des organes mécaniques dépendent, non seulement d'une maintenance correcte et constante, mais également de la rapidité d'intervention en cas de pannes ou d'anomalies. En vous proposant ce manuel, on envisage l'hypothèse d'une révision générale du groupe, mais c'est au mécanicien d'évaluer la nécessité de monter ou non chacun des composants en cas de réparation. Le manuel est un guide rapide et sûr consentant des interventions précises, au travers de photographies et de dessins prospectifs qui illustrent les différentes phases des opérations. Ensuite, sont reportées toutes les informations et précautions nécessaires pour un démontage correct et les vérifications et assemblage de chaque composant. En ce qui concerne le déplacement du pont d'étai du véhicule, il est nécessaire consulter les manuels fournis par le constructeur du véhicule. En décrivant les opérations suivantes, on présume que le pont ait déjà été enlevé du véhicule.

**IMPORTANT:** Pour faciliter le travail en sauvegardant en même temps les surfaces usinées et la sécurité des opérateurs, il est préconisé d'utiliser des installations appropriées telles que des étais ou banc de support, maillets en plastique ou cuivre, leviers appropriés, extracteurs et clés spécifiques. Avant de procéder au démontage des parties et vidanger l'huile, il vaut mieux nettoyer soigneusement le pont, en enlevant incrustations et blocs de gras.

**PRELIMINAIRE:** Tous les organes mécaniques démontés doivent être soigneusement nettoyés à l'aide de produits appropriés et réparés ou remplacés dans le cas où ils seraient abîmés, usés, fêlés, grippés, etc. Vérifier, l'intégrité, en particulier, de toutes les parties en mouvement (paliers, engrenages, couple conique, arbres) et l'étanchéité des bagues (bagues OR, parahuile), qui sont sujettes à plus de sollicitations et à l'usure. Il est préconisé, de toute façon, de substituer les organes d'étanchéité, chaque fois que l'on effectue une révision ou une réparation des composants. Au moment du montage, les bagues d'étanchéité doivent être lubrifiées sur les bords étanches. Dans le cas du couple conique, la substitution de l'un de ses engrenages comporte également la substitution de l'autre. En phase de montage, il faut respecter scrupuleusement les jeux, les précharges et les couples prescrits.

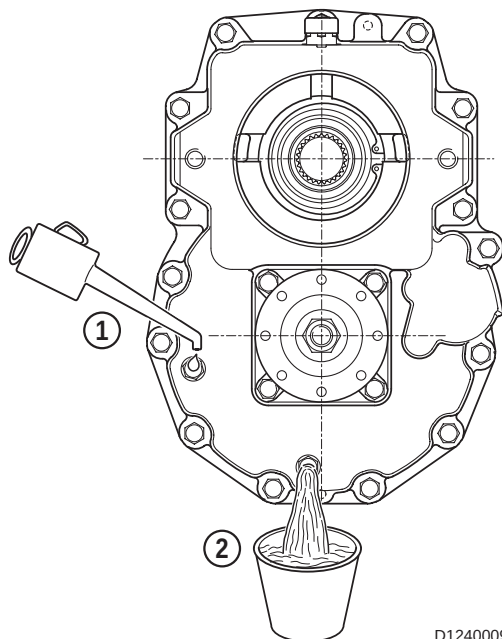
**VALIDITE:** Le manuel fournit la validité des groupes sous forme de matricule. Pour une meilleure interprétation, les validités sont indiquées comme:

➡➡ [ ] = jusqu'à l'immatriculation

[ ] ➡➡ = à partir de l'immatriculation et après

Si les validités ne sont pas indiquées, les opérations de démontage et d'assemblage sont pareilles dans toutes les versions.

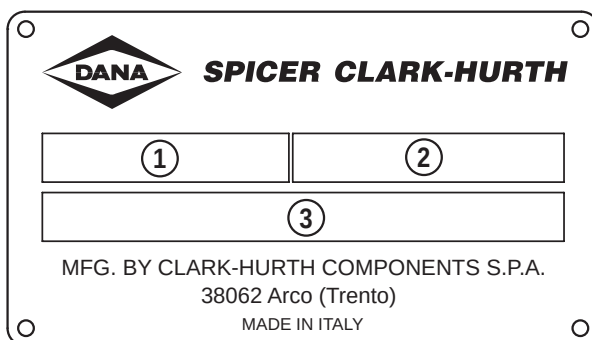
**INSTALLATIONS SPECIFIQUES ET PIECES DETACHEES:** Les dessins des installations spécifiques nécessaires pour effectuer des interventions d'entretien sont reportées à la fin du manuel, les pièces détachées peuvent être commandées au constructeur de la machine ou directement aux Centres de Services, ou Distributeurs agréés de la Société SPICER CLARK-HURTH.



D1240009

**1** Oil fill and level plug  
Tappo carico e livello olio  
Öleinfüll- und Ölstandschraube  
Tapón de relleno y nivel aceite  
Bouchon de remplissage et jauge d'huile

**2** Oil drain plug  
Tappo scarico olio  
Öleinfüll- und Ölablaßschraube  
Tapón de vaciado nivel aceite  
Bouchon de vidage huile



D1240011

**1** Type and model unit  
Tipo e modello gruppo  
Type und modell Antriebes  
Tipo y modelo unidad  
Type et modèle de ensemble

**2** Serial number  
Numero di serie  
Seriennummer  
Número de serie  
Numero de serie

**3** Lubricant  
Lubrificante  
Schmieröl  
Lubricante  
Lubrifiant

| OPERATION<br>OPERAZIONE<br>ARBEITSVORGANG<br>OPERACION<br>OPERATION                                                                                                         | FREQUENCY<br>PERIODICITA<br>ZEITABSTAND<br>FRECUENCIA<br>PERIODICITE                              | LUBRICANTS<br>LUBRIFICANTI<br>SCHMIERSTOFFE<br>LUBRICANTES<br>LUBRIFIANTS |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Check levels:</li> <li>Controllo livelli:</li> <li>Ölstandkontrolle:</li> <li>Control niveles:</li> <li>Contrôle niveaux:</li> </ul> | monthly<br>mensile<br>monatlich<br>cada mes<br>mensuel                                            | SAE85W90 API GL3                                                          |
| <ul style="list-style-type: none"> <li>Oil change:</li> <li>Cambio olio:</li> <li>Ölwechsel:</li> <li>Cambio aceite:</li> <li>Vidange huile:</li> </ul>                     | every 1000 hours *<br>ogni 1000 ore<br>alle 1000 Std.<br>cada 1000 horas<br>toutes les 1000 hours |                                                                           |

\* Initially after 100 working hours - Inizialmente dopo 100 ore di lavoro - Erstmals nach 100 Betriebsstunden - Al principio, después de 100 horas de trabajo - Initialement après 100 heures de travail





CONVERSION TABLES - TABELLE DI CONVERSIONE - UMRECHNUNGSTABELLEN  
TABLAS DE CONVERSION - TABLEAUX DE CONVERSION

$$1 \text{ Atm} \cong 1 \text{ bar} \cong 10^5 \text{ Pa} \cong 14.4 \text{ PSI}$$

|      | N    | daN   | kN      | kg    | lbs   |
|------|------|-------|---------|-------|-------|
| 1N   | 1    | 0,1   | 0,001   | 0,102 | 0,225 |
| 1daN | 10   | 1     | 0,01    | 1,02  | 2,25  |
| 1kN  | 1000 | 100   | 1       | 102   | 225   |
| 1kg  | 9,81 | 0,981 | 0,00981 | 1     | 2,205 |
|      |      |       |         |       |       |

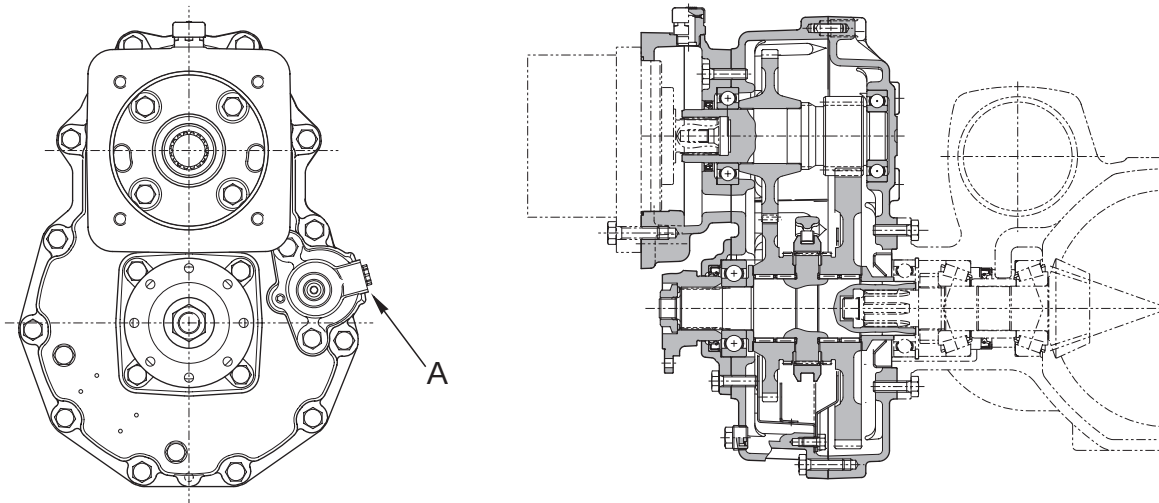
|        | Nm     | daNm    | kNm       | kgm     | lb-in |
|--------|--------|---------|-----------|---------|-------|
| 1Nm    | 1      | 0,1     | 0,001     | 0,102   | 8,854 |
| 1daNm  | 10     | 1       | 0,01      | 1,02    | 88,54 |
| 1kNm   | 1000   | 100     | 1         | 102     | 8854  |
| 1kgm   | 9,81   | 0,981   | 0,00981   | 1       | 86,8  |
| 1lb-in | 0,1129 | 0,01129 | 0,0001129 | 0,01152 | 1     |

TIGHTENING TORQUES - COPPIE DI SERRAGGIO - ANZIEHDREHMOMENTE  
PARES DE TORSION - COUPLES DE SERRAGE

| SIZE OF BOLT<br>MISURA VITE<br>SCHRAUBENMASS<br>TAMAÑO TORNILLO<br>MESURE VIS | TYPE OF BOLT - TIPO VITE - GEWINDE - TIPO DE TORNILLO - TYPE DE VIS |                |                |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------|----------------|
|                                                                               | 8G/8,8<br>Nm                                                        | 10k/10,9<br>Nm | 12k/10,9<br>Nm |
| M4                                                                            | 2,9                                                                 | 4,1            | —              |
| M6                                                                            | 10,0                                                                | 14,0           | —              |
| M8                                                                            | 25,0                                                                | 35,0           | —              |
| M10                                                                           | 49,0                                                                | 69,0           | —              |
| M10x1,25                                                                      | 52,0                                                                | 73,0           | 88,0           |
| M12                                                                           | 86,0                                                                | 120,0          | —              |
| M14                                                                           | 135,0                                                               | 190,0          | —              |
| M14x1,5                                                                       | 150,0                                                               | 210,0          | 250,0          |
| M16                                                                           | 210,0                                                               | 295,0          | —              |
| M18x1,5                                                                       | 325,0                                                               | 460,0          | 550,0          |
| A22                                                                           | 550                                                                 |                |                |



DIAGRAM  
SCHEMA  
SCHEMAS  
DIAGRAMAS  
TRACES

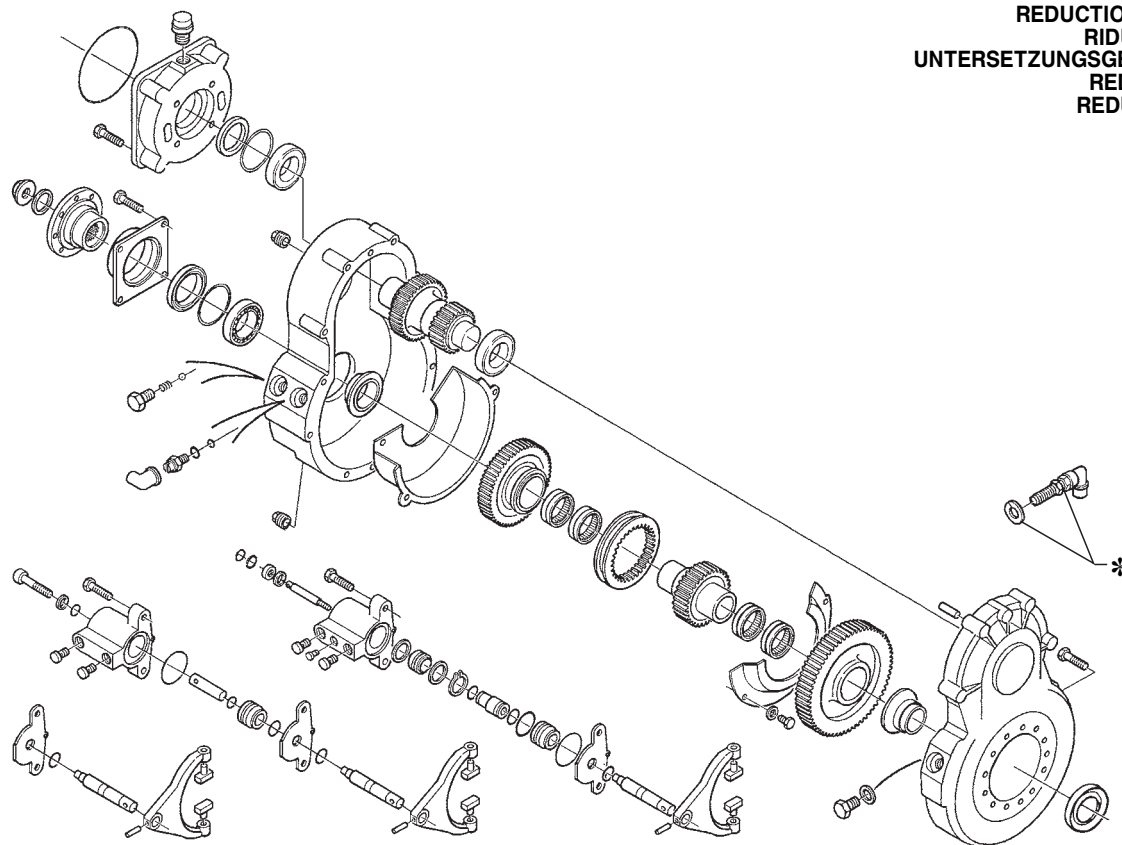


D1240001

TECHNICAL DATA - CARATTERISTICHE TECNICHE - TECHNISCHE DATEN - CARACTERÍSTICAS TÉCNICAS - CARACTERISTIQUES TECHNIQUES

A - Connector for hydraulic gear control - Pressure required 15-30 bar  
Raccordi comando marce idraulico - Pressione di comando 15-30 bar  
Anschluss für hydraulischer Betätigung der Gangschaltung Schalldruck 15-30 bar  
Conexión mando marcha hidráulico - Presión de mando 15-30 bar  
Raccord commande des vitesses hydraulique - Pression de commande 15-30 bar

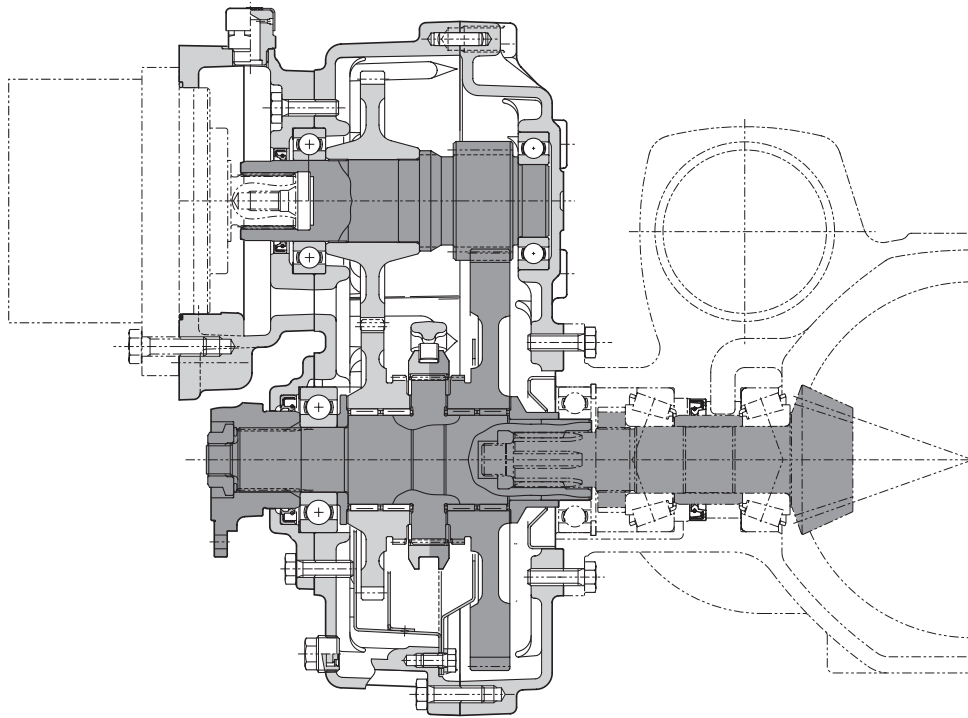
REDUCTION GEAR  
RIDUTTORE  
UNTERSETZUNGSGETRIEBE  
REDUCTOR  
REDUCTEUR



\* OPTIONAL

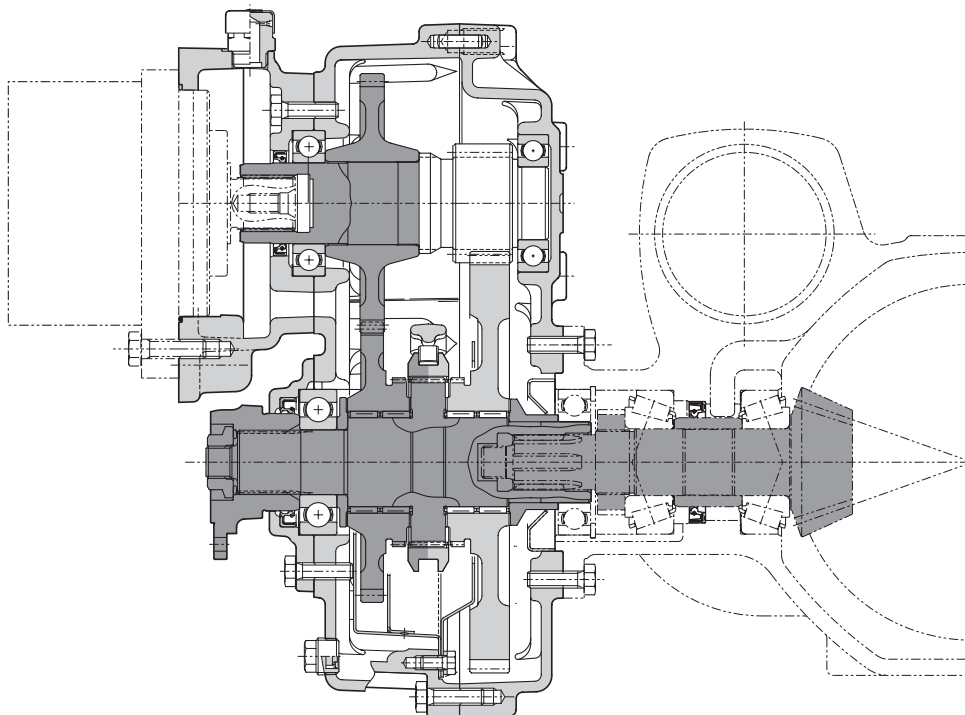
D1240012

I<sup>st</sup> GEAR  
I<sup>o</sup> MARCIA  
I<sup>o</sup> GANG  
I<sup>o</sup> MARCHA  
I<sup>o</sup> VITESSE



D1240002

II<sup>nd</sup> GEAR  
II<sup>o</sup> MARCIA  
II<sup>o</sup> GANG  
II<sup>o</sup> MARCHA  
II<sup>o</sup> VITESSE



D1240003



SYMBOLS - SIMBOLI - SYMBOLS  
SIMBOLOS - SYMBOLES

|                                                                                     |                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Disassembly of assembly groups<br>Smontaggio di sottogruppi<br>Zerlegen von Baugruppen<br>Desmontaje de subgrupos<br>Démontage des sous-groupes                                                                                                                                                            |
|    | Reassemble to from assembly groups<br>Montaggio di sottogruppi<br>Zusammenbauen von Baugruppen<br>Ensamblaje de subgrupos<br>Montage des sous-groupes                                                                                                                                                      |
|     | Remove obstruction parts<br>Smontaggio di particolari ingombri<br>Abbauen-Ausbauen<br>Desmontaje de componentes abultados<br>Démontage des pièces encombrantes                                                                                                                                             |
|     | Reinstall-remount parts which had obstructed disassembly<br>Montaggio di particolari ingombri<br>Einbauen-Ausbauen<br>Montaje de componentes abultados<br>Montage des pièces encombrantes                                                                                                                  |
|     | Attention! Important notice<br>Attenzione, indicazione importante<br>Achtung, wichtiger Hinweis<br>¡Cuidado! Indicación importante<br>Attention, indication importante                                                                                                                                     |
|    | Check - adjust e.g. torque, dimensions, pressures, etc.<br>Controllare - regolare p.e. coppie, misure, pressioni ecc.<br>Prüfen - Einstellen z.B. Momente, Maße, Drucke u.s.cs.<br>Controlar y ajustar, por ej. pares, medidas, presiones, etc.<br>Controler, régler p.e. couples, mesures, pressions ecc. |
|    | T = Special tool<br>T = Attrezzature speciali<br>T = Spezialwerkzeug<br>T = Herramientas especiales<br>T = Outils                                                                                                                                                                                          |
|     | Note direction of installation<br>Rispettare direzione di montaggio<br>Einbaurichtung beachten<br>Respetar la dirección de ensamble<br>Respecter direction de montage                                                                                                                                      |
|   | Visual inspection<br>Esaminare con controllo visuale<br>Kontrollieren - Prüfen<br>Examinar mediante inspección visual<br>Controler, examiner, controle visuel                                                                                                                                              |
|   | Possibly still serviceable, renew if necessary<br>Eventualmente riutilizzare (sostituire se necessario)<br>Bedingt weiderverwendbar<br>Puede volver a utilizarse (reemplazar, si es preciso)<br>Eventuellement a utiliser a nouveau (remplacer si nécessaire)                                              |
|   | Renew at each reassembly<br>Sostituire con ogni montaggio<br>Beim Zusammenbau immer erneuern<br>Puede reemplazarse a cada ensamble<br>Remplacer avec chaque montage                                                                                                                                        |
|  | Unlock - lock e.g. split pin, locking plate, etc.<br>Togliere-mettere la sicura<br>Entsichern-Sichern<br>Quitar-colocar el seguro<br>Enlever-mettre la securite                                                                                                                                            |
|   | Lock-adhere (liquid sealant)<br>Mettere la sicura, incollare (mastice liquido)<br>Sichern-Kleben (flüssige Dichtung)<br>Colocar el seguro, pegar (mastique líquido)<br>Mettre la securite, coller (mastic liquide)                                                                                         |
|   | Guard against material damage, damage to parts<br>Evitare danni materiali, danni a pezzi<br>Materialschaden verhüten<br>Evitar dañar los materiales o las piezas<br>Eviter dommages au matériaux, dommages au pièces                                                                                       |
|  | Mark before disassembly, observe marks when reassembly<br>Marchiare prima dello smontaggio (per il montaggio)<br>Vor dem Ausbau markieren (für den Zusammenbau)<br>Marcar antes de desmontar (para facilitar el ensamble)<br>Marquer avant le démontage (pour le montage)                                  |
|  | Filling - topping up - refilling e.g. oil, cooling water, etc.<br>Caricare - riempire (olio - lubrificante)<br>Einfüllen - Auffüllen - Nachfüllen (Öl-Schmiermittel)<br>Cargar - llenar (aceite lubricante)<br>Charger - remplir (huile - lubrifiant)                                                      |
|  | Drain off oil, lubricant<br>Scaricare olio, lubrificante<br>Öl, bzw. Schmiermittel Ablassen<br>Descargar aceite lubricante<br>Vidanger, lubrifiant                                                                                                                                                         |
|   | Tighten<br>Tendere<br>Spannen<br>Tensar<br>Tendre                                                                                                                                                                                                                                                          |
|   | Apply pressure into hydraulic circuit<br>Inserire pressione nel circuito idraulico<br>Leitung unter Druck setzen<br>Introducir presión en el circuito hidráulico<br>Insérer pression dans le circuit hydraulique                                                                                           |
|   | To clean<br>Pulire<br>Reinigen<br>Limpiar<br>Nettoyer                                                                                                                                                                                                                                                      |



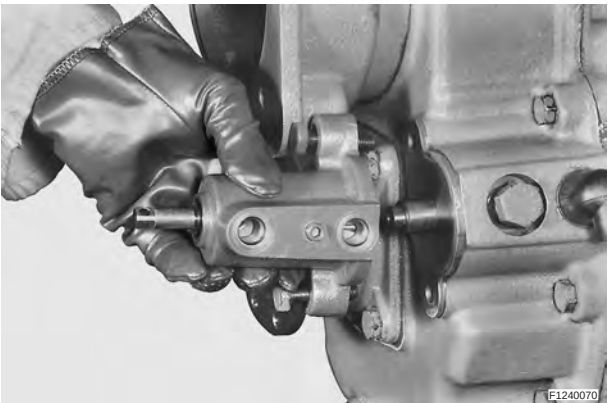
DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER  
REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

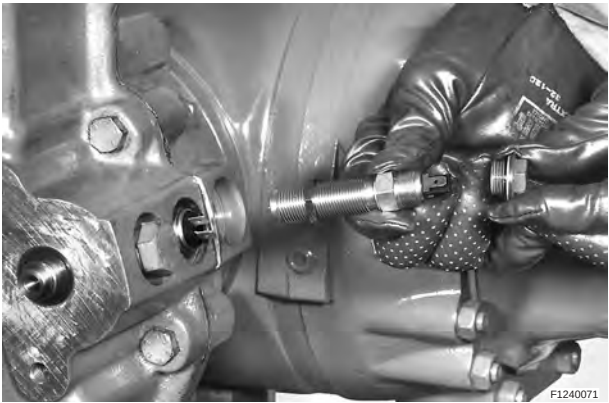
Reduction gear directly flanged on the axle with mechanic gear control.



GB

b

Reduction gear directly flanged on the axle with hydraulic gear control.



GB

c

Reduction gear directly flanged on the axle with or without revolution indicator.



**ITA**

Versione afflangiata al ponte con comando marcia meccanico.

**D**

Direkt an der Triebachse geflanscht mit mechanischer Gangschaltung.

**ESP**

Versión con brida en el puente con mando mecánico de la marcha.

**F**

Modèle bridé au pont à commande de vitesses mécanique.

**ITA**

Versione afflangiata al ponte con comando marcia idraulico.

**D**

Direkt an der Triebachse geflanscht mit hydraulischer Gangschaltung.

**ESP**

Versión con brida en el puente con mando hidráulico de la marcha.

**F**

Modèle bridé au pont à commande de vitesses hydraulique.

**ITA**

Versione afflangiata al ponte con o senza rilevatore di giri.

**D**

Direkt an der Triebachse geflanscht mit oder ohne Drehzahlmesser.

**ESP**

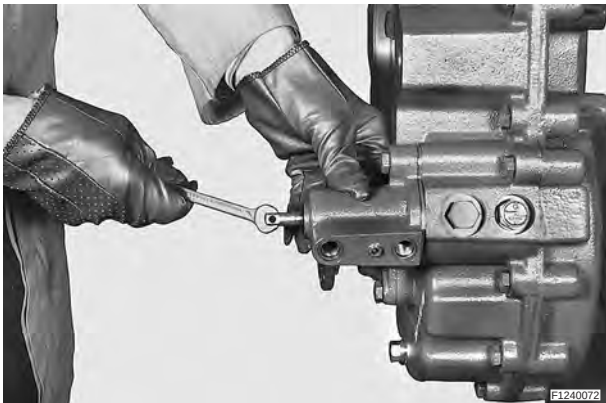
Versión con brida en el puente con o sin detector de revoluciones.

**F**

Modèle bridé pont avec ou sans compteur de tours.



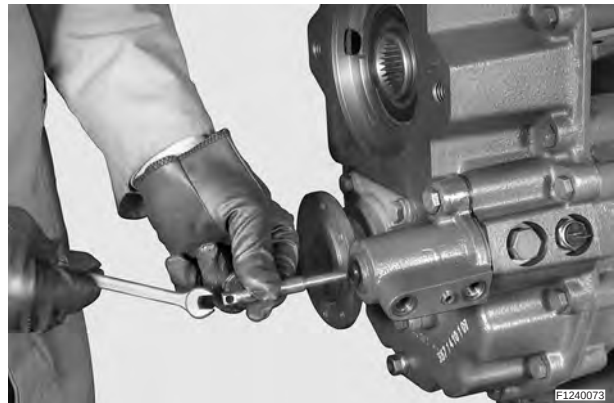
REMOVAL OF HYDRAULIC GEAR CONTROL - RIMOZIONE COMANDO IDRAULICO - HYDRAULISCHER GANGSCHALTUNG ENFERNEN - REMOCION MANDO MARCHA HIDRAULICO - DEPLACEMENT DE LA COMMANDE DE VITESSES HYDRAULIQUE



GB

a

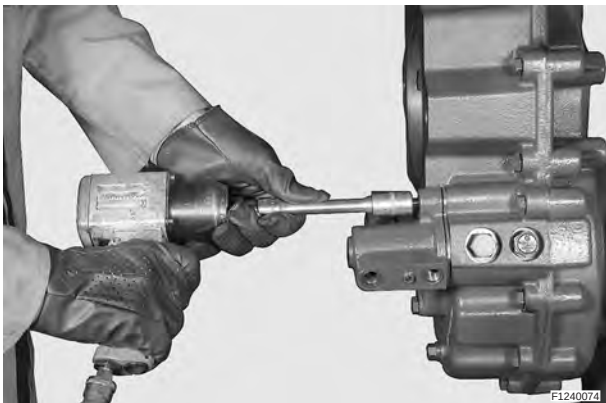
Remove the gear control rod.



GB

b

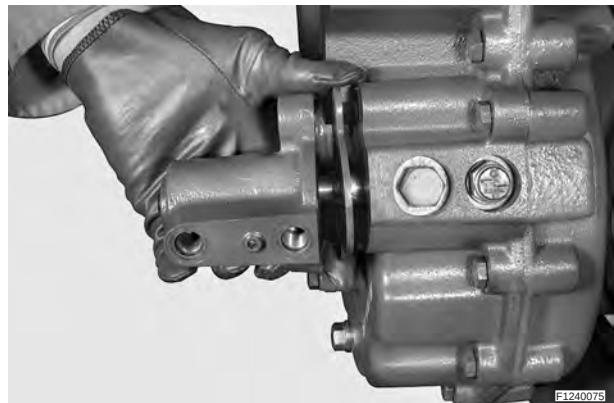
Pull out the control rod.



GB

c

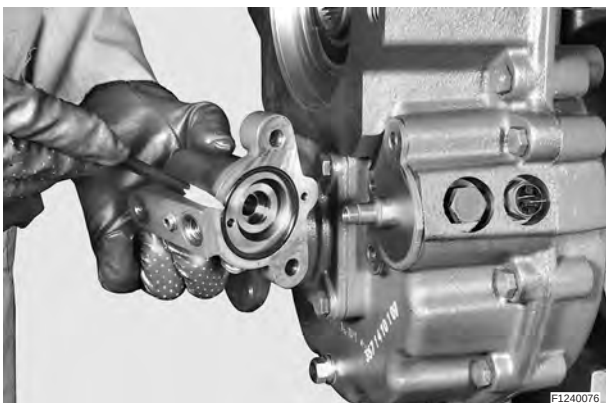
Remove screws on the gear control cylinder.



GB

d

Remove the gear control cylinder.



GB

e

Pull out the gear control cylinder. Pay attention to the position of the O-rings. Remove the protection plate.



GB

f

Re-assembly arrangement of gear control cylinder parts.





- a**
- ITA Rimuovere l'asta di comando marce.
  - D Gangschalterhebel abnehmen.
  - ESP Remove the varilla de mando de las marchas.
  - F Enlever la tringle de commande de vitesses.

- b**
- ITA Estrarre l'asta comando.
  - D Hebel herausziehen.
  - ESP Extraer la varilla de mando.
  - F Extraire la tringle de commande.

- c**
- ITA Rimuovere le viti del cilindro comando marce.
  - D Die Schrauben vom Zylinder des Gangschalters abnehmen.
  - ESP Remove los tornillos del cilindro de mando de las marchas.
  - F Enlever les vis du cylindre de commande de vitesses.

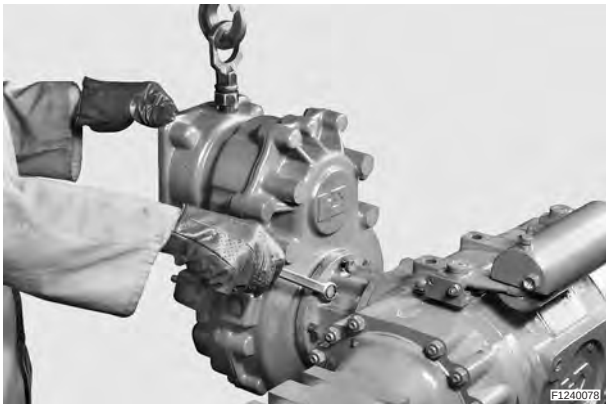
- d**
- ITA Rimuovere il cilindro comando marce.
  - D Zylinder des Gangschalters abnehmen.
  - ESP Remove el cilindro de mando de las marchas.
  - F Enlever le cylindre de commande de vitesses.

- e**
- ITA Estrarre il cilindro comando marce. Prestare attenzione alla posizione degli anelli OR. Rimuovere la lamiera di protezione.
  - D Zylinder des Gangschalters herausziehen. Auf die Position der O-Ringe achten. Schutzblech abnehmen.
  - ESP Extraer el cilindro de mando de las marchas. Tener cuidado con la posición de los anillos OR. Remover la placa de protección.
  - F Extraire le cylindre de commande de vitesses. Faire attention au positionnement des bagues OR. Enlever la tôle de protection.

- f**
- ITA Ordine di rimontaggio dei particolari del cilindro di comando marce.
  - D Reihenfolge zur Montage der Einzelteile des Gangschalterzylinders.
  - ESP Orden para volver a montar las piezas del cilindro de mando de las marchas.
  - F Placer les pièces en ordre en vue du remontage du cylindre de commande de vitesses.



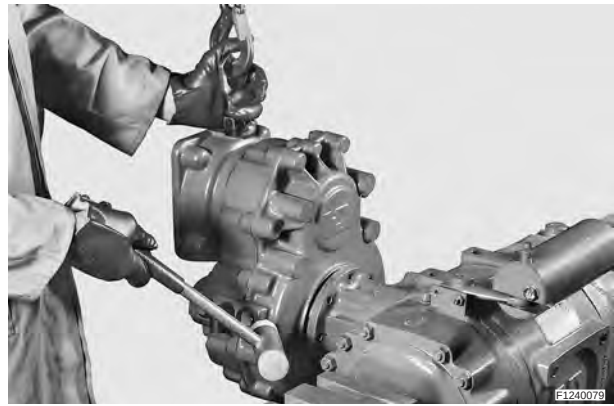
DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

Remove fastening screws from the reduction unit.



GB

b

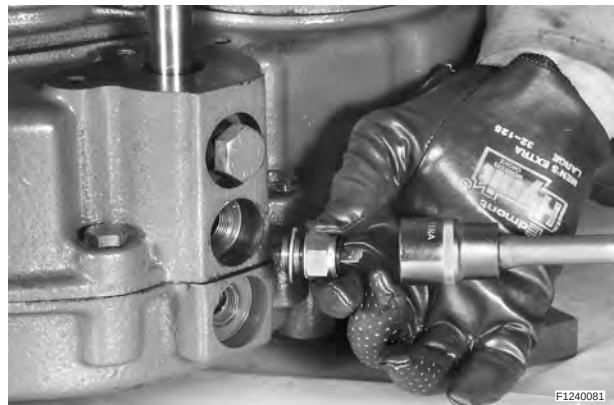
Disjoin the entire reduction unit from the axle and place it on a bench.



GB

c

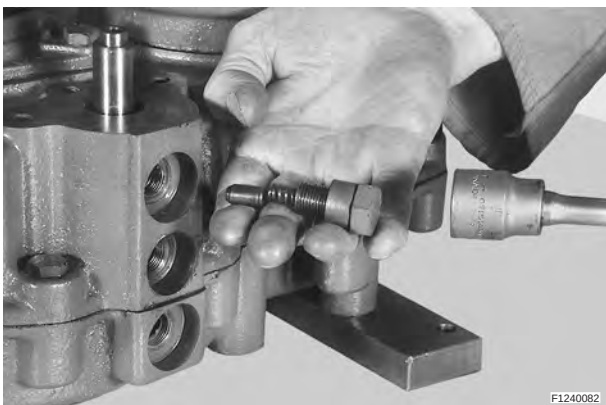
Remove the sealing cover with the relative washer or the revolution indicator.



GB

d

Remove gear-in position switch, O-ring and washer.



GB

e

Remove screw, spring, together with gear-and-neutral position spindle (mechanical version).



GB

f

Remove screw, spring and neutral position ball (hydraulic version).



**ITA** Rimuovere le viti di fissaggio del riduttore.

**D** Reduziererbefestigungsschrauben abschrauben.

**ESP** Remover los tornillos de fijación de reductor.

**F** Enlever les vis de fixation du réducteur.

**ITA** Staccare il riduttore completo dal ponte e posizionarlo su un banco.

**D** Den gesamten Reduzierer von der Triebachse nehmen und einen Tisch legen.

**ESP** Desprender el reductor completo del puente y posicionarlo en un banco.

**F** Détacher le réducteur tout entier du pont et le mettre sur le banc.

**ITA** Rimuovere il tappo di chiusura con rosetta oppure il rilevatore di giri.

**D** Stopfen mit Unterlegscheibe oder Drehzahlmesser entfernen.

**ESP** Remover el tapón de cierre con la roseta o bien el detector de revoluciones.

**F** Enlever le bouchon de verrouillage à rondelle ou bien le compteur de tours.

**ITA** Rimuovere l'interruttore di posizione marcia inserita con anello OR e rosetta.

**D** Schalter für die Position der Gangschaltung mit O-Ring und Unterlegscheibe entfernen.

**ESP** Remover el interruptor de posición de marcha embragada con el anillo OR y la roseta.

**F** Enlever l'interrupteur de la position vitesses incorporé avec la bague OR et la rondelle.

**ITA** Rimuovere la vite, la molla ed il puntalino di posizione marcia e folle (versione meccanica).

**D** Schraube, Feder und Stift für die Position der Gangschaltung und des Leerlaufs entfernen (mechanische Ausführung).

**ESP** Remover el tornillo, el muelle y el pasador de posición de marcha y punto neutro (versión mecánica).

**F** Enlever la vis, le ressort et la butée de position vitesses et point mort (modèle mécanique).

**ITA** Rimuovere la vite, la molla e la sfera di posizione folle (versione idraulica).

**D** Schraube, Feder und Kugel für die Position des Leerlaufs entfernen (hydraulische Ausführung).

**ESP** Remover el tornillo, el muelle y la bola de posición de punto neutro (versión hidráulica).

**F** Enlever la vis, le ressort et la sphère de position point mort (modèle hydraulique).





DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



F1240084



a

Remove screws from the motion input cover.



F1240085



b

Disjoin the motion entrance cover.



F1240086



c

Remove the nut from the flange.



F1240087



d

Remove the O-ring and pull out the flange.



F1240088



e

Remove screws from the cover.



ITA

Rimuovere le viti del coperchio di entrata del moto.

D

Die Deckelschrauben am Anfang der Bewegung abschrauben.

ESP

Remover los tornillos de la tapa de entrada del movimiento.

F

Enlever les vis du couvercle d'entrée du mouvement.

a

ITA

Staccare il coperchio di entrata del moto.

D

Deckel am Eingang des Bewegung abnehmen.

ESP

Desprender la tapa de entrada del movimiento.

F

Décrocher le couvercle d'entrée du mouvement.

b

ITA

Rimuovere il dado della flangia.

D

Flanschmutter abschrauben.

ESP

Remover la tuerca de la brida.

F

Enlever l'écrou de la flasque.

c

ITA

Asportare l'anello OR ed estrarre la flangia.

D

O-Ring abnehmen und Flansch herausziehen.

ESP

Quitar el anillo OR y extraer la brida.

F

Enlever la bague OR et extraire la flasque.

d

ITA

Rimuovere le viti del coperchio.

D

Deckelschrauben abschrauben.

ESP

Remover los tornillos de la tapa.

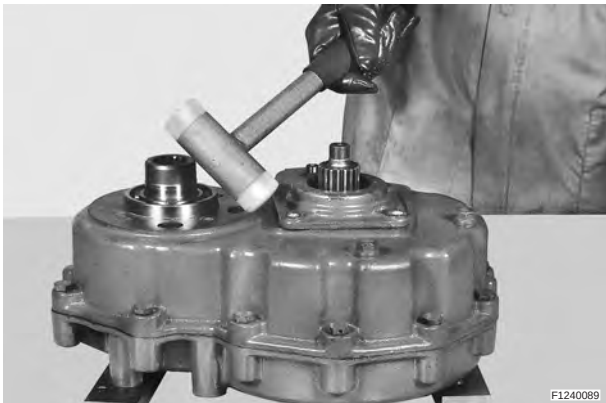
F

Enlever les vis du couvercle.

e



DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

Disjoin the cover.



GB

b

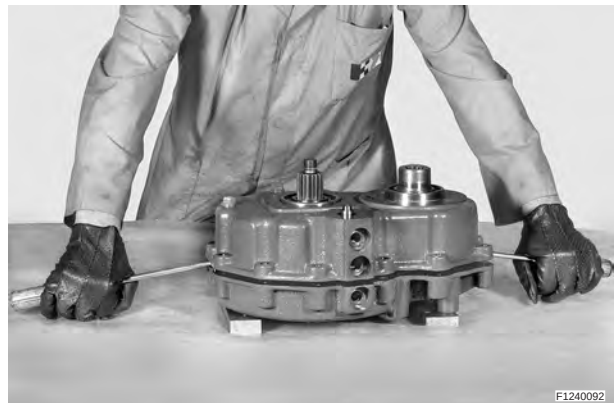
Remove the cover by fixing the distance washers onto the cover itself.  
Caution: the niche must be facing upwards.



GB

c

Remove screws.



GB

d

Remove the cover.  
Take care not to damage planes.



GB

e

Take away the cover.  
Pay attention to the position of the pins.





- a**
- ITA Staccare il coperchio.
  - D Deckel abnehmen.
  - ESP Desprender la tapa.
  - F Décrocher le couvercle.

- b**
- ITA Rimuovere il coperchio fissando gli spessori allo stesso.  
Attenzione: nicchia rivolta verso l'alto.
  - D Deckel abnehmen und Distanzstücke am Deckel befestigen.  
Achtung: die Nische ist nach oben gerichtet.
  - ESP Remover la tapa fijando los espesores en la misma.  
Cuidado: el hueco tiene que estar dirigido hacia arriba.
  - F Enlever le couvercle en fixant les cales à ce dernier.  
Attention: au logement tourné vers le haut.

- c**
- ITA Rimuovere le viti.
  - D Schrauben abschrauben.
  - ESP Remover los tornillos.
  - F Enlever les vis.

- d**
- ITA Rimuovere il coperchio.  
Prestare attenzione per non danneggiare i piani.
  - D Deckel abnehmen.  
Darauf achten, die Flächen nicht zu beschädigen.
  - ESP Remover la tapa.  
Poner mucho cuidado a fin de no dañar las superficies.
  - F Enlever le couvercle.  
Faire attention à ne pas endommager les surfaces.

- e**
- ITA Togliere il coperchio.  
Prestare attenzione alla posizione delle spine.
  - D Deckel abnehmen.  
Auf die Position der Stifte achten.
  - ESP Sacar la tapa.  
Tener mucho cuidado con la posición de las clavijas.
  - F Enlever le couvercle.  
Faire attention à la position des broches.



DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



Pull out gear, needle bearings and distance piece form the box.



Remove the bearing if it needs replacing.



Re-introduce the bearing into the box.



Remove the oil shield plate only if necessary.  
Caution: the oil inlet must face upwards.



Re-introduce the oil shield plate with oil inlet facing upwards.  
Apply LOCTITE 510 on the outside.



Fit the oil shield plate into position 5-5.5 mm from box plane.



**ITA** Estrarre dalla scatola l'ingranaggio, i cuscinetti a rullini ed il distanziale.

**D** Aus der Schachtel das Zahnrad, die Kugellager und das Distanzstück nehmen.

**ESP** Extraer de la caja el engranaje, los cojinetes de agujas y el separador.

**F** Extraire la boîte d'engrenage, les paliers à rouleaux et l'entretoise.

**ITA** Rimuovere il cuscinetto se è da sostituire.

**D** Lager herausnehmen, wenn es ausgewechselt werden soll.

**ESP** Remover el cojinete si hay que sustituirlo.

**F** Enlever le palier s'il est à remplacer.

**ITA** Reinserire il cuscinetto nella scatola.

**D** Lager in die Schachtel einsetzen.

**ESP** Volver a colocar el cojinete en la caja.

**F** Réinsérer le palier dans la boîte.

**ITA** Rimuovere la lamiera paraolio solo se necessario. Attenzione: l'entrata dell'olio deve essere rivolta verso l'alto.

**D** Ölabdichtung nur abnehmen, wenn es nötig sein sollte. Achtung: der Öleingang muß nach oben gerichtet sein.

**ESP** Remover el sello de aceite si fuera necesario. Cuidado: la entrada del aceite tiene que estar dirigida hacia arriba.

**F** Enlever la tôle pare-huile seulement si besoin. Attention: l'orifice de huile doit être tournée vers le haut.

**ITA** Reinserire lamiera paraolio con l'entrata dell'olio verso l'alto. Spalmare sull'esterno LOCTITE 510.

**D** Ölabdichtung mit dem Eingang nach oben wieder einsetzen. Außen mit LOCTITE 510 schmieren.

**ESP** Volver a colocar el sello de aceite con la entrada del aceite hacia arriba. Engrasar por fuera con LOCTITE 510.

**F** Réinsérer la tôle pare-huile avec l'orifice de l'huile tournée vers le haut. Enduire du LOCTITE 510 à l'extérieur.

**ITA** Posizionare la lamiera paraolio a 5÷5,5 mm dal piano scatola.

**D** Ölabdichtung in einem Abstand von 5÷5,5 mm von der Schachtfäche einsetzen.

**ESP** Posicionar el sello de aceite a 5÷5,5 mm de la superficie de la caja.

**F** Placer la tôle pare-huile à 5÷5,5 mm de la surface de la boîte.





DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



F1240100



a

Remove the check screws from the flow regulator plate.

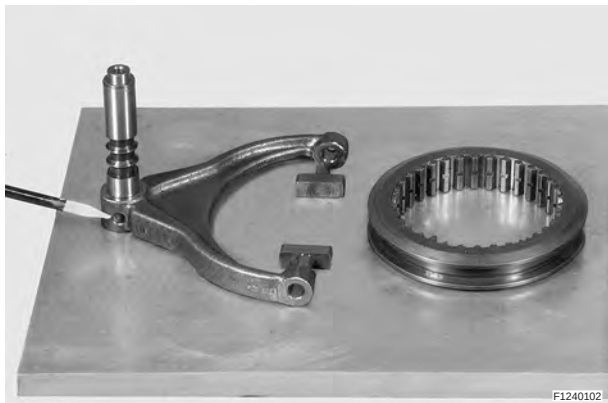


F1240101



b

Remove the plate and pull out coupling and fork at the same time.

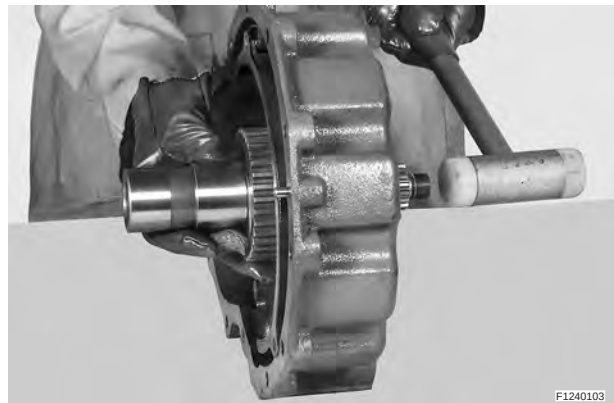


F1240102



c

Check: sliding blocks, pin, and sliding coupling. Replace if worn.



F1240103



d

Remove the lower shaft.



F1240104



e

Remove the entire shaft and the flow regulator plate.



**ITA** Rimuovere le viti di ritegno lamiera frangiflusso.

**D** Befestigungsschrauben des Strahlreglers abschrauben.

**ESP** Remover los tornillos de retención de la placa deflectora.

**F** Enlever les vis de fixation de la tôle brise-jet.

**a**

**ITA** Asportare la lamiera ed estrarre contemporaneamente il manicotto e la forcella.

**D** Strahlregler abnehmen und gleichzeitig Hülse und Gabel herausziehen.

**ESP** Sacar la placa y extraer contemporáneamente el manguito y la horquilla.

**F** Enlever la tôle et extraire, en même temps, le manchon et la fourchette.

**b**

**ITA** Verificare: pattini, spina e manicotto scorrevole. Sostituirli se sono usurati.

**D** Zu kontrollieren: Gleitschuhe, Stift und Gleithülse. Wenn verschleißt, auswechseln.

**ESP** Comprobar: patines, clavija y manguito corredizo. Sustituirlos si están gastados.

**F** Vérifier: pattes, broches et manchon coulissant. Remplacer s'ils sont usés.

**c**

**ITA** Rimuovere l'albero di uscita.

**D** Ausgangswelle abnehmen.

**ESP** Remover el eje de salida.

**F** Déplacer l'arbre de sortie.

**d**

**ITA** Asportare l'albero completo e la lamiera frangiflusso.

**D** Die ganze Welle und den Strahlregler abnehmen.

**ESP** Sacar el eje completo y la placa deflectora.

**F** Enlever l'arbre au complet ainsi que la tôle brise-jet.

**e**



DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



a

Disassembly of the entire lower shaft.



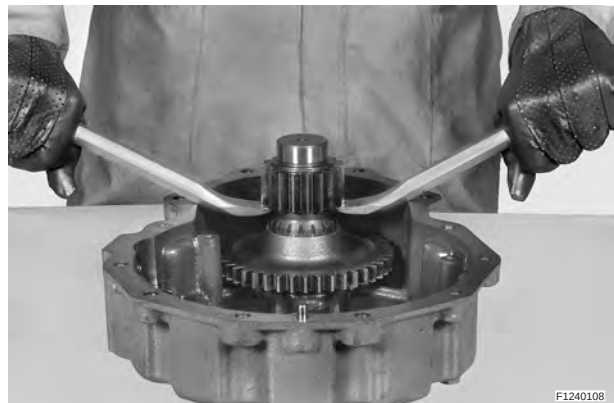
b

Progressive arrangement of parts fitted onto the lower shaft.



c

Assembly of lower shaft.



d

Removal of upper shaft.  
(In case of replacement, the shaft is supplied already assembled).



e

Pull out the sealing ring.



f

Re-insert a new sealing ring.





- a**
- ITA Smontaggio dell'albero di uscita completo.
  - D Ganze Ausgangswelle abmontieren.
  - ESP Desmontaje del eje de salida completo.
  - F Démontage complet de l'arbre de sortie.

- b**
- ITA Disposizione progressiva dei particolari montati su albero di uscita.
  - D Reihenfolge der auf der Ausgangswelle montierten Einzelteile.
  - ESP Disposición progresiva de las piezas montadas en el eje de salida.
  - F Mise en place progressive des pièces montées sur l'arbre de sortie.

- c**
- ITA Assemblaggio dell'albero di uscita.
  - D Zusammenbau der Ausgangswelle.
  - ESP Montaje del eje de salida.
  - F Assemblage de l'arbre de sortie.

- d**
- ITA Rimuovere l'albero di entrata.  
(Nel caso di sostituzione, viene fornito premontato).
  - D Eingangswelle entfernen.  
(Bei Ersatz, wird sie schon montiert geliefert).
  - ESP Remover el eje de entrada.  
(En el caso de sustitución, se entrega ya premontado).
  - F Déplacer l'arbre d'entrée.  
(En cas de substitution, il est fourni prémonté).

- e**
- ITA Estrarre l'anello di tenuta.
  - D Dichtungsring herausziehen.
  - ESP Extraer el segmento de compresión.
  - F Extraire la bague d'étanchéité.

- f**
- ITA Reinserire il nuovo anello di tenuta.
  - D Den neuen Dichtungsring einsetzen.
  - ESP Volver a insertar el segmento de compresión.
  - F Introduire la bague d'étanchéité neuve.



DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357- SMONTAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 ZERLEGEN - DESMONTAJE GRUPO REDUCTOR 357 CON BRIDA - DEMONTAGE DU GROUPE REDUCTEUR BRIDE 357



a

Pull out the sealing ring of the cover.



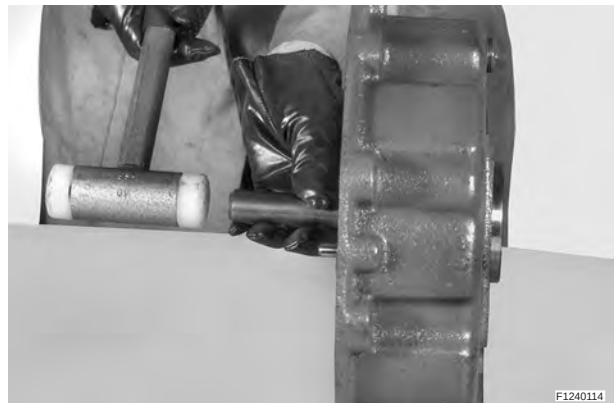
b

Re-insert a new sealing ring.



c

Pull out the sealing ring from the motion input cover.



d

Remove the bearing from the cover of the reduction unit.



- a**
- ITA Estrarre l'anello di tenuta del coperchio.
  - D Dichtungsring des Deckels herausziehen.
  - ESP Extraer el segmento de compresión de la tapa.
  - F Extraire la bague d'étanchéité du couvercle.

- b**
- ITA Reinsere il nuovo anello di tenuta.
  - D Den neuen Dichtungsring einsetzen.
  - ESP Insertar el nuevo segmento de compresión.
  - F Introduire la bague d'étanchéité neuve.

- c**
- ITA Estrarre l'anello di tenuta dal coperchio di ingresso del moto.
  - D Dichtungsring am Anfang der Bewegung herausziehen.
  - ESP Extraer el segmento de compresión de la tapa de entrada del movimiento.
  - F Extraire la bague d'étanchéité du couvercle d'entrée du mouvement.

- d**
- ITA Rimuovere il cuscinetto dal coperchio riduttore.
  - D Lager des Reduzierendeckels entfernen.
  - ESP Remove el cojinete de la tapa del reductor.
  - F Enlever le palier du couvercle du réducteur.





ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 - ASSEMBLAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 MONTIEREN - MONTAJE GRUPO REDUCTOR 357 CON BRIDA - ASSEMBLAGE DU GROUPE REDUCTEUR BRIDE 357



F1240115



Re-fit the bearing in the cover of the reduction unit using ordinary tools.



F1240116



Re-insert the new sealing ring in the motion input cover.



F1240117



Re-assemble the cover, spreading LOCTITE 510 on planes and screws.



F1240118



Tighten screws using a torque wrench setting of 49–51 Nm.



F1240119



Lubricate the lip of the sealing ring with grease.



ITA

Rimontare il cuscinetto nel coperchio riduttore con i normali attrezzi.

D

Lager in den Reduzierendeckel mit gewöhnlichen Werkzeugen montieren.

ESP

Volver a montar el cojinete en la tapa del reductor con las herramientas normales.

F

Remonter le palier du couvercle réducteur à l'aide d'outils habituels.

a

ITA

Reinserire il nuovo anello di tenuta coperchio di ingresso del moto.

D

Den neuen Dichtungsring in den Deckel am Eingang der Bewegung montieren.

ESP

Volver a insertar el nuevo segmento de compresión en la tapa de entrada del movimiento.

F

Introduire la bague d'étanchéité neuve dans le couvercle d'entrée du mouvement.

b

ITA

Rimontare il coperchio spalmando sui piani e sulle viti LOCTITE 510.

D

Deckelflächen und -schrauben mit LOCTITE 510 schmieren und montieren.

ESP

Volver a montar la tapa engrasando las superficies y los tornillos con LOCTITE 510.

F

Remonter le couvercle en étalant du LOCTITE 510 sur les surfaces et sur les vis.

c

ITA

Serrare le viti con una coppia di serraggio di 49÷51 Nm.

D

Schrauben mit einem Anziehdrehmoment zu 49÷51 Nm anziehen.

ESP

Apretar los tornillos a un par de torsión de 49÷51 Nm.

F

Serrer les vis à un couple de serrage de 49÷51 Nm.

d

ITA

Lubrificare con grasso il labbro dell'anello di tenuta.

D

Dichtlippe mit Fett schmieren.

ESP

Lubricar con grasa el labio del segmento de compresión.

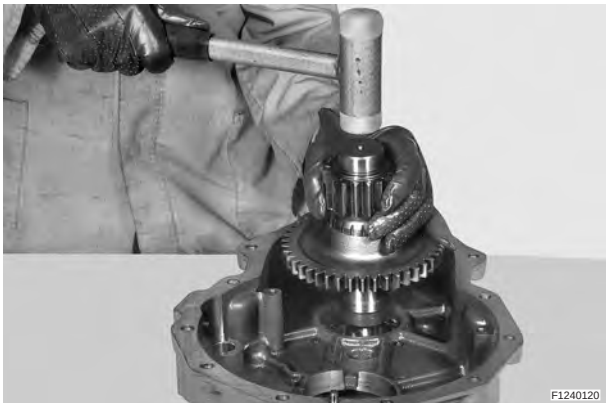
F

Lubrifier avec du gras la lèvre de la bague d'étanchéité.

e



ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 - ASSEMBLAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 MONTIEREN - MONTAJE GRUPO REDUCTOR 357 CON BRIDA - ASSEMBLAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

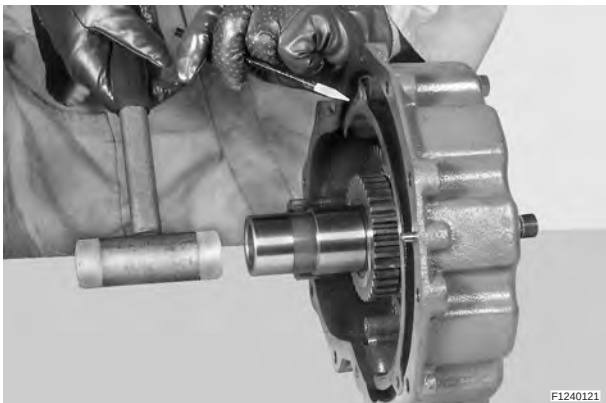
Re-assemble the motion upper shaft.



GB

b

Re-assemble the full lower shaft and the flow regulator plate.



GB

c

Position the shaft so that the bearing juts out approximately 5 mm from the cover of the reduction unit.



GB

d

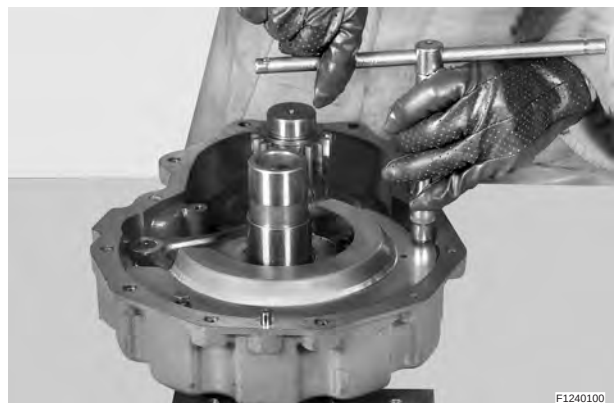
Temporarily re-assemble the cover with screws. (Be sure that the niche faces upwards).



GB

e

Simultaneously insert: fork and sliding blocks, coupling and flow regulator plate.



GB

f

Re-insert screws and tighten.





**ITA** Rimontare l'albero di entrata del moto.

**D** Welle am Eingang der Bewegung montieren.

**ESP** Volver a montar el eje de entrada del movimiento.

**F** Remonter l'arbre d'entrée du mouvement.

**a**

**ITA** Rimontare l'albero uscita completo e la lamiera frangiflusso.

**D** Ganze Ausgangswelle und Strahlregler montieren.

**ESP** Volver a montar el eje de salida completo y la placa deflectora.

**F** Remonter l'arbre de sortie tout entier et la tôle brise-jet.

**b**

**ITA** Posizionare l'albero in modo che il cuscinetto sporga dal coperchio riduttore circa 5 mm.

**D** Die Welle so positionieren, daß das Lager vom Reduziererdeckel ca. 5 mm herausragt.

**ESP** Posicionar el eje de manera que el cojinete sobresalga de la tapa del reductor en unos 5 mm aproximadamente.

**F** Positionner l'arbre de telle sorte que le palier saillisse du couvercle du réducteur d'environ 5 mm.

**c**

**ITA** Rimontare provvisoriamente il coperchio con le viti. (Attenzione alla nicchia che deve essere rivolta verso l'alto).

**D** Vorübergehend den Deckel mit den Schrauben montieren. (Achtung, die Nische muß nach oben gerichtet sein).

**ESP** Volver a montar provisionalmente la tapa con los tornillos. (Cuidado con el hueco que tiene que estar dirigido hacia arriba).

**F** Remonter provisoirement le couvercle avec les vis. (Attention le logement doit être tourné vers le haut).

**d**

**ITA** Reinserire contemporaneamente: la forcella con pattini, il manicotto e la lamiera frangiflusso.

**D** Gleichzeitig Gabel mit Gleitschuh, Hülse und Strahlregler montieren.

**ESP** Volver a insertar contemporáneamente la horquilla con los patines, el manguito y la placa deflectora.

**F** Réinsérer en même temps: la fourchette avec les pattes, le manchon et la tôle brise-jet.

**e**

**ITA** Reinserire le viti ed avvitarle.

**D** Schrauben anbringen und festschrauben.

**ESP** Volver a introducir los tornillos y atornillarlos.

**F** Introduire les vis et visser.

**f**



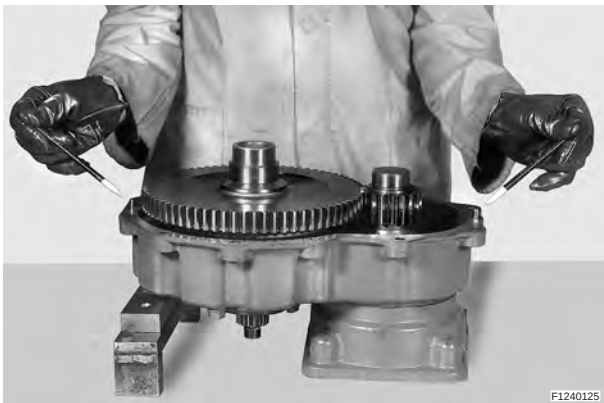
ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 - ASSEMBLAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 MONTIEREN - MONTAJE GRUPO REDUCTOR 357 CON BRIDA - ASSEMBLAGE DU GROUPE REDUCTEUR BRIDE 357



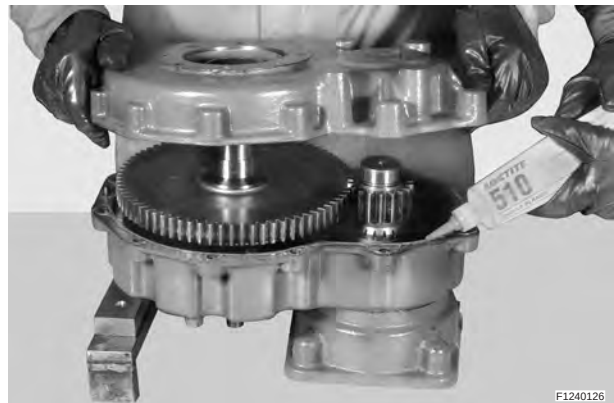
Tighten screws using a torque wrench setting of 25–26 Nm.



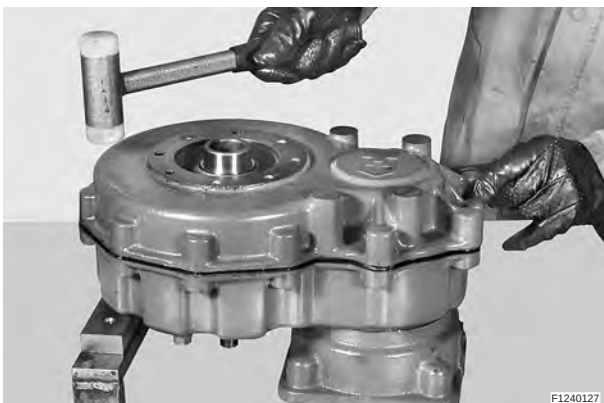
Re-assemble needle bearings, gear and distance piece.



Check the insertion of pins.



Spread LOCTITE 510 on the surface and assemble the cover.



Fasten the cover.



- a**
- ITA** Serrare le viti con una coppia di serraggio di 25÷26 Nm.
  - D** Schrauben mit einem Anziehdrehmoment zu 25÷26 Nm anziehen.
  - ESP** Apretar los tornillos a un par de torsión de 25÷26 Nm.
  - F** Serrer les vis à un couple de serrage de 25÷26 Nm.

- b**
- ITA** Rimontare i cuscinetti a rullini, l'ingranaggio ed il distanziale.
  - D** Kugellager, Zahnrad und Distanzstück montieren.
  - ESP** Volver a montar los cojinetes de agujas, el engranaje y el separador.
  - F** Remonter les paliers à rouleaux, l'engrenage et l'entretoise.

- c**
- ITA** Verificare l'inserimento delle spine.
  - D** Einsatz der Stifte kontrollieren.
  - ESP** Comprobar la inserción de las clavijas.
  - F** Vérifier l'introduction des broches.

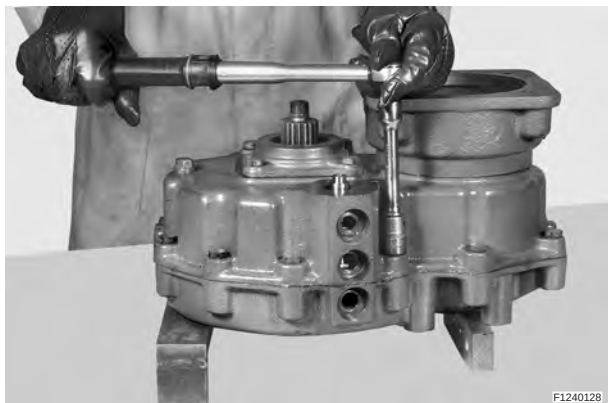
- d**
- ITA** Spalmare la superficie con LOCTITE 510 e montare il coperchio.
  - D** Fläche mit LOCTITE 510 schmieren und Deckel montieren.
  - ESP** Engrasar la superficie con LOCTITE 510 y montar la tapa.
  - F** Enduire la surface avec du LOCTITE 510 et monter le couvercle.

- e**
- ITA** Mandare il coperchio in battuta.
  - D** Den Deckel zum Anschlag bringen.
  - ESP** Llevar la tapa a tope.
  - F** Lancer le couvercle butée.





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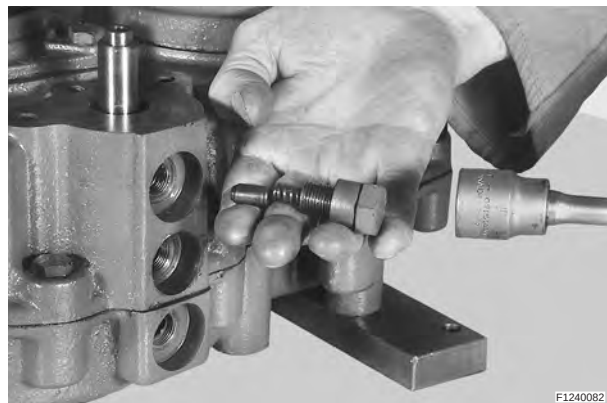
F1240128



GB

a

Tighten screws using a torque wrench setting of 49–51 Nm.  
Caution: tighten using the crossed method.



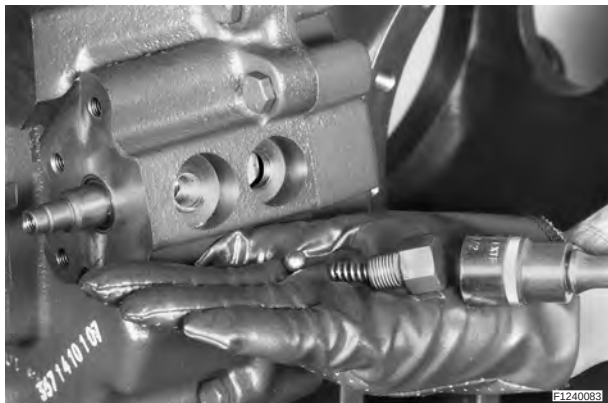
F1240082



GB

b

Grease components and re-introduce spindle, spring and screw (mechanical version).  
Tighten using a max. torque wrench setting of 80–100 Nm.



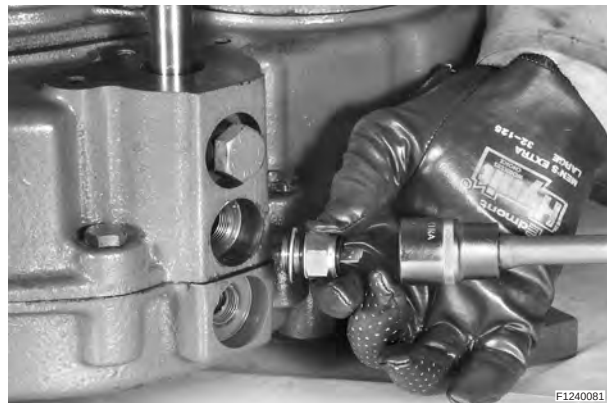
F1240083



GB

c

Grease components and re-introduce ball, spring and screw (hydraulic version).  
Tighten using a max. torque wrench setting of 80–100 Nm.



F1240081



GB

d

Fix the gear-in position switch with washer and O-ring.  
Tighten with torque wrench setting of max. 54.2 Nm.



F1240080



GB

e

Assemble the sealing cover with washer and revolution indicator.  
Tighten using a torque wrench setting of max. 25 Nm.



ITA

Serrare le viti con una coppia di serraggio di 49÷51 Nm.  
Attenzione: serrare con il metodo incrociato.

D

Schrauben mit einem Anziehdrehmoment zu 49÷51 Nm anziehen.  
Achtung: Schrauben abwechselnd im Kreuz anziehen.

ESP

Apretar los tornillos a un par de torsión de 49÷51 Nm.  
Cuidado: apretar con el método cruzado.

F

Serrer les vis à un couple de serrage de 49÷51 Nm.  
Attention: serrer avec la méthode croisée.

a

ITA

Ingrassare i componenti e reinserire il puntalino, la molla, la vite (versione meccanica). Serrare con una coppia di serraggio max. di 80÷100 Nm.

D

Einzelteile schmieren und Stift, Feder und Schraube einsetzen (mechanische Ausführung). Mit einem Anziehdrehmoment zu max. 80÷100 Nm anziehen.

ESP

Engrasar los componentes y volver a insertar el pasador, el muelle, el tornillo (versión mecánica). Apretar a un par de torsión máx. de 80÷100 Nm.

F

Graisser les composants et réinsérer la butée, le ressort, la vis (modèle mécanique). Serrer à un couple de serrage max. de 80÷100 Nm.

b

ITA

Ingrassare i componenti e reinserire la sfera, la molla e la vite (versione idraulica). Serrare con una coppia max. di 80÷100 Nm.

D

Einzelteile schmieren und Kugel, Feder und Schraube einsetzen (hydraulische Ausführung). Mit einem Anziehdrehmoment zu 80÷100 Nm anziehen.

ESP

Engrasar los componentes y volver a colocar la bola, el muelle y el tornillos (versión hidráulica). Apretar a un par máx. de 80÷100 Nm.

F

Graisser les composants et réinsérer la sphère, le ressort et la vis (modèle hydraulique). Serrer à un couple max. de 80÷100 Nm.

c

ITA

Montare l'interruttore di posizione marcia inserita con rosetta e anello OR. Serrare con una coppia di serraggio max. di 54,2 Nm.

D

Schalter für die Position der Gangschaltung mit Unterlegscheibe und O-Ring montieren. Mit einem Anziehdrehmoment zu max. 54,2 Nm anziehen.

ESP

Montar el interruptor de posición marcha embragada con roseta y anillo OR. Apretar a un par de torsión máx. de 54,2 Nm.

F

Monter l'interrupteur de position de vitesses incorporé avec la rondelle et la bague OR. Serrer à un couple de serrage max. de 54,2 Nm.

d

ITA

Montare tappo di chiusura con rosetta e rilevatore di giri. Serrare con una coppia max. di 25 Nm.

D

Stopfen mit Unterlegscheibe und Drehzahlmesser montieren. Mit einem Anziehdrehmoment zu max. 25 Nm anziehen.

ESP

Montar el tapón de cierre con la roseta y el detector de revoluciones. Apretar a un par máx. de 25 Nm.

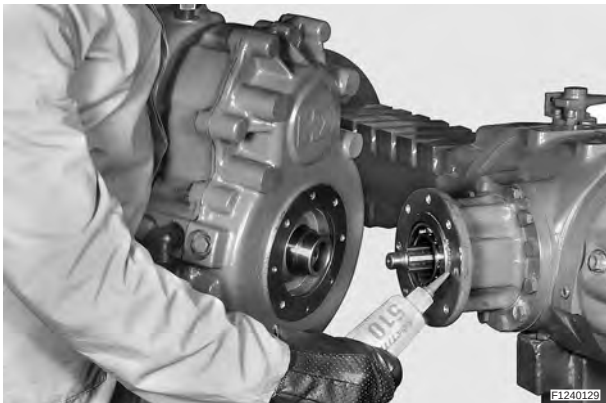
F

Monter le bouchon de verrouillage accompagné de la rondelle et du compteur de tours. Serrer à un couple max. de 25 Nm.

e



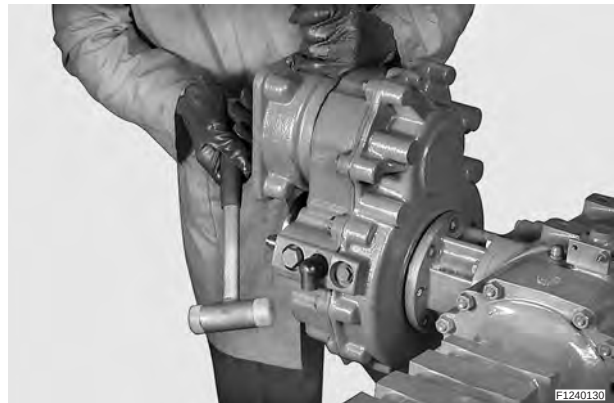
ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 - ASSEMBLAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 MONTIEREN - MONTAJE GRUPO REDUCTOR 357 CON BRIDA - ASSEMBLAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

Re-fit the reduction unit onto the axle by spreading LOCTITE 510 on the planes.



GB

b

Fasten the support planes (turn flange to assist assembly).



GB

c

Insert screws by applying LOCTITE 510.



GB

d

Screw down by placing the reduction unit in a vertical position in relation to the axis.



GB

e

Tighten screws using a torque wrench setting of 49–51 Nm.



GB

f

Extract screws and remove the temporarily assembled cover.





ITA

Rimontare il riduttore sul ponte spalmando i piani con LOCTITE 510.

D

Reduzierer auf die Triebachse montieren; zuvor die Flächen mit LOCTITE 510 schmieren.

ESP

Volver a montar el reductor en el puente engrasando las superficies con LOCTITE 510.

F

Remonter le réducteur au pont en étalant sur les surfaces du LOCTITE 510.

a

ITA

Mandare in battuta i piani di appoggio (ruotare la flangia per facilitare il montaggio).

D

Auflageflächen bis zum Anschlag bringen (Flansch drehen um die Montage zu erleichtern).

ESP

Llevar a tope las superficies de apoyo (girar la brida para facilitar el montaje).

F

Lancer les surfaces d'appui en butée (tourner la flasque pour faciliter le montage).

b

ITA

Inserire le viti spalmandole con LOCTITE 510.

D

Schrauben mit LOCTITE 510 schmieren und einsetzen.

ESP

Insertar los tornillos engrasándolos con LOCTITE 510.

F

Introduire les vis en les enduisant d'abord de LOCTITE 510.

c

ITA

Avvitare le viti posizionando il riduttore in modo verticale rispetto l'asse.

D

Schrauben festschrauben; dabei den Reduzierer senkrecht zur Achse halten.

ESP

Atornillar los tornillos posicionando el reductor de manera vertical con respecto al eje.

F

Visser les vis en plaçant le réducteur verticalement par rapport à l'axe.

d

ITA

Serrare le viti con una coppia di serraggio di 49÷51 Nm.

D

Schrauben mit einem Anziehdrehmoment zu 49÷51 Nm anziehen.

ESP

Apretar los tornillos a un par de torsión de 49÷51 Nm.

F

Serrer les vis à un couple de serrage de 49÷51 Nm.

e

ITA

Asportare le viti e rimuovere il coperchio montato provvisoriamente

D

Schrauben abschrauben und vorübergehend montierter Deckel abnehmen.

ESP

Sacar los tornillos y remover la tapa montada provisionalmente.

F

Enlever les vis et enlever le couvercle provisoirement monté.

f



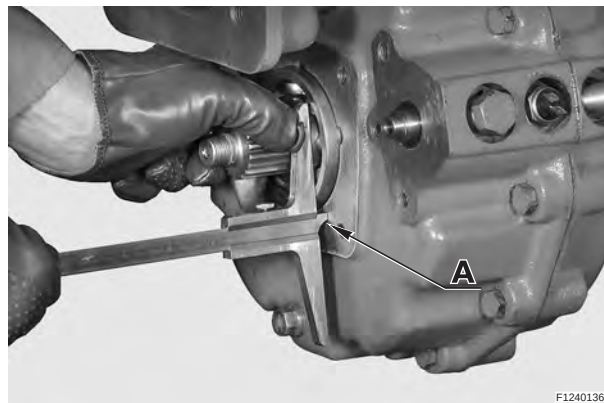
ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 - ASSEMBLAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 MONTIEREN - MONTAJE GRUPO REDUCTOR 357 CON BRIDA - ASSEMBLAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

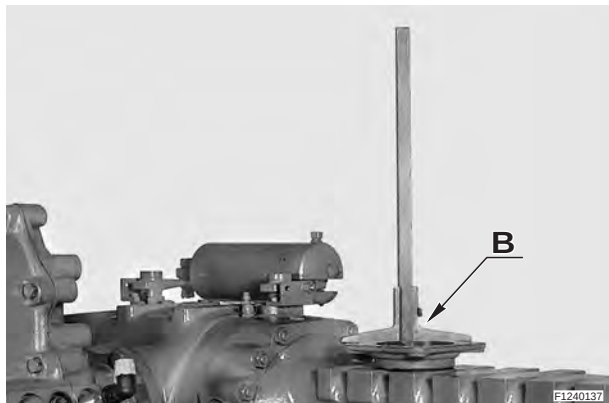
Fasten the bearing by using a standard tool.



GB

b

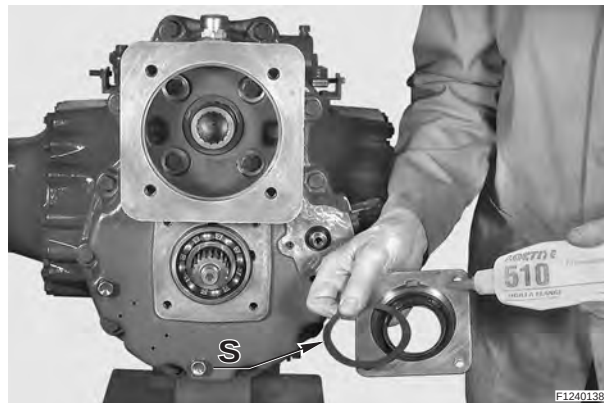
Measure dimension "A" between the bearing and the box plane using an ordinary depth gauge (if parts are not replaced, use disassembled distance washers).



GB

c

Measure dimension "B" on the cover, between the bearing plane and bearing support. Calculate the dimension of the distance washers required:  
 $S = \text{Dimension B} - \text{Dimension A}$   
 Es:  $B = 5.2 - A = 4.6 \text{ mm} - \text{Backlash } 0.2-0.3 = \text{Distance washer required} = 0.4-0.3$ .



GB

d

Apply LOCTITE 510 on the surface, lubricate the sealing ring, insert the distance washers and re-assemble the cover with niche facing upwards.



GB

e

Fit screws after applying LOCTITE 510.



**ITA** Mandare in battuta il cuscinetto utilizzando un normale attrezzo.

**D** Das Lager bis zum Anschlag bringen; dazu ein gewöhnliches Werkzeug verwenden.

**ESP** Llevar a tope el cojinete utilizando una herramienta normal.

**F** Lancer en butée le palier à l'aide d'un outil normal.

**ITA** Rilevare la quota "A" fra cuscinetto e piano scatola usando un normale calibro di profondità.  
(Se non vengono sostituiti pezzi, utilizzare gli spessori smontati).

**D** Maß "A" zwischen Lager und Schachtelfläche mit einem gewöhnlichen Kaliber messen (wenn keine Teile ausgewechselt werden, die abmontierten Distanzstücke verwenden).

**ESP** Registrar la cota "A" entre el cojinete y la superficie de la caja utilizando un normal calibre de profundidad.  
(Si no se sustituyen las piezas, utilizar los espesores desmontados).

**F** Relever la cote "A" entre palier et surface de la boîte à l'aide d'un calibre de profondeur normal (S'il n'y a pas de pièces à remplacer, utiliser les cales démontées).

**ITA** Rilevare la quota "B" sul coperchio fra piano e appoggio cuscinetto. Calcolare gli spessori da inserire  
 $S = \text{Quota B} - \text{Quota A}$   
Es:  $B = 5,2 - A = 4,6 \text{ mm} - \text{Gioco } 0,2 \div 0,3 = \text{Spessore da inserire} = 0,4 \div 0,3$

**D** Maß "B" am Deckel zwischen Fläche und Auflagefläche des Lagers messen. Die einzulegenden Distanzstücke ausrechnen.  $S = \text{Maß B} - \text{Maß A}$   
Bsp:  $B = 5,2 - A = 4,6 \text{ mm} - \text{Spiel } 0,2 \div 0,3 = \text{einzusetzende Distanzstücke} = 0,4 \div 0,3$

**ESP** Registrar la cota "B" en la tapa entre la superficie y el soporte del cojinete. Calcular los espesores que hay que insertar  $S = \text{Cota B} - \text{Cota A}$   
Es:  $B = 5,2 - A = 4,6 \text{ mm} - \text{Juego } 0,2 \div 0,3 = \text{Espesor a insertar} = 0,4 \div 0,3$

**F** Relever la cote "B" sur le couvercle entre surface et support palier. Calculer le nombre de cales à introduire  $S = \text{Cote B} - \text{Cote A}$   
Exp:  $B = 5,2 - A = 4,6 \text{ mm} - \text{Jeu } 0,2 \div 0,3 = \text{Cales à introduire} = 0,4 \div 0,3$

**ITA** Spalmare la superficie con LOCTITE 510, lubrificare l'anello di tenuta, inserire gli spessori e rimontare il coperchio con la nicchia rivolta verso l'alto.

**D** Fläche mit LOCTITE 510 schmieren; Dichtungsring schmieren; Distanzstücke einsetzen und Deckel mit Nische nach oben gerichtet, montieren.

**ESP** Engrasar la superficie con LOCTITE 510, lubricar el segmento de compresión, insertar los espesores y volver a montar la tapa con el hueco dirigido hacia arriba.

**F** Enduire la surface de LOCTITE 510, lubrifier la bague d'étanchéité, introduire les cales et remonter ensuite le couvercle avec le logement tourné vers le haut.

**ITA** Inseire le viti dopo averle spalmate con LOCTITE 510.

**D** Schrauben einsetzen; zuvor mit LOCTITE 510 schmieren.

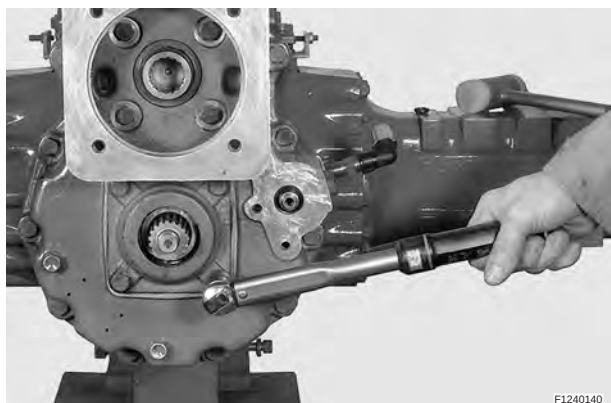
**ESP** Introducir los tornillos después de engrasarlos con LOCTITE 510.

**F** Introduire les vis après les avoir enduites de LOCTITE 510.





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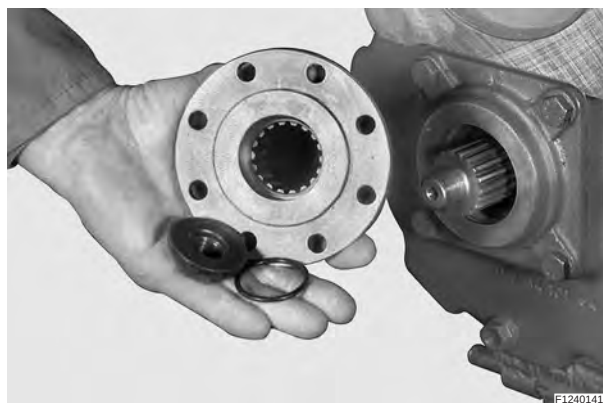
F1240140



GB

a

Tighten screws using a torque wrench setting of 49–51 Nm.



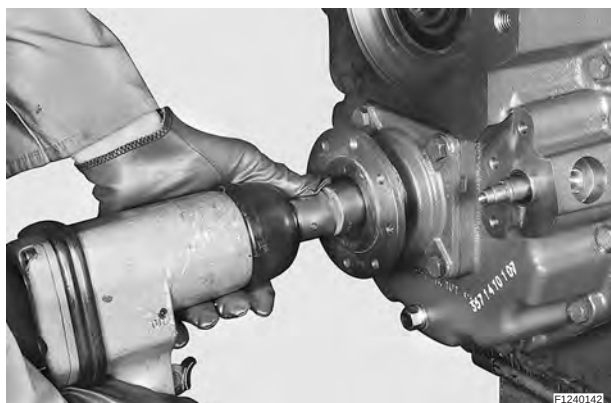
F1240141



GB

b

Assemble flange, O-ring and nut using LOCTITE 242.



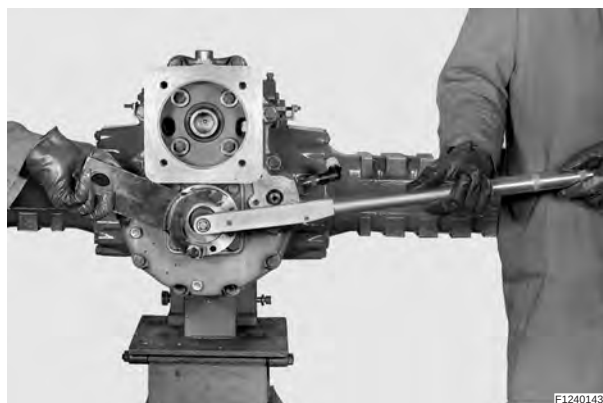
F1240142



GB

c

Screw down the nut of the flange.



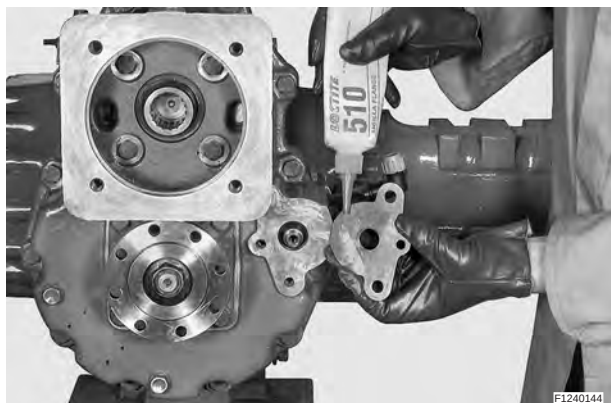
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GB

d

Tighten the nut using a torque wrench setting of 260–280 Nm.



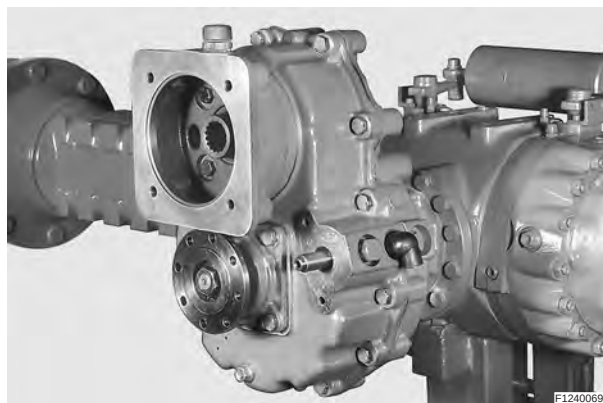
F1240144



GB

e

Re-fix the protection plate after applying LOCTITE 510.



F1240069



GB

f

Complete flanged reduction gear 357 with mechanical gear control.

**ITA** Serrare le viti con una coppia di serraggio di 49÷51 Nm.

**D** Schrauben mit einem Anziehdrehmoment zu 49÷51 Nm anziehen.

**ESP** Apretar los tornillos a un par de torsión de 49÷51 Nm.

**F** Serrer les vis à un couple de serrage de 49÷51 Nm.

**a**

**ITA** Montare la flangia, l'anello OR e il dado con LOCTITE 242.

**D** Flansch, O-Ring und Mutter mit LOCTITE 242 schmieren und montieren.

**ESP** Montar la brida, el anillo OR y la tuerca con LOCTITE 242.

**F** Monter la flasque, la bague OR et l'écrou enduit de LOCTITE 242.

**b**

**ITA** Avvitare il dado della flangia.

**D** Flanshmutter festschrauben.

**ESP** Atornillar la tuerca de la brida.

**F** Visser l'écrou de la flasque.

**c**

**ITA** Serrare il dado con una coppia di serraggio di 260÷280 Nm.

**D** Mutter mit einem Anziehdrehmoment zu 260÷280 Nm anziehen.

**ESP** Apretar la tuerca a un par de torsión de 260÷280 Nm.

**F** Serrer l'écrou à un couple de serrage de 260÷280 Nm.

**d**

**ITA** Rimontare lamiera di protezione dopo averla spalmata con LOCTITE 510.

**D** Schutzblech mit LOCTITE 510 schmieren und montieren.

**ESP** Volver a montar la placa de protección después de engrasarla con LOCTITE 510.

**F** Remonter la tôle de protection après l'avoir enduite de LOCTITE 510.

**e**

**ITA** Gruppo riduttore 357 afflangiato con comando marcia meccanico completo.

**D** Ganzes direkt geflanschter Reduzierer 357 mit mechanischer Gangschaltung.

**ESP** Grupo reductor 357 con brida con mando de marcha mecánico completo.

**F** Groupe réducteur bridé 357 à commande de vitesses mécanique complet.

**f**



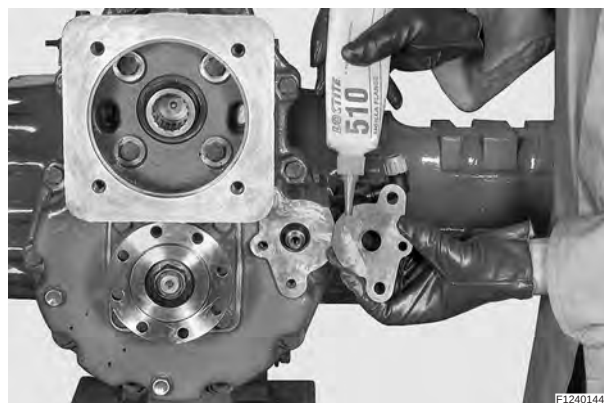
ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 - ASSEMBLAGGIO GRUPPO RIDUTTORE 357 AFFLANGIATO - DIREKT GEFLANSCHTER REDUZIERER 357 MONTIEREN - MONTAJE GRUPO REDUCTOR 357 CON BRIDA - ASSEMBLAGE DU GROUPE REDUCTEUR BRIDE 357



GB

a

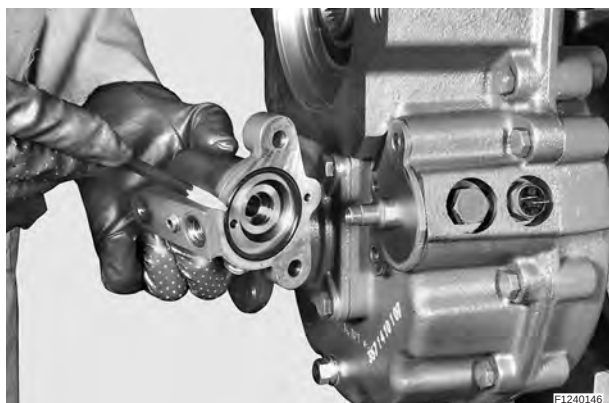
Re-assemble all the parts of the gear control cylinder, according to their arrangement.



GB

b

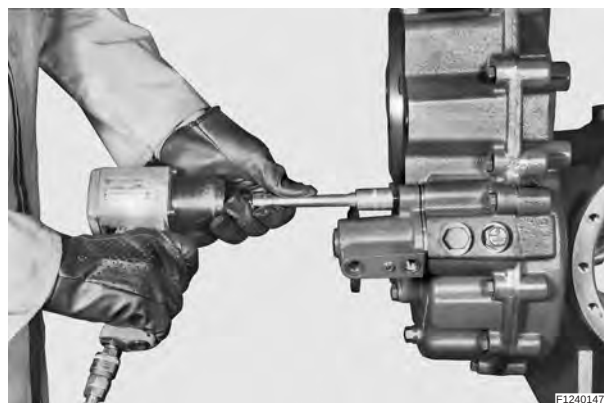
Re-fix the protection plate after applying LOCTITE 510 on it.



GB

c

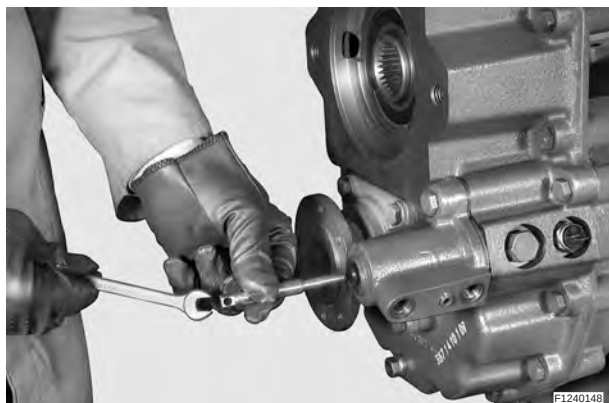
Re-fit the gear control cylinder into place with its O-ring.



GB

d

Re-fit screws and screw down.



GB

e

Re-introduce the gear control rod after applying LOCTITE 242 on it.





**ITA** Rimontare tutti i particolari del cilindro comando marcia come disposti in ordine.

**D** Alle Einzelteile des Zylinders des Gangschalters der Reihenfolge nach montieren.

**ESP** Volver a montar todas las piezas del cilindro mando marcha dispuestos en su orden.

**F** Remonter toutes les pièces du cylindre de commande de vitesses placé dans l'ordre.

**a**

**ITA** Rimontare lamiera di protezione dopo averla spalmata con LOCTITE 510.

**D** Schutzblech mit LOCTITE 510 schmieren und montieren.

**ESP** Volver a montar la placa de protección después de engrasarla con LOCTITE 510.

**F** Remonter la tôle de protection après l'avoir enduite de LOCTITE 510.

**b**

**ITA** Rimontare il cilindro comando marcia completo di anello OR.

**D** Zylinder des Gangschalters mit O-Ring montieren.

**ESP** Volver a montar el cilindro mando marcha completo de anillo OR.

**F** Remonter le cylindre de commande de vitesses complet de bague OR.

**c**

**ITA** Reinserire le viti ed avvitarle.

**D** Schrauben einsetzen und festschrauben.

**ESP** Volver a introducir los tornillos y atornillarlos.

**F** Introduire les vis et visser.

**d**

**ITA** Reinserire asta di comando marcia dopo averla spalmata con LOCTITE 242.

**D** Gangschalterhebel mit LOCTITE 242 schmieren und montieren.

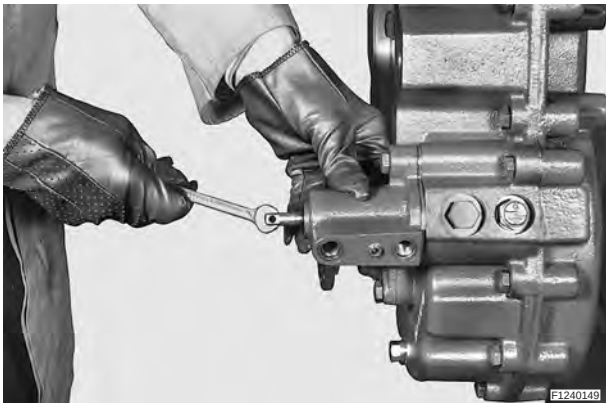
**ESP** Volver a insertar la varilla de mando de la marcha después de engrasarla con LOCTITE 242.

**F** Introduire la tringle de commande de vitesses après l'avoir enduite de LOCTITE 242.

**e**



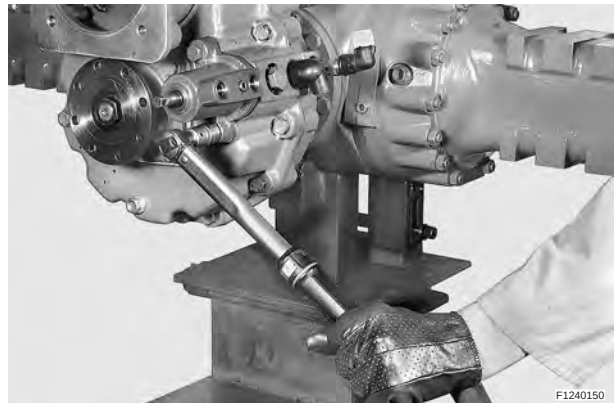
INSTALLATION OF HYDRAULIC GEAR CONTROL - INSTALLAZIONE COMANDO MARCIA IDRAULICO - HYDRAULISCHER GANGSCHALTUNG  
MONTIEREN - MONTAJE MANDO MARCHA HIDRAULICO - INSTALLATION DE LA COMMANDE DE VITESSES HYDRAULIQUE



GB

a

Tighten the gear control rod using a torque wrench setting of 25–26 Nm.



GB

b

Tighten gear control cylinder screws using a torque wrench setting of 49–51 Nm.



**ITA**

Serrare asta di comando marcia con una coppia di serraggio di 25÷26 Nm.

**D**

Den Gangschalterhebel mit einem Anziehdrehmoment zu 25÷26 Nm anziehen.

**ESP**

Apretar la varilla de mando a un par de torsión de 25÷26 Nm.

**F**

Serrer la tringle de commande de vitesses à un couple de serrage de 25÷26 Nm.

**ITA**

Serrare le viti cilindro comando marcia con una coppia di serraggio di 49÷51 Nm.

**D**

Die Zylinderschrauben des Gangschalters mit einem Anziehdrehmoment zu 49÷51 Nm anziehen.

**ESP**

Apretar los tornillos de mando de la marcha a un par de torsión de 49÷51 Nm.

**F**

Serrer les vis du cylindre de commande de vitesses à un couple de serrage de 49÷51 Nm.



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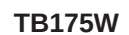
**SPICER®**

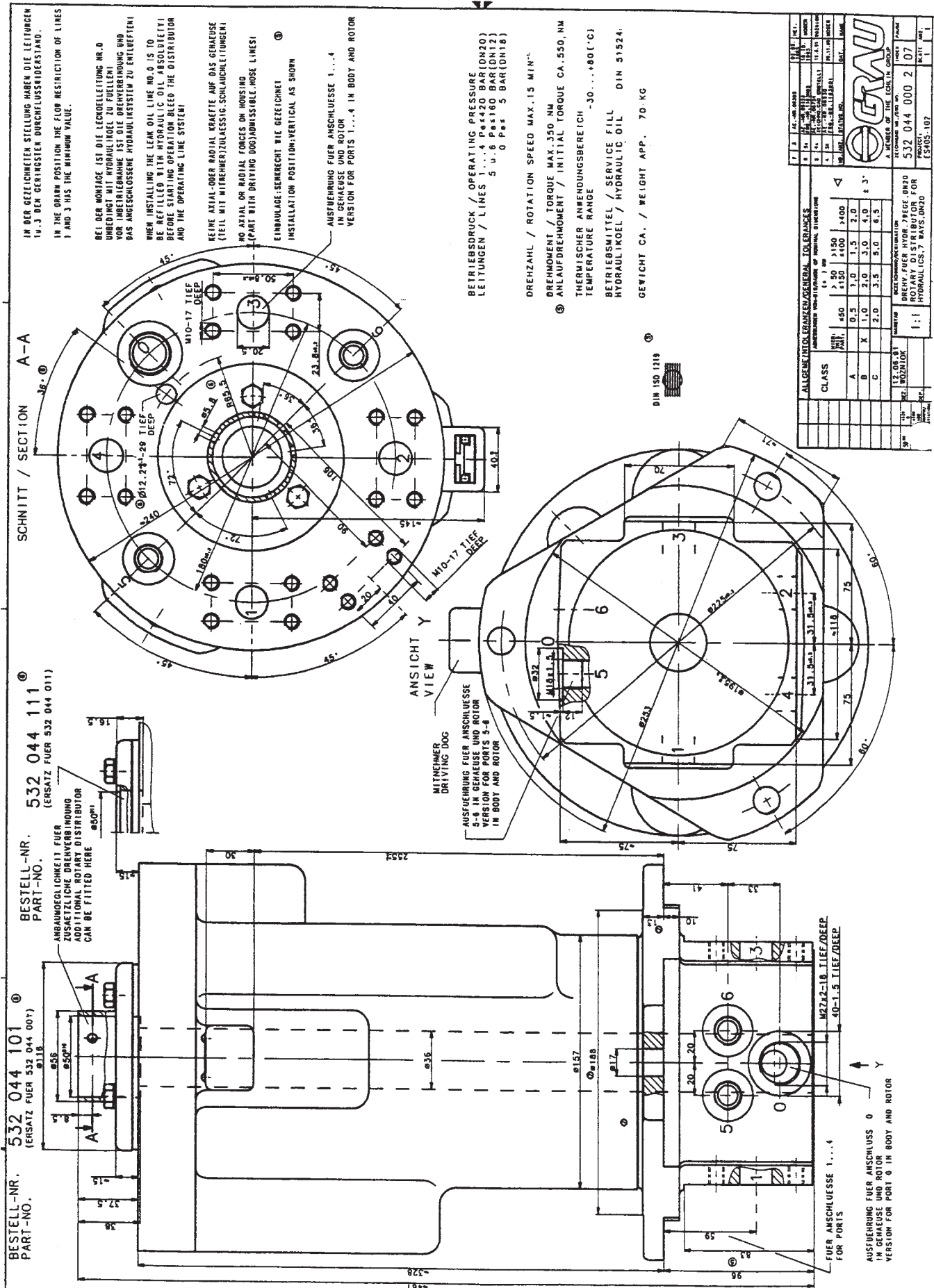
*Off-Highway Products*

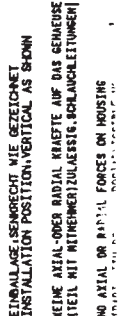
# **SWIVEL JOINT TYPE: 532**







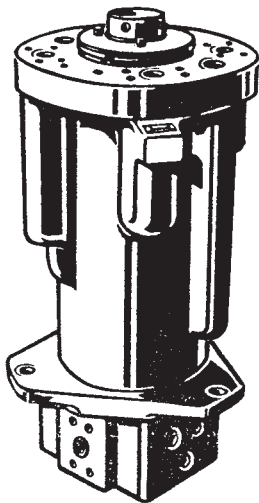






## INSTALLATION INSTRUCTIONS

# 532 044 001



### 7-way swivel joint for hydraulic applications

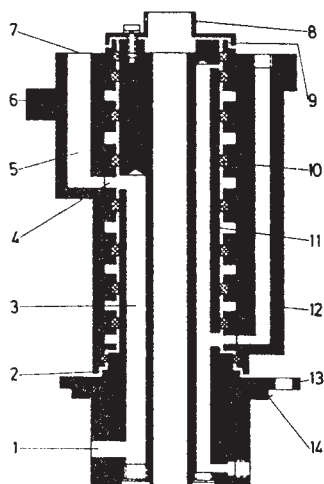
#### Application

As rotating line connector for introducing hydraulic fluid from at-rest to rotating machine parts. Example: in hydraulic excavators to transfer energy from the rotatable upper assembly with pumps and control blocks to the lower assembly with hydraulic motors for driving and hydrostatic linkages.

Other applications upon request.

#### Principles of operation

Rotor 11 in housing 12 is maintained in the axial direction by cover 8. Channels 5 run from connectors 7 on the upper side of the housing to toroidal chambers 4 which are sealed from each other by special gaskets 10. Each toroidal chamber 4 is connected to a radial connector 1 in rotor 11 by an axial bore 3.



The introduction of dust and spray interferes with labyrinths 9 and 2 at the interface between housing 12 and rotor 11.

Cover 8 has a seat for fitting a rotating connector. This makes it possible to introduce hydraulic and compressed air with a perfect separation of media within the swivel joint.

#### Installation instructions

The swivel joint is attached to flange 13 with adapter 14 and fastened with three M16 bolts. The line connectors can then attach to the tubes.

In the housing, there should be adequate play between connector 6 and the fork. Line connectors must be flexible, i.e., hoses. Additional sideways loads on the swivel joint must be avoided.

Slight leakage is possible between toroidal chambers when no pressure is present. This drains away in a common leakage channel. If the hydraulic circuits are separate, a common oil container will be needed.

## INSTALLATION INSTRUCTIONS

# 532 044 001

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The oil which leaks provides continuous lubrication for the bearing between the rotor and the housing and must be filled with oil before start-up. The swivel joint is installed vertically, with the axial connectors facing upwards. Contact the company for information on horizontal installation.

### Warning!

During assembly, the oil line (no. 0) must be filled with hydraulic oil.

The swivel joint and the attached hydraulic system must be bled before start-up.

### Service

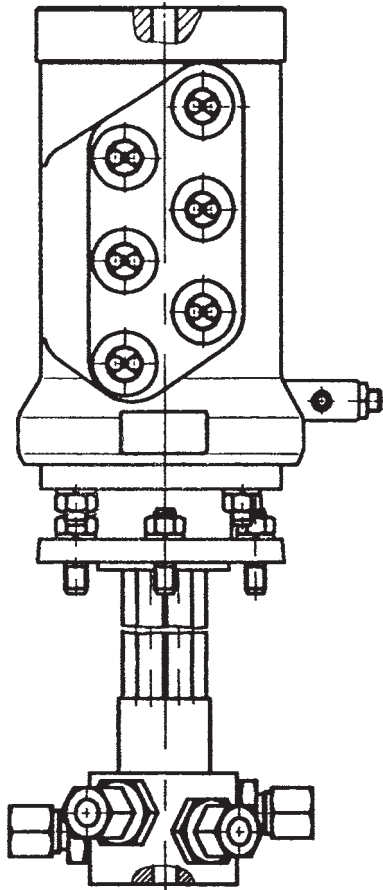
If the operating instructions in the installation drawings are observed, no maintenance will be necessary.

### Installation drawing

532 044 000 2

These installation instructions correspond to the present state of knowledge and are subject to revision. Grau accepts no responsibility for application beyond those covered in these installation instructions. Special consultation is required in these cases.

Changes in accordance with technical progress are reserved. Changes, even with our consent, must be authorized by our modification department.

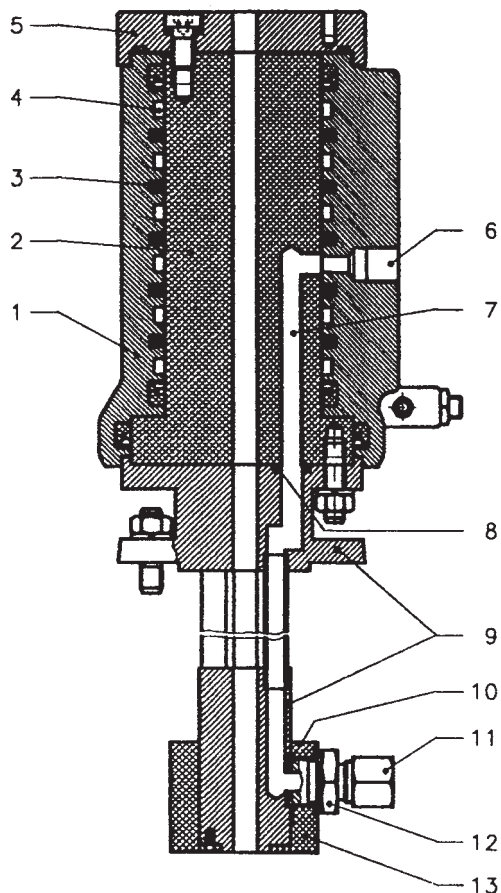


## APPLICATION

As swivel joint between moving and rotating machine parts.

Use preferably as part of a Grau combination swivel joint for independent support of different circuits such as work and pre-control hydraulics.

Some designs have a central bore for a cable. In these cases, fixing threads are located in the cover for a slip ring mount.



## OPERATION

The rotatable bearing supported rotor 2 in the housing is held in the axial plane by cover 5.

Connectors 6 in the housing are connected by toroidal chambers 4, axial bores 7 and intermediate piece 9 to connectors 11 in the connector unit.

There is a seal between toroidal chambers 4 by means of gaskets 3, by gaskets 8 between rotor 2 and intermediate piece 9, and by gaskets 10 between rotor 10 and connector 13.



## **INSTALLATION INSTRUCTIONS**

Before mounting the swivel joint on a Grau swivel joint for hydraulic applications, connector 13 must be removed by loosening bolts 12 (by about 2 turns). The swivel joint mount is then placed with intermediate piece 9 through the central bore of the swivel joint for hydraulic applications and fastened with the flange bolts.

Finally, connector 13 is slid with seals held in place by bolts 12 over the protruding intermediate piece 9, with the locator pin sitting in the correct position in the connector.

Bolts 12 are tightened again to secure connector piece 13 and to seal the connectors.

Make sure there is sufficient play between the housing mount and the counter-piece.

There must be no tension when the tubes are connected, preferably with hose connectors. Additional lateral loads on the rotating connector induced by too short or inflexible hoses must be avoided.

## **MAINTENANCE**

If the installation instructions are observed to the letter, no maintenance will be required.

## **INSTALLATION DRAWING**

532 124 000 2

These installation instructions correspond to the present state of knowledge and are subject to revision. Grau accepts no responsibility for application beyond those covered in these installation instructions. Special consultation is required in these cases.

Changes in accordance with technical progress are reserved. Changes, even with our consent, must be authorized by our modification department.



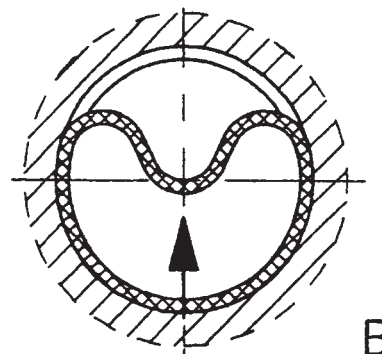
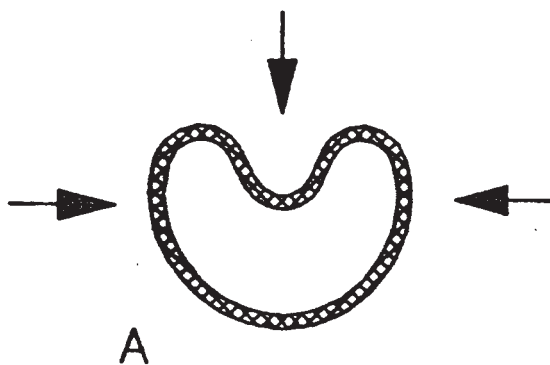
# MONTAGEHINWEIS ASSEMBLY INSTRUCTION

G 14087

BLATTZ. 1 | BLATT 1

## FÜR DICHRINGWECHSEL AN HYDRAULIK-DREHVERBINDUNGEN FOR REPLACING THE SEALING RINGS OF HYDRAULIK ROTARY DISTRIBUTOR

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. Deckel demontieren.</p> <p>2. Gehäuse abheben, wobei eventl. Abzugsvorrichtung zu verwenden ist.</p> <p>3. Dichtringe herausnehmen. Es ist zu beachten, daß die Dichtringe hierbei beschädigt werden und daher nicht wieder verwendet werden können.</p> <p>4. Gehäuse und Rotor, insbesondere die Dichtringnuten säubern.</p> <p>5. Neue Dichtringe sowie Lauffläche des Rotors mit Schmierfett nach DIN 51825-KP2N-40 ( z.B. Renolit LZR 2 ) gut einfetten.</p> <p>6. Dichtringe einsetzen. Hierbei werden zuerst die Gummidichtringe ohne die Kunststoff-Backringe nierenförmig verformt in die Gehäusenut eingebracht. Danach werden auf die gleiche Weise die Kunststoff-Backringe auf beiden Seiten des Gummidichtrings hinzugefügt. Es dürfen keine scharfen Knicke entstehen (Bild A und B).</p> <p>7. Montage in umgekehrter Reihenfolge wie Punkt 1 und 2.</p> | <p>1. Remove the cover.</p> <p>2. Lift off the housing. Use a puller, where necessary.</p> <p>3. Take out the sealing rings. Note that the sealing rings are now damaged and cannot be used again.</p> <p>4. Clean housing, rotor and especially the sealing ring grooves.</p> <p>5. Grease the new sealing rings as well as the working surface of the rotor with grease according to DIN 51825-KP2N-40 ( f.e. Renolit LZR 2 ).</p> <p>6. Insert the sealing rings: First the rubber sealing rings without plastic back rings are squeezed together and inserted in the squeezed state in the groove of the housing. Then the plastic back rings are added in the same way on both sides of the rubber sealing ring. Ensure that there are no sharp kinks ( Fig. A and B ).</p> <p>7. Reassembly according to point 1 and 2 above in reverse order.</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



SCHUTZVERMERK DIN 34 - 1 - 0 -  
E - F - I - Pt - R - Sv - S

GRAU  
GmbH

| TAG  | NAME      |
|------|-----------|
| GEZ. | <i>16</i> |



**MONTAGEHINWEIS  
ASSEMBLY INSTRUCTION**  
FÜR AUFSETZDREHVERBINDUNGEN  
FOR ROTARY DISTRIBUTOR TOP TYPE

**G 14150**

BLATTZ. 1 BLATT 1

Vor dem Einbau der Aufsetz-Drehverbindung ist das Anschlußstück (lösen der Verschraubungen um ca. zwei Umdrehungen) zu entfernen.

Before mounting the top type remove the adapter (by loosening the fittings by two turns).

Dann wird die Aufsetz-Drehverbindung durch die Mittelbohrung einer Hydraulik-Drehverbindung bzw. durch eine Bohrung von  $\varnothing 36$  mm gesteckt und befestigt.

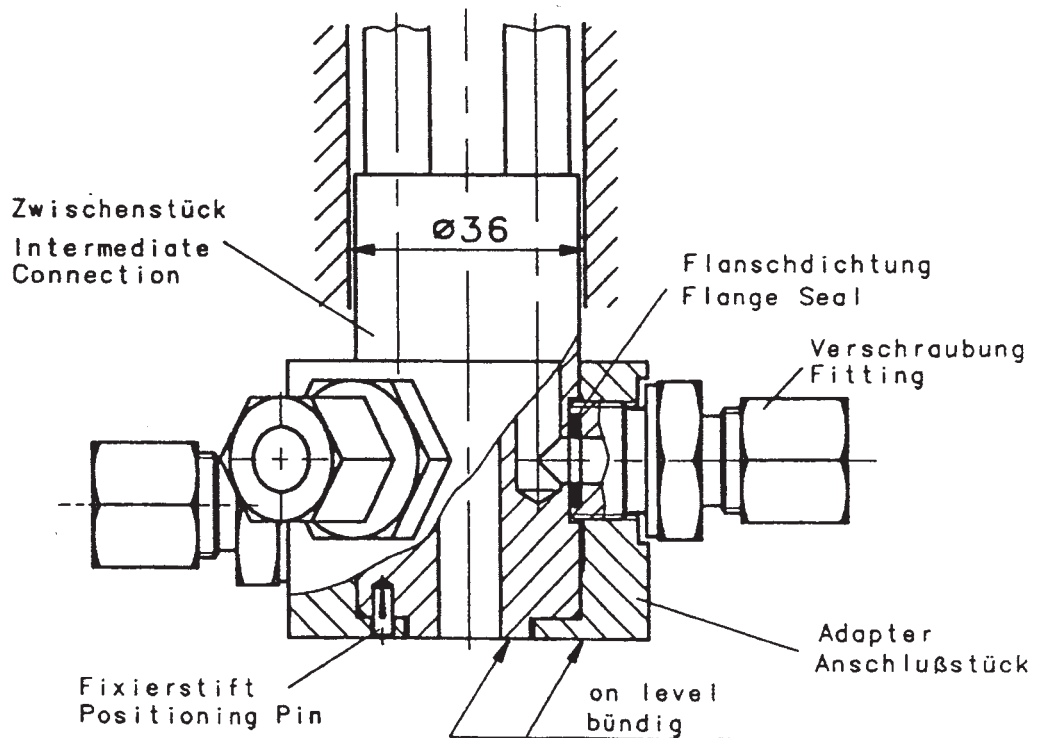
Then pass the top-type through the basic type's middle bore respectively through bore with a 36 mm dia and fix it.

Anschließend wird das Anschlußstück wieder über das Zwischenstück geschoben, wobei der Fixierstift die richtige Reihenfolge der Anschlüsse gewährleistet.

Subsequently slip the adapter on the intermediate connection. The positioning pin guarantees the correct sequence of all ports.

Die Stirnflächen von Zwischen- und Anschlußstück müssen vor dem Anziehen und Abdichten der Verschraubungen bündig sein.

The faces of intermediate connection and adapter have to be in line before screwing the fittings and tighten to seal.



SCHUTZVERMERK DIN 34 - 1 - D -  
E - F - I - P - R - S - S

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| GEZ. | TAG | NAME |
|------|-----|------|
|      |     |      |





# **V . TROUBLESHOOTING**

## TROUBLESHOOTING

---

### CAUTIONS IN TROUBLESHOOTING AND REPAIRS

- (1) Do not begin disassembling the equipment immediately just because it has broken down. Conduct a thorough preliminary check before attempting disassembly.
  - a. Ask the user the following questions.
    - What were the conditions when the machine broke down?
    - Did anything abnormal happen before breakdown occurred?
    - Are there any other places which were functioning poorly other than the part that broke down?
    - Are there any parts which have been repaired previous to the breakdown? What were they?
    - Has the same thing happened before?
  - b. Run the machine yourself and confirm the breakdown conditions.
    - Judge whether the machine is really broken down or not following the judgment standards.  
The judgment on whether the machine has broken down may differ between individuals.

**IMPORTANT:** When running the machine, it is possible that moving the machine could make the breakdown worse than it already is, so do not forget to ask the user if there is anything to prevent your operating the machine.

- c. Based on the information that you have gathered from the user and the information obtained from running the machine yourself, judge the cause of the trouble. Also keep in mind that it is difficult to reproduce the conditions of the breakdown again once the machine has been disassembled, and early disassembly may make it impossible to determine the true cause of the trouble. Therefore be sure to find the true cause of the trouble before attempting disassembly.
- (2) When it is thought that the trouble has more than one cause, begin investigating from the simplest cause.
- (3) Think over why the trouble could have occurred and try to correct the root cause of that problem.



## CONTENTS

### OVERALL MACHINE

|                                                                              |   |
|------------------------------------------------------------------------------|---|
| No operations can be done. ....                                              | 4 |
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### SLEWING

|                                                                                           |    |
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| The machine slews, but overrun when slewing stops is great, or it cannot be stopped. .... | 16 |
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| Arm cylinder operation is slow, or there is no power. .... | 32 |
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### BUCKET

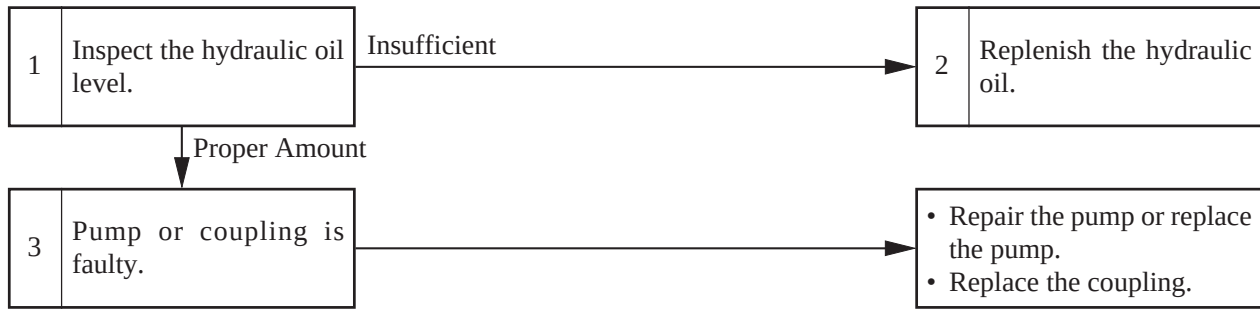
|                                                              |    |
|--------------------------------------------------------------|----|
| The bucket cylinder doesn't move, or there is no power. .... | 35 |
| The amount of bucket natural drop is great. ....             | 37 |

### BOOM SWING

|                                       |    |
|---------------------------------------|----|
| The swing cylinder doesn't move. .... | 38 |
|---------------------------------------|----|

## TROUBLESHOOTING

## OVERALL MACHINE

**NO OPERATIONS CAN BE DONE.**

## 1. Inspect the hydraulic oil level.

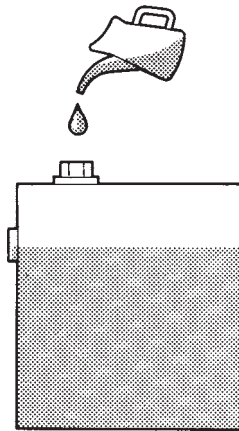
☞ “III. Machine Configuration, Hydraulic Tank”

## 2. Replenish the hydraulic oil.

Take out the plug and replenish the hydraulic oil.

- The hydraulic oil supplied should be the same brand as the oil currently in the tank.

☞ “II. Specifications, Fluid Capacities”



Y2-E001

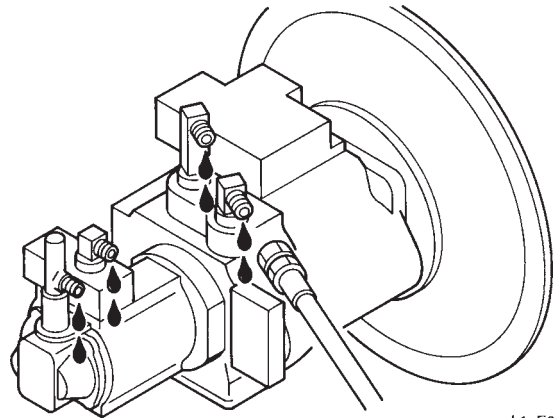
## 3. Pump or coupling is faulty.

- a. Disconnect the discharge hose from the pump side.

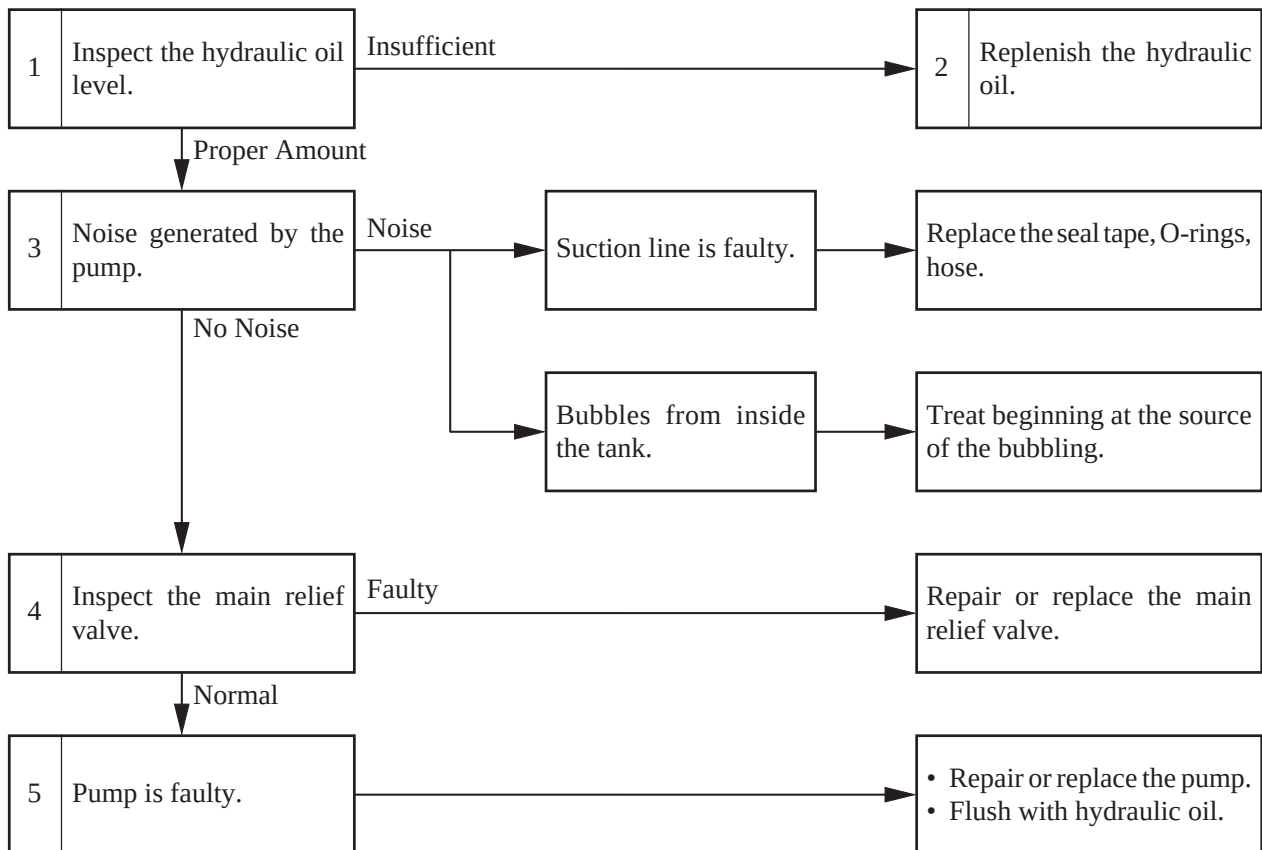
Also fit a plug in the disconnected hose to keep the hydraulic oil from pouring out.

- b. With the engine emergency stop knob pulled out all the way, turn the start switch to the “START” position to cause the engine to begin cranking. Check that the hydraulic oil is discharged from the pump at this time.

If the pump is normal, hydraulic oil will be discharged from it. If hydraulic oil is not discharged, the pump or the coupling is faulty.

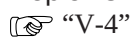


L1-E001

**ALL OPERATIONS CAN BE DONE, BUT THERE IS NO POWER.**

1. Inspect the hydraulic oil level.

2. Replenish the hydraulic oil.



3. Noise generated by the pump.

A faulty suction line can make it easy for cavitation to occur in the pump and for noise to be generated. Carry out the following inspect.

a. Inspect the piping used for suction of hydraulic oil.

- Apply grease or oil to the part which appears to be making the noise and inspect if there is any change. (Inspect if it is sucking in air or not.)

b. Inspect for clogging of the suction filter.



4. Inspect the main relief valve.

Measure the relief pressure of the main relief valve.

- The valve is normal if the pressure gauge reading is the standard value.

☞ “II. Specifications, Standards for Judging Performance”

If the main relief valve's set pressure is too low, adjust it by tightening the valve set screw gradually.

☞ “II. Specifications, Standards for Judging Performance”

5. Pump is faulty.

If the pump is abnormally worn internally, or if it is damaged, it is possible that pieces of metal are mixed into the hydraulic oil. Therefore, carry out the following treatment.

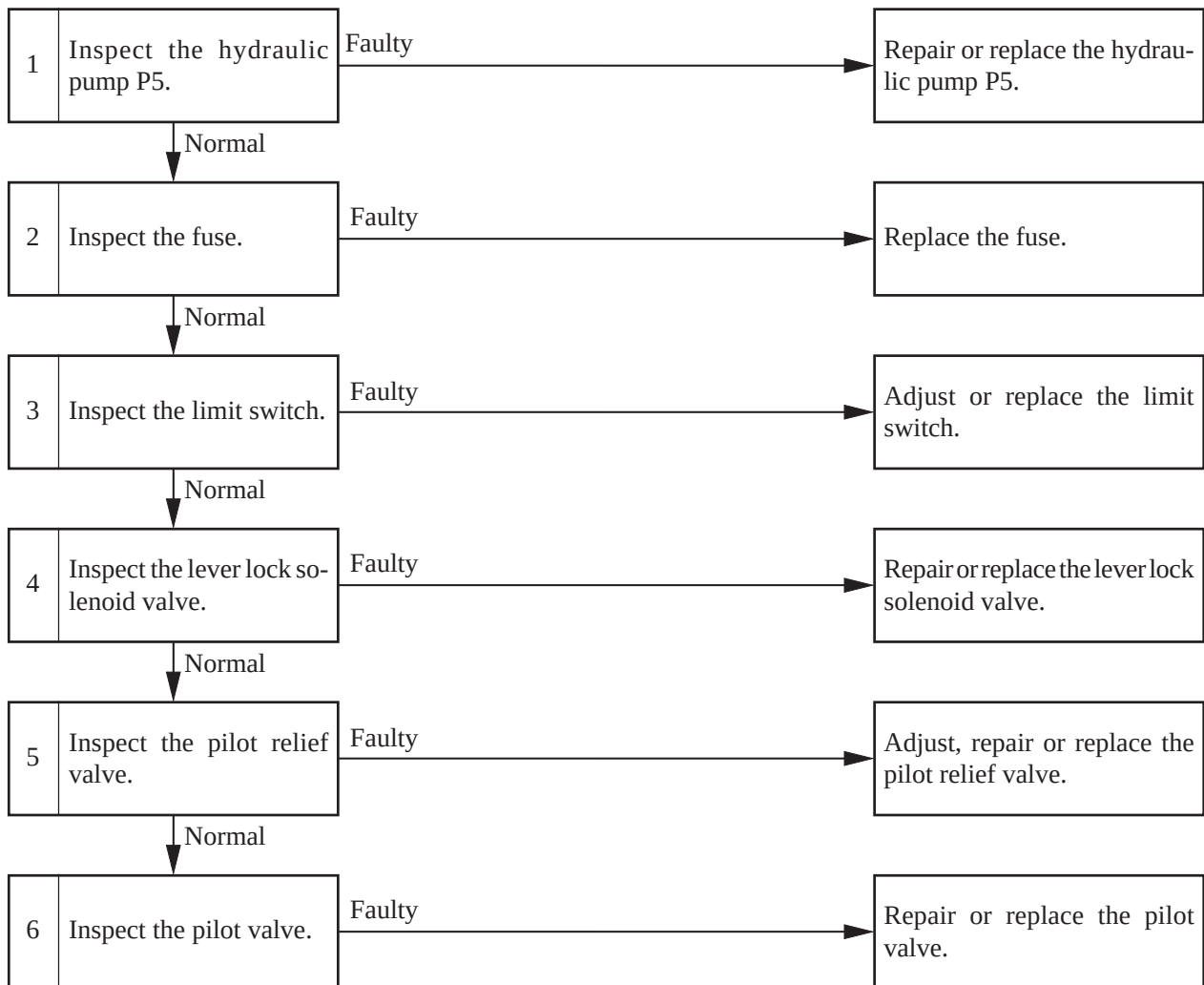
- Replace the spin filter cartridge.
- Replace the hydraulic oil or flush out the hydraulic circuit.

(Up to NAS Class 9)

Caution : When replacing the hydraulic oil, be sure to clean the inside of the Hydraulic Tank and the suction strainer.

If the pump seal is damaged, replace the seal.

☞ “IV. Hydraulic Units, Hydraulic Pump”

**THE BOOM, BUCKET, SLEW AND ARM DO NOT MOVE AT ALL, OR THE SPEED IS LOW.**

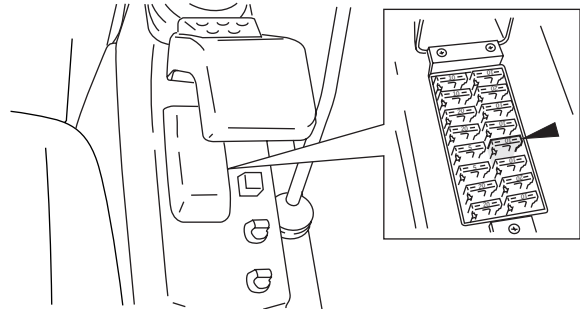
1. Inspect the hydraulic pump P5.  
Inspect the hydraulic pump P5 which is the source of the hydraulic pressure for the pilot valve.  
 "V-4"  
Since clogging of the line filter can also be considered, inspect and clean the filter.

## TROUBLESHOOTING

## OVERALL MACHINE

### 2. Inspect the fuse.

Inspect the fuse for the electric power circuit that operates the pilot solenoid valve.



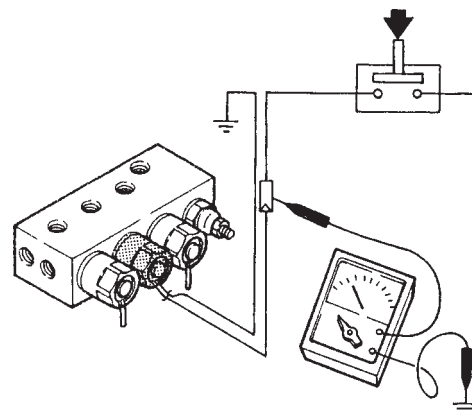
W2E003

### 3. Inspect the limit switch.

Set the lever stand to the operation position to turn on the limit switch. Check the voltage at the lever lock solenoid valve by using a tester.

- The limit switch is normal if the voltage is being applied.

Reference: If the limit switch is found to be faulty and the attachment must be moved, connect the lever lock release connectors (male) and (female) for emergency use.

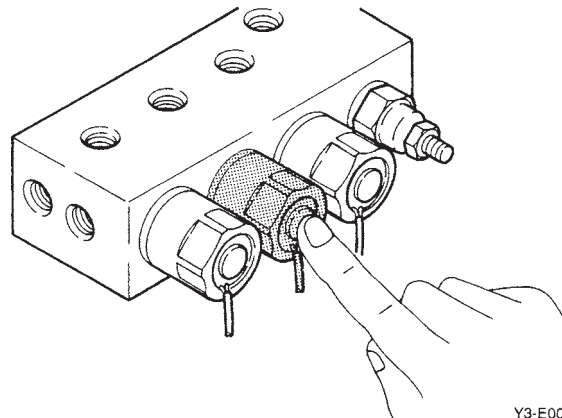


L1-E005

### 4. Inspect the lever lock solenoid valve.

Inspect by the following procedure.

- Turn the starter switch to the "ON" position.
- Push lightly on the projection on the front end of the solenoid valve.
- Move the lever stand and change the limit switch from "OFF" to "ON".
- If the spool moves and vibration can be felt with the fingertip when the circuit changes, then it is normal.



Y3-E007

### 5. Inspect the pilot relief valve.

Measure the relief pressure of the pilot relief valve.

- If the pressure is the standard value, the valve is normal.

☞ "II. Specifications, Standards for Judging Performance"

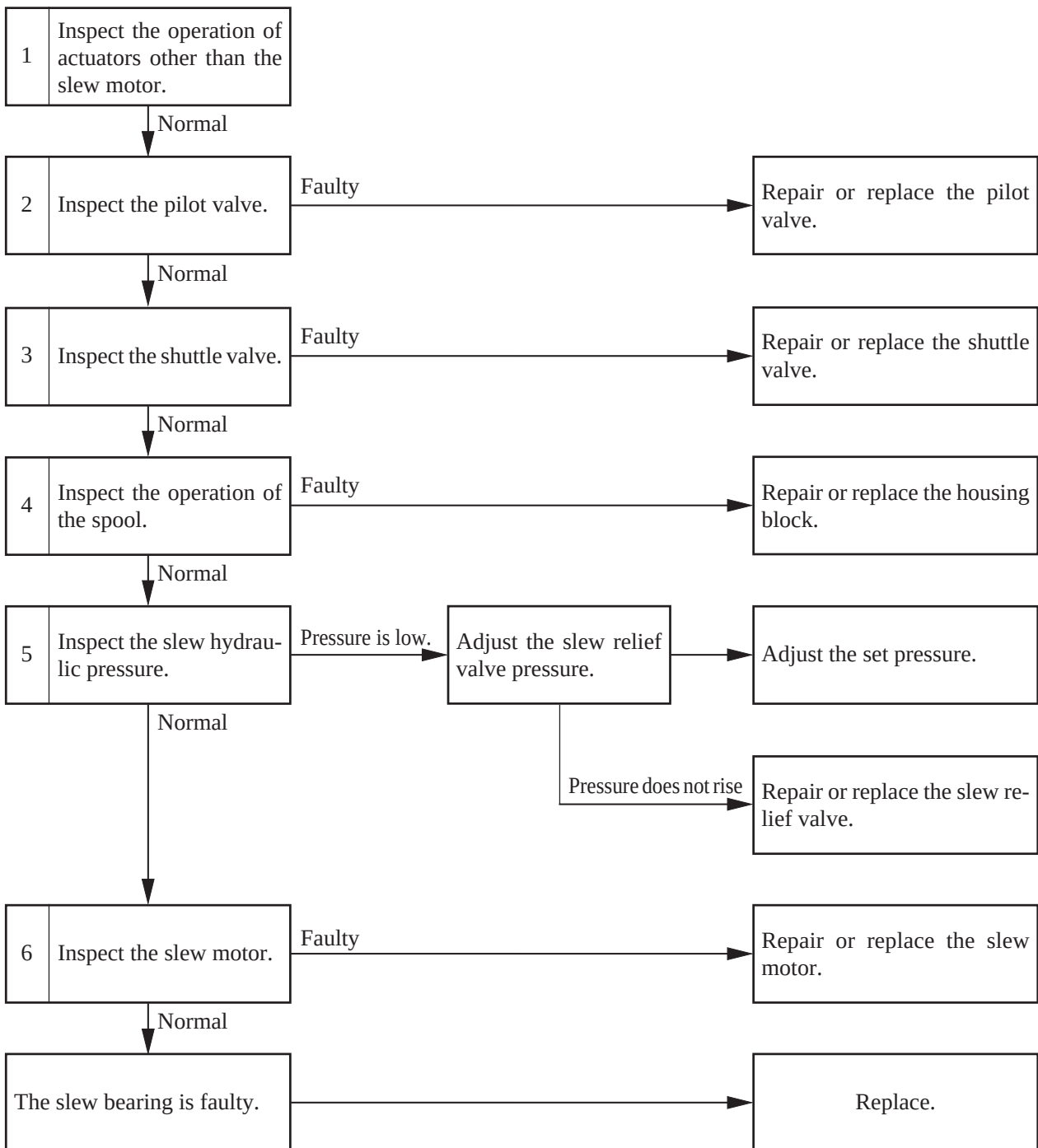
### 6. Inspect the pilot valve.

☞ "IV. Hydraulic Units, Pilot Valve"



## SLEWING

## TROUBLESHOOTING

**NO SLEWING CAN BE DONE.**

1. Inspect the operation of actuators other than the slew motor.

Inspect if the operation of the slew motor only is faulty by the table at right. If its operation is faulty, inspect the main relief valve and the hydraulic pump.

☞ “V-6”

| Lever Operated | Places inspected |         |
|----------------|------------------|---------|
| Dozer Blade    | Relief Valve R3  | Pump P3 |

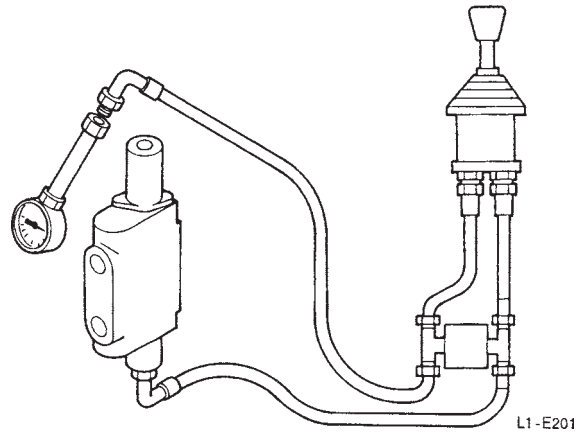
## TROUBLESHOOTING

## SLEWING

## 2. Inspect the pilot valve.

Disconnect the hose between the pilot valve and control valve (slew section) at the control valve side, then set a pressure gauge in the disconnected hose.

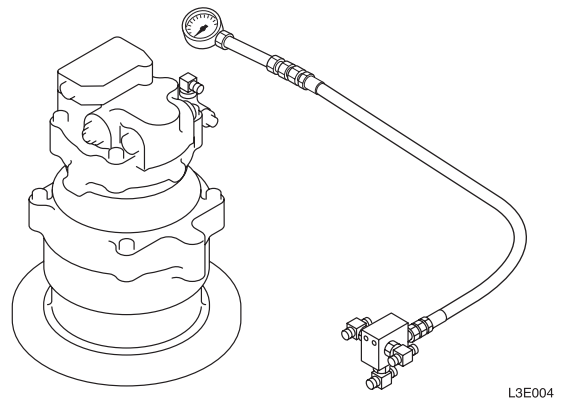
- A plug should be inserted in the control valve port.
- Operate the lever (slew) and measure the pressure.
- Depending on the operating angle, a pressure in the 0~3.4 MPa range is normal.



## 3. Inspect the shuttle valve.

Disconnect the hose that goes between the shuttle valve and the slew motor at the slew motor side and set a pressure gauge to the disconnected hose.

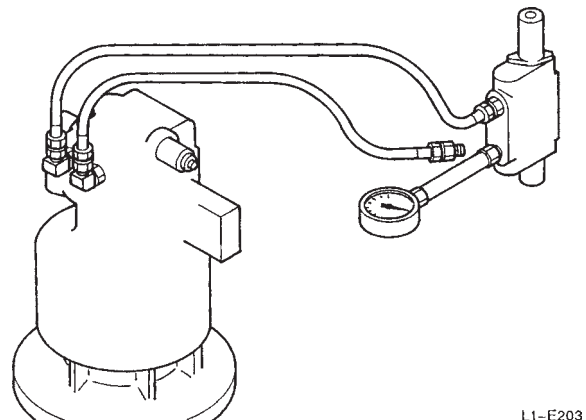
- Operate the lever (slew) and measure the pressure.
- The shuttle valve is normal if between 0 and 3.4 MPa corresponding to the operation angle.



## 4. Inspect the operation of the spool.

Disconnect the hose that goes between the control valve (slew section) and the slew motor at the valve side and set a pressure gauge to the discharge port of the valve.

- Operate the lever (slew) and measure the pressure.
- The operation of the spool is normal if it agrees with the following value of supply pressure:  
23.5 MPa



## 5. Inspect the slew hydraulic pressure.

Measure the pressure at the left and right slew relief valves.

- The pressure is normal if it is the standard value.

☞ “II. Specifications, Standards for Judging Performance”

If adjustment of the pressure is possible, the slew relief valve's adjustment is faulty. Also, if the pressure adjustment is impossible, the slew relief valve is faulty.

## SLEWING

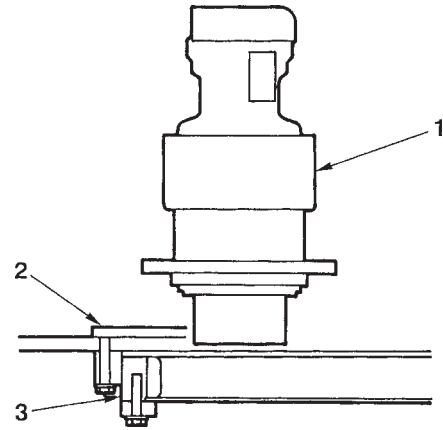
## TROUBLESHOOTING

### 6. Inspect the slew motor.

Separate the slew motor (1) and the turntable (2), then try turning the turntable (2).

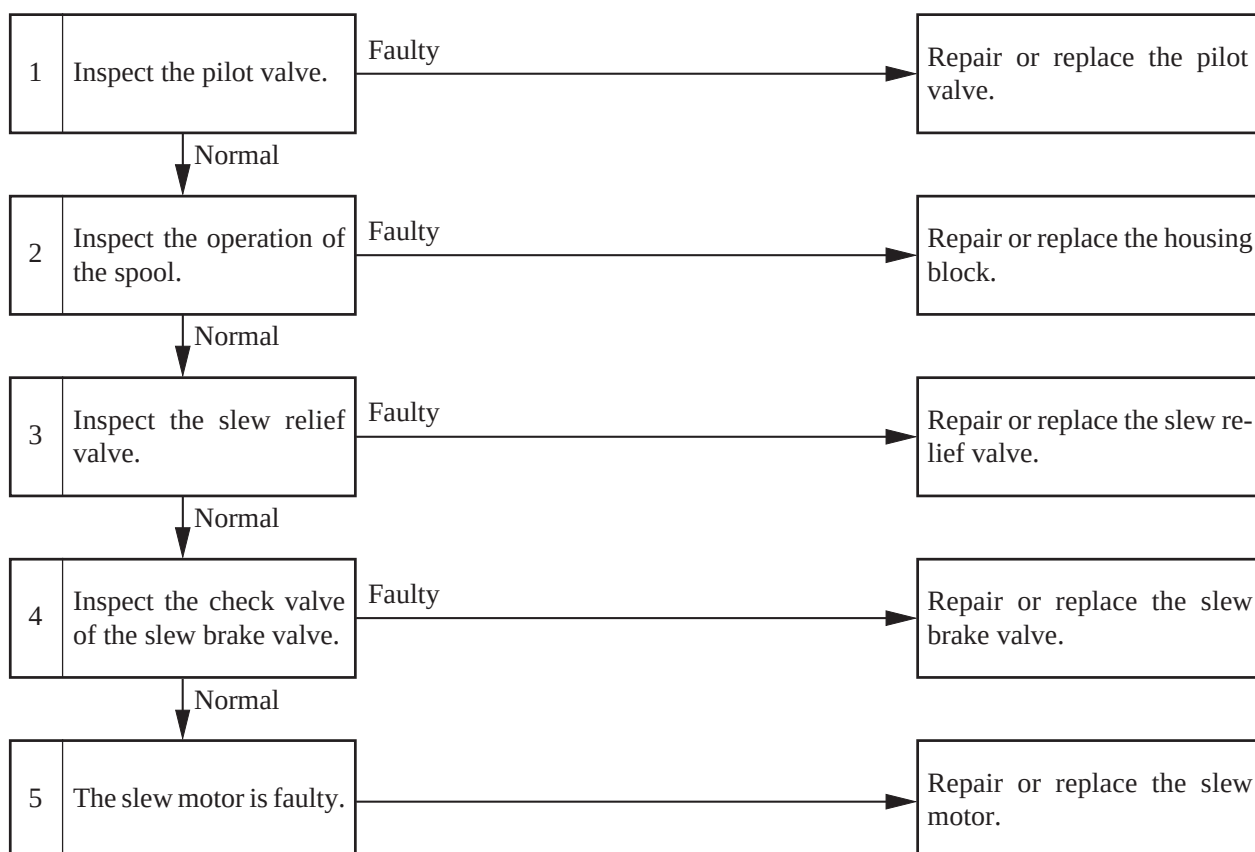
- Turntable doesn't turn .... Faulty slew bearing (3).
- Turntable turns ..... Faulty slew motor (1).

☞ "IV. Hydraulic Units, Slew Motor"



L1- E204



**RIGHT OR LEFT SLEWING CANNOT BE DONE.**

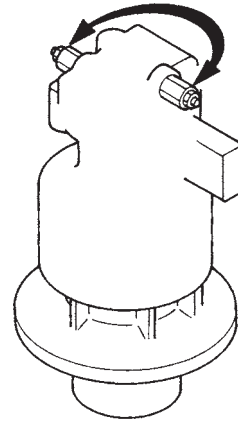
1. Inspect the pilot valve.  
It could be that the spool for only the side of the pilot valve for which slewing is impossible will not operate.  
☞ “V-10”

2. Inspect the operation of the spool.  
It could be that the spool will not move only in the direction in which slewing is impossible.  
☞ “V-10”

## SLEWING

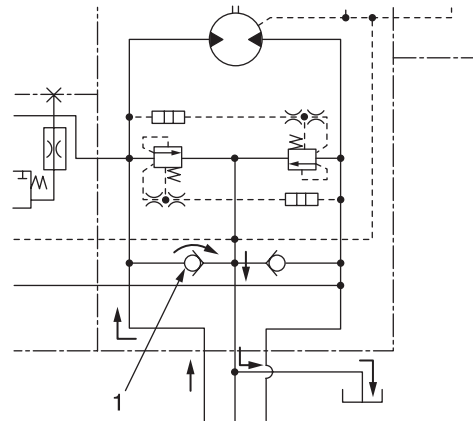
## TROUBLESHOOTING

3. Inspect the slew relief valve.  
Try switching the left and right slew relief valves.  
If slewing becomes possible, the relief valve is faulty.



L1-E205

4. Inspect the check valve of the slew brake valve.  
If foreign matter is caught in one end of the check valve (1), or if the valve is sticking, right or left slewing will be impossible.
  - If foreign matter is caught in one of the check valves, the hydraulic oil returns to the tank from the check valve.



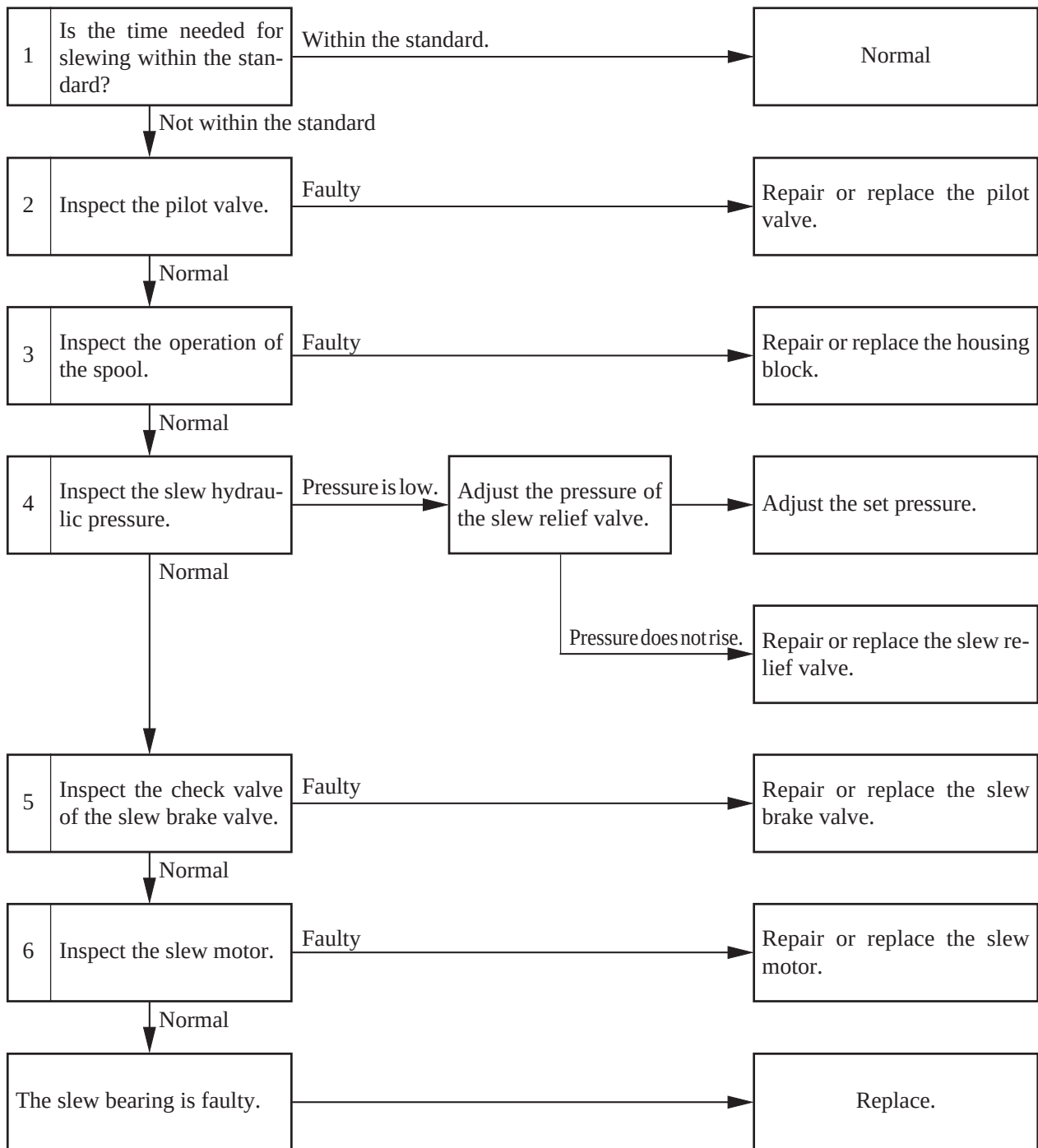
L3E005

5. The slew motor is faulty.  
☞ “IV. Hydraulic Units, Slew Motor”

## TROUBLESHOOTING

## SLEWING

### SLEWING SPEED IS LOW, OR THERE IS NO POWER.





## SLEWING

## TROUBLESHOOTING

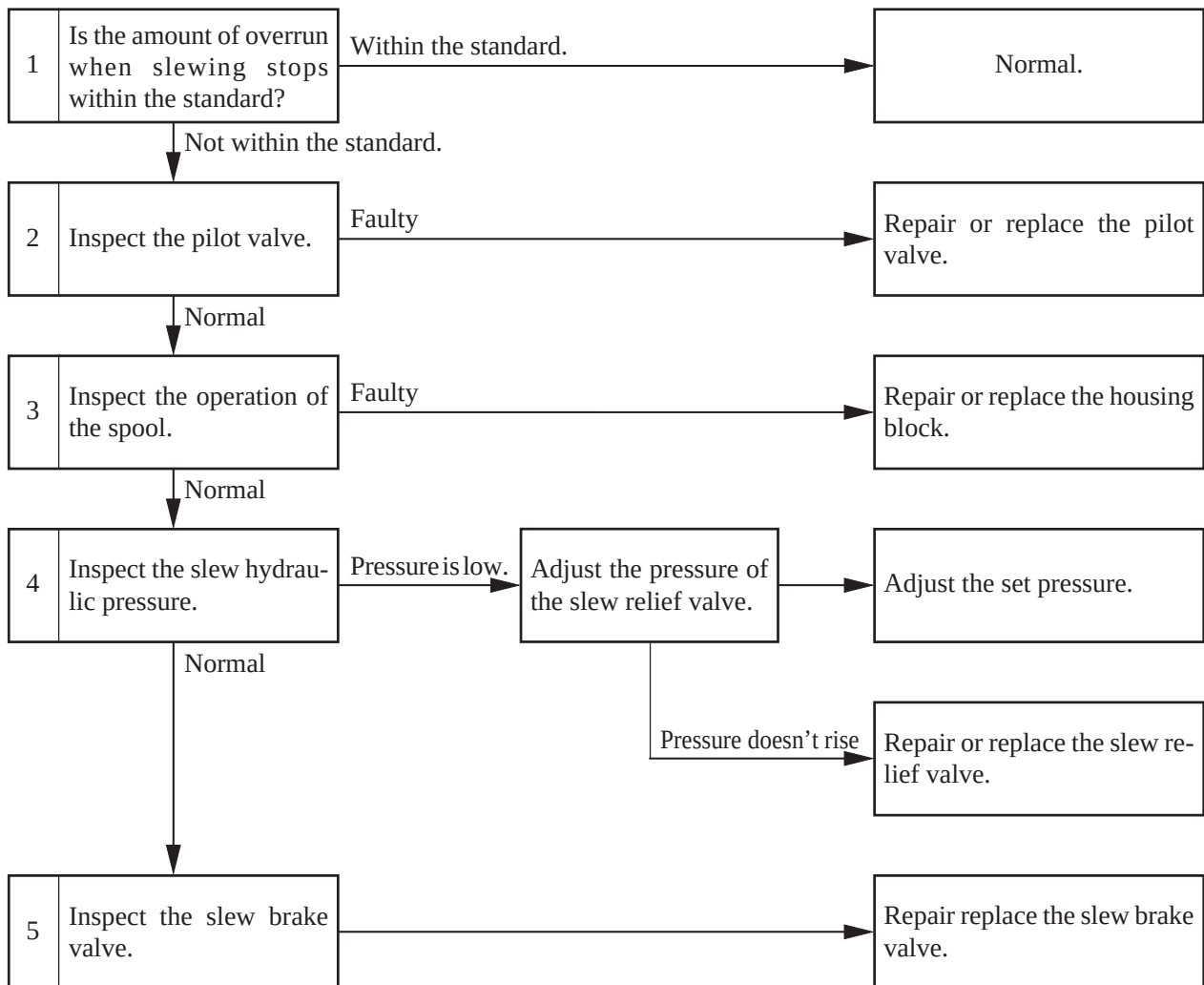
---

1. Is the time needed for slewing within the standard?  
 "II. Specifications, Standards for Judging Performance"
2. Inspect the pilot valve.  
 "V-10"
3. Inspect the operation of the spool.  
 "V-10"
4. Inspect the slew hydraulic pressure.  
 "V-10"
5. Inspect the check valve of the slew brake valve.  
 "IV. Hydraulic Units, Slew Motor"
6. Inspect the slew motor.  
 "IV. Hydraulic Units, Slew Motor"

## TROUBLESHOOTING

## SLEWING

THE MACHINE SLEWS, BUT OVERRUN WHEN SLEWING STOPS IS GREAT, OR IT CANNOT BE STOPPED.



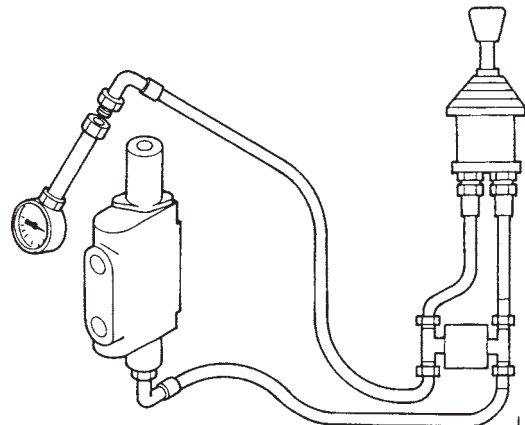
1. Is the amount of overrun when slewing stops within the standard?

☞ “II. Specifications, Standards for Judging Performance”

2. Inspect the pilot valve.

Inspect if the spool of the pilot valve returns to the neutral position when the operation lever (slew) is released after operation. Disconnect the hose between the pilot valve and the control valve (slew section) on the control valve side, then set a pressure gauge in the disconnected hose.

- Read the pressure gauge after operating the lever (slew), then releasing it.
- If the pressure is zero, the pilot valve is normal.



L1-E201

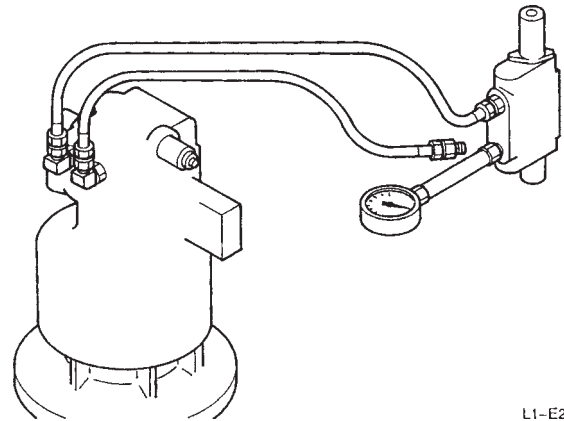
## SLEWING

## TROUBLESHOOTING

### 3. Inspect the operation of the spool.

Inspect if the spool of the control valve (slew section) returns to the neutral position when the operation lever (slew) is released after operation. Disconnect the line from the slew section of the control valve, then set a pressure gauge in its supply port.

- Read the pressure gauge after operating the lever (slew), then releasing it.
- If the pressure is zero, the pilot valve is normal.



L1-E203

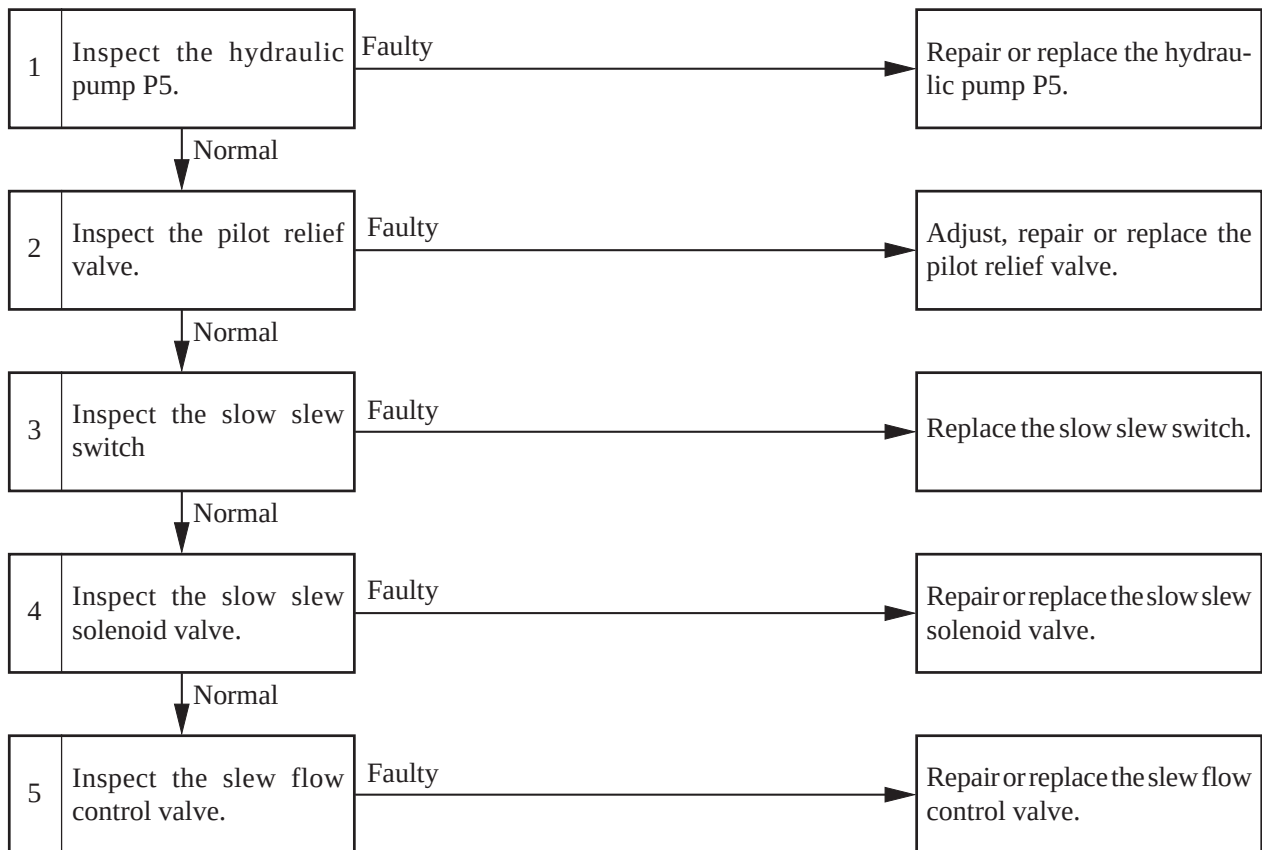
### 4. Inspect the slew hydraulic pressure.

☞ “V-10”

### 5. Inspect the slew brake valve.

☞ “IV. Hydraulic Units, Slew Motor”



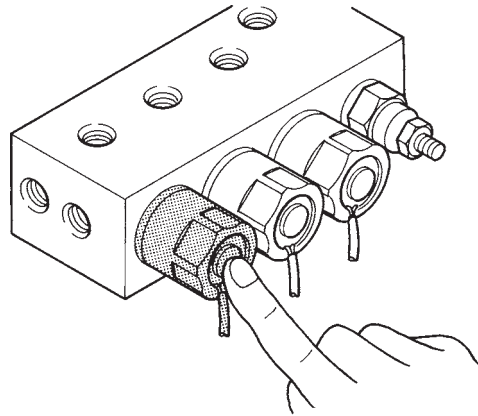
**SLEWING IN SLOW GEAR IS NOT POSSIBLE.**

1. Inspect the hydraulic pump P5.  
Inspect the hydraulic pump P5 which is the source of the hydraulic pressure for switching to slow gear.  
 "V-4"  
Since clogging of the line filter can also be considered, inspect and clean the filter.
2. Inspect the pilot relief valve.  
Measure the relief pressure of the pilot relief valve.
  - If the pressure is the standard value, the valve is normal.
 "II. Specifications Standards for Judging Performance"
3. Inspect the slow slew switch.  
Press the switch to obtain "ON" condition. The switch is normal when the lamp lights in this condition.

## SLEWING

## TROUBLESHOOTING

4. Inspect the slow slew solenoid valve.
  - a. Turn the start switch "ON".
  - b. Press the protruding portion of the solenoid valve lightly.
  - c. Turn the slow slew switch "ON".
  - d. If the spool moves and vibration can be felt with the fingertip when the circuit changes, then it is normal.

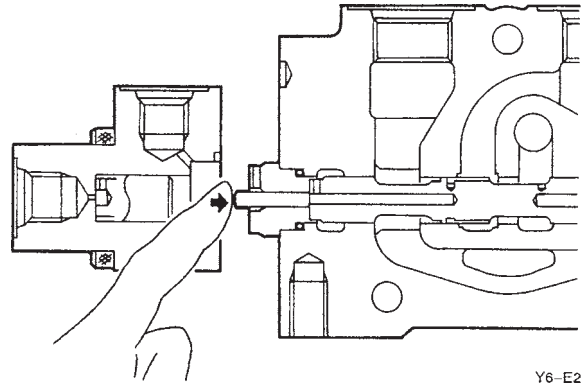


Y6-E121

5. Inspect the slew flow control valve.

Inspect if the spool of the slew flow control valve moves smoothly.

  - Remove the spool cover at the FC port and try pushing the spool with a finger. It is normal if it moves smoothly about 9 mm.

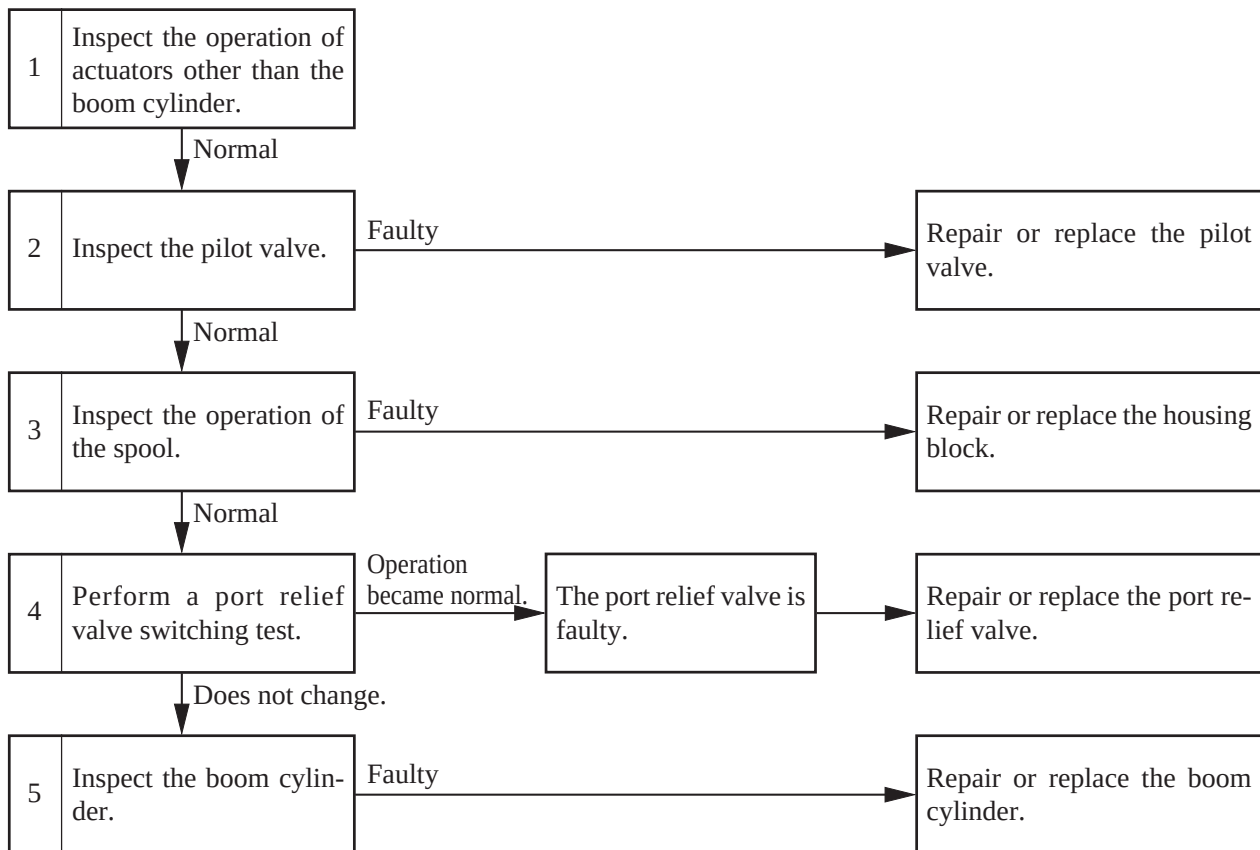


Y6-E251

## TROUBLESHOOTING

## BOOM

## THE BOOM CYLINDER DOESN'T MOVE.



1. Inspect the operation of actuators other than the boom cylinder.

Inspect if the operation of the boom cylinder only is faulty by the table at right. If its operation is faulty, inspect the main relief valve and the hydraulic pump.

☞ “V-6”

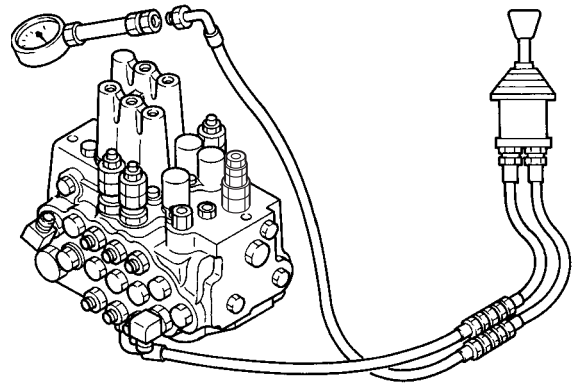
| Lever Operated | Places inspected |         |
|----------------|------------------|---------|
| Bucket         | Relief Valve R1  | Pump P1 |



## 2. Inspect the pilot valve.

Disconnect the hose between the pilot valve and control valve (boom section) on the control valve side, then set a pressure gauge in the disconnected hose.

- Operate the (boom) lever and measure the pressure.
- Depending the operation angle, if the pressure is normal, it will range between 0~3.4 MPa.

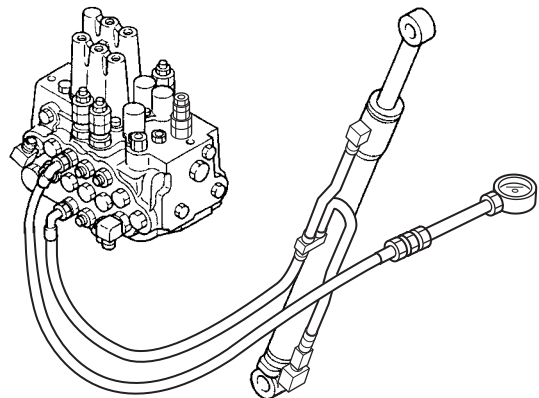


W2E004

## 3. Inspect the operation of the spool.

Disconnect the hose between the control valve (boom section) and the cylinder on the cylinder side, then set a pressure gauge in the disconnected hose.

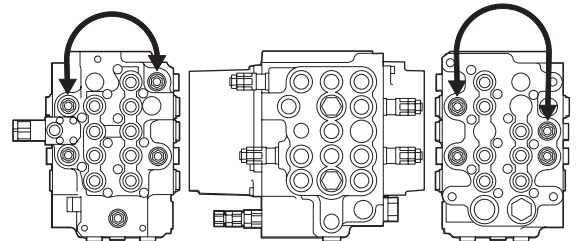
- Operate the (boom) lever and measure the pressure.
- A pressure of 27.5 MPa is normal.



W2E005

## 4. Perform a port relief valve switching test.

Switch the port relief valve for the port relief valve of the normal arm. If the boom cylinder operates, the boom side port relief valve is faulty.

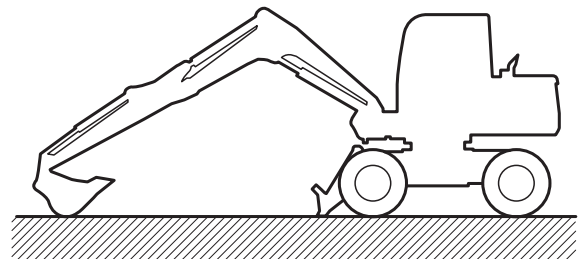


W2E006

## 5. Inspect the boom cylinder.

- Disconnect the hose between the control valve and the boom cylinder on the control valve side.
- Connect the disconnected hose to the arm section or the bucket section.
- Try operating the boom cylinder. If the cylinder doesn't operate, the cylinder is faulty.

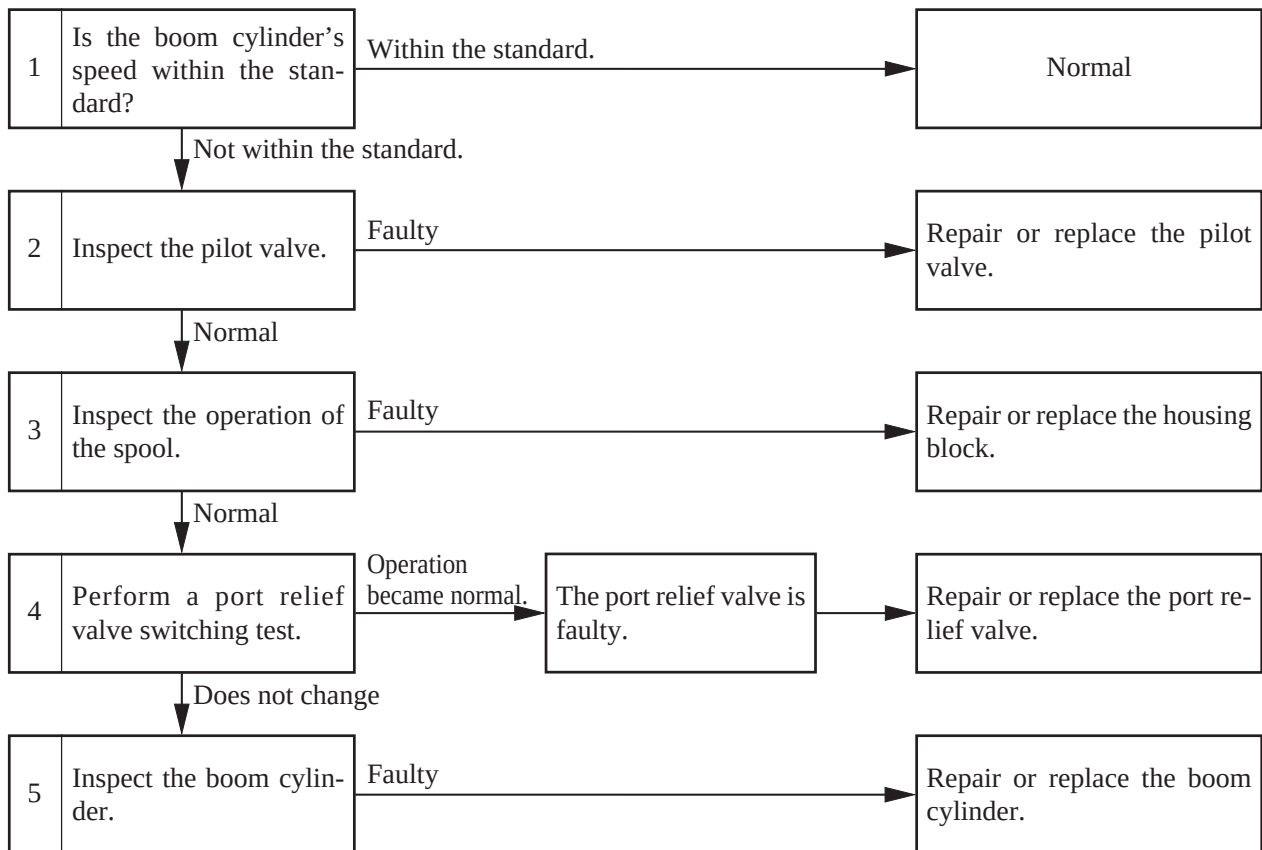
When performing the operation in "a~c" above, the bucket cylinder should be fully extended, the arm cylinder should be fully retracted and the bucket should be lowered to the ground.



W1-E004

## TROUBLESHOOTING

## BOOM

**BOOM CYLINDER OPERATION IS SLOW, OR THERE IS NO POWER.**

1. Is the boom cylinder's speed within the standard?

☞ "II. Specifications, Standards for Judging Performance"

2. Inspect the pilot valve.

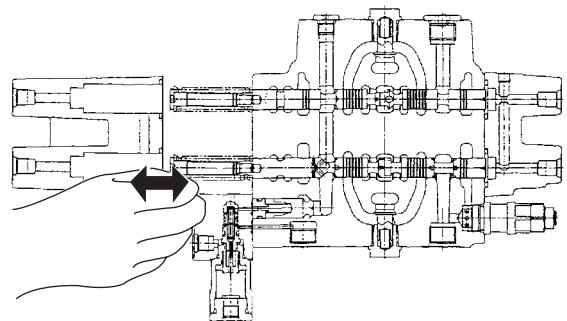
☞ "V-21"

3. Inspect the operation of the spool.

Stroke the spools of the boom [1] and boom [2] sections and inspect whether they move smoothly, or remove the spools and check whether there is any foreign matter engaged in them.

4. Perform a port relief valve switching test.

☞ "V-21"

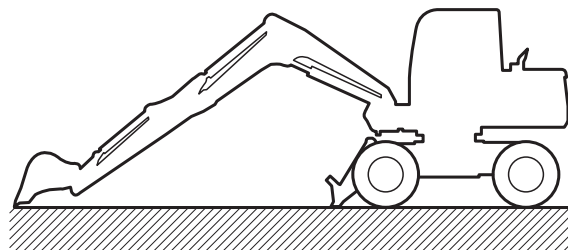


L3E007

5. Inspect the boom cylinder.

Boom Cylinder internal Leakage Inspect (1)

- a. With the bucket cylinder fully retracted and with the rod of the arm cylinder a little extended from the fully retracted position, lower the bucket front end to the ground.

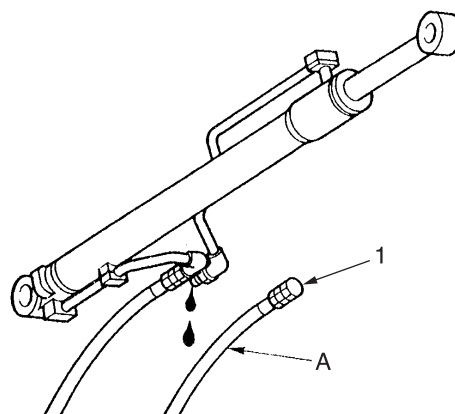


W1-E005

- b. Disconnect the rod side hose (A) only and let the oil in the piping run out.

Insert a plug (1) in the disconnected hose.

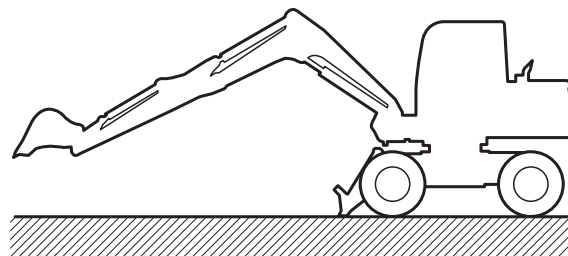
- Test the left and right cylinders one at a time. Remove both hoses from the cylinder that is not being inspected at this time and plug the disconnected hoses.



L3E008

- c. Retract the arm cylinder and lift the bucket so it is floating above the ground.

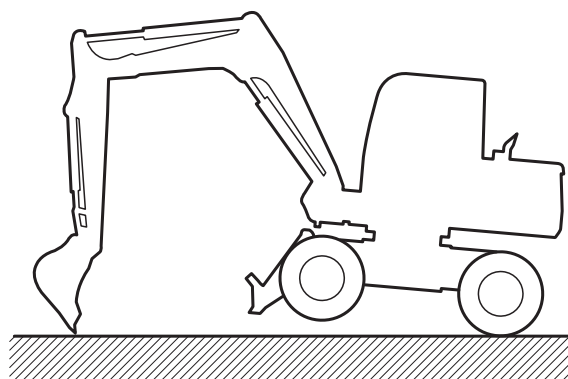
At this time, if there is oil leaking from the piping of the cylinder where the hose was disconnected, and if the boom cylinder's rod is retracted, the cylinder is leaking internally. Also, if there is no leakage of oil from the cylinder's piping, if the boom cylinder's rod is retracted, the control valve is leaking internally.



W1-E006

Boom Cylinder Internal Leakage Inspect (2)

- a. Place the machine in the posture shown in the figure.



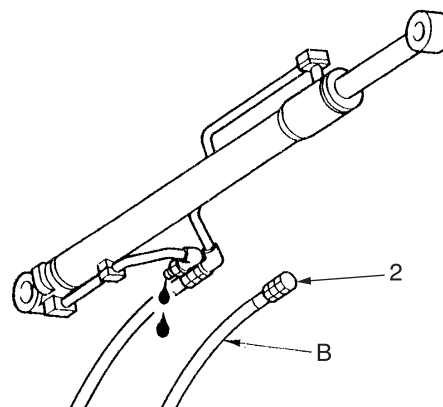
W1-E008



## TROUBLESHOOTING

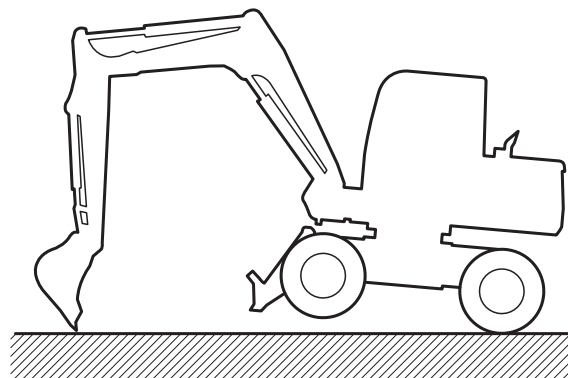
## BOOM

- b. Disconnect the head side hose (B) and let the hydraulic oil out of the cylinder's piping. Insert a plug (2) in the disconnected hose.
- Test the left and right cylinders one at a time. Remove both hoses from the cylinder that is not being inspected at this time and plug the disconnected hoses.



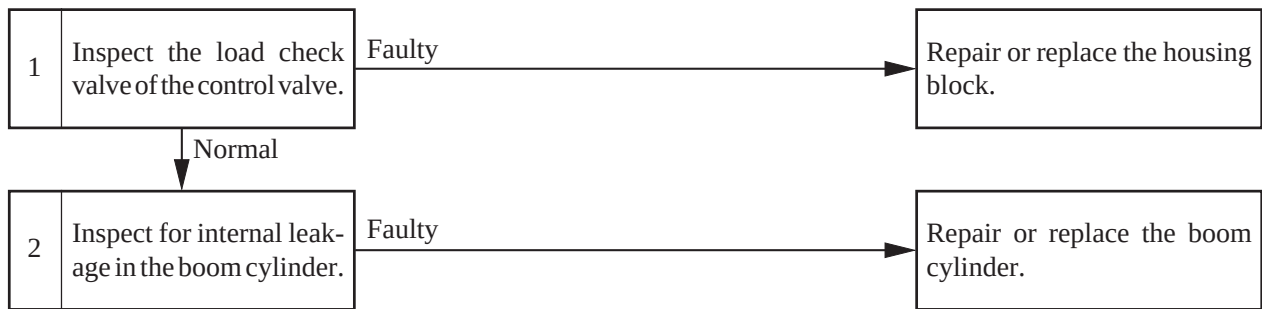
L3E009

- c. Operate the bucket and raise the machine's body.
- At this time, if there is oil leaking from the piping of the cylinder where the hose was disconnected, and if the boom cylinder's rod is extended, the cylinder is leaking internally. Also, if there is no leakage of oil from the cylinder's piping, if the boom cylinder's rod is extended, the control valve is leaking internally.



W1-E008

If the cylinder is damaged internally, the system should be flushed out to remove any broken pieces (NAS Class 9).

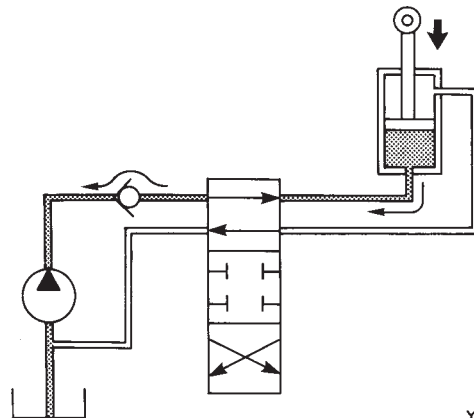
**WHEN THE BOOM OPERATION LEVER IS PULLED GENTLY, THE BOOM DROPS TEMPORARILY.**

1. Inspect the load check valve of the control valve.
  - a. Disconnect the hose between the control valve and boom cylinder at the control valve side.
  - b. Connect the disconnected hose to the arm or bucket section.
  - c. Try operating the boom cylinder.
 If operation is normal, the load check valve is faulty.

Place the machine in the following posture when performing the operation in "a~c" above.

- The bucket cylinder should be fully extended, the arm cylinder should be fully retracted and the bucket should be lowered to the ground.

Reference: When the spool first starts to pull, the oil's pressure and flow are small, so if the load check valve is faulty, it causes a load to bear on the boom cylinder, which causes the oil to flow backwards for a time. For this reason, the boom will drop temporarily.

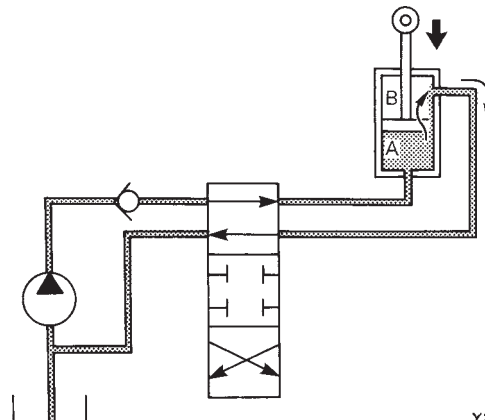


Y2-E310

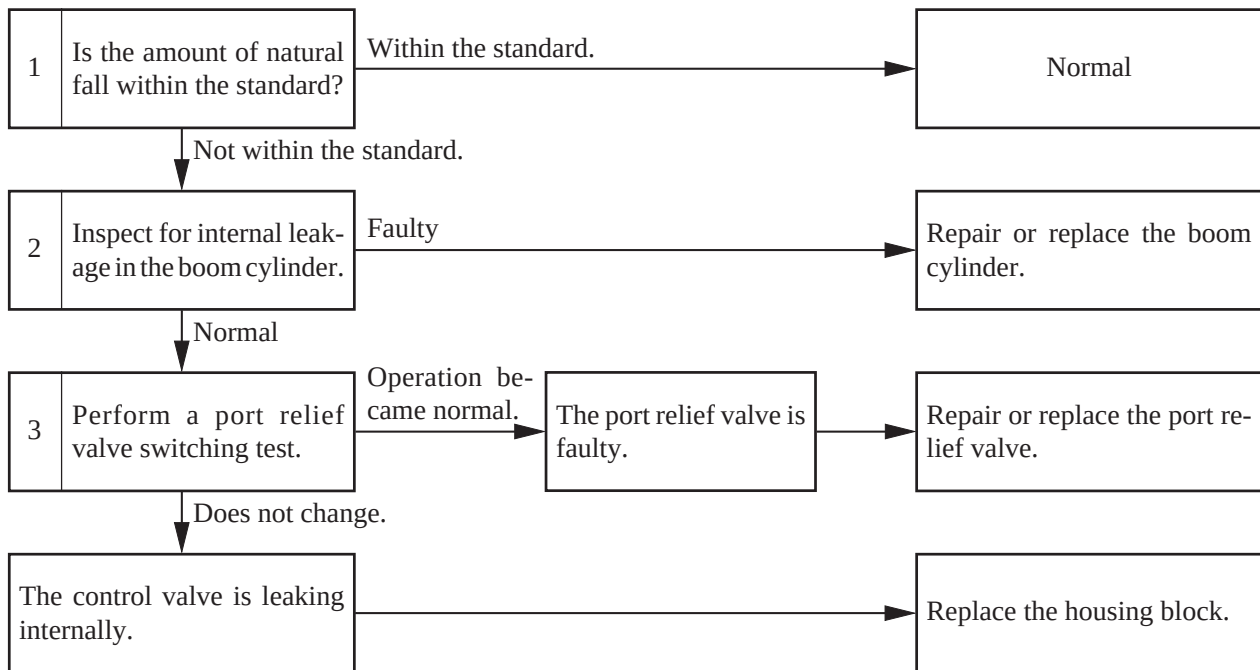
2. Inspect for internal leakage in the boom cylinder.

When the boom cylinder's piston or tube is faulty, if oil is leaking from the head side (A) to the rod side (B), since the oil's pressure and flow are low when the spool first starts pulling, the boom cylinder will drop temporarily. Also, the cylinder will have inadequate driving force. However, in this case as well, the amount of natural drop will be great.

- Cylinder Inspect  
☞ "V-23~24"

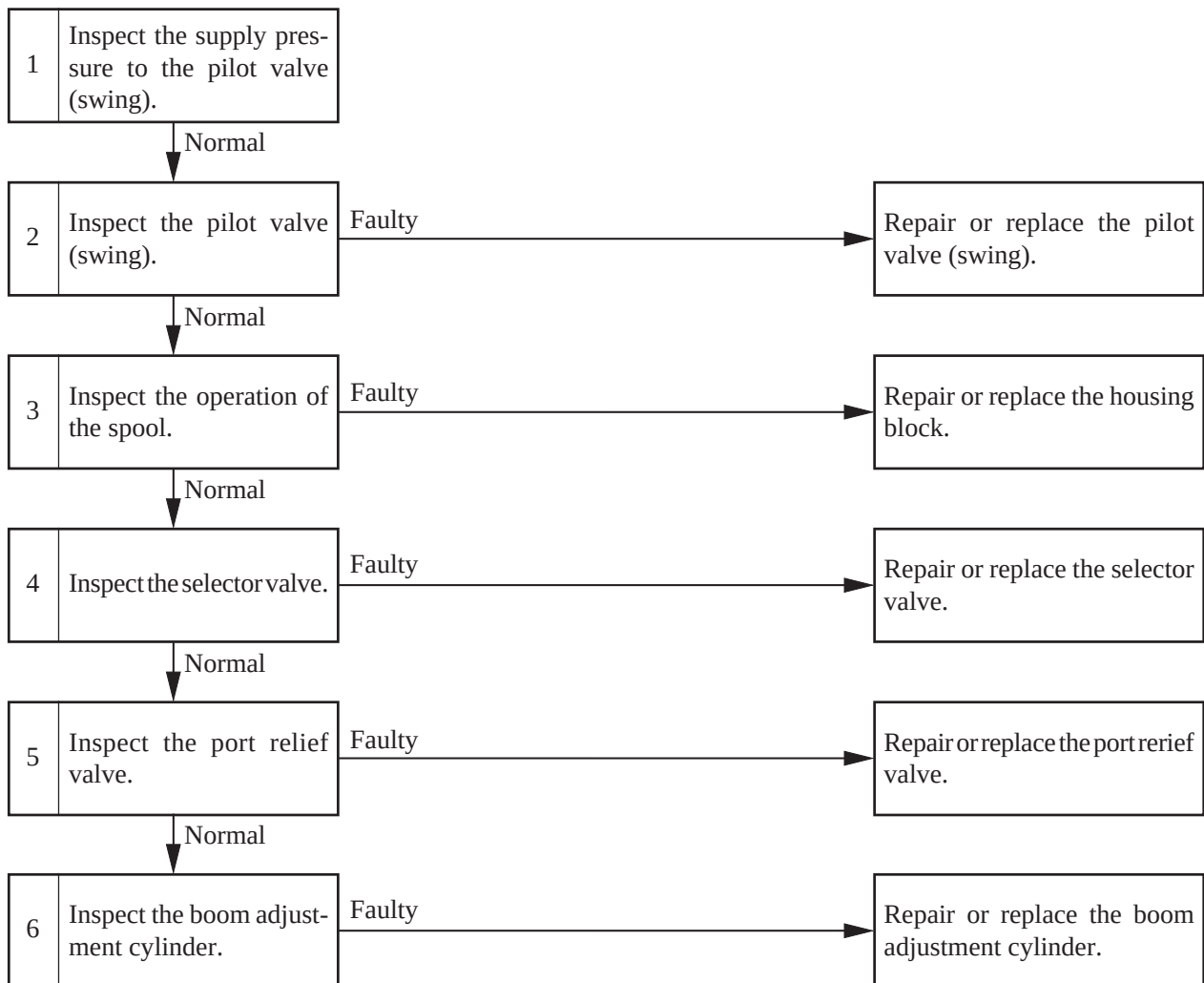


Y2-E311

**THE AMOUNT OF BOOM NATURAL DROP IS GREAT.**

1. Is the amount of natural drop within the standard?  
☞ “II. Specifications, Standards for Judging Performance”
2. Inspect for internal leakage in the boom cylinder.  
☞ “V-23~24”
3. Perform a port relief valve switching test.  
☞ “V-21”



**THE BOOM ADJUSTMENT CYLINDER DOESN'T MOVE.**

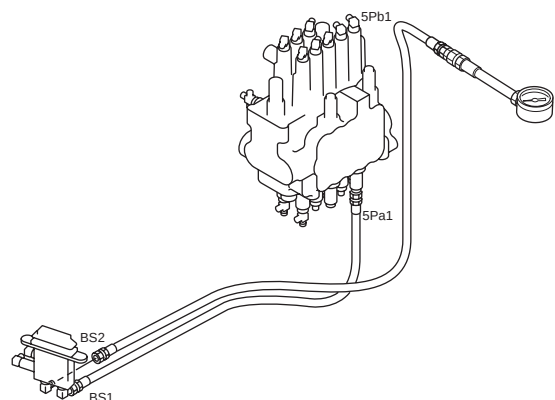
1. Inspect the supply pressure to the pilot valve (swing).

☞ “V-7~8”

2. Inspect the pilot valve (swing).

Disconnect the hose between the pilot valve (swing) and control valve on the control valve side, then set a pressure gauge in the disconnected hose.

- Operate the boom swing pedal and measure the pressure.
- Depending the operation angle, if the pressure is normal, it will range between 0~3.4 MPa.



W2E007

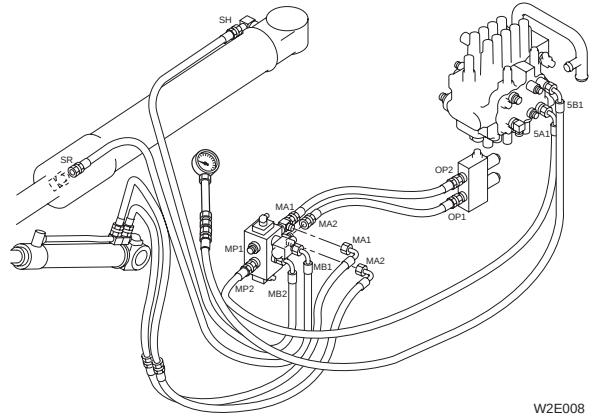
## TROUBLESHOOTING

## BOOM

### 3. Inspect the operation of the spool.

Disconnect the hose between the control valve (swing section) and the selector valve on the selector valve side, then set a pressure gauge in the disconnected hose.

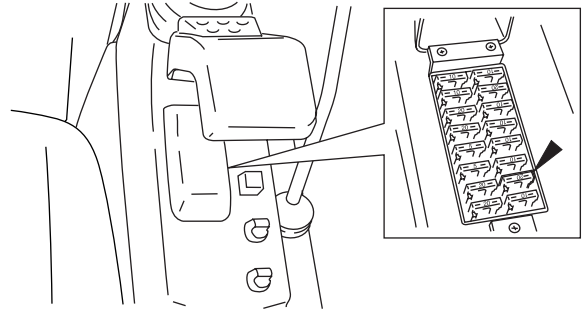
- Operate the boom swing pedal and measure the pressure.
- A pressure of 27.5 MPa is normal.



### 4. Inspect the selector valve.

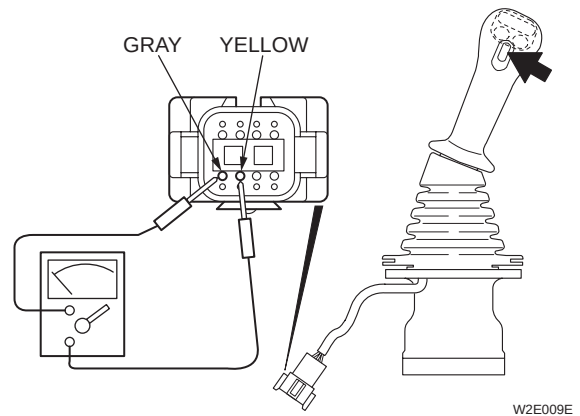
#### a. Inspect the fuse.

Operate the solenoid valve and check the fuse for the power supply circuit.



#### b. Inspect the selector switch.

Press the selector switch to turn it "ON". While it is in this condition, check if there is continuity with a tester.

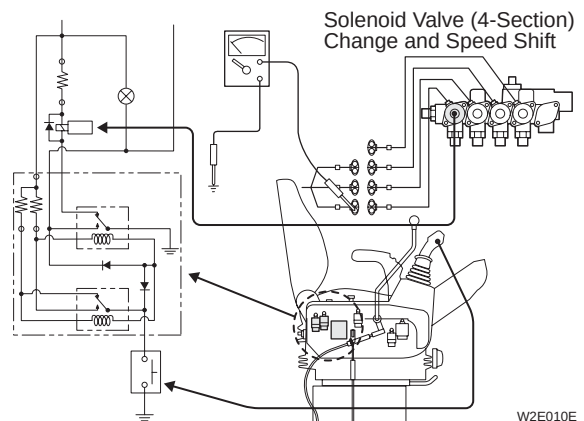


#### c. Inspect the relay.

Press the selector switch to turn the relay to "ON". Check whether the voltage is applied to the solenoid valve by using a tester. Be sure to stop the engine before starting the inspection.

#### d. Inspect the solenoid valve.

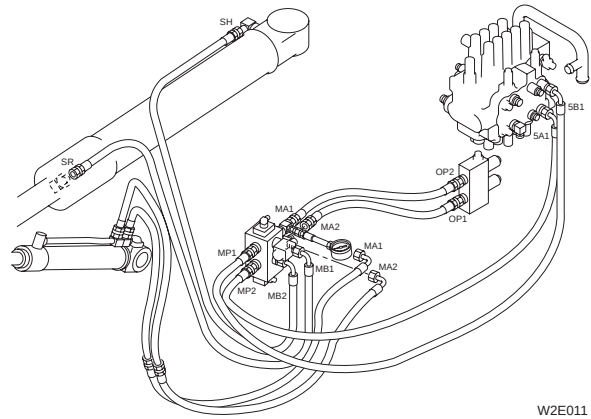
☞ "IV. Hydraulic Units, Solenoid Valves, Swing/Adjust Cange"



## BOOM

## TROUBLESHOOTING

- e. Inspect the operation of the spool.
- Disconnect the hose between the selector valve and the cylinder on the selector valve side, then set a pressure gauge in the disconnected hose.
- Operate the boom swing pedal and measure the pressure.
  - A pressure of 33.3 MPa is normal.



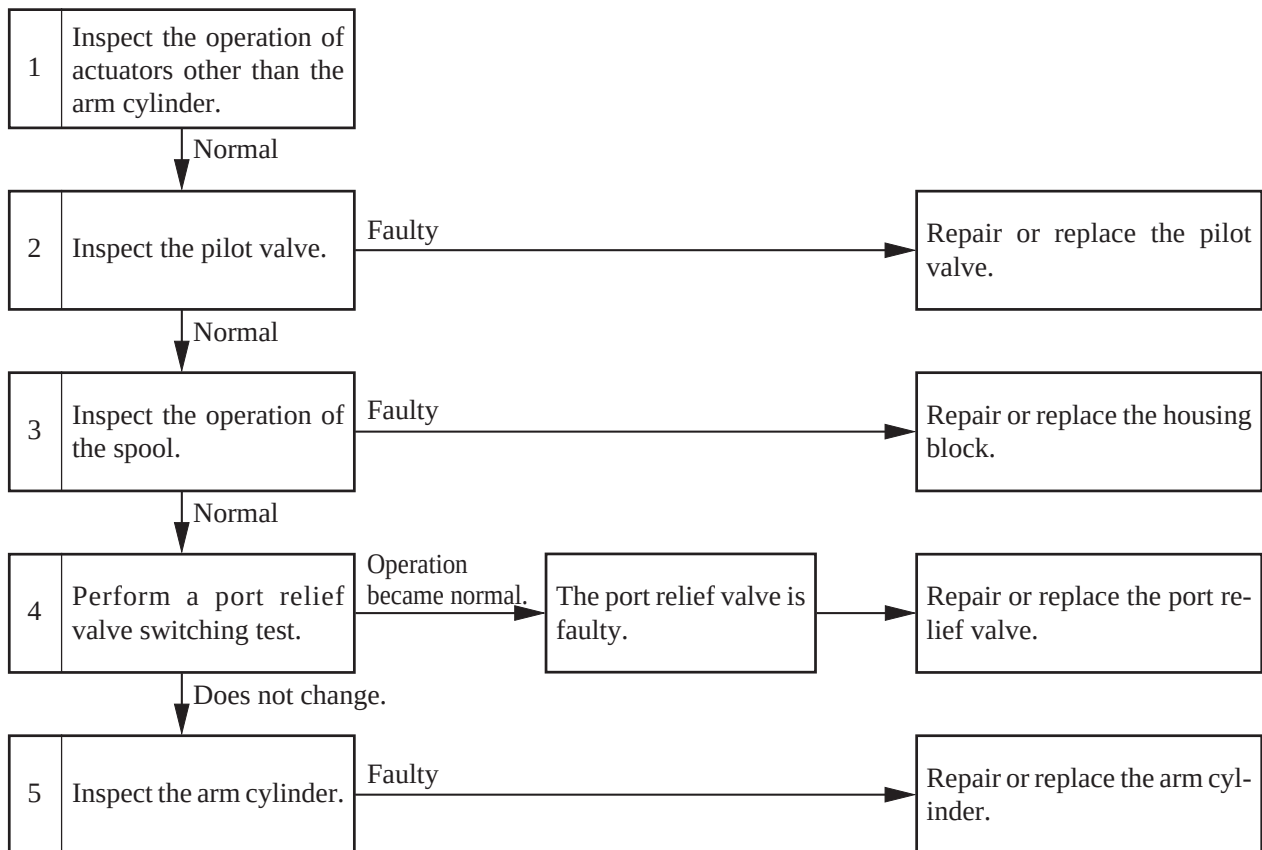
W2E011

5. Inspect the port relief valve.  
☞ “IV. Hydraulic Units, Port Relief Valve”
6. Inspect the boom adjustment cylinder.  
☞ “IV. Hydraulic Units, Cylinders”



## TROUBLESHOOTING

## ARM

**THE ARM CYLINDER DOESN'T MOVE.**

1. Inspect the operation of actuators other than the arm cylinder.

Inspect if the operation of the arm only is faulty by the table at right. If operation is faulty, inspect the main relief valve and the hydraulic pump.

☞ “V-6”

2. Inspect the pilot valve.

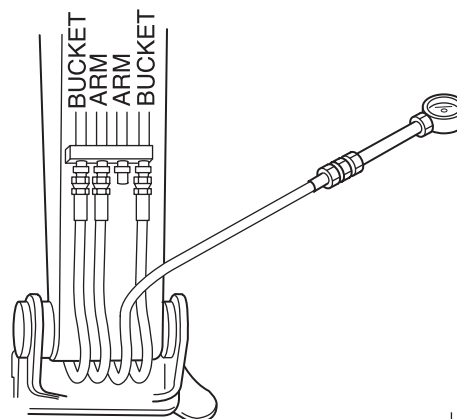
☞ “V-21”

| Lever Operated | Places inspected |         |
|----------------|------------------|---------|
| Swing          | Relief Valve R1  | Pump P2 |

3. Inspect the operation of the spool.

Disconnect the arm hose connected to the pipe at the boom foot, then set a pressure gauge in the disconnected hose.

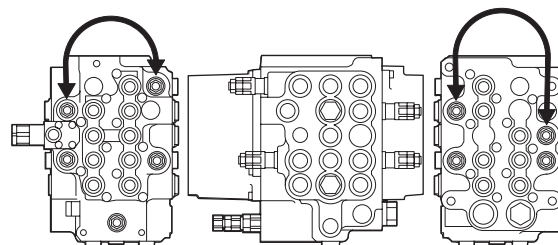
- Operate the (arm) lever and measure the pressure.
- If the pressure is 27.5 MPa, it is normal.



L3E010E

4. Perform a port relief valve switching test.

Switch the port relief valve with that of the normal boom. If the arm cylinder then operates, the port relief valve is faulty.



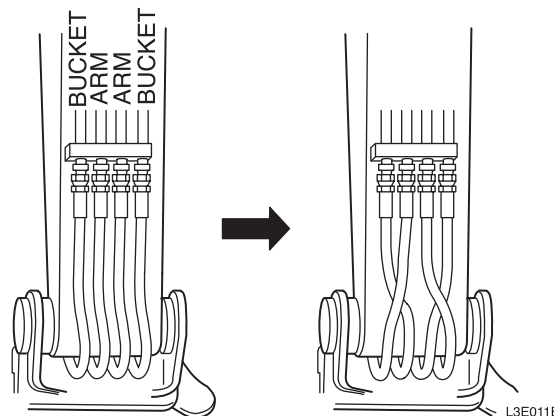
W2E006

5. Inspect the arm cylinder.

Switch the arm hoses and bucket hoses connected to the pipes at the boom foot.

- Try operating the (bucket) operation lever to operate the arm cylinder.
- If the cylinder doesn't operate, the cylinder is faulty.

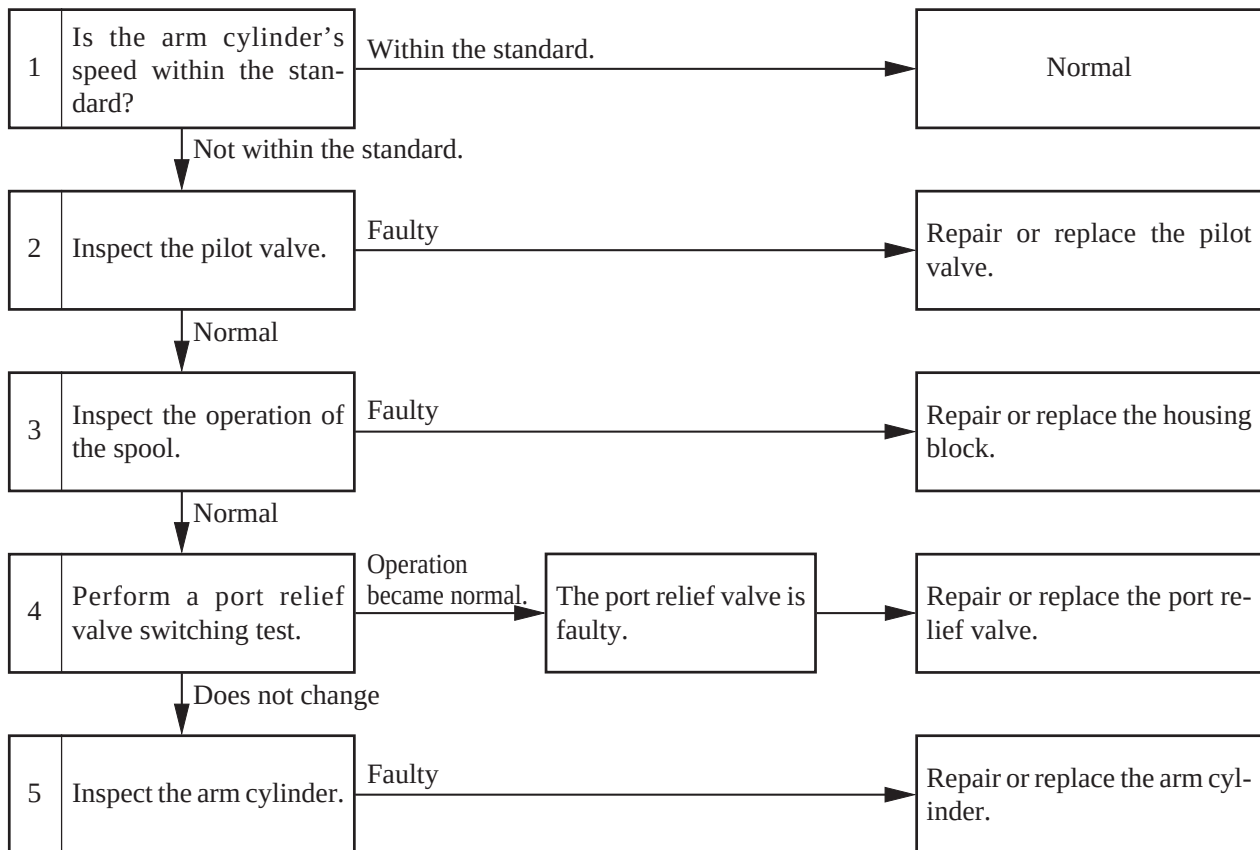
When performing the operation above, the bucket cylinder should be fully extended, the arm cylinder should be fully retracted, and the bucket should be lowered to the ground.



L3E011E

## TROUBLESHOOTING

ARM

**ARM CYLINDER OPERATION IS SLOW, OR THERE IS NO POWER.**

1. Is the arm cylinder's speed within the standard?

☞ “II. Specifications, Standards for Judging Performance”

2. Inspect the pilot valve.

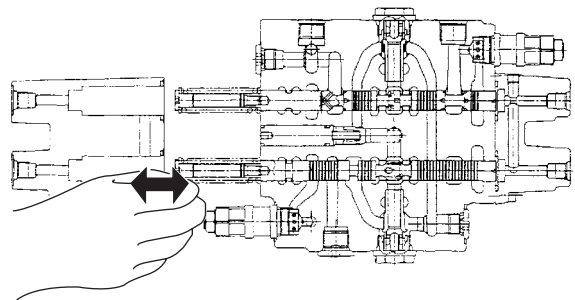
☞ “V-21”

3. Inspect the operation of the spool.

Stroke the spools of the boom [1] and boom [2] sections and inspect whether they move smoothly, or remove the spools and check whether there is any foreign matter engaged in them.

4. Perform a port relief valve switching test.

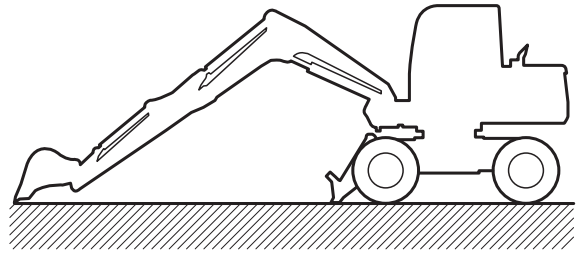
☞ “V-21”



L3E012

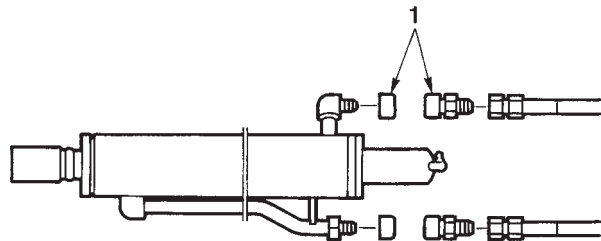


5. Inspect the arm cylinder.
  - a. Fully retract the bucket cylinder, fully retract the arm cylinder and lower the bucket to the ground.



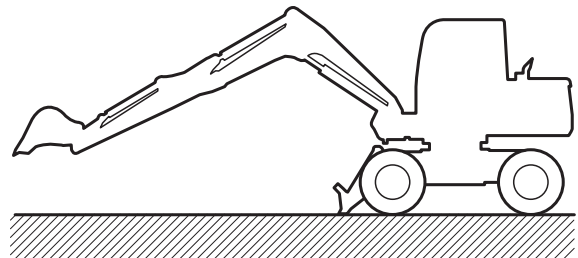
W1-E005

- b. Disconnect the two hoses connected to the cylinder. Insert plugs (1) in the disconnected hoses and the cylinder piping.



C3-E401

- c. Raise the boom and raise the hoe attachment so it floats above the ground. If the arm drops, the cylinder is faulty. If the arm does not drop, there is leakage inside the control valve.

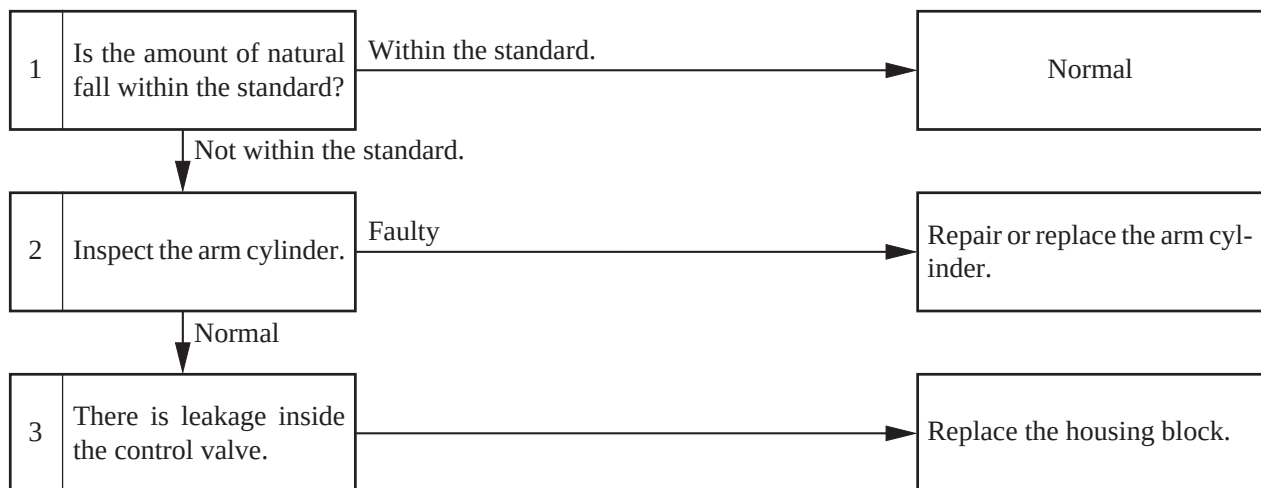


W1-E006

## TROUBLESHOOTING

ARM

### THE AMOUNT OF ARM NATURAL DROP IS GREAT.

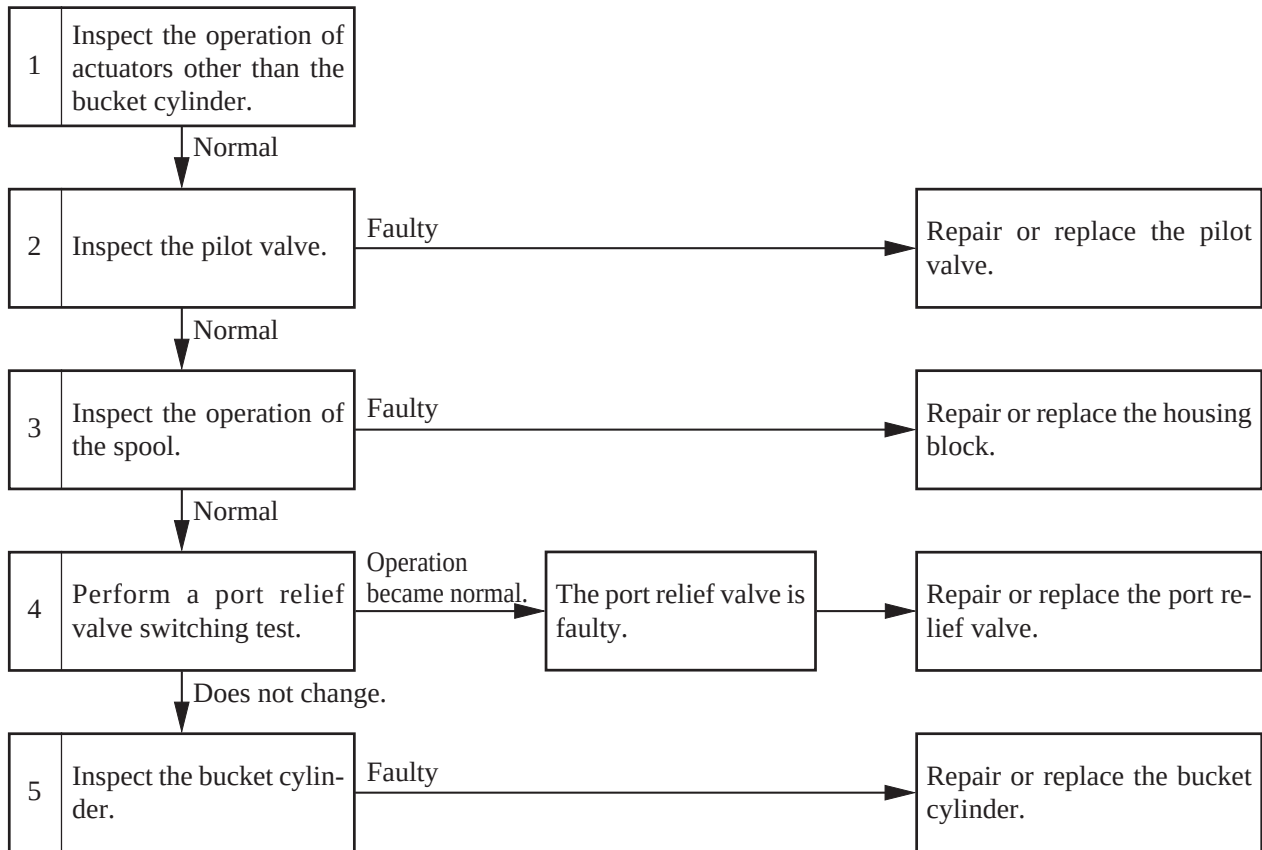


1. Is the amount of natural fall within the standard?

☞ “II. Specifications, Standards for Judging Performance”

2. Inspect the arm cylinder.

☞ “V-31”

**THE BUCKET CYLINDER DOESN'T MOVE, OR THERE IS NO POWER.**

1. Inspect the operation of actuators other than the bucket cylinder.

Inspect if the operation of the bucket only is faulty by the table at right. If operation is faulty, inspect the main relief valve and the hydraulic pump.

☞ “V-6”

2. Inspect the pilot valve.

☞ “V-21”

3. Inspect the operation of the spool.

☞ “V-21”

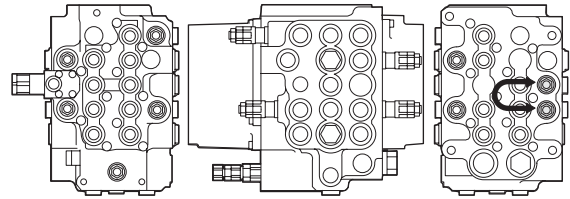
| Lever Operated | Places inspected |         |
|----------------|------------------|---------|
| Boom           | Relief Valve R1  | Pump P1 |



## TROUBLESHOOTING

## BUCKET

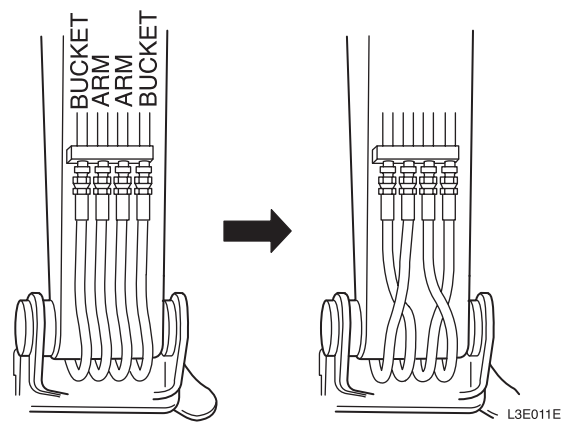
4. Perform a port relief valve switching test.  
When only “bucket load” side is inoperable:  
Replace the port relief valve with that of the normal boom, and test. If the bucket cylinder operates, the replaced old port relief valve was faulty.

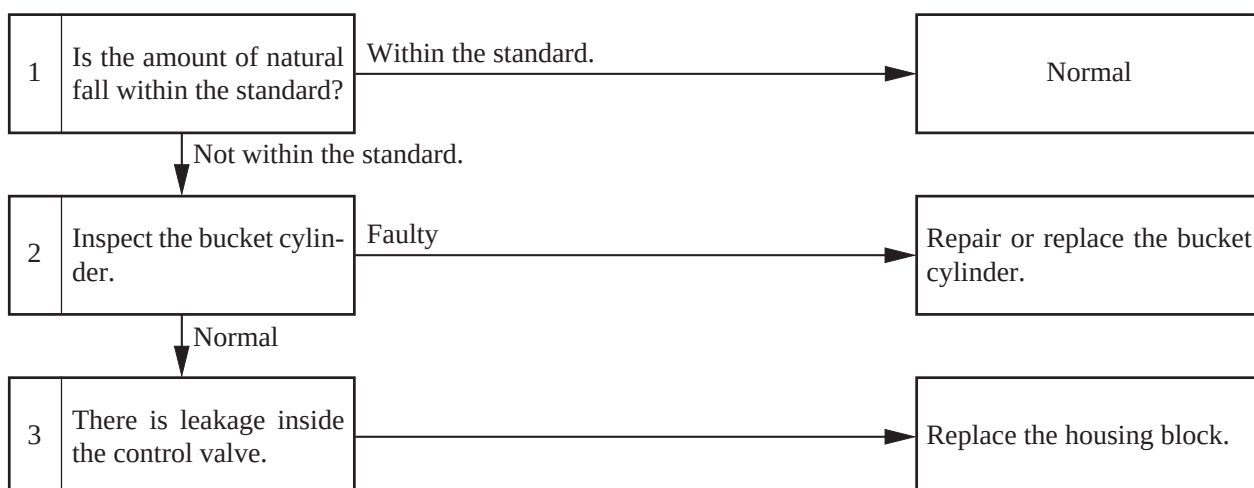


W2E012

5. Inspect the bucket cylinder.
- At the boom foot, exchange the arm hose with the bucket hose that is connected to the pipe.
- Move the lever (arm) and check whether the bucket cylinder operates.
  - If the bucket cylinder does not operate, the bucket cylinder is faulty.

This inspection should be done with the bucket cylinder fully extended and the arm cylinder fully retracted. Also, the bucket must be lowered to the ground.



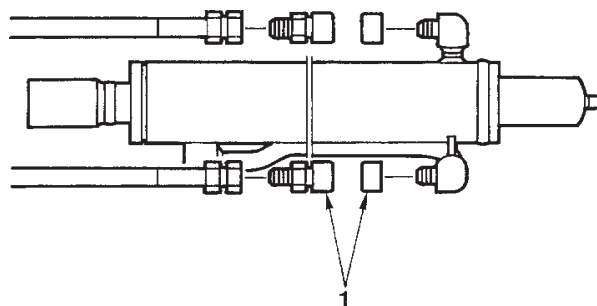
**THE AMOUNT OF BUCKET NATURAL DROP IS GREAT.**

1. Is the amount of natural drop within the standard?

☞ “II, Specifications, Standards for Judging Performance”

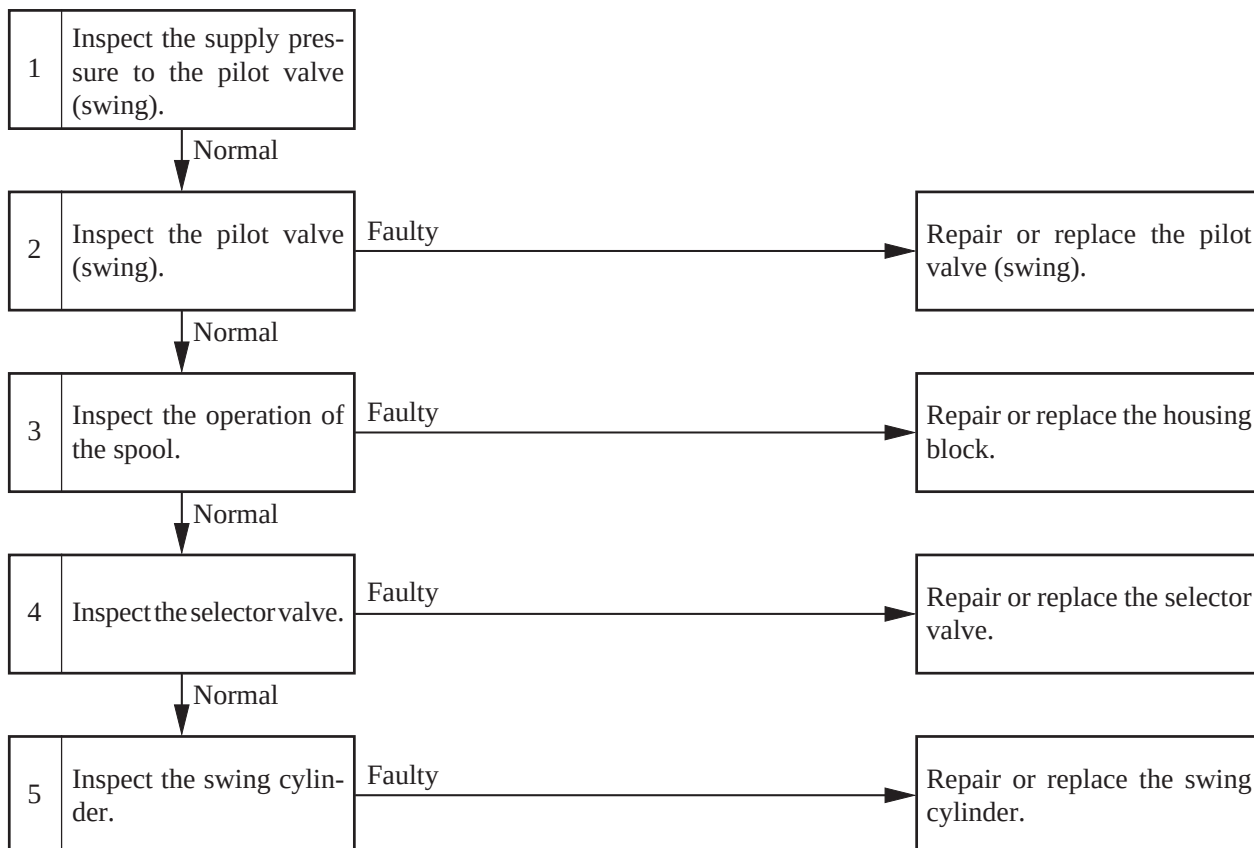
2. Inspect the bucket cylinder.

- a. Fully extend the bucket cylinder, fully retract the arm cylinder and lower the bucket to the ground,
- b. Disconnect the 2 hoses connected to the cylinder.  
Insert the plugs (1) in the disconnected hoses and the piping.



C3-E501

- c. Raise the boom and raise the hoe attachment so that it floats above the ground, If the bucket drops, the cylinder is faulty, If the bucket does not drop, there is leakage inside the control valve.

**THE SWING CYLINDER DOESN'T MOVE.****2-Piece Boom**

1. Inspect the supply pressure to the pilot valve (swing).

☞ “V-7~8”

2. Inspect the pilot valve (swing).

☞ “V-27”

3. Inspect the operation of the spool.

☞ “V-28”

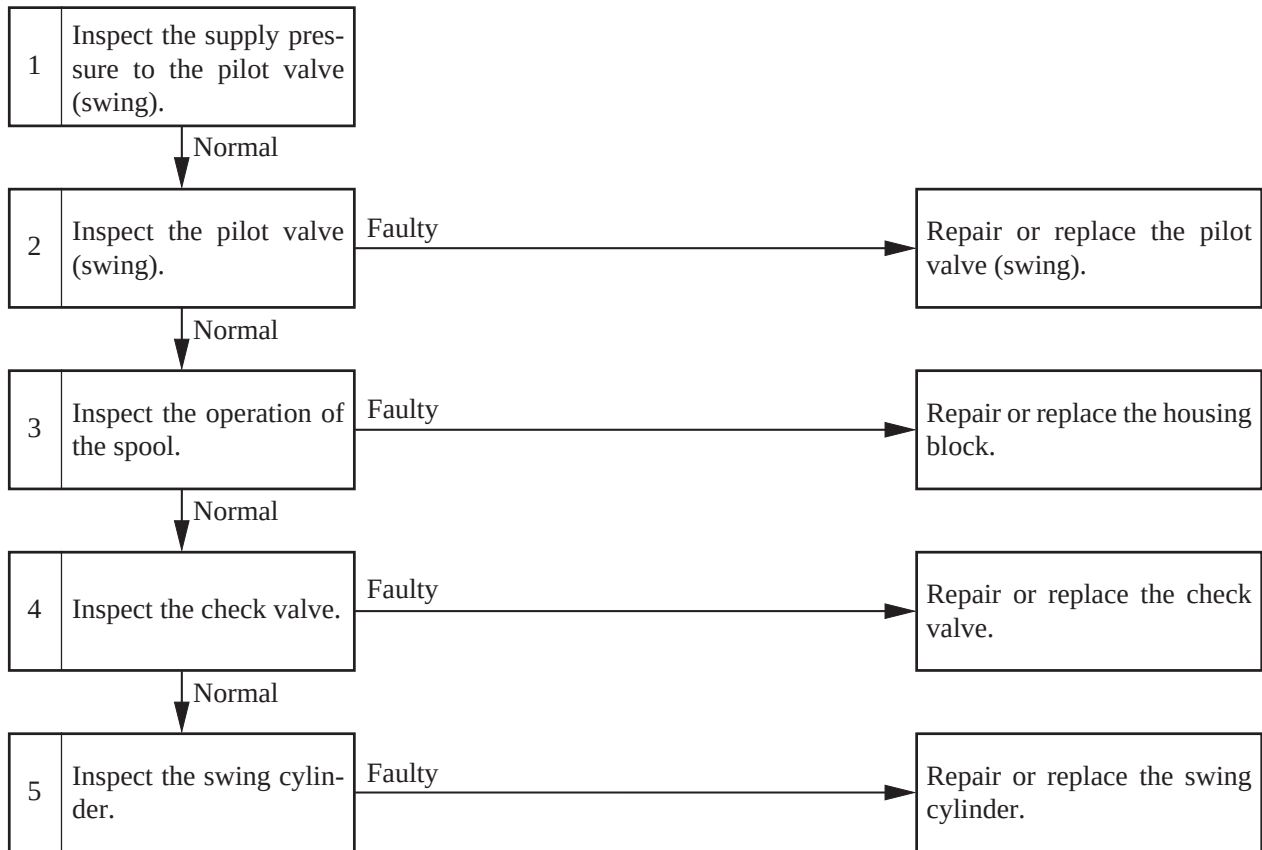
4. Inspect the selector valve.

☞ “V-28~29”

5. Inspect the swing cylinder.

☞ “IV. Hydraulic Units, Cylinders”



**Mono Boom**

1. Inspect the supply pressure to the pilot valve (swing).

☞ “V-7~8”

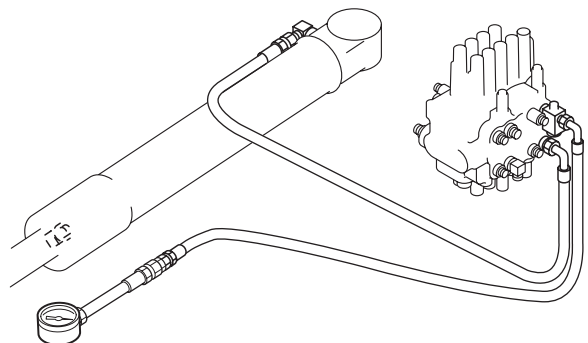
2. Inspect the pilot valve (swing).

☞ “V-27”

3. Inspect the operation of the spool.

Disconnect the hose between the control valve (swing section) and the cylinder on the cylinder side, then set a pressure gauge in the disconnected hose.

- Operate the boom swing pedal and measure the pressure.
- A pressure of 27.5 MPa is normal.

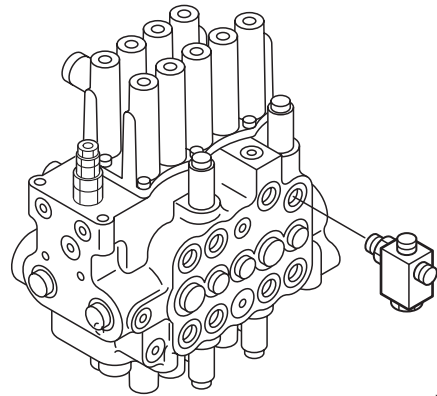


L3E016

## TROUBLESHOOTING

## BOOM SWING

4. Inspect the check valve.  
If right swing cannot be done, then foreign matter is caught in the check valve or the valve is sticking.
5. Inspect the swing cylinder.  
☞ “IV. Hydraulic Units, Cylinders”



W2E013

## VI . ENGINE

| Machine Model | Machine Serial No. | Mounted Engine |
|---------------|--------------------|----------------|
| TB175W        | 17540001~          | 4TNV98T        |



## ENGINE TROUBLE DIAGNOSTICS TOOL AND MAINTENANCE TOOL

### 1. Introduction

Our maintenance tools are designed to identify the causes of troubles so that machines can be quickly returned to normal. We also offer a tool to adjust the quantity of oil in the service port for machines with an optional attachment, to ensure safer maintenance work. These tools are offered only to the designated dealers, and are to be used by maintenance technicians with knowledge of computers, so the basic computer operations are not explained.

### 2. System overview

There are two main tools for maintenance: the engine trouble diagnostic tool provided by the engine manufacturer and the maintenance tool provided by Takeuchi. Some of our machines have a control computer which can be connected to a personal computer for communications, allowing computers to read or write data.

#### (1) Engine trouble diagnostic tool

This tool is used to diagnose troubles with the engine controller of machines with Tier 3-compliant engines and to flash the engine control data. It can be purchased from the engine manufacturer, Isuzu or Yanmar. Tier 3-compliant engines are electronically controlled by the Engine Control Unit (ECU) or Engine Control Module (ECM). These controllers use data specific to Tier 3-compliant and regulation-approved engines, and the trouble diagnostic tool is specifically designed for them; regular maintenance software for the controller intended for the whole machine cannot be used.

In case of trouble, the engine trouble diagnostic tool is used to display the error codes and states, from which the cause of trouble can be identified and action taken according to the engine manufacturer's manual.

To purchase the tool, contact our Sales or Parts department.

For details of the tool, read the user's manual of the manufacturer.

The maintenance software is permitted to be used only by licensed manufacturers and service dealers.

#### (2) Maintenance tool and maintenance software

This tool is used to read data from the machine controller and to adjust peripheral devices.

- Reading the error codes stored in the Takeuchi Electrical Control Unit (T-ECU)  
Past trouble details can be read or deleted.
  - \* For the details of error codes, refer to the manual included in the software CD and the maintenance manual.
- Reading the parameters and writing the modified data in the proportional amplifier for the service port  
The proportional output for the first/second auxiliary line can be modified.  
The operation speed of various attachments can be modified.
- It is possible to read each serial number and the software version of the controller connected to the device.  
The serial number of the controller is necessary for manufacturing management or for troubleshooting.

| Machine maintenance tool and trouble analysis tool |                    |                  |                   |                                      |        |                           |                      |                                                                                                                                               |
|----------------------------------------------------|--------------------|------------------|-------------------|--------------------------------------|--------|---------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Model                                              | Emission standards | Development code | Machine Ser. No.  | Engine manufacturer maintenance tool |        | Takeuchi maintenance tool |                      |                                                                                                                                               |
|                                                    |                    |                  |                   | Engine                               | Name   | Kit part No. *1           | Software CD part No. | Description of software                                                                                                                       |
| TB180FR                                            |                    | F14C             | 17830001 or later |                                      |        |                           |                      |                                                                                                                                               |
| TB153FR                                            |                    | F10C             | 15830001 or later |                                      |        | 17301-42800               | 17301-42700          | • T-ECU maintenance software                                                                                                                  |
|                                                    |                    | F10B             | 15820001 or later |                                      |        |                           |                      |                                                                                                                                               |
| TB1140                                             |                    | A25B             | 51410001 or later |                                      |        | 17301-42810               | 17301-42660          | • T-ECU maintenance software<br>• Maintenance software for the proportional amplifier of the service port                                     |
| TB1140                                             |                    | A25D             | 51430001 or later |                                      |        |                           |                      |                                                                                                                                               |
| TL240                                              | T-3                | L8B              | 22400001 or later | Yanmar                               | EDT    |                           |                      |                                                                                                                                               |
| TL230                                              | T-3                | L6B              | 22300001 or later | Yanmar                               | EDT    |                           |                      |                                                                                                                                               |
| TL220                                              | T-3                | L5B              | 22200001 or later | Yanmar                               | EDT    |                           |                      |                                                                                                                                               |
| TB180FR                                            | T-3                | F14E             | 17840001 or later | Yanmar                               | EDT    | 17301-42820               | 17301-42690          | • T-ECU maintenance software                                                                                                                  |
| TB175                                              | T-3                | A14E             | 17530001 or later | Yanmar                               | EDT    | 17301-42830               | 17301-42680          | • T-ECU maintenance software                                                                                                                  |
| TB175W                                             | T-3                | A14EW            | 17540001 or later |                                      |        |                           |                      |                                                                                                                                               |
| TB1140                                             | T-3                | A25C             | 51420001 or later | Isuzu                                | EMPS-3 | 17301-42840               | 17301-42670          | • T-ECU maintenance software<br>• Controller management software<br>• Maintenance software for the proportional amplifier of the service port |
| TB175                                              | T-3                | A14E Isuzu       | Monitor machines  | Isuzu                                | EMPS-3 | 17301-42850               | 17301-42710          | • T-ECU maintenance software<br>• Controller management software<br>• Maintenance software for the proportional amplifier of the service port |

\*1 The kit includes the USB cable assembly to be used to connect to the controller. (Part No.: 17301-42720)

T-ECU: Takeuchi-Electrical Control Unit (Takeuchi)

EDT: Engine Diagnostic Tool (Yanmar)

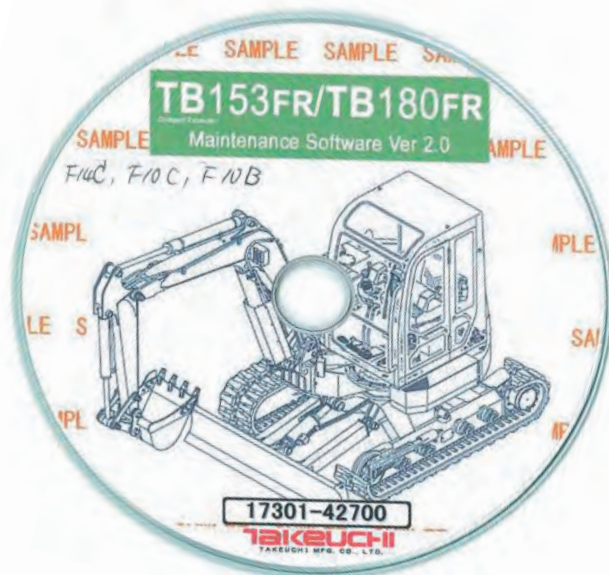
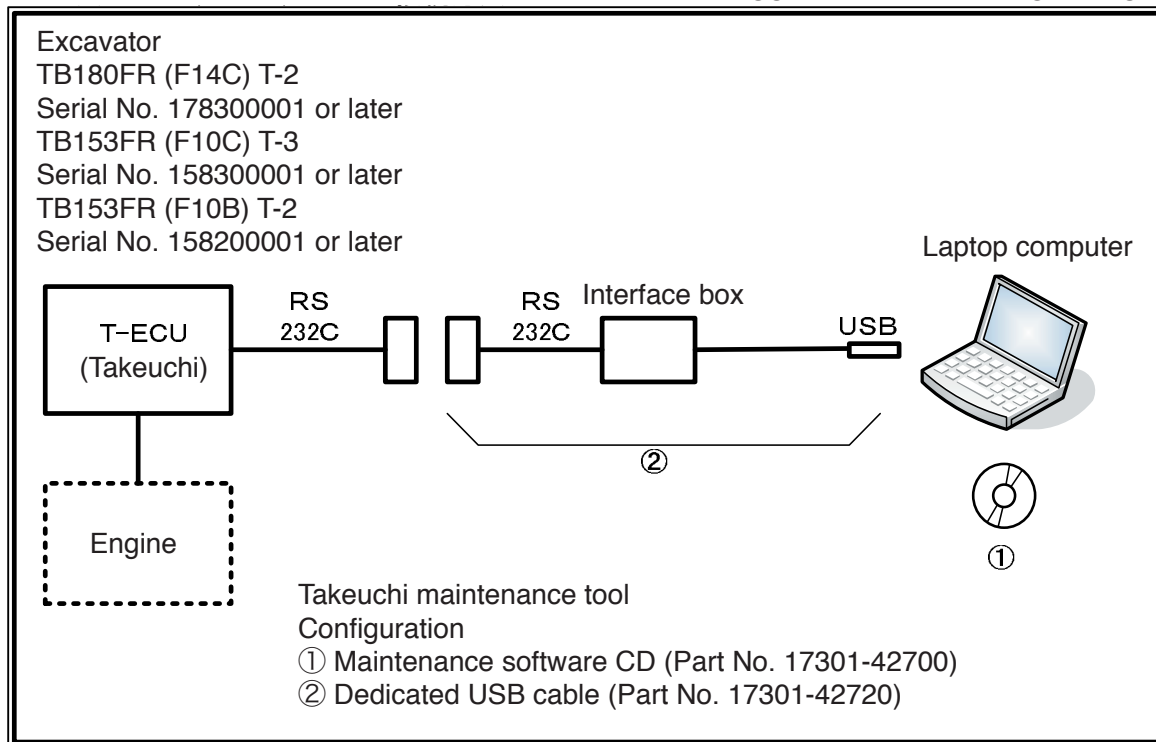
EMPS-3: Engine Module Programming System (Isuzu)

### 3. Controller connection diagram and system requirements

#### 3.1 Machines with standard engines

(1) Connection diagram for F14C, F10C and F10B

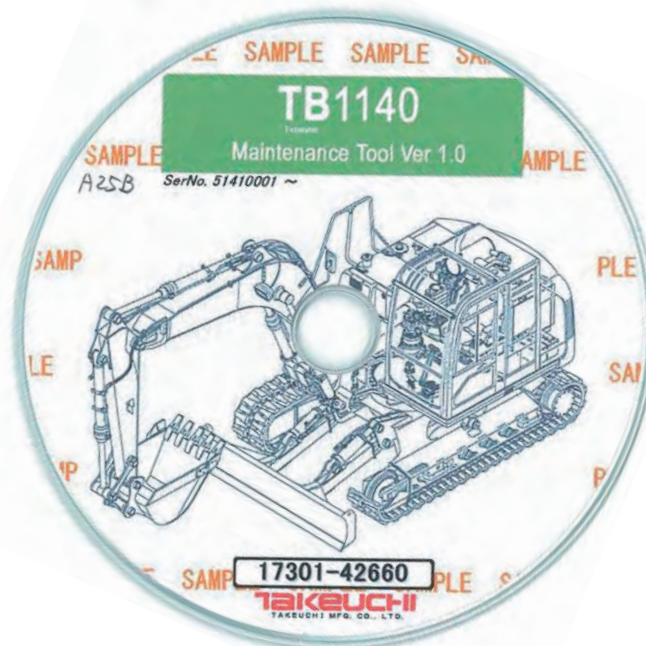
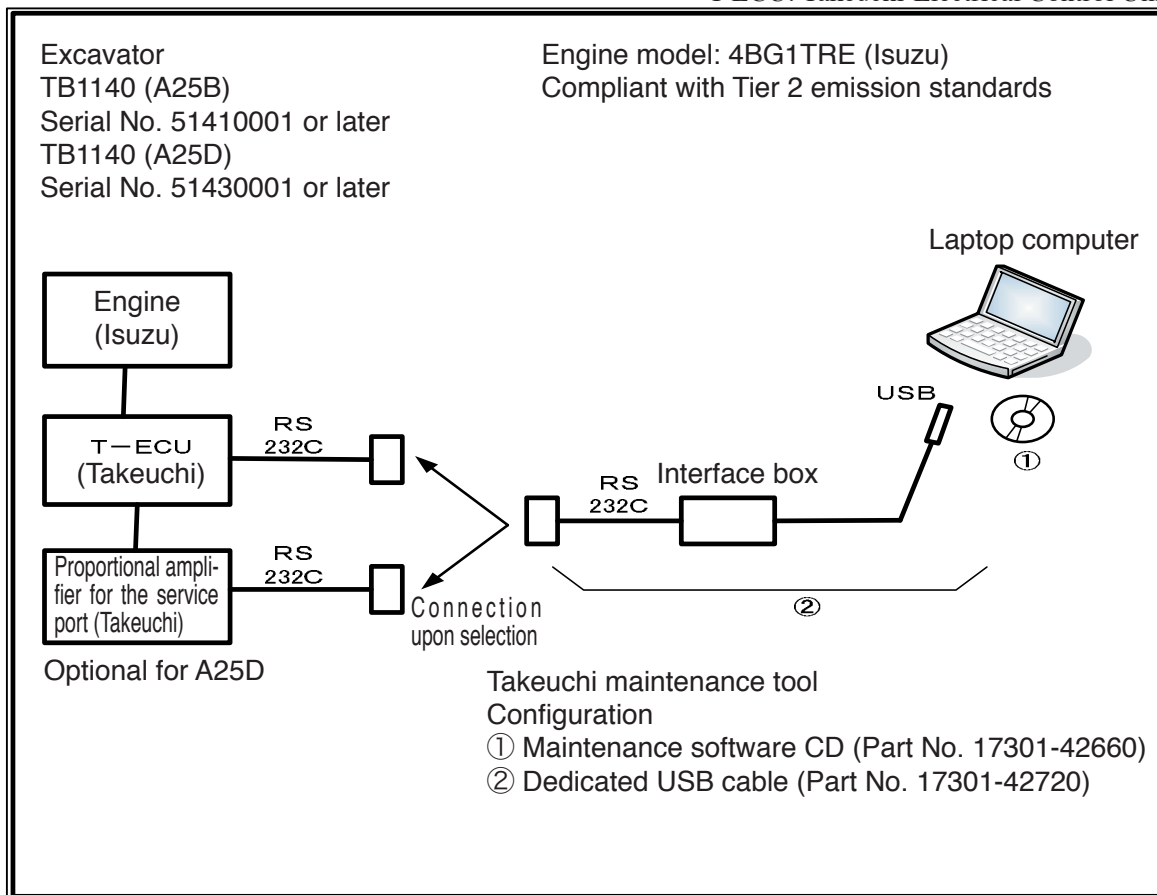
T-ECU: Takeuchi-Electrical Control Unit





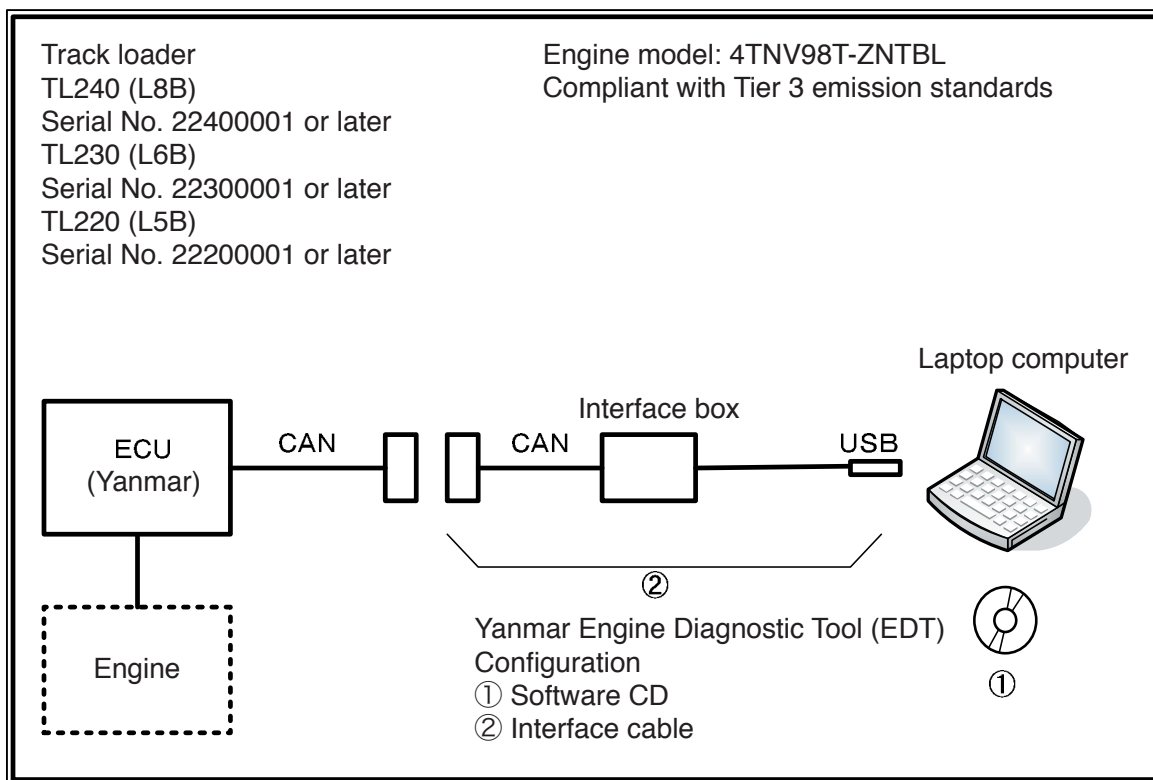
(2) Connection diagram for A25B and A25D

T-ECU: Takeuchi-Electrical Control Unit



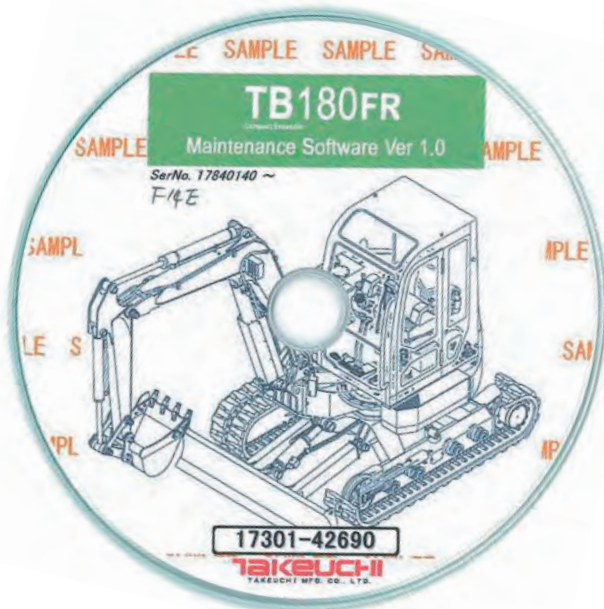
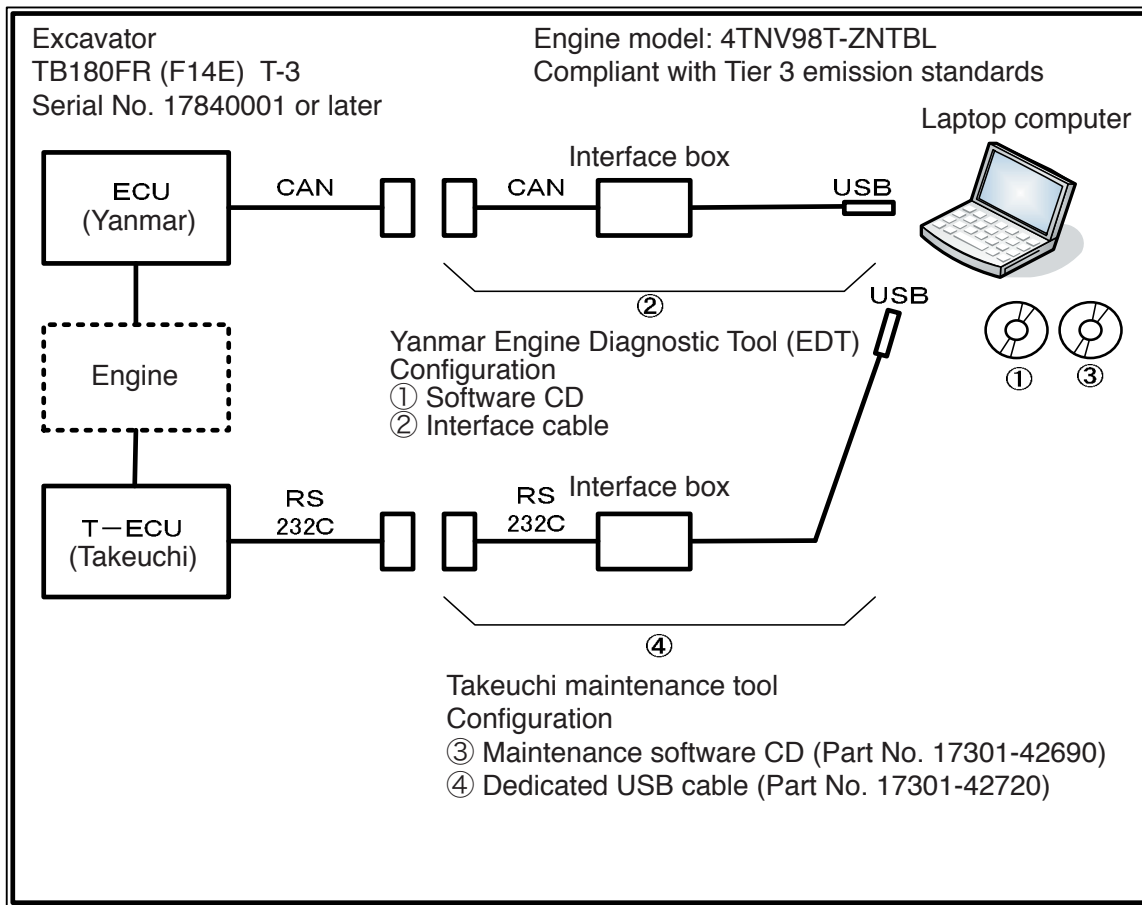
### 3.2 Machines with standard engines

#### (1) Connection diagram for TL240, TL230, and TL220



(2) Connection diagram for TB180FR

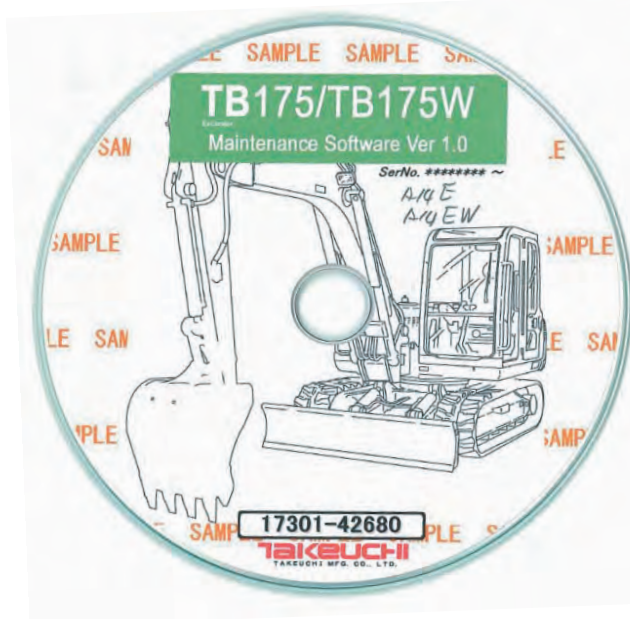
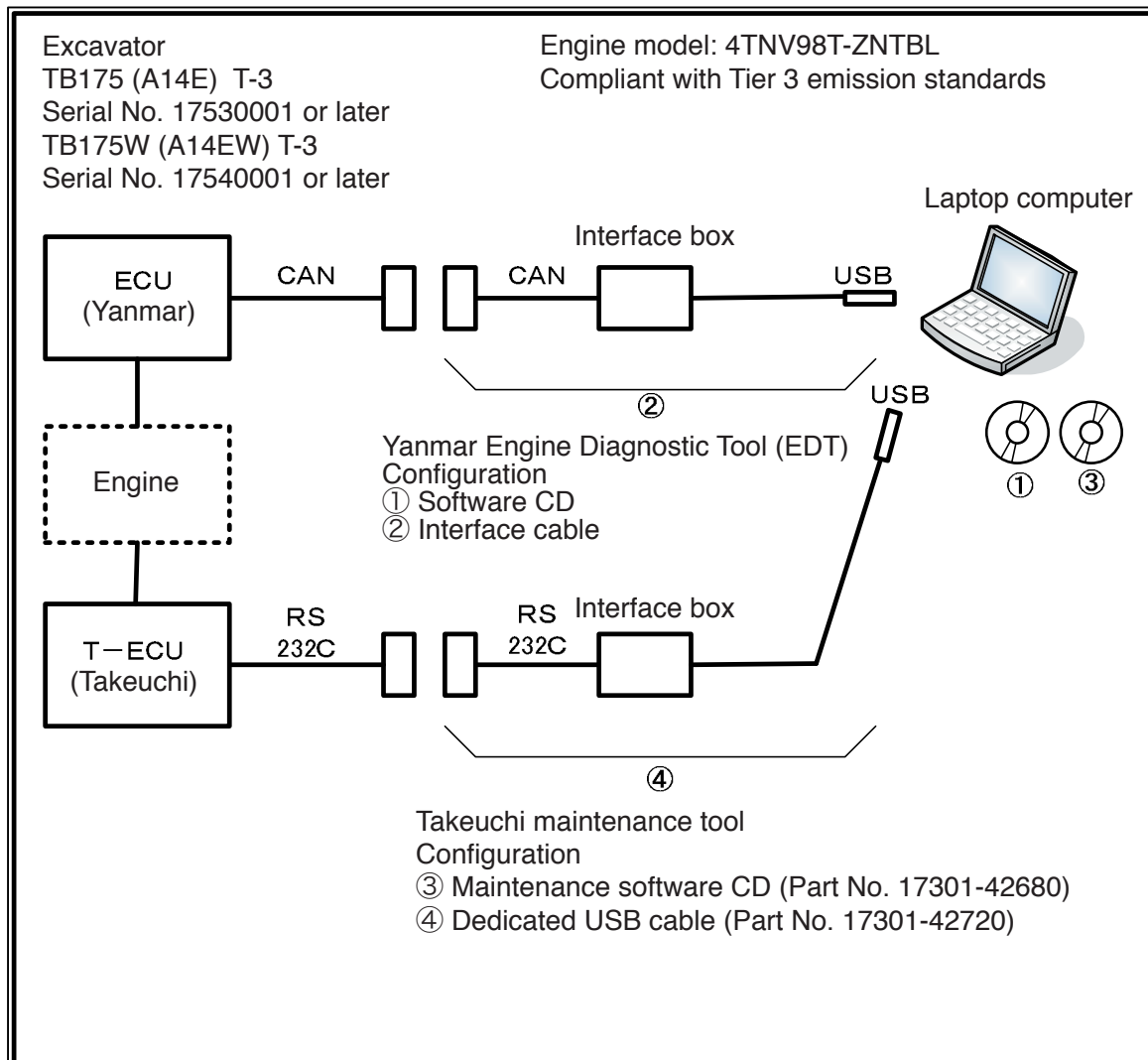
T-ECU: Takeuchi-Electrical Control Unit



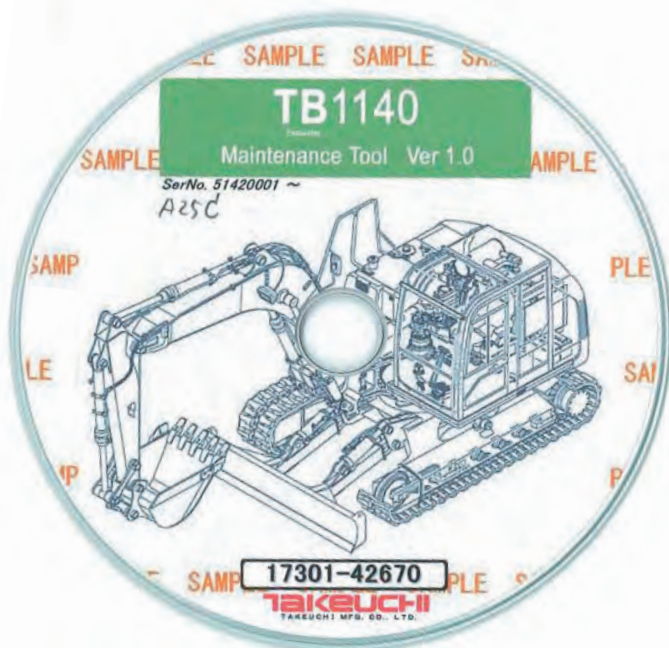


(3) Connection diagram for TB175 and TB175W

T-ECU: Takeuchi-Electrical Control Unit







## EMPS (Engine Module Programming System) Operating Instructions

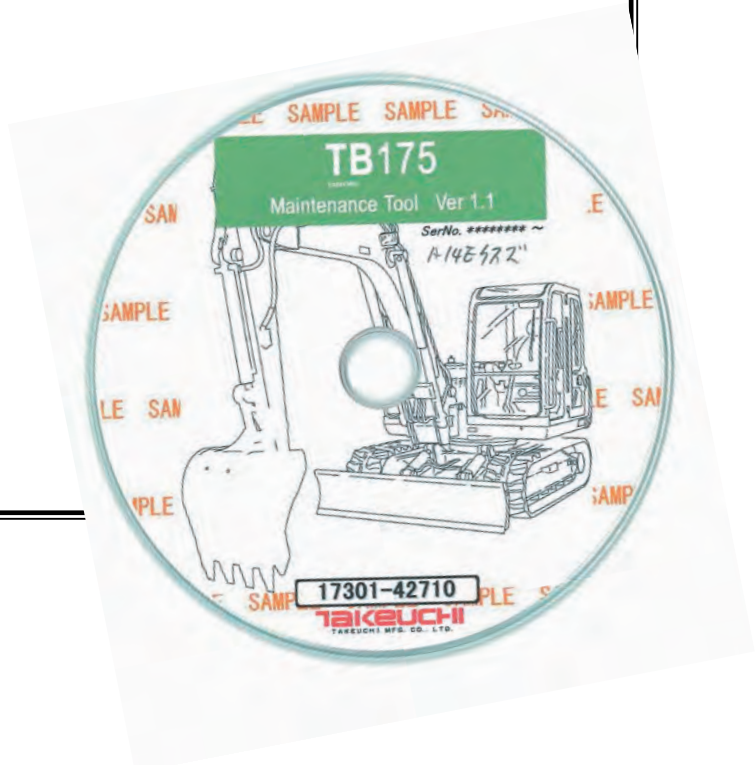
**EMPS III**  
Engine Module Programming System

2007.10.26

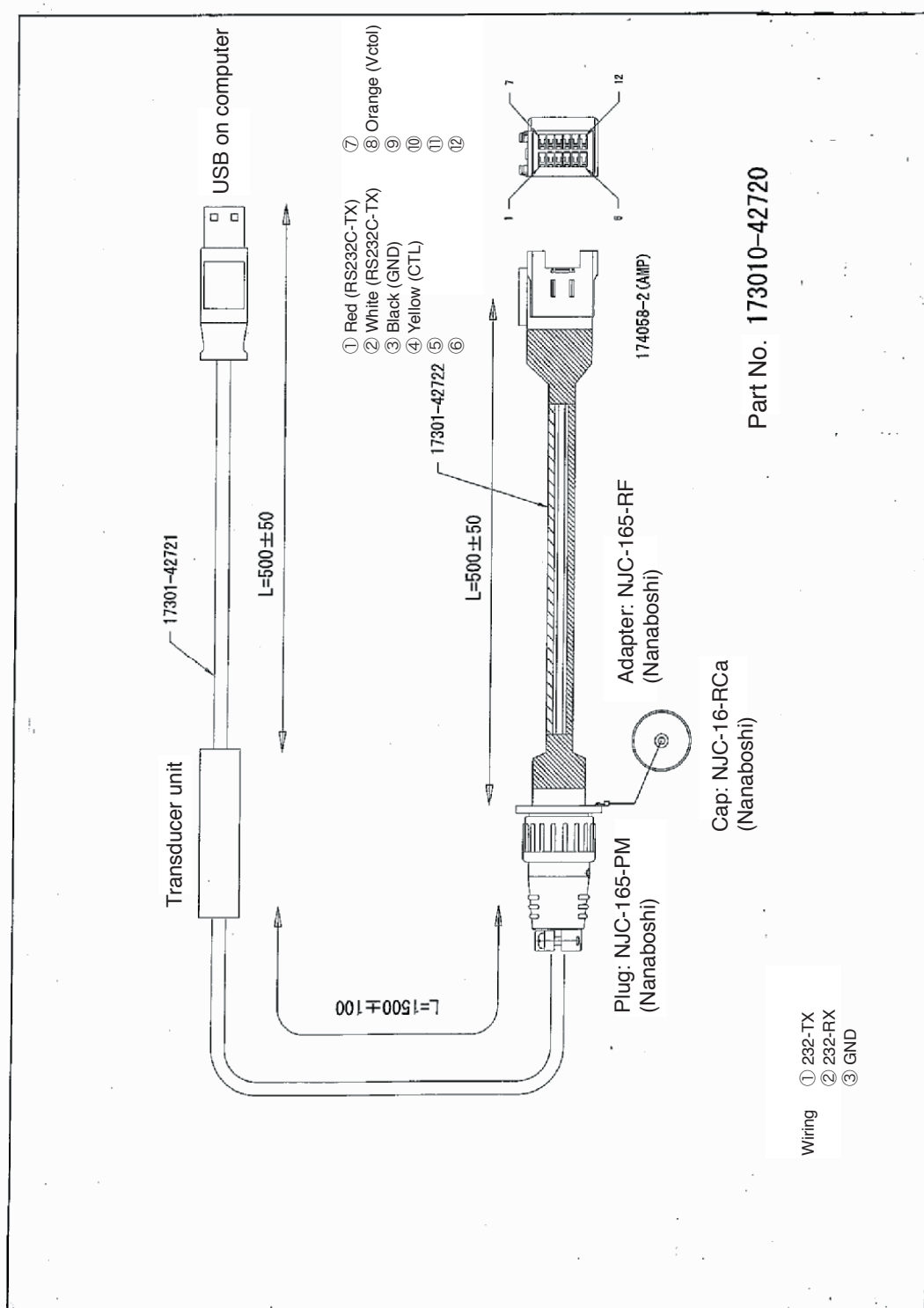
**ISUZU MOTORS LIMITED**  
Off-highway Powertrain Service  
Tokyo, Japan



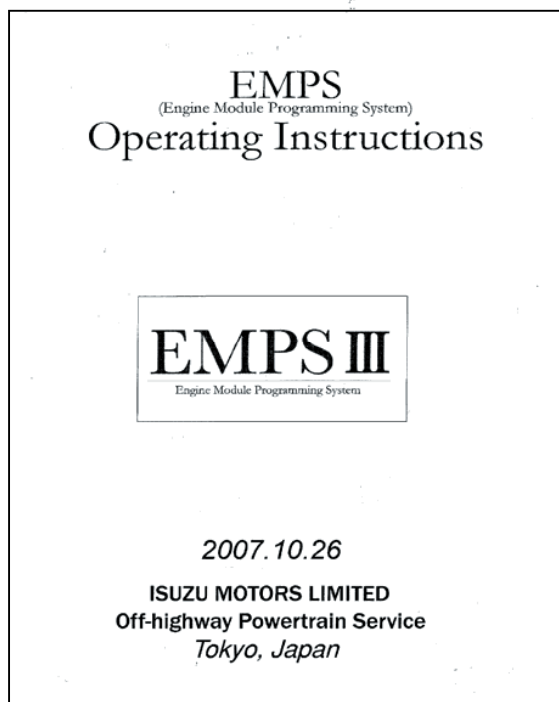




Dedicated USB cable connecting the computer and the connector on the machine



## Isuzu Engine Maintenance tool



**EMPSIII Component Parts**

**Name**

|                        |                  |
|------------------------|------------------|
| 1. Selector (Hardware) | 5. AC adapter    |
| 2. ECM cable           | 6. USB cable     |
| 3. Battery cable       | 7. RS-232C cable |
| 4. Datalink cable      | 8. EMPS CD-ROM   |

**Before the EMPSIII (software) Setup**

**Caution:**  
The ID (user name) and Password attached which are used to setup run EMPS, refer to the "Please Read This First" on the separate sheet. (The ID and Password are attached to the bottom of the sheet.) After EMPS setup is done, keep the paper for future reference.

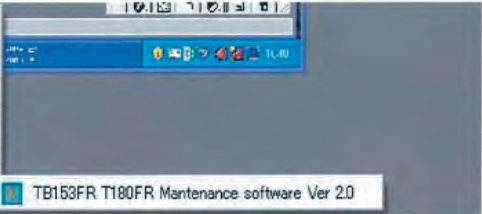
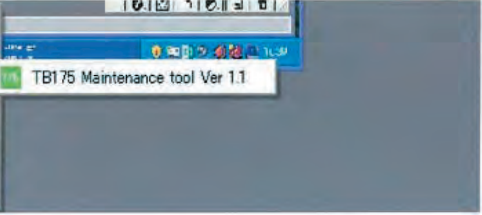
**Before starting EMPSIII**

EMPS performs data communication. Exit all other communication software before starting the EMPS. In addition, deactivate software and features that automatically communication regularly, such as Windows Update. These may interfere with EMPS data communication.



#### 4. Computer screen after software installation

| Model                | Start menu 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1/2                                                             |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------|-------------|---|----------------|-------------|---|-----------------|-------------|---|-------|---------|---|----------|--------------|---|---------|--------------|---|----------|----------------------|---|-----------------|-------------|-----------------------------------------------------------------|----------------|-------------|---------------------------------------|-----------------|-------------|---|-------|---------|---|----------|--------------|---|---------|--------------|---|----------|----------------------|---|-----------------|-------------|---|----------------|-------------|-----------------------------------------------------------------|-----------------|-------------|-----------------------------------|-------|---------|---|----------|--------------|---|---------|--------------|---|----------|----------------------|---|-----------------|-------------|---|----------------|-------------|---|-----------------|-------------|---|-------|---------|---|----------|--------------|--------------------------------------|---------|--------------|---------------------------------------|----------|----------------------|---|
| Maintenance software | <p>Start menu configuration</p> <p>The start menu configuration of maintenance software after installation is illustrated as follows.</p> <p><b>TAKEUCHIグループ</b></p> <table border="1"> <tr><td>Microsoft Excel</td><td>TB1140(T-2)</td><td>▶</td></tr> <tr><td>Microsoft Word</td><td>TB1140(T-3)</td><td>▶</td></tr> <tr><td>Microsoft Visio</td><td>TB175(SUZU)</td><td>▶</td></tr> <tr><td>Adobe</td><td>TB1140W</td><td>▶</td></tr> <tr><td>簡単インストーラ</td><td>TB175 TB175W</td><td>▶</td></tr> <tr><td>Renesas</td><td>TB180FR(T-3)</td><td>▶</td></tr> <tr><td>TAKEUCHI</td><td>TB153FR TB180FR(T-2)</td><td>▶</td></tr> </table> <p><b>A25B メンテナンスソフト</b></p> <table border="1"> <tr><td>Microsoft Excel</td><td>TB1140(T-2)</td><td>▶ Maintenance Software(Ver 1.2) for Proportion Output Amplifier</td></tr> <tr><td>Microsoft Word</td><td>TB1140(T-3)</td><td>▶ TB1140 Maintenance software Ver 1.0</td></tr> <tr><td>Microsoft Visio</td><td>TB175(SUZU)</td><td>▶</td></tr> <tr><td>Adobe</td><td>TB1140W</td><td>▶</td></tr> <tr><td>簡単インストーラ</td><td>TB175 TB175W</td><td>▶</td></tr> <tr><td>Renesas</td><td>TB180FR(T-3)</td><td>▶</td></tr> <tr><td>TAKEUCHI</td><td>TB153FR TB180FR(T-2)</td><td>▶</td></tr> </table> <p><b>A25C メンテナンスソフト</b></p> <table border="1"> <tr><td>Microsoft Excel</td><td>TB1140(T-2)</td><td>▶</td></tr> <tr><td>Microsoft Word</td><td>TB1140(T-3)</td><td>▶ Maintenance Software(Ver 2.2) for Proportion Output Amplifier</td></tr> <tr><td>Microsoft Visio</td><td>TB175(SUZU)</td><td>▶ TB1140 Maintenance tool Ver 1.0</td></tr> <tr><td>Adobe</td><td>TB1140W</td><td>▶</td></tr> <tr><td>簡単インストーラ</td><td>TB175 TB175W</td><td>▶</td></tr> <tr><td>Renesas</td><td>TB180FR(T-3)</td><td>▶</td></tr> <tr><td>TAKEUCHI</td><td>TB153FR TB180FR(T-2)</td><td>▶</td></tr> </table> <p><b>A14E A14EW メンテナンスソフト</b></p> <table border="1"> <tr><td>Microsoft Excel</td><td>TB1140(T-2)</td><td>▶</td></tr> <tr><td>Microsoft Word</td><td>TB1140(T-3)</td><td>▶</td></tr> <tr><td>Microsoft Visio</td><td>TB175(SUZU)</td><td>▶</td></tr> <tr><td>Adobe</td><td>TB1140W</td><td>▶</td></tr> <tr><td>簡単インストーラ</td><td>TB175 TB175W</td><td>▶ TB175 Maintenance software Ver 1.0</td></tr> <tr><td>Renesas</td><td>TB180FR(T-3)</td><td>▶ TB175W Maintenance software Ver 1.0</td></tr> <tr><td>TAKEUCHI</td><td>TB153FR TB180FR(T-2)</td><td>▶</td></tr> </table> |                                                                 | Microsoft Excel | TB1140(T-2) | ▶ | Microsoft Word | TB1140(T-3) | ▶ | Microsoft Visio | TB175(SUZU) | ▶ | Adobe | TB1140W | ▶ | 簡単インストーラ | TB175 TB175W | ▶ | Renesas | TB180FR(T-3) | ▶ | TAKEUCHI | TB153FR TB180FR(T-2) | ▶ | Microsoft Excel | TB1140(T-2) | ▶ Maintenance Software(Ver 1.2) for Proportion Output Amplifier | Microsoft Word | TB1140(T-3) | ▶ TB1140 Maintenance software Ver 1.0 | Microsoft Visio | TB175(SUZU) | ▶ | Adobe | TB1140W | ▶ | 簡単インストーラ | TB175 TB175W | ▶ | Renesas | TB180FR(T-3) | ▶ | TAKEUCHI | TB153FR TB180FR(T-2) | ▶ | Microsoft Excel | TB1140(T-2) | ▶ | Microsoft Word | TB1140(T-3) | ▶ Maintenance Software(Ver 2.2) for Proportion Output Amplifier | Microsoft Visio | TB175(SUZU) | ▶ TB1140 Maintenance tool Ver 1.0 | Adobe | TB1140W | ▶ | 簡単インストーラ | TB175 TB175W | ▶ | Renesas | TB180FR(T-3) | ▶ | TAKEUCHI | TB153FR TB180FR(T-2) | ▶ | Microsoft Excel | TB1140(T-2) | ▶ | Microsoft Word | TB1140(T-3) | ▶ | Microsoft Visio | TB175(SUZU) | ▶ | Adobe | TB1140W | ▶ | 簡単インストーラ | TB175 TB175W | ▶ TB175 Maintenance software Ver 1.0 | Renesas | TB180FR(T-3) | ▶ TB175W Maintenance software Ver 1.0 | TAKEUCHI | TB153FR TB180FR(T-2) | ▶ |
| Microsoft Excel      | TB1140(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Word       | TB1140(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Visio      | TB175(SUZU)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Adobe                | TB1140W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| 簡単インストーラ             | TB175 TB175W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Renesas              | TB180FR(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| TAKEUCHI             | TB153FR TB180FR(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Excel      | TB1140(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶ Maintenance Software(Ver 1.2) for Proportion Output Amplifier |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Word       | TB1140(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶ TB1140 Maintenance software Ver 1.0                           |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Visio      | TB175(SUZU)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Adobe                | TB1140W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| 簡単インストーラ             | TB175 TB175W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Renesas              | TB180FR(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| TAKEUCHI             | TB153FR TB180FR(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Excel      | TB1140(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Word       | TB1140(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶ Maintenance Software(Ver 2.2) for Proportion Output Amplifier |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Visio      | TB175(SUZU)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶ TB1140 Maintenance tool Ver 1.0                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Adobe                | TB1140W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| 簡単インストーラ             | TB175 TB175W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Renesas              | TB180FR(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| TAKEUCHI             | TB153FR TB180FR(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Excel      | TB1140(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Word       | TB1140(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Microsoft Visio      | TB175(SUZU)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Adobe                | TB1140W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| 簡単インストーラ             | TB175 TB175W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶ TB175 Maintenance software Ver 1.0                            |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| Renesas              | TB180FR(T-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ▶ TB175W Maintenance software Ver 1.0                           |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |
| TAKEUCHI             | TB153FR TB180FR(T-2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ▶                                                               |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |                                                                 |                |             |                                       |                 |             |   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |                                                                 |                 |             |                                   |       |         |   |          |              |   |         |              |   |          |                      |   |                 |             |   |                |             |   |                 |             |   |       |         |   |          |              |                                      |         |              |                                       |          |                      |   |

|                                                                                                     |                                                                                                            |   |                                                                                      |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------|
| Model                                                                                               | Start menu 2                                                                                               |   | 2/2                                                                                  |
| Maintenance software                                                                                |                                                                                                            |   |                                                                                      |
| F14E メンテナンスソフト                                                                                      |                                                                                                            |   |                                                                                      |
|  Microsoft Excel   |  TB1140(T-2)              | ▶ |    |
|  Microsoft Word    |  TB1140(T-3)              | ▶ |                                                                                      |
|  Microsoft Visio   |  TB175(SUZU)              | ▶ |                                                                                      |
|  Adobe             | ▶  TB1140W                | ▶ |                                                                                      |
|  簡単インストーラ          | ▶  TB175 TB175W           | ▶ |                                                                                      |
|  Renesas           | ▶  TB180FR(T-3)           | ▶ |                                                                                      |
|  TAKEUCHI          | ▶  TB153FR TB180FR(T-2)   | ▶ |                                                                                      |
| F14C F10B F10C メンテナンスソフト                                                                            |                                                                                                            |   |                                                                                      |
|  Microsoft Excel   |  TB1140(T-2)              | ▶ |    |
|  Microsoft Word    |  TB1140(T-3)              | ▶ |                                                                                      |
|  Microsoft Visio   |  TB175(SUZU)              | ▶ |                                                                                      |
|  Adobe             | ▶  TB1140W                | ▶ |                                                                                      |
|  簡単インストーラ          | ▶  TB175 TB175W           | ▶ |                                                                                      |
|  Renesas           | ▶  TB180FR(T-3)           | ▶ |                                                                                      |
|  TAKEUCHI          | ▶  TB153FR TB180FR(T-2)   | ▶ |                                                                                      |
| A14E ISUZU メンテナンスソフト                                                                                |                                                                                                            |   |                                                                                      |
|  Microsoft Excel |  TB1140(T-2)            | ▶ |  |
|  Microsoft Word  |  TB1140(T-3)            | ▶ |                                                                                      |
|  Microsoft Visio |  TB175(SUZU)            | ▶ |                                                                                      |
|  Adobe           | ▶  TB1140W              | ▶ |                                                                                      |
|  簡単インストーラ        | ▶  TB175 TB175W         | ▶ |                                                                                      |
|  Renesas         | ▶  TB180FR(T-3)         | ▶ |                                                                                      |
|  TAKEUCHI        | ▶  TB153FR TB180FR(T-2) | ▶ |                                                                                      |

## 5. Maintenance software for F14C, F10C and F10B executed

T-ECU serial number

Version of the software installed

Serial: 05003

Version: F14C Controller Ver 1.00

| Date             | Error No | Emergency release | Error Information                                         |
|------------------|----------|-------------------|-----------------------------------------------------------|
| 2006/02/07 18:19 | 16       | 00                | Engine oil disconnection                                  |
| 2006/02/07 18:19 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/20 08:40 | 16       | 00                | Engine oil disconnection                                  |
| 2005/12/20 08:40 | 05       | 00                | Coolant level decrease                                    |
| 2005/12/20 08:40 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/20 08:40 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/20 08:40 | 16       | 00                | Engine oil disconnection                                  |
| 2005/12/20 08:40 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/20 08:40 | 05       | 00                | Coolant level decrease                                    |
| 2005/12/20 08:40 | 05       | 00                | Coolant level decrease                                    |
| 2005/12/20 08:40 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/20 08:40 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 16:49 | 07       | 00                | Lift overload                                             |
| 2005/12/14 16:49 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 16:49 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/14 16:48 | 07       | 00                | Lift overload                                             |
| 2005/12/14 16:48 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 16:47 | 07       | 00                | Lift overload                                             |
| 2005/12/14 16:47 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 16:46 | 07       | 00                | Lift overload                                             |
| 2005/12/14 16:46 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 08:25 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 08:25 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/14 08:21 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/14 08:21 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/12 19:00 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/12 18:50 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/12 18:48 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/12 18:48 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/09 16:10 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/09 08:20 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/09 08:19 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/09 08:19 | 17       | 00                | Alternator charge disconnection                           |
| 2005/12/07 20:29 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/06 08:13 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/12/06 08:13 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/11/30 12:52 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |
| 2005/11/30 12:50 | 13       | 00                | The lower bound of the voltage of the battery is abnormal |

Date and time the error occurred

Error code

State of the emergency release  
00: Off  
01: On

Display of errors or abnormal states

If the "01" state is displayed when the engine is overheating or seizing, it indicates that the emergency release has been turned on to force engine operation. (It is not due to a defect in the machine.)

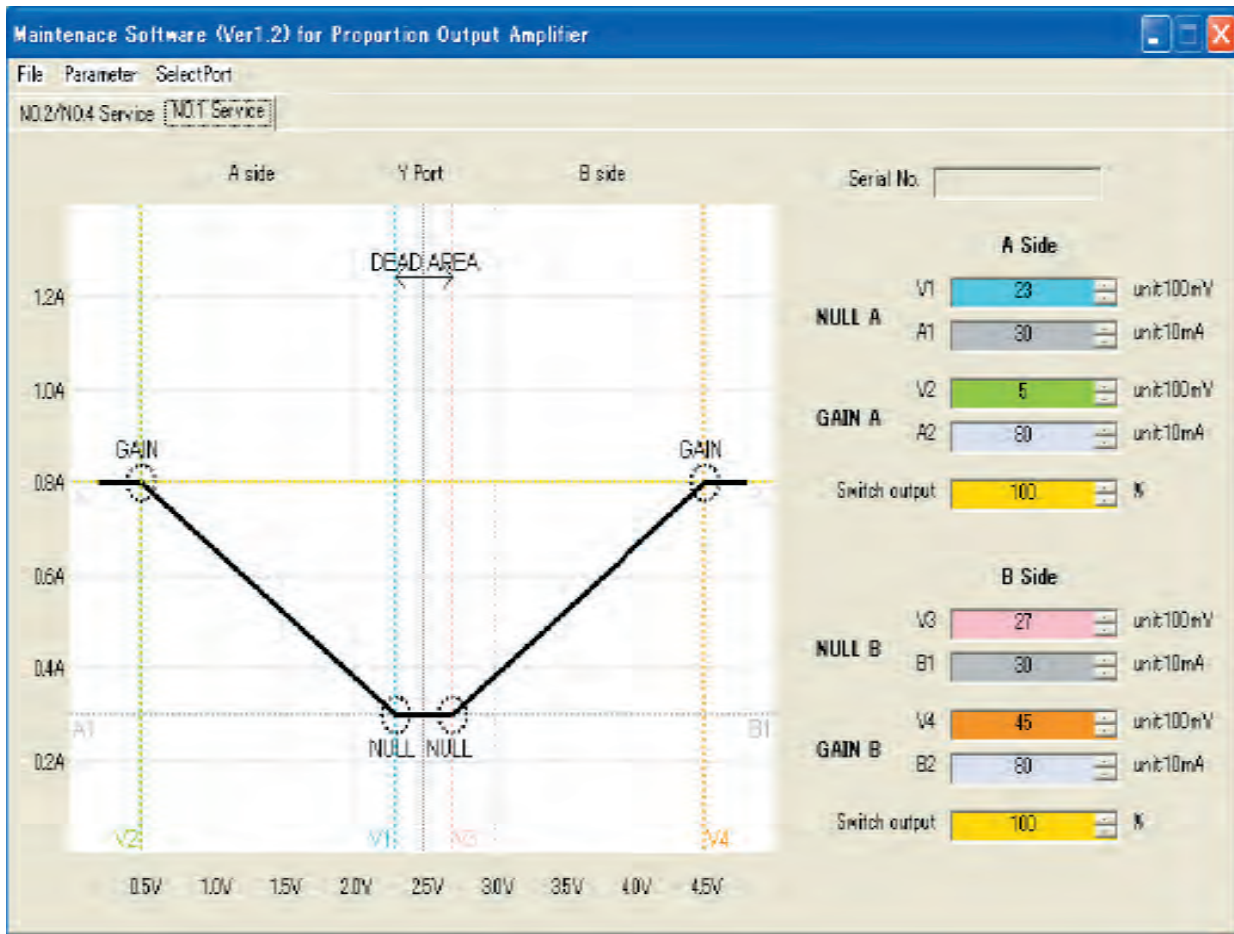
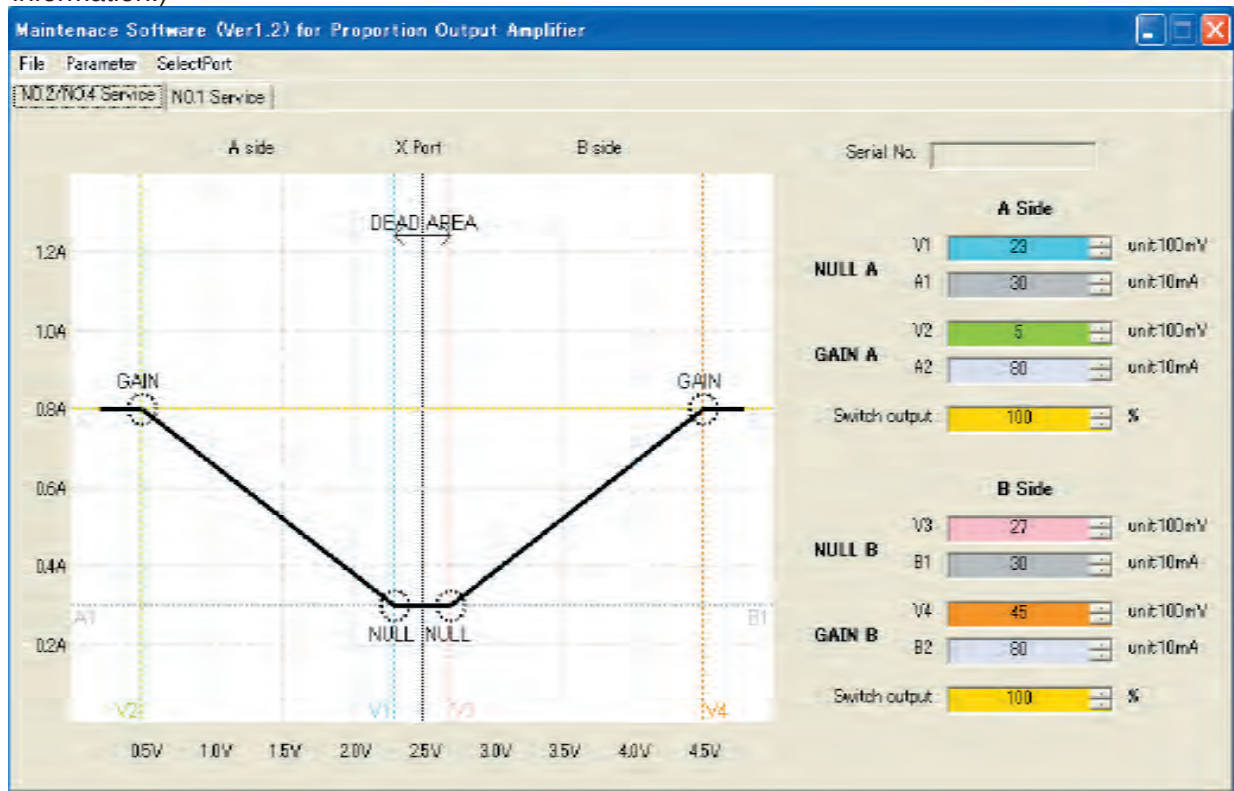


## 6. Maintenance software for A25B and A25D executed

### (1) Maintenance software is selected

| TB1140 Maintenance software         |                          |                   |                                                           |                   |
|-------------------------------------|--------------------------|-------------------|-----------------------------------------------------------|-------------------|
| Log(L) Option(O) Help(H) Program(P) |                          |                   |                                                           |                   |
| Serial                              | Version                  | Manufactured date |                                                           |                   |
| 05003                               | A25B Controller Ver 1.00 | 2006/08/01        |                                                           |                   |
| Date                                | Error No                 | Emergency release | Error Information                                         | Water temperature |
| 2006/02/07 18:19                    | 16                       | 00                | Engine oil disconnection                                  | 160               |
| 2006/02/07 18:19                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/20 08:40                    | 16                       | 00                | Engine oil disconnection                                  |                   |
| 2005/12/20 08:40                    | 05                       | 00                | Coolant level decrease                                    |                   |
| 2005/12/20 08:40                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/20 08:40                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/20 08:40                    | 16                       | 00                | Engine oil disconnection                                  |                   |
| 2005/12/20 08:40                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/20 08:40                    | 05                       | 00                | Coolant level decrease                                    |                   |
| 2005/12/20 08:40                    | 05                       | 00                | Coolant level decrease                                    |                   |
| 2005/12/20 08:40                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/20 08:40                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 16:49                    | 07                       | 00                | Lift overload                                             |                   |
| 2005/12/14 16:49                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 16:49                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/14 16:48                    | 07                       | 00                | Lift overload                                             |                   |
| 2005/12/14 16:48                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 16:47                    | 07                       | 00                | Lift overload                                             |                   |
| 2005/12/14 16:47                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 16:46                    | 07                       | 00                | Lift overload                                             |                   |
| 2005/12/14 16:46                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 08:25                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 08:25                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/14 08:21                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/14 08:21                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/12 19:00                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/12 18:50                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/12 18:48                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/12 18:48                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/09 16:10                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/09 08:20                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/09 08:19                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/09 08:19                    | 17                       | 00                | Alternator charge disconnection                           |                   |
| 2005/12/07 20:29                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/06 08:13                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/12/06 08:13                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/11/30 12:52                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |
| 2005/11/30 12:50                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal |                   |

- (2) A25B and A25D Maintenance Software for Proportion Output Amplifier (Refer to each manual for further information.)





## 7. F14E maintenance software executed

| TB180FR Maintenance software        |                          |                   |                                                           |                   |
|-------------------------------------|--------------------------|-------------------|-----------------------------------------------------------|-------------------|
| Log(L) Option(O) Help(H) Program(P) |                          |                   |                                                           |                   |
| Serial                              | Version                  | Manufactured date |                                                           |                   |
| SP1                                 | F14E Controller Ver 1.02 | 2007/01/01        |                                                           |                   |
| Date                                | Error No                 | Emergency release | Error Information                                         | Water temperature |
| 2005/09/29 00:18                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/09/29 00:18                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/09/29 00:18                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/09/29 00:17                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/09/29 00:17                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/09/29 00:17                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:16                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:16                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:16                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:15                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:15                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:15                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:14                    | 02                       | 00                | Engine oil pressure decrease after engine starts          | 0                 |
| 2005/08/01 00:14                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:14                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:14                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:14                    | 16                       | 00                | Engine oil disconnection                                  | 0                 |
| 2005/08/01 00:14                    | 16                       | 00                | Engine oil disconnection                                  | 0                 |
| 2005/08/01 00:14                    | 16                       | 00                | Engine oil disconnection                                  | 0                 |
| 2005/08/01 00:14                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:14                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:14                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:13                    | 02                       | 00                | Engine oil pressure decrease after engine starts          | 0                 |
| 2005/08/01 00:13                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:13                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:13                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:13                    | 03                       | 00                | After the engine starts, Oilstartcharge is defective      | 0                 |
| 2005/08/01 00:13                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:13                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:13                    | 33                       | 00                | CAN Communication Error                                   | 0                 |
| 2005/08/01 00:13                    | 02                       | 00                | Engine oil pressure decrease after engine starts          | 0                 |
| 2005/08/01 00:12                    | 32                       | 00                | The accelerator volume lower bound value is abnormal      | 0                 |
| 2005/08/01 00:12                    | 13                       | 00                | The lower bound of the voltage of the battery is abnormal | 0                 |
| 2005/08/01 00:12                    | 33                       | 00                | CAN Communication Error                                   | 0                 |



## 8. A14E and A14EW maintenance software executed

### (1) A14E Maintenance software is selected

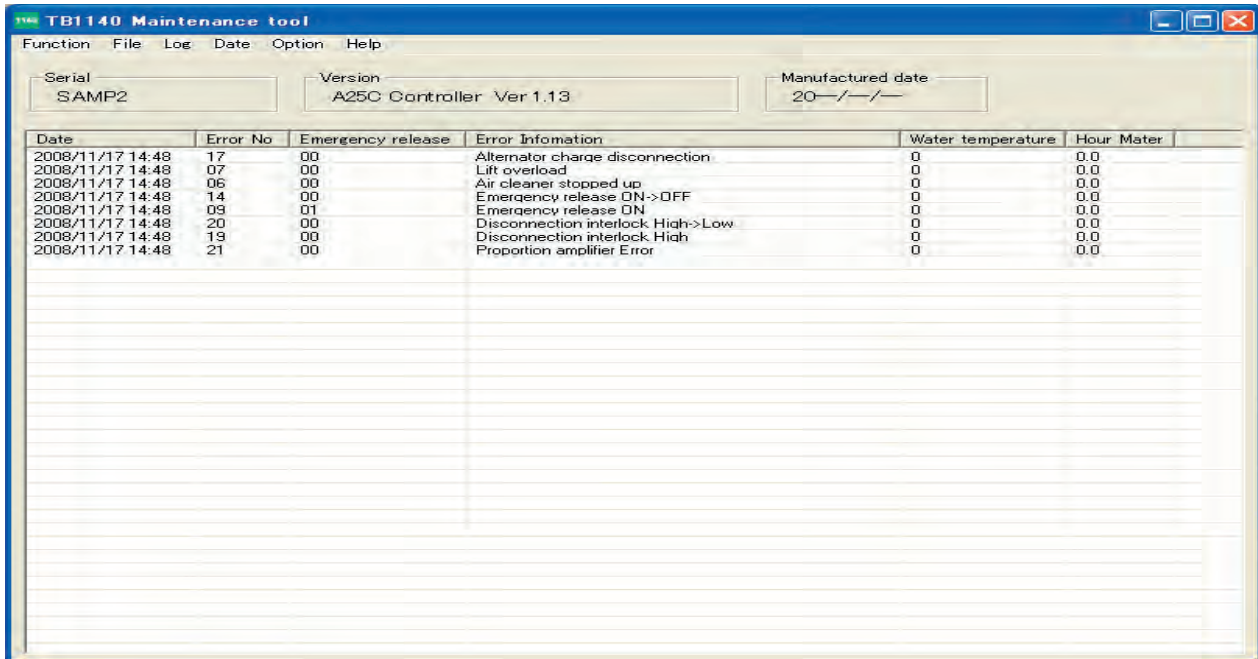
| Date             | Error No | Emergency release | Error Information                                           | Water temperature |
|------------------|----------|-------------------|-------------------------------------------------------------|-------------------|
| 2006/04/09 22:40 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/04/09 22:40 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/04/09 22:38 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/04/09 22:38 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:54 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:54 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:54 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:54 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:53 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:53 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:52 | 32       | 00                | The lower bound of the voltage of the accelerator sensor... | 0                 |
| 2006/03/24 01:52 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:52 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:51 | 32       | 00                | The lower bound of the voltage of the accelerator sensor... | 0                 |
| 2006/03/24 01:51 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:51 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/16 20:10 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/16 20:10 | 33       | 00                | CAN Communication Error                                     | 0                 |

### (2) A14EW Maintenance software is selected

| Date             | Error No | Emergency release | Error Information                                           | Water temperature |
|------------------|----------|-------------------|-------------------------------------------------------------|-------------------|
| 2006/04/09 22:49 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/04/09 22:49 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/04/09 22:40 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/04/09 22:40 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/04/09 22:38 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/04/09 22:38 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:54 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:54 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:54 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:54 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:53 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:53 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:52 | 32       | 00                | The lower bound of the voltage of the accelerator sensor... | 0                 |
| 2006/03/24 01:52 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:52 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/24 01:51 | 32       | 00                | The lower bound of the voltage of the accelerator sensor... | 0                 |
| 2006/03/24 01:51 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/24 01:51 | 33       | 00                | CAN Communication Error                                     | 0                 |
| 2006/03/16 20:10 | 13       | 00                | The lower bound of the voltage of the battery is abnormal   | 0                 |
| 2006/03/16 20:10 | 33       | 00                | CAN Communication Error                                     | 0                 |

## 9. A25C maintenance software executed

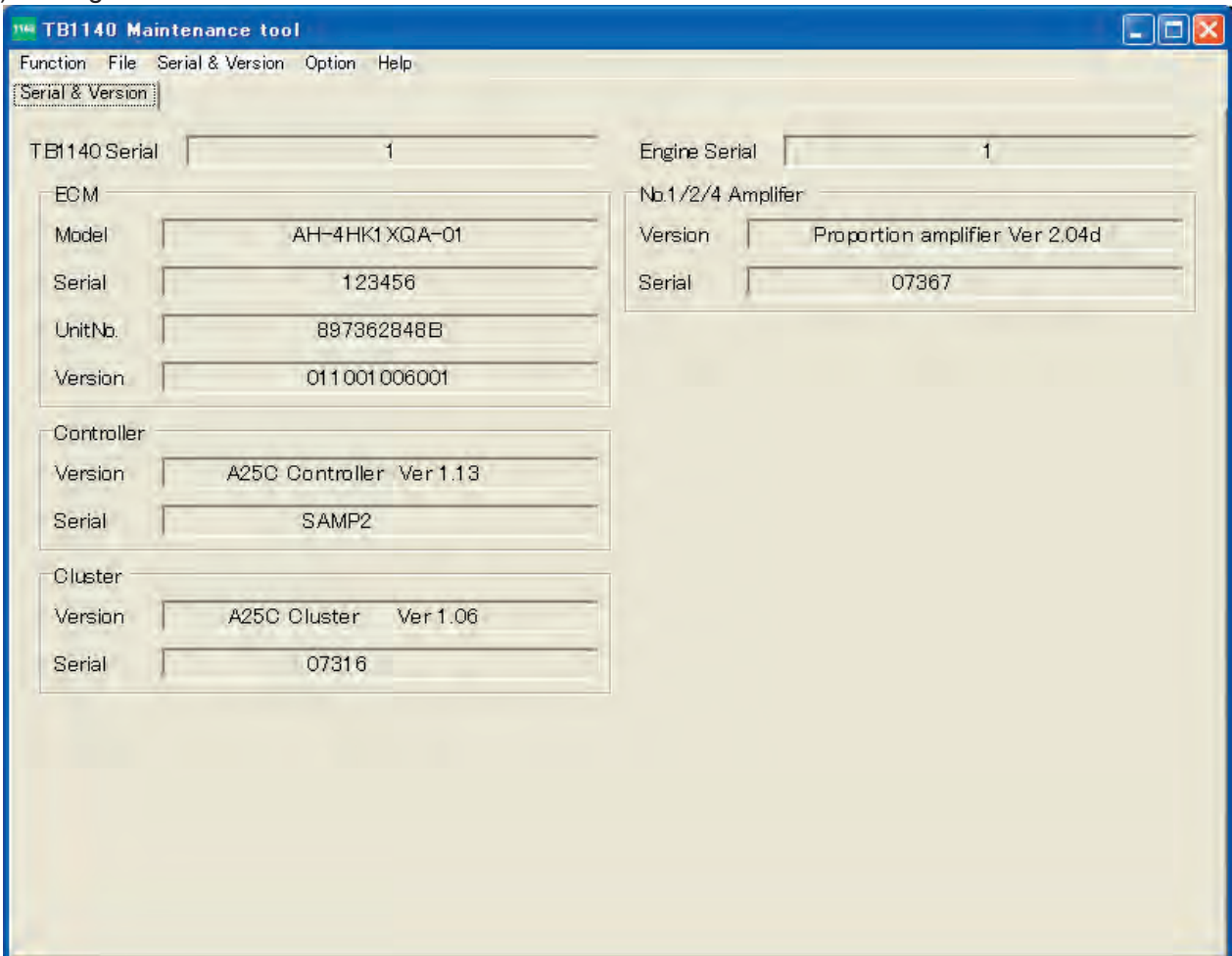
### (1) Maintenance software is selected



The screenshot shows the 'TB1140 Maintenance tool' window. The 'Function' menu is selected. The interface includes fields for 'Serial' (SAMP2), 'Version' (A25C Controller Ver 1.13), and 'Manufactured date' (20--/--/--). Below these is a table with the following data:

| Date             | Error No | Emergency release | Error Information                 | Water temperature | Hour Meter |
|------------------|----------|-------------------|-----------------------------------|-------------------|------------|
| 2008/11/17 14:48 | 17       | 00                | Alternator charge disconnection   | 0                 | 0.0        |
| 2008/11/17 14:48 | 07       | 00                | Lift overload                     | 0                 | 0.0        |
| 2008/11/17 14:48 | 06       | 00                | Air cleaner stopped up            | 0                 | 0.0        |
| 2008/11/17 14:48 | 14       | 00                | Emergency release ON->OFF         | 0                 | 0.0        |
| 2008/11/17 14:48 | 09       | 01                | Emergency release ON              | 0                 | 0.0        |
| 2008/11/17 14:48 | 20       | 00                | Disconnection interlock High->Low | 0                 | 0.0        |
| 2008/11/17 14:48 | 19       | 00                | Disconnection interlock High      | 0                 | 0.0        |
| 2008/11/17 14:48 | 21       | 00                | Proportion amplifier Error        | 0                 | 0.0        |

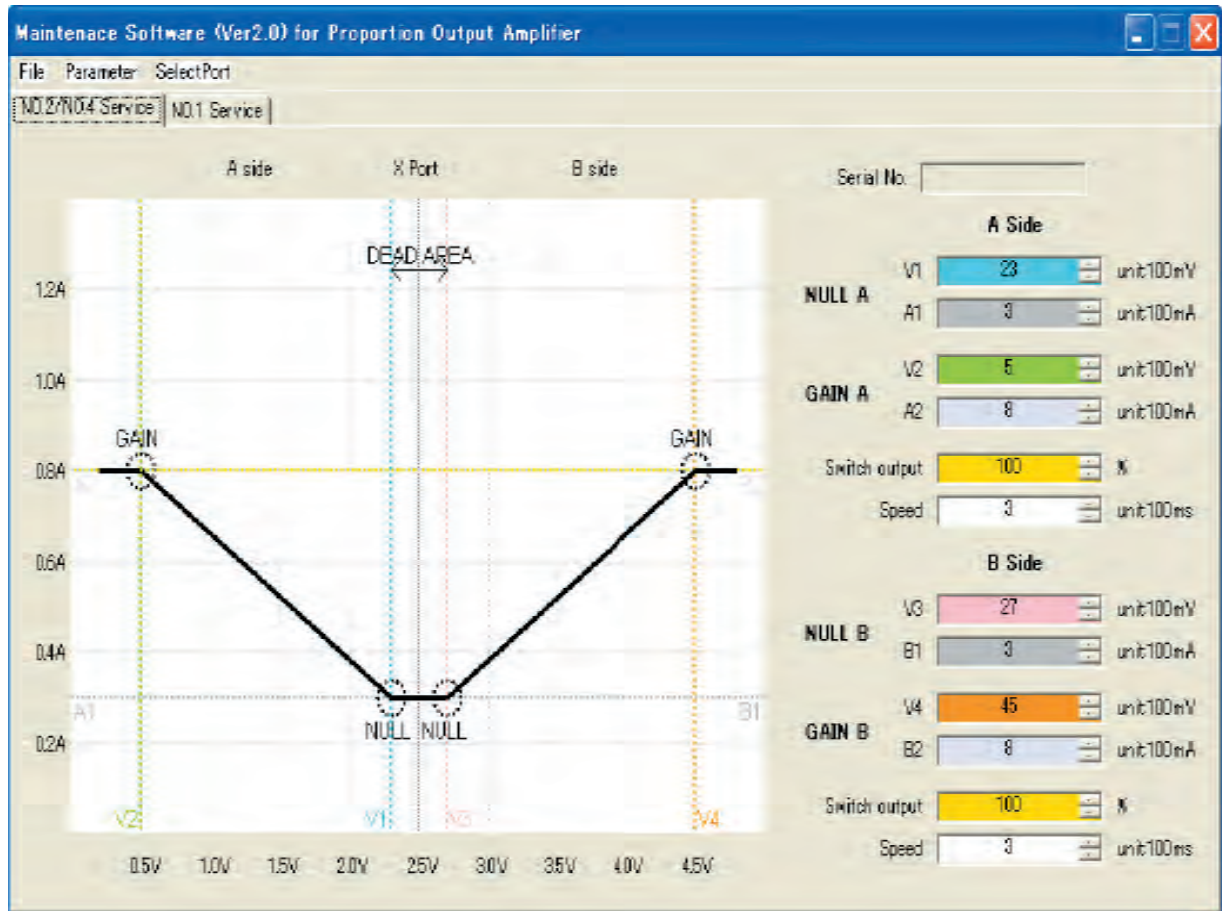
### (2) Management software is selected



The screenshot shows the 'TB1140 Maintenance tool' window with the 'Serial & Version' menu selected. The interface displays various configuration fields for different components:

- TB1140 Serial:** 1
- Engine Serial:** 1
- ECM:**
  - Model: AH-4HK1 XQA-01
  - Serial: 123456
  - UnitNo: 897362848B
  - Version: 011001006001
- No.1/2/4 Amplifier:**
  - Version: Proportion amplifier Ver 2.04d
  - Serial: 07367
- Controller:**
  - Version: A25C Controller Ver 1.13
  - Serial: SAMP2
- Cluster:**
  - Version: A25C Cluster Ver 1.06
  - Serial: 07316

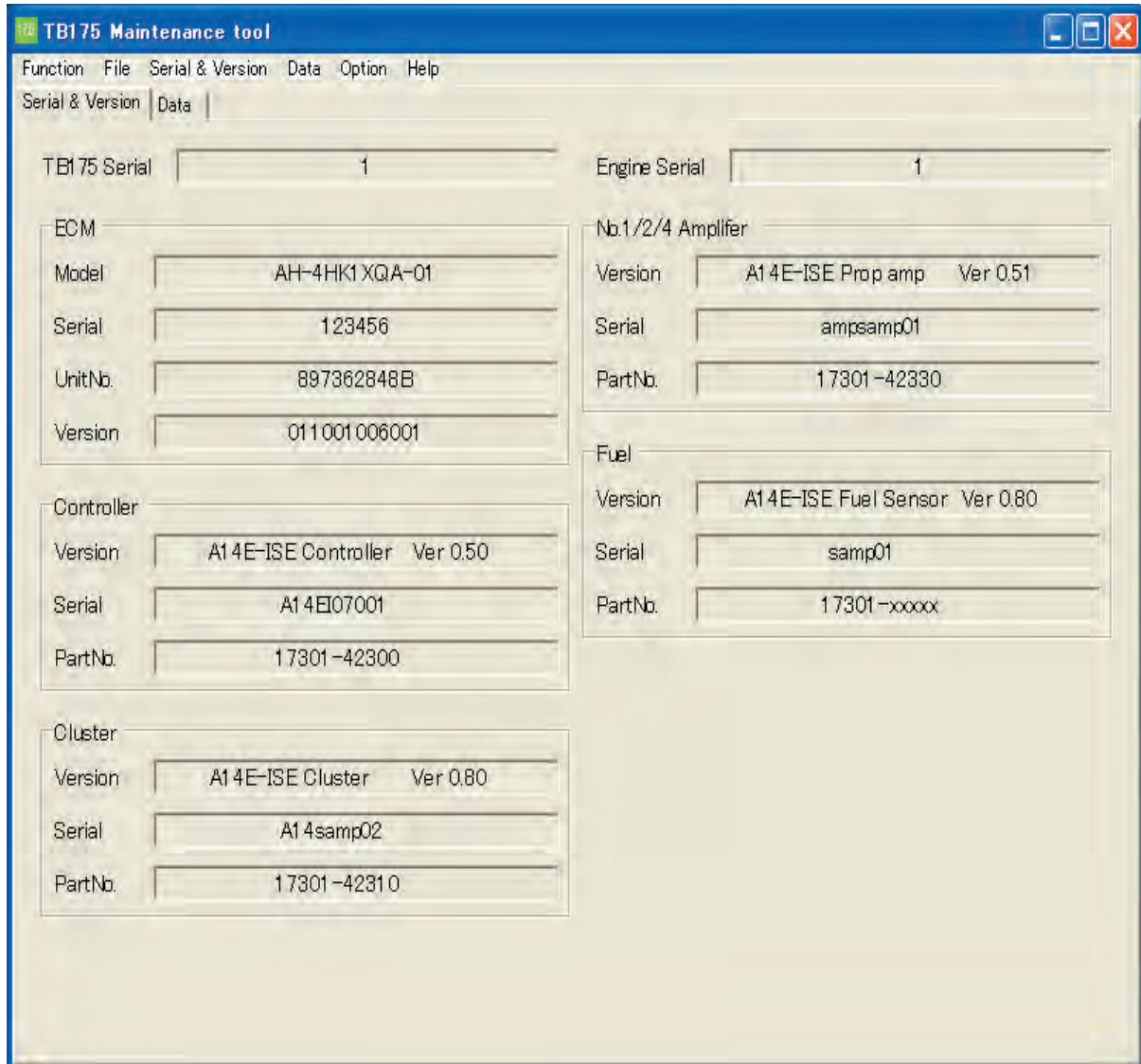
(3) Maintenance Software for Proportion Output Amplifier is selected





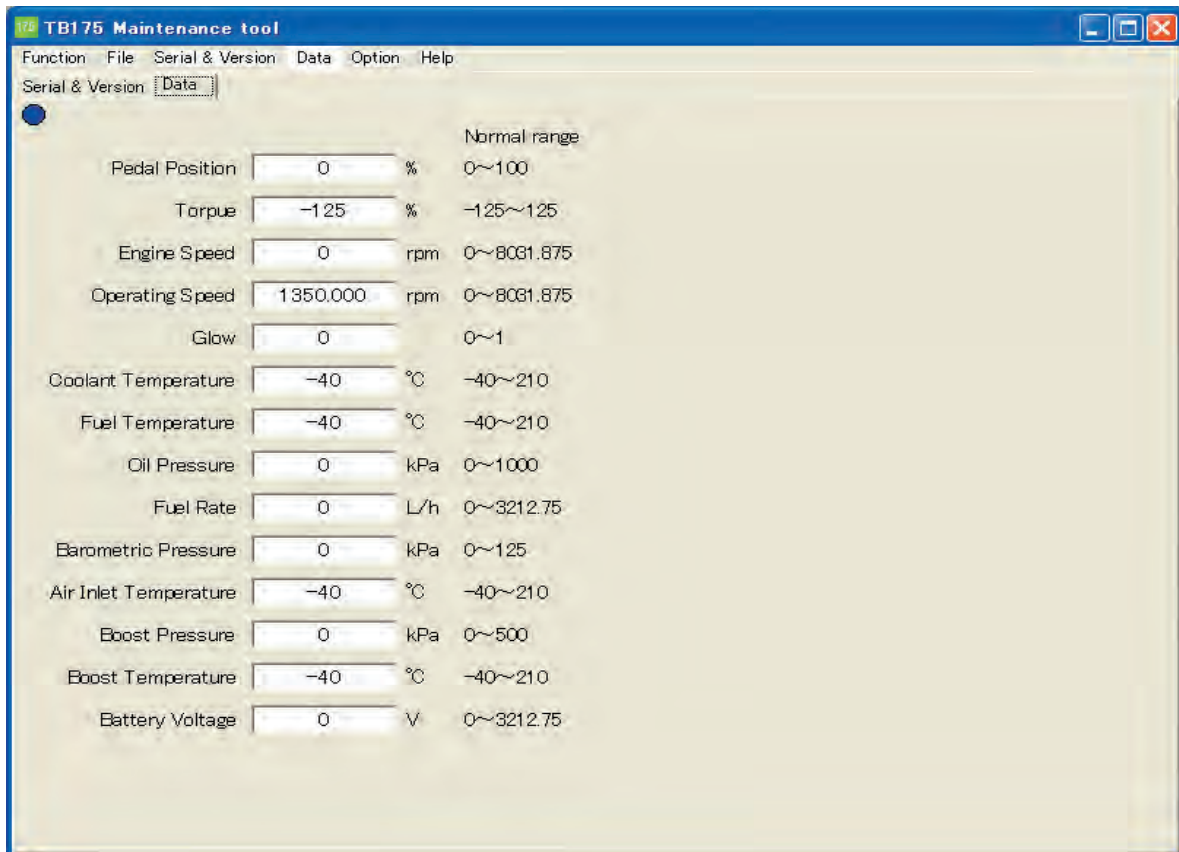
## 10. Maintenance tool executed on the A14E Isuzu monitor machine

(1) Management software is selected.

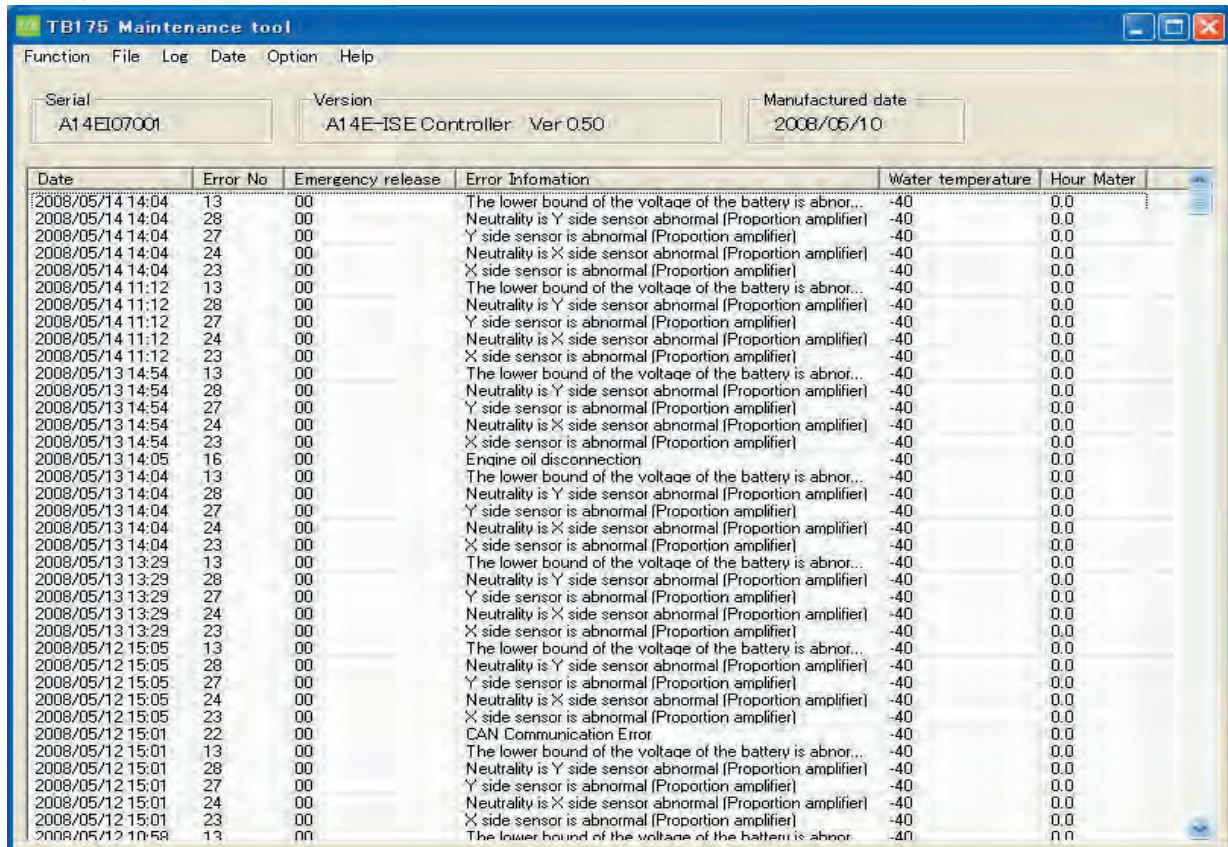


| TB175 Maintenance tool                          |                               |
|-------------------------------------------------|-------------------------------|
| Function File Serial & Version Data Option Help |                               |
| Serial & Version   Data                         |                               |
| TB175 Serial                                    | 1                             |
| Engine Serial                                   | 1                             |
| ECM                                             |                               |
| Model                                           | AH-4HK1XQA-01                 |
| Serial                                          | 123456                        |
| UnitNo.                                         | 897362848B                    |
| Version                                         | 011001006001                  |
| No.1/2/4 Amplifier                              |                               |
| Version                                         | A14E-ISE Prop amp Ver 0.51    |
| Serial                                          | ampsamp01                     |
| PartNo.                                         | 17301-42330                   |
| Controller                                      |                               |
| Version                                         | A14E-ISE Controller Ver 0.50  |
| Serial                                          | A14E07001                     |
| PartNo.                                         | 17301-42300                   |
| Fuel                                            |                               |
| Version                                         | A14E-ISE Fuel Sensor Ver 0.80 |
| Serial                                          | samps01                       |
| PartNo.                                         | 17301-xxxxx                   |
| Cluster                                         |                               |
| Version                                         | A14E-ISE Cluster Ver 0.80     |
| Serial                                          | A14samps02                    |
| PartNo.                                         | 17301-42310                   |

(2) ECM data browse is selected

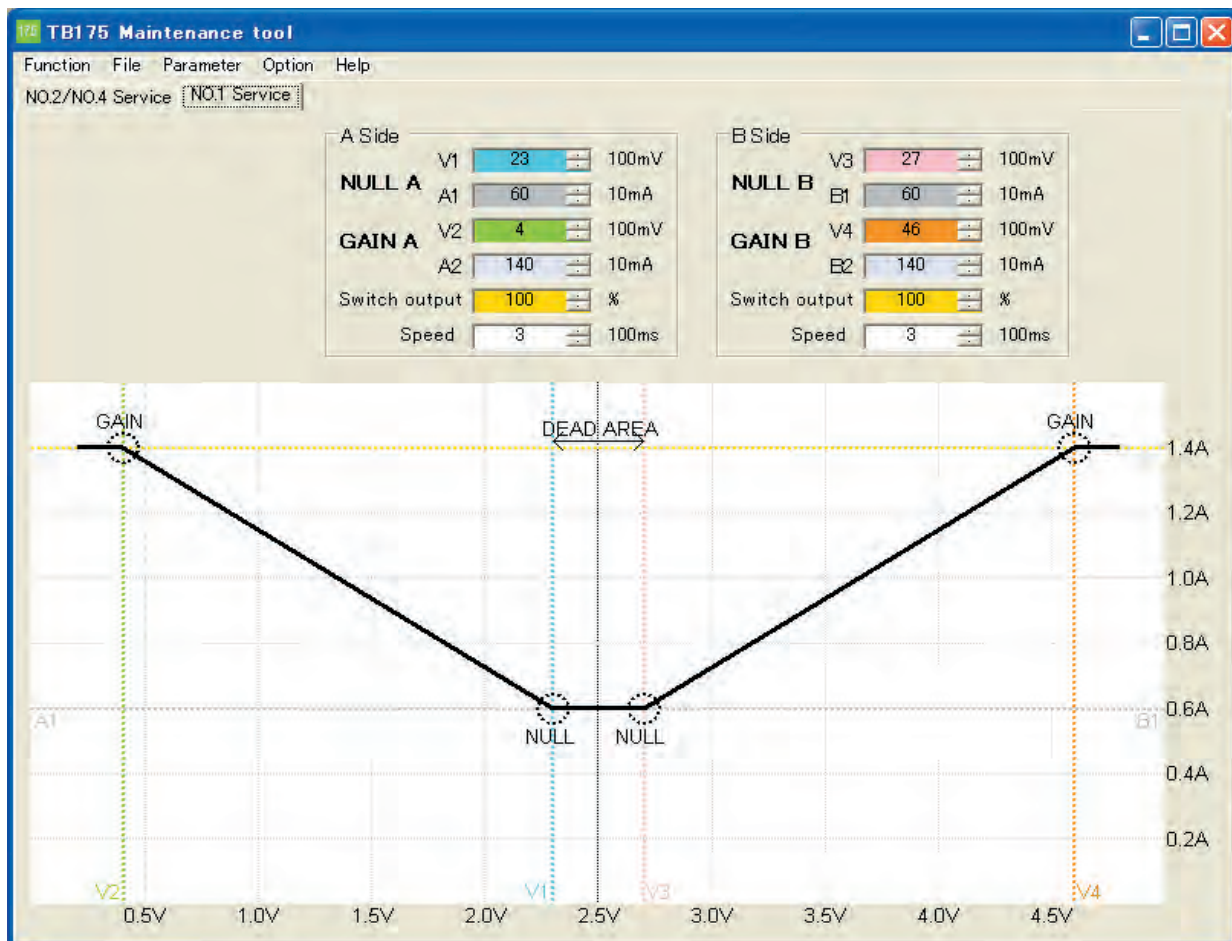
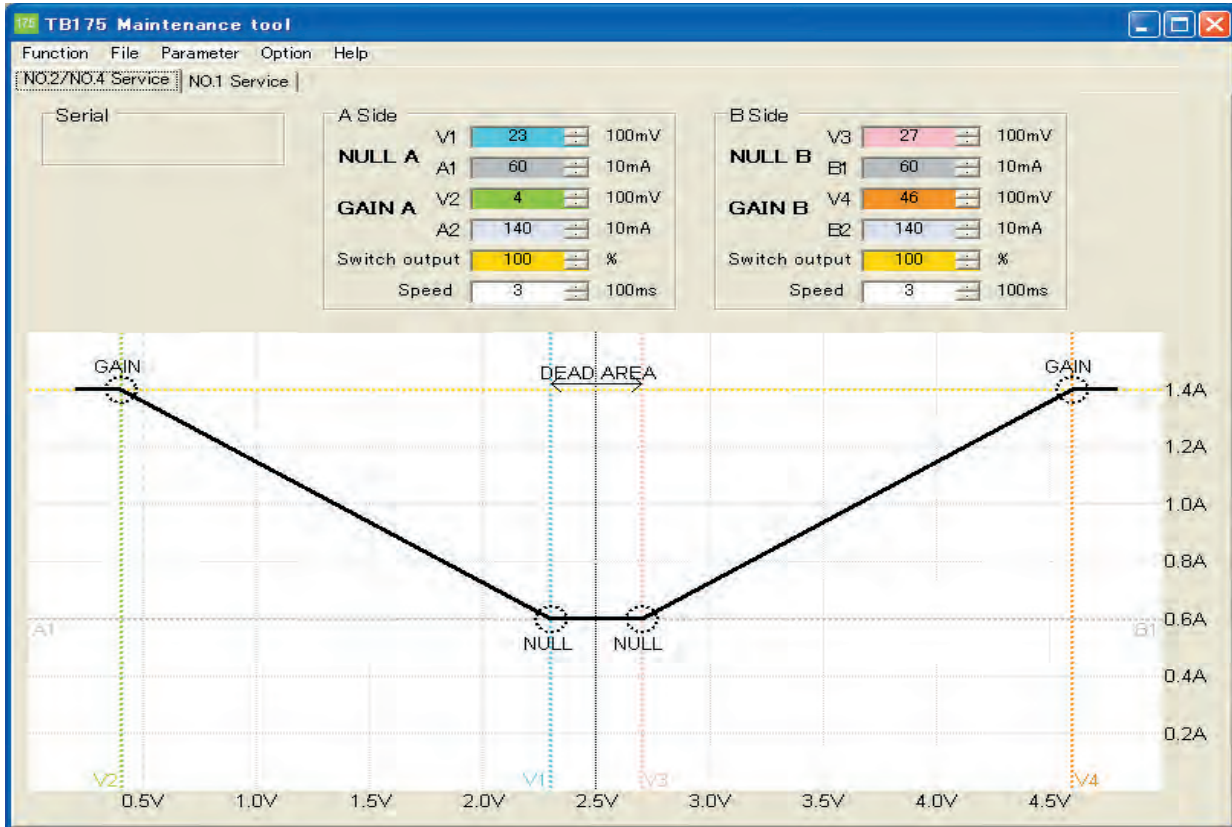


(3) Management software is selected





(4) Maintenance Software for Proportion Output Amplifier is selected





# TB175W Maintenance software Ver1.0

SerNO. 17540001~

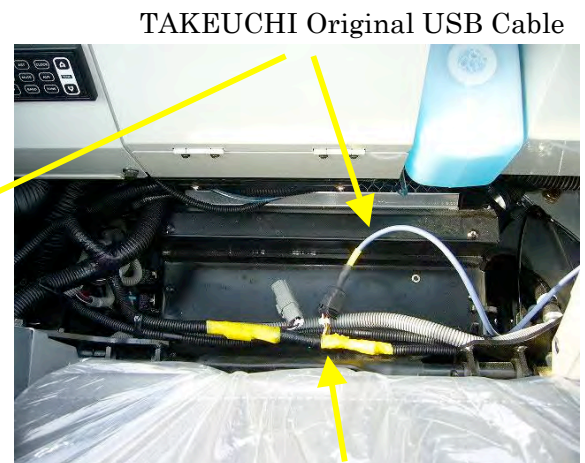
## 1. Connecting

-TB175W CABIN.

-Connect Maintenance cable as shown as picture.



LAPTOP



Maintenance Connector

-Connect cable to USB port of PC.

**Note: Please check COM port number of Serial to USB cable.**

See [Control panel] in start menu.

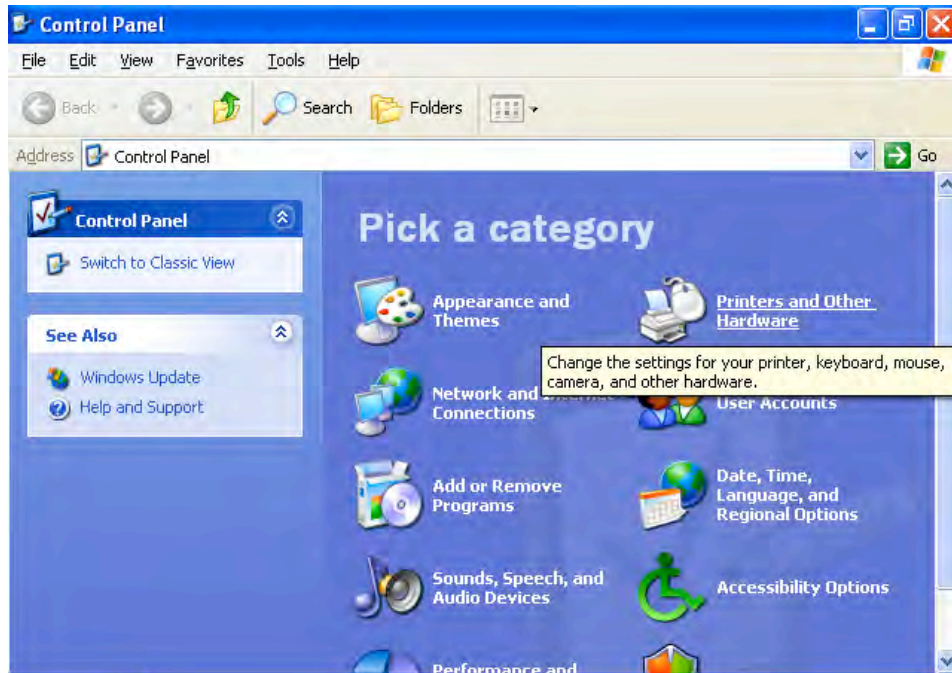
Hit [Performance and maintenance], and then hit [System].

Hit [Hard ware] tag on [System property], and then hit [Device manager].

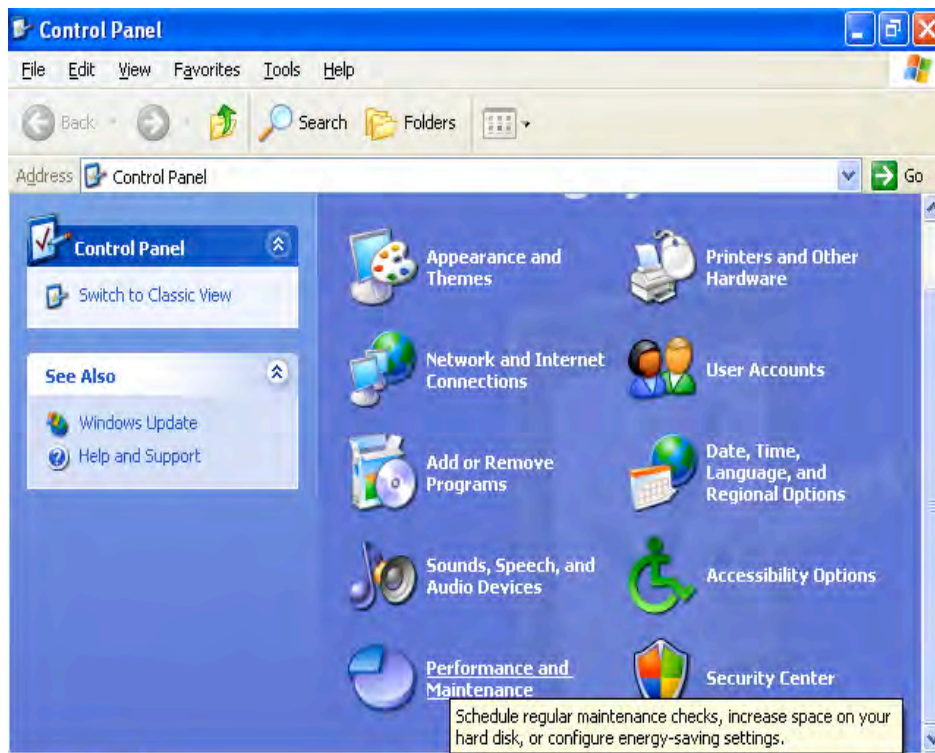
Check COM Port number on the tree.

[ C o n t r o l   P a n e l   ] O P E N



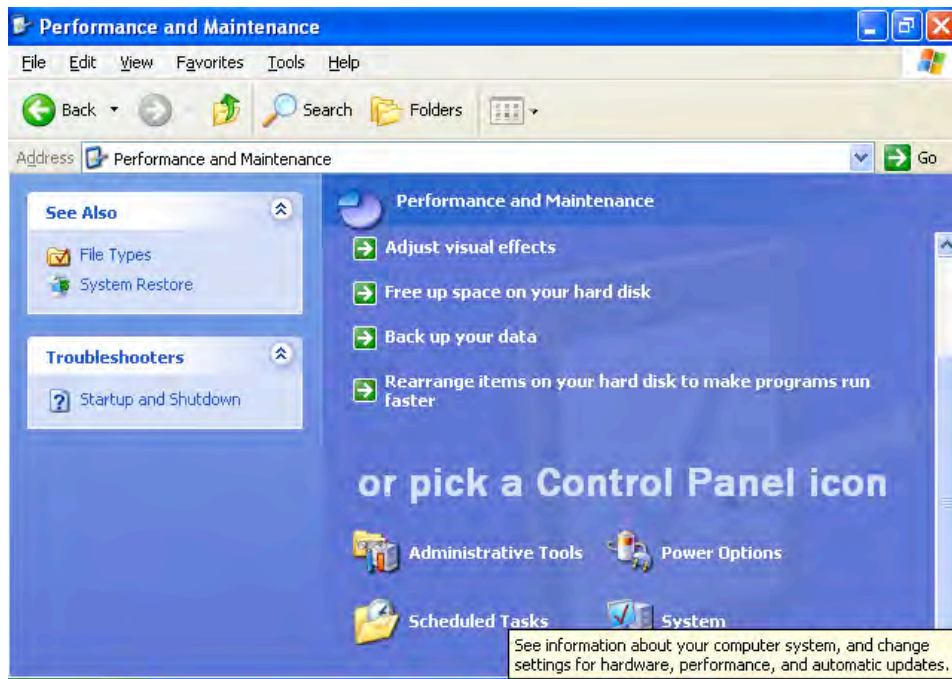


[Performance and Maintenance] OPEN

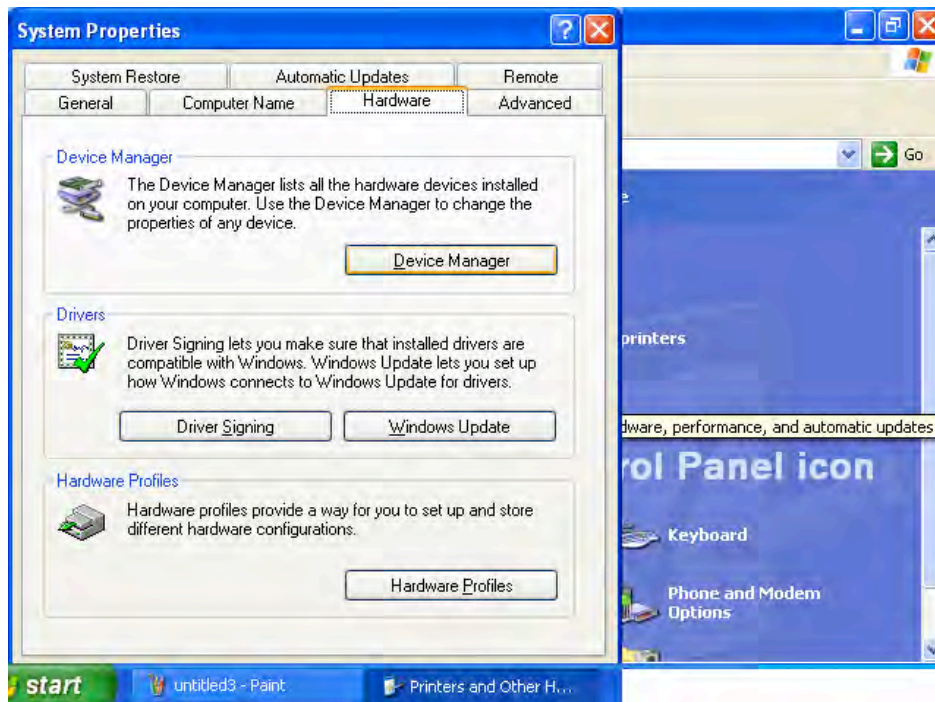




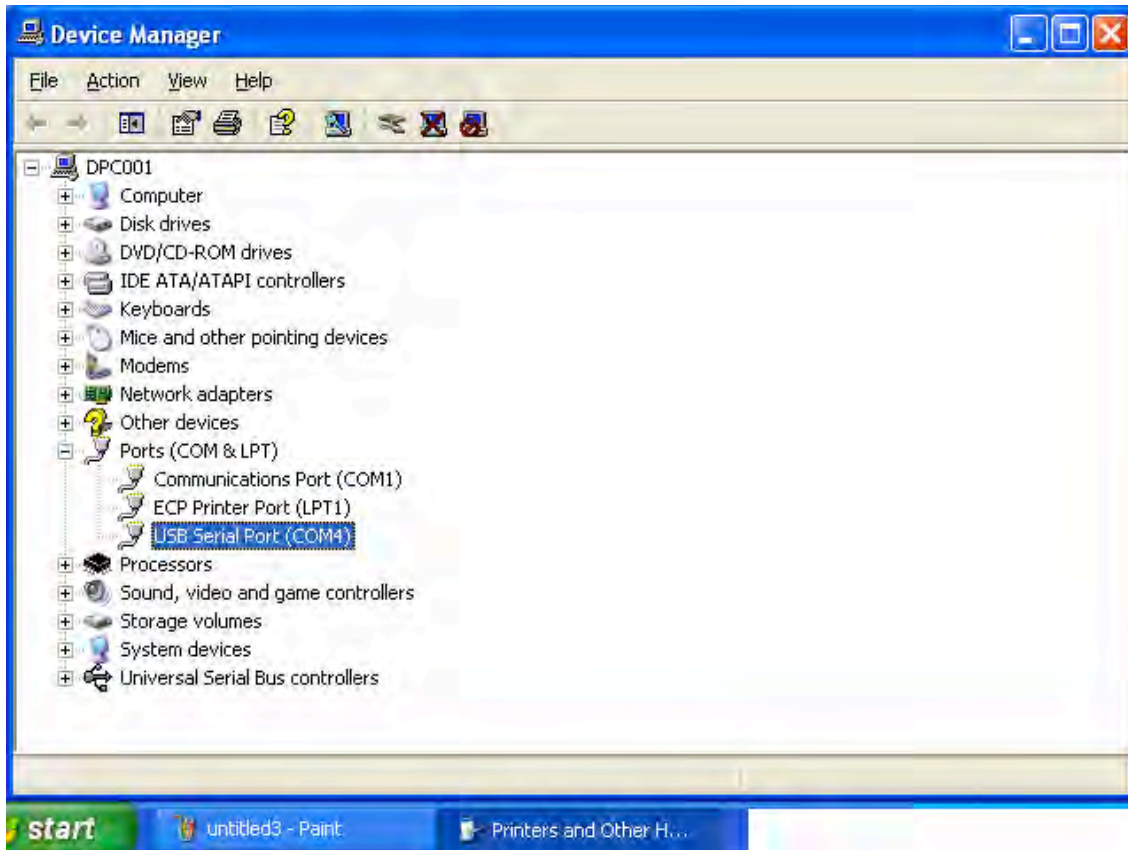
[System] OPEN



[Device Manager] OPEN



The personal computer displayed what TB175W Maintenance software could use in COM4 of the Universal Serial Bus port.

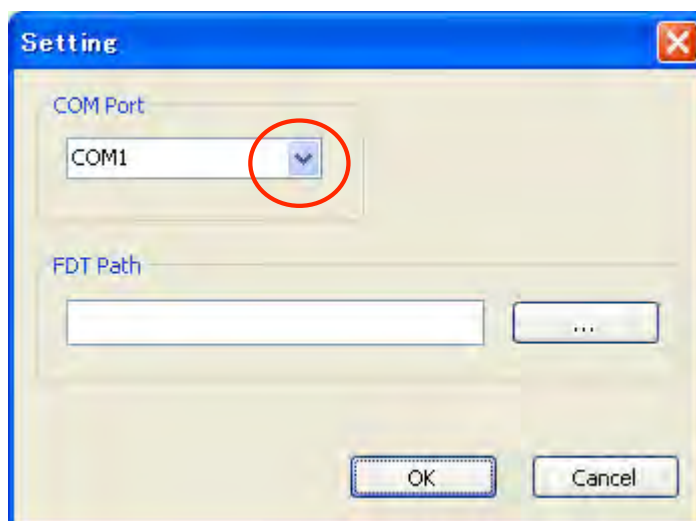
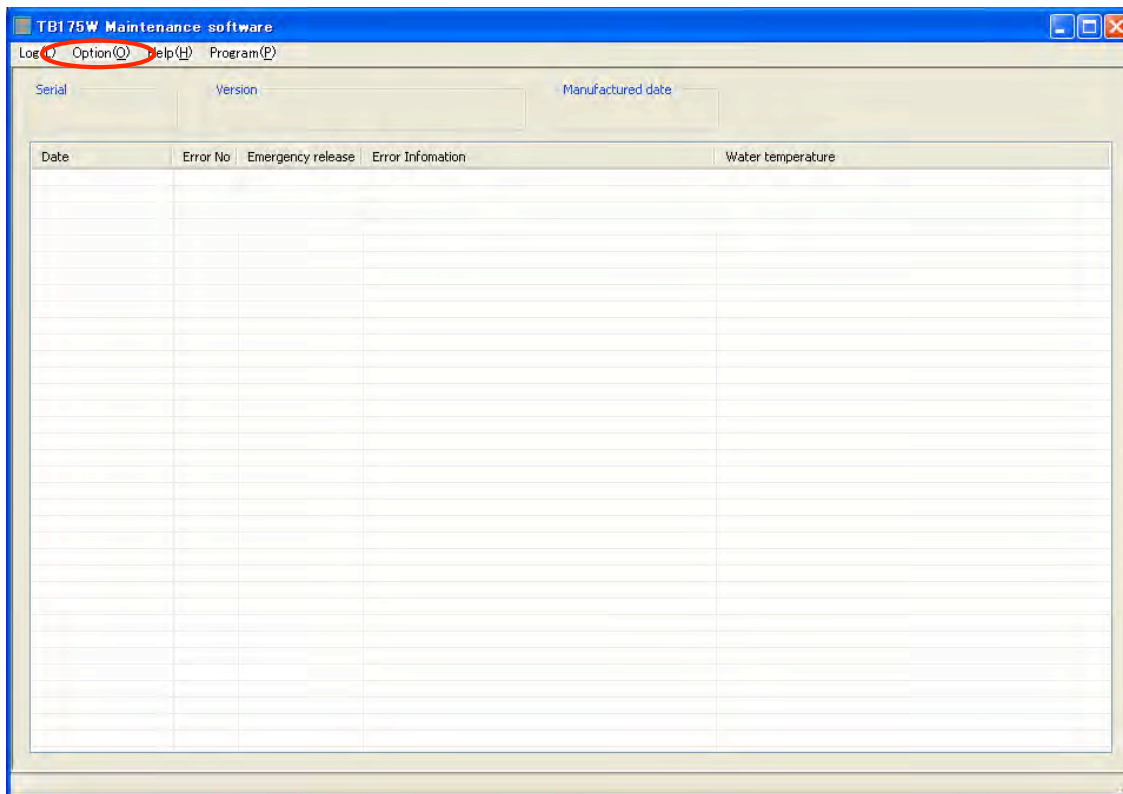


Choose this COM port number at the time of initial setting.

See 6 page

## 2. Maintenance software setting.

- Start [TB175W MAINTENACE SOFTWARE Ver1.0] from start menu.
- Hit [Option] → [Setting]
- Choose COM port number on the list.





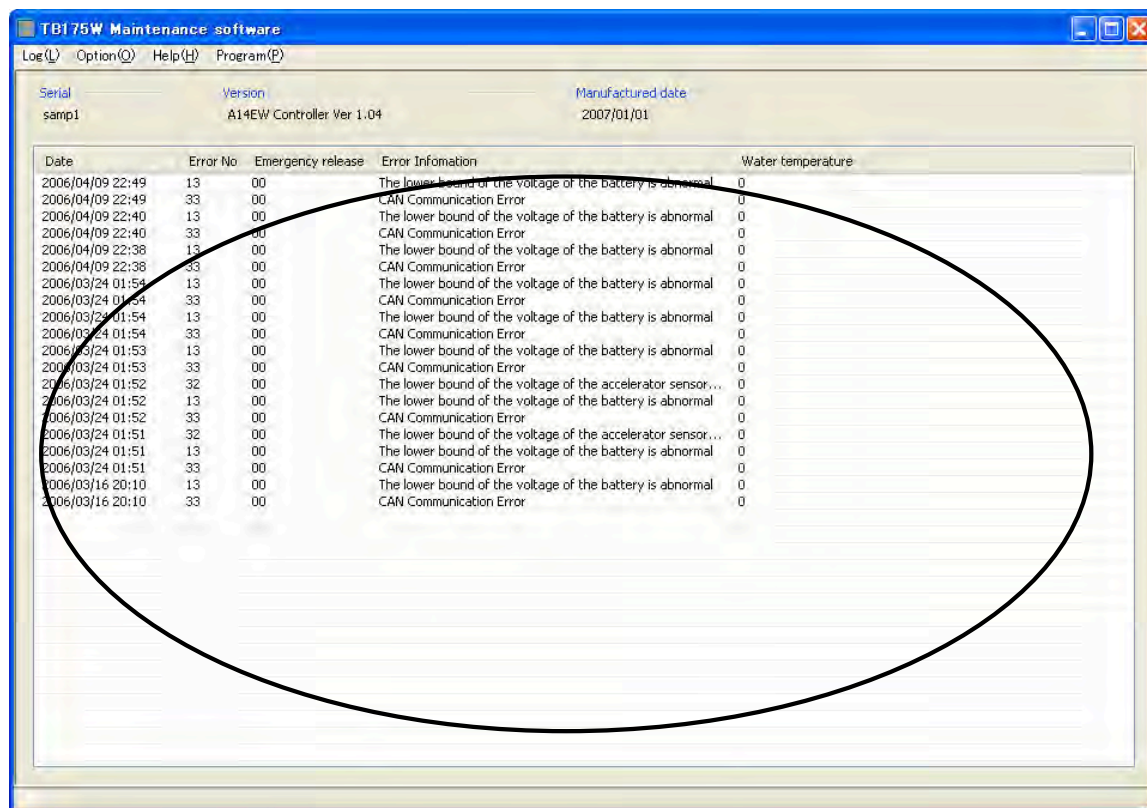
### 3. Monitor Error Log

-Verify connection from machine to PC.

-Turn key switch ON of machine.

-Hit [Log] → [Load] on the menu.

Note: Don't forget turn machine key switch **off** after loading the data.



### 4. Delete Log.

-When hitting [Log] → [Delete], log data in the controller will be deleted.

**Basically, DON'T DO IT.**

### 5. Save Log

- Hit [Log] → [Save]
- Chose location of file, and enter the file name.
- Log will be saved as CSV file. We can read the file by Excel.

### 6. Open saved Log file.

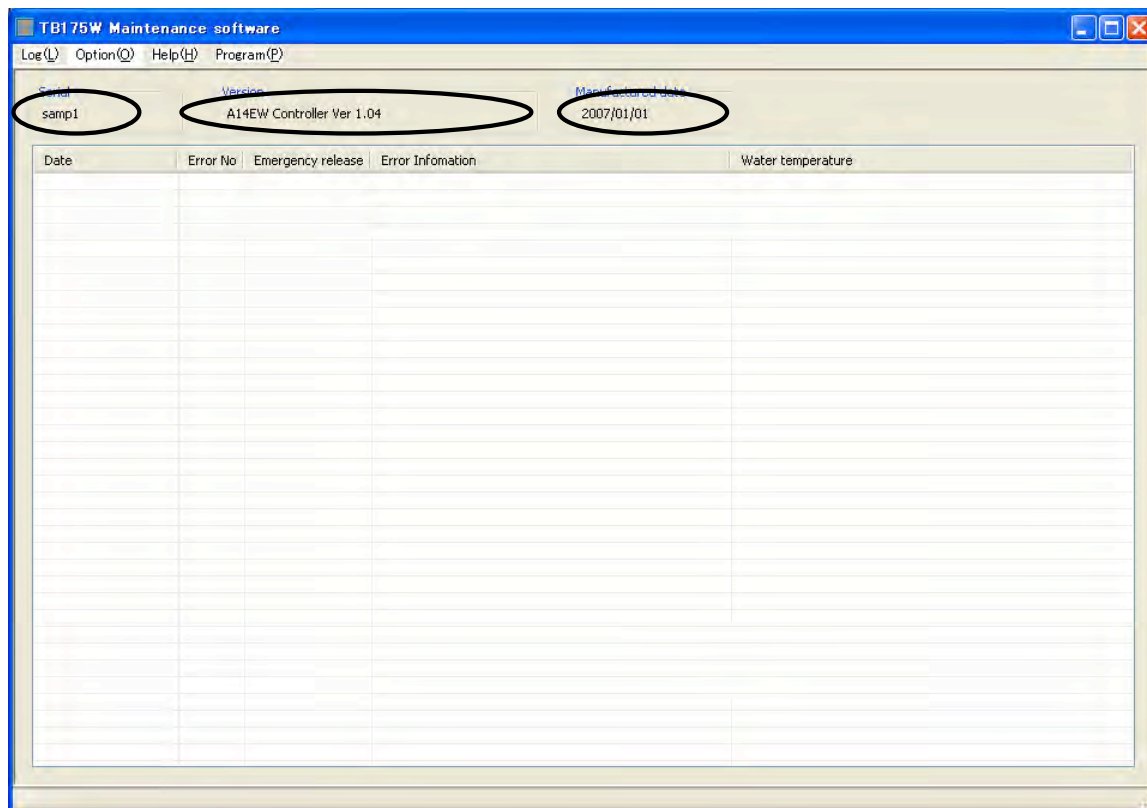
- Hit [Log] → [Open]
- Choose CSV file.

### 7. Print Log

- Hit [Log] → [Print].
- The log now you opened will be printed.

### 8. See Serial number of Controller.

- Hit [Option] → [Version and Serial]
- Current Version of software, Serial number of controller and manufactured date of controller will be shown.



## TB175W Maintenance software Ver1.0, Error Code Table

| Error Code | Discription                                                          | Note                                                                                                                                          |
|------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 01         | Key SW starter signal and start operation for a short time.          | Key switch starter signal was entered in less than 2 seconds interval.<br>PULL action of Engine Stop solenoid was repeated in short interval. |
| 02         | Engine oil pressure decrease after engine starts                     |                                                                                                                                               |
| 03         | After the engine starts, Alternator charge is defective              |                                                                                                                                               |
| 04         | Overheating                                                          | Signal from water temperature switch                                                                                                          |
| 06         | Air cleaner stopped up                                               |                                                                                                                                               |
| 07         | Lift over load                                                       | Lifting overload appeared (more than 1second) after ACC power supply                                                                          |
| 10         | Glow key SW turning on for a long Time                               | Glow key switch had connected more than 10 seconds.                                                                                           |
| 11         | Ignition at time of head Glow                                        | Glow had ignited more than 10 seconds.                                                                                                        |
| 12         | The upper bound of voltage of the battery is abnormal                | Voltage as over 29V had been measured over 0.5 second, after ACC power was supplied or engine was started.                                    |
| 13         | the lower bound of voltage of the battery is abnormal                | Voltage as under 16V had been measured over 2 second, after ACC power was supplied or engine was started.                                     |
| 15         | Clock initialization                                                 | Clock in the controller had been reset.<br>For example, It will happen when Battery have abnormal lower voltage in                            |
| 16         | Engine oil disconnection                                             | Engine oil pressure switch condition was OFF, when key switch was turned on .                                                                 |
| 17         | Alternator charge disconnection                                      | Charge signal was ON, when key switch was turned on .                                                                                         |
| 31         | The upper bound of the voltage of the accelerator sensor is abnormal | Voltage as over 4.8V had been measured over 1.5 second                                                                                        |
| 32         | The lower bound of the voltage of the accelerator sensor is abnormal | Voltage as under 0.2V had been measured over 1.5 second                                                                                       |
| 33         | CAN Communication Error                                              |                                                                                                                                               |