



BT Svenska

SERVICE MANUAL

TOYOTA FBESF 10-15

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FOREWORD

This manual covers the service procedures of the BT Cargo range FBESF 10-15. Please use this manual for providing quick, correct servicing of the corresponding forklift models.

This manual deals with the above models as of April 1996. Please understand that disagreement can **take place** between the descriptions in the manual and actual vehicles due to change in design and specifications. Any change or modifications thereafter will be informed by Toyota Industrial Vehicles' Parts I Service News.

TOYOTA MOTOR CORPORATION

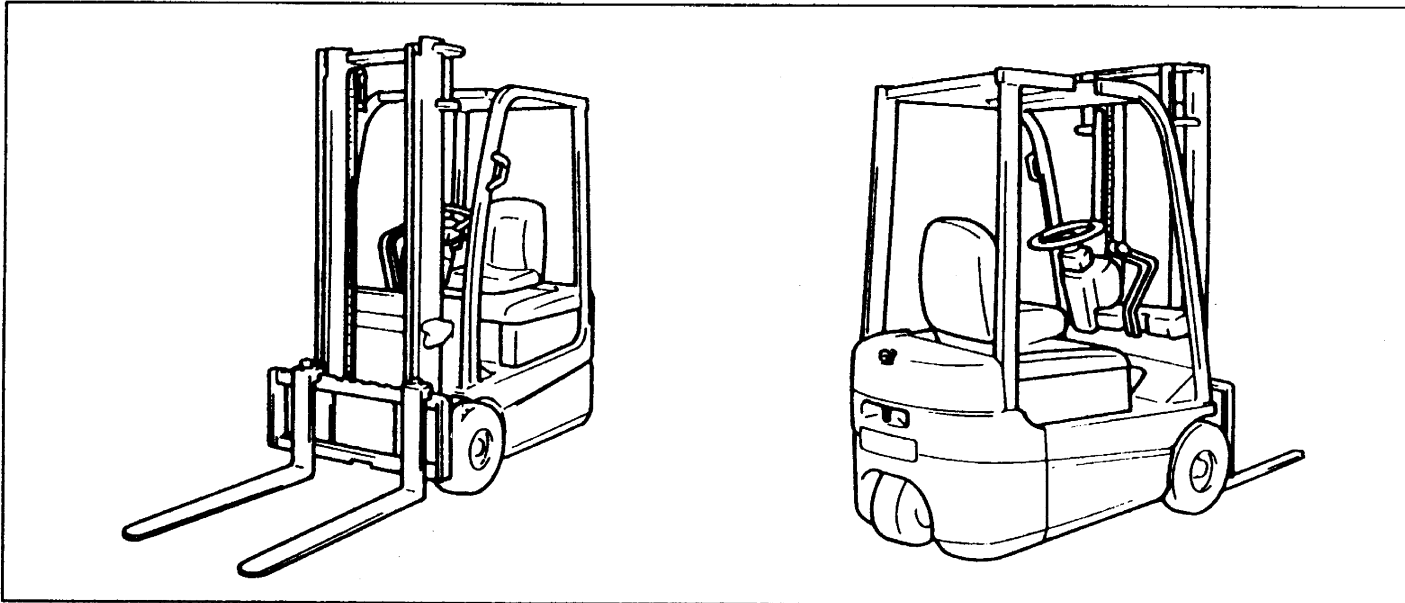
GENERAL

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EXTERIOR VIEWS



VEHICLE MODEL

Material handling capacity ton	Model	Control system	Battery voltage V	Battery capacity AH/5HR	Mast standard lifting high mm	Set lifting high by mast mm			
						V	FV	FSV	FSN
1.0	FBESF10	Microprocessor	24	500 600 700 720	3300				
1.2	FBESF12			600 700 720 840		3000 }	3000 }	3700 }	3700 }
1.5	FBESF15			700 800 840 960		5000	4000	6000	6000

FRAME NUMBER

Material handling capacity ton	Model	Punching type	Punching position
1.0	FBESF10	FBESF15-10001	
1.2	FBESF12		
1.5	FBESF15		

HOW TO READ THIS MANUAL

EXPLANATION METHOD

1. Operation procedure

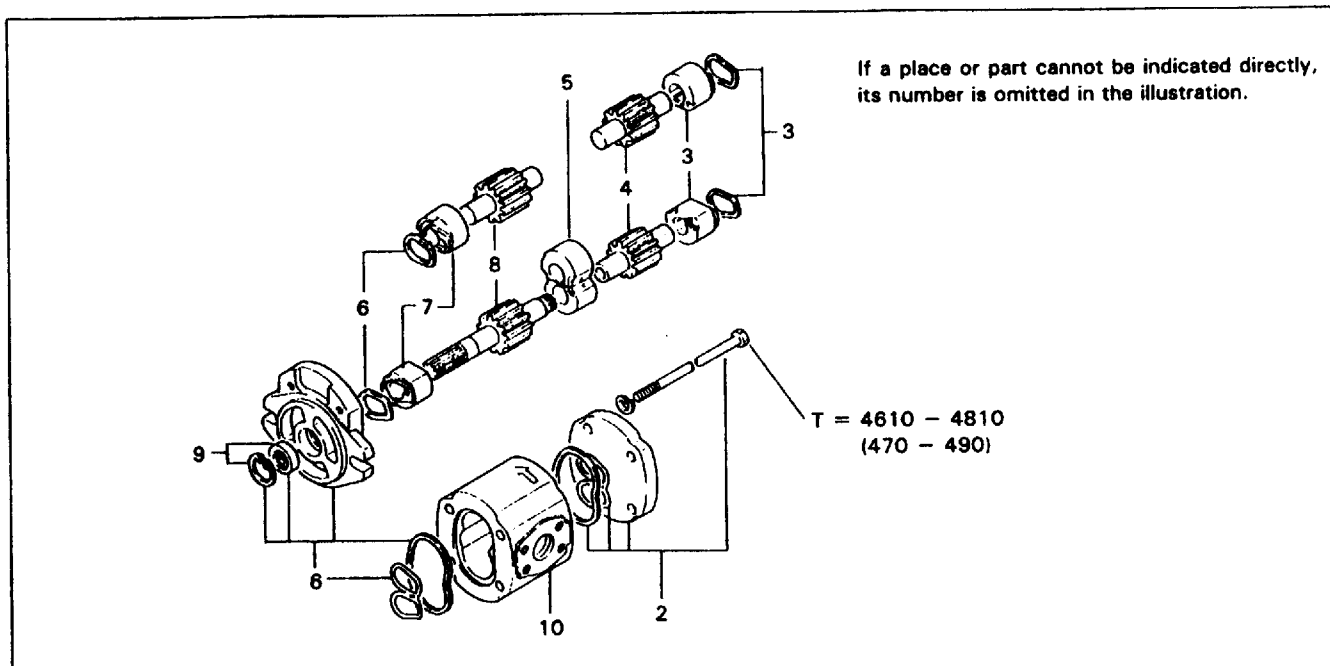
(1) The operation procedure is described in either pattern A or pattern B below.

Pattern A: Explanation of each operation step with illustration.

Pattern B: Explanation of operation procedure by indicating step numbers in one illustration, followed by explanation of cautions and notes summarized as point operations.

Example of description in pattern B

DISASSEMBLY · INSPECTION · REASSEMBLY Tightening torque unit $T = \text{N} \cdot \text{m} (\text{kgf} \cdot \text{cm}) [\text{ft} \cdot \text{lbf}]$



Disassembly Procedure

- 1 Remove the cover. [Point 1]
- 2 Remove the bush [Point 2] ← Operation explained later
- 3 Remove the gear.

Point operations Explanation of key point for operation with an illustration

[Point 1]

Disassembly: Put a match mark when removing the pump cover.

[Point 2]

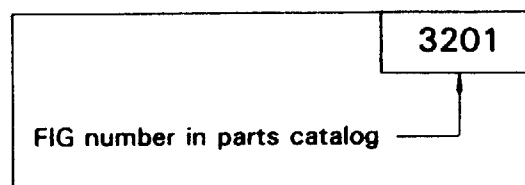
Inspection: Measure the bush inside diameter.

Bush inside diameter limit: 19.12mm (0.7528 in)

2. How to read components figures

- (1) The components figure use the illustration in the parts catalog for the vehicle model. Please refer to the catalog for checking the part name.
The number at the right shoulder of each components figure indicates the Fig. number in the parts catalog.

(Example)



3. Matters omitted in this manual

- (1) This manual omits description of the following jobs, but perform them in actual operation:
- ① Cleaning and washing of removed parts as required
 - ② Visual inspection (Partially described)

TERMINOLOGY

Caution:

Important matters of which negligence may cause accidents. Be sure to observe them.

Note:

Important items of which negligence may cause accidents or matters in operation procedure requiring special attention.

Standard: Values showing allowable range in inspection and adjustment.

Limit: Maximum or minimum allowable value in inspection or adjustment.

ABBREVIATIONS

Abbreviation (code)	Meaning	Abbreviation (code)	Meaning
ASSY	Assembly	RR	Rear
EPS	Electrical power steering	SAE	Society of automotive engineers (USA)
FR	Front	SST	Special service tool
L/	Less	STD	Standard
LH	Left hand	T =	Tightening torque
OPT	Option	OOT	Number of teeth(OO)
O/S	Oversize	U/S	Undersize
PS	Power steering	W/	With
RH	Right hand		

ELECTRICAL SYMBOLS

Symbol	Meaning	Symbol	Meaning
BATT	BATTERY	SW _S	SEAT SWITCH
CS _D	DRIVE CURRENT SENSOR	SW _{KY}	KEY SWITCH
CS _P	PUMP CURRENT SENSOR	SW _L	LIGHT SWITCH
F0	MOTOR FUSE	SW _F	FLASHER SWITCH
F4	LAMP FUSE	SW _H	HORN SWITCH
F5	CONTROL CIRCUIT FUSE	SW _{WP}	WIPER SWITCH
F _{WP}	WIPER FUSE	PRS	PRESSURE SWITCH
DM _D	DRIVE MOTOR	PL _B	BRUSH PILOT LAMP (OPT)
DM _P	PUMP MOTOR	L _{H-L}	HEAD LAMP LH
DM _{WP}	WIPER MOTOR	L _{H-R}	HEAD LAMP RH
TMD	DRIVE MAIN TRANSISTOR	L _{T-L}	TAIL LAMP LH
TMP	PUMP MAIN TRANSISTOR	L _{T-R}	TAIL LAMP RH
VRAD	DRIVE ACCEL VARI-OHM	L _W	WORKING LAMP
DF ₁	FLY-WHEEL DIODE, NO. 1	L _{F-LR}	FLASHER LAMP LH (REAR)
DF ₂	FLY-WHEEL DIODE, NO. 2	L _{F-RR}	FLASHER LAMP RH (REAR)
DF ₃	FLY-WHEEL DIODE, NO. 3	L _{F-L}	FLASHER LAMP LH
MF	FORWARD CONTACTOR	L _{F-R}	FLASHER LAMP RH
MR	REVERSE CONTACTOR	L _{ST-L}	STOP LAMP LH
MB	BATTERY CONTACTOR	L _{ST-R}	STOP LAMP RH
DS _F	FORWARD DIRECTION SWITCH	L _{BU-L}	BACK-UP LAMP LH
DS _R	REVERSE DIRECTION SWITCH	L _{BU-R}	BACK-UP LAMP RH
DS _{F0}	FORWARD OPTIONAL DIRECTION SWITCH	B _Z	BUZZER
DS _{BU}	BACK-UP DIRECTION SWITCH	H	HORN
LS _{L1}	LIFT LIMIT SWITCH NO. 1	FR _Y	FLASHER RELAY
LS _{L2}	LIFT LIMIT SWITCH NO. 2	HM	METER HOUR
LS _T	TILT LIMIT SWITCH	BDI	BATTERY DISCHARGE INDICATOR
LS _{ATT1}	ATTACHEMENT LIMIT SWITCH 1	FAN	FAN
LS _{ATT2}	ATTACHEMENT LIMIT SWITCH 2		
LS _{ST}	STOP LAMP LIMIT SWITCH		

OPERATIONAL TIPS

- 1. Safe operation**
 - (1) After jacking up, always support with rigid stands.
 - (2) When hoisting the vehicle or its heavy component, use wire rope(s) with a sufficient load capacity.
 - (3) Always disconnect the battery plugs before the inspection or servicing of electrical parts.
- 2. Protection of functional parts**
 - (1) After the end of vehicle inspection and/or maintenance, carefully check each connector for perfect connection without omission before battery plug connection.
Omission of connection of any connector related to the controller, especially, may cause failure of controller internal elements.
- 3. Tactful operation**
 - (1) Prepare the mechanic tools, necessary measuring instruments (circuit tester, megger, pressure gauge, etc.) and SSTs before starting operation.
 - (2) Before disconnecting wiring, always check the cable color and wiring state.
 - (3) When overhauling functional parts, complicated portions or related mechanisms, arrange them neatly to prevent confusion.
 - (4) When disassembling and inspecting precision parts such as the control valve, use clean rags and operate in a clean location.
 - (5) Follow the described procedures for disassembly, inspection and reassembly.
 - (6) Replace, gaskets, packings and O-rings with new ones each time of disassembly.
 - (7) Use genuine Toyota parts for replacement.
 - (8) Use specified bolt and nuts. Observe the specified tightening torque at the time of reassembly. If no tightening torque is specified, tighten the bolt or nut according to the standard tightening torque table.
- 4. Grasping the problem**

When a problem occurs, do not attempt immediate disassembly or replacement but first see if the trouble requires disassembly or replacement for remedying.

CIRCUIT TESTER

Circuit testers are available in both the analog and digital types. They should be used selectively according to the purpose of measurement.

Analog type: This type is convenient for observing movement during operation, but the measured value should only be used for reference or rough judgement.

Digital type: Fairly accurate reading is possible, but it is difficult to observe the variation or movement.

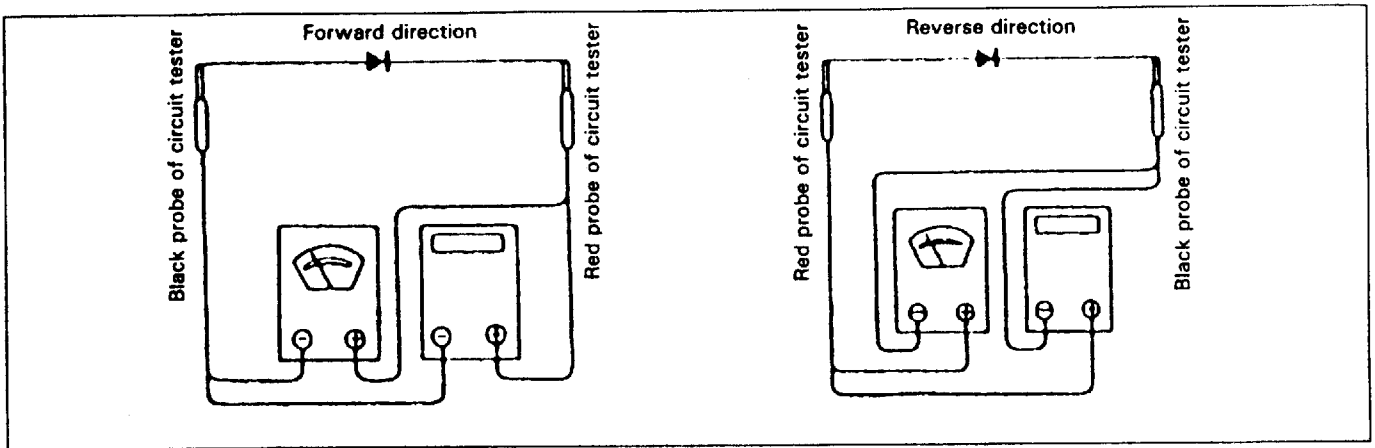
1. Difference in measurement results with the digital type and analog type

- * The result may be different between measurements with the analog type and digital type. Always use a circuit tester according to its operation manual. Cautions when the polarities are different between the analog type and digital type are described below.

Circuit tester range

Analog type → kΩ range

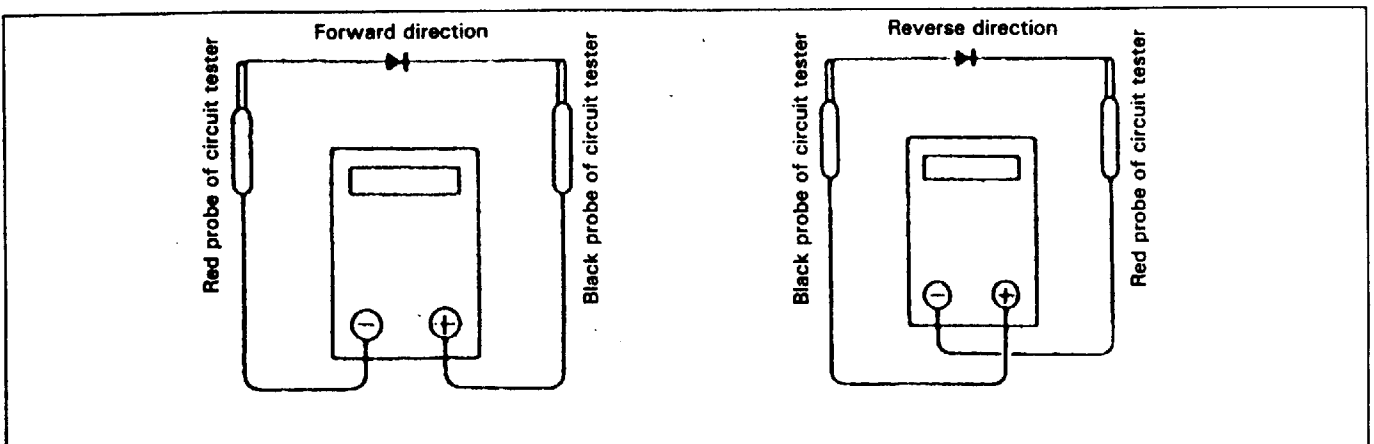
Digital type → 2 MΩ range



Measurement result example

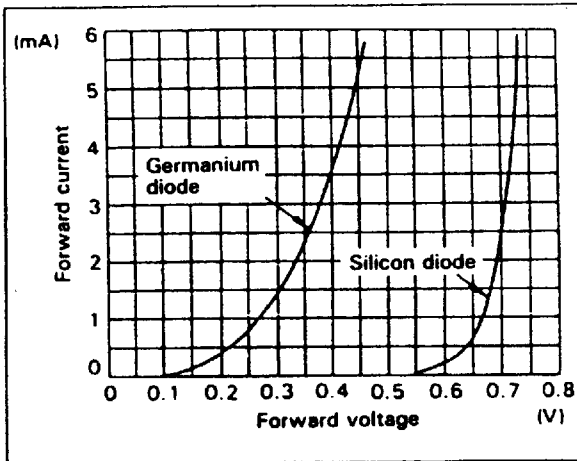
	Analog type	Digital type
Forward	Continuity shall exist	No continuity
	11 KΩ	1
Reverse	No continuity	Continuity shall exist
	∞	2 MΩ

As seen from the example above, the measurement results with the analog and digital types are reverse. In measurement with a digital type circuit tester, therefore, use the tester probes as shown below.



2. Difference in result of measurement with circuit tester

The circuit tester power supply voltage depends on the tester type. 1.5 V, 3.0 V or 6.0 V is used. The resistance of a semiconductor such as a diode varies with the circuit tester power supply voltage. The diode characteristics are shown in the figure below.

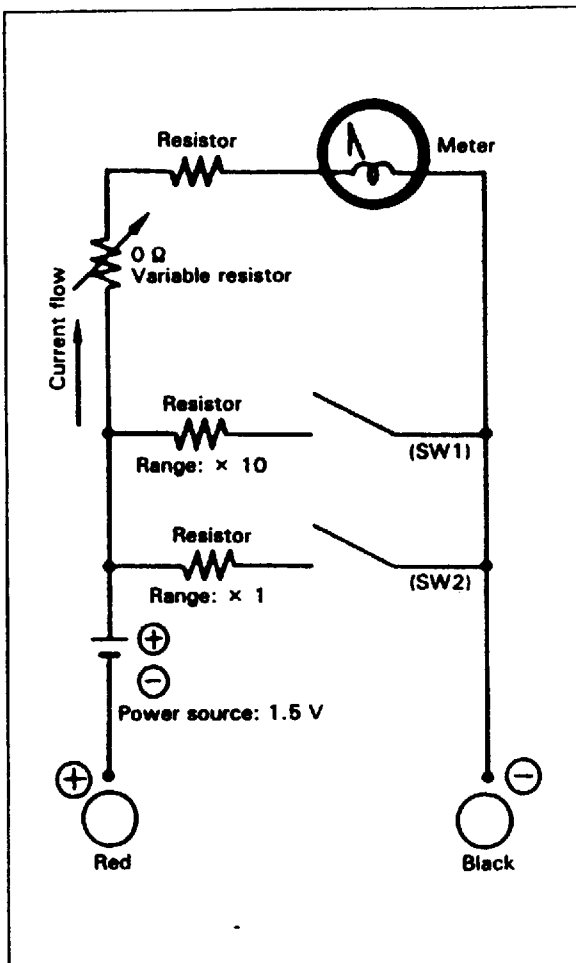


The resistance values of the same semiconductor measured with two types of circuit testers having different power supply voltages are different.

This manual describes the results of measurement with a circuit tester whose power supply voltage is 3.0 V.

3. Difference in measurement result by measurement range (analog type)

In the analog type circuit tester, changing the measurement range switches over the internal circuit to vary the circuit resistance. Even when the same diode is measured, the measurement result varies with the measurement range.



Always use the range described in the repair manual for measurement.

STANDARD BOLT & NUT TIGHTENING TORQUE

Standard bolt and tightening torques are not indicated.
Judge the standard tightening torque as shown below.

- Find out the type of the bolt from the list below and then find the bolt tightening torque from the table.
- The nut tightening torque can judged from the mating bolt type.

BOLT STRENGTH TYPE IDENTIFICATION METHOD

1. Identification by bolt shape

	Shape and class	Class
Hexagon head bolt	 Bolt head No.	4 = 4T 5 = 5T 6 = 6T 7 = 7T 8 = 8T
	 No mark	4T
Hexagon flange bolt	 No mark	4T
Hexagon head bolt	 Two protruding lines	5T
Hexagon flange bolt	 Two protruding lines	6T
Hexagon head bolt	 Three protruding lines	7T
Hexagon head bolt	 Four protruding lines	8T
Welded bolt		4T
Stud bolt	 No mark	4T
	 Grooved	6T

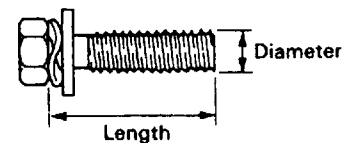
2. Identification by part No.

Hexagon head bolt

Parts No.

91611-40625

Length (mm)
Diameter (mm)
Class

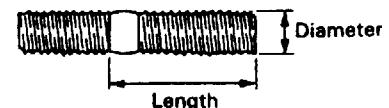


Stud bolt

Parts No.

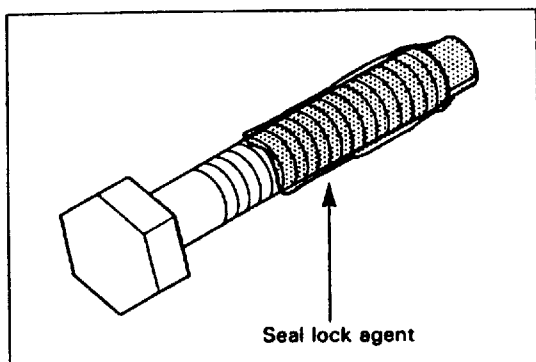
92132-40614

Length (mm)
Diameter (mm)
Class



TIGHTENING TORQUE TABLE

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt 			Hexagon flange bolt 		
			N·m	kgf·cm	ft-lbf	N·m	kgf·cm	ft-lbf
4T	6	1.0	5.4	55	48 in-lbf	5.9	60	52 in-lbf
	8	1.25	13	130	9	14	145	10
	10	1.25	25	260	19	28	290	21
	12	1.25	47	480	35	53	540	39
	14	1.5	75	760	55	83	850	61
	16	1.5	113	1150	83	—	—	—
5T	6	1.0	6.4	65	56 in-lbf	7.5	75	65 in-lbf
	8	1.25	16	160	12	18	175	13
	10	1.25	32	330	24	36	360	26
	12	1.25	59	600	43	65	670	48
	14	1.5	91	930	67	100	1050	76
	16	1.5	137	1400	101	157	1600	116
6T	6	1.0	7.8	80	69 in-lbf	8.8	90	78 in-lbf
	8	1.25	19	195	14	21	215	16
	10	1.25	38	400	29	43	440	32
	12	1.25	72	730	53	79	810	59
	14	1.5	110	1100	80	123	1250	90
	16	1.5	170	1750	127	191	1950	141
7T	6	1.0	11	110	8	12	120	9
	8	1.25	25	260	19	28	290	21
	10	1.25	52	530	38	58	590	43
	12	1.25	95	970	70	103	1050	76
	14	1.5	147	1500	108	167	1700	123
	16	1.5	226	2300	166	—	—	—
8T	6	1.0	12	125	9	14	145	9
	8	1.25	29	300	22	32	330	24
	10	1.25	61	620	45	68	690	50
	12	1.25	108	1100	80	123	1250	90
	14	1.5	172	1750	127	196	2000	145
	16	1.5	265	2700	195	299	3050	221



PRECOAT BOLTS

(Bolts with seal lock agent coating on threads)

1. Do not use the precoat bolt as it is in either of the following cases.
 - (a) After is removed.
 - (b) When the precoat bolt is moved (loosened or tightened) by tightness check, etc.

Note:

For torque check, use the lower limit of the allowable tightening torque range. If the bolt moves, retighten it according to the steps below.

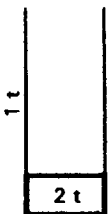
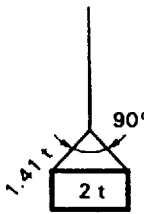
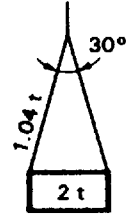
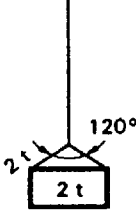
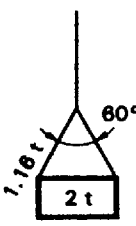
2. Method for reuse of precoat bolts
 - (1) Wash the bolt and threaded hole. (The threaded hole must be washed even for replacement of the bolt.)
 - (2) Perfectly dry the washed parts by air blowing.
 - (3) Coat the specified seal lock agent to the threaded portion of the bolt.

HIGH PRESSURE HOSE FITTING TIGHTENING TORQUE

1. When connecting a high pressure hose, wipe the hose fitting and mating nipple contact surfaces with clean cloth to remove foreign matters and dirt. Also check no dent or other damage on the contact surfaces before installation.
2. When connecting a high pressure hose, hold the hose to align the fitting with the nipple and tighten the fitting.
3. The maximum tightening torque must not exceed twice the standard tightening torque.

Nominal diameter of screw	Standard tightening torque N·m (kgf·cm) [ft·lbf]		Hose inside diameter mm (in)
	Standard	Tightening range	
7/16 – 20UNF	25 (250) [18.1]	24 ~ 26 (240 ~ 270) [17.4 ~ 19.5]	6 (0.24)
9/16 – 18UNF	49 (500) [36.2]	47 ~ 52 (480 ~ 530) [34.7 ~ 38.3]	9 (0.35)
3/4 – 16UNF	59 (600) [43.4]	56 ~ 62 (570 ~ 630) [41.2 ~ 45.6]	12 (0.47)
7/8 – 14UNF	59 (600) [43.4]	56 ~ 62 (570 ~ 630) [41.2 ~ 45.6]	12 (0.47)
7/8 – 14UNF	78 (800) [57.9]	74 ~ 82 (760 ~ 840) [55.0 ~ 60.8]	15 (0.59)
1.1/16 – 12UNF	118 (1200) [86.8]	112 ~ 123 (1140 ~ 1250) [82.5 ~ 90.4]	19 (0.75)
1.5/16 – 12UNF	137 (1400) [101.3]	130 ~ 144 (1330 ~ 1470) [96.2 ~ 106.4]	25 (0.98)
PF1/4	25 (250) [18.1]	24 ~ 26 (240 ~ 270) [17.4 ~ 19.5]	6 (0.24)
PF3/8	49 (500) [36.2]	47 ~ 52 (480 ~ 530) [34.7 ~ 38.3]	9 (0.35)
PF1/2	59 (600) [43.4]	56 ~ 62 (570 ~ 630) [41.2 ~ 45.6]	12 (0.47)
PF3/4	118 (1200) [86.8]	112 ~ 123 (1140 ~ 1250) [82.5 ~ 90.4]	19 (0.75)
PF1	137 (1400) [101.3]	130 ~ 144 (1330 ~ 1470) [96.2 ~ 106.4]	25 (0.98)

WIRE ROPE SUSPENSION ANGLE LIST

Suspension angle	Tension	Compression	Suspension method	Suspension angle	Tension	Compression	Suspension method
0°	1.00 time	0 time		90°	1.41 time	1.00 time	
30°	1.04 time	0.27 time		120°	2.00 time	1.73 time	
60°	1.16 time	0.58 time					

SAFE LOAD FOR EACH WIRE ROPE SUSPENSION ANGLE Unit: N (ton) [lbf]

Rope diameter	Cutting load	Single-rope suspension	Two-rope suspension					Four-rope suspension			
		0°	0°	30°	60°	90°		0°	30°	60°	90°
6mm (0.24in)	21380 (2.18) [4807]	3040 (0.31) [683.6]	6080 (0.62) [1367]	5880 (0.6) [1323]	5200 (0.53) [1169]	4310 (0.44) [970]		12160 (1.24) [2734]	11770 (1.2) [2646]	10400 (1.06) [2337]	8630 (0.88) [1940]
8mm (0.32 in)	31480 (3.21) [7078]	4410 (0.45) [992.3]	8830 (0.9) [1985]	8530 (0.87) [1918]	7650 (0.78) [1720]	6280 (0.64) [1411]		17650 (1.8) [3969]	17060 (1.74) [3937]	15300 (1.56) [3440]	12550 (1.28) [2322]
10mm (0.4 in)	49230 (5.02) [11069]	6960 (0.71) [1565.6]	14020 (1.43) [3153]	13440 (1.37) [3021]	11770 (1.2) [2646]	9810 (1.0) [2205]		27460 (2.8) [6174]	26480 (2.7) [5954]	23540 (2.4) [5292]	19610 (2.0) [4410]
12.5mm (0.5 in)	76880 (7.84) [17387]	10980 (1.12) [2469.5]	21570 (2.2) [4851]	21280 (2.1) [4631]	18630 (1.9) [4190]	14710 (1.5) [3308]		43150 (4.4) [9702]	41190 (4.2) [9261]	37270 (3.8) [8379]	29420 (3.0) [6615]
14mm (0.56 in)	96400 (9.83) [21675]	13730 (1.4) [3087]	27460 (2.8) [6174]	26480 (2.7) [5954]	23540 (2.4) [5292]	18630 (1.9) [4190]		54920 (5.6) [12348]	52960 (5.4) [11907]	47070 (4.8) [10584]	37270 (3.8) [8379]

COMPONENTS WEIGHT

Parts	Weight (kg)
Drive motor	Approx. 44
Material handling motor	Approx. 44
Mast w/lift bracket (w/lift cylinder, L/fork) (mast lifting height)	Approx. 434
Drive unit assy	Approx. 66
Drive tire assy	Approx. 28.5
Controller assy	Approx. 21
Battery assy	See page (P1-2).

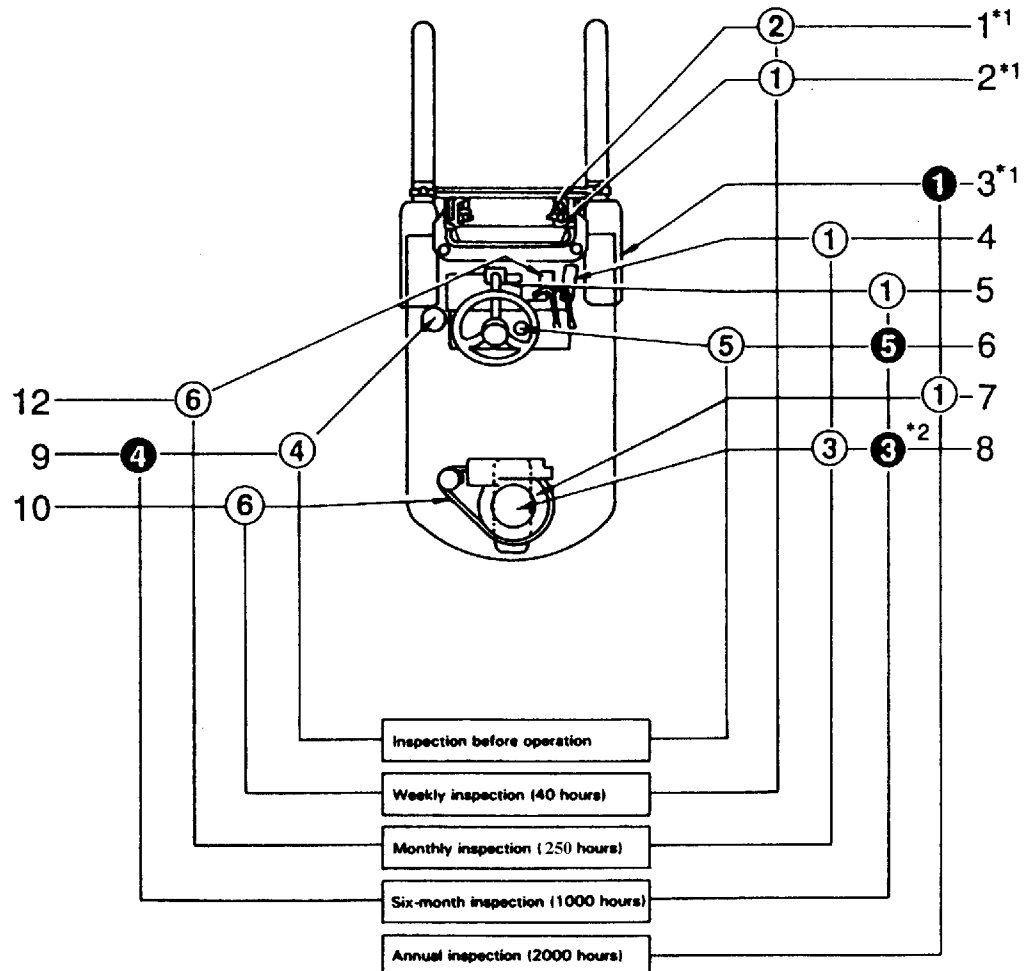
RECOMMENDED LUBRICANT QUANTITY & TYPES

Item	Type	Quantity
Drive unit	Hypoid gear oil SAE80W-90 (API GL-5)	4.5 ℓ
Hydraulic oil (total volume)	Hydraulic oil ISO VG32	17.5 ℓ (*1) 22.5 ℓ (*2)
Brake line	SAEJ-1703 DOT-3	As needed
Chassis and mast	MP Grease No.2	As needed

*1: For mast lifting height of 3000 mm

*2: For mast lifting height of 6000 mm

LUBRICATION CHART



○: Inspection and replenishment

●: Replacement

* Parts available on both sides

① MP Grease

② Engine Oil

③ Hypoid Gear Oil

④ Brake Fluid

⑤ Hydraulic Oil

⑥ Dry lubricant with disulfide molybdenum for coating

For the oil/grease types, see the recommended lubricant quantities and types.

1 Lift chain

2 Mast strip

3 Front axle hub

4 Brake fluid reservoir tank

5 Oil control valve ring pin

6 Accelerator pedal link

7 Tilt steering lock system

8 Brake pedal link

9 Oil tank

10 Steering chain

11 Limit switch roller

12 Drive unit turn table

13 Drive unit

Totaldokument

TOYOTA FBESF 10-15

Var 250:e timme**Pos Kontrollav:**

0:0	Grupp 0 Hel maskin
0:1	Dörrar/luckor
0:2	Motviktsinfästning
0:3	Förarskydd/hytt
0:4	Batterilåsning
0:5	Skyltar/dekal
0:6	Förarmiljö
0:7	Stol/mattor
0:8	Pedal gummin
0:9	Torkare/spolare
0:10	Provkörning test av samtliga funktioner
0:11	Smörjning enligt schema

1:0 Grupp 1 Motorer

1:1	Missljud
1:2	Fastsättning/infästning

2:0 Grupp 2 Kraftöverföring

2:1	Oljenivå
2:2	Fastsättning

Pos Kontrollav:

3:0	Grupp 3 Bromsar/hjul
3:1	Däck/hjul
3:2	Lufttryck däck
3:3	Hjulsbultar
3:4	Färdbroms, funktion/läckage
3:5	Parkeringsbroms
3:6	Bromsvätskenivå
3:7	Pedallänkage/pedalspel

4:0 Grupp 4 Styrning

4:1	Styrkedja, kontroll/justering
4:2	Styrmotor, fastsättning
4:3	Styrlagring/upphängning

5:0 Grupp 5 Elsystem

5:1	Belysning/körriktningsvisare
5:2	Instrument/kontrollampor
5:3	Signalhorn
5:4	P-broms-/Backalarm
5:5	Timmätare, avläsning
5:6	Färdväljare/länkage
5:7	Kablar/anslutningar
5:8	Startfrekvens

Pos Kontrollav:

5:9	Accelerationspedal/fartreglage
5:10	Microbrytare
5:11	Kontakter/kontakter
5:12	Säkringar
5:13	Batterivätskenivå
5:14	Batteri, smuts/läckage
5:15	Batterianslutningar
5:16	Batteripoler reng./infettning
5:17	Batterihandskar, kontroll

6:0 Grupp 6 Hydraulik

6:1	Slangar/rör
6:2	Ventilreglage/länkage
6:3	Andningsfilter/ventilatorer
6:4	Oljenivå

7:0 Grupp 7 Arbetsfunktion

7:1	Lyftstativ
7:2	Gafflar
7:3	Lyftkedjor
7:4	Laststöd
7:5	Lyft-/tiltcylindrar

Var 500:e timme tillkommer:**1:0 Grupp 1 Motorer**

1:3	Drivmotor, renblåsning
1:4	Pumpmotor, renblåsning
1:5	Motorer, isolationsprov

5:0 Grupp 5 Elsystem

5:18	Batteri, isolationsprov
------	-------------------------

Var 1000:e timme tillkommer:**1:0 Grupp 1 Motorer**

1:6	Drivmotorkol, kontroll
1:7	Pumpmotorkol, kontroll

2:0 Grupp 2 Kraftöverföring

2:3	Drivväxel, oljebyte
-----	---------------------

3:0 Grupp 3 Bromsar/hjul

3:8	Hjullager infettning
3:9	Bromsvätska byte

6:0 Grupp 6 Hydraulik

6:5	Hydraulolja, byte
6:6	Sugfilter, rengöring/byte
6:7	Andningsfilter, reng./byte

Var 2000:e timme tillkommer:**0:0 Grupp 0 Hel maskin**

0:12	Ram, kontroll av sprickor
0:13	Bultar/Muttrar, fastsättning

1:0 Grupp 1 Motorer

1:8	Kolfjädrar, styrka
-----	--------------------

3:0 Grupp 3 Bromsar/hjul

3:10	Läckage
3:11	Hjulsbroms, slitagekontroll
3:12	Framaxel, sprickor/deformering

4:0 Grupp 4 Styrning

4:4	Slangar, kontroll
-----	-------------------

5:0 Grupp 5 Elsystem

5:19	Batteribelastningsprov
5:20	Motorström, mätning

6:0 Grupp 6 Hydraulik

6:8	Hydraultryck, kontroll
-----	------------------------

7:0 Grupp 7 Arbetsfunktion

7:6	Gafflar, gaffeltest
-----	---------------------

FBESF 10-15

Kapitel 0

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BATTERY

Page

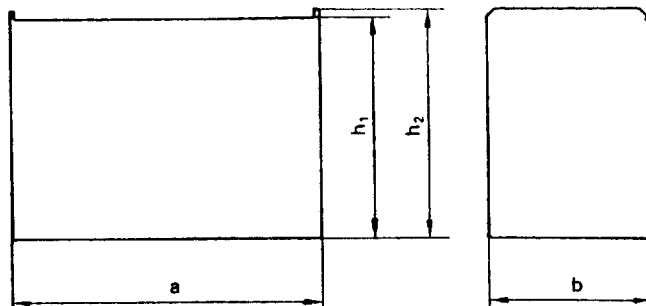
BATTERY COMPARTMENT AND NECESSARY WEIGHT	1-2
MAINTENANCE STANDARD	1-3
BATTERY CAPACITY INDICATOR	1-3
TROUBLESHOOTING	1-3
BATTERY ASSEMBLY	1-4
REMOVAL INSTALLATION	1-4
INSPECTION	1-5

BATTERY COMPARTMENT AND NECESSARY WEIGHT

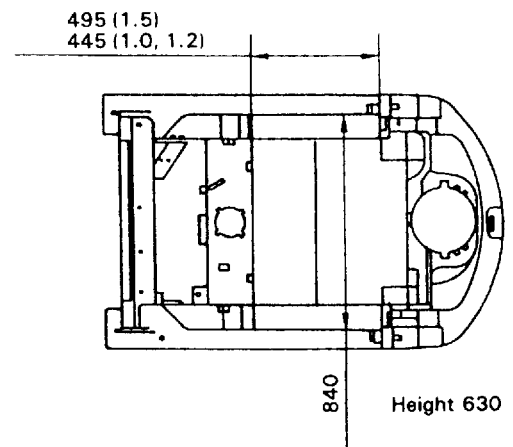
When installing a battery, adjust the weight to satisfy the necessary minimum weight, referring to the table below.

Model		Battery case out-side size (mm)				Necessary minimum battery weight (with case) kg
		Length a	Width b	Height		
				H1	H2	
FBESF10	MIN.	327	830	612	627	445
	MAX.	435				
FBESF12	MIN.	381	830	612	627	524
	MAX.	435				
FBESF15	MIN.	435	830	612	627	600
	MAX.	489				

Battery dimensions

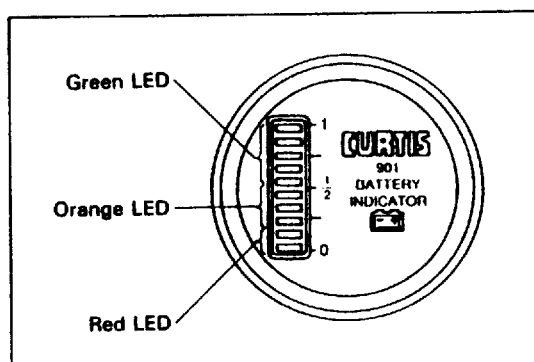


Battery compartment dimensions (mm)



MAINTENANCE STANDARD

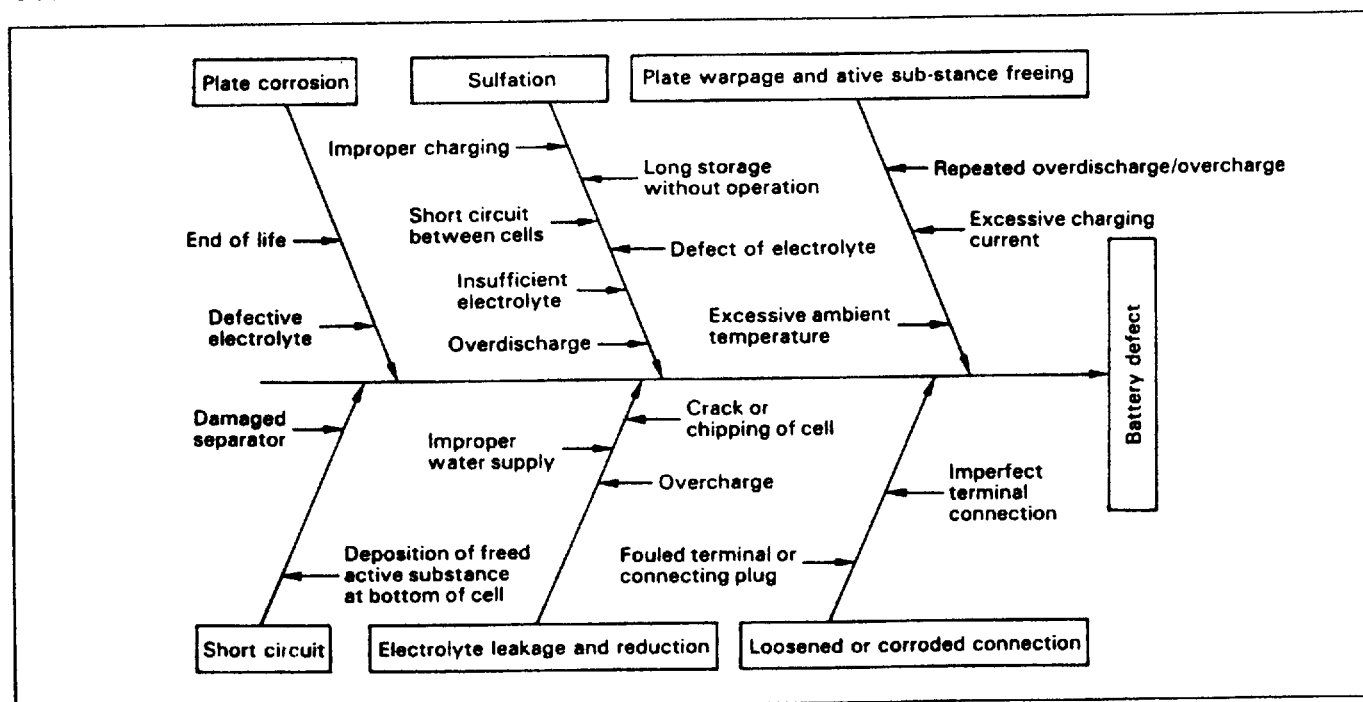
Specific gravity at full charge		1.280 (20°C)
Specific gravity at full discharge		1.150 (20°C)
Voltage at end of discharge	24 V	21.5 V
Electrolyte		Purified dilute sulfuric acid
Filling fluid		Purified water (distilled water)
Insulation resistance		1MΩ or more



BATTERY CAPACITY INDICATOR

The three color LEDs indicate remaining level of the battery fluid. The five LEDs from the FULL position are green, the next 3 LEDs are orange and the last 2 LEDs are red. One of them flashes to indicate the remaining level. When discharge of the battery reaches 70%, the ninth red LED flashes. When it reaches 80%, the ninth and tenth LEDs flash alternately.

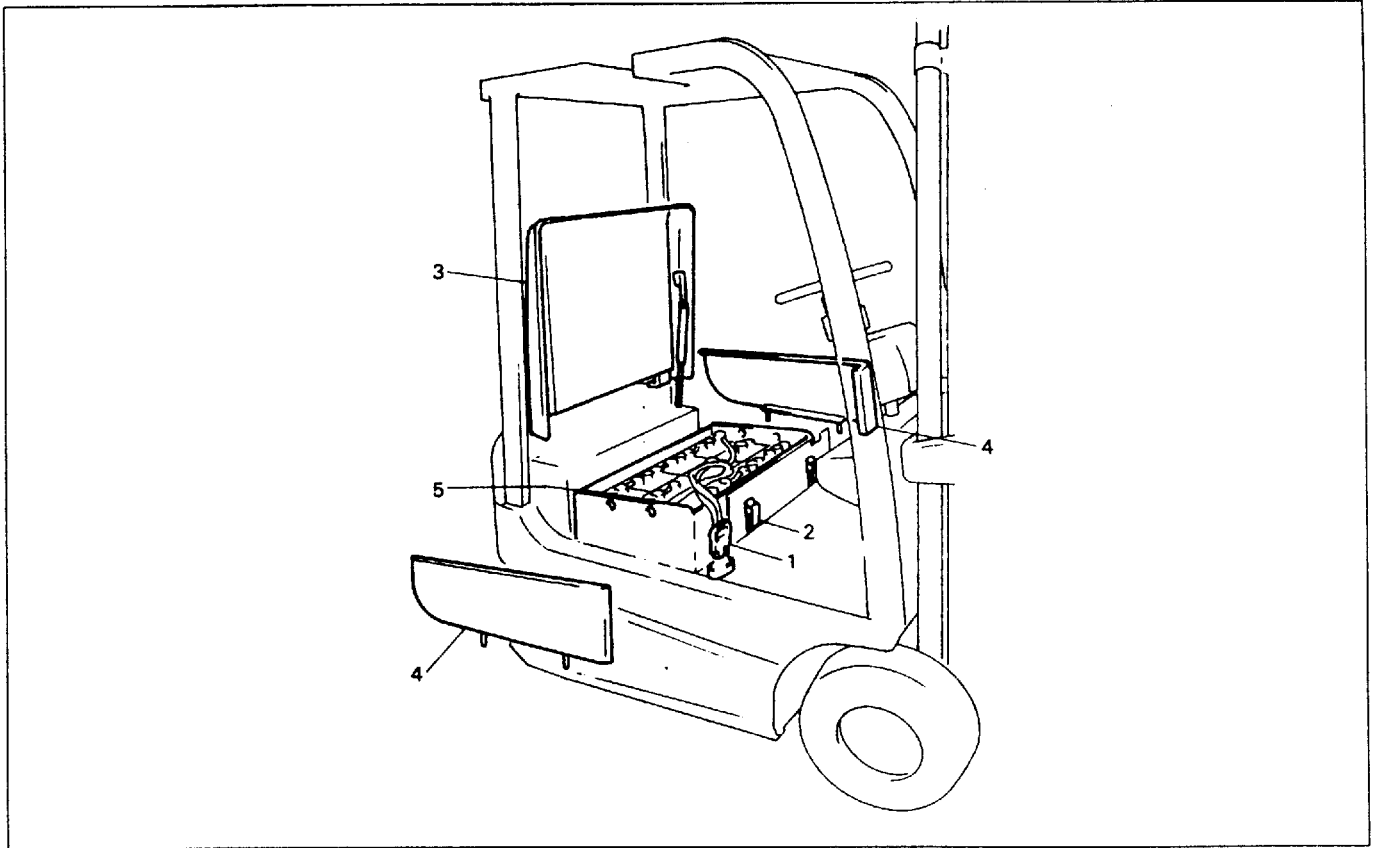
TROUBLESHOOTING



BATTERY ASSEMBLY

REMOVAL-INSTALLATION

Always remove or install the battery under no-load conditions (no cargo loading).

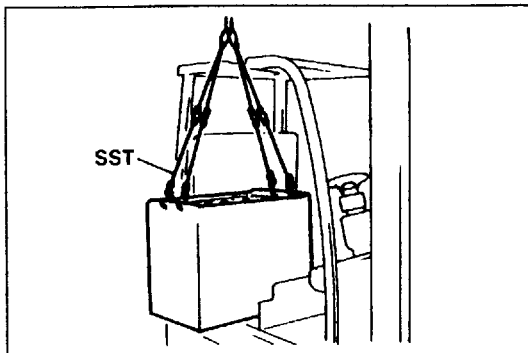


REMOVAL PROCEDURE

- 1 Disconnect the battery plug.
- 2 Remove the battery hood catch.
- 3 Open the battery hood.
- 4 Remove the side cover.
- 5 Remove the battery assembly. [Point 1]

REASSEMBLY PROCEDURE

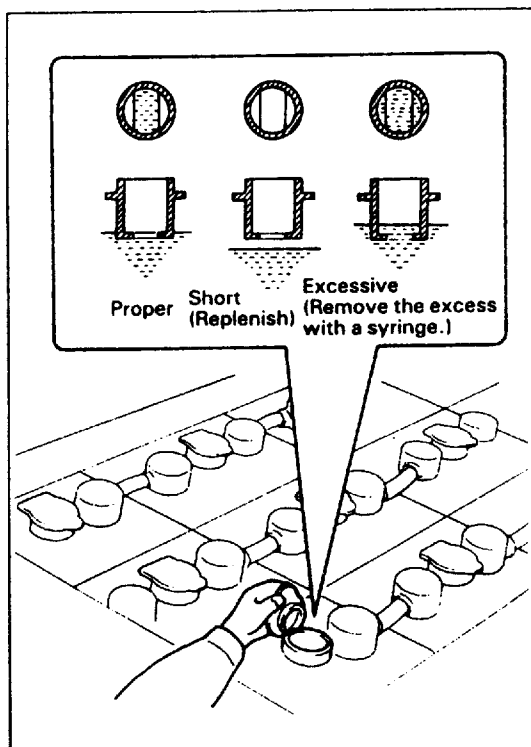
Installation is reverse of the removal procedure.



Point Operation

[Point 1]

Removal-Installations: SST 80201-10250-71



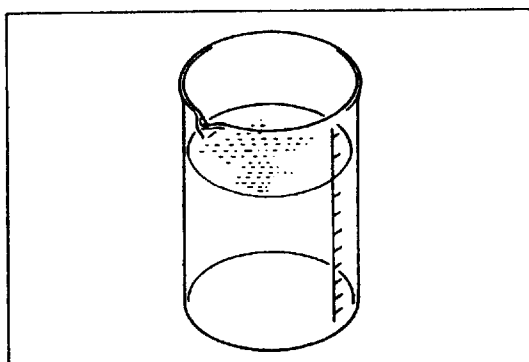
INSPECTION

1. **Electrolyte level inspection**
Open the cap and look inside the battery. If the electrolyte level is low, add distilled water.

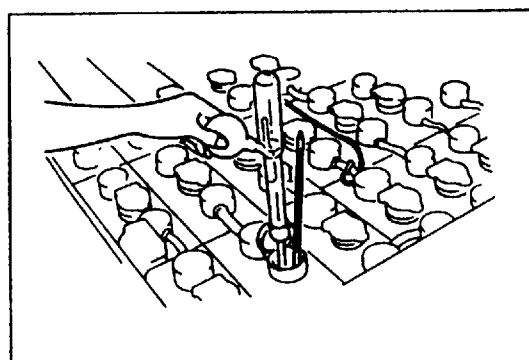
Reference

Electrolyte consumption can be calculated by the following equation:

$$\text{Consumption (cc)} = 5\text{-hour capacity} \times 0.0336 \times \text{number of cells} \times \text{number of charging cycles}$$



2. **Electrolyte inspection**
The battery electrolyte is colorless and transparent in normal state. Inspect any turbidity at the time of specific gravity inspection. If not checked clearly, put the electrolyte in a beaker for inspection.



3. **Battery electrolyte specific gravity inspection**

Use a hydrometer and measure the specific gravity of the electrolyte.

Specific gravity upon perfect charging:

1.280 at 20°C (68°F)

Specific gravity upon end of discharge:

1.150 at 20°C (68°F)

The specific gravity of the electrolyte is expressed with that at 20°C (68°F) as the standard.

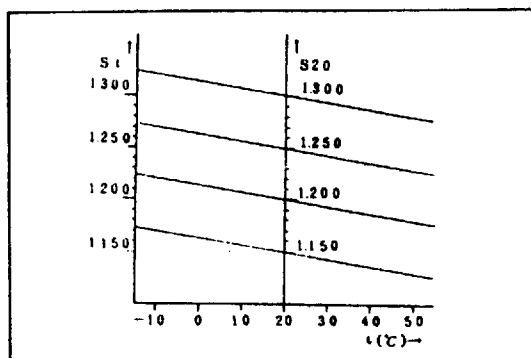
Equation for converting specific gravity

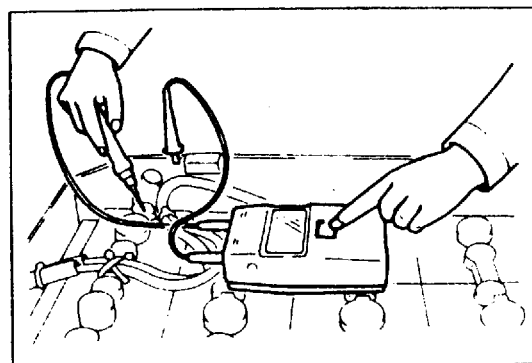
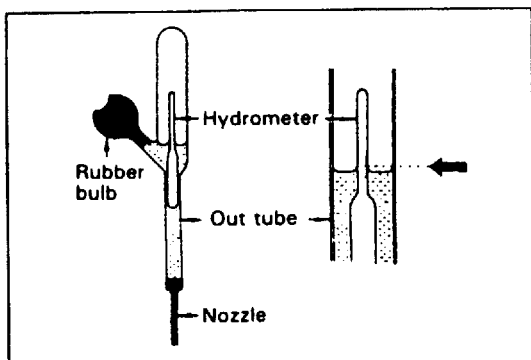
$$S_{20} = S_t + 0.0007 (t - 20)$$

S_{20} : Specific gravity at 20°C

S_t : Specific gravity at t °C

t : Electrolyte temperature (°C) at the time of measurement





* How to use the hydrometer

- ① Insert the nozzle of the hydrometer into the electrolyte port and let the electrolyte be sucked into its outer tube.
- ② Make the hydrometer in the outer tube float correctly without contact with the outer tube, its top or bottom. Wait until the air bubbles in the sucked electrolyte disappear. Read the scale at the top of the raised portion of the surface as shown at left.
- ③ After the measurement, wash the inside and outside of the hydrometer with clear water, and wipe the hydrometer thoroughly with clean cloth for storage.

4. Insulation resistance inspection

Measure the resistance between the battery and battery case with an insulation resistance meter (megger).

Insulation resistance value:

1 MΩ or more

Note:

- When the insulation resistance is less than 1 MΩ, remove the battery from the vehicle and wash it with water.
- After washing with water, make the battery dry thoroughly. Measure the insulation resistance again and install the battery on the vehicle after confirming that it is 1 MΩ or more.

* Battery control table

Prepare a control table for the battery to record and maintain the inspection results.

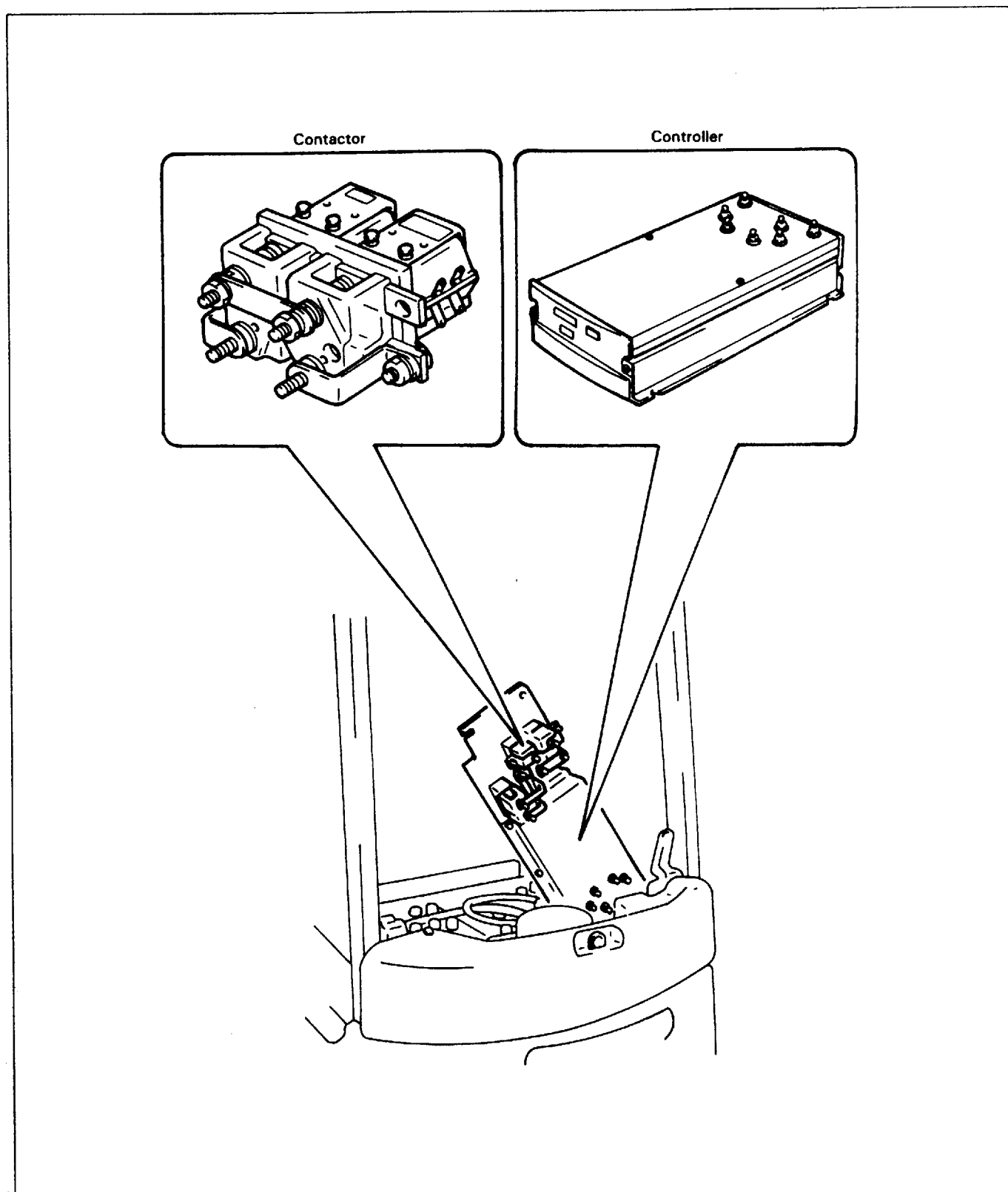
Inspection date and time	Inspected cell No.	Specific gravity	Electrolyte temperature	Added water quantity	Remarks	Inspector

ELECTRICAL SYSTEM

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GENERAL

An integrated micro-computer controller for traveling and material handling is installed on the EC 10~15. The controller has a function for communication with the off-truck analyzer for fault detection as well as functional check of the main drive and material handling circuits, each operating system and sensors to improve the serviceability. For the analyzer, refer to the troubleshooting section (page 3-1).



Portion		FBESF 10-15
Fuse	F ₀ (Drive and material handling circuits)	750 A
	F ₄ (For lamp: OPT)	10 A
	F ₅ (Control circuit)	10 A
Contactor	MF (For forward traveling)	} SW202 (MF and MR combined type)
	MR (For reverse traveling)	
	MB (For battery)	SW200

91659-51230 01

Refer to FIG.2403

BQ BN IL 09

IM

KK

BM IN

KG

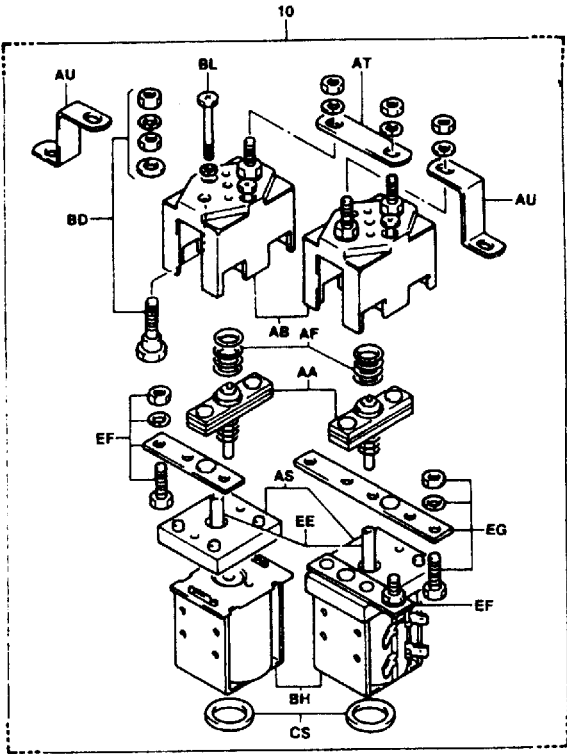
39

EC IE

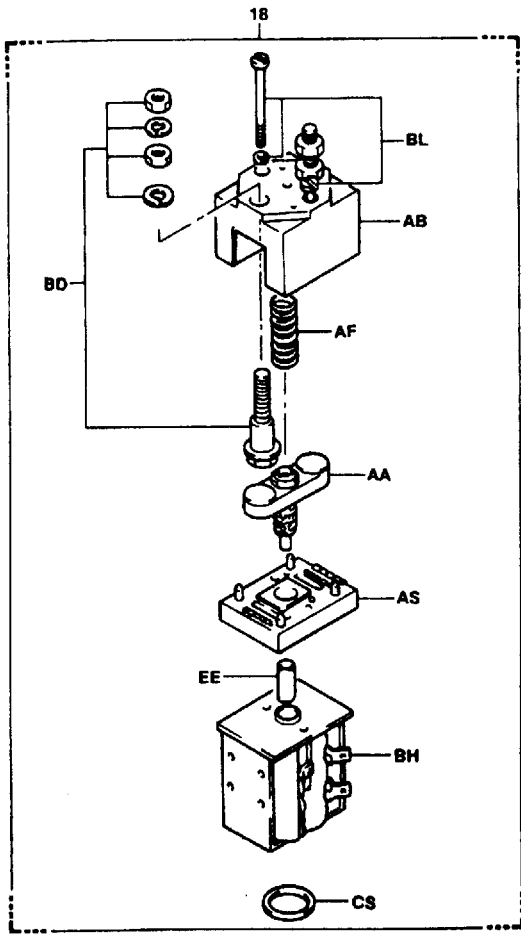
PY

DZ

2403

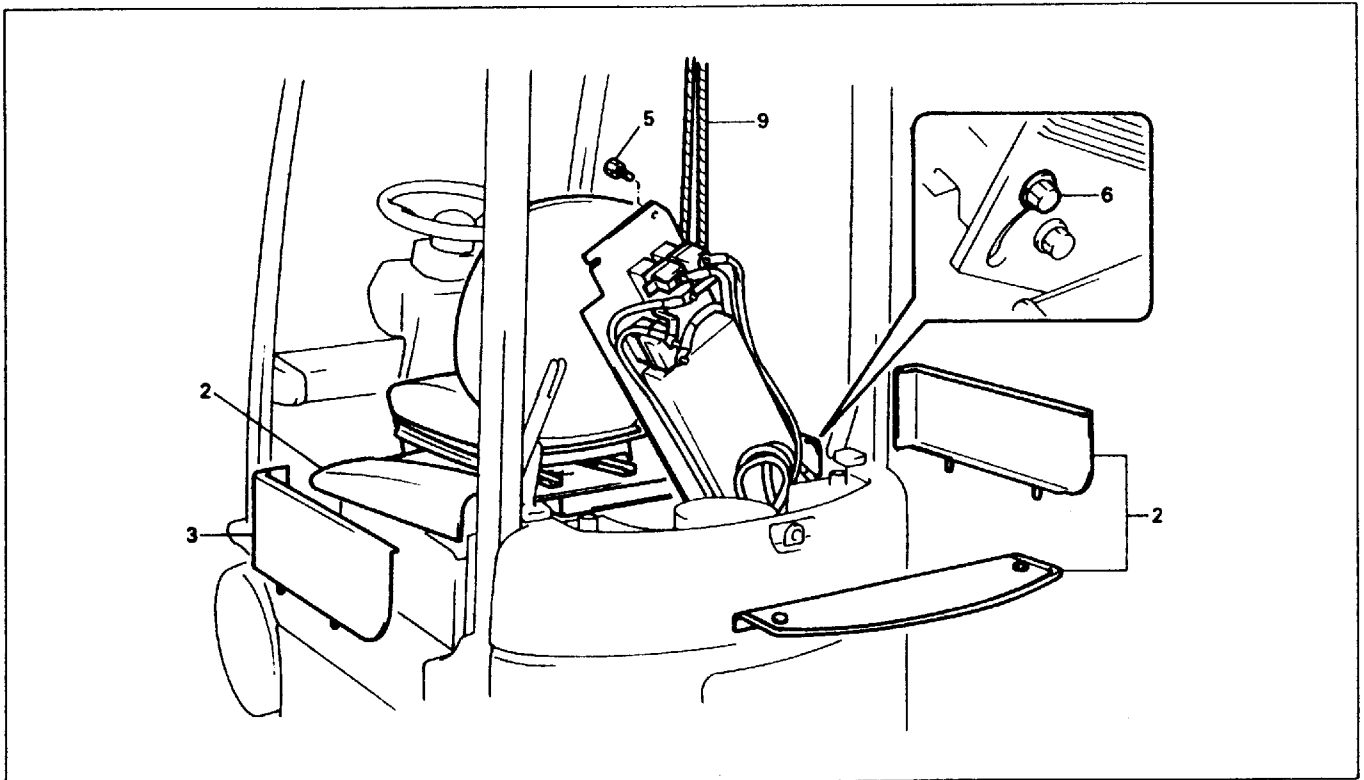


2403



CONTROL PANEL ASSY

REMOVAL · INSTALLATION



Removal Procedure

- 1 Disconnect the battery plug.
- 2 Disconnect the damper only on the hood side, and remove the battery hood.
- 3 Remove the Rear panel and side cover.
- 4 Remove the controller upper cover.
- 5 Loosen the control panel ASSY set bolts. Remove the set bolt at upper left.
- 6 Raise the control panel ASSY and set a bolt at the notched portion of the plate. (Maintenance should generally be performed in this state.)
- 7 Disconnect the connector.
- 8 Disconnect the wiring.
- 9 Remove the control panel ASSY by hoisting it with a wire rope.

Installation Procedure

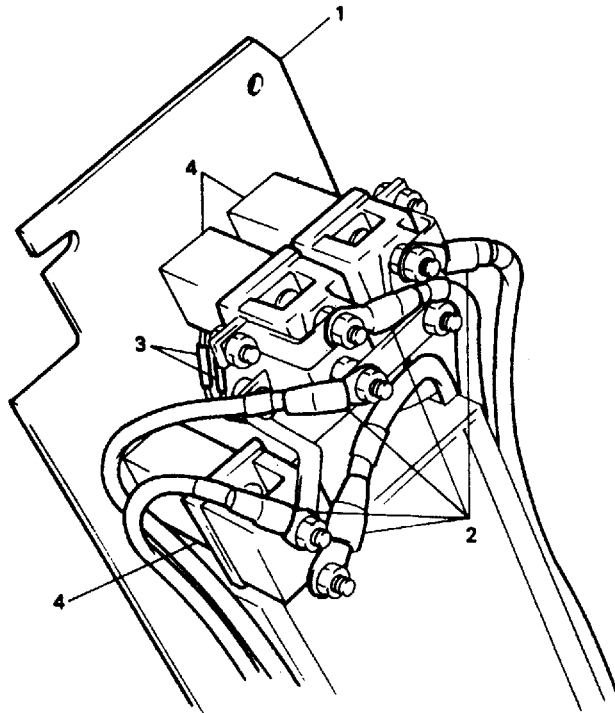
The installation procedure is the reverse of the removal procedure.

Note:

Check the cable connection for omission of or insufficient tightening before connecting the battery plug. If loosened, elements in the control panel ASSY may be damaged.

CONTACTOR

REMOVAL · INSTALLATION



Removal Procedure

- 1 Keep the control panel ASSY in raised state.
(See steps 1 to 6 of the Control Panel ASSY removal procedure on page 2-4.)
- 2 Disconnect the wiring.
- 3 Disconnect the terminals.
- 4 Remove the contactor.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:

Before connecting the battery plug, check the cable for omission of or insufficient tightening. If loosened, contactor elements may be damaged.

INSPECTION

Some components allow inspection in the removed state from the vehicle while other components cannot be inspected unless they are installed on the vehicle.

The printed circuit board is inspected as installed on the vehicle because the battery voltage must be applied. (Use SST 09230-F1060-71.)

Here the procedure for controller ASSY inspection after removal from the vehicle is mainly described.

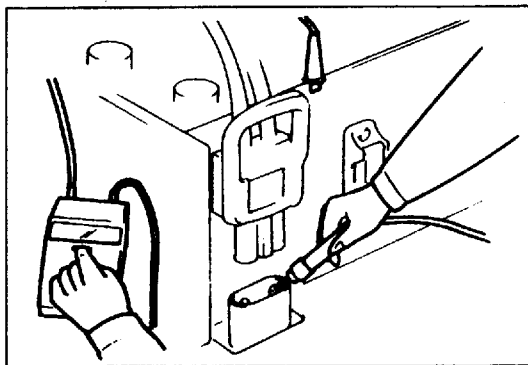
1. Insulation resistance measurement (Always inspect before starting controller ASSY inspection.)

Caution:

All of wires connected to the controller must be rewired before measurement.

- (1) Disconnect the battery plug, and measure the insulation resistance between the battery plug and body.

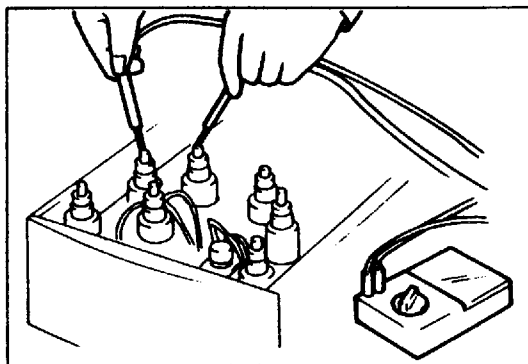
Measurement terminals	Battery plug controller side - Body
Standard	The resistance value shall be as high as possible, but it varies greatly with the vehicle operation status, place and weather. (Approx. 1 M Ω)



2. TMD (drive circuit main transistor)

- (1) Inspection method
Disconnect the TMD wiring.

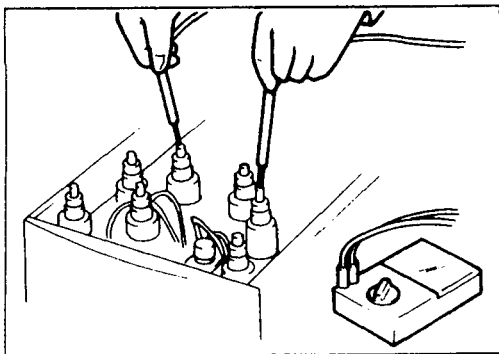
Inspecting point	Measurement terminals		Standard	Circuit tester range
TMD (controller)	P8 - N1	P8: (-) probe - N1: (+) probe P8: (+) probe - N1: (-) probe	Approx. 3 k Ω	$\Omega \times 1k$



3. TMP (material handling circuit main transistor)

- (1) Inspection method
Disconnect the TMP wiring.

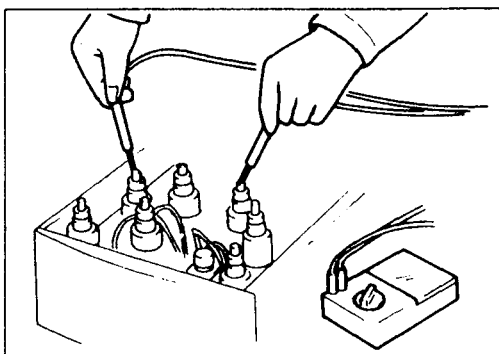
Inspecting point	Measurement terminals		Standard	Circuit tester range
TMP (controller)	P13 - N1	P13: (-) probe - N1: (+) probe N1: (+) probe - P13: (-) probe	Approx. 3 k Ω	$\Omega \times 1k$



4. DF1 (Flywheel diode No. 1)

- (1) Inspection method

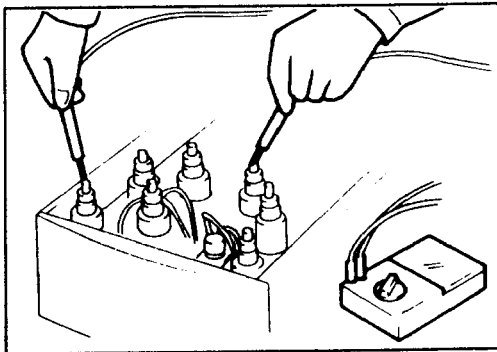
Inspecting point	Measurement terminals	Standard	Circuit tester range
DF1	Forward: Anode (P8): (-) probe - Cathode (P1B): (+) probe	Approx. 1 k Ω	$\Omega \times 1k$
	Reverse: Anode (P8): (+) probe - Cathode (P1B): (-) probe	Approx. 3 k Ω	



5. DF2 (Flywheel diode No.2)

(1) Inspection method

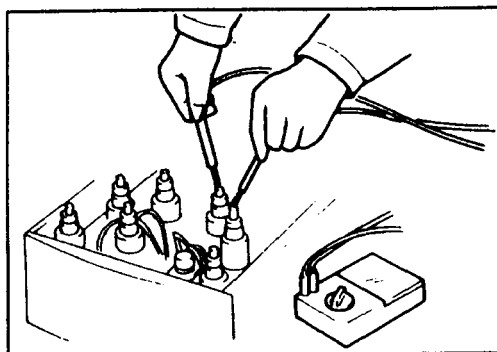
Inspecting point	Measurement terminals	Standard	Circuit tester range
DF2	Forward: Anode (P7): (-) probe - Cathode (P1B): (+) probe	Approx. 5 k Ω	$\Omega \times 1k$
	Reverse: Anode (P7): (+) probe - Cathode (P1B): (-) probe	Approx. 10 k Ω	



6. DF3 (Flywheel diode No.3)

(1) Inspection method

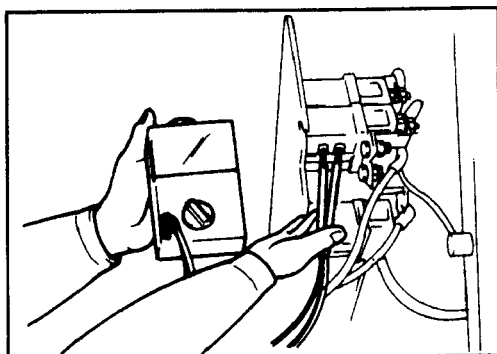
Inspecting point	Measurement terminals	Standard	Circuit tester range
DF3	Forward: Anode (P13): (-) probe - Cathode (P1B): (+) probe	Approx. 1 k Ω	$\Omega \times 1k$
	Reverse: Anode (P13): (+) probe - Cathode (P1B): (-) probe	Approx. 3 k Ω	



7. MF, MR contactor

- (1) Inspection method
Disconnect the bar and wiring harness.

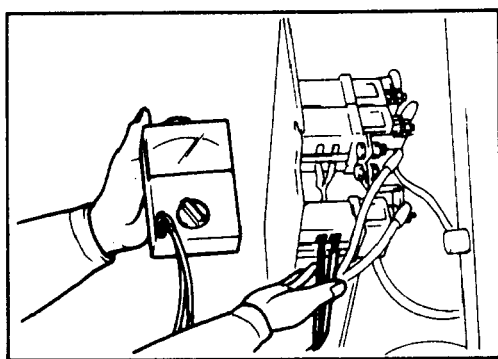
Inspection point	Measurement terminals	Standard	Circuit tester range
MF, MR contactor coil	MF, MR contactor coil both terminals	Approx. 15 Ω	$\Omega \times 1$



8. MB contactor

- (1) Inspection method
Disconnect the bar and wiring harness.

Inspection point	Measurement terminals	Standard	Circuit tester range
MB contactor coil	MB contactor coil both terminals	Approx. 32 Ω	$\Omega \times 1$



BEFORE DISASSEMBLY

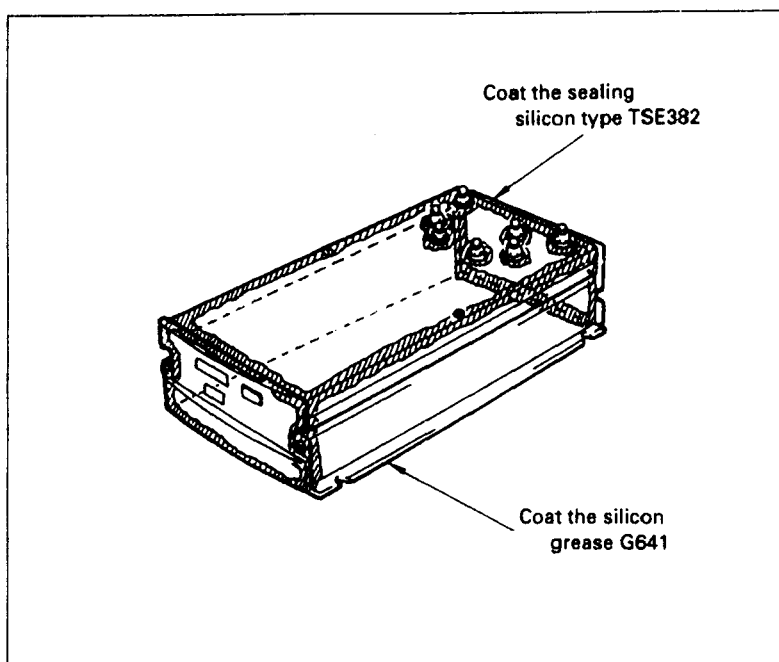
Control panel ASSY seldom requires overhaul. Mostly defective parts are replaced after grasping the trouble cause by inspection.

Therefore, perform correct operation by referring to the components drawing and assembly drawing.

Precautions for Parts Replacement:

- Tighten the bar and harness set nuts and screws to the specified torques. Loosening and omission of tightening will cause other troubles.
- When disconnecting a bar or harness, be sure to take a memo or put a tag for identifying the position. At the time of connection, prevent errors in installation or wiring by referring to the memo or tag. Incorrect installation or connection will cause other problems.
- Always apply silicone grease on parts coated with silicone grease. Omission of application may cause overheating.
- In reassembly of disassembled controller ASSY, coat sealing silicone on the portion shown below when installing the cover.

Sealing silicone: Type TSE382



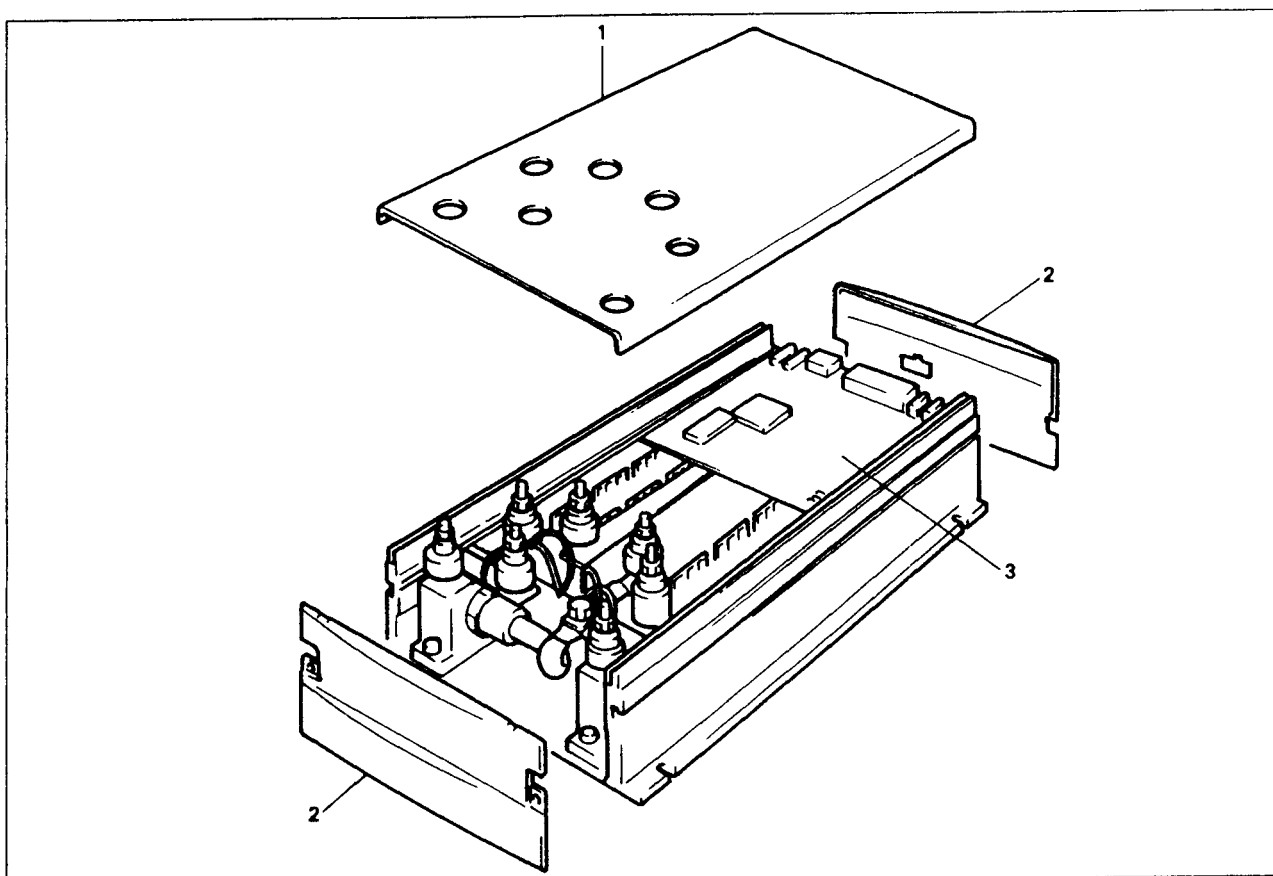
- When installing the controller ASSY on the base, coat silicone grease between the controller ASSY and base plate.

Silicone grease: Type GE silicone grease G641

- After reassembly, check the bar or wiring for erroneous contact at non-contact portions. Before installation on the vehicle, use a circuit tester and check continuity at points. (See page 2-14 for points to be inspected with the circuit tester.)

CONTROLLER

DISASSEMBLY · REASSEMBLY

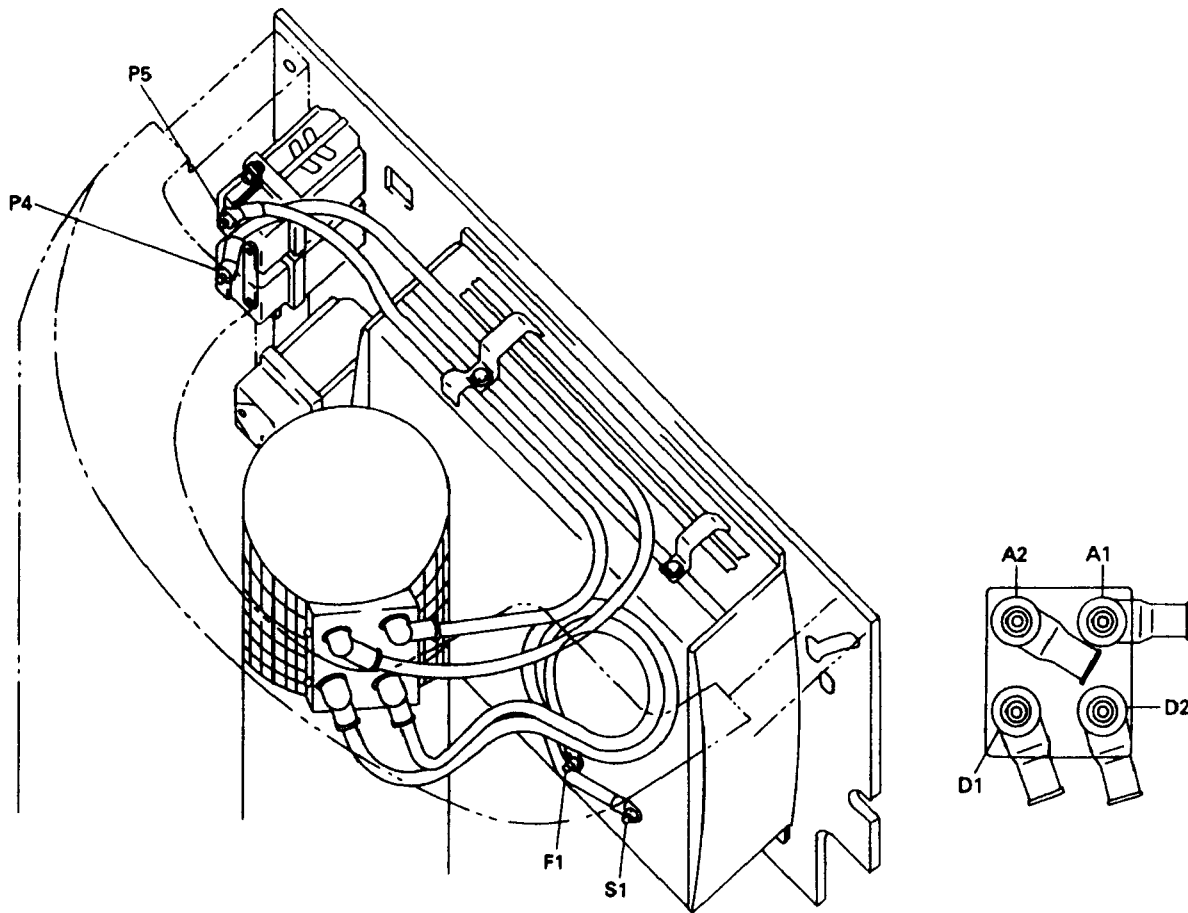


Disassembly Procedure

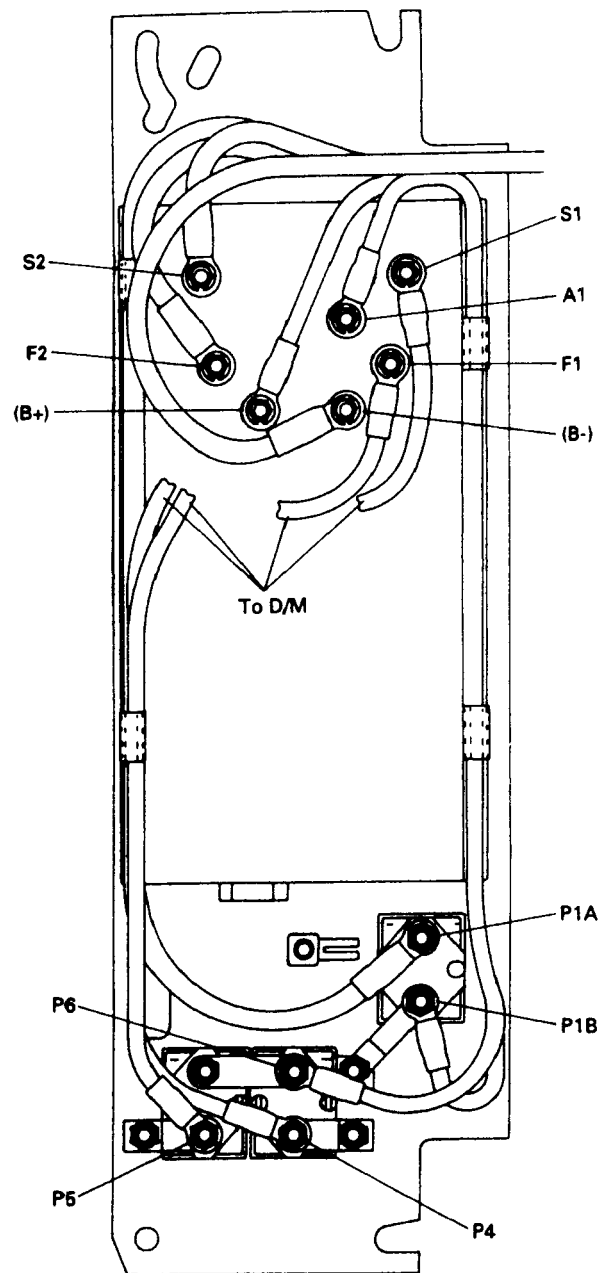
- 1 Remove the upper cover.
- 2 Remove the side cover.
- 3 Remove the CPU.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

CHECKING REASSEMBLY**Control ASSY Assembly Drawing (Drive Motor)**

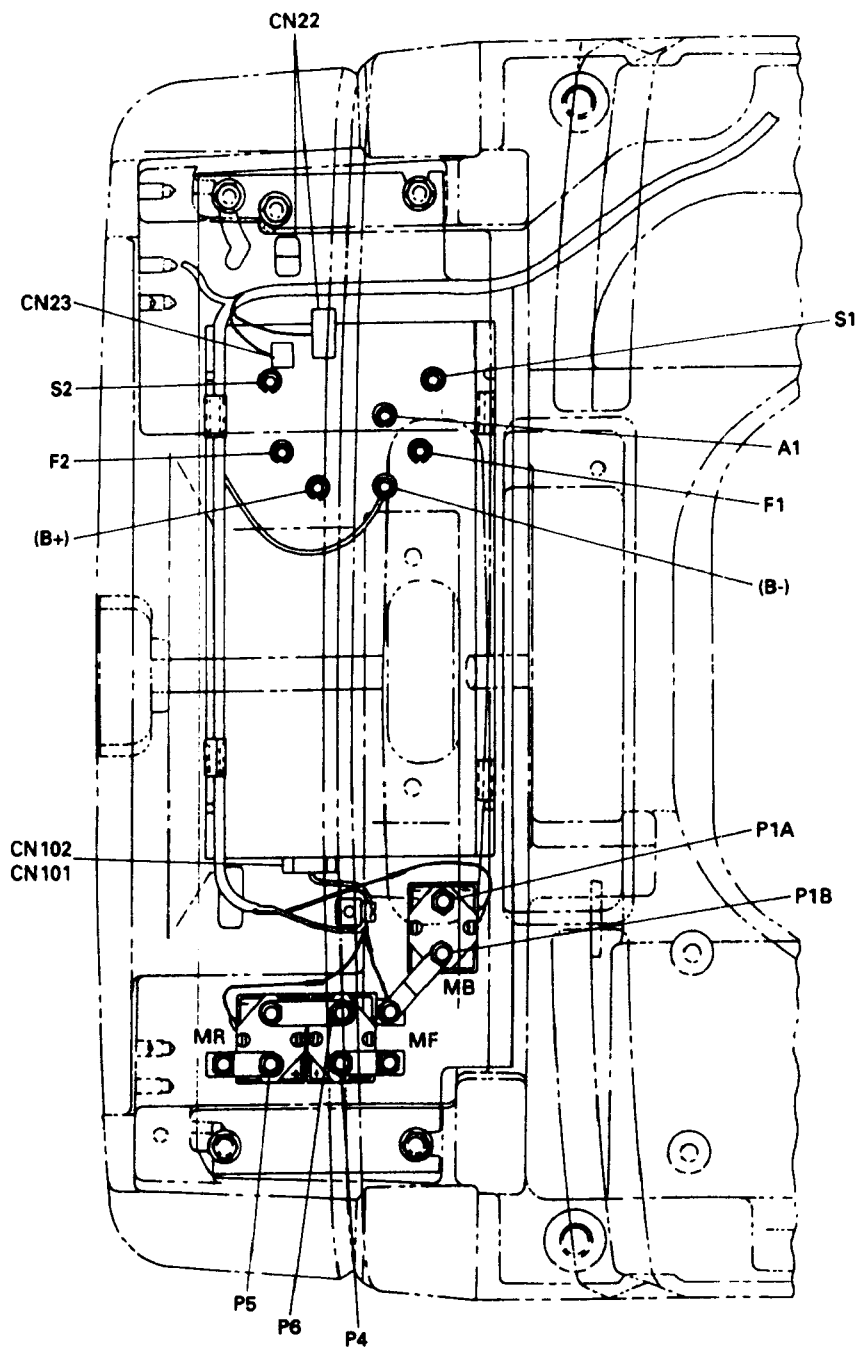
Control ASSY Assembly Drawing (Cables)



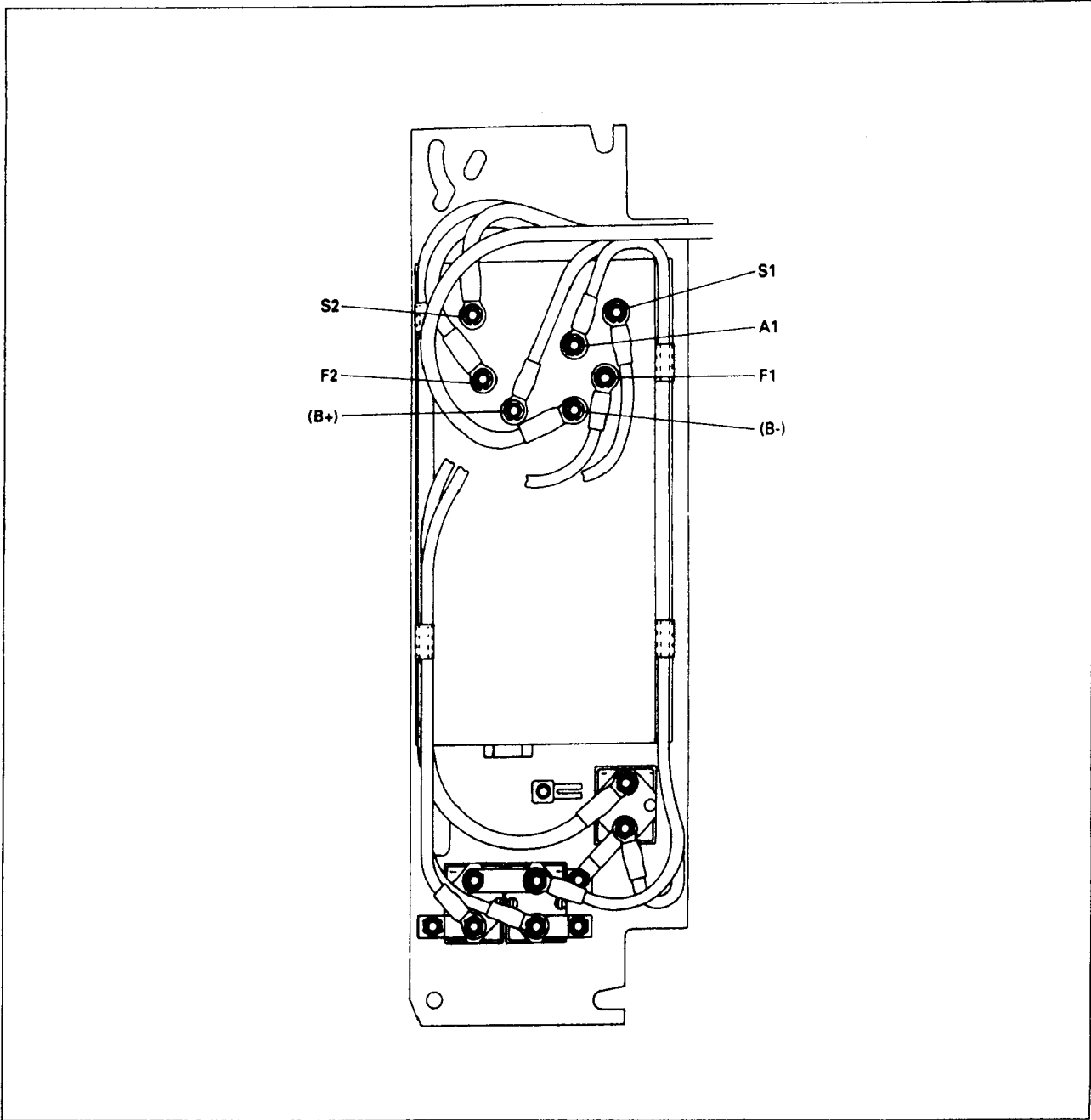
Panel Parts Tightening Torques

Controller terminals (M8): 10 to 12 N·m (102 to 122 kgf·cm)

Contactor terminals (M10): 13 to 15 N·m (133 to 153 kgf·cm)

Control ASSY (Wiring) Panel

CONTINUITY CHECK USING CIRCUIT TESTER



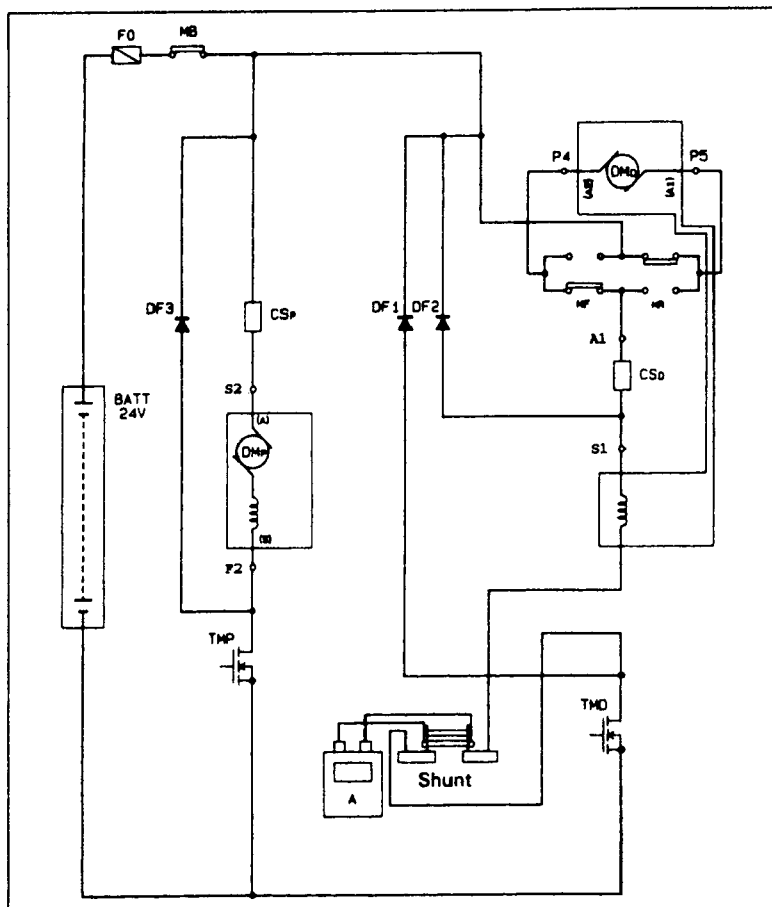
Inspection Procedure

Inspecting point		Standard	Circuit tester range
Inspecting point	P18 (B+)⊕ - N1(B-)⊖	Capacitor characteristic	ΩX1
	P18 (B+)⊖ - N1(B-)⊕	Approx. 20 Ω	ΩX1

OCL VALUE (OVERCURRENT LIMIT VALUE)

1. Drive circuit OCL value measurement

- (1) Lock the front and rear wheels in the driving state, and measure the drive motor lock current by connecting the ammeter and shunt as illustrated below.



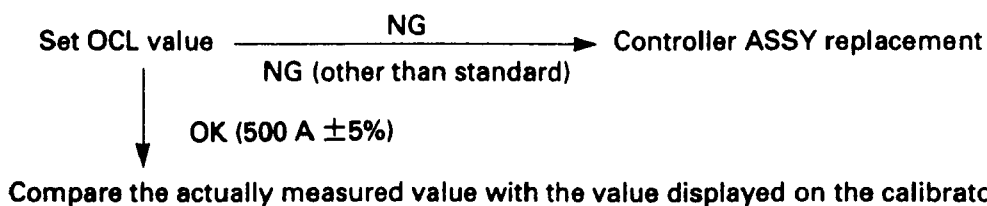
OCL value standard: 500 A $\pm$ 5%

Ammeter: 500 A

Shunt: 50 mV

- (2) Connect the calibrator and check the set OCL value.

See the adjustment method in the "Troubleshooting" section.



Actually measured value	Calibrator indication	Cause
Other than standard	Within standard	Controller abnormality
Measured value > Standard	Indicated value > Standard	Controller abnormality
Measured value < Standard	Indicated value < Standard	- Controller abnormality - Motor ASSY or motor cable abnormality (loosened terminal, damaged cable, or other)

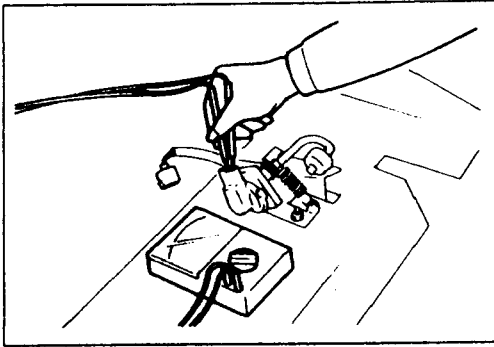
2. Material handling circuit OCL value measurement

The OCL value of the material handling circuit cannot be measure because of the following reasons:

The relief valve in the control valve is activated at the stroke end of each cylinder in the material handling circuit.

The OCL value for the material handling circuit is set higher than the current value at the relief valve set pressure.

The OCL value, therefore, cannot be measured because relief in the hydraulic circuit occurs before the material handling circuit current reaches the OCL value.



ACCELERATION POTENTIOMETER

ADJUSTMENT

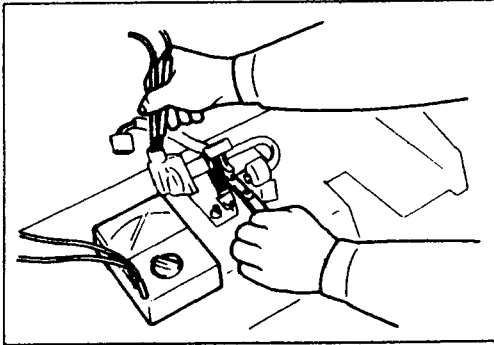
Make adjustment in the state of acceleration potentiometer W/front toe board.

1. Check if the switch is turned ON and OFF according to the accelerator pedal operation.

Measurement terminals: 64-N

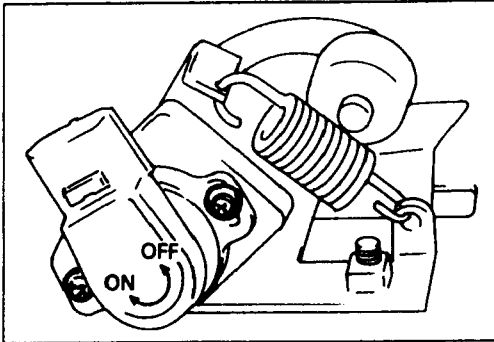
Standard: The pedal is not operated : $\infty \Omega$

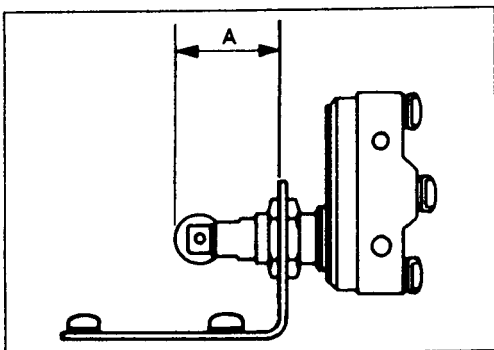
The pedal is operated : several ten Ω



2. Acceleration potentiometer installation adjustment
 - (1) Insert a 1.5 mm thickness gage under the accelerator link stopper.
 - (2) Temporarily install the potentiometer to turn the switch (SWAC) ON.
 - (3) Inspect the switch (SWAC) ON/OFF changeover point.
 OFF: when 1.0 mm thickness gauge is inserted
 ON: when 2.0 mm thickness gauge is inserted
 - (4) After adjusting the switch ON/OFF changeover point, tighten the set screw securely.

T = 1.57~2.35 N·m (16~24 kg·cm)





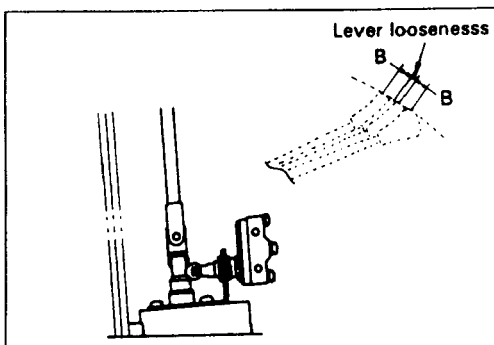
MATERIAL HANDLING SWITCH

ADJUSTMENT

1. Adjust the switch (LS_{L1}/LS_T) ON timing when the control lever is operated.

- (1) Adjust protrusion (A) of the LS_{L1}/LS_T roller. Dimension A is the reference value at the time of reassembly.

A = 25 mm

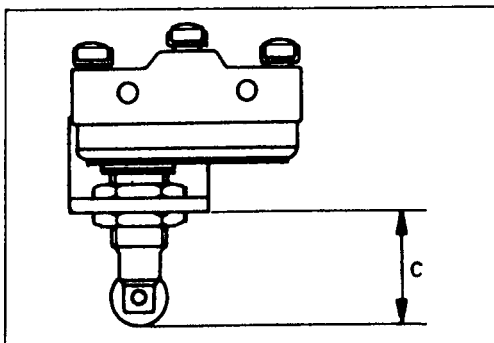


- (2) The switch shall be turned ON at dimension B at the tip end of the control lever.

Standard

B = 5 ~ 20 mm

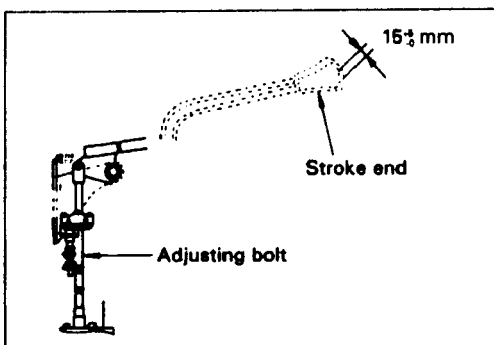
When the standard is not satisfied, make adjustment by changing the roller protrusion and mounting position.



2. Adjust the material handling chopper switch (LS_{L2}) ON timing.

- (1) Adjust protrusion (C) of the LS_{L2} roller.

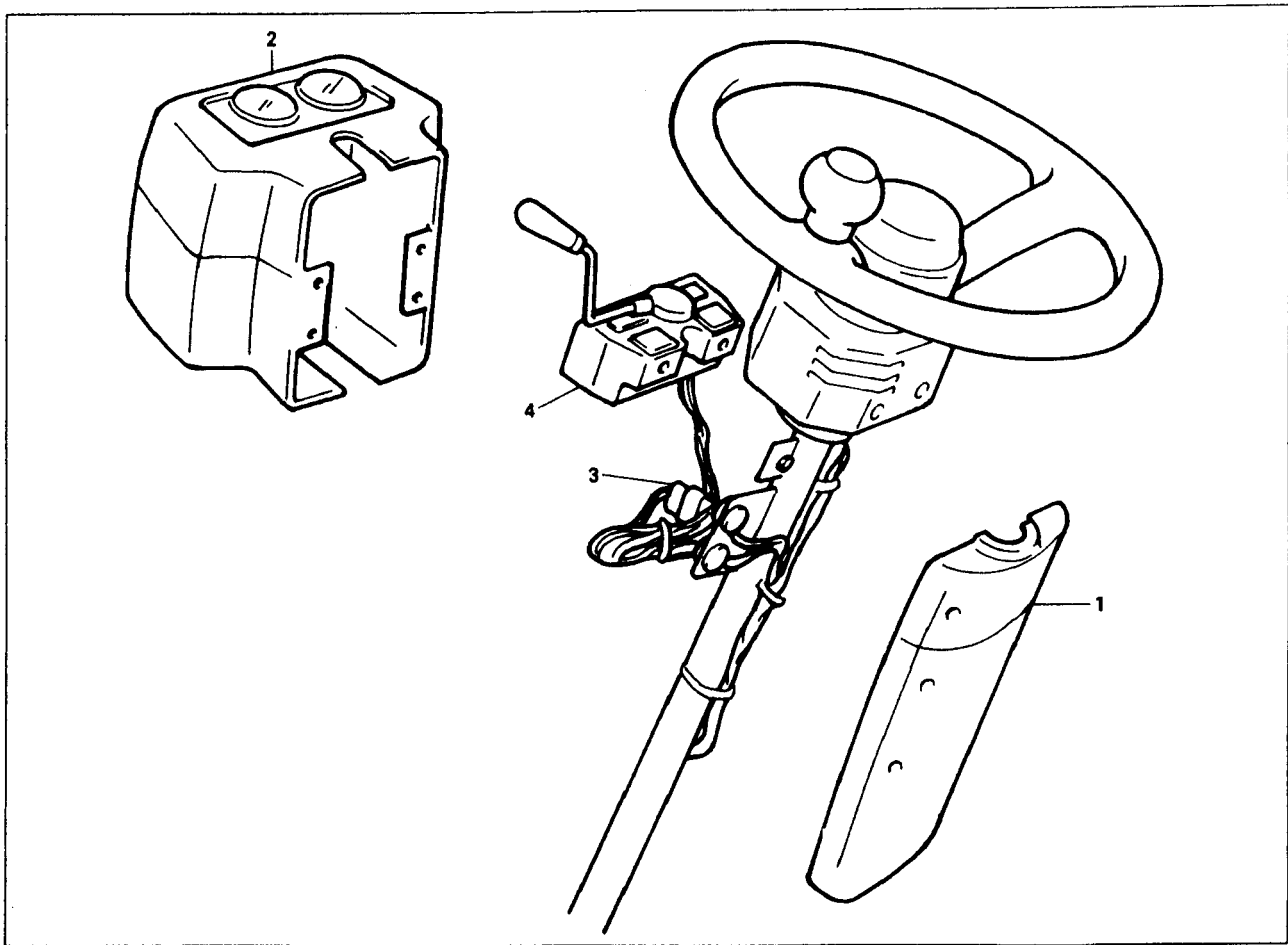
C = 25 mm



- (2) Make adjustment by turning the adjusting bolt so that the switch is turned ON at 15 ± mm before the stroke end when the lift lever is pulled.

DIRECTION SWITCH

REMOVAL · INSTALLATION

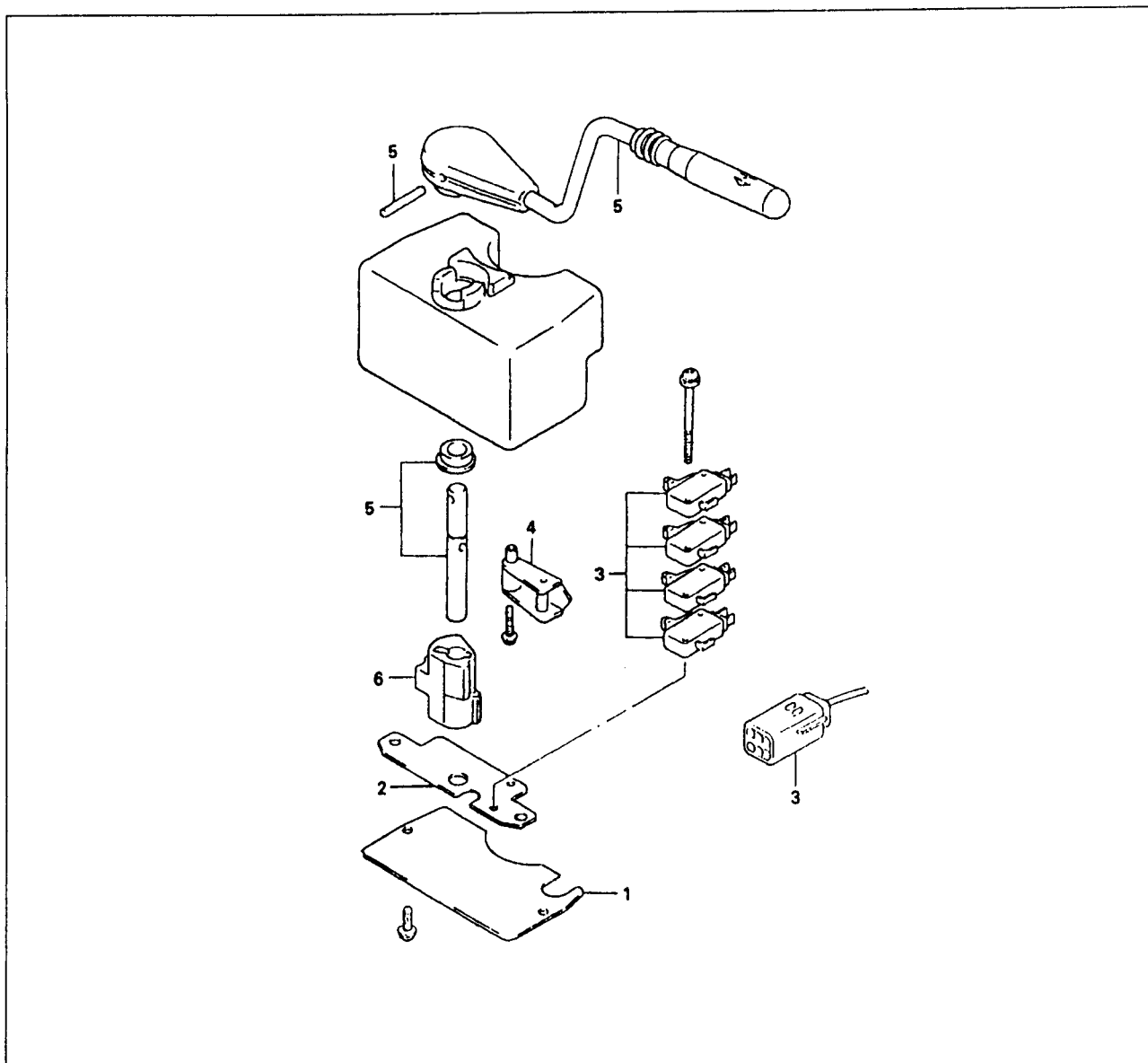


Removal Procedure

- 1 Remove the steering rear cover.
- 2 Remove the steering front cover W/meter.
- 3 Disconnect the direction switch connector.
- 4 Remove the direction switch.

Installation Procedure

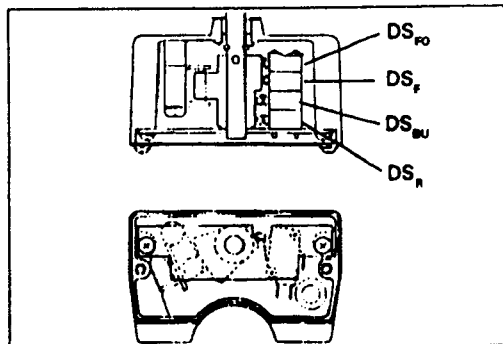
The installation procedure is the reverse of the removal procedure.

DISASSEMBLY · INSPECTION · REASSEMBLY**Disassembly Procedure**

- 1 Remove the plate.
- 2 Remove the microswitch base.
- 3 Remove the microswitch W/wire harness. [Point 1]
- 4 Remove the cam roller and spring.
- 5 Remove the direction lever W/knob.
- 6 Remove the cam.

Reassembly procedure

The reassembly procedure is the reverse of the disassembly procedure.

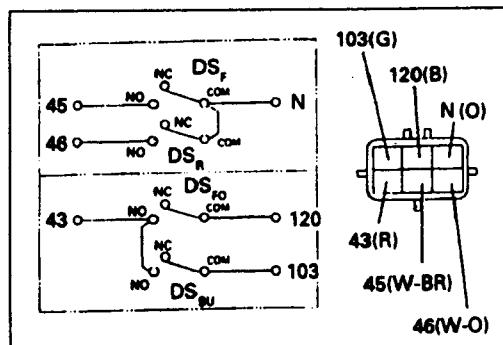


Point Operation

[Point 1]

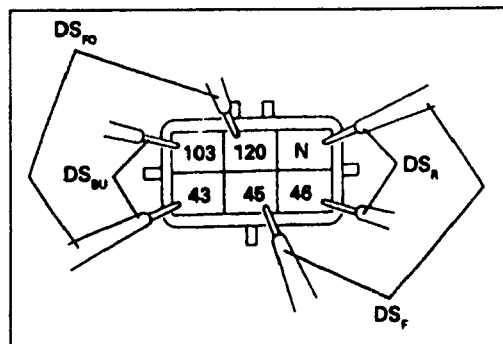
Reassembly:

Install the microswitch in the correct position.



Reassembly:

When replacing the microswitch, connect wiring as indicated by color specifications in the illustration.



Inspection:

After reassembling the direction switch, check each switch for continuity before installation.

Standard

Inspecting point	Lever position		
	Neutral	Forward	Reverse
DS _F	$\infty \Omega$	0 Ω	$\infty \Omega$
DS _R	$\infty \Omega$	$\infty \Omega$	0 Ω
DS _{FO}	$\infty \Omega$	0 Ω	$\infty \Omega$
DS _{BU}	$\infty \Omega$	$\infty \Omega$	0 Ω

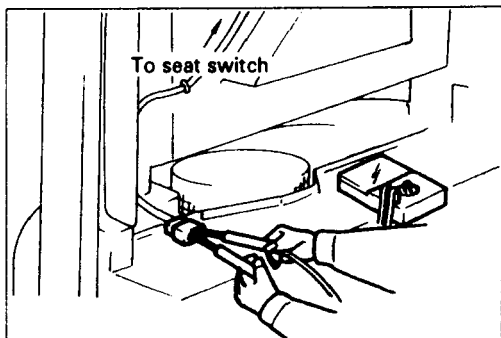
SEAT SWITCH

INSPECTION

1. Seat switch individual inspection

Battery plug OFF, connector CN20 disconnection

Measurement terminals	Both terminals of seat switch connector CN20
Circuit tester range	$\Omega \times 1$
Standard	Switch OFF (no operator on seat): $\infty \Omega$ Switch ON (operator on seat): 0Ω



3-1

SEVCON ADJUSTMENTS

	Page
GENERAL	3-2
ADJUSTMENT METHOD	3-3
TROUBLE SHOOTING	3-12

3-2

GENERAL

The troubleshooting procedure here is for adjustment of the following functions using the calibrator (SST09230-F1060-71) and for quick repair by checking the cause of any diagnosis error or other electrical system trouble.

1 Error display

2 Tuning (personalities)

Some items can be adjusted while others cannot.

3 Test run (status)

Simple measurement of main circuit for battery voltage, motor voltage and current.

4 Analogue switch input test

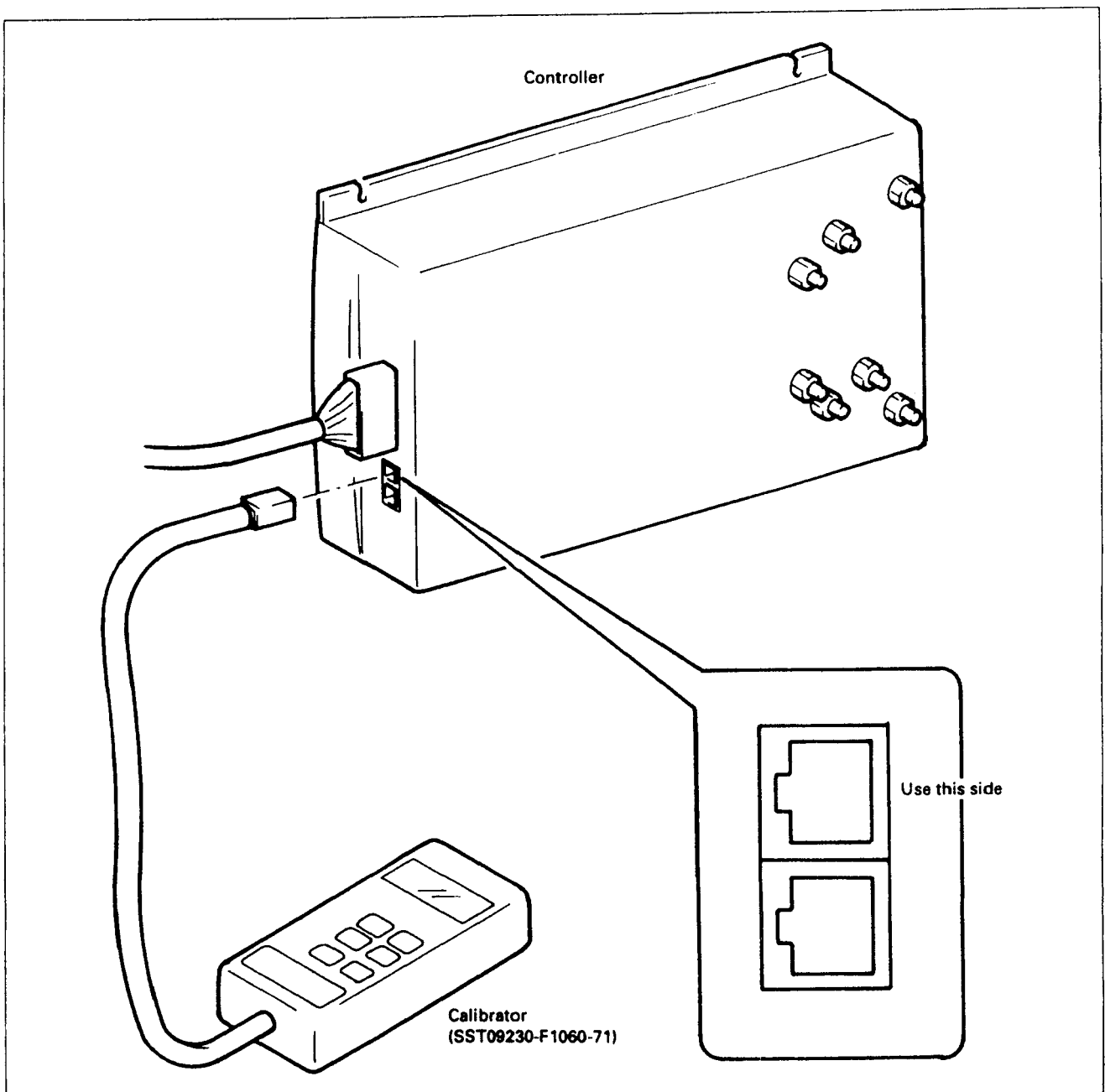
Simple measurement of accelerator voltage, switch ON/OFF and other inputs.

Note: Measuring instruments such as a circuit tester and megger are used for checking errors. The explanation in this manual assumes mechanics who have mastered handling of measuring instruments, are able to correctly read wiring and connecting diagrams and are capable of actual measurement according to the connector diagram.

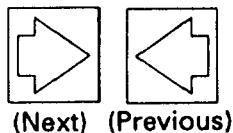
ADJUSTMENT METHOD

Precautions

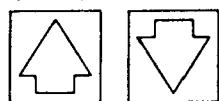
- 1 Turn the key switch OFF and disconnect the battery connector before connecting/disconnecting the calibrator.
 - 2 Do not touch the calibrator switches when turning the key switch ON/OFF.
 - 3 Pay sufficient attention to the safety in and around the vehicle because the vehicle may travel even during adjustment.
 - Jack up the vehicle to make the drive wheels float above the ground.
 - Set the direction lever in the neutral position.
1. Set the calibrator.



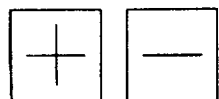
2. Switch operating method



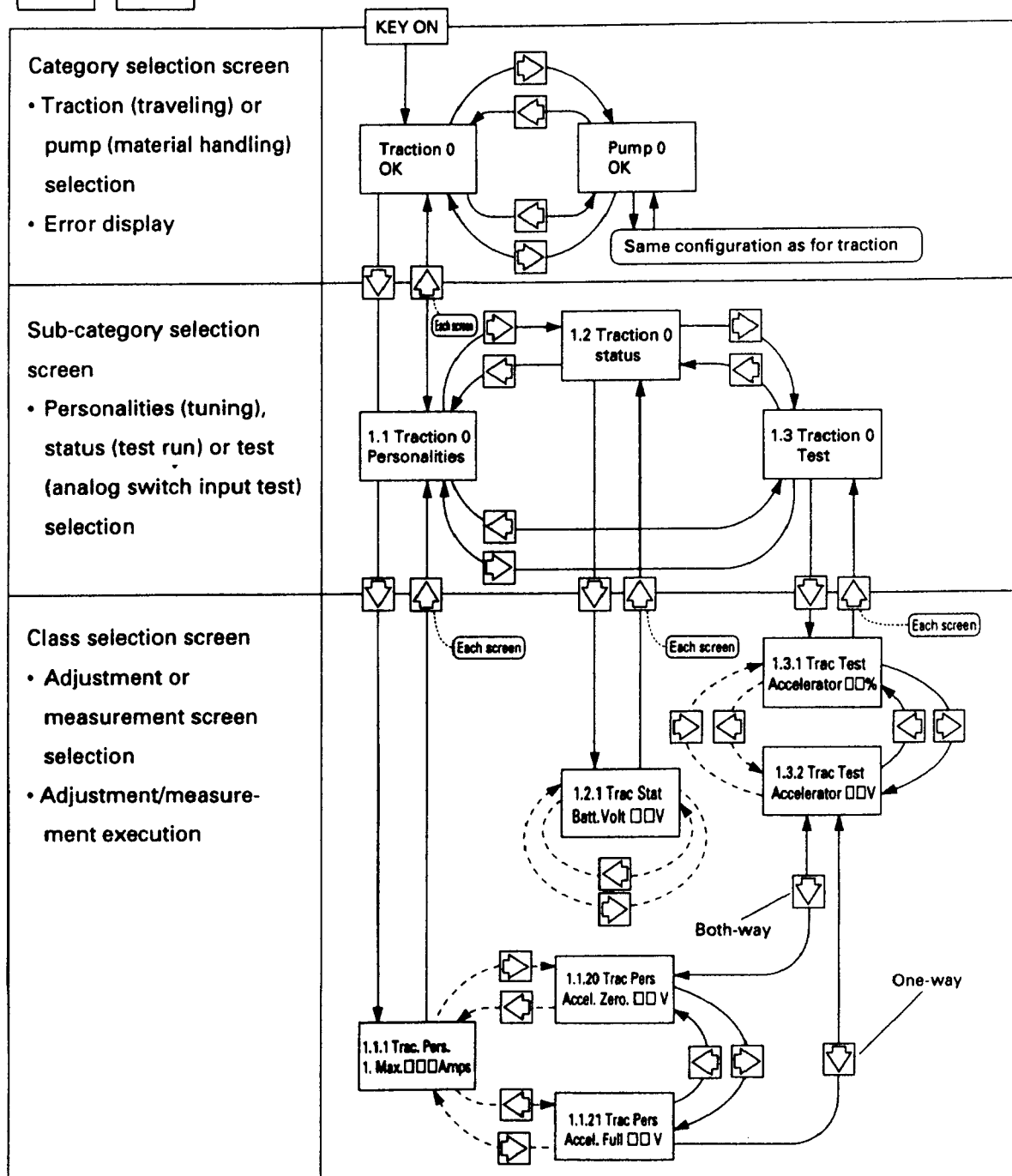
Changing over screens in the same level



Changing the screen to upper/lower level



For adjustment (used only for personalities)



3. Measure the acceleration voltage.

Operation	Indication of calibrator
Key switch ON	Traction OK
	1.1 Traction Personalities
 × 2	1.3 Traction Test
	1.3.1 Traction test Accelerator xxx %
	1.3.2 Traction test Accelerator x.x V*

Read the value * under the following conditions:

- Accelerator pedal in free position.
- Accelerator pedal in max. position.

4. Adjust the accelerator zero voltage.

Operation	Indication of calibrator
	1.1.20 Trac. Pers. Accel Zero X.X V*

Adjust the value* to the following level by using the + or - switch:

- Accelerator pedal free voltage + 0.5 V

5. Adjust the accelerator full voltage.

Operation	Indication of calibrator
	1.1.21 Trac Pers Accel Zero X.X V*

Adjust the value * to the following level by using the + or - switch:

- Accelerator max. voltage - 0.1 V

Confirmation

1. Confirmation of acceleration stage

Operation	Indication of calibrator
	1.3.2 Trac Test Accelerator x.x V
	1.3.1 Trac Test Accelerator xxx % *

Confirm that the value* increases from 0 to 100% as the accelerator pedal is depressed.

2. Confirmation of fault message

Operation	Indication of calibrator
 ×2	Traction OK

Depress the accelerator pedal to its stroke end, and confirm that this indication is OK.

Parametrar för åkning (Traction)

Personalities

Ref.	Parameter	Värde	Beskrivning	Används	Justerbar
1.1.1	CURRENT LIMIT	430 A	Strömgräns	JA	
1.1.2	ACCEL. DELAY	1,4 S	Fördröjningstid för acceleration	JA	JA
1.1.3	DECEL. DELAY	0,5 S	Fördröjningstid för inbromsning	JA	
1.1.4	CREEP SPEED	10%	Kryphastighet	JA	
1.1.5	MAX SPEED	100%	Max hastighet	JA	JA
1.1.6	CUTBACK SPEED 1	100%	Max hastighet och kryphastighet med brytare för hastighetsreducering, eller brytare för inching påverkade	NEJ	
1.1.7	ACCEL DELAY 1	0,1 S		NEJ	
1.1.8	CUTBACK SPEED 2	100%		NEJ	
1.1.9	ACCEL. DELAY 2	0,1 S		NEJ	
1.1.10	DIR BRAKE CURRENT	320 A	Reverseringsbroms	JA	
1.1.11	NEUTRAL BRAKE CURRENT	0 A	Rullbroms	NEJ	
1.1.12	FOOTBRAKE CURRENT	0 A	Bromskraft med bromsbrytare påverkad	NEJ	
1.1.13	BYPASS OVER CURRENT	-----	Maxström (säkring löser ut)	NEJ	
1.1.16	POWER STEER DELAY	0,0 S	Fördröjningstid för styrning	NEJ	
1.1.17	SEAT SW. DELAY	2,0 S	Fördröjningstid för sätesbrytare	JA	
1.1.20	ACCEL. ZERO LEVEL	MIN. +0,5 V	Värde i parameter 1.3.2 med opåverkat fartreglage, +0,5 V	JA	JA
1.1.21	ACCEL. FULL LEVEL	MAX. -0,1 V	Värde i parameter 1.3.2 med fullt påverkat fartreglage, -0,1 V	JA	JA
1.1.22	FOOTBRAKE POT. ZERO	4,5 V	Bromspot. Opåverkad	NEJ	
1.1.23	FOOTBRAKE POT. FULL	0,5 V	Bromspot. Fullt påverkad	NEJ	
1.1.24	ECONOMY POT. ZERO	4,5 V	Ekonomipot. Opåverkad	NEJ	
1.1.25	ECONOMY POT. FULL	0,5 V	Ekonomipot. Fullt påverkad	NEJ	
1.1.35	CONTACTOR CHOPPER	ON	Transistorstyrning av kontaktor	JA	

Traction Status Information, displayed as follows:

Cal. Ref.	Traction Parameter Displayed	Min. Display (all units)	Max. Display (all units)	Step size (all units)	Provided or not provided
1.2.1	Battery Voltage	0 V	127 V	0.1 Volts	○
1.2.2	Traction Motor Voltage	0 V	127 V	0.5 Volts	○
1.2.3	Traction Motor Current	0 A	1200 A	6 Amps	○
1.2.4	Traction Controller Temperature	-30 °C	+225 °C	1 °C	○
1.2.5	Traction Mosfet Voltage	0 V	127 V	0.5 Volts	○
1.2.6	Capacitor Voltage	0 V	127 V	0.5 Volts	○
1.2.7	Keyswitch Hours	0	65279.9	0.1 Hours	○
1.2.8	Drive Hours	0	65279.9	0.1 Hours	○

Traction Test Information-condition of the following inputs:

Cal. Ref.	Traction Input Displayed	Min. Display (or normal state) (all units)	Max. Display (or active state) (all units)	Step size (all units)	Provided or not provided
1.3.1	Accelerator % Range	0 %	100 %	1 %	○
1.3.2	Accelerator Voltage Range	0.0 V	5.5 V	0.1 Volt	○
1.3.3	Footbrake Pot % Range	0 %	100 %	1 %	×
1.3.4	Footbrake Pot V. Range	0.0 V	5.5 V	0.1 Volt	×
1.3.5	Economy Pot % Range	0 %	100 %	1 %	×
1.3.6	Economy Pot V. Range	0.0 V	5.5 V	0.1 Volt	×
1.3.9	Forward	Open	Closed	–	○
1.3.10	Reverse	Open	Closed	–	○
1.3.11	FS1 (Accel switch)	Open	Closed	–	○
1.3.12	Seat	Open	Closed	–	○
1.3.13	Handbrake	Open	Closed	–	×
1.3.14	Speed Cutback 1	Open	Closed	–	×
1.3.15	Speed Cutback 2	Open	Closed	–	×
1.3.16	P.S.Trigger	–	Closed	–	×
1.3.22	Software Version/Revision	0.00	999.99	–	○

Parametrar för hydraulik (material handling)

Personalities

Ref.	Parameter	Värde	Beskrivning	Används	Justerbar
2.1.1	CURRENT LIMIT	500 A	Strömgräns	JA	
2.1.2	RAMP UP. DELAY	0,4 S	Fördröjningstid för start av pumphmotor	JA	JA
2.1.3	RAMP DOWN DELAY	0,1 S	Fördröjningstid för stopp av pumphmotor	JA	
2.1.4	CREEP SPEED	10%	Min hastighet	JA	
2.1.5	BASE SPEED 1	0%	Acc. för lyftfunktion (när lyftpot används, 2.1.23 och 2.1.24)	NEJ	
2.1.6	COMPENSATION 1	0%	Acc. för lyftfunktion (när lyftpot används, 2.1.23 och 2.1.24)	NEJ	
2.1.7	BASE SPEED 2	7%	Varvtal för Tilt funktionen	JA	
2.1.8	COMPENSATION 2	85%	Kompensation för Tilt funktionen	JA	
2.1.9	BASE SPEED 3	100%	Varvtal för Lyft, steg 2	JA	
2.1.10	COMPENSATION 3	0%	Kompensation för Lyft, steg 2	JA	
2.1.11	BASE SPEED 4	0%	Reserverad	NEJ	
2.1.12	COMPENSATION 4	0%	Reserverad	NEJ	
2.1.13	BASE SPEED 5	70%	Varvtal för Lyft, steg 1	JA	JA
2.1.14	SPEED 5	Prioritera	Prioritera funktionen (före funktioner med lägre varvtal)	JA	
2.1.15	BASE SPEED 6	100%	Varvtal för Aux 1&2	JA	JA
2.1.16	SPEED 6	Prioritera	Prioritera funktionen (före funktioner med lägre varvtal)	JA	
2.1.17	BASE SPEED 7	0%	Reserverad	NEJ	
2.1.18	SPEED 7	Prioritera	Reserverad	NEJ	
2.1.19	STEER BASE SPEED	15%	Varvtal för Styrning	JA	
2.1.20	STEER COMPENSATION	60%	Kompensation för Styrning	JA	
2.1.21	STEER ACCEL. TIME	0,1 S	Fördröjningstid för start av pumphmotor, styrfunktion	JA	
2.1.22	STEER DECEL. TIME	0,1 S	Fördröjningstid för stopp av pumphmotor, styrfunktion	JA	
2.1.23	ACCEL. ZERO LEVEL	4,5 V	Lyftpot. Min	NEJ	
2.1.24	ACCEL. FULL LEVEL	0,5 V	Lyftpot. Max	NEJ	
2.1.25	CONTACTOR CHOPPER	ON	Transistorstyrning av kontaktor	JA	

Pump Status Information - parameters displayed as follows:

Cal. Ref.	Pump Parameter Displayed	Min. Display (all units)	Max. Display (all units)	Step size (all units)	Provided or not provided
2.2.1	Battery Voltage	0 V	127 V	0.1 Volts	○
2.2.2	Pump Motor Voltage	0 V	127 V	0.5 Volts	○
2.2.3	Pump Motor Current	0 A	1200 A	6 Amps	○
2.2.4	Pump Controller Temperature	-30℃	+225℃	1℃	○
2.2.5	Pump Mosfet Voltage	0 V	127 V	0.5 Volts	○
2.2.6	Capacitor Voltage	0 V	127 V	0.5 Volts	○
2.2.7	Keyswitch Hours	0	65279.9	0.1 Hours	○
2.2.8	Pump Hours	0	65279.9	0.1 Hours	○

Pump Test Information - condition of the following inputs:

Cal. Ref.	Pump Input Displayed	Min. Display (or normal state) (all units)	Max. Display (or active state) (all units)	Step size (all units)	Provided or not provided
2.3.1	Accelerator % Range	0 %	100 %	1 %	×
2.3.2	Accelerator Voltage Range	0.0 V	5.5 V	0.1 Volt	×
2.3.3	Pump Switch 2 TILT	Open	Closed	–	○
2.3.4	Pump Switch 3 LIFT Second Speed	Open	Closed	–	○
2.3.5	Pump Switch 4 Reserved	Open	Closed	–	×
2.3.6	Pump Switch 5 LIFT First Speed	Open	Closed	–	○
2.3.7	Pump Switch 6 ATT	Open	Closed	–	○
2.3.8	Pump Switch 7 Reserved	Open	Closed	–	×
2.3.9	P.S. Trigger PS Pressure Switch	Closed	Open	–	○
2.3.10	Pump Inhibit Switch for Locking in Overdischarge State	Open	Closed	–	○
2.3.11	Software Version/Revision	0.00	999.99	–	○

Traction Fault Message Priorities

Message	LED Status	Priority	Description	Cause	Avail.
"Mosfet s/c"	3FF	30	Drive Mosfet S/C	Main Circuit S/C	○
"CRC error"	1FF	29	Personality or other config error	Data destruction	○
"Battery low"	7FF	28	Battery < Low battery personality	Low voltage	○
"Steer Fault"	2FF	27	–		×
"Inch Fault"	2FF	26	Inch sw. at power up, or both selected		×
"Seat Fault"	2FF	25	Drive selected and no seat sw.	Seat switch OFF	○
"SRO Fault"	2FF	24	Dir. sw. selected > 2 secs after FS1		×
"2 Dir. Fault"	2FF	23	Two directions selected together	F & R switches selected together	○
"Sequence Fault"	2FF	22	Direction or FS1 sw. at power up		×
"Accel Fault"	6FF	21	Accelerator wire off	Accelerator O/C	○
"Capacitor Fault"	5FF	20	Main Caps not charging at power up	Capacitor defect	○
"Coil s/c"	9FF	19	A contactor coil s/c or misconnected	Cont. Coil S/C	○
"Regen s/c"	4FF	18	Regen contactor didn't open		×
"Rev Left s/c"	4FF	17	–		×
"Rev Right s/c"	4FF	16	–		×
"Reverse s/c"	4FF	15	Reverse contactor didn't open	REV contactor failed to open	○
"Fwd Left s/c"	4FF	14	–		×
"Fwd Right s/c"	4FF	13	–		×
"Forward s/c"	4FF	12	Forward contactor didn't open	FWD contactor failed to open	○
"Contactor s/c"	4FF	11	Fwd or Rev cont. short circuit	FWD or REV contactor failed to open	○
"Regen o/c"	4FF	10	Regen contactor didn't close		×
"Rev Left o/c"	4FF	9	–		×
"Rev Right o/c"	4FF	8	–		×
"Reverse o/c"	4FF	7	Reverse contactor didn't close	REV contactor failed to close	○
"Fwd Left o/c"	4FF	6	–		×
"Fwd Right o/c"	4FF	5	–		×
"Forward o/c"	4FF	4	Forward contactor didn't close	FWD contactor failed to open	○
"Contactor o/c"	4FF	3	Fwd or Rev cont. open circuit	FWD or REV contactor failed to close	○
"Thermal cutback"	8FF	2	Drive heatsink above 75°C	Overheating	○
"Testing"	ON	1	Controller performing internal tests	Controller self-check operating	○

- Messages with the highest number have the highest priority.
"Failed"30 is the highest priority Drive diagnostic message.
- When 2 or more errors at a time, only the message having a greater number is displayed.

Material Handling Fault Message Priorities

Message	LED Status	Priority	Description	Cause	Avail.
"Mosfet s/c"	3FF	7	Material Handling Mosfet S/C	Main circuit S/C	○
"CRC error"	1FF	6	Personality or other config error	Data destruction	○
"Battery low"	7FF	5	Battery < low battery personality	Low voltage	○
"Capacitor Fault"	5FF	4	Main Caps not charging at power up	Capacitor defect	○
"Coil s/c"	91FF	3	A contactor coil s/c or misconnected	Cont. coil S/C	×
"Thermal cutback"	8FF	2	Material Handling heatsink above 75°C	Overheating	○
"Testing"	ON	1	Controller performing internal tests	Controller self check operating	○

- Messages with the highest number have the highest priority.
"Failed" 7 is the highest priority Material Handling diagnostic message.
- When 2 or more errors occur at a time, only the message having a greater number is displayed.

Power-up Failsafe Diagnostic Message Priorities

Message	LED Status	Priority	Description	Avail.
"Cap. Fault"	Out	48	Caps not charged at keyswitch ON	○
"P. Up Trac. Weld"	Out	47	Direction contactors S/C at key sw ON	○
"P. Up Trac. Mos"	Out	46	Drive MOSFETs S/C at key sw ON	○
"P. Up Pump Mos"	Out	45	M.H. MOSFETs S/C at key sw ON	○
"Drive 0 on"	Out	44	Failsafe cannot disable contactor drive 0*	○
"Drive 1 on"	Out	43	Failsafe cannot disable contactor drive 1*	×
"Traction on"	Out	42	Failsafe cannot disable Drive MOSFETs	○
"Pump on"	Out	40	Failsafe cannot disable M.H. MOSFETs	○
"Drive 0 off"	Out	38	Contactor drive 0 does not operate in failsafe tests	○
"Drive 0 mos s/c"	Out	37	Contactor drive 0 does not operate and Drive MOSFETs s/c in failsafe tests	○
"Drive 1 off"	Out	36	Contactor drive 1 does not operate in failsafe tests	×
"Drive 1 mos s/c"	Out	35	Contactor drive 1 does not operate and M.H. MOSFETs s/c in failsafe tests	×
"Traction off"	Out	34	Drive MOSFETs O/C in failsafe tests	○
"Pump off"	Out	32	M.H. MOSFETs O/C in failsafe tests	○

Note 1: Power-up failsafe diagnostic messages have priority over any Drive or Material Handling fault message.

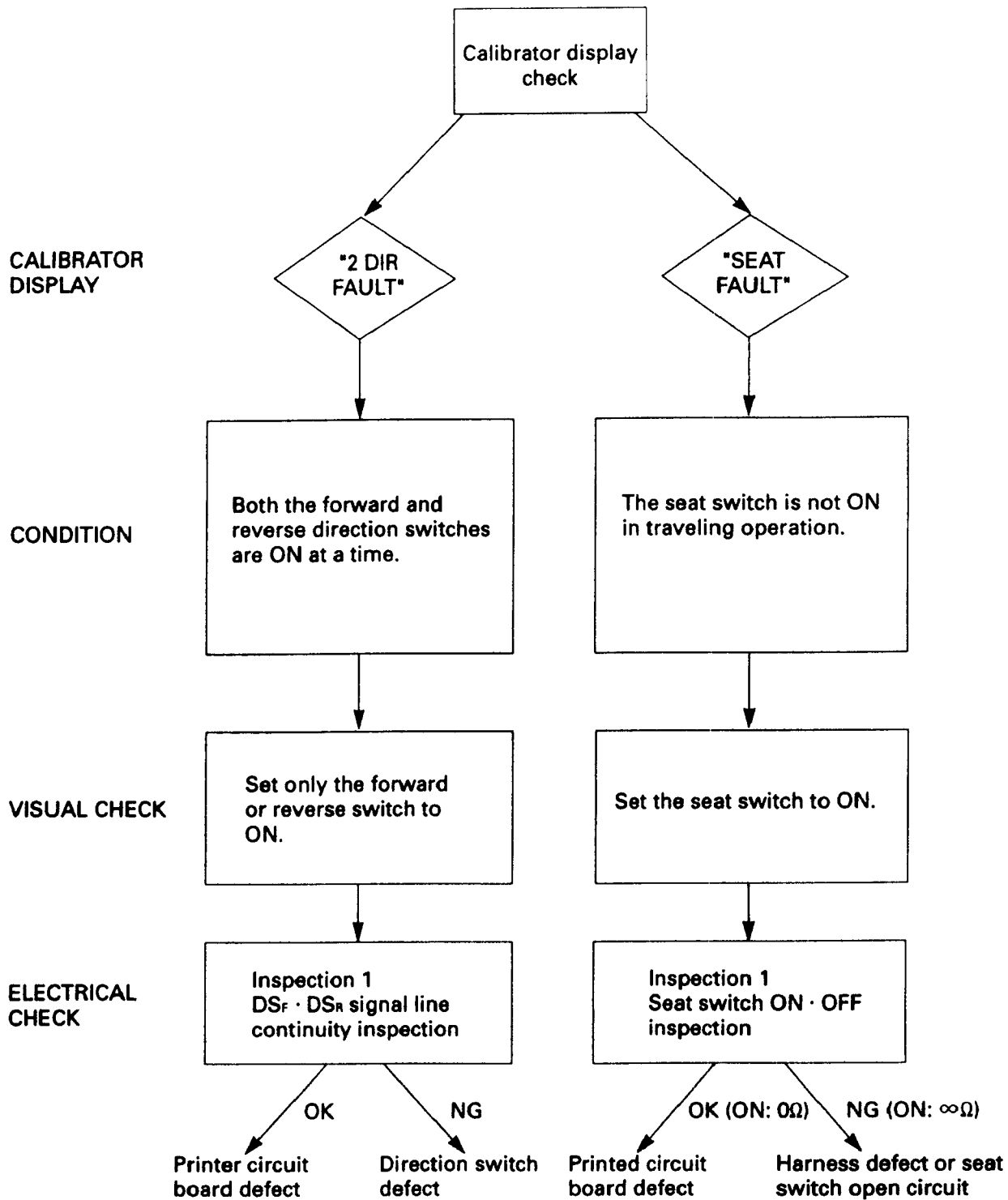
Note 2: Drive 0 refers to Drive contactor drivers.

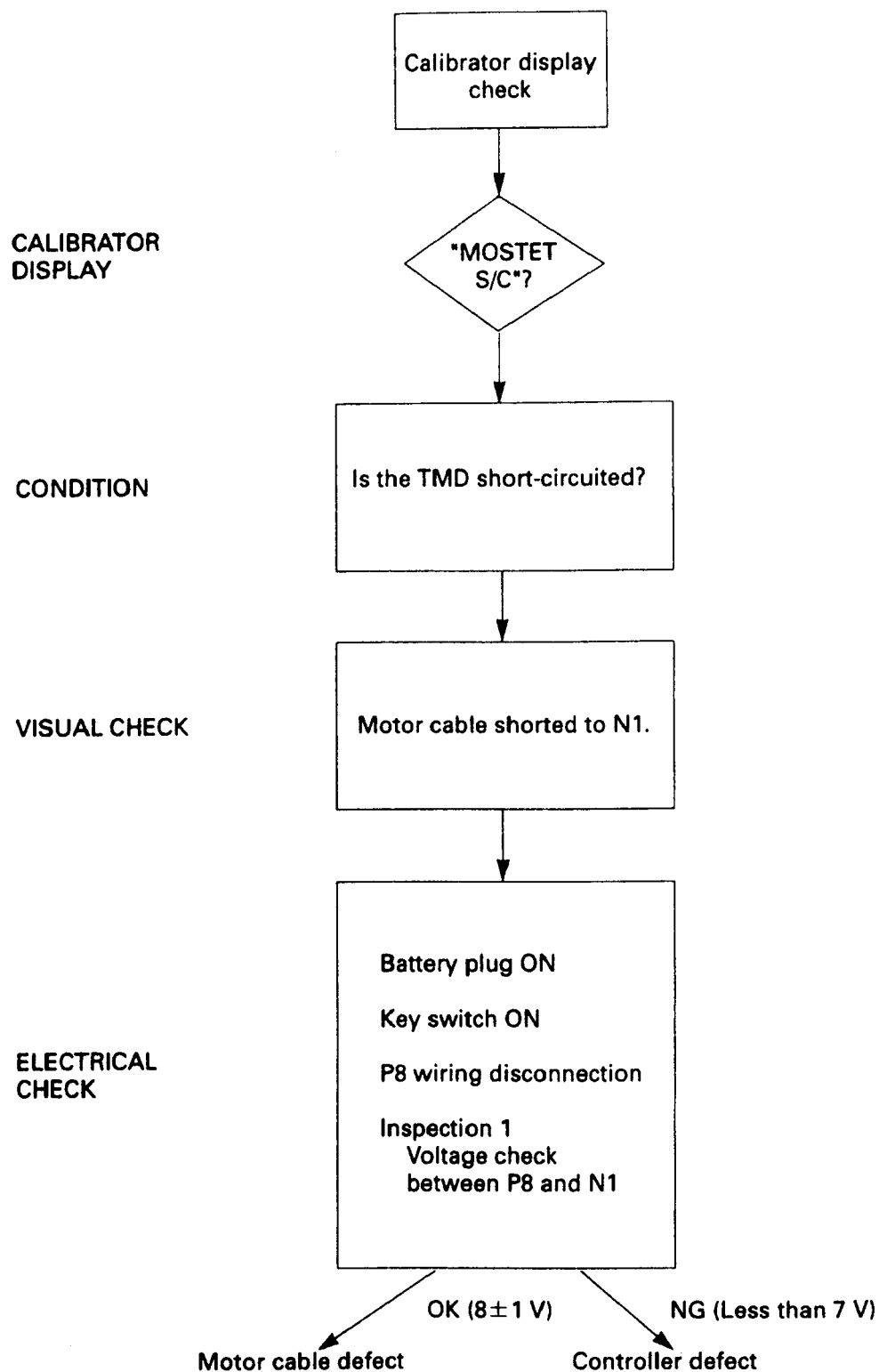
Drive 1 refers to Material Handling drivers.

TROUBLESHOOTING

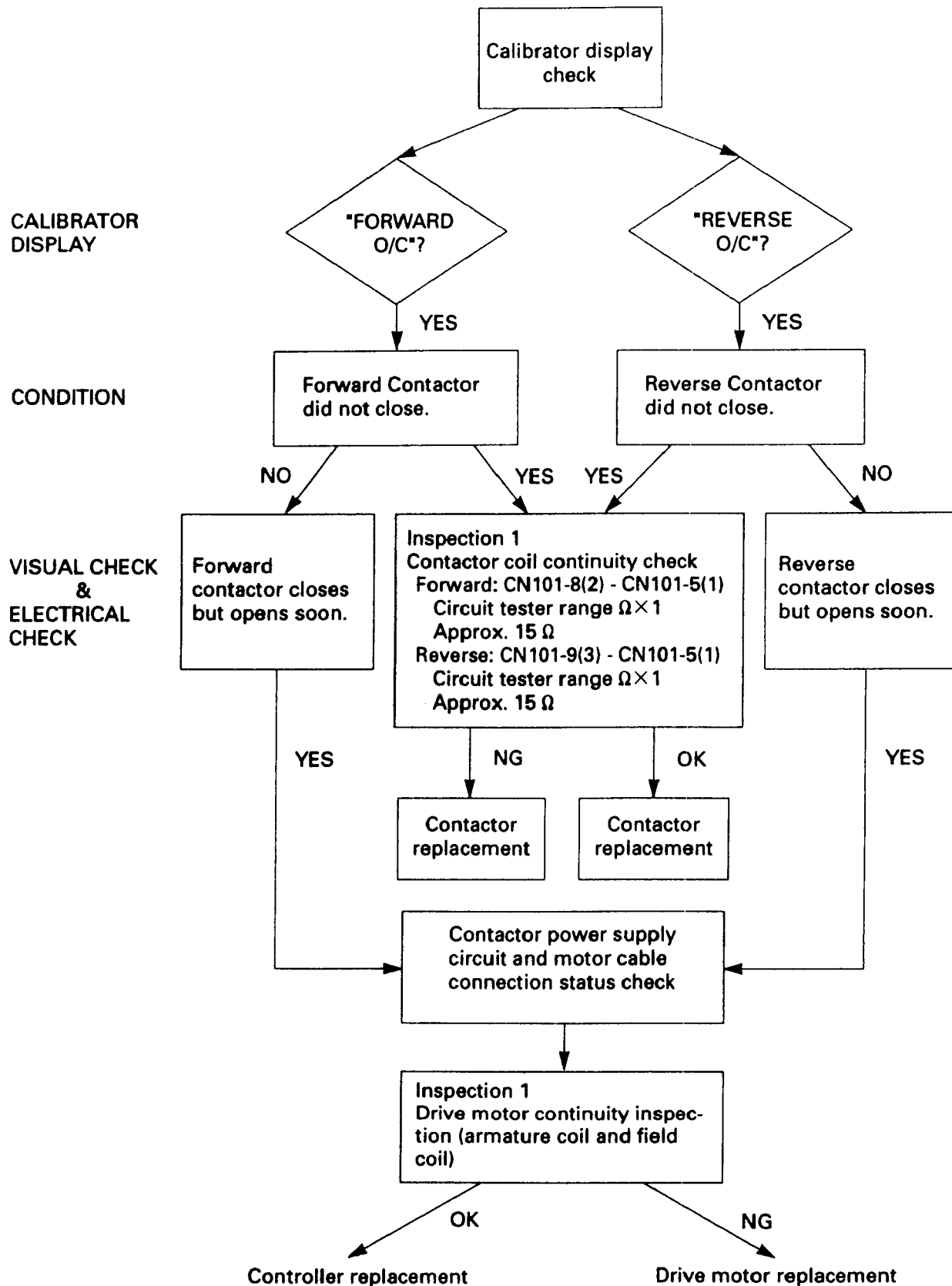
Blinking once: CPU board exchange

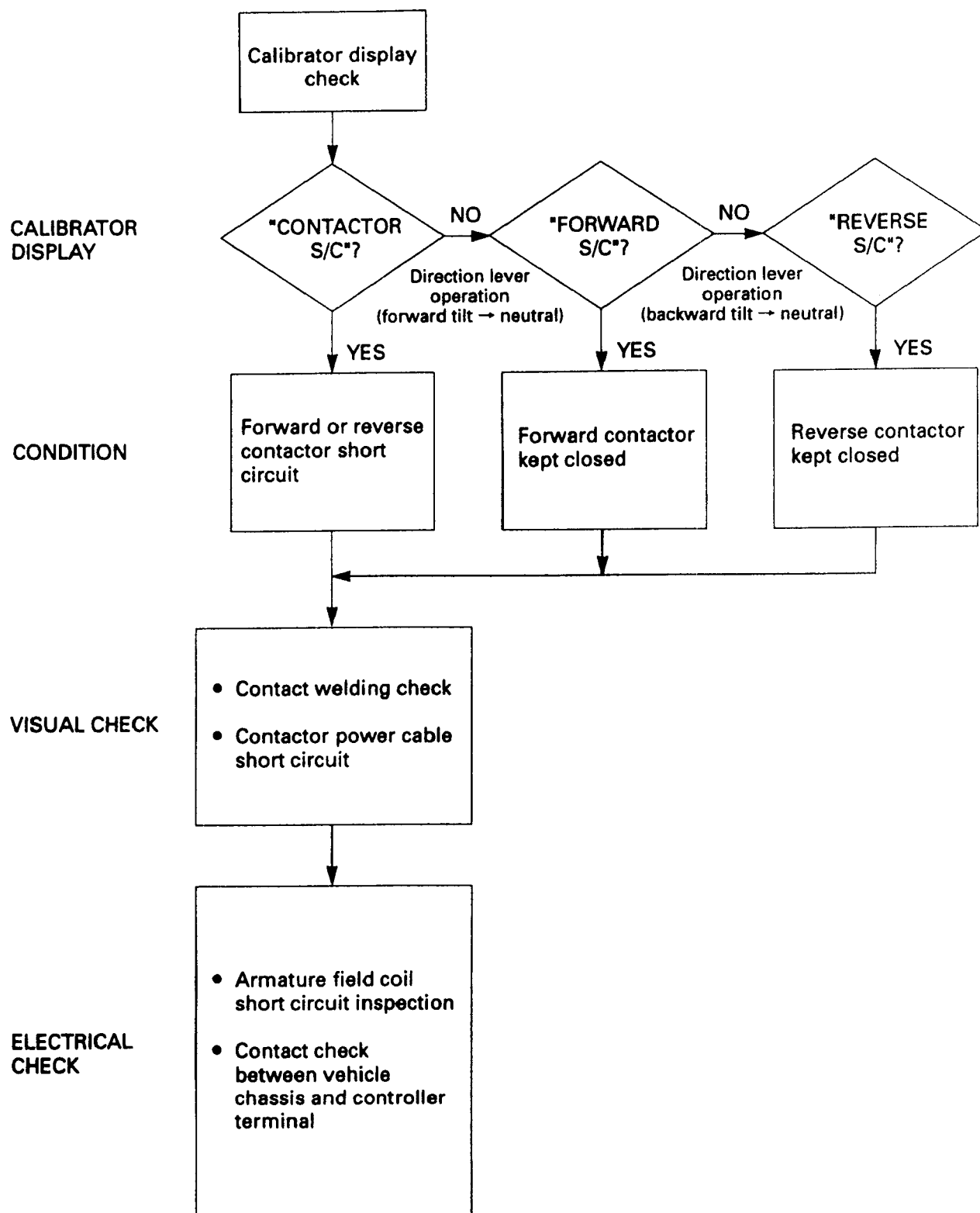
Blinking twice: Operation procedure abnormality



Blinking three times: TMD short-circuit

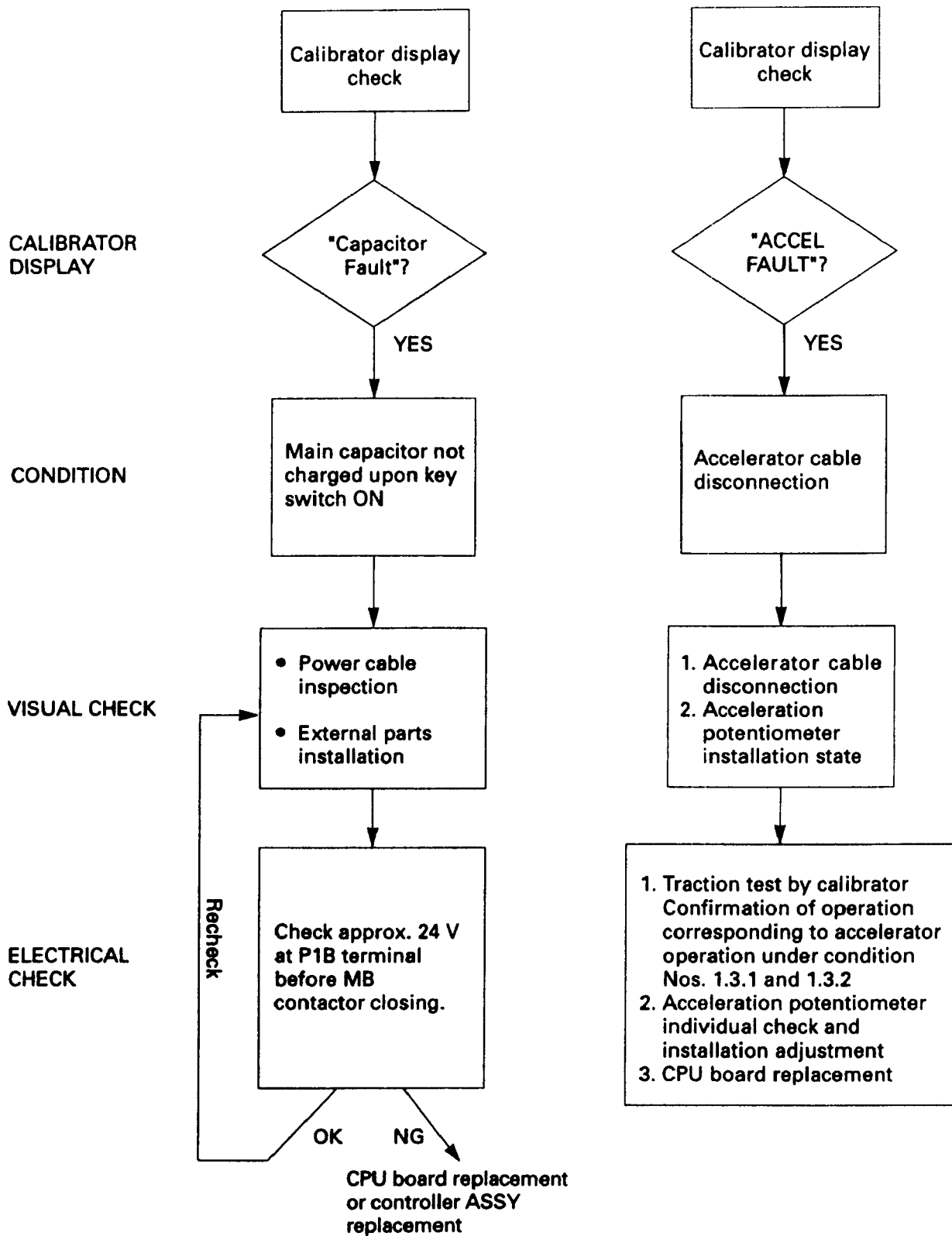
Blinking four times: Contactor or motor abnormality (open or short circuit) <1/2>

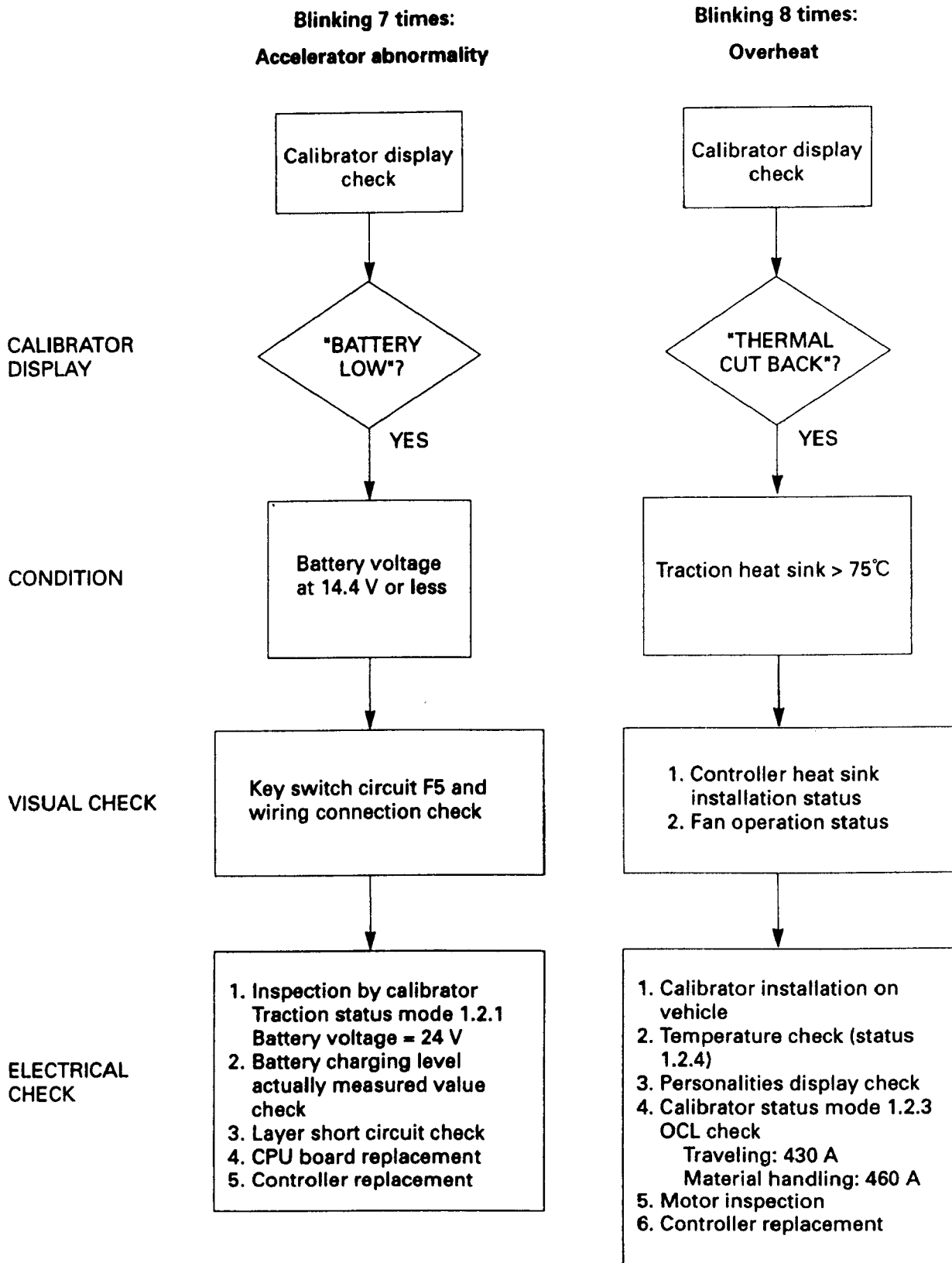


Blinking four times: Contactor or motor abnormality (open or short circuit) <2/2>

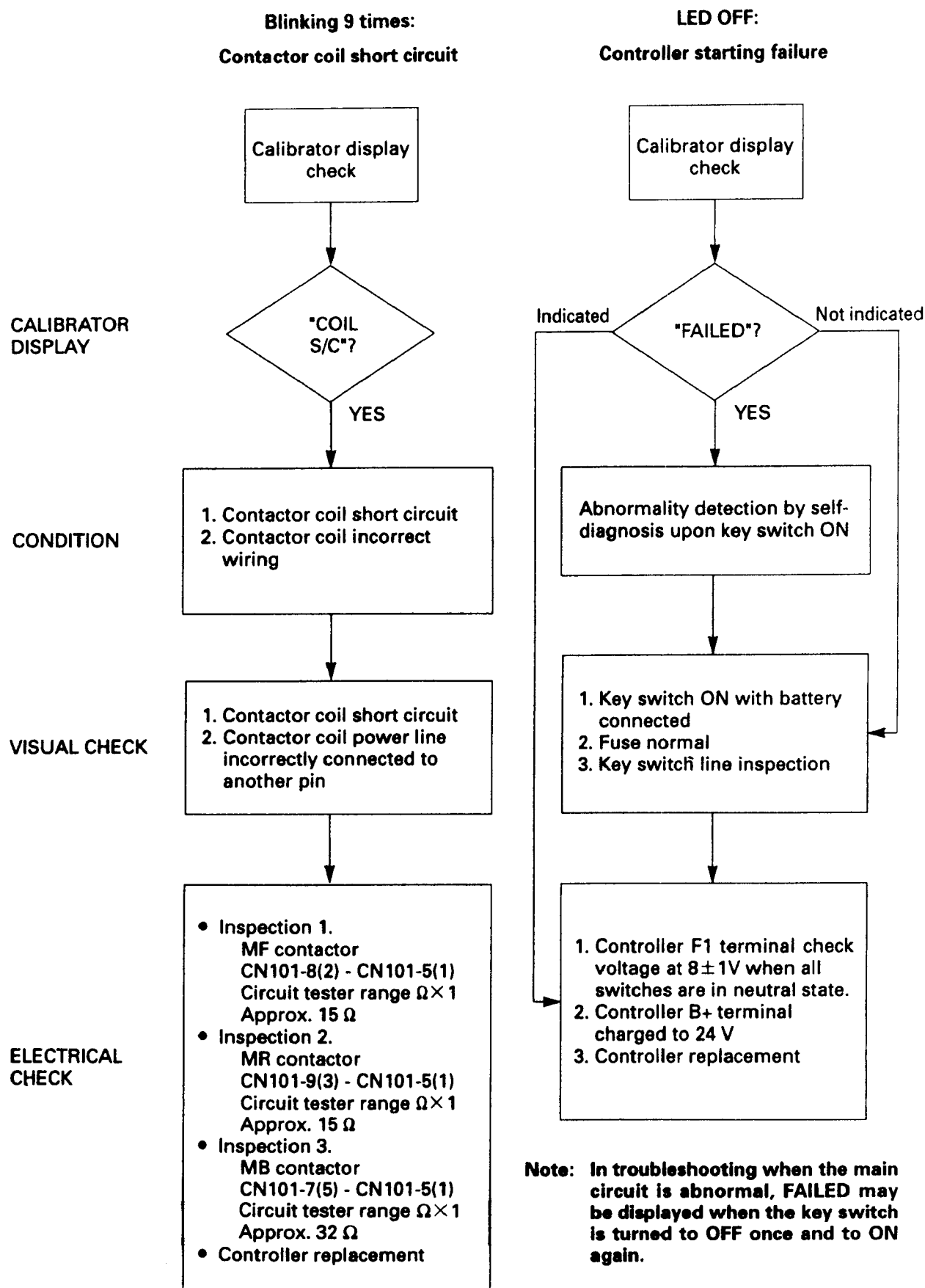
**Blinking five times:
Capacitor abnormality**

**Blinking six times:
Accelerator abnormality**





Note: If "THERMAL CUT BACK" is displayed, traveling and material handling speeds are restricted. Immediately stop the vehicle operation.

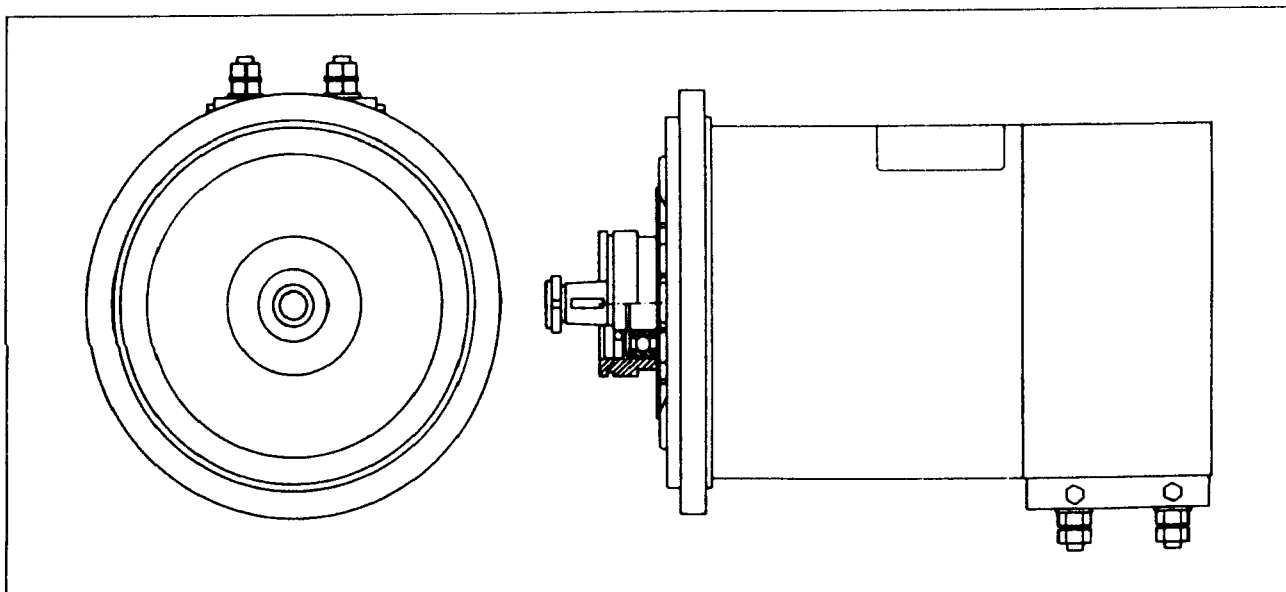


MOTOR

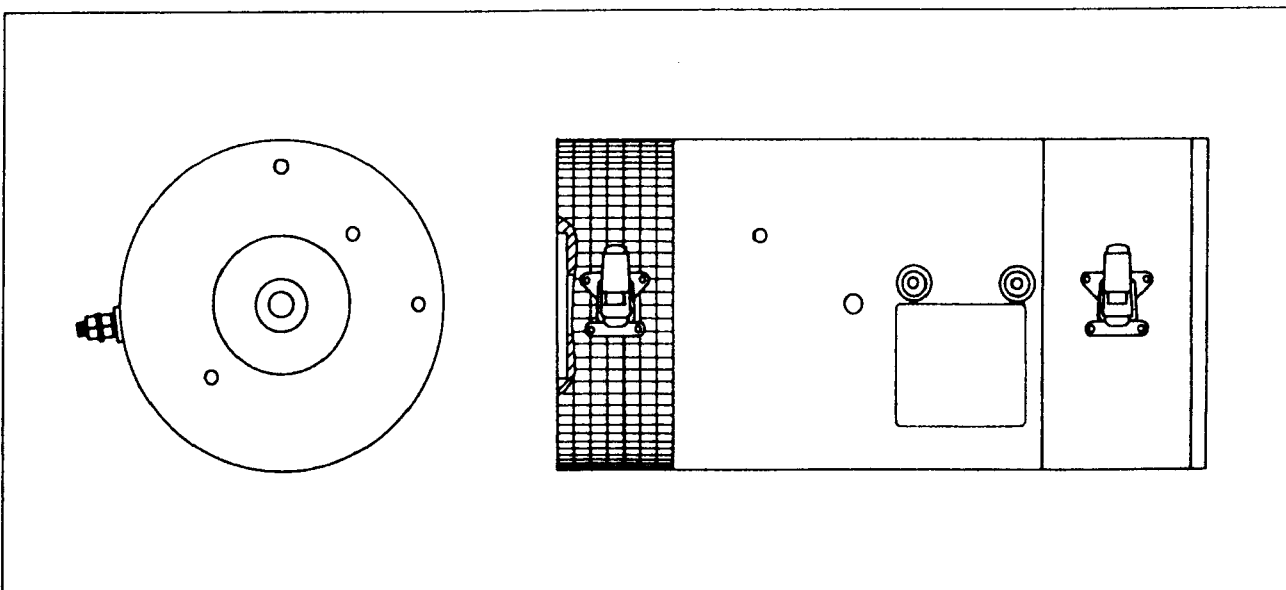
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GENERAL

Drive motor



Pump motor

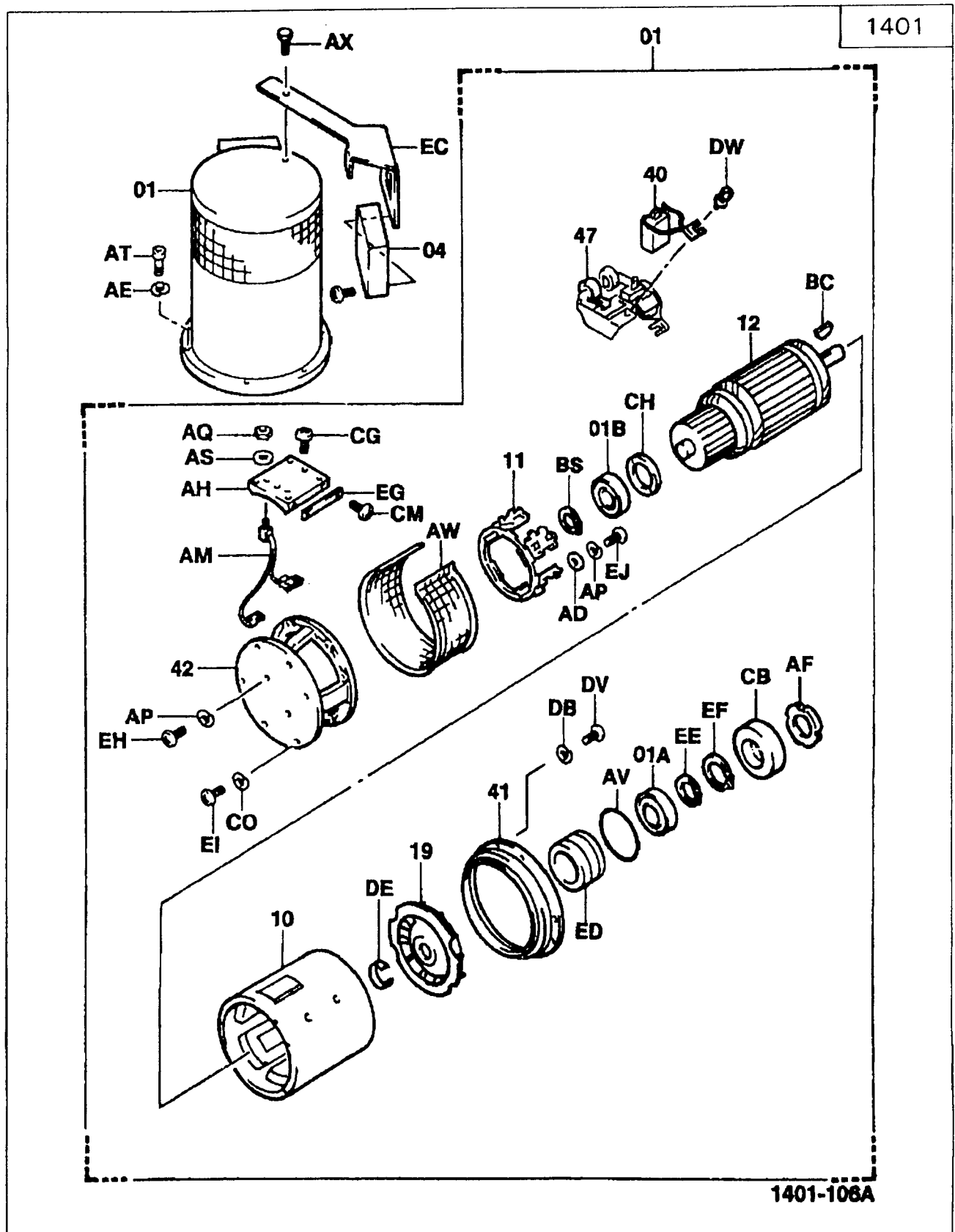


SPECIFICATIONS

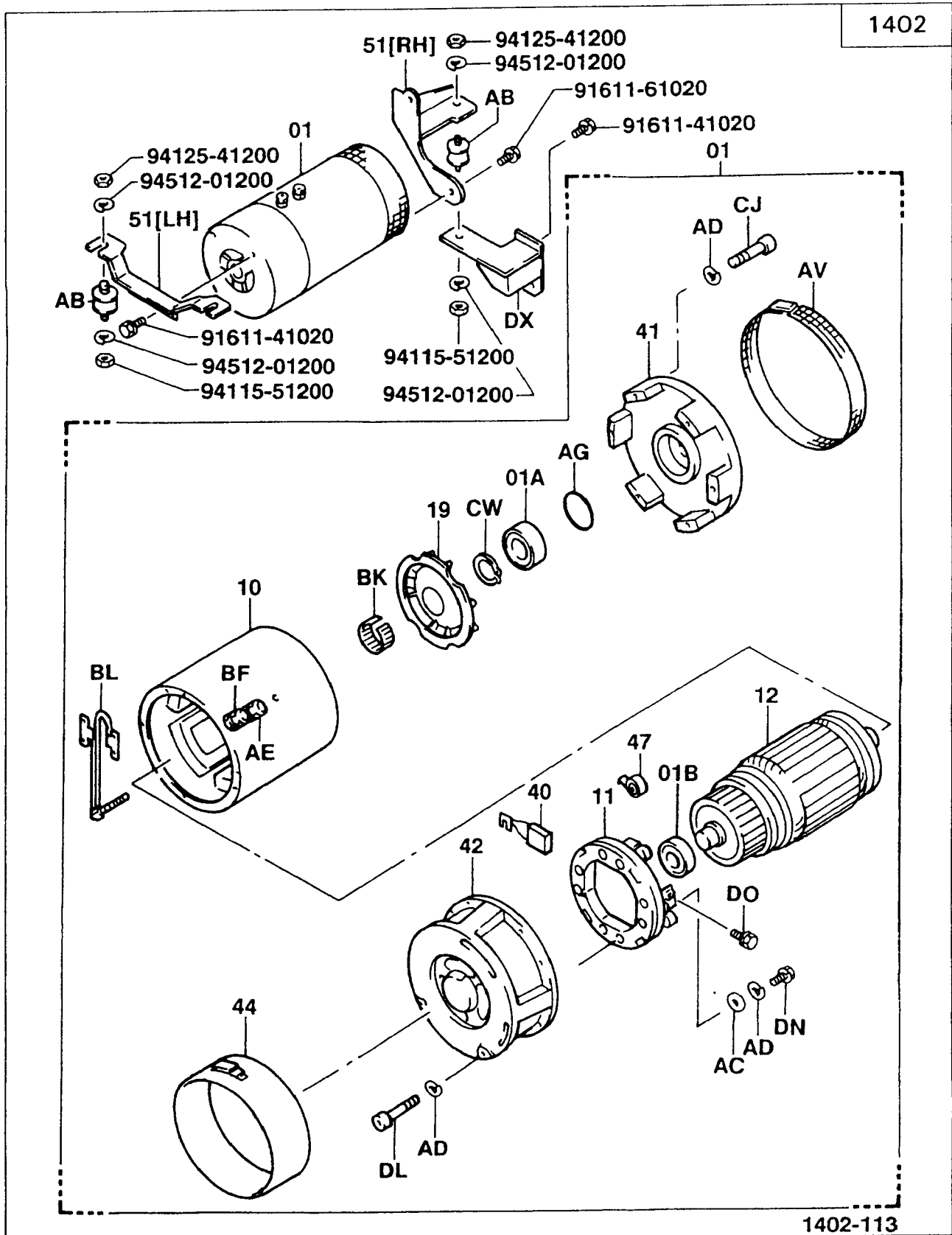
	Drive motor	Pump motor
Type	DC direct wound, open type	←
Rated voltage	24 V	←
Rated output	4.2 kw	8.8 kw
Insulation class	H	←
Brush size (thickness × width × length)	12.5 × 25 × 32 mm	16 × 20 × 28 mm
Number of brushes	8	←

COMPONENTS

(Drive Motor)

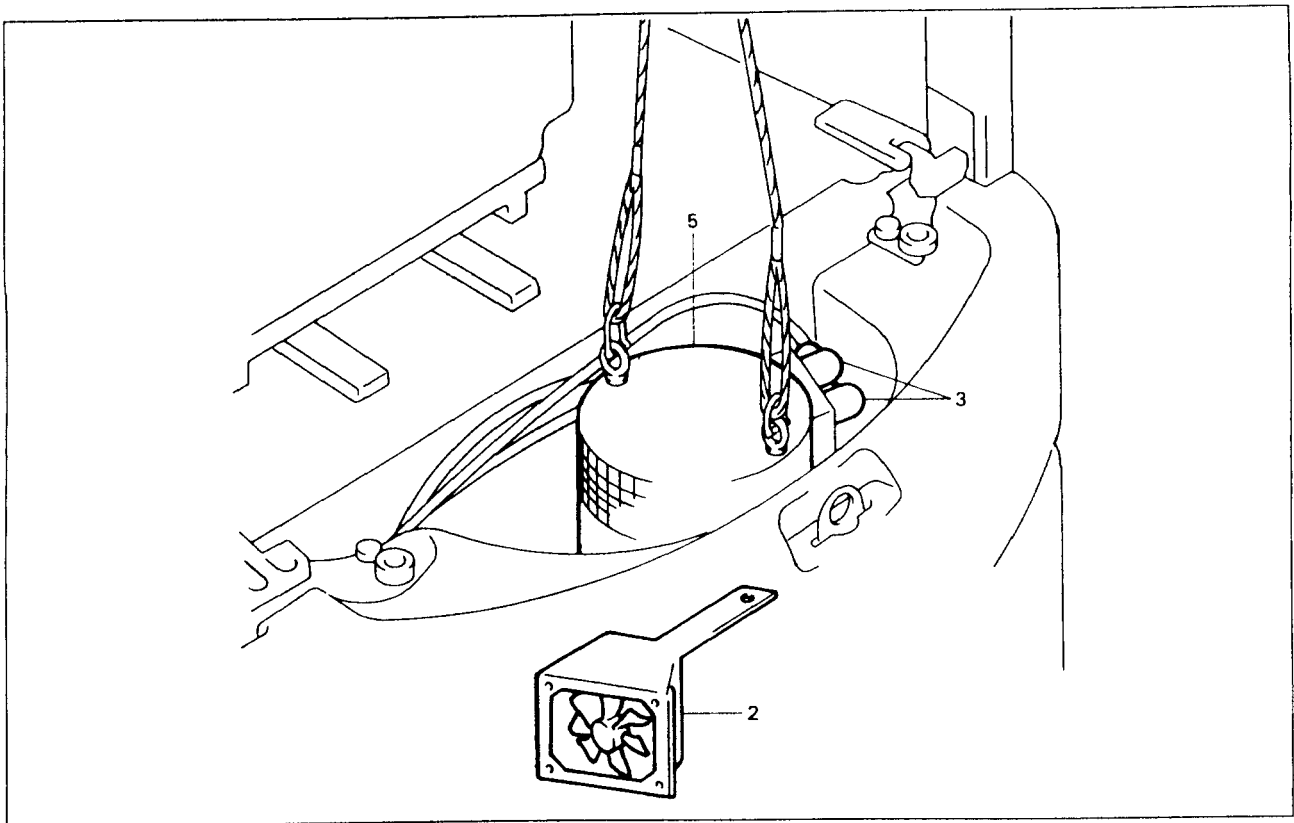


(Pump Motor)



DRIVE/PUMP MOTOR ASSEMBLY

REMOVAL-INSTALLATION (DRIVE MOTOR)

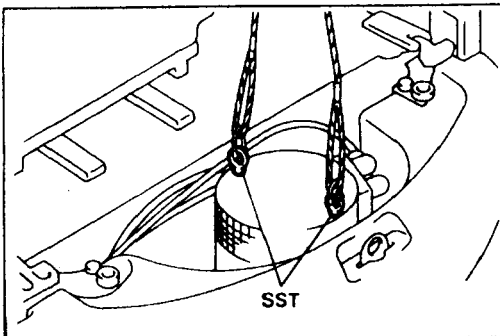


Removal Procedure

- 1 Remove the rear panel and controller upper cover.
- 2 Remove the fan motor w/bracket.
- 3 Disconnect the wiring
- 4 Remove the drive motor set bolts.
- 5 Hoist the drive motor using wire rope and remove the motor. [Point 1]

Installation Procedure

Installation is reverse of the removal procedure.

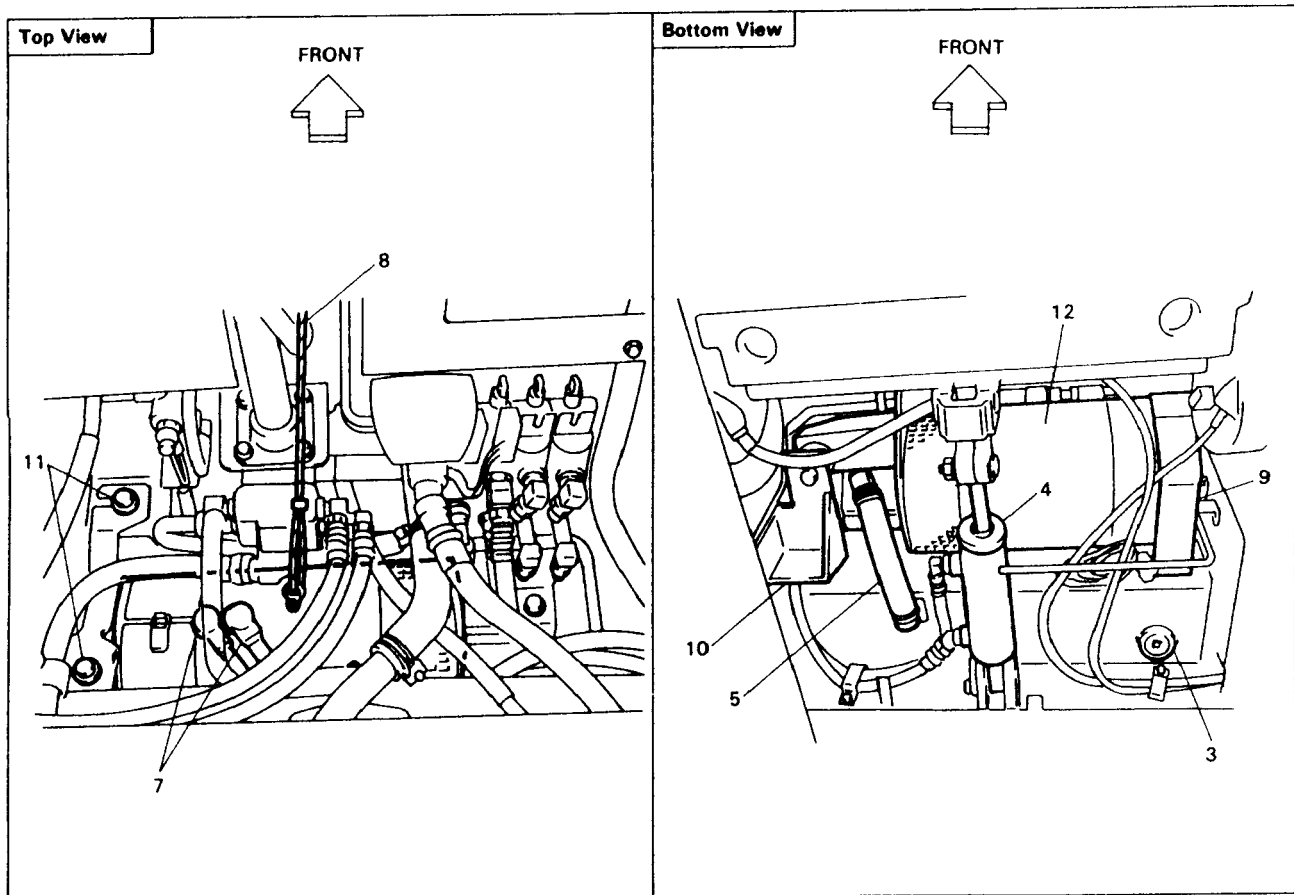


Point Operation

[Point 1]

Removal-Installation: SST 09140-12460-71

REMOVAL-INSTALLATION (PUMP MOTOR)

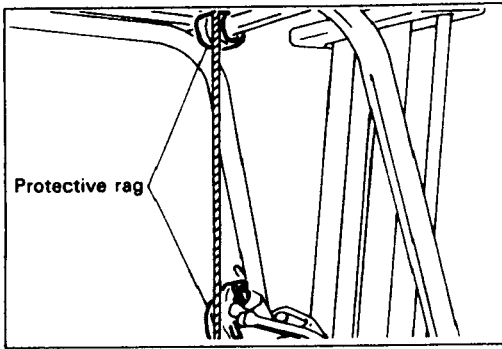


Removal Procedure

- 1 Set the steering tilt angle to the forward-most position and remove the steering wheel (see the section on removal of steering wheel and mast jacket).
- 2 Remove the front and rear toeboards.
- 3 Drain the hydraulic oil.
- 4 Remove only the front of the tilt cylinder to free it (see the section on removal of tilt cylinder).
- 5 Disconnect the inlet hose.
- 6 Disconnect the high-pressure hose.
- 7 Disconnect the wiring.
- 8 Tentatively hoist the pump motor ASSY by wire rope. [Point 1]
- 9 Remove the motor cover. [Point 2]
- 10 Remove the bracket.
- 11 Loosen pump motor ASSY set bolts, move the ASSY to the left and remove from the cutout.
- 12 Lower the pump motor ASSY slowly to remove it.

Installation Procedure

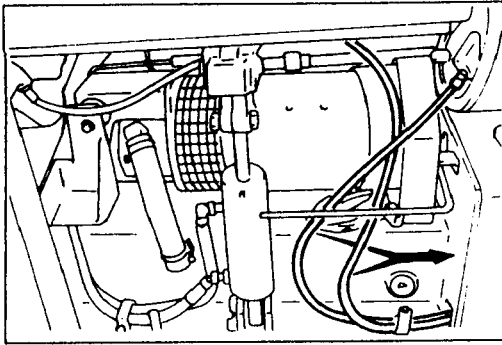
Installation is reverse of the removal procedure.



Point Operations

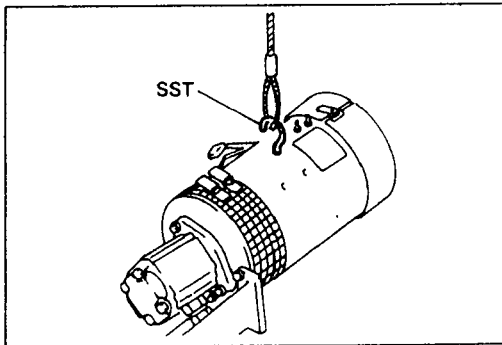
[Point 1]

Removal-Installation: Protect the body with rags so that the wire rope does not come in direct contact.



[Point 2]

Removal: Move the parking brake wire aside to avoid interference when lowering the pump motor.



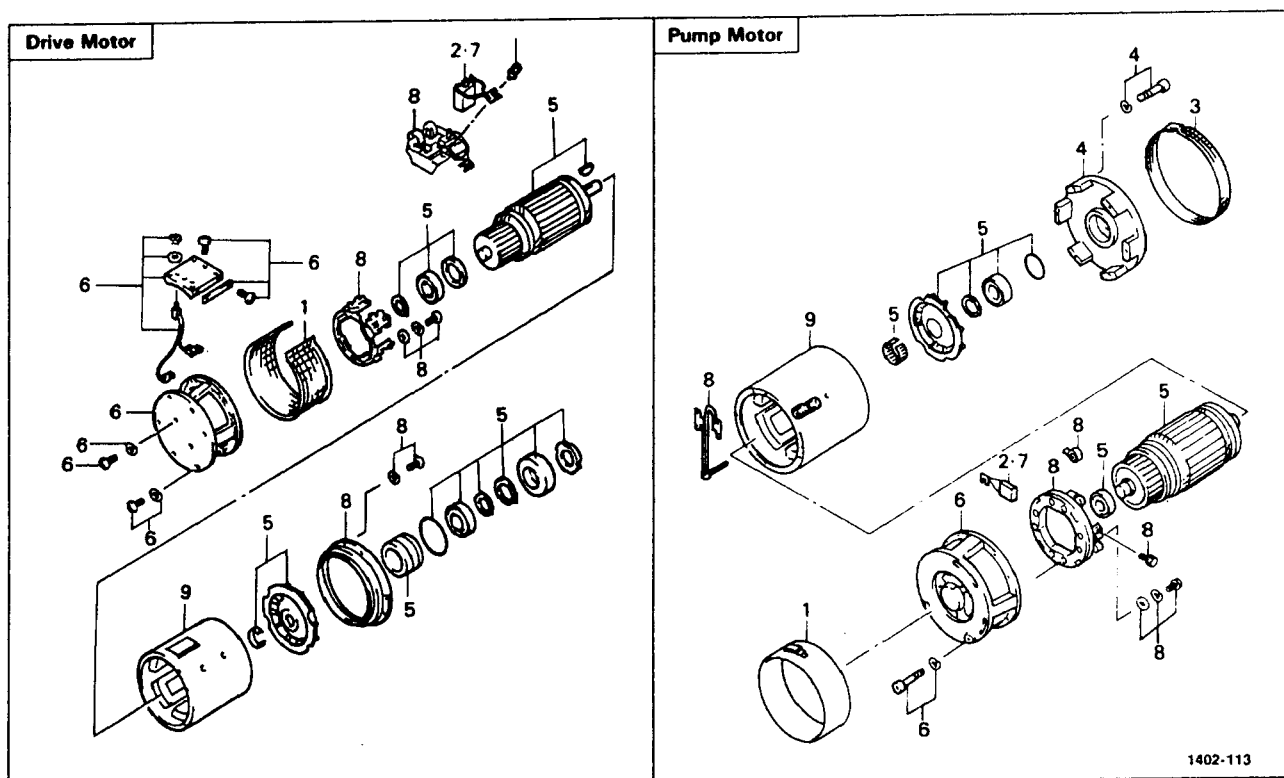
Removal-Installation: SST 09010-10260-71

DISASSEMBLY·INSPECTION·REASSEMBLY (DRIVE MOTOR, PUMP MOTOR)

Note:

Measure the insulation resistance of the motor wirings and the motor before beginning overhaul.

Reference value: 1 MΩ or more (500 VDC megger)



Disassembly Procedure

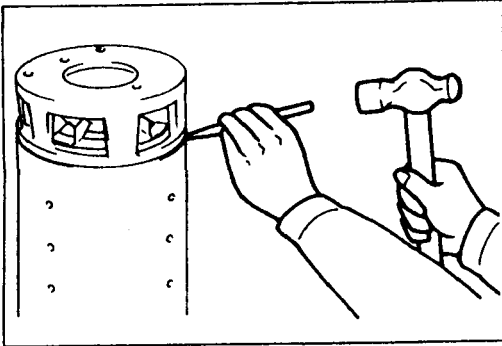
- 1 Remove the brush cover.
- 2 Free the brushes.
- 3 Remove the cover. (Pump motor)
- 4 Remove bracket No.1. (Pump motor) [Point 1]
- 5 Remove the armature ASSY. [Point 2]
- 6 Remove the commutator frame ASSY. [Point 3]
- 7 Remove the eight brushes from the commutator frame. [Point 4]
- 8 Remove the brush holder from the commutator frame.
- 9 Remove the yoke ASSY. [Point 5]

Reassembly Procedure

Reassembly is reverse of the disassembly procedure.

Note:

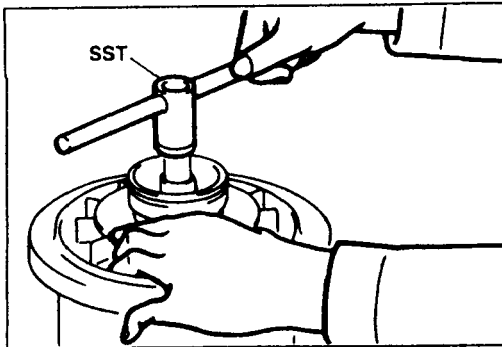
- Measure the insulation resistance of motor wirings and the motor body.
Reference: 1 MΩ or more (500 VDC megger)
- Check the continuity of the field coil. Measuring terminals: Between E and F
Reference: 0 Ω (circuit tester range × 1Ω)



Operation Points

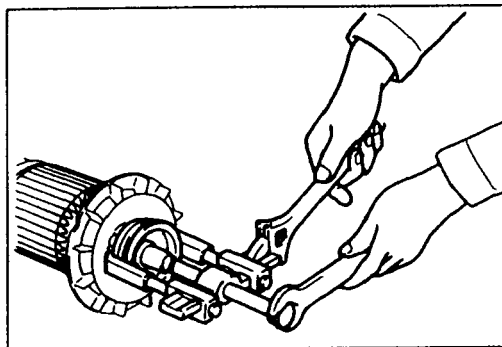
[Point 1] Pump motor

Disassembly: Mark matching marks on bracket No.1 and the yoke (also on the commutator frame and yoke).

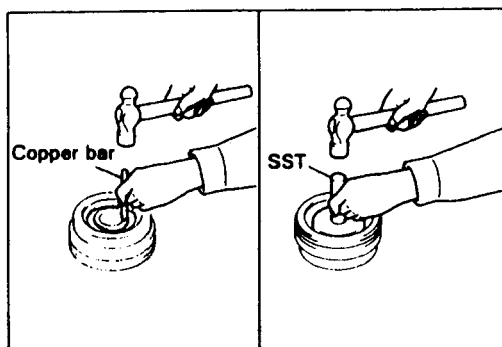


[Point 2] Drive Motor

Disassembly: Remove the safety nut.
SST 09310-10330-71



Disassembly: Remove the hub ASSY.
SST 09950-40010

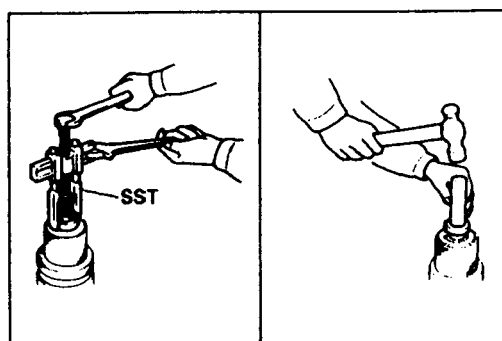


Inspection: Inspect bearings No.1 and No.2. Replace if worn or damaged.

No.1 bearing

Removal: Remove using a suitable copper bar.

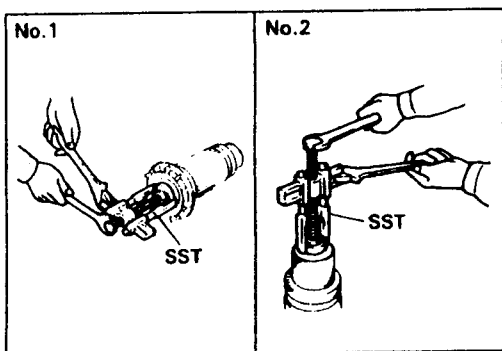
Installation: SST 09950-60010 (set)
SST 09951-00600 (single part)



No.2 bearing

Removal: SST 09950-40010

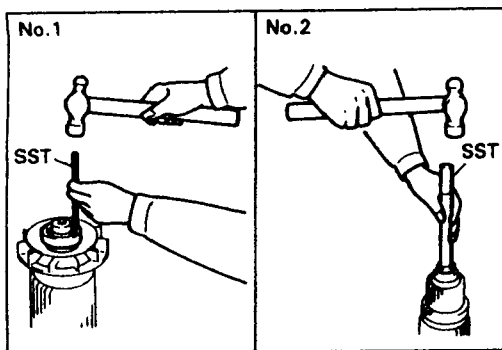
Installation: SST 09381-41950-71



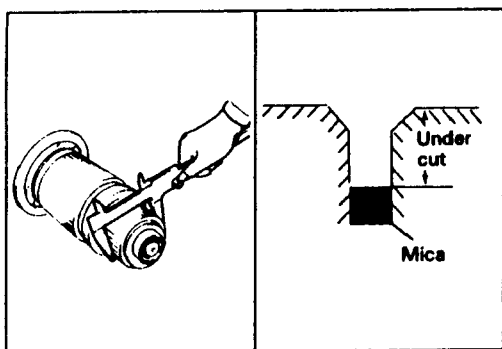
[Point 2] Pump motor

Inspection: Inspect bearings No.1 and No.2. Replace if worn or damaged.

Removal (common for No.1 and No.2):
SST 09950-40010



Installation: No.1: SST 09700-30200-71
No.2: SST 09620-30010



[Point 2-1] Drive motor, Pump motor

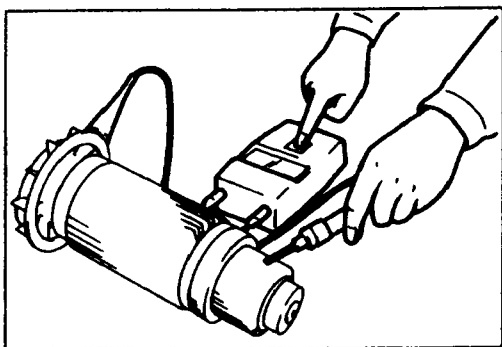
Inspection: If the commutator surface is rough, repair using emery paper (#600 or so) and completely clean after repair. If the surface is excessively rough, repair in a lathe.

Commutator outside diameter

	Drive motor	Pump motor
Standard:	90 mm	80 mm
Limit:	87 mm	70 mm

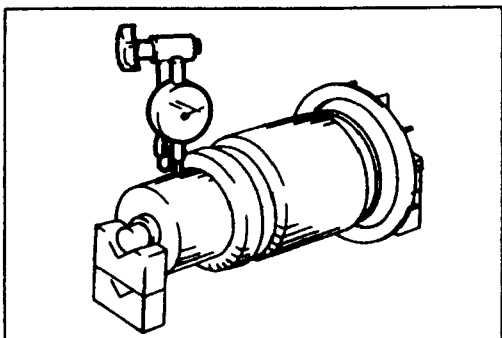
Under-cut the mica when repairing the commutator.

	Drive motor	Pump motor
Standard:	0.6 mm	←
Limit:	0.3 mm	←



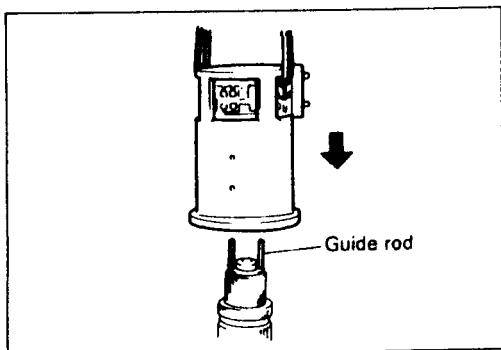
Inspection: Measure the insulation resistance of the armature coil.

Standard: 1 MΩ or more



Inspection: Measure commutator deviation.

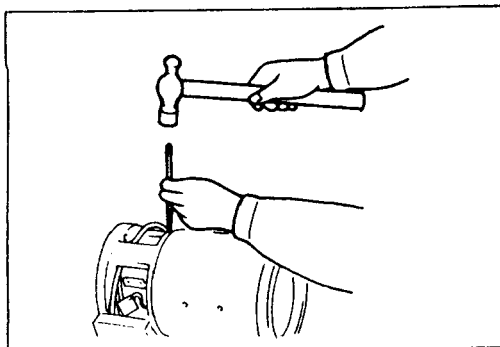
Standard: 0.02 mm or less

**[Point 2-2] Drive motor**

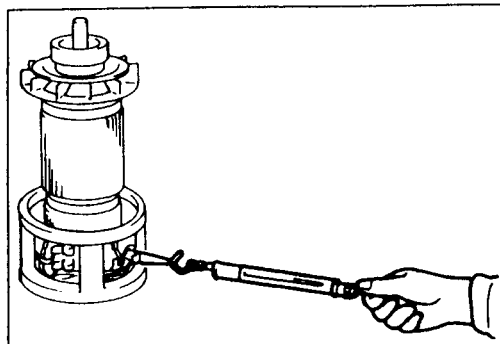
Reassembly: Attach the guide rod to the armature coil plate, hoist the yoke assembly by wire rope and position so that the guide rod can be inserted into the screw hole by lowering the assembly.

Prepare the guide rod whose size is as follows:

5 mm dia round rod, length at 380 mm or more

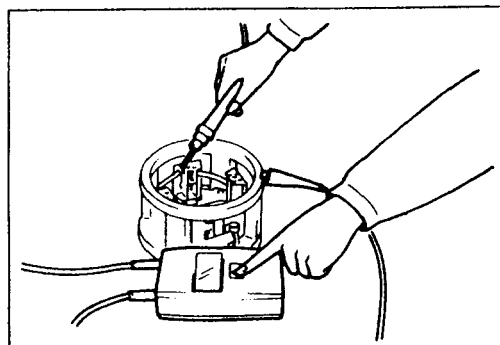
**[Point 3] Drive motor**

Removal: Mark matching marks on the commutator frame and yoke.

**[Point 3-1] Drive motor, Pump motor**

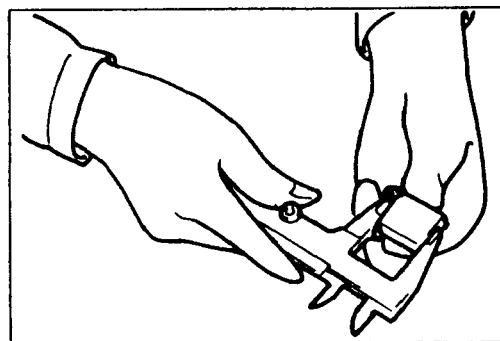
Inspection: Install the armature coil and brushes and then hook a spring balance to the brush spring to measure the spring force when the brush separates from the spring.

Standard:	Drive motor	$9.35 \pm 0.9 \text{ N}$ ($0.95 \pm 0.1 \text{ kgf}$)
	Pump motor	$9.6 \pm 0.7 \text{ N}$ ($0.98 \pm 0.07 \text{ kgf}$)



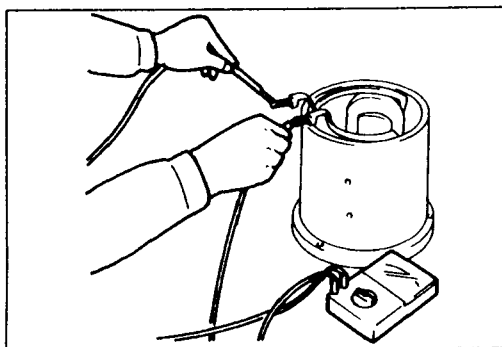
Inspection: Measure the insulation resistance between the brush holder and the commutator.

Standard: 1 MΩ or more

**[Point 4] Drive motor, Pump motor**

Inspection: Check brush wear and degree of contact.

	Drive motor	Pump motor
Standard:	32 mm	28 mm
Limit:	13 mm	11 mm

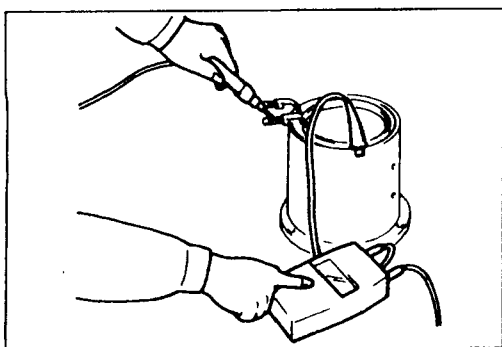


[Point 5]

Inspection: Check the continuity of the field coil.

Measuring terminals: Between terminals E and F (Drive motor)

Standard: Between terminal E/F and coil end terminal (Pump motor)
 0Ω (circuit tester range $\times 1 \Omega$)



Inspection: Measure the insulation resistance of the field coil.

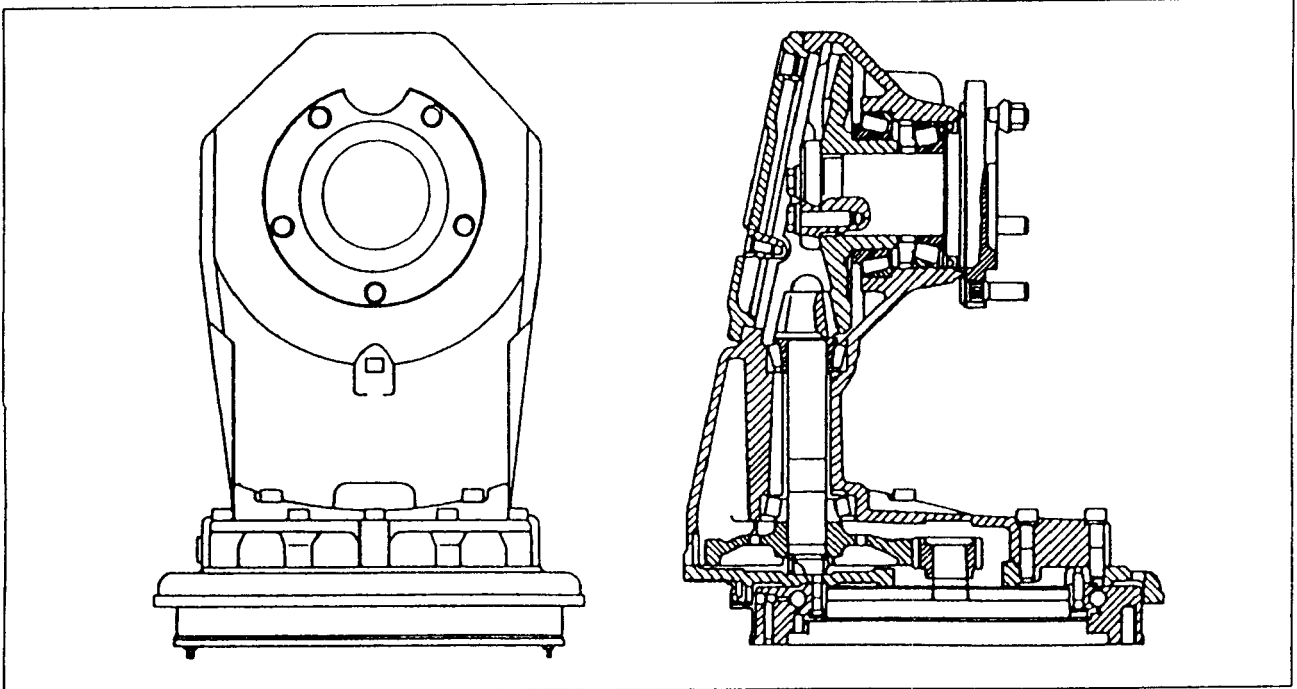
Measuring terminals: Between terminals E and F

Standard: $1 M\Omega$ or more

DRIVE UNIT AND REAR WHEELS

	Page
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SPECIFICATIONS	5-2
COMPONENTS	5-3
DRIVE UNIT ASSEMBLY	5-4
REMOVAL INSTALLATION	5-4
DISASSEMBLY INSPECTION-REASSEMBLY	5-6

GENERAL



SPECIFICATIONS

Drive Unit

Vehicle model			EC 10T-15T
Item			
Reduction-gear type			Single-stage helical gear Single-stage spiral bevel gear
Number of gear teeth	Helical gear first stage	Drive	15
		Driven	57
	Spiral bevel gear	Drive	9
		Driven	37
Total reduction ratio			20.37
Drive unit gear oil quantity		ℓ (US gal)	Approx. 4.5 (1.19)

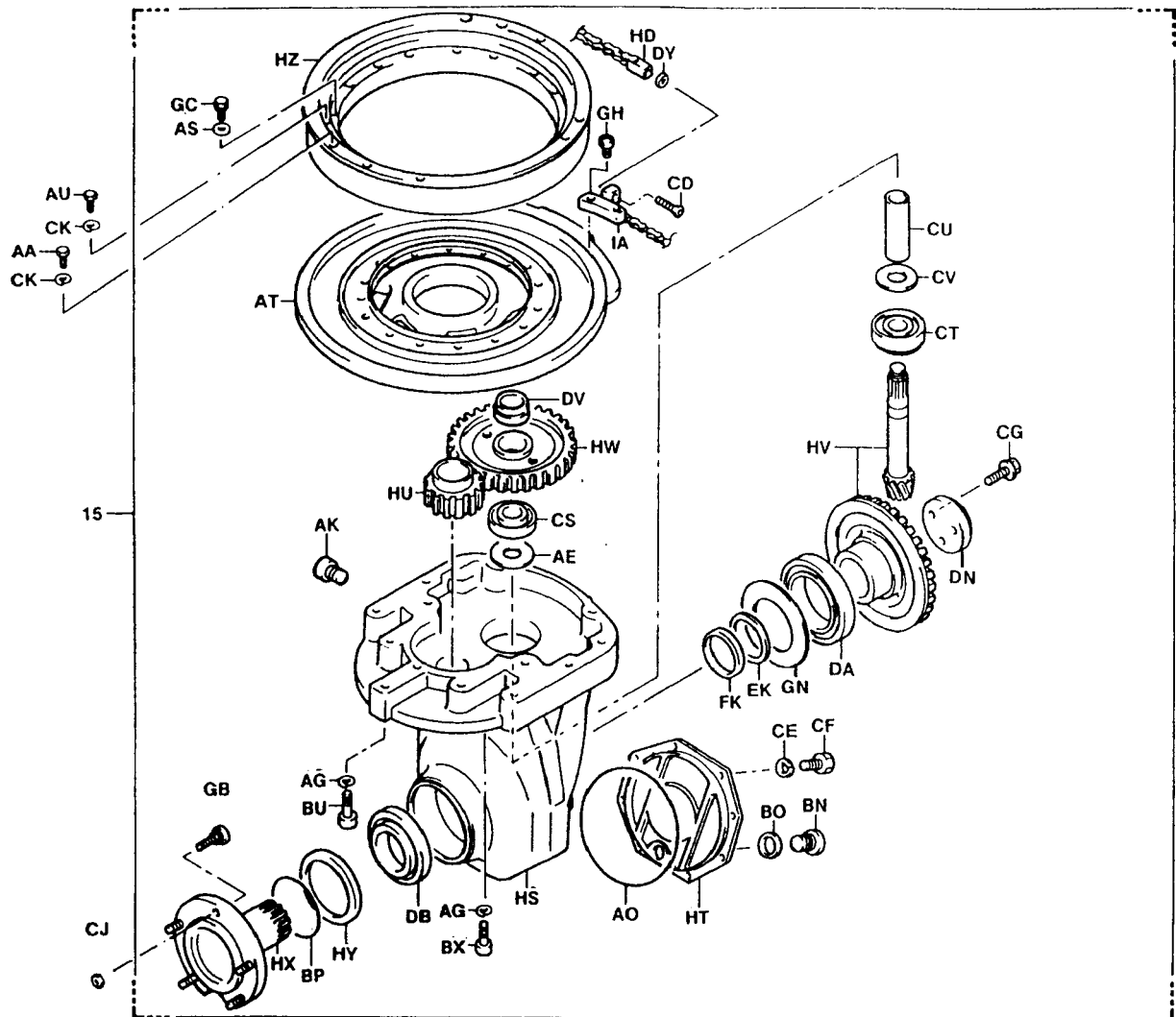
Rear wheel tire

○: STD △: OPT —: Not available

	PSC tire	Pneumatic tire	Cushion tire
Tire outside diameter × width (in)	18 × 7 - 8	18 × 7 - 8 16 PLY	16.25 × 7 × 11.25
Rim	Side ring rim 4.33R-8	←	—
EC 10T	○	△	△
EC 12T	○	△	△
EC 15T	○	△	△
Air pressure kPa (kgf/cm ²)	—	980 (10)	—
Offset (mm)	19 (common for front and rear)	9 (common for front and rear)	

COMPONENTS

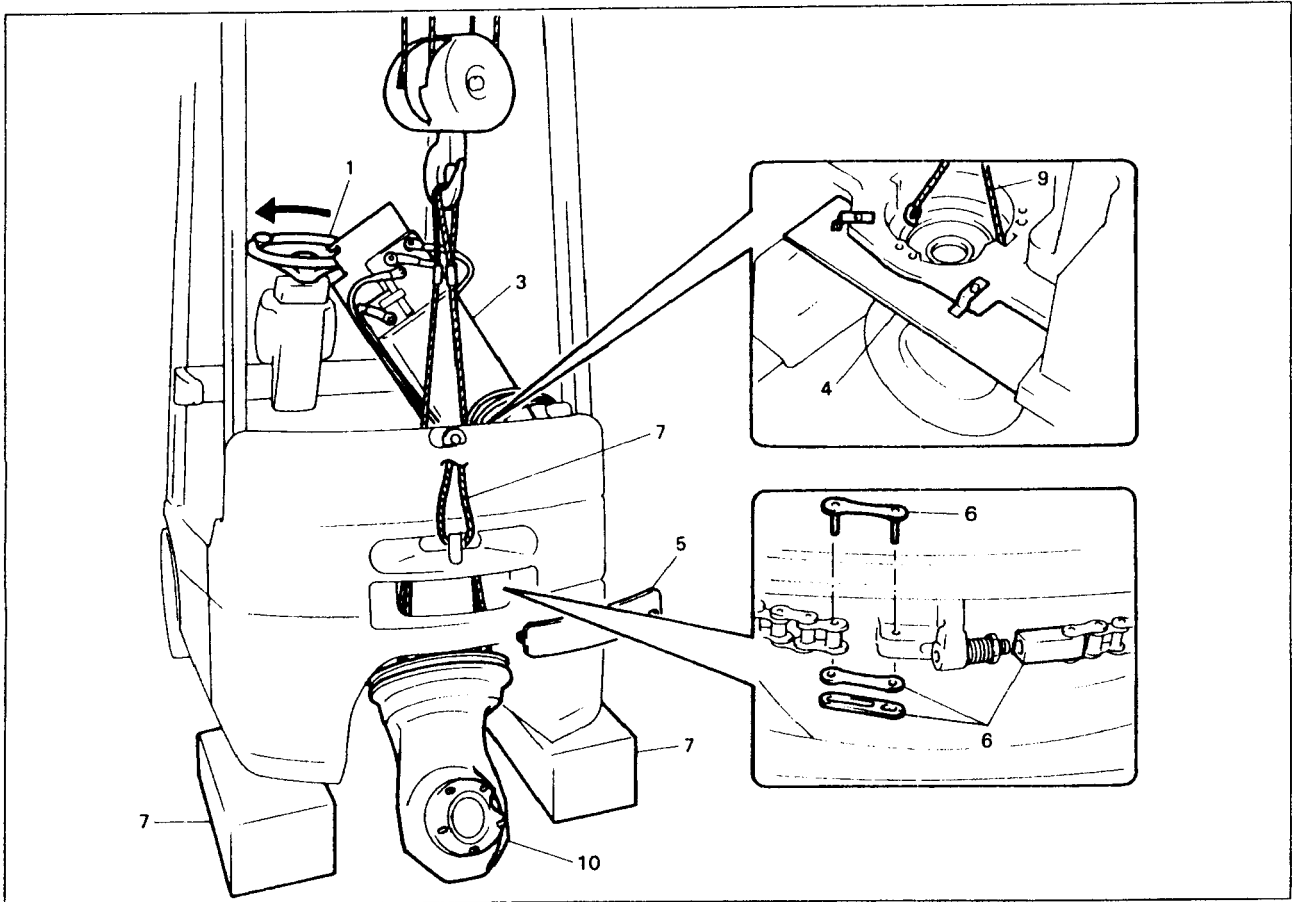
4301



4301-104

DRIVE UNIT ASSEMBLY

REMOVAL-INSTALLATION



Removal Procedure

- 1 Lift the fork slightly and turn the steering wheel fully counterclockwise for hoisting the vehicle. [Point 1]
- 2 Remove the drive motor (see page (P4-6) for removal of drive motor).
- 3 Set the controller with its left end raised (see page (P4-6) for removal of the controller).
- 4 Remove the center cover.
- 5 Remove the chain cover.
- 6 Disconnect the steering chain from the weight window and remove the steering chain. [Point 2]
- 7 Hoist the vehicle by wire rope, set supporting wooden blocks and remove the rear wheel.
- 8 Drain the gear oil.
- 9 Tentatively hoist the drive unit and remove the set bolts. [Point 3]
- 10 Remove the drive unit from the bottom.

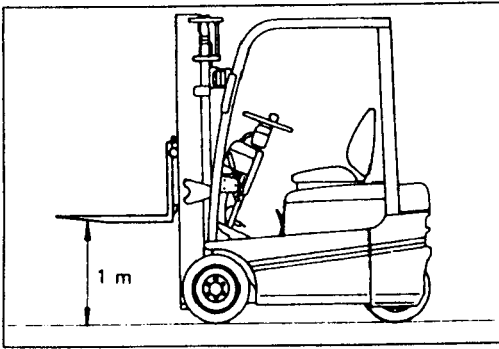
Installation Procedure

Installation is reverse of the removal procedure.

Note:

- Standard gear oil quantity: 4.5 liters
- Use Hypoid Gear Oil SAE80W-90 API GL-5
- Oil replacement

Replace the oil after the first 170 hours of operation. The oil replacement thereafter is about every 1000 hours or annually.

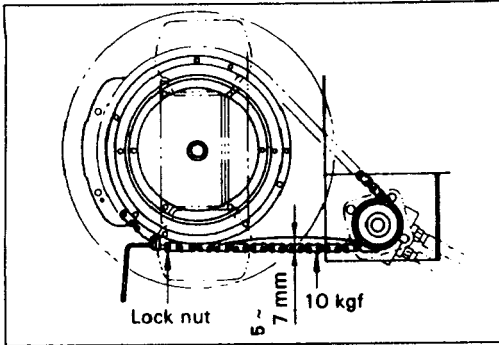


Operation Points

[Point 1]

Removal: Raise the fork about 1 m. Be sure to support the body on wooden blocks.

Removal: Be sure to chock the front wheels to prevent accidents.



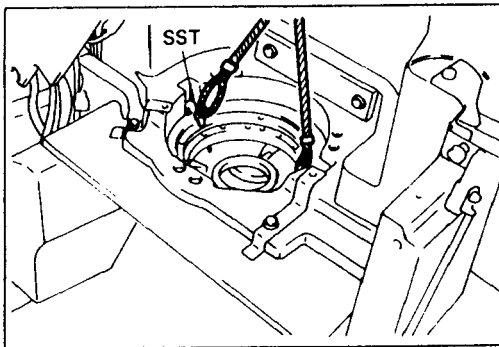
[Point 2]

Installation: Adjust the chain tension by applying a force of 10 kgf at the center. After adjustment, be sure to tighten the lock nut.

Standard: 5 ~ 7 mm

Note:

Unload the battery before adjusting the chain tension.

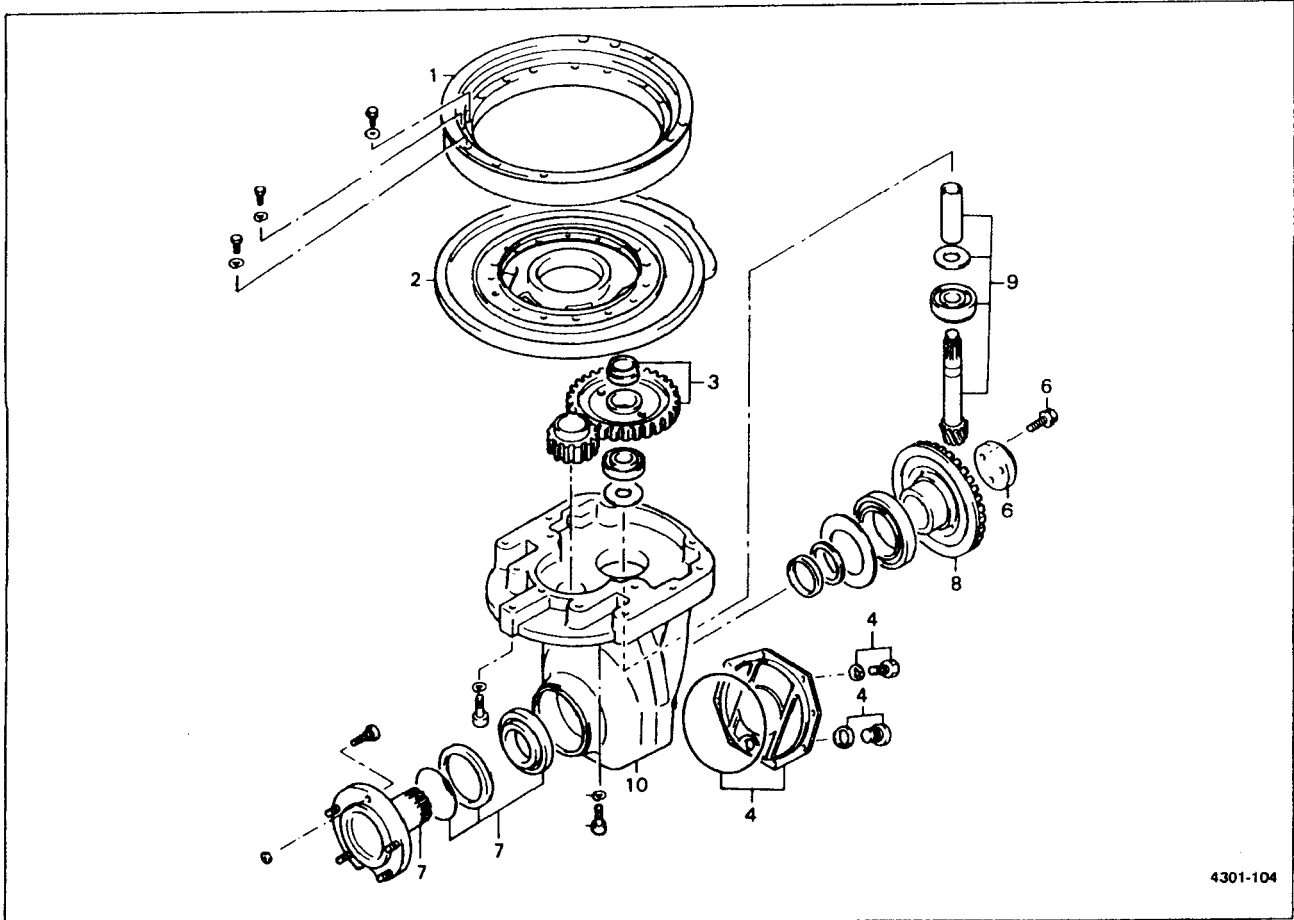


[Point 3]

Removal-Installation: SST 09241-40530-71

DISASSEMBLY-INSPECTION-REASSEMBLY

T = N·m (Kgf·cm)



4301-104

Disassembly Procedure

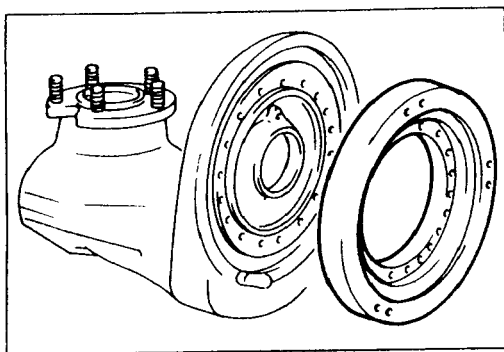
- 1 Remove the turn table. [Point 1]
- 2 Remove the upper cover. [Point 2]
- 3 Remove the safety nut and helical gear. [Point 3]
- 4 Remove the lower cover. [Point 4]
- 5 Measure the backlash between the pinion and bevel gears. [Point 5]
- 6 Remove the disc. [Point 6]
- 7 Remove the drive wheel shaft ASSY. [Point 7]
- 8 Remove the bevel gear ASSY. [Point 8]
- 9 Remove the pinion shaft ASSY.
- 10 Remove the gear case.

Reassembly Procedure

Reassembly is reverse of the disassembly procedure.

Note:

- Be sure to fill the turn table bearing with the specified grease.

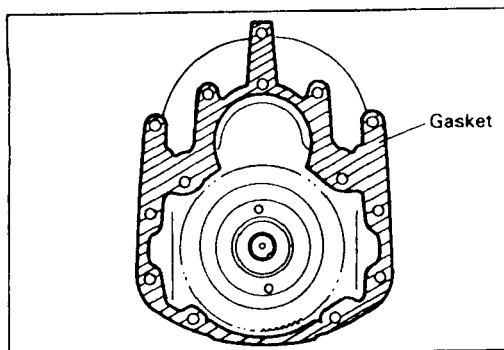


Operation Points

[Point 1]

Disassembly: Apply sealing material, set at the low position of the turn table and then apply seal packing. At this time, apply special fluid Del0187 to the set bolts.

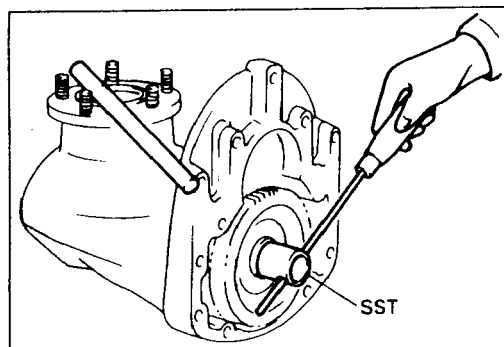
Inspection: Lubricate the turn table at least annually, with Westfalen Gresalite LZ2.



[Point 2]

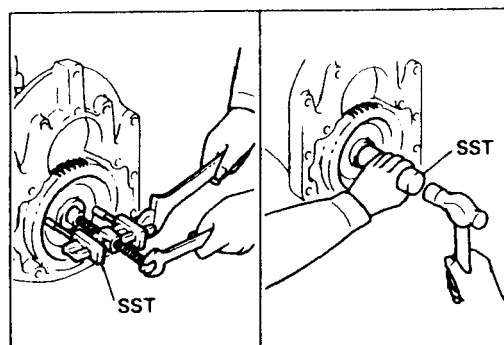
Reassembly: Apply liquid gasket to the matching face of the gear case before assembling.

Gasket: CURIL K2
Apply special fluid Del0187 to the bolts.



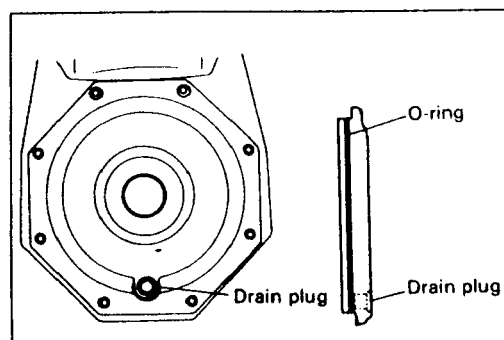
[Point 3]

Disassembly-Reassembly: Secure using a suitable round bar as shown and then remove the safety nut. Use the round bar in the same way when tightening the nut.
SST 09320-10330-71



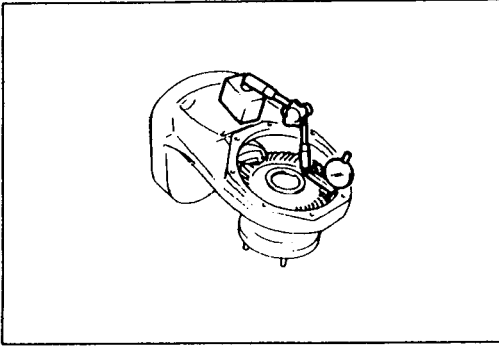
Disassembly: Remove the helical gear.
SST 09950-50010

Reassembly: Install the helical gear.
SST 09410-40120-71



[Point 4]

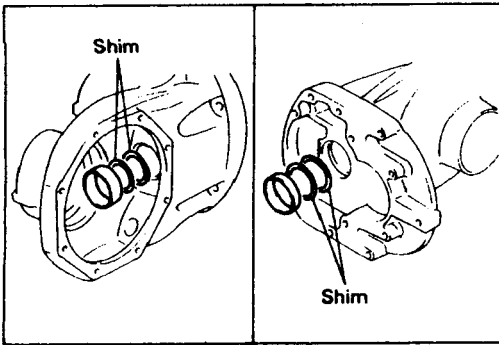
Reassembly: Install so that the drain plug is at the bottom. Coat oil on the outer periphery of the O-ring and reassemble so as not to damage the O-ring.

**[Point 5]**

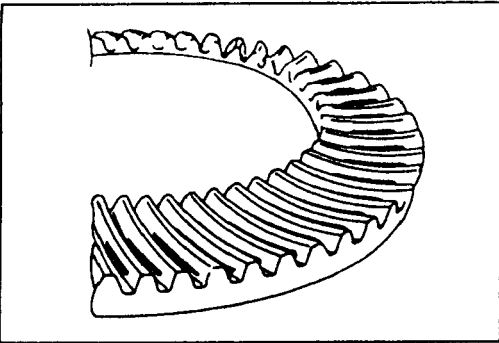
Inspection: Check and adjust the backlash between the drive pinion and bevel gears.

1. Turn the drive wheel shaft and measure the backlash.

Standard: 0.05 ~ 0.1 mm (0.002 ~ 0.004 in)



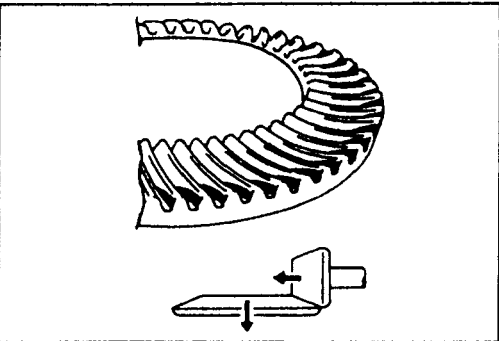
2. If the measured backlash is beyond the standard replace the drive pinion projection adjustment shim and measure again.



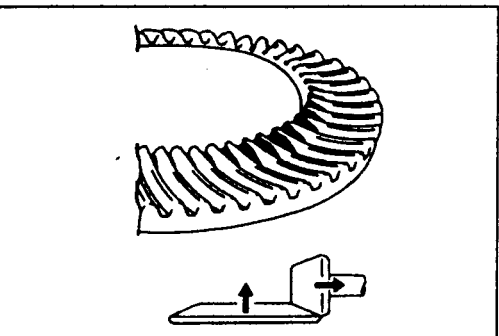
Inspection: Check and adjust the tooth contact of the drive pinion and bevel gear teeth.

1. Clean the gear teeth and apply red lead thinly and uniformly to 9 to 10 teeth of the bevel gear. Turn the drive wheel shaft forward and backward to check tooth contact.

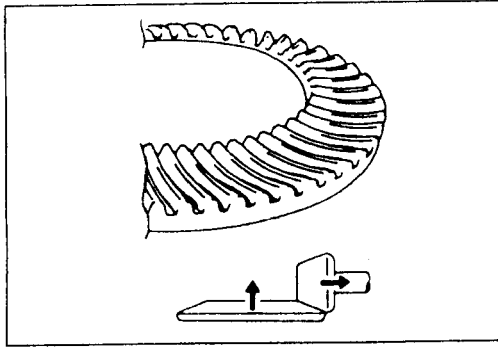
If tooth contact is incorrect, adjust the drive pinion projection and the bevel gear shim as well as the backlash. When adjusting the bevel gear shim, be sure to adjust the starting force of the bevel gear bearing.



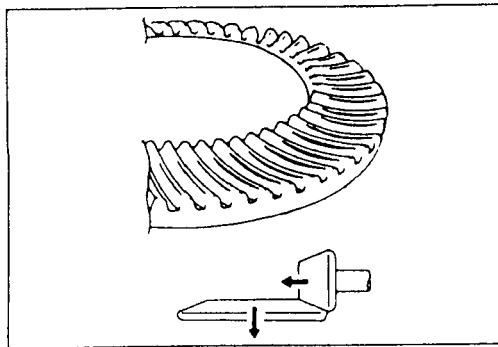
- (1) **Heel contact**
Reduce the thickness of the drive gear pinion shim to bring the pinion closer to the bevel gear. Next, reduce the thickness of the bevel gear shim to keep the bevel gear away from the pinion.



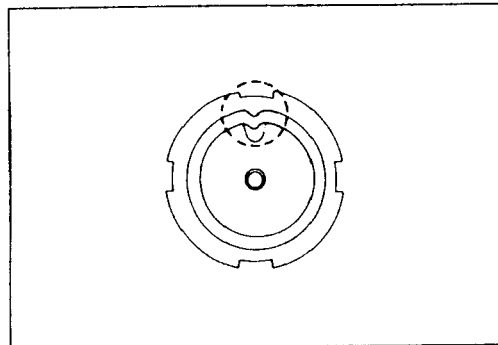
- (2) **Toe contact**
Increase the thickness of the drive gear pinion shim to keep the pinion away from the bevel gear. Next, increase the thickness of the bevel gear shim to bring the bevel gear closer to the pinion.



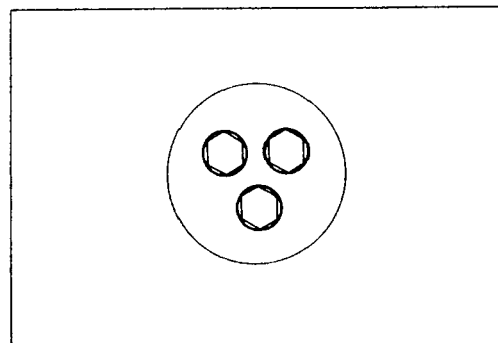
- (3) Crank contact (low and shallow contact)
Increase the thickness of the drive pinion shim to keep the pinion away from the bevel gear. Next, increase the thickness of bevel gear shim to bring the bevel gear closer to the pinion.



- (4) Face contact (high and shallow contact)
Reduce the thickness of drive pinion shim to bring the pinion closer to the bevel gear. Next, reduce the thickness of bevel gear shim to keep the bevel gear away from the pinion.



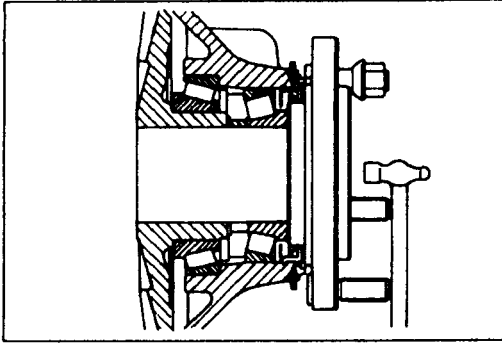
2. When tooth contact is correct, firmly tighten the safety nut of the helical gear.



[Point 6]

Disassembly: Since the bolts are tightened firmly using Loktite, carefully use a hexagon wrench to avoid damaging the heads.

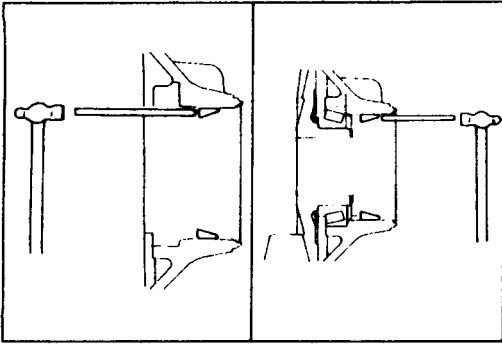
Assembly: Apply Loktite 270 to the thread when assembling the disc.



[Point 7]

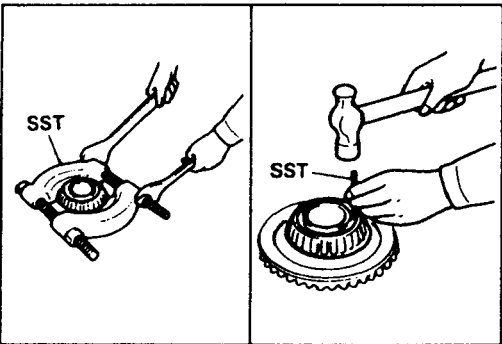
Reassembly: Apply gear oil on the oil seal lip and sealant 08826-00080 on the outer periphery of the oil seal before reassembly.

Gear oil: Hypoid Gear oil SAE75W—90



Removal: Remove the bearing outer race using a copper bar.

Reassembly: Install the bearing outer race to the gear case, using a copper bar.



[Point 8]

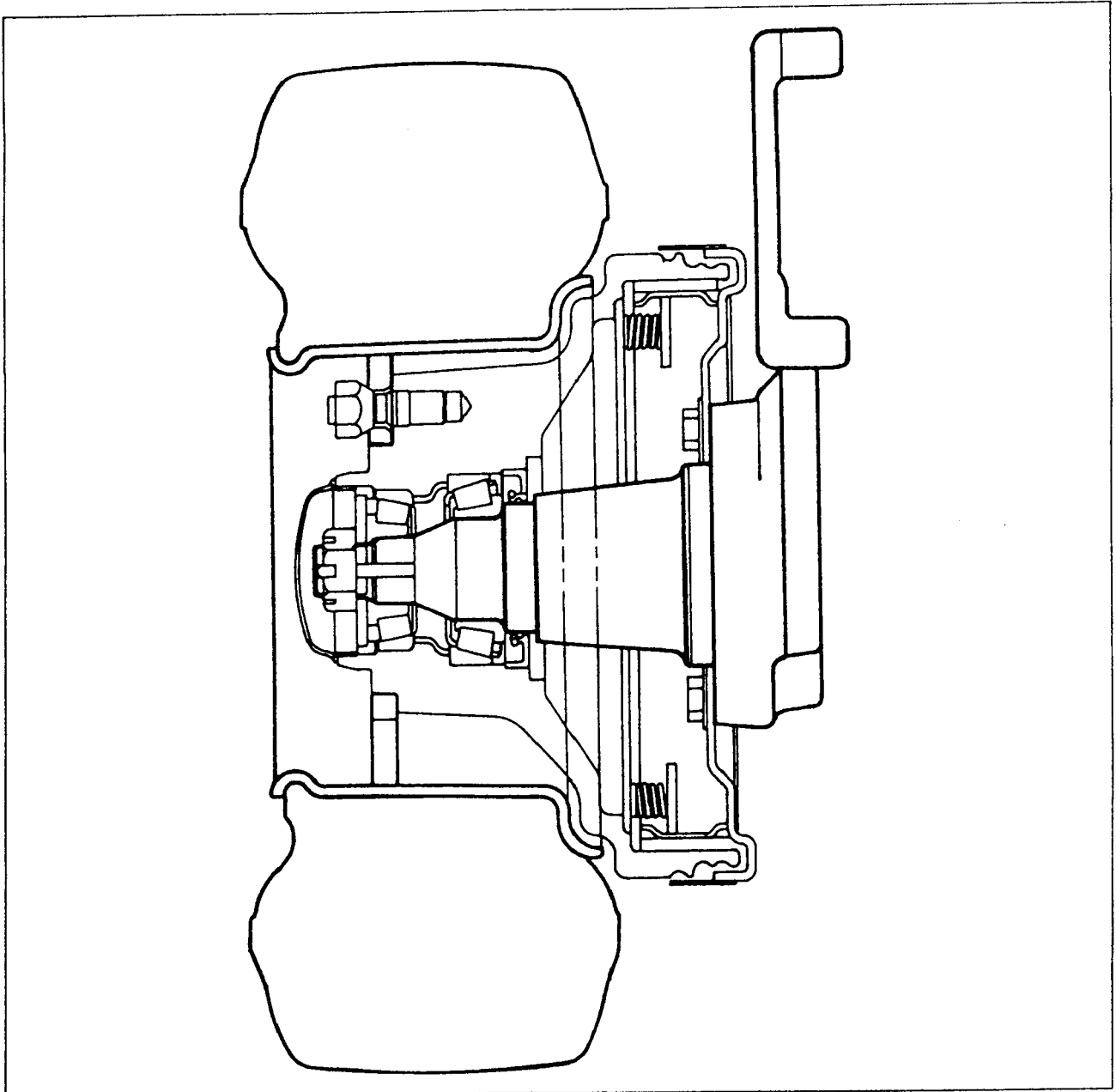
Inspection: Inspect the bevel gear bearing. Replace if any abnormalities are found.

1. Remove the bearing.
SST 09420-23000-71
2. Install the bearing.
SST 09700-30200-71

FRONT AXLE

	Page
GENERAL	6-2
SPECIFICATIONS	6-2
FRONT AXLE HUB	6-3
REMOVAL INSTALLATION	6-3
DISASSEMBLY INSPECTION-REASSEMBLY	6-5

GENERAL



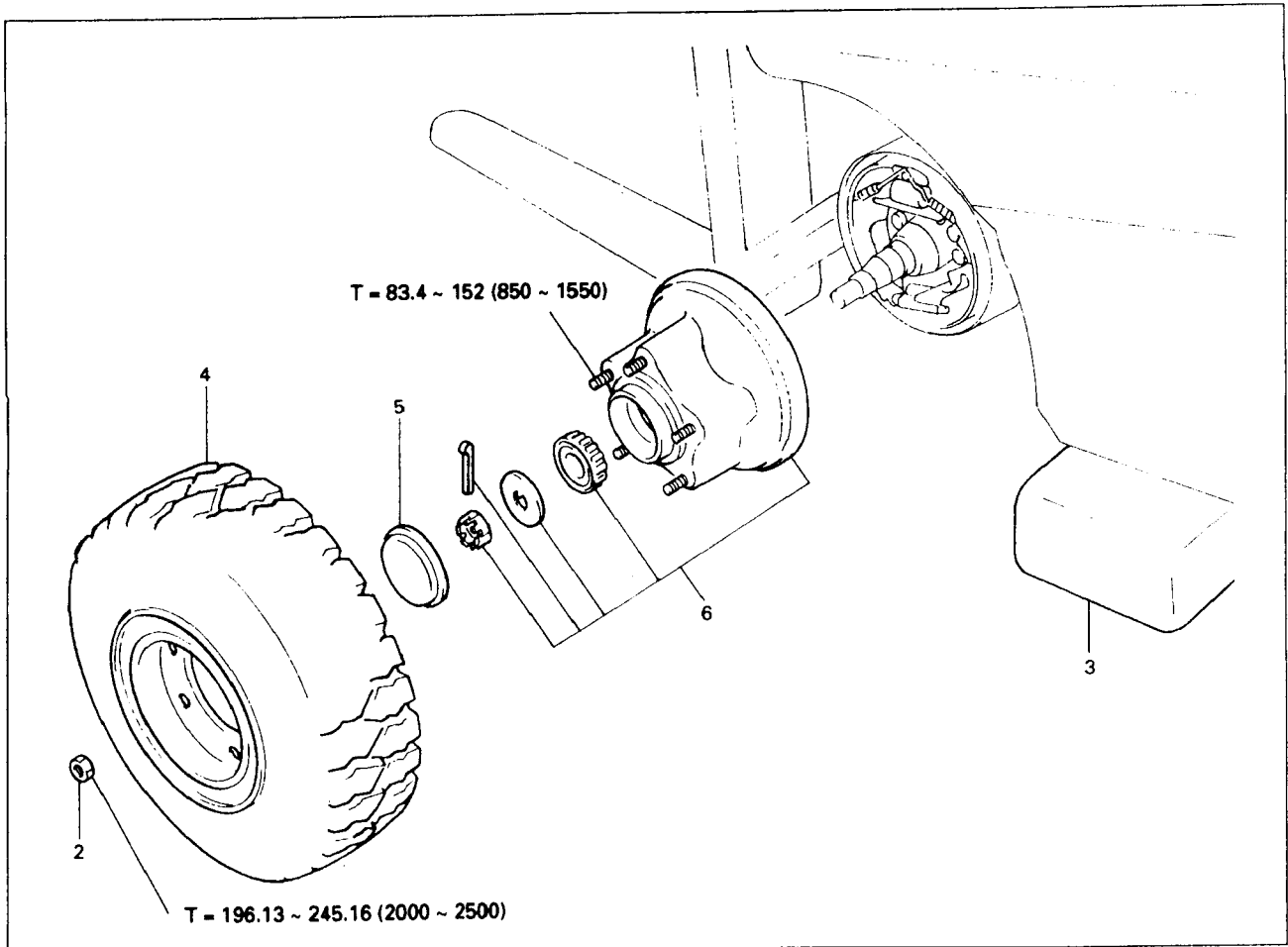
SPECIFICATIONS

Axle shaft diameter		mm (in)	: 90 (3.54)
Wheel (STD)	Tire size		: 18 x 7 - 8
	Rim size		: 4.33R - 8

FRONT AXLE HUB

REMOVAL-INSTALLATION

Unit: N·m (kgf·cm)



Removal Procedure

- 1 Chock the rear wheel.
- 2 Loosen the front wheel hub nuts.
- 3 Jack-up the vehicle and support the frame with wooden blocks.
- 4 Remove the front wheels.
- 5 Remove the hub caps. [Point 1]
- 6 Remove the front axle hub ASSY. [Point 2]

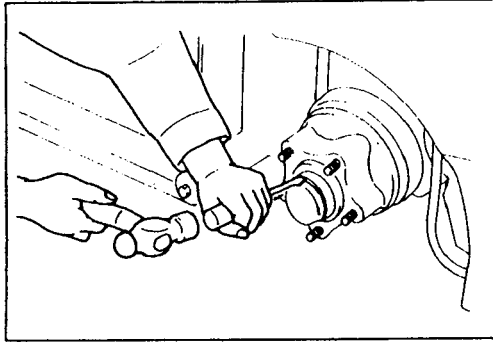
Installation Procedure

Installation is reverse of the removal procedure.

Note:

Before installation see that there is no oil or grease on the lining surface and drum inside surface (in sliding contact with the lining).

After installation, adjust the braking force. Repeat forward and backward travel and apply the brakes about 10 times.

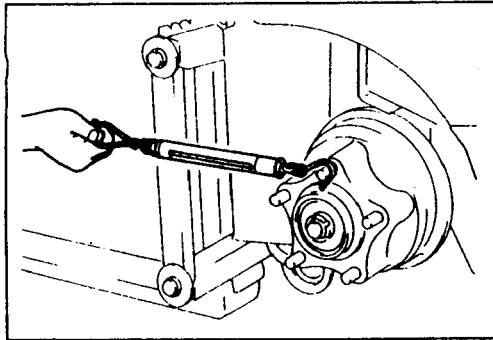


Operation Points

[Point 1]

Installation: Apply MP grease to the inside of the caps.

Installation: Install by driving in the cap flange.



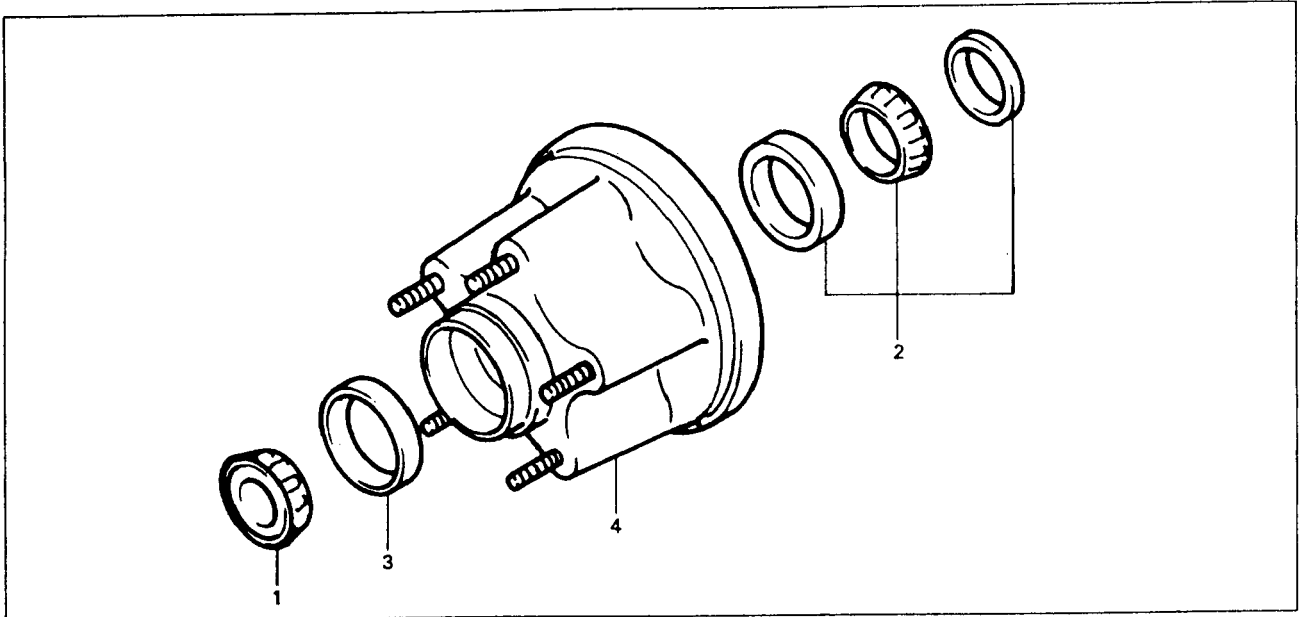
[Point 2]

Installation: Adjust the starting force of the front axle bearings.

1. Tighten the bearing lock nuts all the way, strike the periphery of the hub a few times with a soft hammer, and loosen the castle nut by 1/12 to 1/6 turn.
2. Hook a spring balance on the hub bolt and measure the starting force.

Starting force: 19.6 ~ 24.5 N (2 ~ 5.5 kgf)
[4.41 ~ 12.13 lbf]

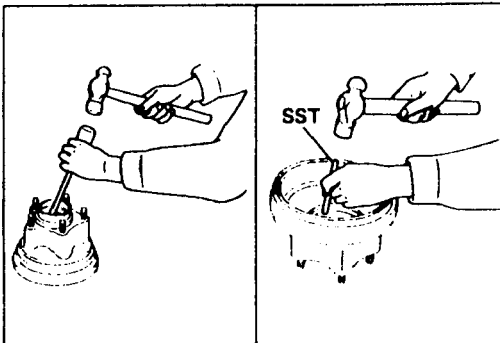
3. If the measured value is beyond the specified range, adjust by tightening or loosening the lock nut.

DISASSEMBLY·INSPECTION·REASSEMBLY**Disassembly Procedure**

- 1 Remove bearing No.1.
- 2 Remove bearing No.2, outer race No.2 and oil seal. [Point 1]
- 3 Remove outer race No.1. [Point 2]
- 4 Front axle hub

Reassembly Procedure

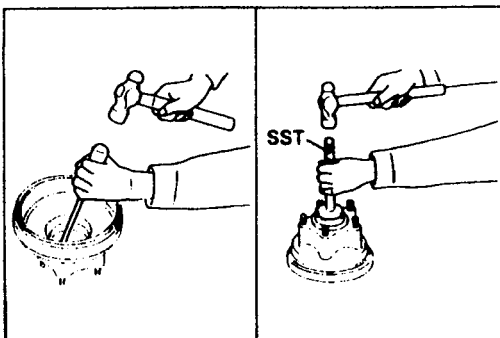
Reassembly is reverse of the disassembly procedure.

**Point Operations****[Point 1]**

Disassembly: Use an appropriate screwdriver and other necessary tools for disassembly.

Installation: SST 09370-30200-71

Reassembly: Apply grease to the lip of the oil seal.

**[Point 2]**

Disassembly: Use an appropriate screwdriver and other necessary tools for disassembly.

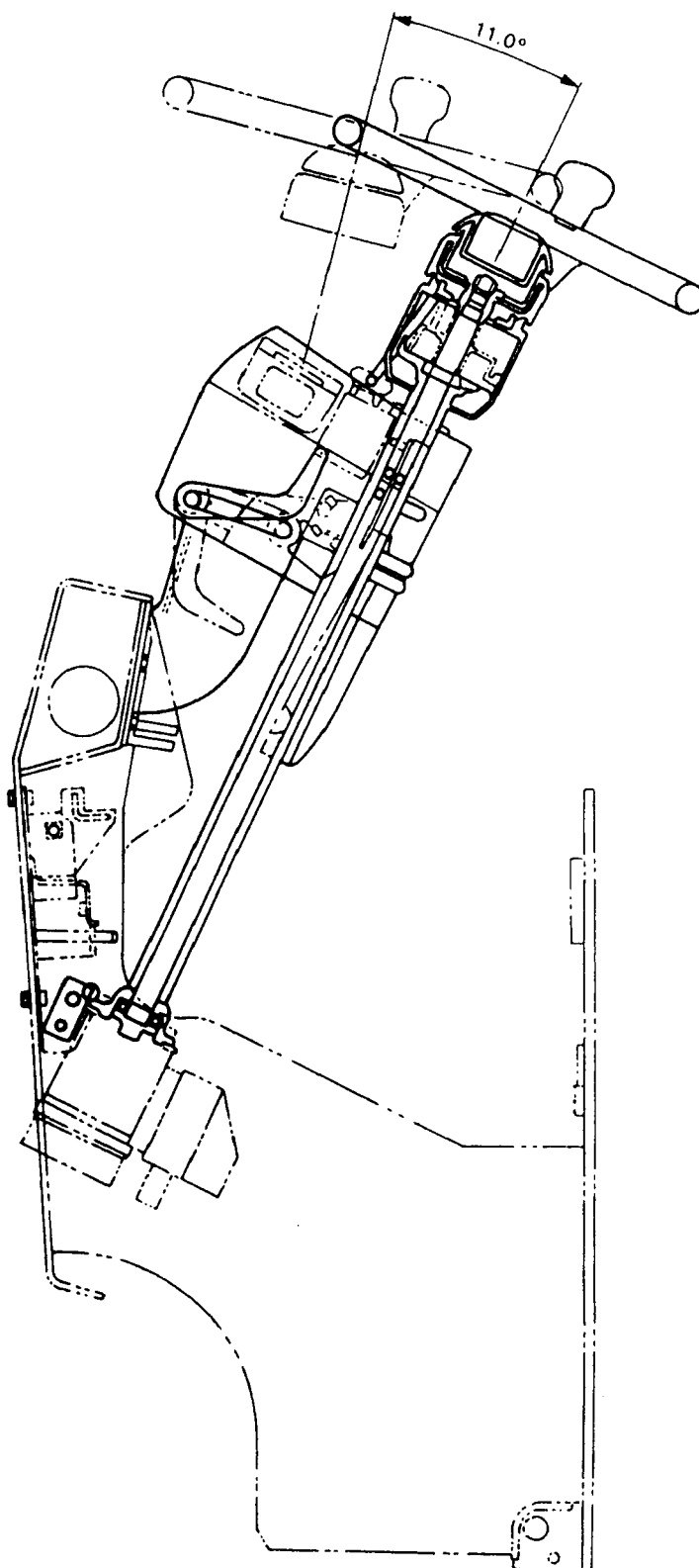
Installation: SST 09950-60020

STEERING

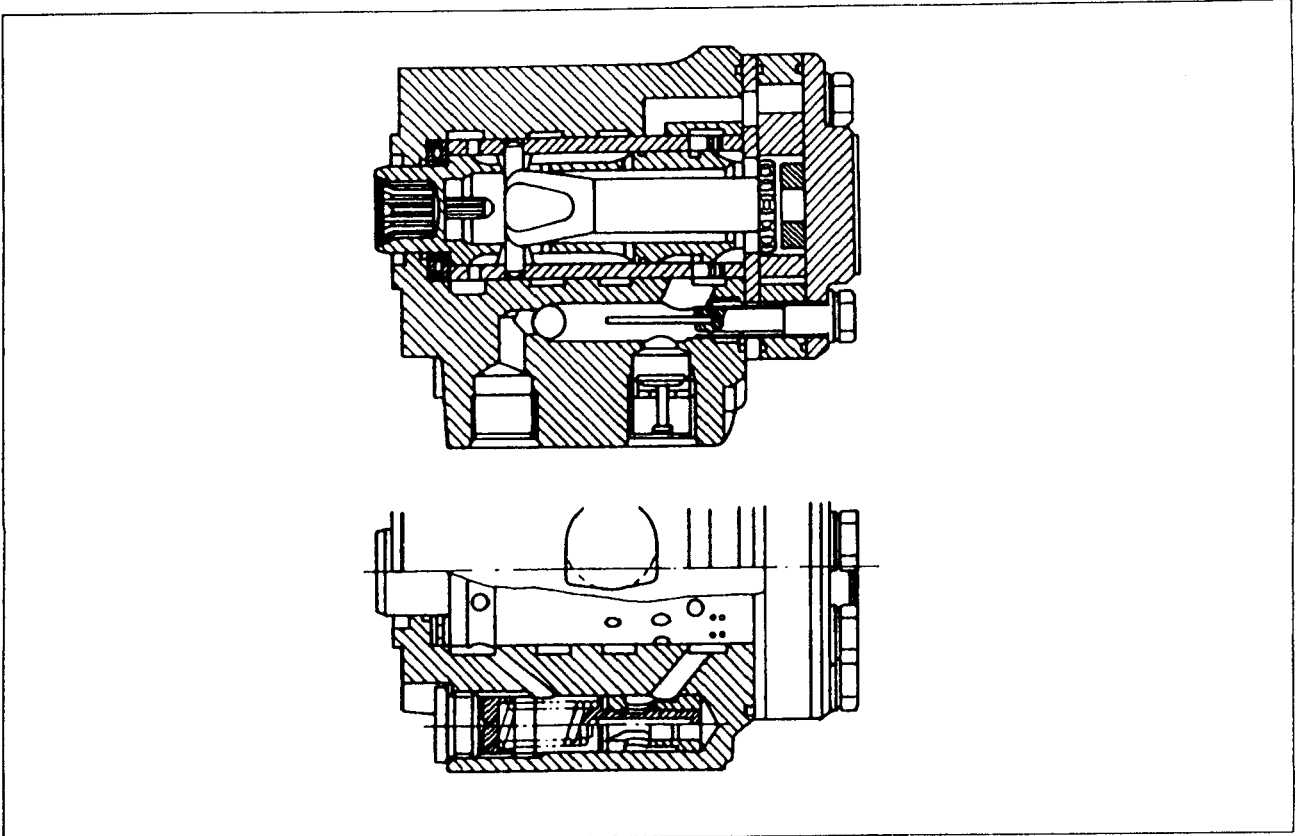
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GENERAL

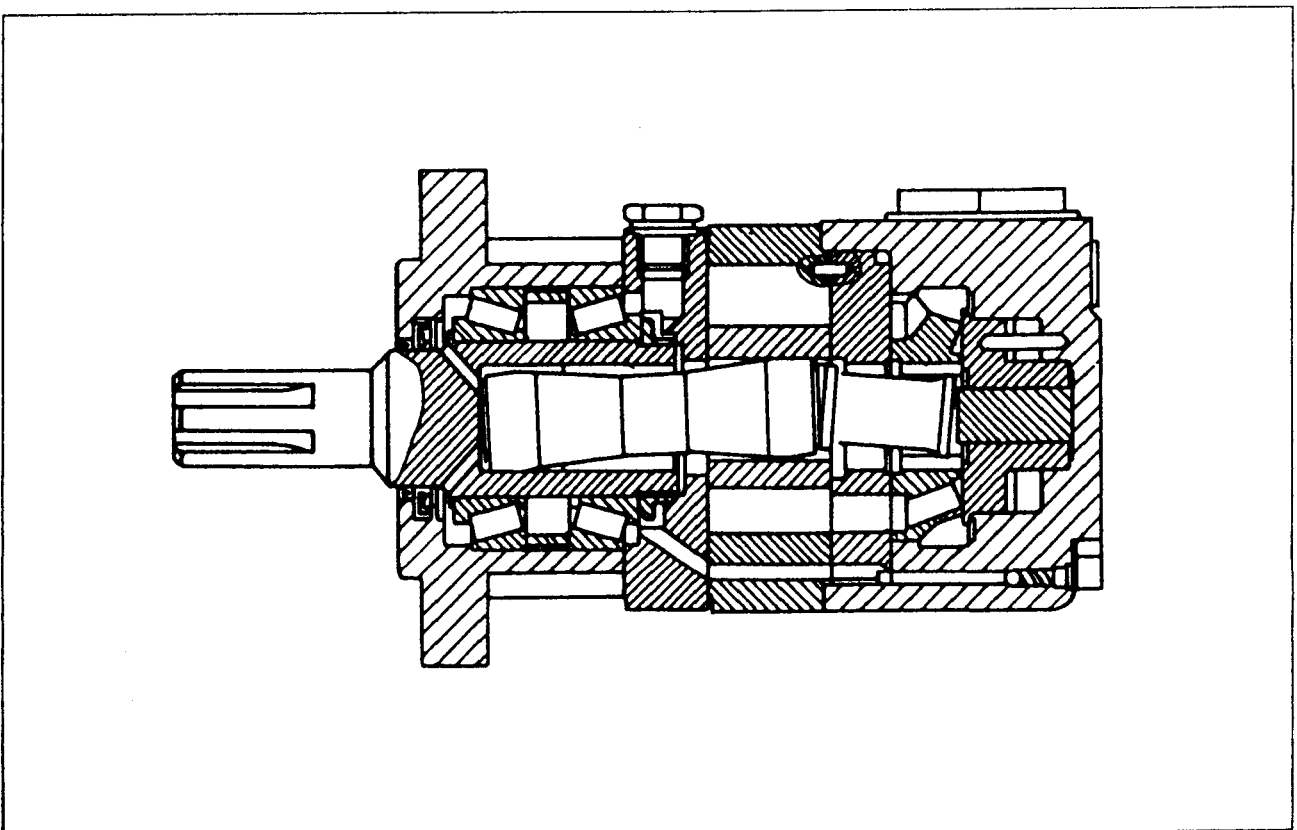
Tilt Steering System



Steering Valve



Oil Motor

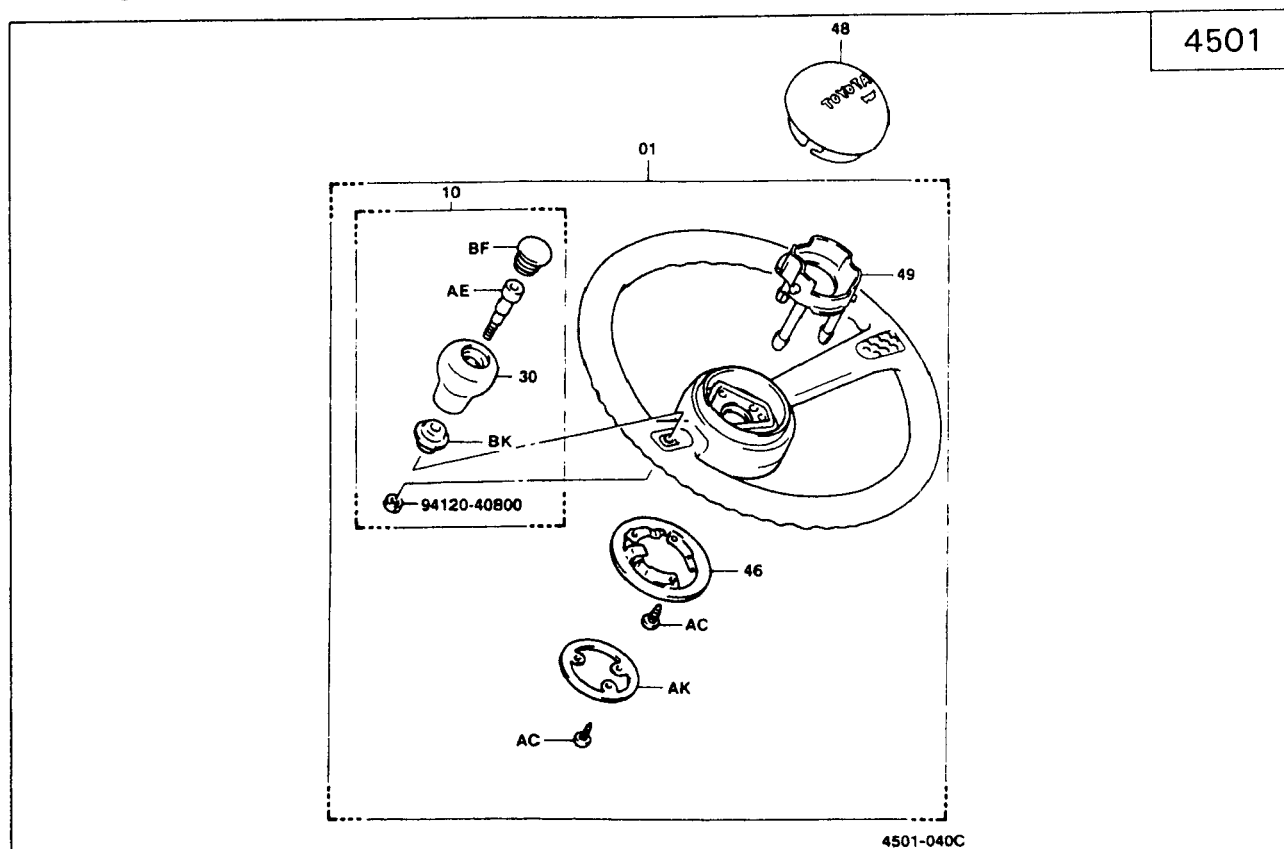


SPECIFICATIONS

Item		Vehicle model	EC 10T-15T
Steering wheel	Diameter	mm	360
	Play	mm	20 ~ 40
Power steering type			Hydrostatic power steering
Hydrostatic steering valve	Relief valve pressure kPa (kg/cm ²)		10600 ~ 11080 (108 ~ 113)
	Max. input torque N·m (kg-cm)		117.7 (1200)
	Relief valve type		Built-in type
Oil motor	Max. flow	ℓ/min	75

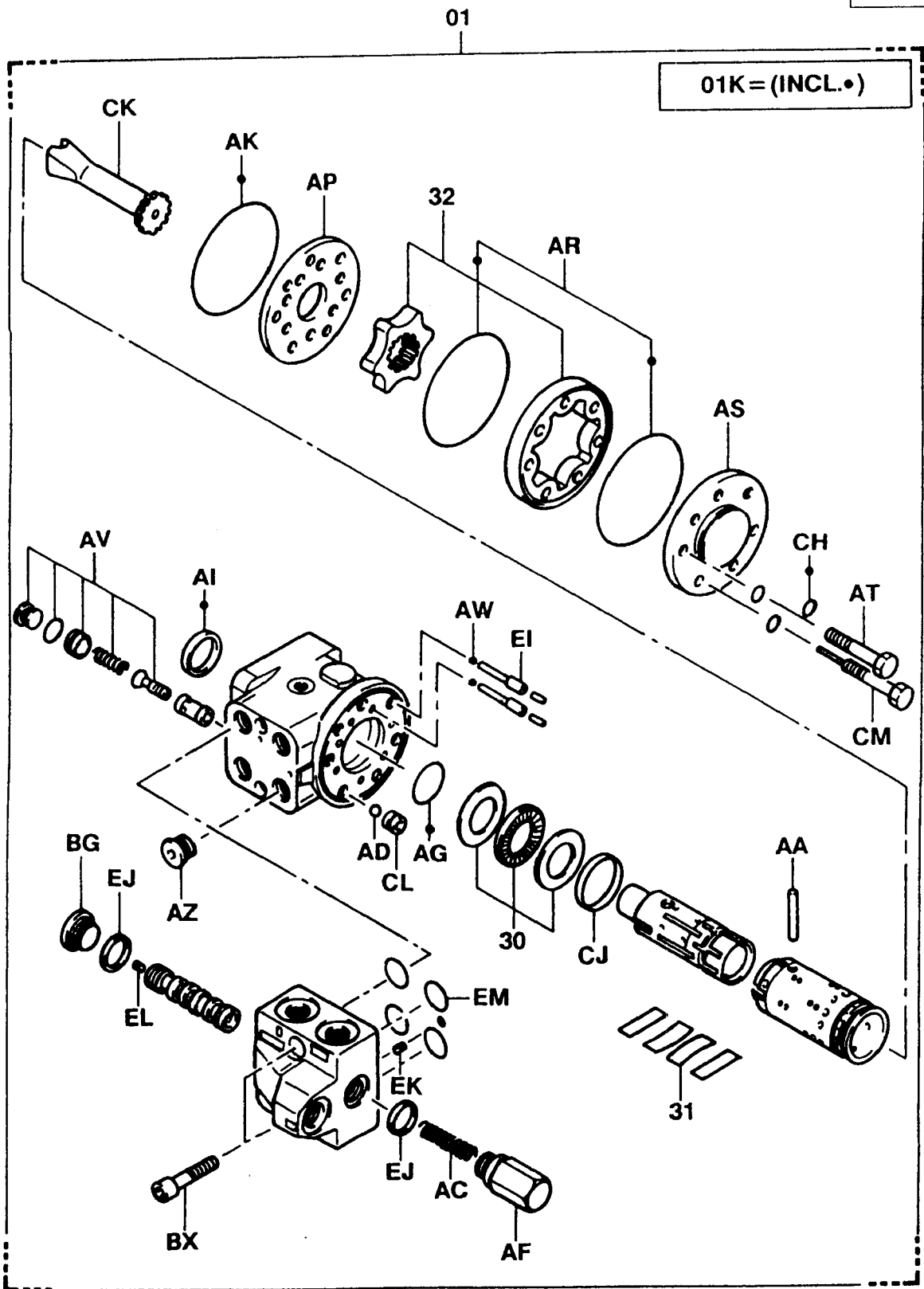
COMPONENTS

Steering Wheel



Steering Valve w/Priority Valve

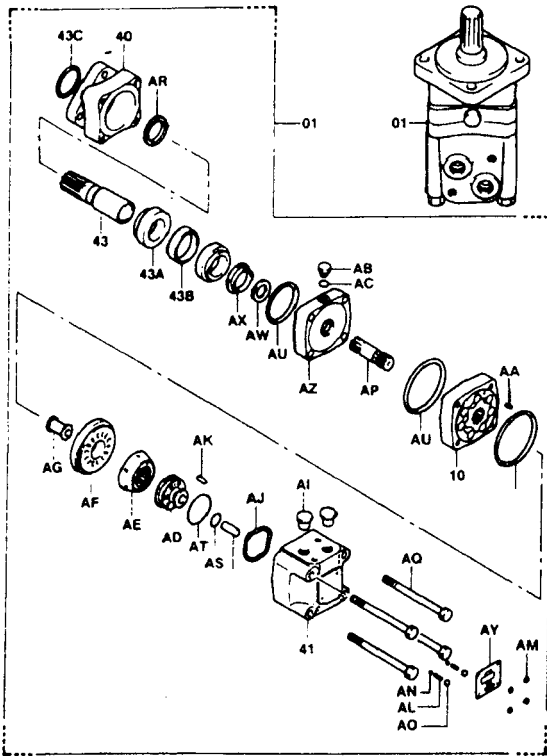
4503



4503-021

Oil Motor

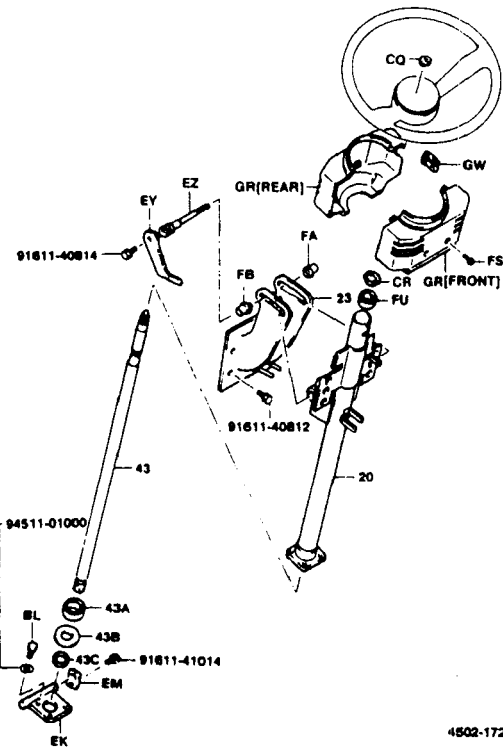
4519



4519-001

Steering Post

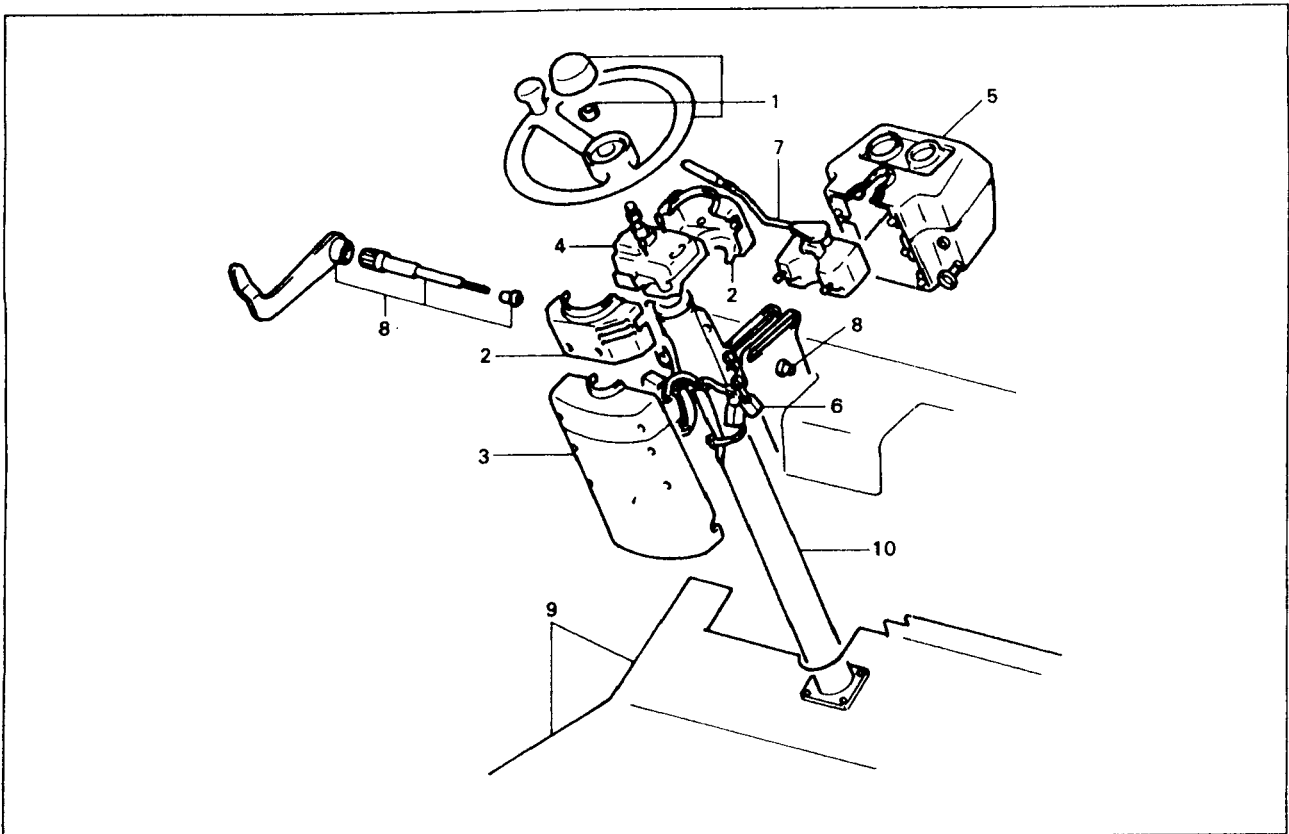
4502



4502-172

STEERING WHEEL AND MAST JACKET

REMOVAL-INSTALLATION



Removal Procedure

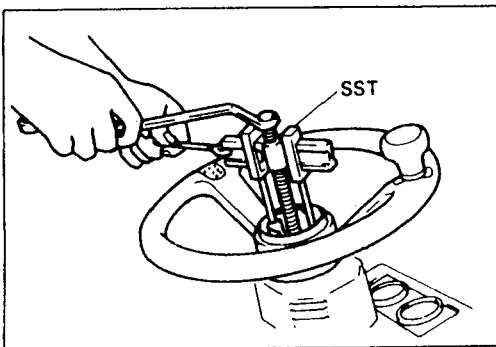
- 1 Remove the steering wheel. [Point 1]
- 2 Remove the horn switch cover.
- 3 Remove the rear cover.
- 4 Remove the horn switch.
- 5 Remove the front cover w/meter.
- 6 Disconnect the meter wiring.
- 7 Remove the direction switch.
- 8 Remove the tilt lock unit. [Point 2]
- 9 Remove the front and rear toe boards.
- 10 Remove the mast jacket ASSY.

Installation Procedure

Installation is reverse of the removal procedure.

Note:

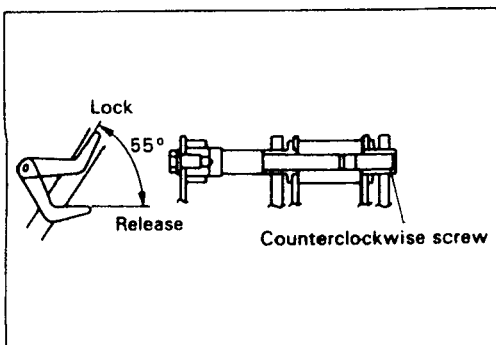
Apply MP grease to the tilt lock unit and sliding parts.



Point Operation

[Point 1]

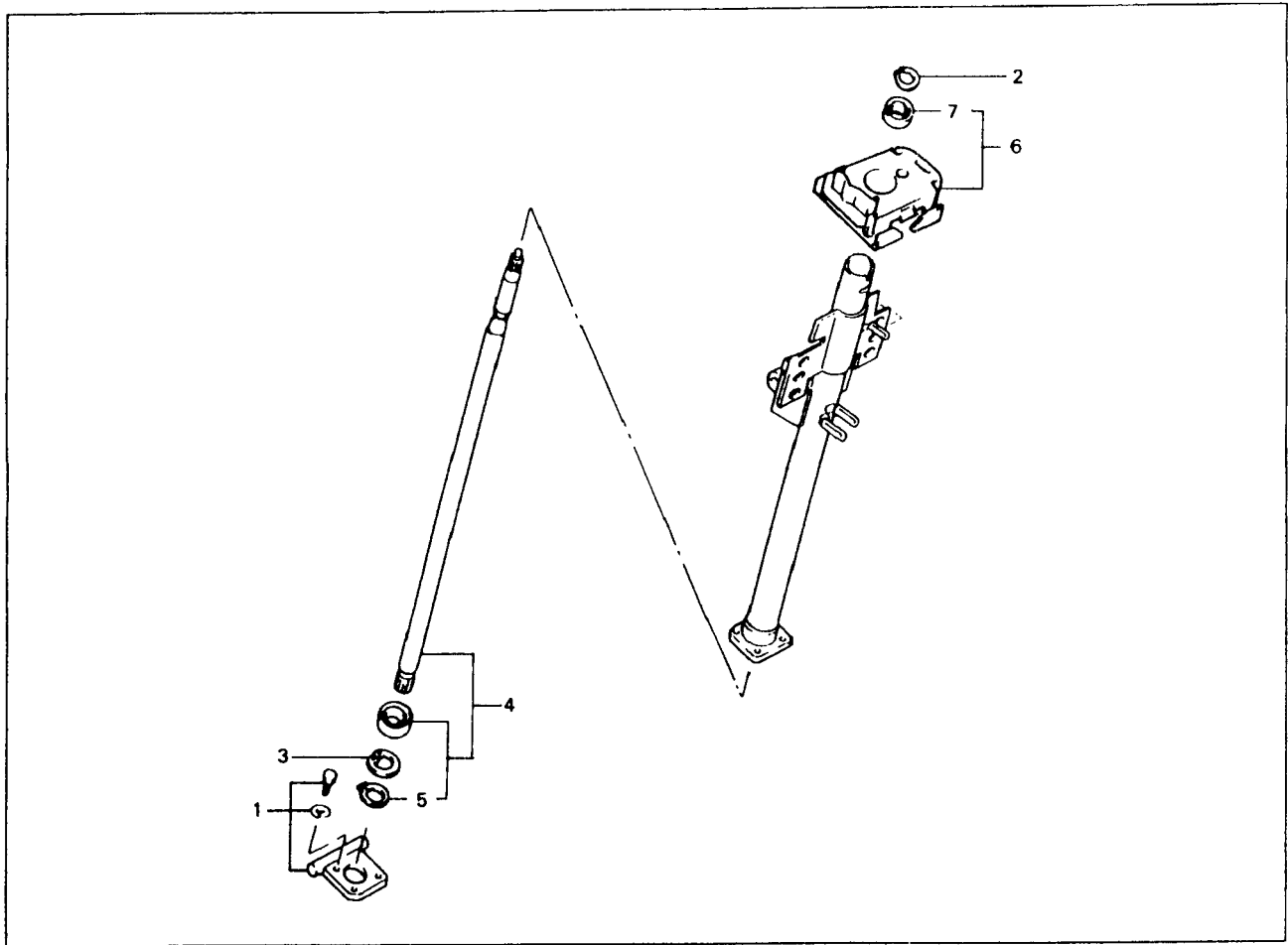
Removal: SST 09950-50010



Installation: Check operation of the tilt lock unit.

MAST JACKET ASSY

Disassembly·Inspection·Reassembly



Disassembly Procedure

- 1 Remove the steering bracket.
- 2 Remove the snap ring (upper).
- 3 Remove the snap ring (lower).
- 4 Extract the main shaft.
- 5 Remove the bearing.
- 6 Remove the horn contactor.
- 7 Remove the bearing.

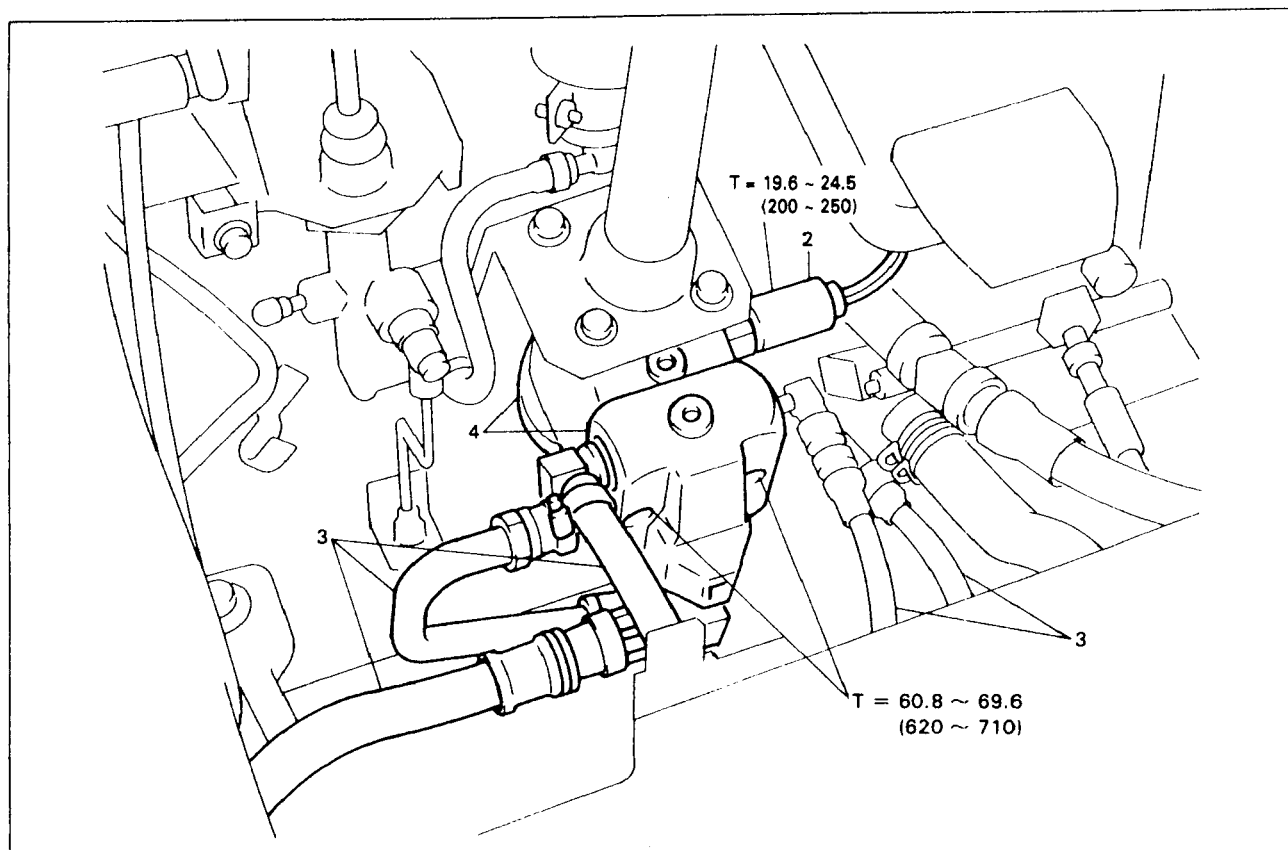
Reassembly Procedure

The reassembly procedure is the reverse of disassembly procedure.

STEERING AND PRIORITY VALVES

REMOVAL-INSTALLATION

T = N·m (kgf·cm)

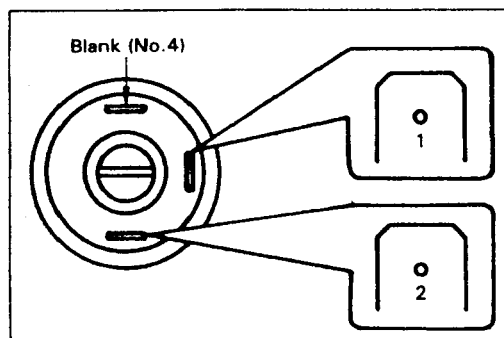


Removal Procedure

- 1 Remove the front and rear toeboards.
- 2 Disconnect the pressure switch wiring. [Point 1]
- 3 Disconnect the piping.
- 4 Remove the steering and priority valves.
- 5 Remove the steering valve.

Installation Procedure

Installation is reverse of the removal procedure.



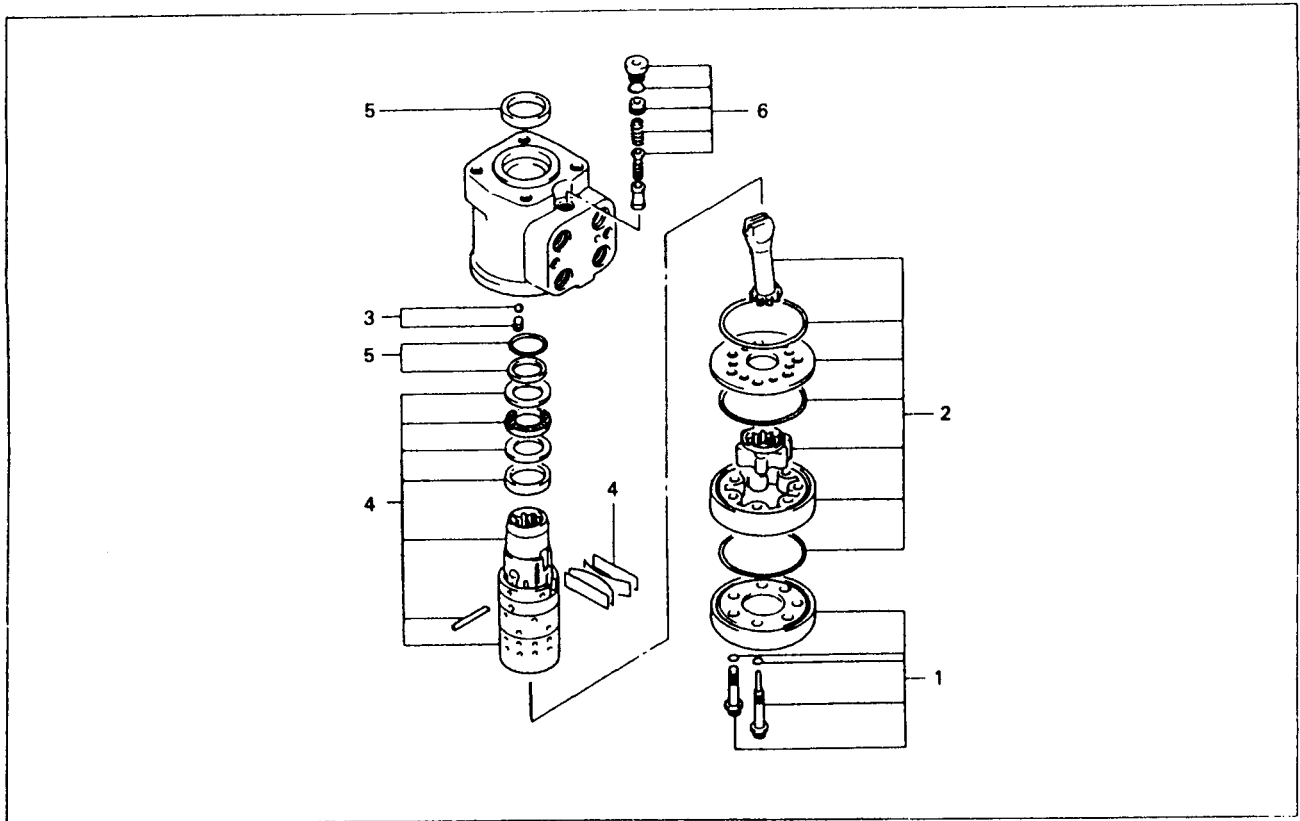
Operation Points

[Point 1]

Installation: Connect the leads to pressure switch pins No.1 and No.2. Pin No.4 is reserved.

STEERING VALVE

Disassembly · Inspection · Reassembly



Disassembly Procedure

- 1 Remove the end cover. [Point 1]
- 2 Remove the gear wheel set, cardan shaft and distributor plate. [Point 2]
- 3 Remove the check valve.
- 4 Remove the sleeve W/spool and bearing [Point 3]
- 5 Remove the O-ring, kin-ring and dust seal ring. [Point 4]
- 6 Remove the relief valve. [Point 5]

Reassembly Procedure

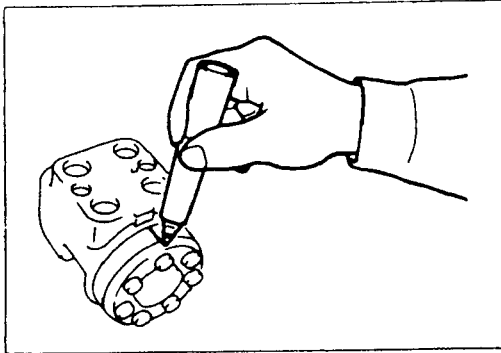
The reassembly procedure is the reverse of the disassembly procedure.

Note:

- Wash each part with clean hydraulic oil before assembly.
- The tightening torque for each portion is as follows:

Unit: N·m (kgf-cm) [ft-lbf]

Relief valve plug	40 ~ 60 (408 ~ 612) [29.52 ~ 44.28]
End cover set bolt	24 ~ 36 (245 ~ 367) [17.73 ~ 26.55]

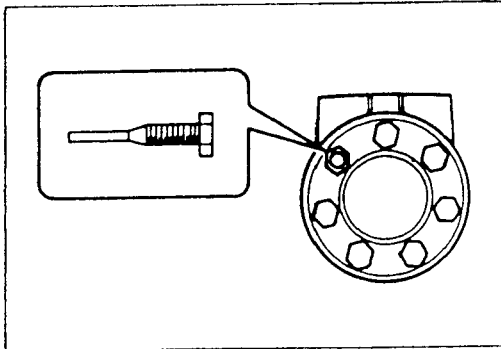


Point Operations

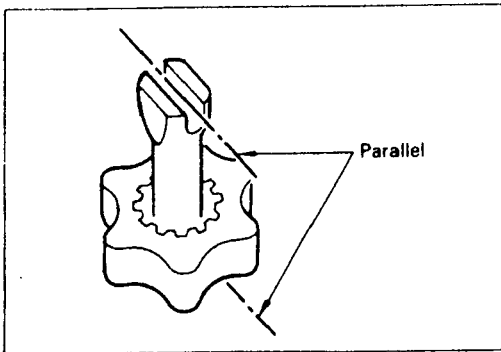
[Point 1]

Disassembly: Make a match mark.

Reassembly: Align the match marks.



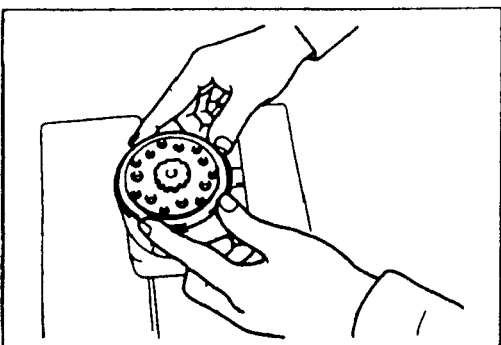
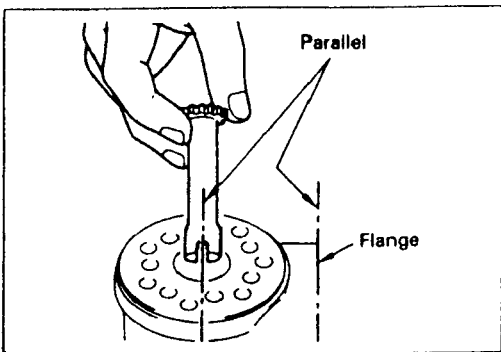
Reassembly: As one out of seven set bolts is a bolt with pin, install it in the correct position.

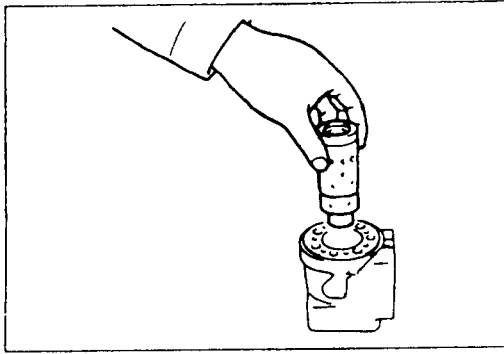


[Point 2]

Reassembly: Pay attention to the following points at the time of reassembly.

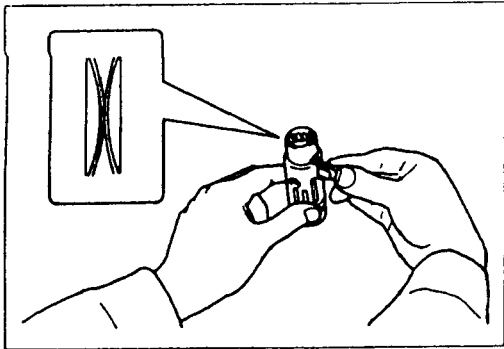
1. Fit the gearwheel (rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through holes match the holes in the housing.
2. Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.
3. Align the match marks on the distributor plate and gear wheel made at the time of disassembly. When these parts are replaced, match the holes in the housing and plate at the time of reassembly.



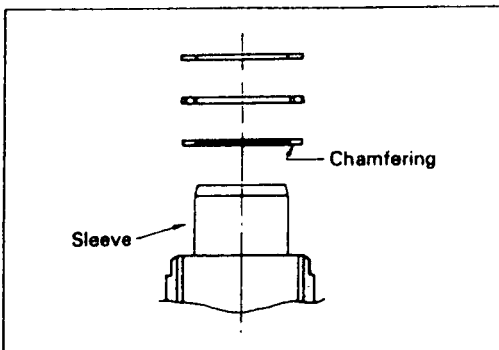


[Point 3]

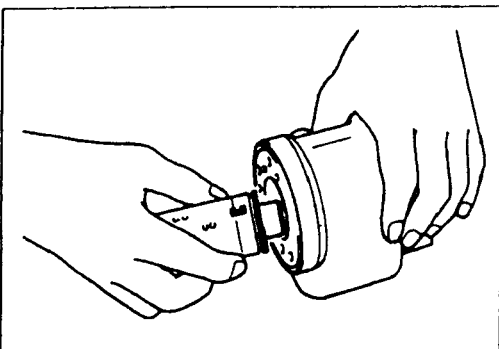
Disassembly: Extract the spool W/sleeve upward. Otherwise, the spool cross pin may move during extraction to cause sticking.



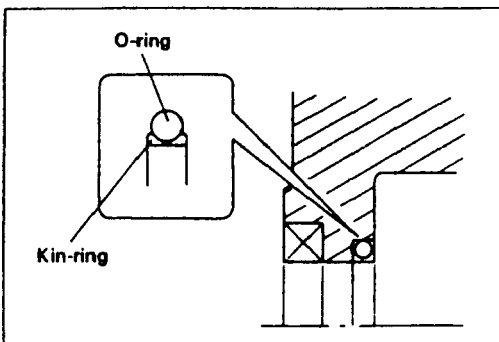
Reassembly: Set and install the neutral position spring correctly.



Reassembly: Pay attention to the bearing direction for installation. (See the figure.)



Reassembly: Place the housing with its flanged side facing down, and insert the spool W/sleeve into the housing. Set the cross pin of the spool in horizontal state during insertion.

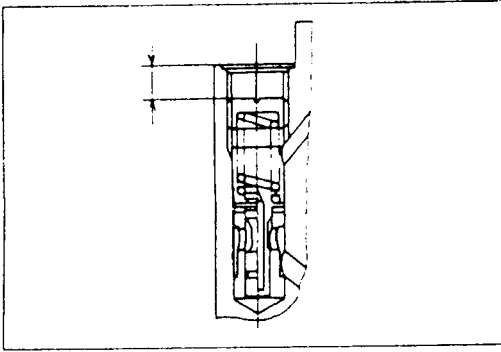


[Point 4]

Reassembly: Install the kin-ring and O-ring correctly.

Note:

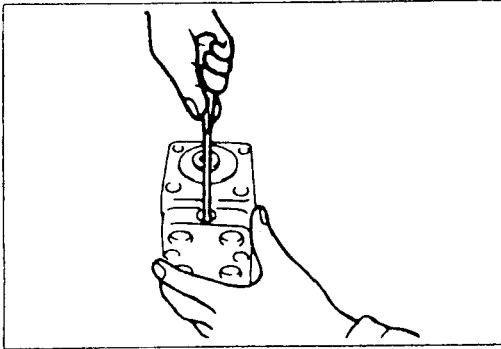
For SST No. SJ150-9000-11, please inquire at the nearest Danfoss service shop.



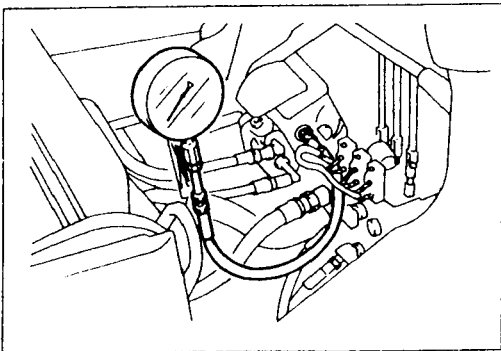
[Point 5]

Disassembly: Do not remove the relief valve unless it is estimated to be defective.
The valve seat cannot be removed.

Disassembly: Measure the valve spring retainer screwed-in depth before disassembly.



Reassembly: Reassemble by adjusting to the screwed-in depth of the valve spring retainer measured before disassembly. After installing the steering valve ASSY on the vehicle, measure the relief pressure. If it is not within the standard range, adjust it by changing the screwed-in depth of the retainer.



RELIEF PRESSURE MEASUREMENT

1. Measure the power steering relief pressure.

- (1) Disconnect the steering valve piping (at one place shown in the figure : pump port) and install the SST.
Then set an oil pressure gage.
SST 09450-23610-71
Plug size: PT 1/8
- (2) Start the motor and turn the steering wheel slowly clockwise and counterclockwise.
- (3) Start the motor, rotate the steering wheel and measure the relief pressure when the relief occurs.

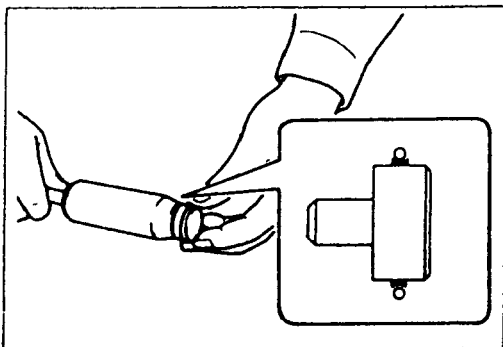
Standard relief pressure

10600 ~ 11080 kPa (108 ~ 113 kgf/cm²)

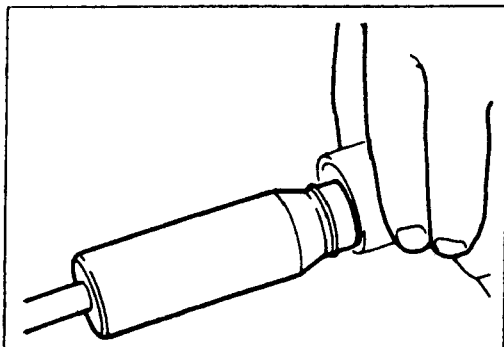
Authorized service shops:

Austria	: Hainzl Industriesysteme, Gesellschaft m.b.H, Linz
Belgium	: N.V. Danfoss S.A., Bruxelles
Denmark	: H. Søndergaard A/S, Måløv
Finland	: OY Danfoss AB, Espoo
France	: Danfoss S.a.r.l., Trappes (Paris)
FRG (Germany)	: Danfoss GmbH, Offenbach/Main
Great Britain	: Danfoss Limited, Greenford
Iceland	: Velsmidjan Hedinn, Reykjavik
Italy	: Sordella & C. Oleodinamica s.r.l., Torino
Norway	: Danfoss Norge A/S, Skui
Spain	: Danfoss S.A., Madrid
Sweden	: Transventor Hydraulik AB, Mölndal, Göteborg
Switzerland	: Werner Kuster AG, Frenkendorf

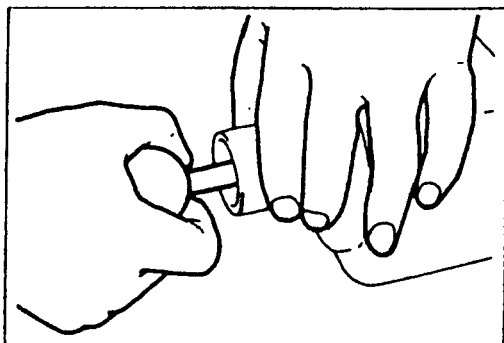
(Refer to Parts & Service News Ref. No. GE-4027 of Dec. 1, 1994 for detail.)



1. Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool/sleeve.
2. Grease O-ring and kin-ring with hydraulic oil and place them on the tool.



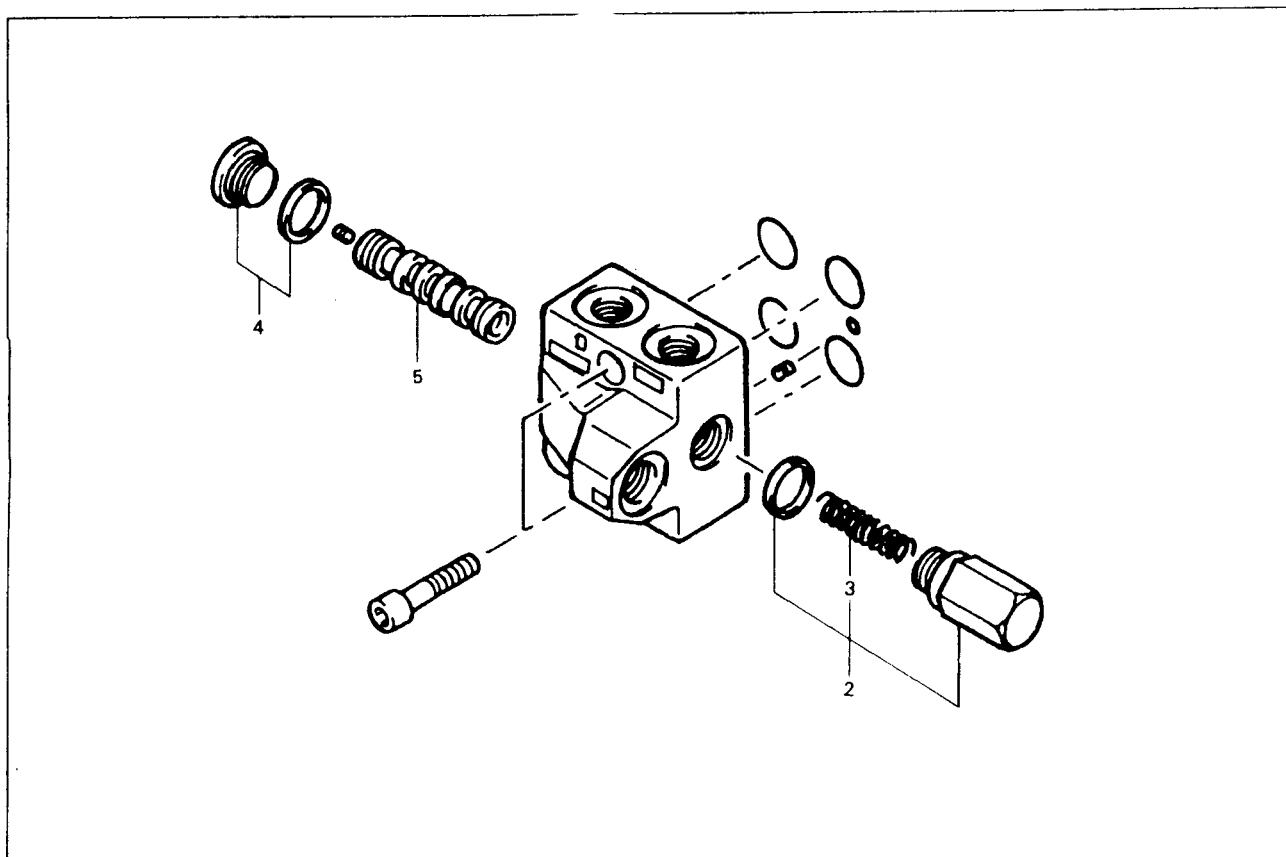
3. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



4. Press and turn the O-ring/kin-ring into position in the housing.
5. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.

PRIORITY VALVE

Disassembly · Inspection · Reassembly

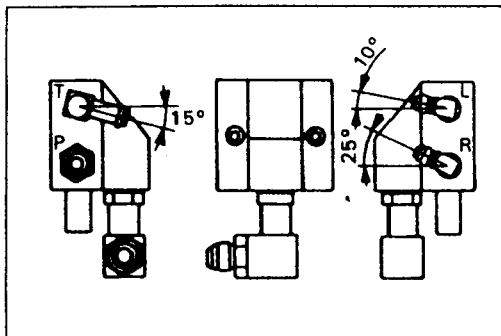


Disassembly Procedure

- 1 Remove the fitting. [Point 1]
- 2 Remove the plug w/spring and seal ring.
- 3 Remove the spring.
- 4 Remove the plug and seal ring.
- 5 Remove the spool. [Point 2]

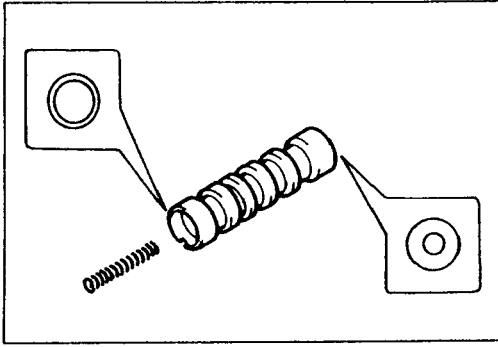
Reassembly Procedure

Reassembly is reverse of the disassembly procedure.



Point Operations

[Point 1]
Installation: Reassemble the fitting to the angles shown at left.



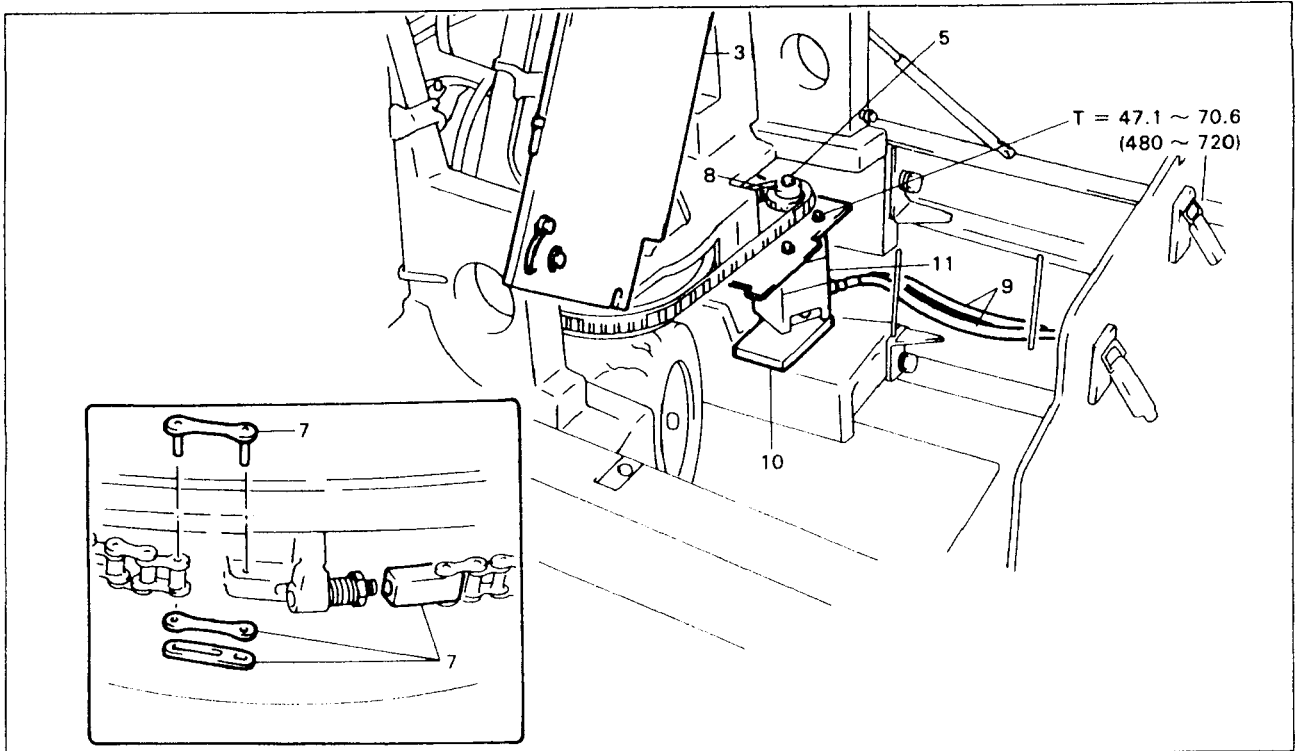
[Point 2]

Reassembly: Be careful to position the spool correctly.
Reassemble the spool so that the spring is inserted in the groove.

OIL MOTOR

REMOVAL-INSTALLATION

T = N·m (kgf·cm)



Removal Procedure

- 1 Turn the steering wheel counterclockwise all the way beforehand.
- 2 Remove the battery (see page P1-4, for removal of the battery).
- 3 Set the controller with its left end raised (see page 2-5, for removal of the controller.)
- 4 Remove the center cover.
- 5 Remove the sprocket set bolt.
- 6 Remove the chain maintenance cover.
- 7 Disconnect the steering chain from the weight window. [Point 1]
- 8 Remove the sprocket.
- 9 Disconnect the piping.
- 10 Place an appropriate supporting wooden block under the oil motor and remove the set bolts.
- 11 Remove the oil motor.

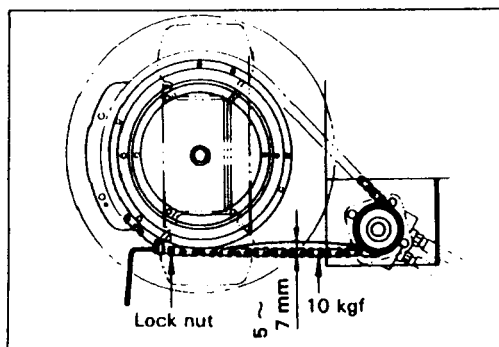
Installation Procedure

Installation is reverse of the removal procedure.

Note:

- After chain adjustment, apply grease to the chain and sprocket.
- Apply grease to the oil motor shaft.

Grease: Dry lubricant with disulfide molybdenum for coating.

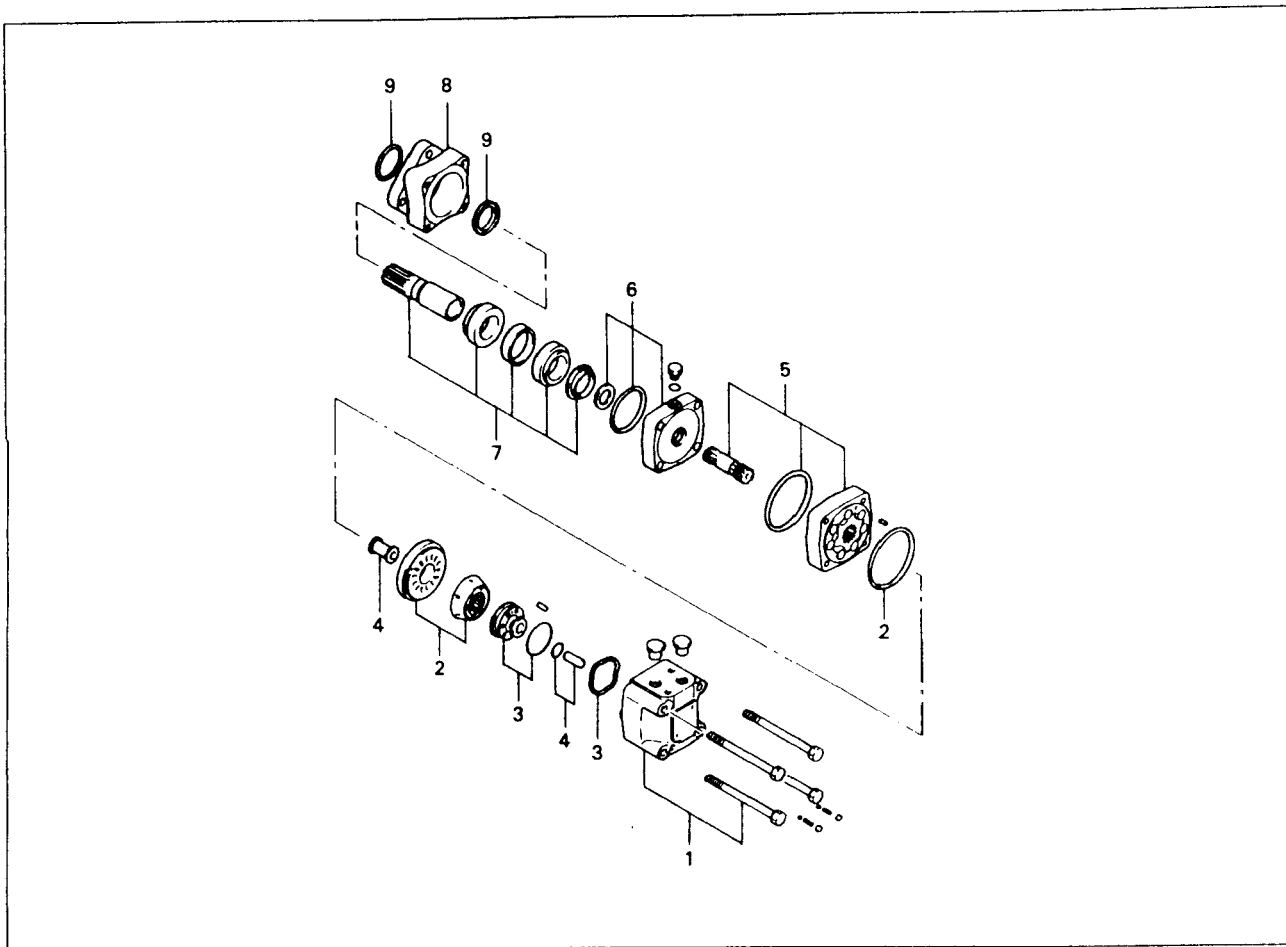


Point Operation

[Point 1]

Installation: Adjust the chain applying a force of 10 kgf at the center. After adjustment, be sure to tighten the lock nut.

Standard: 5 ~ 7 mm

DISASSEMBLY · INSPECTION · REASSEMBLY**Disassembly Procedure**

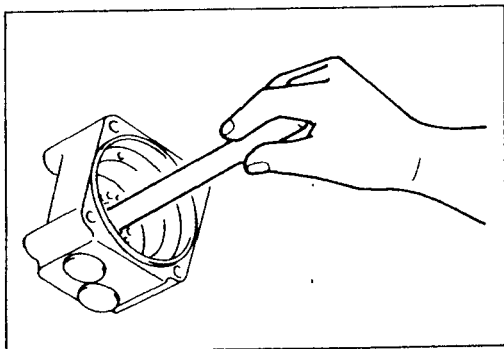
- 1 Remove the screws and then the valve housing.
- 2 Remove the O-ring, channel plate and disc valve.
- 3 Remove the balance plate and spring washer. **[Point 1]**
- 4 Remove the valve drive and spacer. **[Point 2]**
- 5 Remove the gear wheel set, O-ring and cardan shaft.
- 6 Remove the intermediate plate, conical seal and O-ring.
- 7 Remove the output shaft assembly. **[Point 3]**
- 8 Remove the bearing housing.
- 9 Remove the shaft seal and dust sealing.

Reassembly Procedure

Reassembly is reverse of the disassembly procedure.

Note:

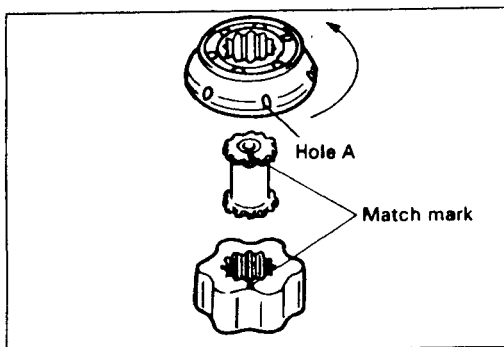
- Completely clean and apply hydraulic oil to each part before reassembly.
- Apply MP grease when reassembling O-rings and dust sealing.



Operation Points

[Point 1]

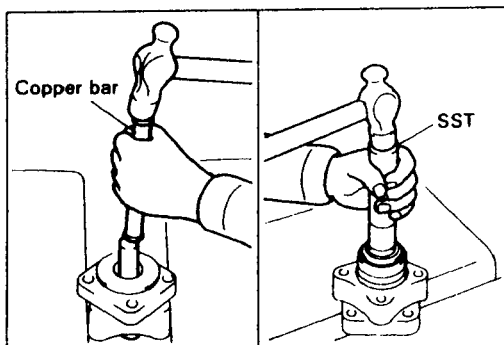
Disassembly: Fill with hydraulic oil to half way up the center hole of the balance plate, then promptly press in the special bar to remove the balance plate.
special bar: 14.5-mm-diameter bar



[Point 2]

Disassembly: Mark matching marks on the rotor and valve drive as shown.

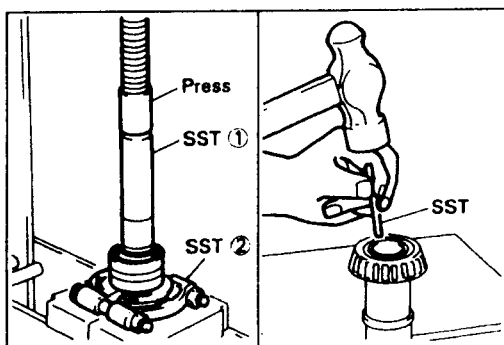
Reassembly: Reassemble by aligning the match marks. Place the disc valve on the channel plate so that hole A is aligned with the mark on the valve drive, then turn counterclockwise to engage it with the spline in the valve drive.



[Point 3]

Disassembly: Use an appropriate copper bar to remove the output shaft assembly.

Reassembly: SST 09608-30012



Inspection: Check the bearing of the output shaft assembly. Replace if any abnormalities are found.

1. Remove the bearing using the press and SST.

SST ①: 09608-30012

SST ②: 09950-00020

2. Install the bearing.

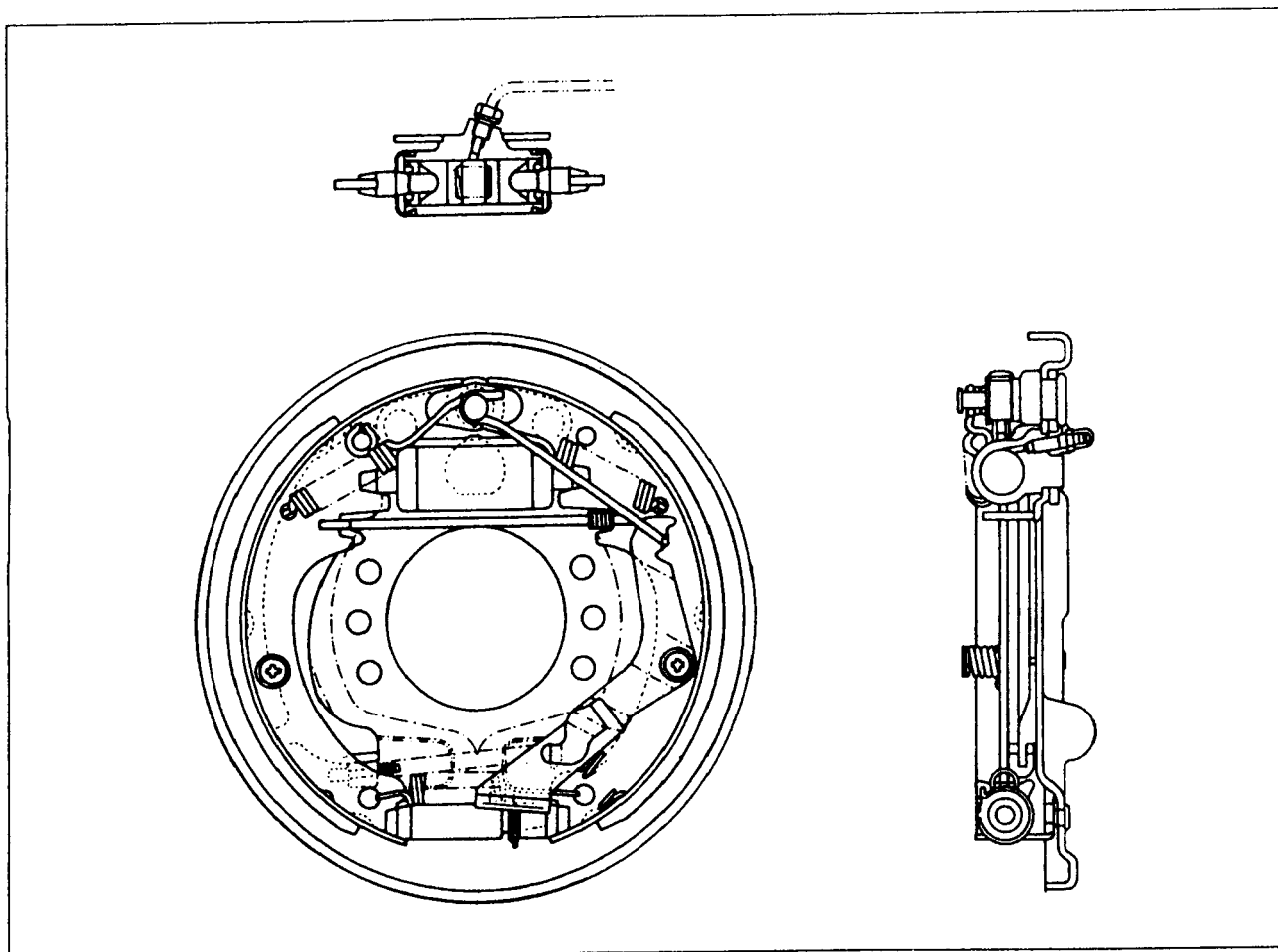
SST 09700-30200-71

BRAKE

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FRONT BRAKE

GENERAL

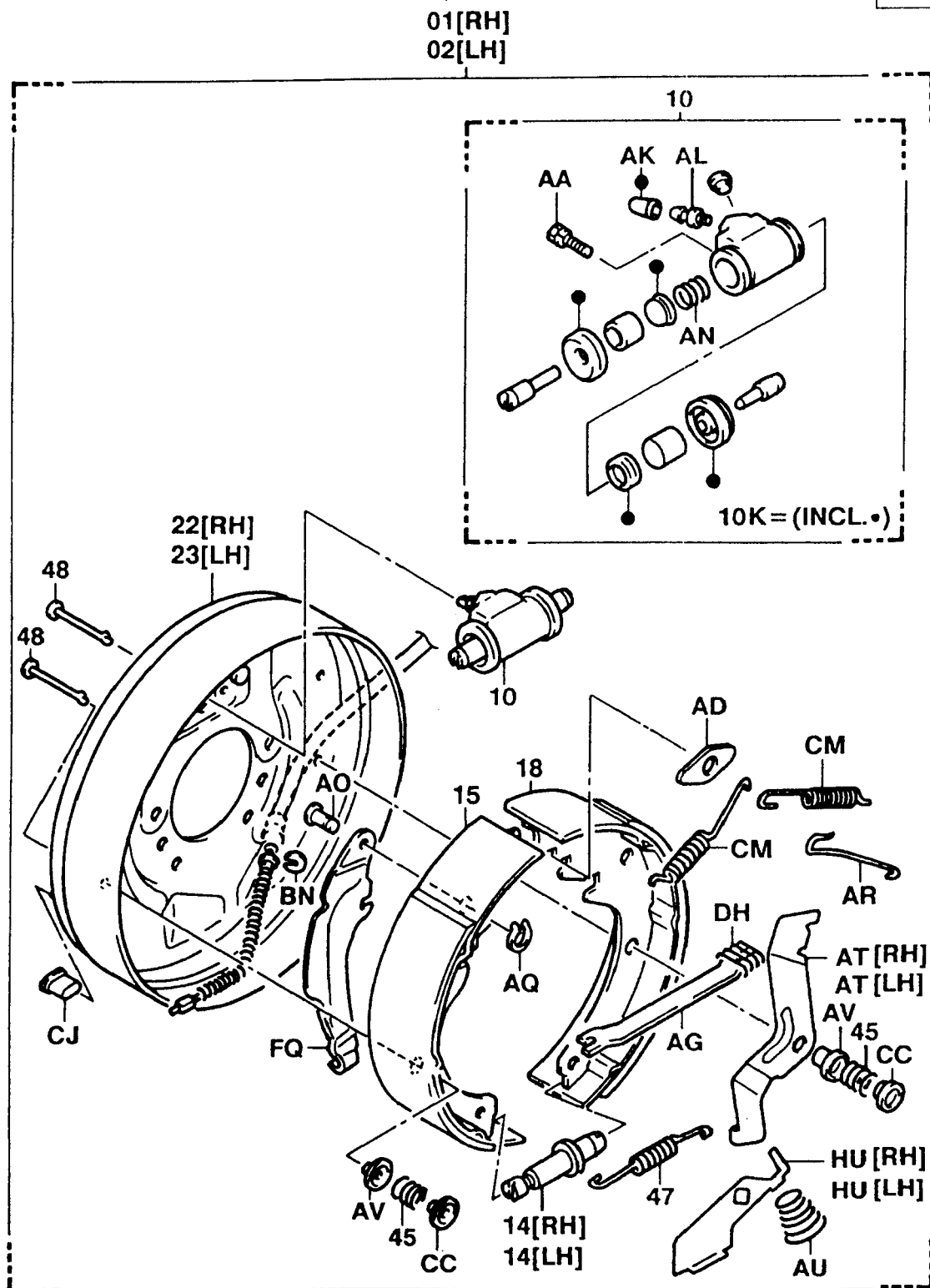


SPECIFICATIONS

Item		Vehicle model	EC 10T-15T
Foot brake type			Hydraulic internal expansion type duo servo brake
Brake drum inside diameter		mm	25.4
Brake lining	Material		Resin mold
	Dimensions (width × thickness × length)	mm	30 × 6 × 255
Wheel cylinder bore			22.22
Brake master cylinder	Bore	mm	19.05
	Stroke	mm	30
Applicable fluid			SAE J-1703 DOT-3

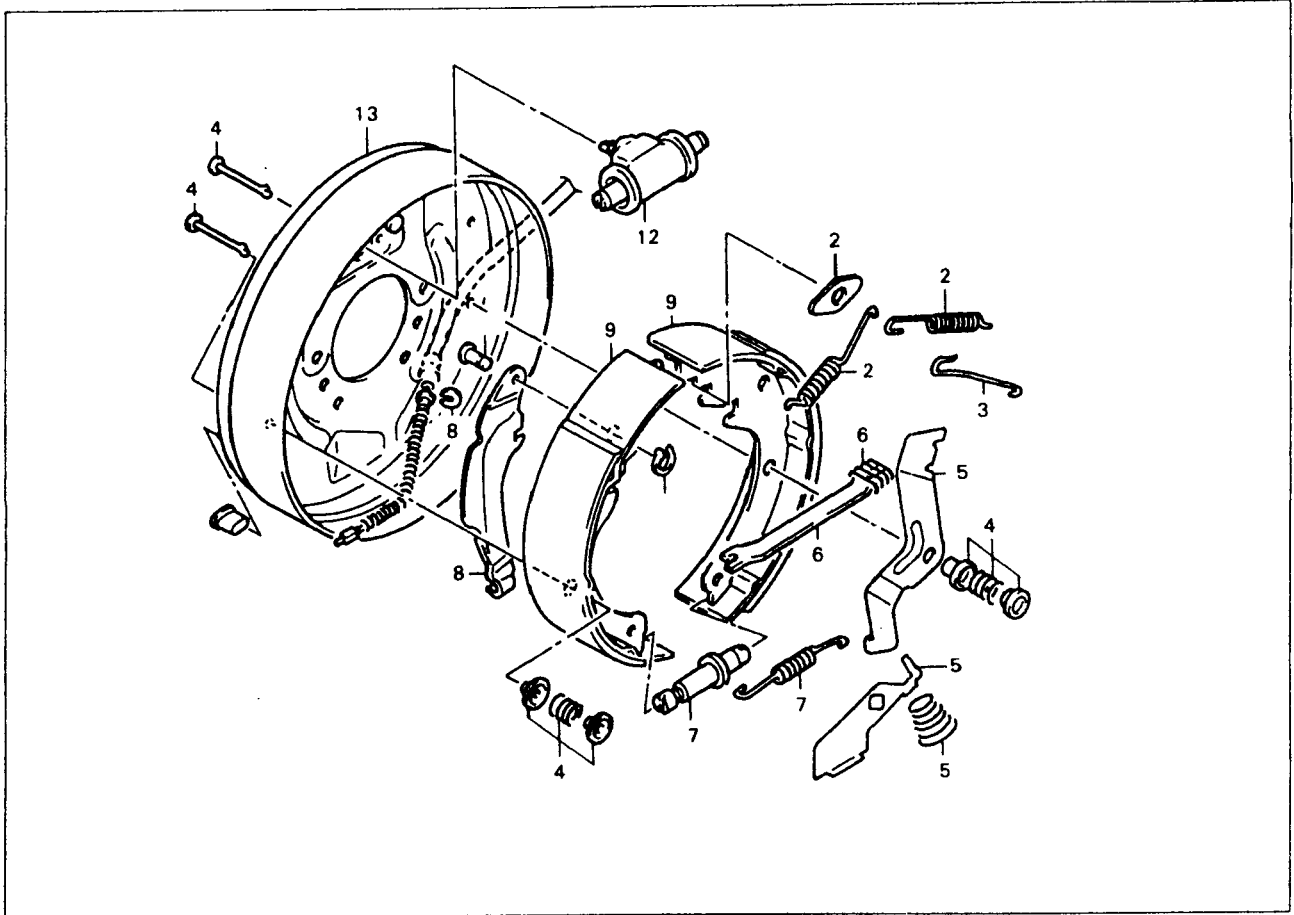
COMPONENTS

4715



4715-090

DISASSEMBLY · INSPECTION · REASSEMBLY



Disassembly Procedure

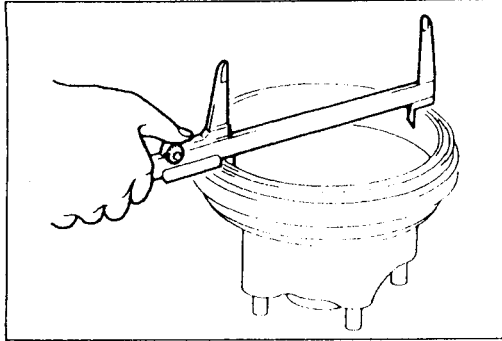
- 1 Remove the front axle hub (see page 6-3 for removal of the front axle hub). [Point 1]
- 2 Remove the anchor-to-shoe spring. [Point 2]
- 3 Remove the pawl lever stopper.
- 4 Remove the hold down spring. [Point 3]
- 5 Remove the pawl lever and spring. [Point 4]
- 6 Remove the strut lever. [Point 5]
- 7 Remove the adjusting spring and screw. [Point 6]
- 8 Disconnect the parking brake cable. [Point 7]
- 9 Remove the brake shoe. [Point 8]
- 10 Drain brake fluid.
- 11 Disconnect the brake pipe.
- 12 Remove the wheel cylinder assembly. [Point 9]
- 13 Remove the backing plate.

Assembly Procedure

Installation is reverse of the removal procedure.

Note:

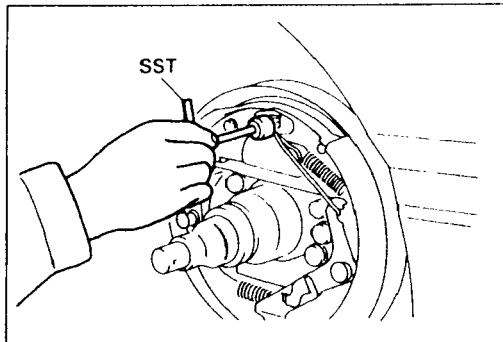
- Check that the brake linings and interior surfaces of the brake drums are not fouled with oil or grease before reassembly.
- Set the outside diameter of the installed 1 mm smaller than inside diameter of the brake drum by tightening the adjusting screw before installing the hub w/brake drum.
- Bleed air from the brake system after reassembly.
- Adjust the brakes after reassembly. For adjustment, repeat forward and reverse travel, stopping the vehicle each time by depressing the brake pedal.

**Point Operations****[Point 1]**

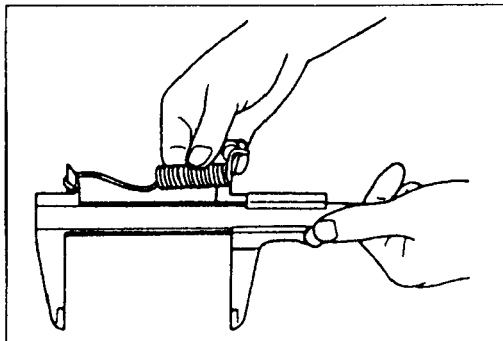
Inspection: Measure the inside diameter of the brake drum.

Standard inside diameter: 254 mm (10 in)

Inside diameter limit: 256 mm (10.07 in)

**[Point 2]**

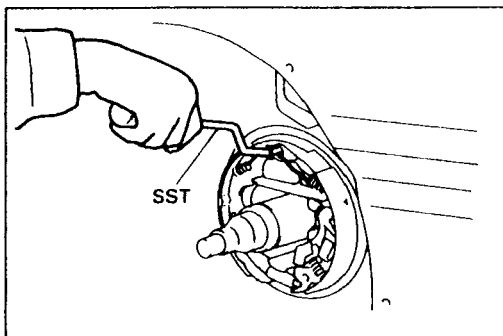
Disassembly: SST 09510-20180-71



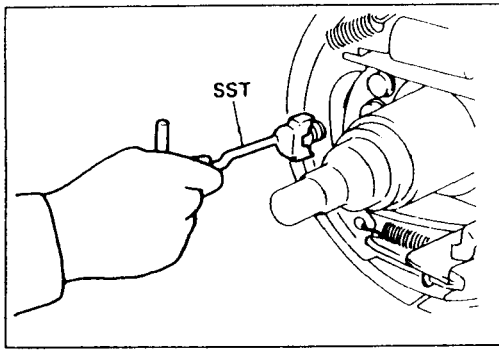
Inspection: Measure the free length of the anchor-to-shoe spring.

Standard free length: 102 mm (4.0 in)

Limit free length: Replace if any coil clearance is found.

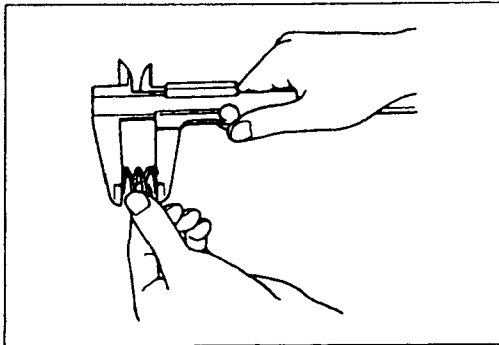


Reassembly: SST 09718-20010



[Point 3]

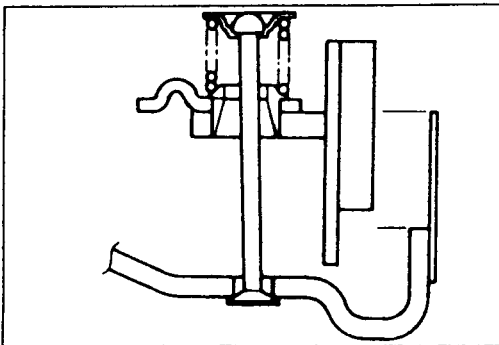
Disassembly/reassembly: SST 09510-31960-71



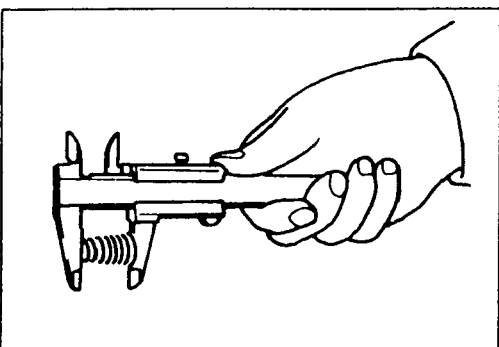
Inspection: Measure the free length of the hold-down spring.

Standard free length: 20.4 mm (0.80 in)

Limit free length: 17 mm (0.67 in)



Reassembly: Apply liquid packing (Helme Seal or equivalent) to the shoe hold-down pin and the rear contact face of the backing plate to eliminate any clearance.

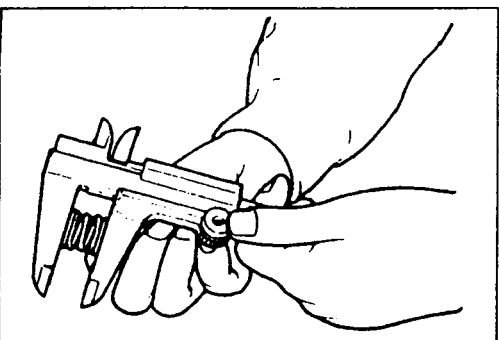


[Point 4]

Inspection: Measure the free length of the pawl lever spring.

Standard free length: 43 mm (1.69 in)

Limit free length: 39 mm (1.54 in)

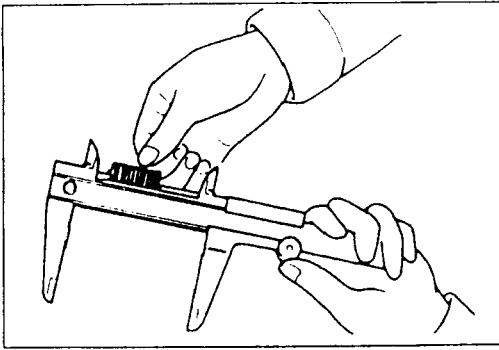


[Point 5]

Inspection: Measure the free length of the strut-to-shoe spring.

Standard free length: 20 mm (0.79 in)

Limit free length: 17 mm (0.67 in)

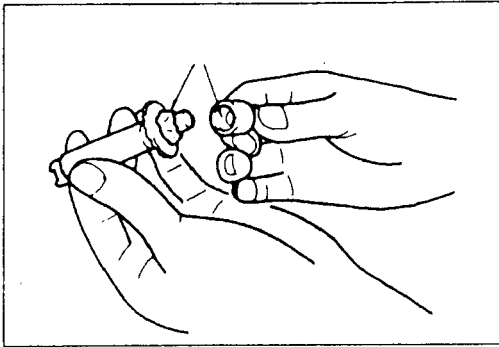


[Point 6]

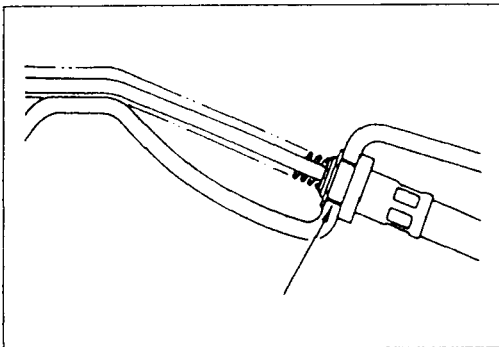
Inspection: Measure the free length of the adjuster spring.

Standard free length: 92 mm (36.2 in)

Limit free length: Replace if any coil clearance is found.

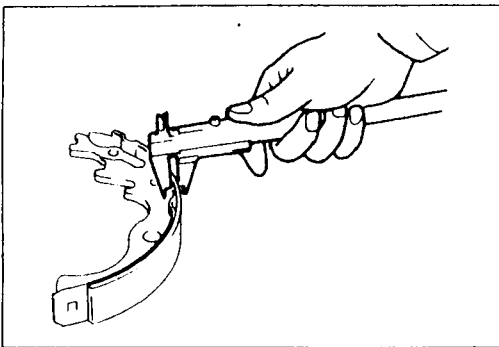


Reassembly: Apply grease to the threaded portion of the adjusting screw and inside the cap.



[Point 7]

Reassembly: Apply liquid packing (Helme Seal or equivalent) to the parking brake cable outlet in the backing plate to eliminate any clearance.

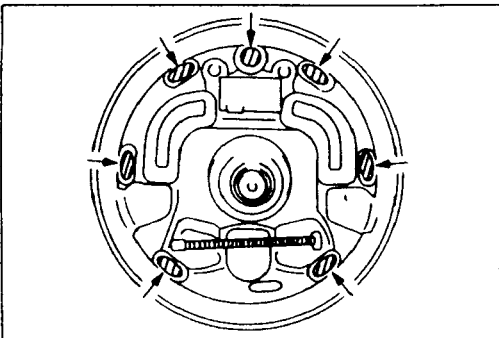


[Point 8]

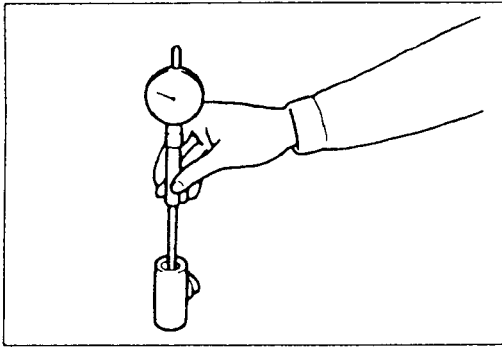
Inspection: Measure the thickness of the brake lining.

Standard thickness: 6 mm (0.24 in)

Limit thickness: 1 mm (0.039 in)



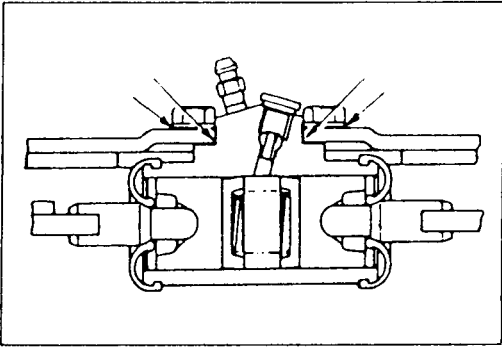
Reassembly: Before installing the brake shoe, apply grease (08887-01406) to the illustrated portions (6 places in contact with the shoe rim and anchor pin) of the backing plate.



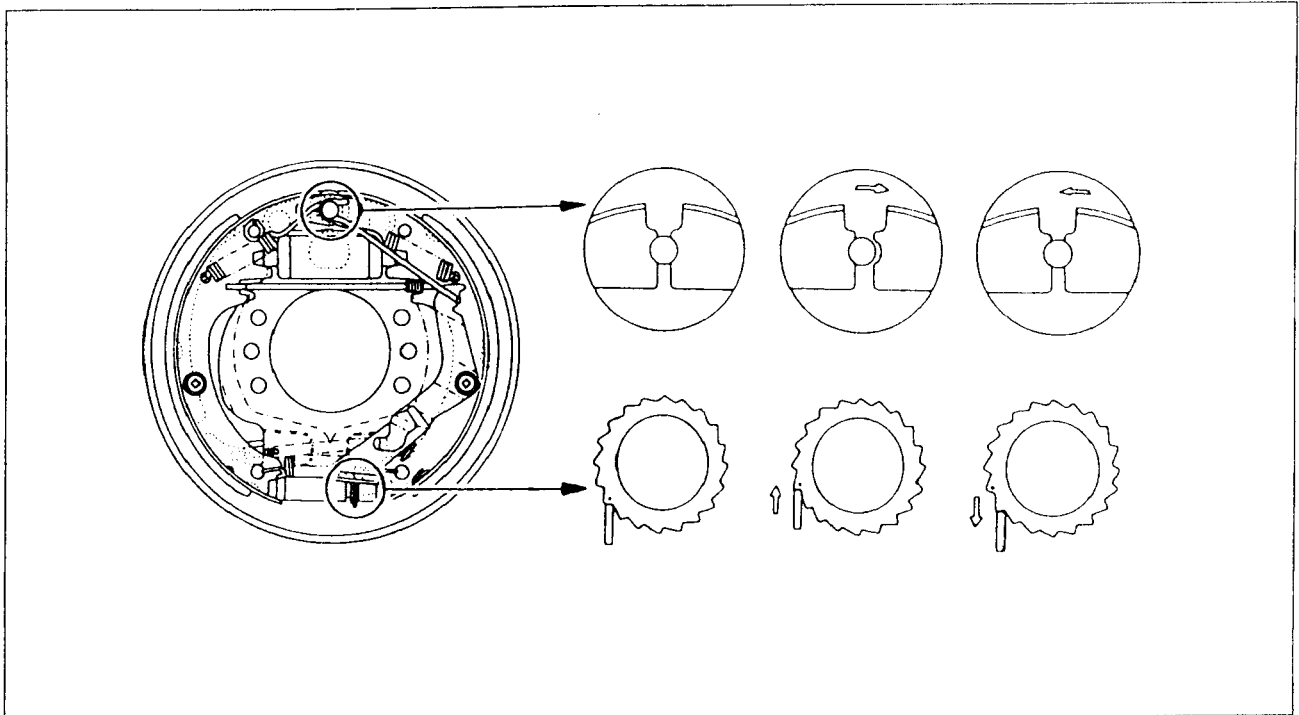
[Point 9]

Inspection: Measure the clearance between the wheel cylinder and the piston.

Limit piston clearance: 0.125 mm
(0.005 in)



Reassembly: Apply liquid packing (Helme Seal or equivalent) to the wheel cylinder portion for fitting in the backing plate and all around the set bolt to eliminate any clearance.

TEST (AUTOMATIC ADJUSTER OPERATION TEST)**Function Test****1. Brake shoe diameter adjustment**

- (1) Adjust the installed outside diameter of the brake shoe to 1.0 mm (0.04 in.) smaller than the brake drum inside diameter by the adjusting screw.

Outside diameter of installed shoe: 253 mm (9.96 in)

2. Adjusting screw function test

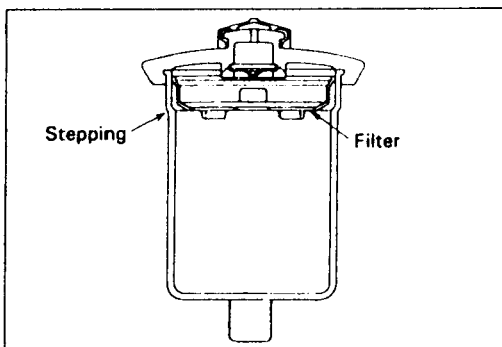
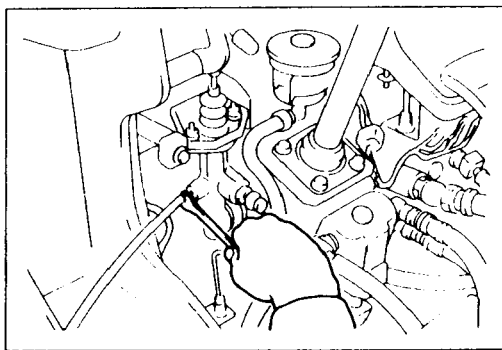
- (1) Use a finger to push and release the fitting cable (in 1 and 3 ton series) or the actuator lever (in 2 ton series) in the direction of the rear side shoe.
- (2) Make sure that the adjusting lever meshes with the next tooth of the adjusting screw.
- (3) When returned, the adjusting lever should release one tooth and return to initial position.

3. Inspect the following points when any malfunction is found:

- (1) The adjusting lever must be in vertical contact with the adjusting screw tooth.
- (2) The adjusting lever contact position must be 5 ~ 7 mm (0.2 ~ 0.28 in.) above the center line of the adjusting screw.

Caution:

If positions (1) and (2) above are improper, good meshing cannot be obtained and adjustment by the adjusting screw will fail.



Brake Air Purging

Note:

Purge air from the brakes while replenishing brake fluid so that sufficient fluid is supplied from the reservoir.

1. Tilt the mast to the fully backward position.
2. Purge air from the brakes using the brake master cylinder.
 - (1) Press the brake pedal a few times to compress the air in the piping and hold in the compressed state.
 - (2) Loosen the bleeder plug to purge air from the piping along with the brake fluid. Tighten the plug immediately before purging is completed.
 - (3) Repeat operations (1) and (2) until no bubbles remain in the brake fluid.
3. Purge air from the right and left wheel cylinders.
 - (1) Conduct the operations listed under in 2., one cylinder at a time.
4. Top up the brake fluid to the specified level.
 - (1) Add brake fluid through the filter attached to the reservoir.
 - (2) Add brake fluid up to the stepped portion of the reservoir tank.

Brake Performance Inspection and Adjustment

1. Inspect brake performance using a brake tester or by traveling test.
Stopping distance when braking (no-load test)

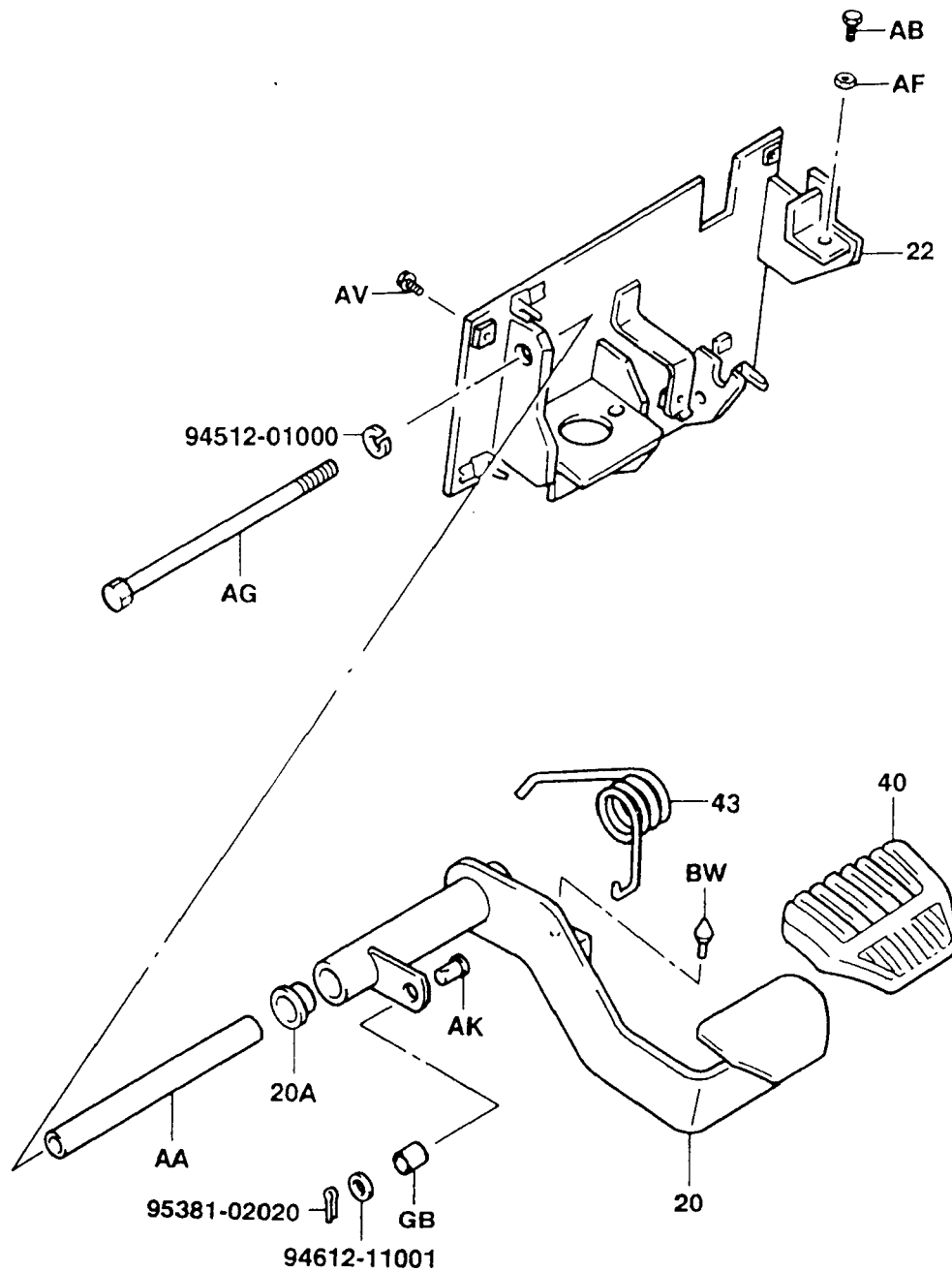
		1 t	1.2 t	1.5 t
Speed on braking	km/h	13.5	13.0	12.5
Stopping distance	m	1.1	1.1	1.1

2. Adjust brake performance.

- (1) Repeat forward and backward travel and adjust the brake shoe clearance.
The adjusting screw automatically adjusts the clearance when the brake pedal is pressed while the vehicle is traveling backward.
- (2) If the braking force is insufficient, possible causes include faulty operation of the adjuster, poor contact of the lining, fouling of the lining with foreign matter and leakage of brake fluid. Disconnect the brake drum and inspect.
- (3) When replacing the brake shoes with new ones, repeat forward and backward travel to ensure brake shoe contact.

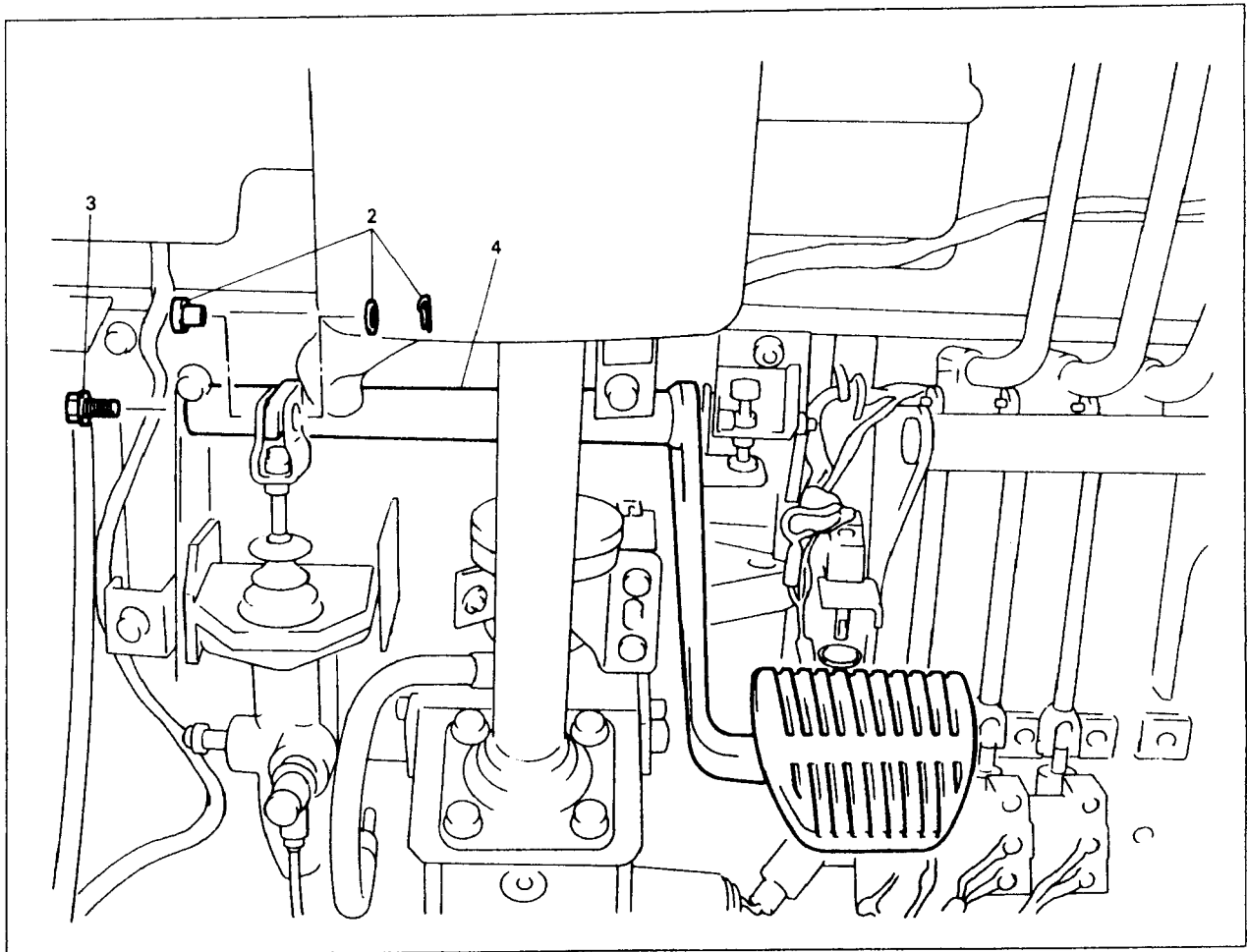
BRAKE PEDAL COMPONENTS

4701



4701-164

REMOVAL-INSTALLATION



Disassembly Procedure

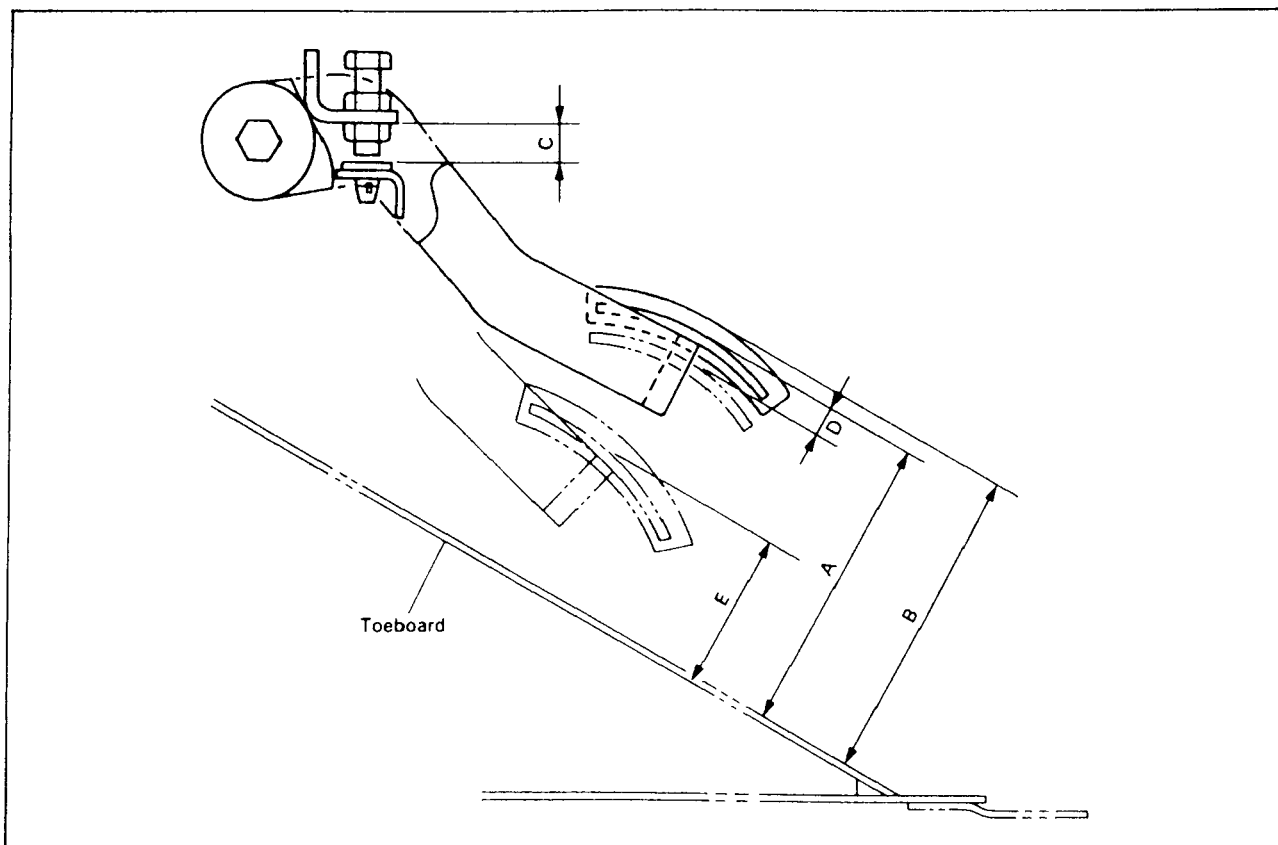
- 1 Remove the right and left covers.
- 2 Remove the push rod clevis.
- 3 Remove the set bolt.
- 4 Remove the brake pedal.

Reassembly Procedure

Installation is reverse of the removal procedure.

ADJUSTMENT

Brake Pedal Adjustment



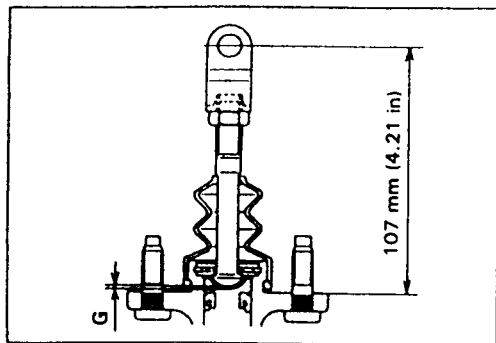
1. Adjust the brake pedal height and play.

- (1) Adjust the stop lamp switch or stopper bolt (dimension C) to make the brake pedal height (dimension A or B) satisfy the standard below.
- (2) Adjust the push rod length to make the brake pedal play (dimension D) satisfy the standard below.
- (3) After adjustment, check the depressed height (dimension E).

Unit: mm (in)

A	B	C (Reference)	D	E
110 ~ 115 (4.33 ~ 4.53)	116 ~ 121 (4.57 ~ 4.76)	14 (0.55)	3 ~ 5 (0.12 ~ 0.2)	20 (0.79) or more

A: Dimension without pad
B: Dimension with pad
C: Reference value
D: Pedal play corresponding to push rod play (G)
E: Depressed height (with pad)



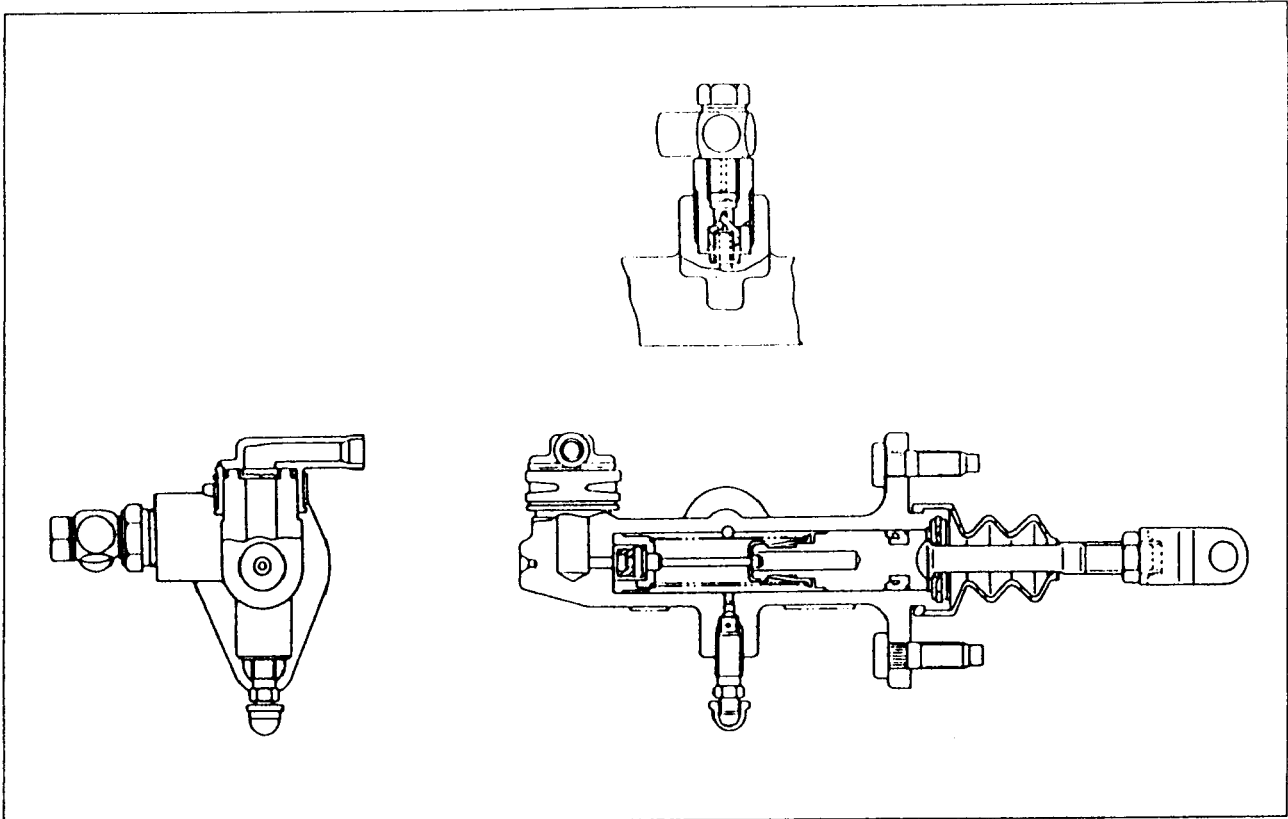
Push rod play

	G	mm(in)
1 ton series	1 ~ 2	(0.04 ~ 0.08)

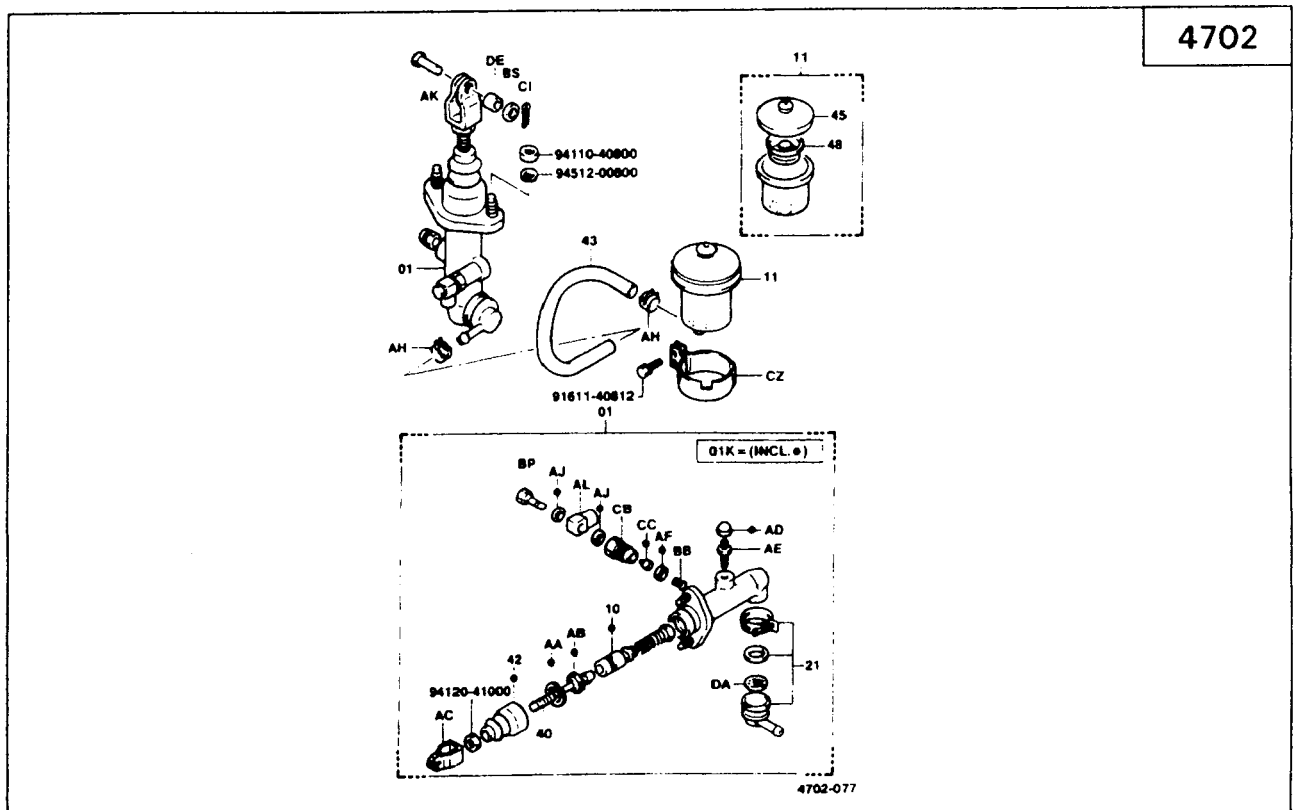
(Note) Always provide the push rod play (G).

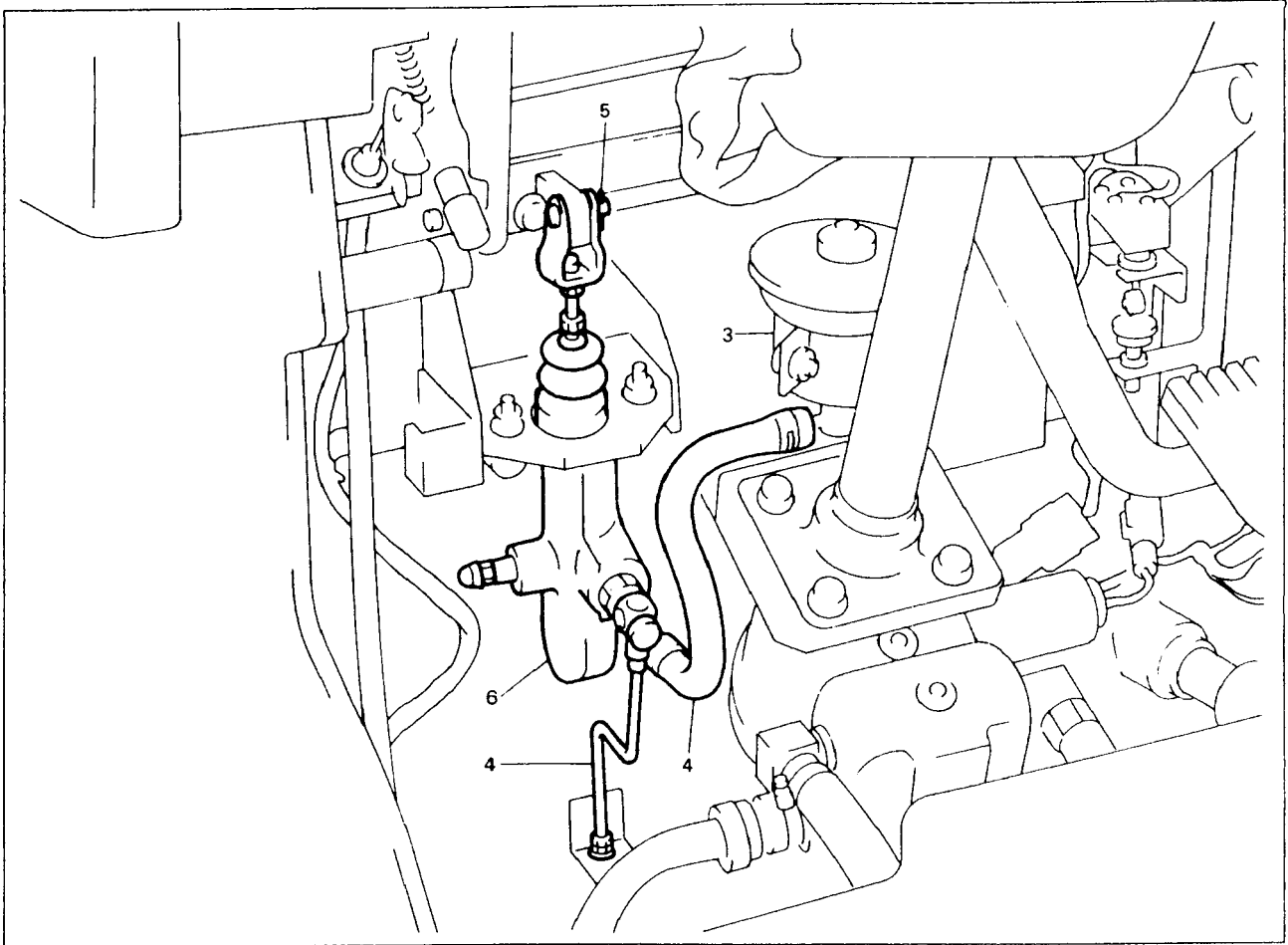
MASTER CYLINDER

GENERAL



COMPONENTS



REMOVAL-INSTALLATION**Removal Procedure**

- 1 Remove the front and rear toeboards.
- 2 Remove the left cover.
- 3 Drain brake fluid from the reservoir.
- 4 Disconnect the bridge hose and brake pipe from the reservoir.
- 5 Remove the push rod clevis pin.
- 6 Remove the brake master cylinder.

Installation Procedure

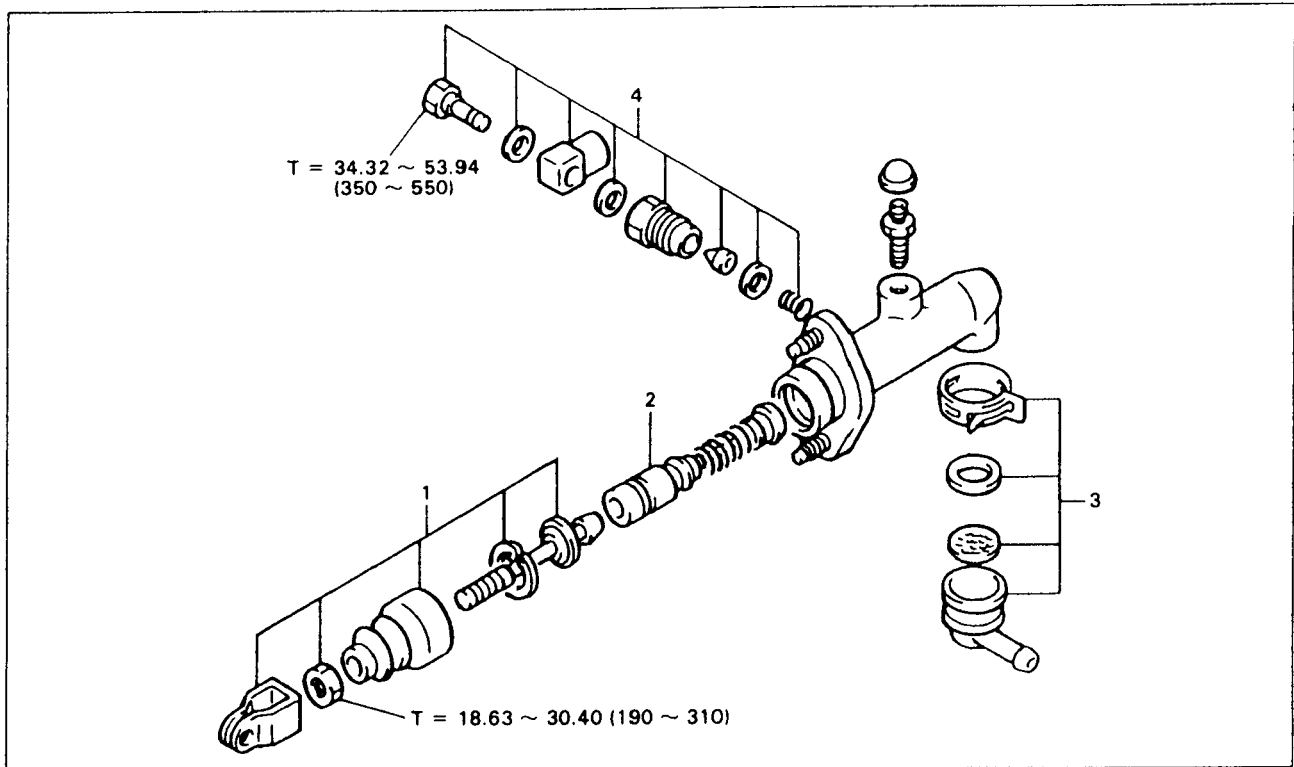
Installation is reverse of the removal procedure.

Note:

- See the brake pedal adjustment procedure (page 8-13) for adjustment after reassembly.
- Carry out air purge (page 8-10).

DISASSEMBLY-REASSEMBLY

T = N·m (kgf·cm)



Disassembly Procedure

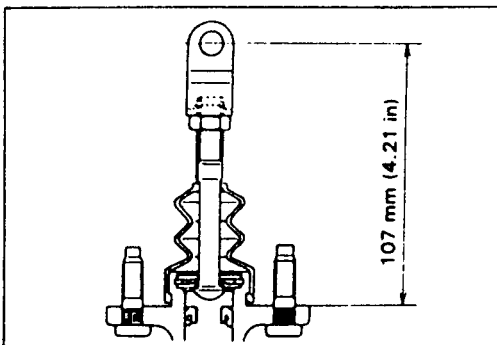
- 1 Turn up the boot and remove the snap ring to remove the push rod. [Point 1]
- 2 Remove the piston.
- 3 Remove the fluid inlet elbow. [Point 2]
- 4 Remove the outlet plug and valve.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

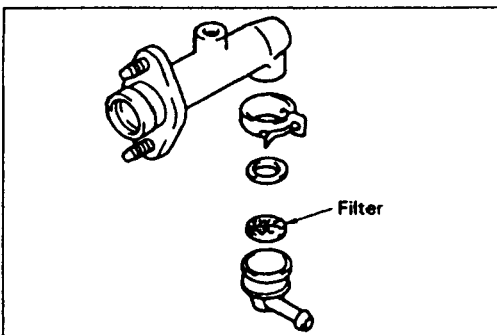
- Coat rubber grease on the piston cup before reassembly.



Point Operations

[Point 1]

Installation: Temporarily set the push rod length to the illustrated dimension and make readjustment after installation.



[Point 2]

Inspection: Check if the filter is clogged or not.

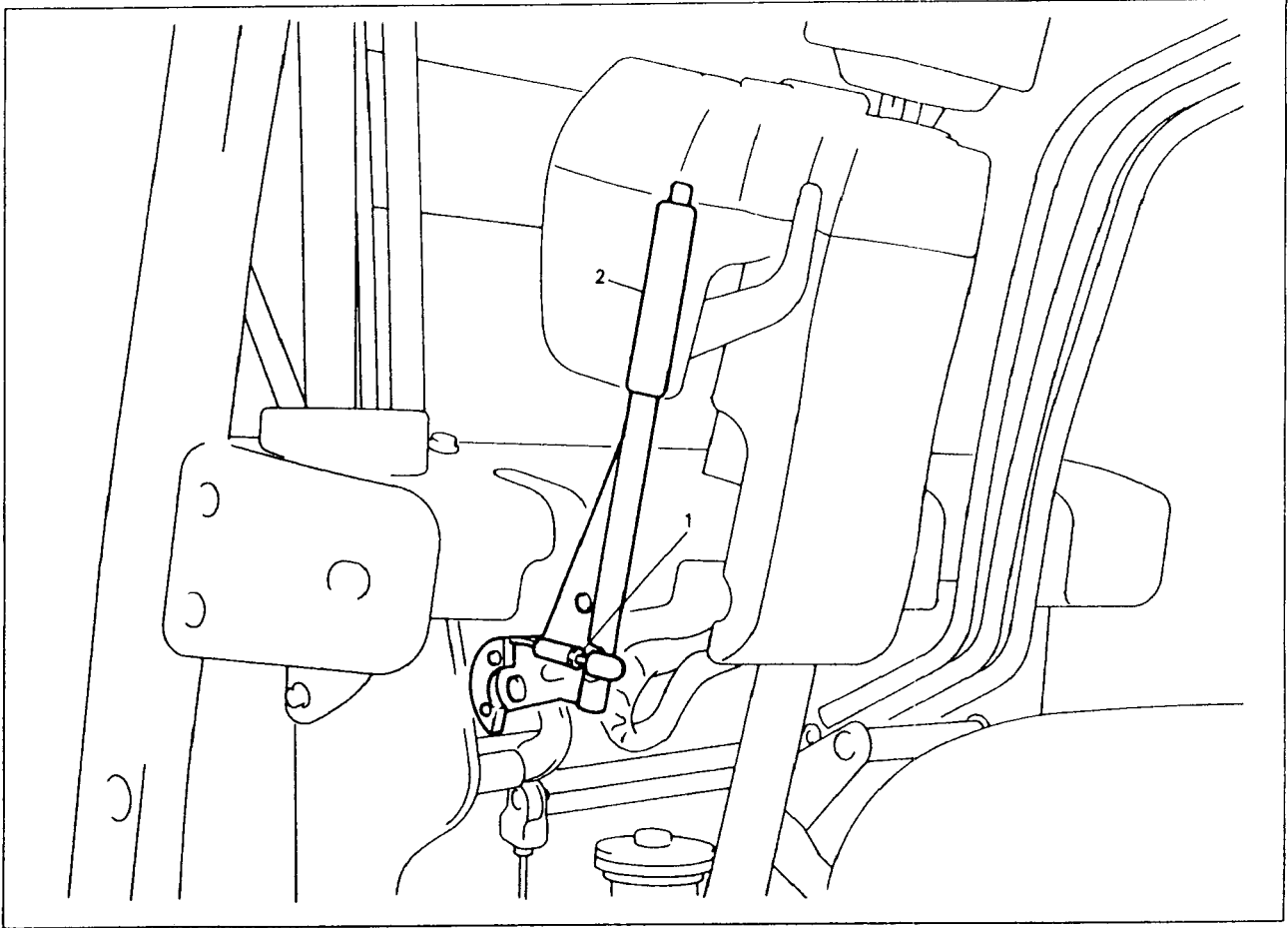
Exploded view diagram of a mechanical assembly. The diagram shows the following components and their labels:

- 28**: A long, thin rod or pin.
- CM**: A coiled spring.
- DW**: A small rectangular component.
- HJ**: A small cylindrical component.
- 94120-40600**: Multiple small circular components, likely washers or spacers.
- 91611-40816**: A long, thin rod with a coiled spring.
- 21**: A small cylindrical component.
- 91611-40812**: A small rectangular component.
- FU**: A small rectangular component.
- 90179-08146**: A small cylindrical component.
- DI**: A long, thin rectangular component.
- AB**: A small rectangular component.
- BS**: A small rectangular component.
- AL**: A small rectangular component.
- FC**: A small rectangular component.
- 91611-40812**: A small rectangular component.
- AI**: A small rectangular component.

The diagram illustrates the assembly of these components into a mechanical structure, with dashed lines indicating the assembly path and alignment.

4601-126

REMOVAL-INSTALLATION



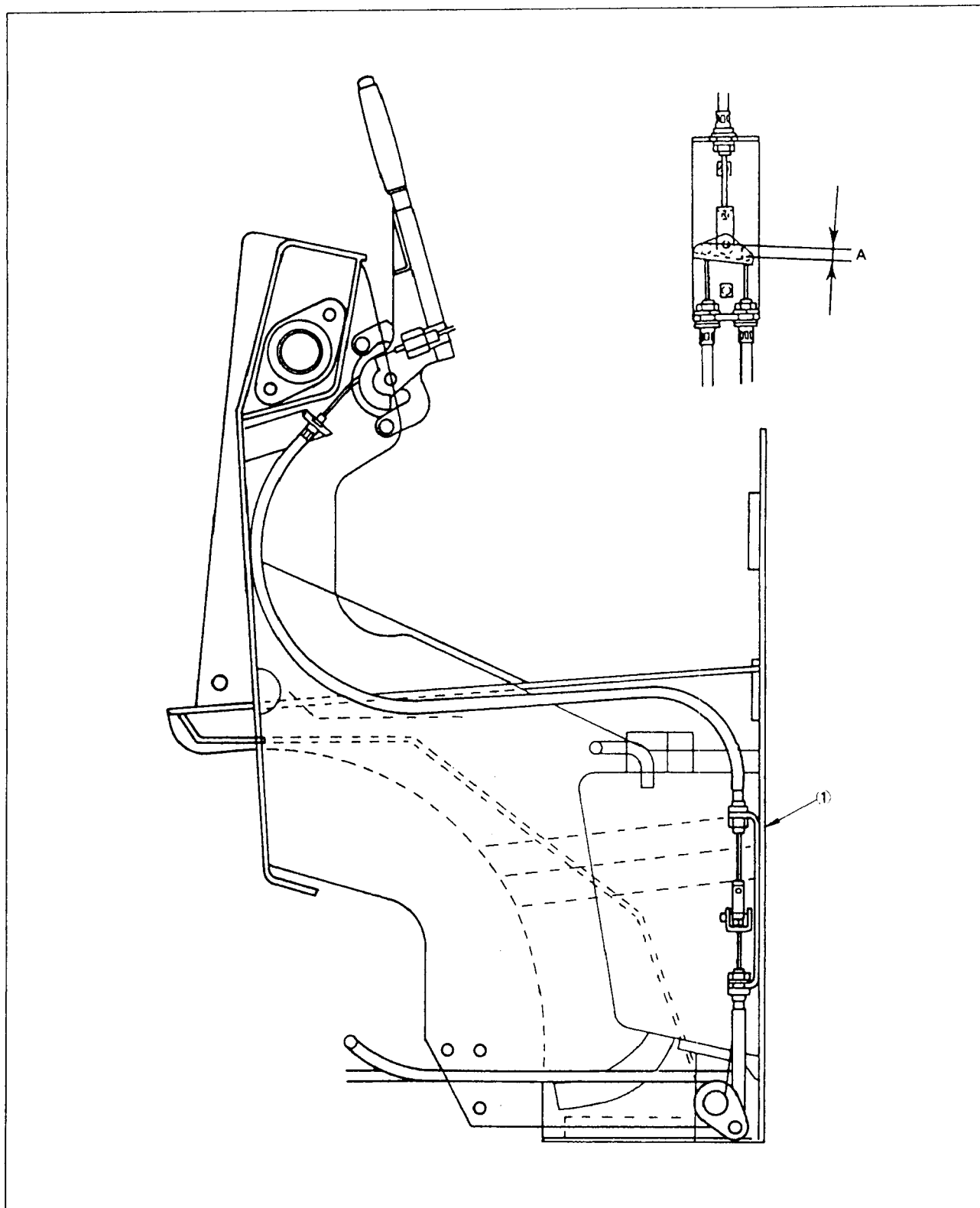
Removal Procedure

- 1 Disconnect the parking brake wiring. **(Point 1)**
- 2 Remove the parking brake assembly.

Installation Procedure

Installation is reverse of the removal procedure.

Point Operation

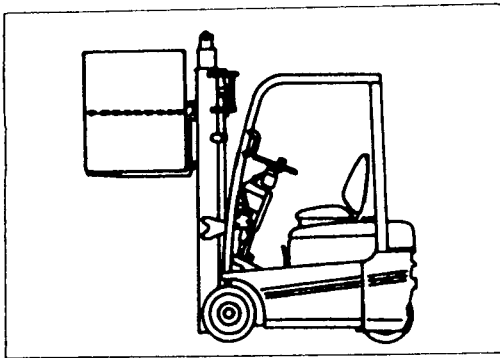


[Point 1]

Adjustment: Adjust to 2 ~ 3 notches at the center of the lever by applying a force of 15 kg.
 Adjust the deviation at this time to 3 mm or less.
 If the value does not satisfy the standard, adjust ①.

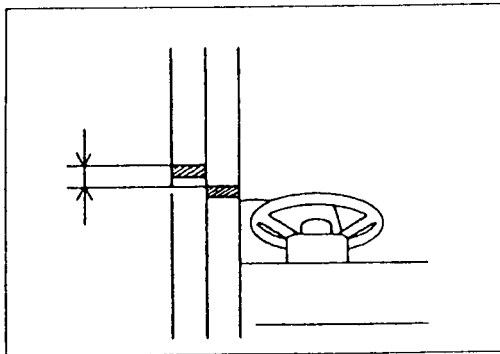
MATERIAL HANDLING SYSTEM

	Page
NATURAL DROP TEST	9-2
NATURAL FORWARD TILT TEST	9-2
OIL LEAK TEST	9-3
LIFT CYLINDER	9-3
TILT CYLINDER	9-3



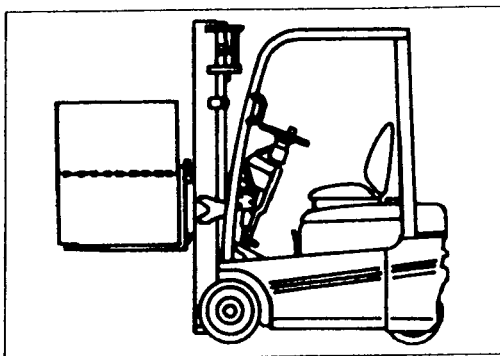
NATURAL DROP TEST

1. Set the mast in the vertical position with the standard load on the fork. Lift the fork by 1 to 1.5 m (40 to 59 in), and stop the engine.



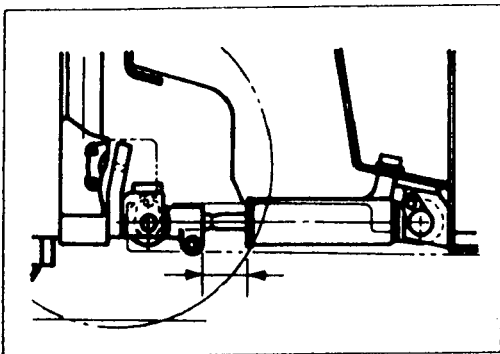
2. Draw datum lines on the inner and outer masts, and measure the drop in 15 minutes.

Vehicle model	Natural drop amount	mm
1 ton series	90 or less	
1.2 ton series	90 or less	
1.5 ton series	90 or less	



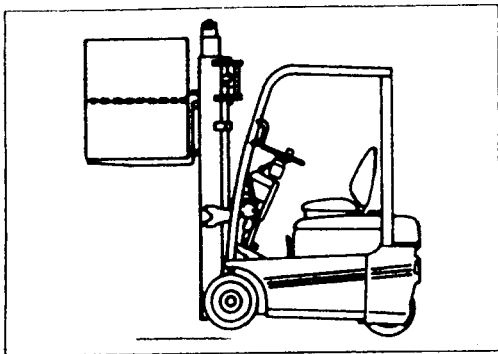
NATURAL FORWARD TILT TEST

1. Set the mast in the vertical position with standard load on the fork. Lift the fork about 50 cm and stop the engine.



2. Measure the tilt cylinder rod retraction in 15 minutes.

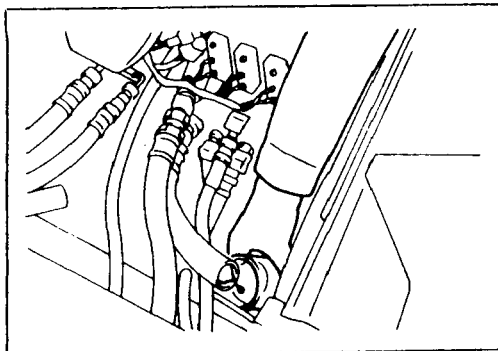
Vehicle model	Natural forward tilt amount	mm
1 ton series	40 or less	
1.2 ton series	40 or less	
1.5 ton series	40 or less	



OIL LEAK TEST

LIFT CYLINDER

1. Set the mast in the vertical position with the standard load on the fork. Lift the fork 1 to 1.5 m.

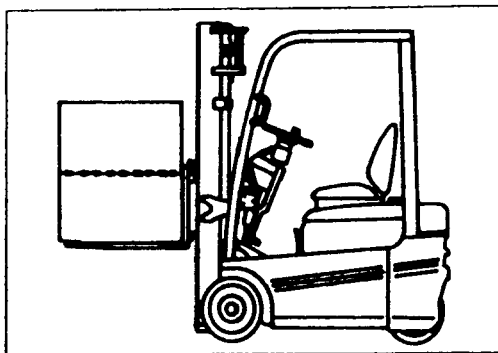


2. Slowly tilt the mast fully forward, and stop the engine. After 5 minutes, disconnect the oil control valve to oil tank hose. Place a measuring cylinder under the elbow and measure the amount of oil leaking in one minute.

Standard oil leak amount (at lift port):
6 ~ 16 cc or less

Note:

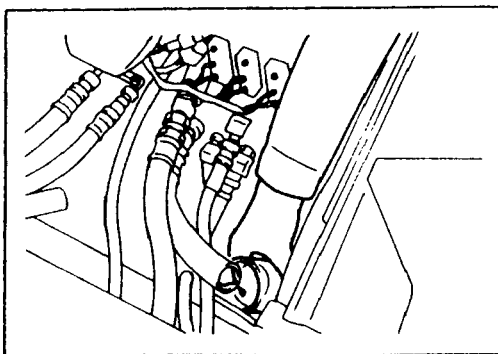
If the natural drop is great even though the oil leak amount is within the standard, the lift cylinder packing is defective.



TILT CYLINDER

1. Set the mast in the vertical position with standard load on the fork. Lift the fork by about 50 cm and stop the engine.
2. After waiting for 5 minutes, disconnect the oil control valve to oil tank hose. Place a measuring cylinder under the elbow and measure the amount of oil leaking in one minute.

Standard oil leak amount (total for lift and tilt):
14 ~ 34 cc



3. The leak amount at the tilt port is the total leak amount less the leak amount from the lift port.

Note:

If the natural forward tilt is great even though the oil leak amount is within the standard, either the tilt lock valve or the tilt cylinder packing is defective.

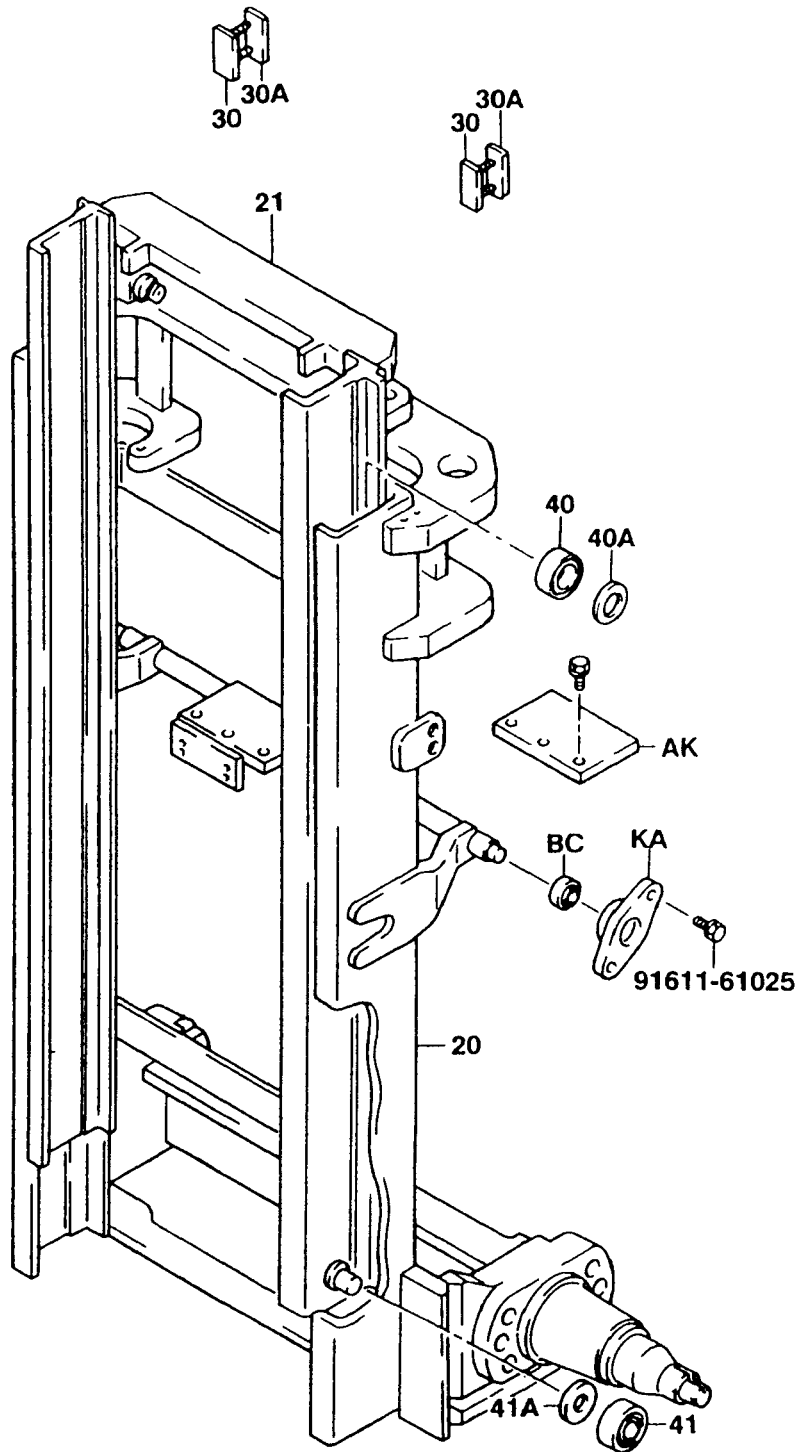
MAST

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V MAST ASSY.	10-2
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MAST DISASSEMBLY INSPECTION REASSEMBLY	10-6
LIFT BRACKET DISASSEMBLY INSPECTION REASSEMBLY	10-8
MAST ADJUSTMENT	10-9
CHAIN	10-15
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MAST ADJUSTMENT	10-18
FSV & FSN MAST ASSY.	10-19
COMPONENTS	10-19
MAST ADJUSTMENT	10-20
LIFT CYLINDER ROD SHIM ADJUSTMENT (PREVENTION OF UNEVEN LIFTING)	10-23

V MAST ASSY

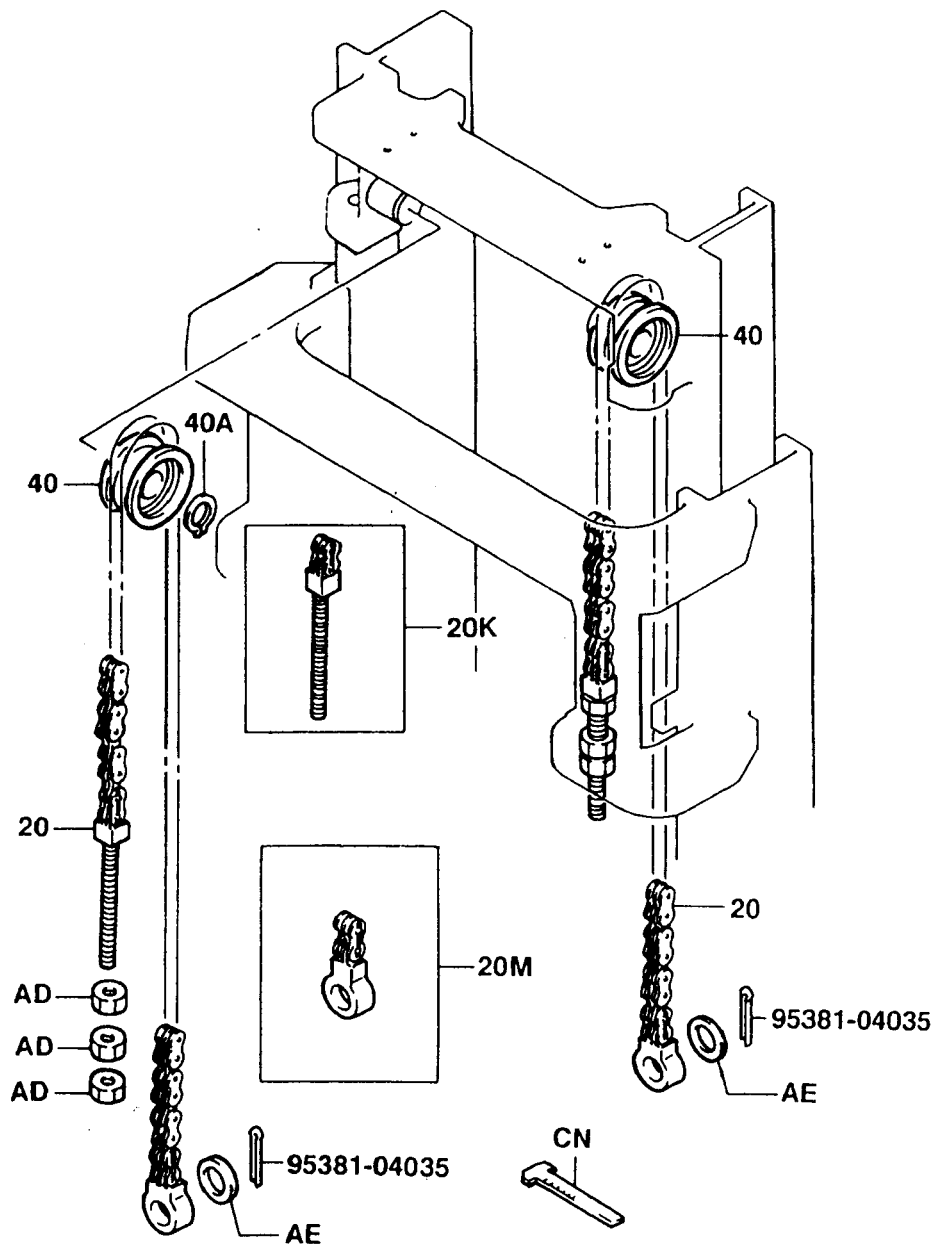
COMPONENTS

6101



6101-419

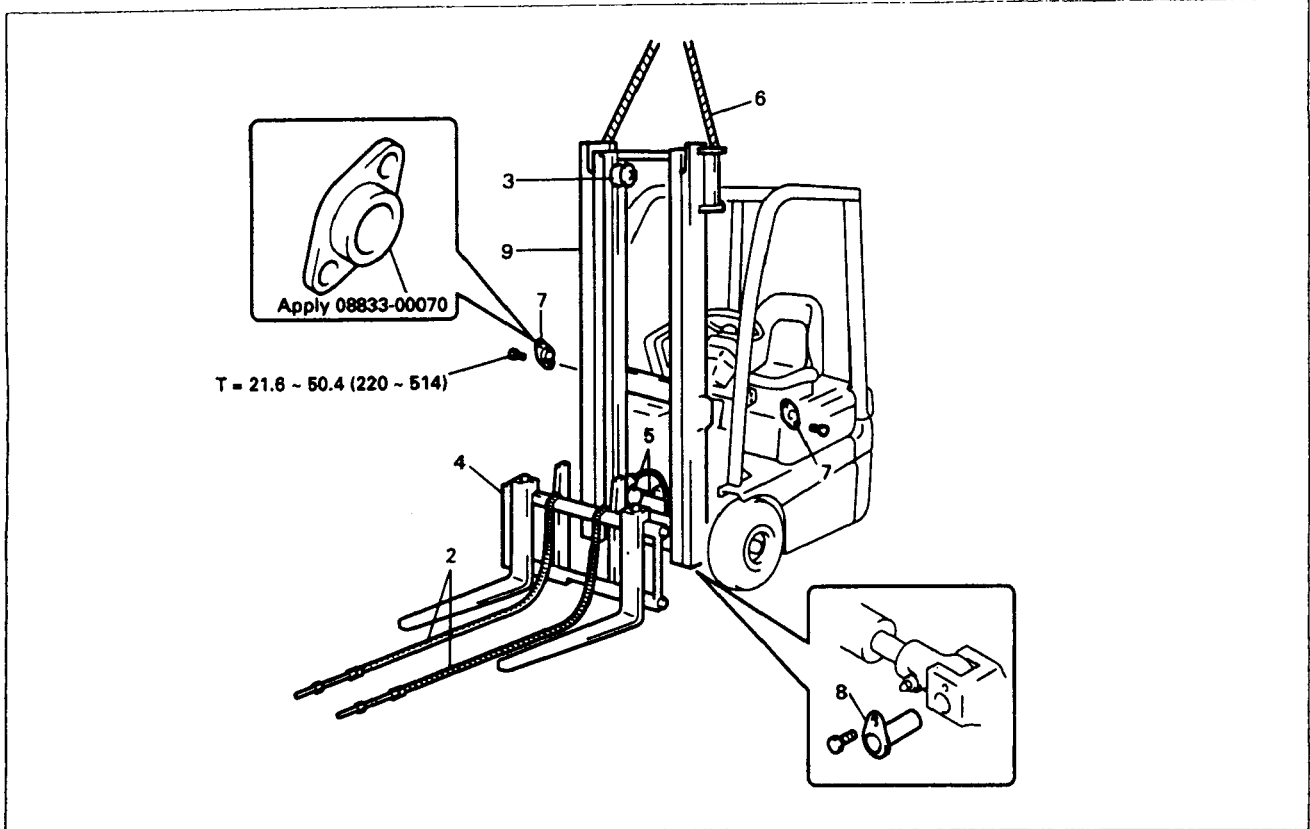
6302



6302-268A

REMOVAL-INSTALLATION

Unit: N·m (kgf·cm)



Removal Procedure

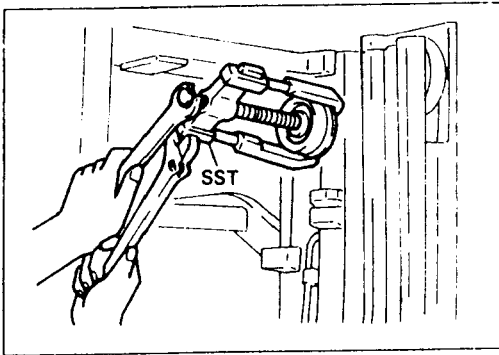
- 1 Set the mast vertical and lower the fork to the bottom position.
- 2 Disconnect the chain.
- 3 Remove the chain wheel. [Point 1]
- 4 Remove the lift bracket. (Raise the inner mast until it comes off from the lift bracket, and slowly move the vehicle in the reverse direction to depart from the lift bracket. Then stop the engine.)
- 5 Disconnect the overflow hose and high pressure hose. (Lower the inner mast to the bottom position and operate the lift lever several times to release the residual pressure in the lift cylinder before disconnecting the hoses.)
- 6 Slightly hoist the mast.
- 7 Remove the mast support caps.
- 8 Remove the tilt cylinder front pin. [Point 2]
- 9 Remove the mast ASSY.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:

- Apply molybdenum disulfide to the fulcrum shafts of the right and left masts.
- Apply MP grease on the interior surface of the mast support bushing, inner surface of the mast support cap and tilt cylinder front pin.
- If any of the mast ASSY, outer mast, inner mast and lift cylinder is replaced, it is necessary to inspect and adjust uneven motion of the lift cylinder. See the lift cylinder rod shim adjustment section (on page 10-8) for the inspection and adjustment method.
- Adjust the chain tension. (See page 10-16.)

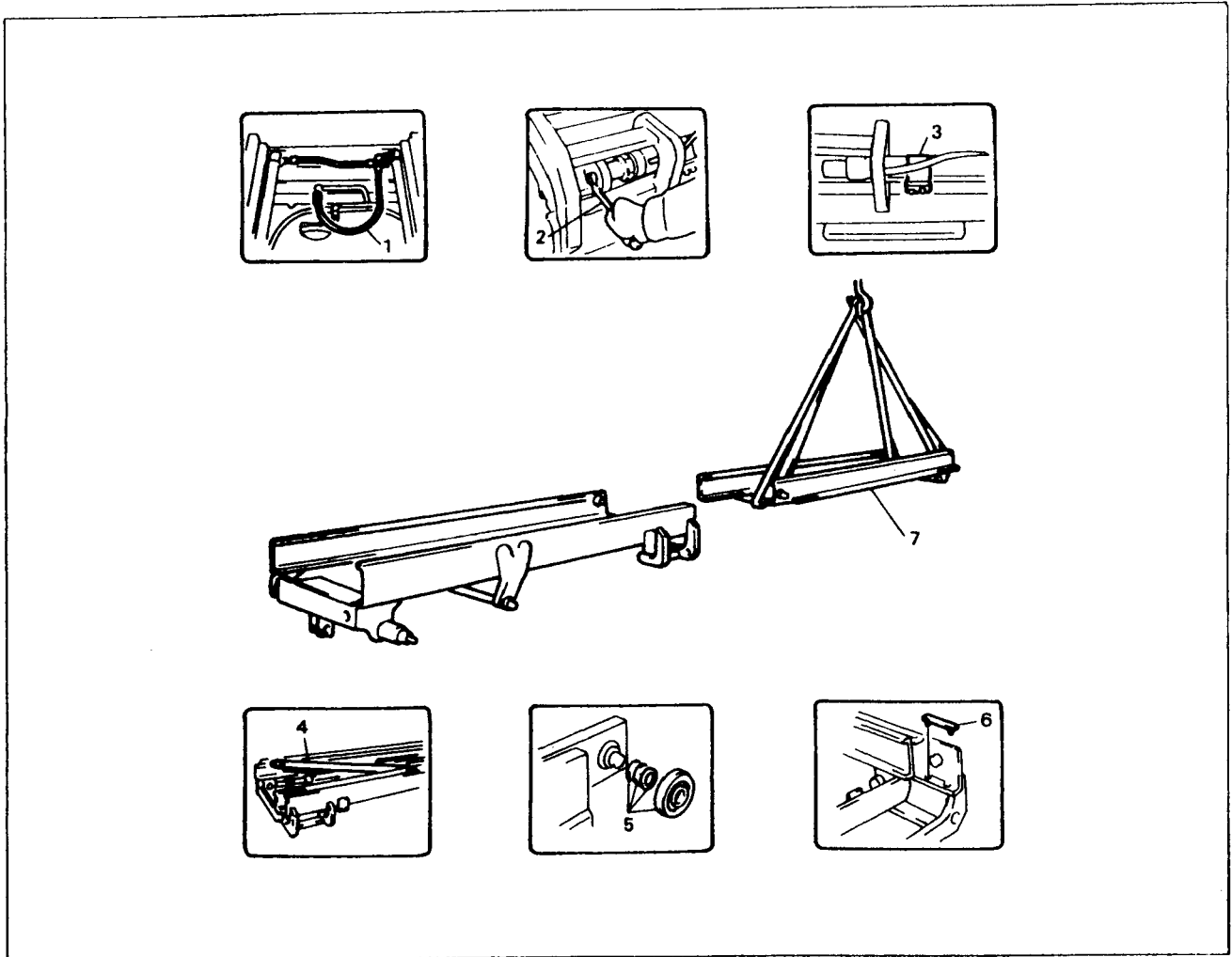


Point Operations

[Point 1]

Removal: Use the SST for removal if the fitting is tight.
SST 09950-40010

MAST DISASSEMBLY · INSPECTION · REASSEMBLY



Disassembly Procedure

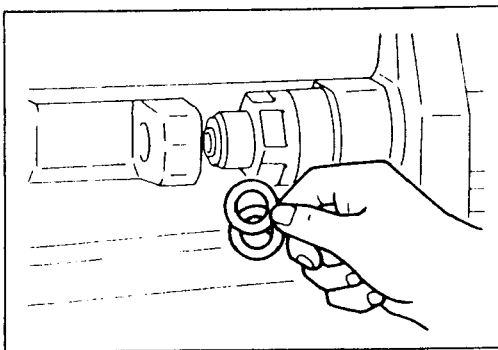
- 1 Disconnect the overflow hose and high pressure hose.
- 2 Remove the cylinder rod end set bolt and disconnect the rod end. [Point 1]
- 3 Remove the cylinder support. [Point 2]
- 4 Remove the cylinder bottom set bolts and remove the lift cylinder.
- 5 Slide the inner mast in the lowering direction and remove the lift rollers. [Point 3]
- 6 Remove the mast strip. [Point 4]
- 7 Remove the outer mast.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

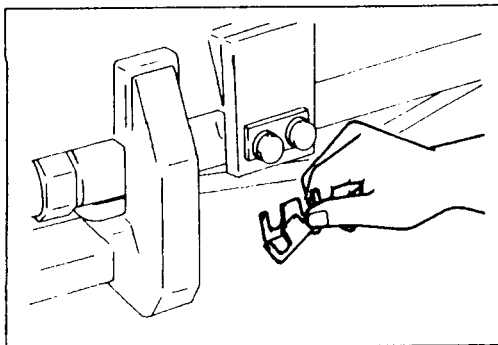
Pay sufficient attention to ensure that the axle shaft does not come in contact with other components to prevent damage or bending of the shaft.



Point Operations

[Point 1]

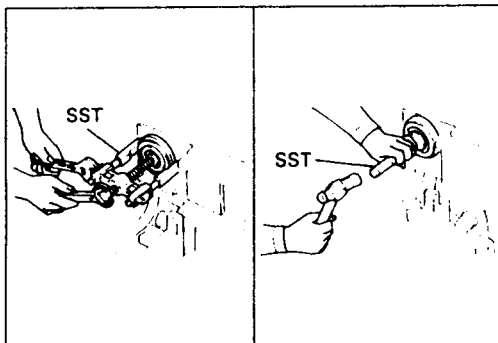
Disassembly: Shim adjustment has been made at the lift cylinder rod end for prevention of cylinder uneven motion between the left and right sides. Take a note on which side the shim adjustment is made and the number of shims used.



[Point 2]

Disassembly: Take a note on the number of cylinder support shims used.

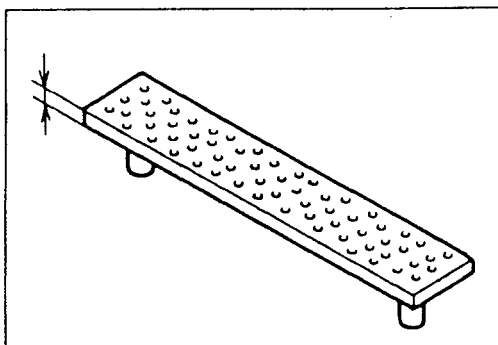
Reassembly: When the mast or cylinder is replaced, make shim adjustment at the cylinder support. With the cylinder rod end inserted to the inner mast, eliminate the clearance between the cylinder support and outer mast by inserting shims. The shim thickness should be slightly thicker.



[Point 3]

Disassembly: If the lift roller is too tight, use the SST. SST 09950-40010

Reassembly: SST 09608-35014

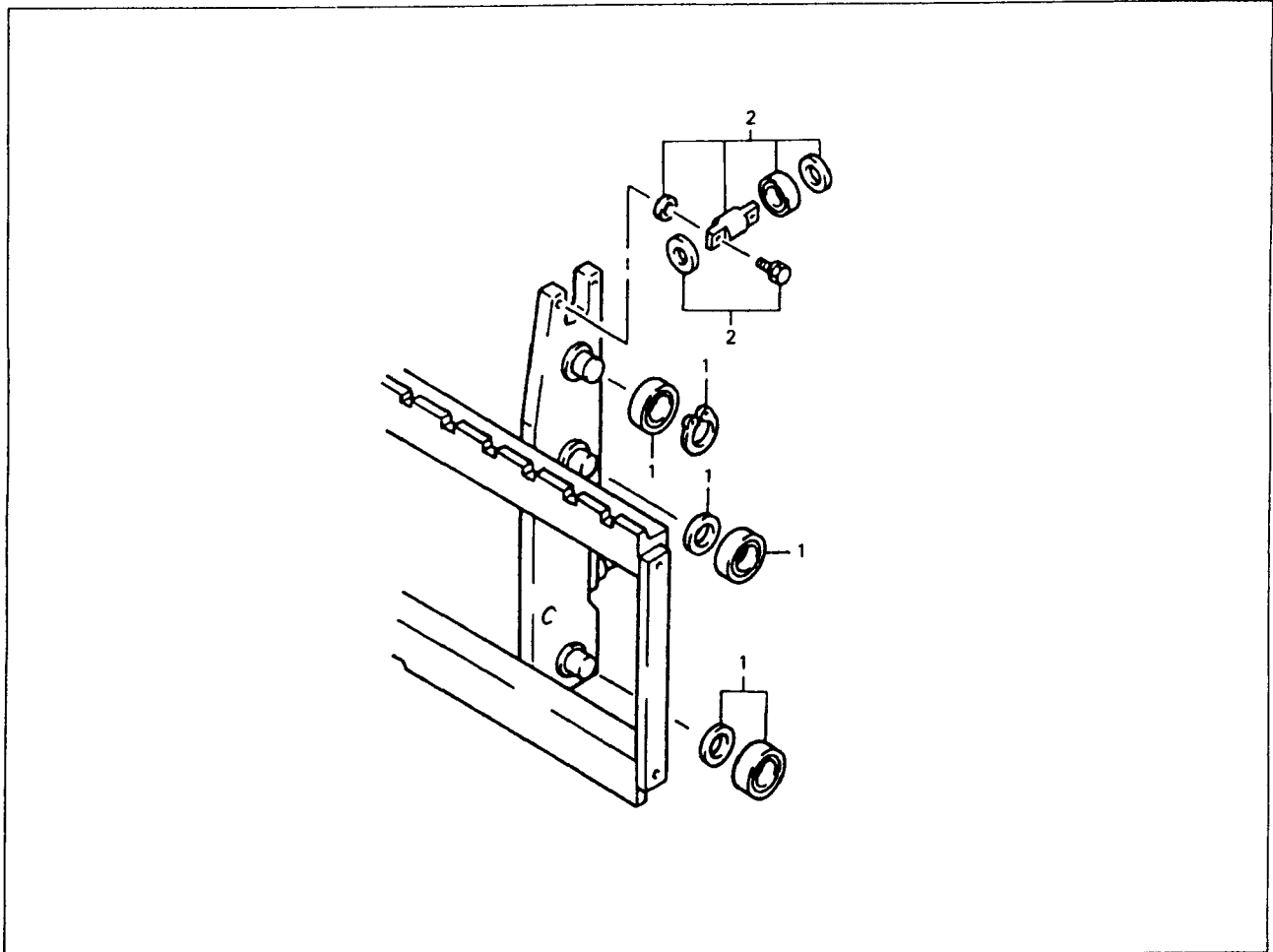


[Point 4]

Inspection: Measure the mast strip thickness.

Thickness limit: 1.5 mm (0.059 in)

LIFT BRACKET DISASSEMBLY·INSPECTION·REASSEMBLY

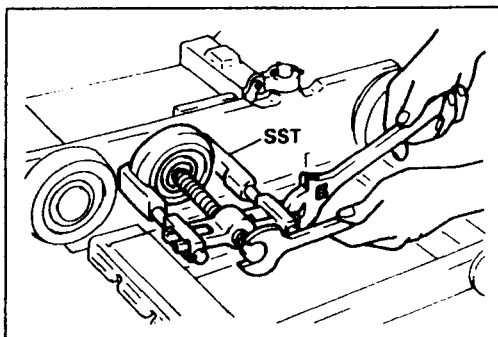


Disassembly Procedure

- 1 Remove the lift rollers. [Point 1]
- 2 Remove the side rollers. [Point 2]

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

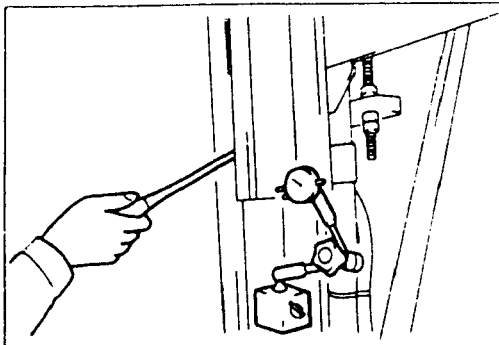
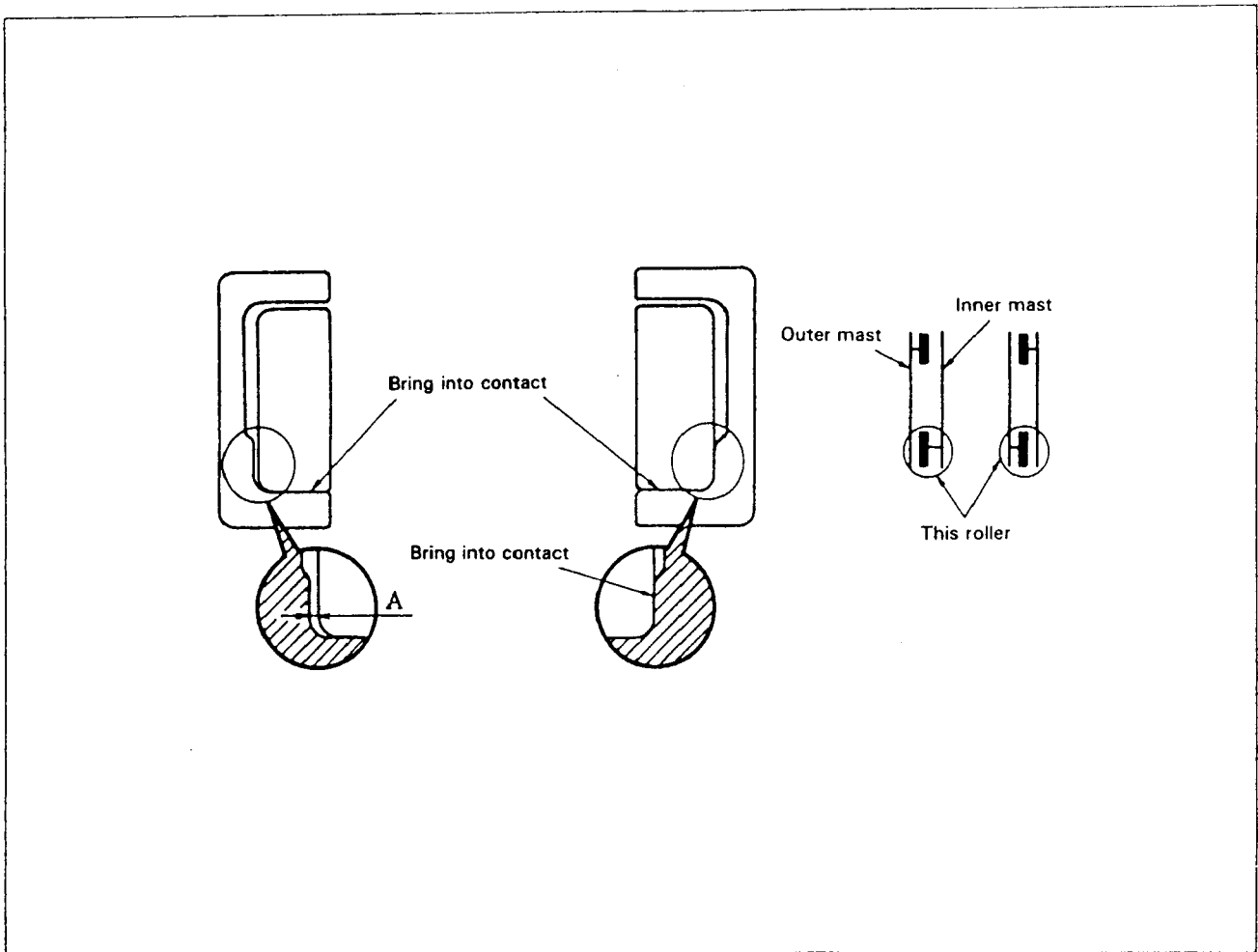


Point Operations

[Point 1]
Disassembly: SST 09950-40010

MAST ADJUSTMENT

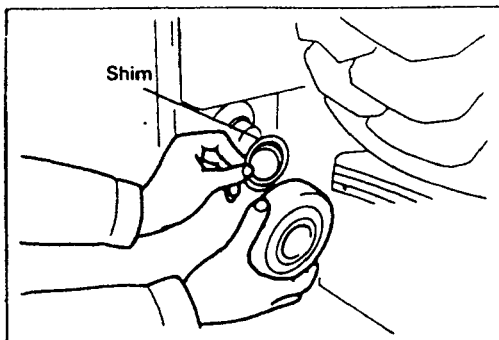
Mast Lift Roller Adjustment



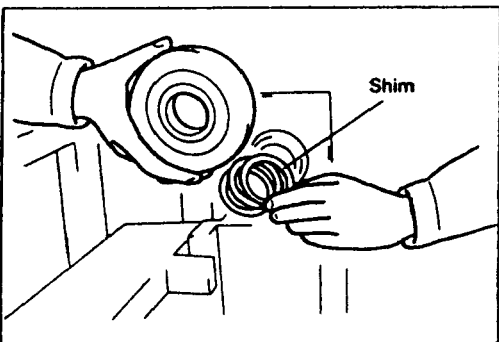
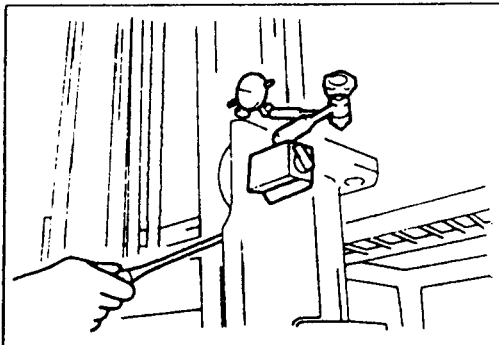
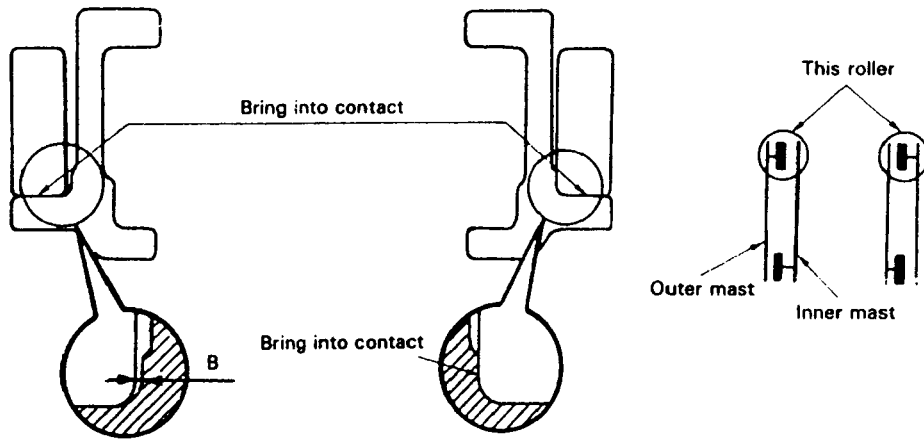
1. Inner mast roller clearance adjustment
 - (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
 - (2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner mast roller shim.

Standard clearance $A = 0 \sim 0.8 \text{ mm}$
(0 ~ 0.031 in)

Shim thickness: 0.5 and 1.0 mm
(0.020 and 0.039 in)



- (3) Distribute the shim thickness equally to the left and right rollers. (See the "mast roller removal-installation" section for the shim replacement procedure.)
- (4) After the adjustment, check that the inner mast moves smoothly in the outer mast.



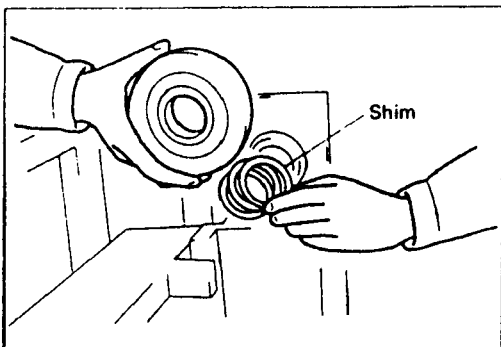
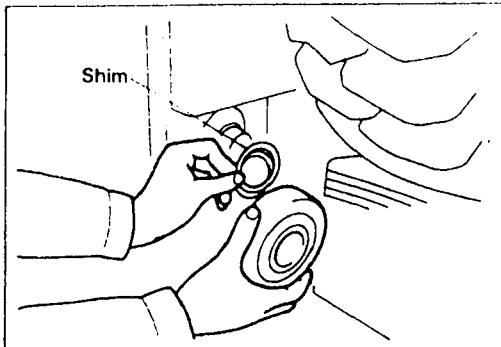
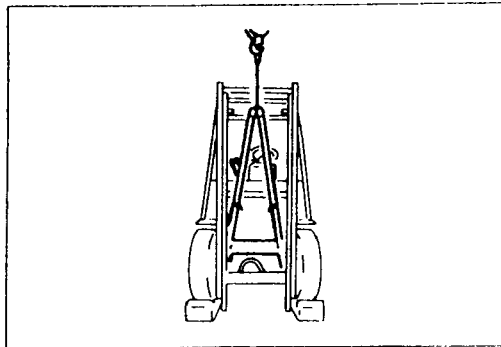
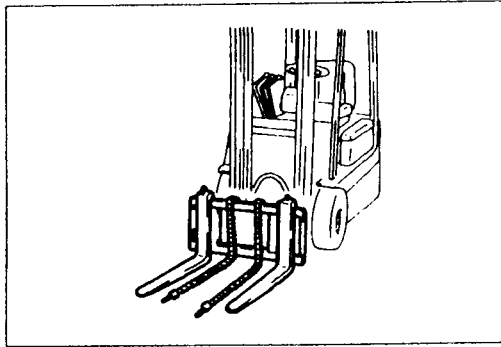
2. Outer mast roller clearance adjustment

- (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
- (2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer mast roller shim:

Standard clearance $B = 0 \sim 0.8 \text{ mm}$
(0 ~ 0.031 in)

Shim thickness: 0.5 and 1.0 mm
(0.020 and 0.039 in)

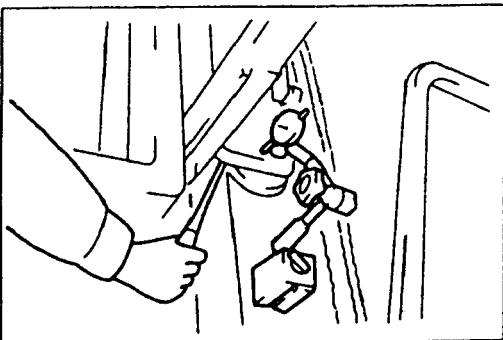
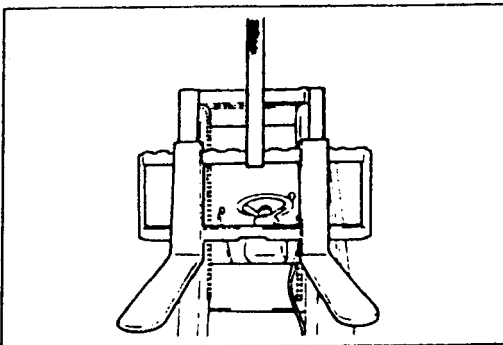
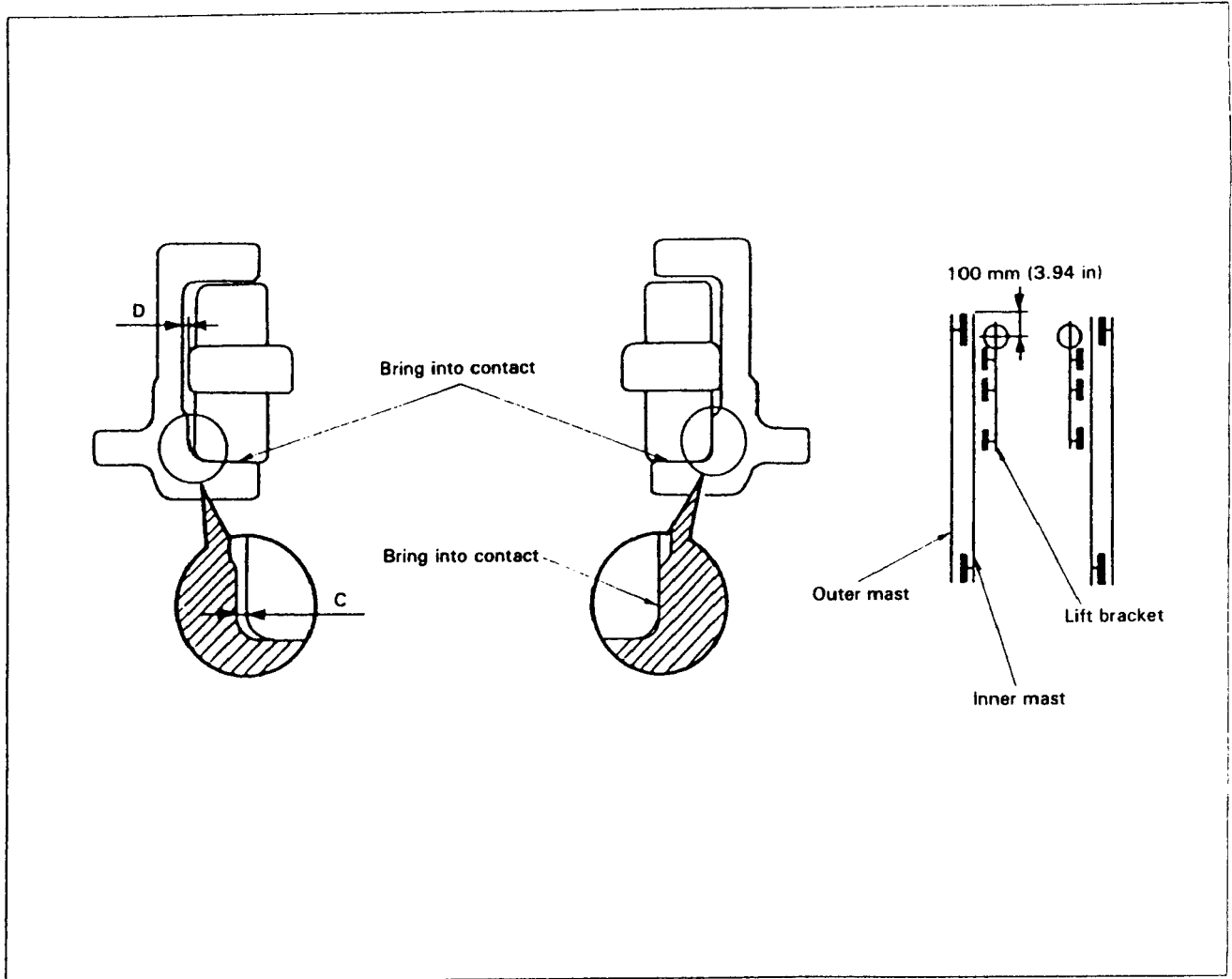
- (3) Distribute the shim thickness equally to the left and right sides. (See the "mast roller removal-installation" section for the shim replacement procedure.)
- (4) After the adjustment, check that the inner mast moves smoothly in the outer mast.



Mast Roller Removal-Installation

1. Remove the lift bracket. (See the mast ASSY removal procedure steps 1 to 4 on page 10-5.)
2. Jack up the vehicle and support the tires with wooden blocks. Lock the front and rear tires to prevent rotation.
3. Tilt the lift cylinder.
 - (1) Disconnect the lift cylinder hose on the LH side.
 - (2) Remove the lift cylinder bottom set bolts.
 - (3) Sling the inner mast upper tie beam with a wire and slightly hoist it.
 - (4) Remove the lift cylinder rod end set bolts, and disconnect the rod end by hoisting the inner mast.
 - (5) Remove the lift cylinder support.
 - (6) Tie the lift cylinders LH and RH and tie them with ropes to the outer mast tie beam.
4. Remove the mast rollers.
 - (1) Lower the hoisted inner mast slowly until mast rollers are visible, and support the bottom with wooden blocks.
 - (2) Remove the inner mast rollers and shims.
 - (3) Remove the outer mast rollers and shims.
5. The installation procedure is the reverse of the removal procedure.

Lift Bracket Roller Adjustment



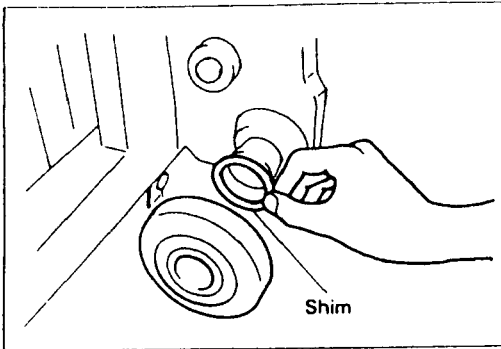
1. Lift roller and side roller clearance adjustment

- (1) Measure the clearance when the center of the lift bracket upper side roller is 100 mm (3.93 in) from the top of the inner mast.
- (2) The upper lift rollers need no adjustment because they are fixed by snap rings.
- (3) Measure the clearances at the middle and lower lift rollers after removing the side rollers.

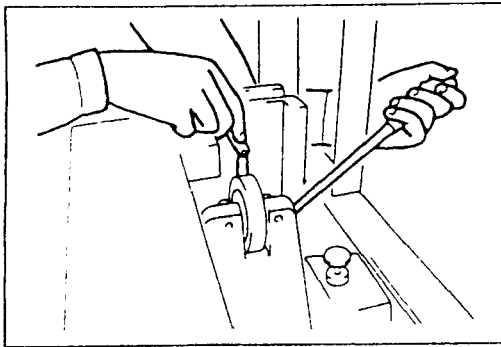
Shift the lift bracket to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

Standard clearance $C = 0 \sim 0.8 \text{ mm}$
(0 ~ 0.031 in)

Shim thickness: 0.5 and 1.0 mm
(0.020 and 0.039 in)



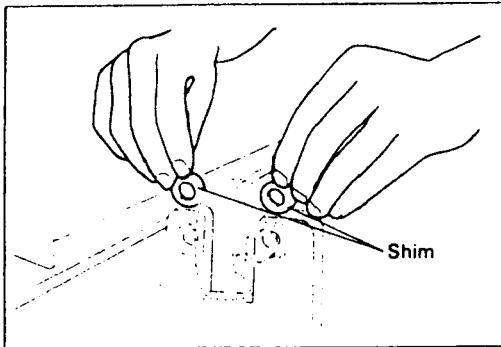
- (4) Distribute the shim thickness equally to the left and right sides. (For the shim replacement procedure, see the lift bracket disassembly section on page 10-9.)
- (5) Install the side rollers.



- (6) Side roller adjustment shall be made after adjusting the middle and lower lift rollers. Bring the side roller on one side into contact with the mast side surface, and make adjustment by shim insertion to make the clearance between the side roller and inner mast side surface on the opposite side satisfy the following standard.

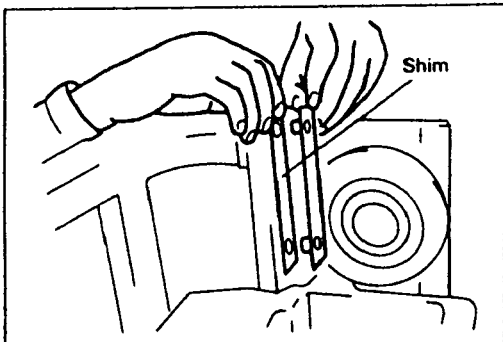
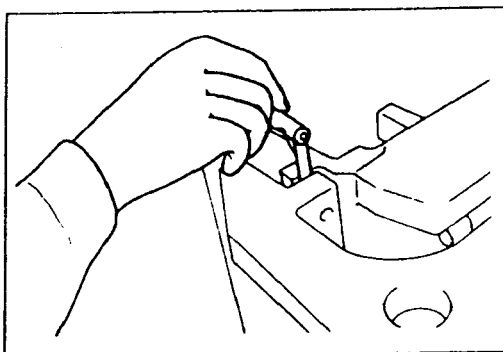
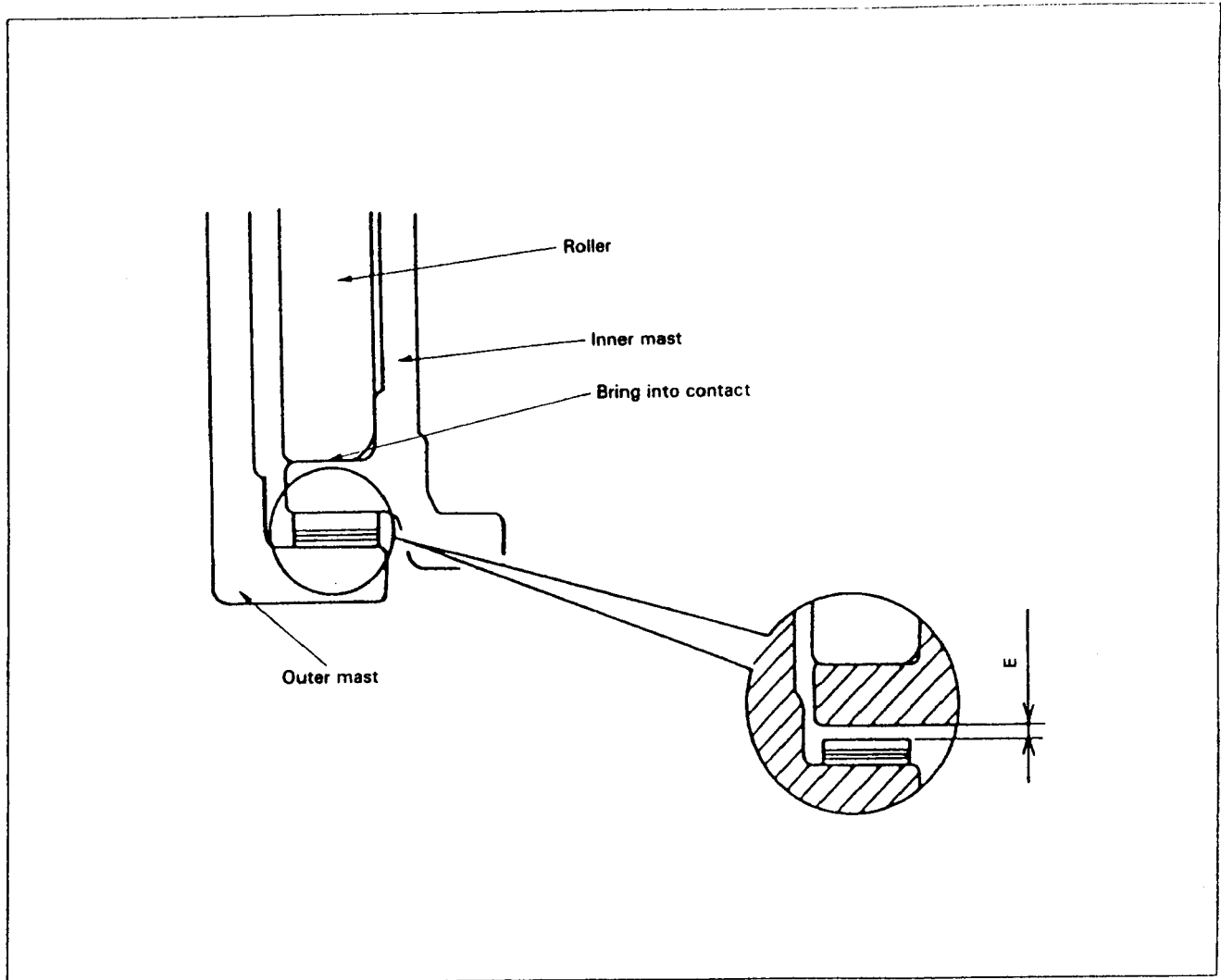
Standard clearance $D = 0 \sim 0.6 \text{ mm}$
(0 ~ 0.024 in)

Shim thickness: 0.5 and 1.0 mm
(0.020 and 0.039 in)



- (7) The shim thickness shall be distributed equally into the left and right sides. (Shim replacement is possible on the vehicle. For the side roller installation, see the lift bracket disassembly section on page 10-9.)
2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

Mast Strip Adjustment



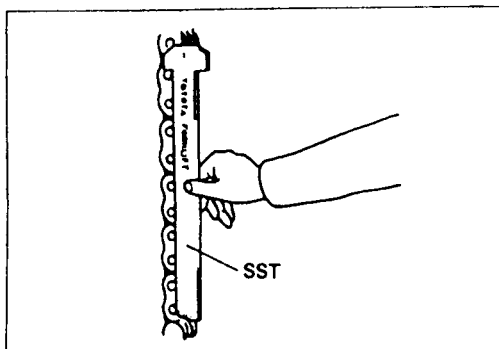
1. Mast strip clearance adjustment

- (1) Measure the clearance with the inner mast at the bottom position.
- (2) With the inner mast in contact with the outer mast roller, adjust the clearance between the mast strip and inner mast to the following value by inserting the mast strip shim. (The shim replacement procedure is the same as that described in the "mast roller removal-installation" section on page 10-12.)

Standard clearance $E = 0 \sim 0.8 \text{ mm}$
(0 ~ 0.0315 in)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (3) After the adjustment, the mast should move smoothly.



CHAIN

Inspection

1. Inspect the chain elongation.
SST 09631-22000-71

Note:

- When inspecting the chain elongation, use the SST above and inspect without removal from the vehicle.
- Standard chain link pitch
15.88 mm (Type: BL534)
19.05 mm (Type: BL634)
25.4 mm (Type: BL823)

Reassembly

Applicable mast and portion	V: Lift bracket	FSV: Lift bracket FSN: Lift bracket	FSV: Inner mast
Sketch	Center of vehicle Cotter pin Install with the cotter pin on the vehicle center side.	Front of vehicle Cotter pin Install with the cotter pin on the vehicle front side.	Center of vehicle Cotter pin Install with the cotter pin on the vehicle center side.

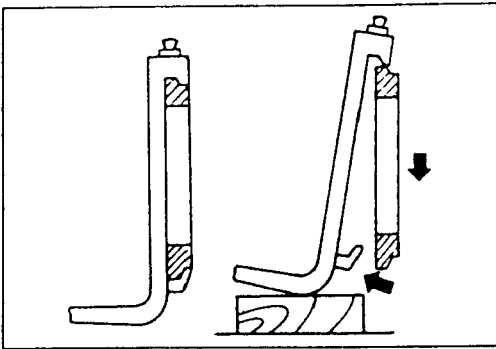
Chain Adjusting Nut Tightening Sequence

1. Tighten nuts ① and ②. Tightening torque $T = 49.03 \sim 78.45 \text{ N}\cdot\text{m}$ (500 ~ 800 kgf-cm)
2. Tighten nut ③

Applicable mast and portion	V: Outer mast	FV: Front cylinder FSV: Front cylinder FSN: Front cylinder	FSV: Outer mast FSN: Outer mast
Sketch	③ ② ①	Clamp ② ①	Clamp ② ①

Adjustment

- 1 Place the vehicle on a flat ground, and set the mast in the vertical position.
- 2 After moving the fork up and down several times without a load, check that the chain tension on the left and right sides are equal.
- 3 Turn the adjusting nut so that the fork bottom surface is about to come into contact with the ground surface without slackening the chain.
- 4 Check the chains for equal tension on the left and right sides.
- 5 Check that the chains are not twisted.
- 6 Check that the maximum fork height is as specified.



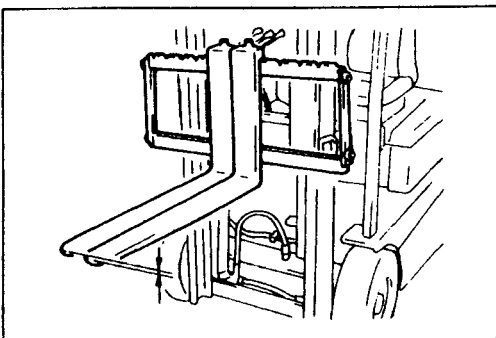
FORK

Removal

- 1 Position the fork at 20 cm (7.9 in) above the ground.
- 2 Place a wooden block under the natched portion of the fork rail.
- 3 Unlock after lifting the fork stopper pin, and shift the fork blades one by one to the center.
- 4 Gradually lower the fork and remove it.

Installation

The installation procedure is the reverse of the removal procedure.



Inspection

- 1 Inspect the fork.

Fork tip end limit misalignment: 10 mm or less

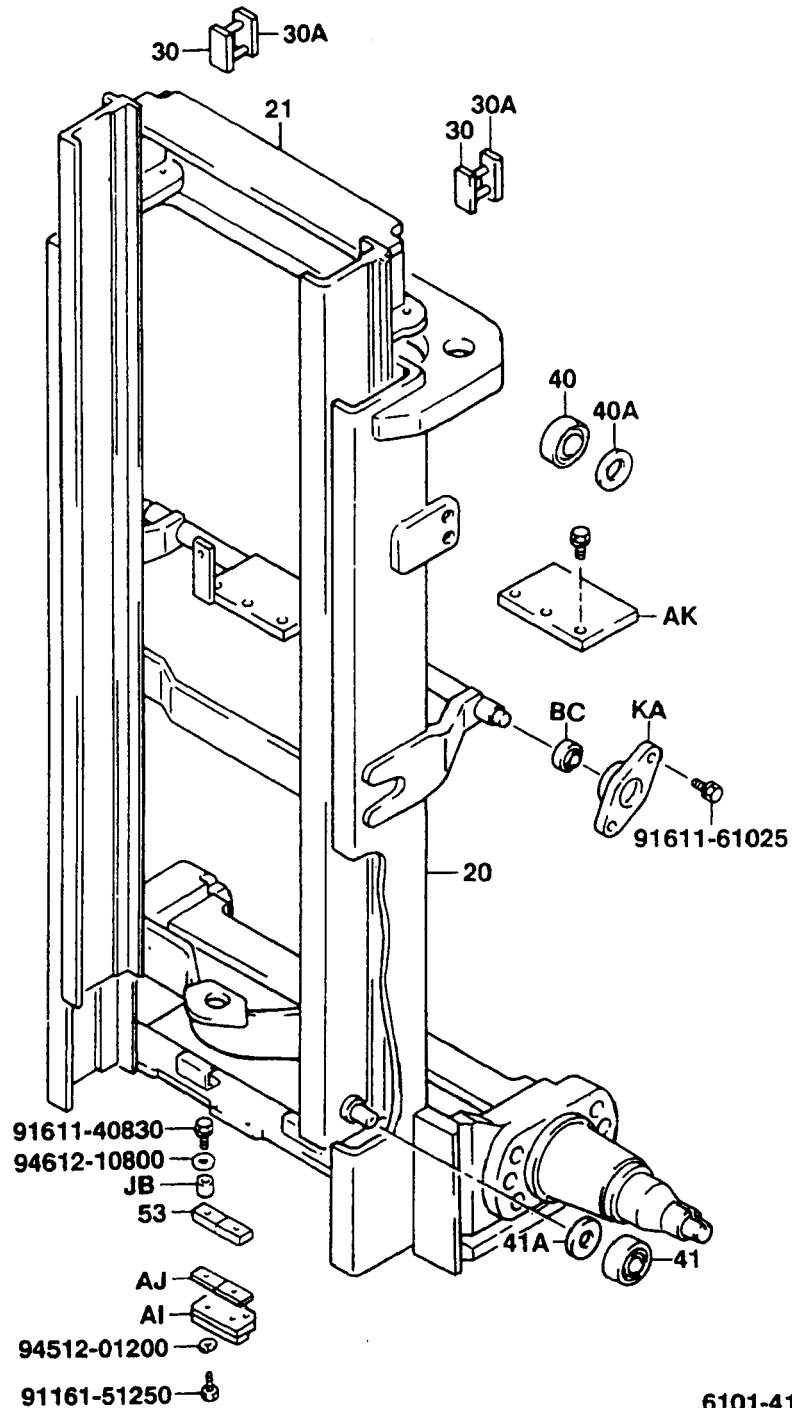
Note:

If the tip end limit misalignment is exceeded, inspect the bend, fork mounting looseness and lift bracket finger bar distortion for each blade.

FV MAST ASSY

COMPONENTS

6101

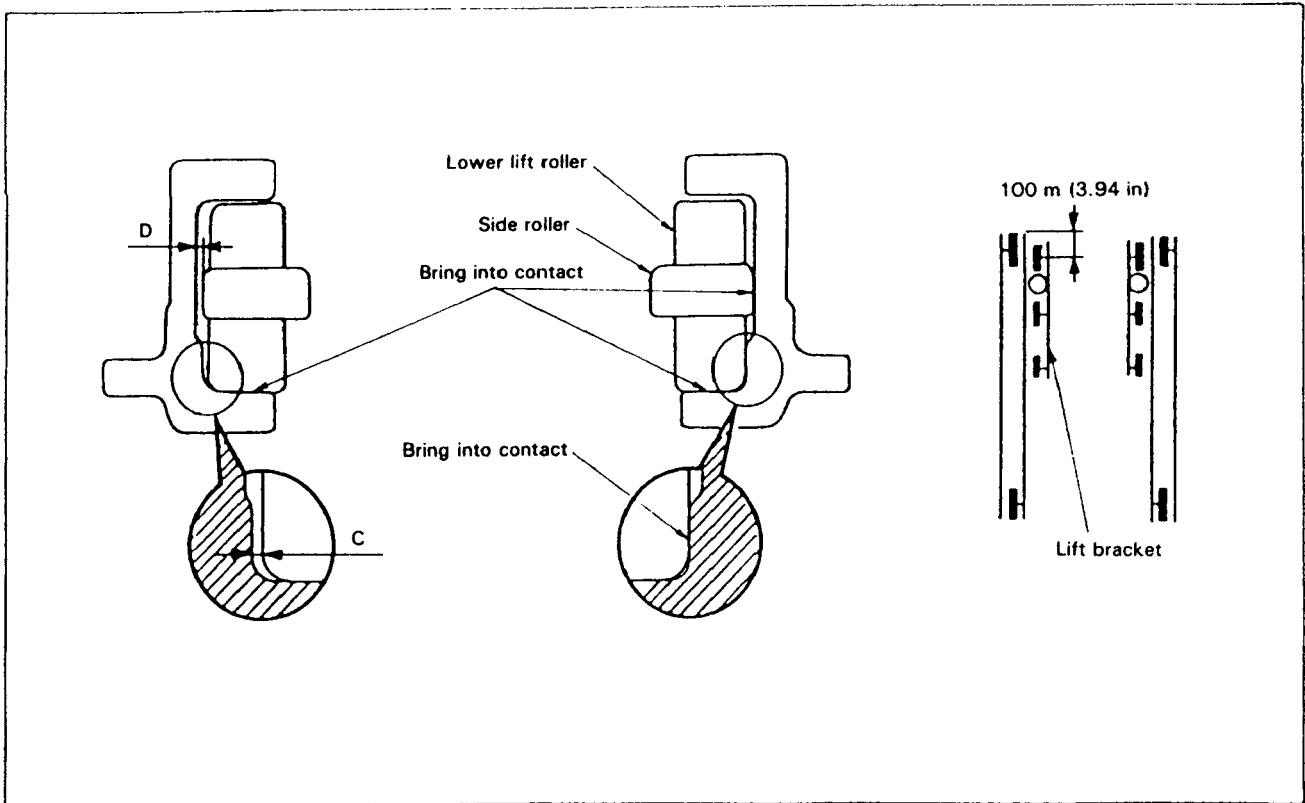


6101-418

MAST ADJUSTMENT

All adjustment procedures for the FV mast are identical to those explained in the V MAST ADJUSTMENT section, except for LIFT BRACKET ROLLER ADJUSTMENT. So refer to the V MAST ADJUSTMENT section (page 10-10).

Lift Bracket Roller Adjustment (FV)



1. Lift roller and side roller clearance adjustment

- (1) Measure the clearance when the center of the lift bracket upper side roller is 100 mm from the top of the inner mast.
- (2) The upper and middle lift rollers need no adjustment because they are fixed by snap rings.
- (3) For the lower lift roller, shift the lift bracket to one side to bring the roller into contact with the inner mast, and adjust the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

Standard clearance $C = 0 \sim 0.5 \text{ mm}$ ($0 \sim 0.020 \text{ in}$)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (4) Distribute the shim thickness equally to the left and right sides.
- (5) Adjust the side rollers after adjusting the lower lift rollers. Bring the side roller on one side into contact with the mast side surface and adjust the clearance between the side roller and inner mast on the opposite side to the following value by inserting the side roller shim:

Standard clearance $D = 0 \sim 0.5 \text{ mm}$ ($0 \sim 0.020 \text{ in}$)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

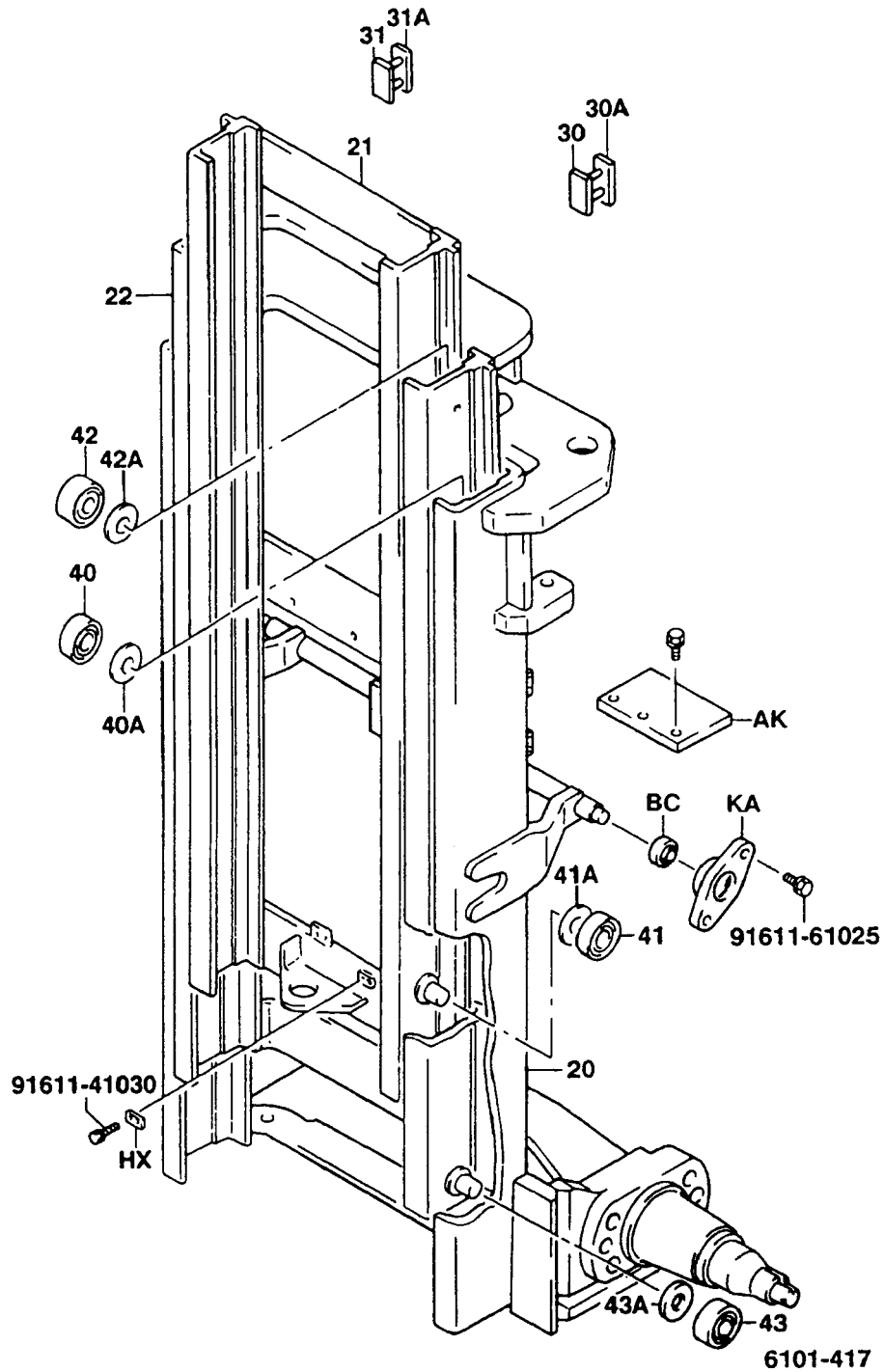
- (6) Distribute the shim thickness equally to the left and right side rollers.

2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

FSV & FSN MAST ASSY

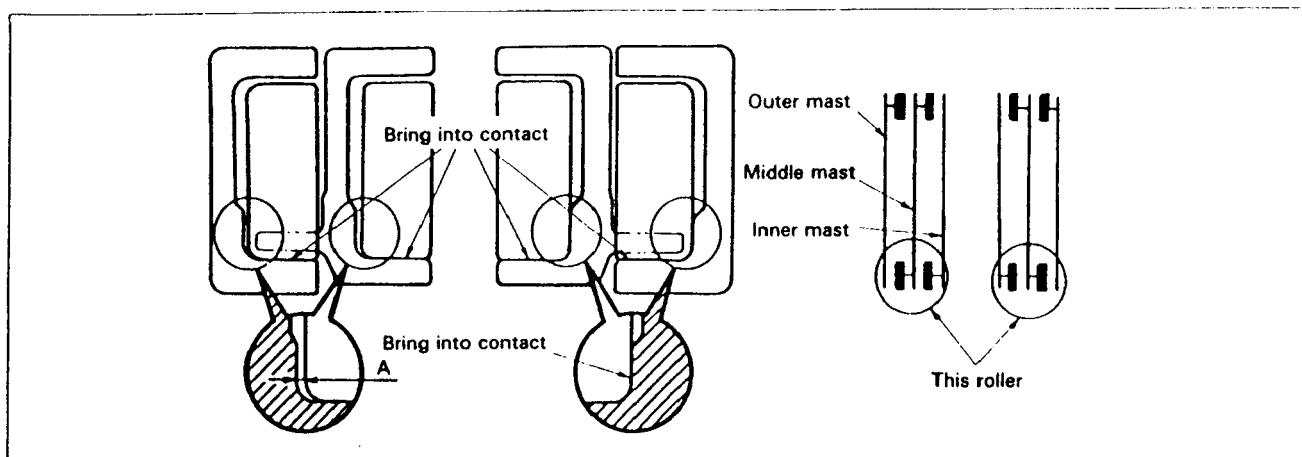
COMPONENTS

6101



MAST ADJUSTMENT

Mast Lift Roller Adjustment (FSV & FSN)



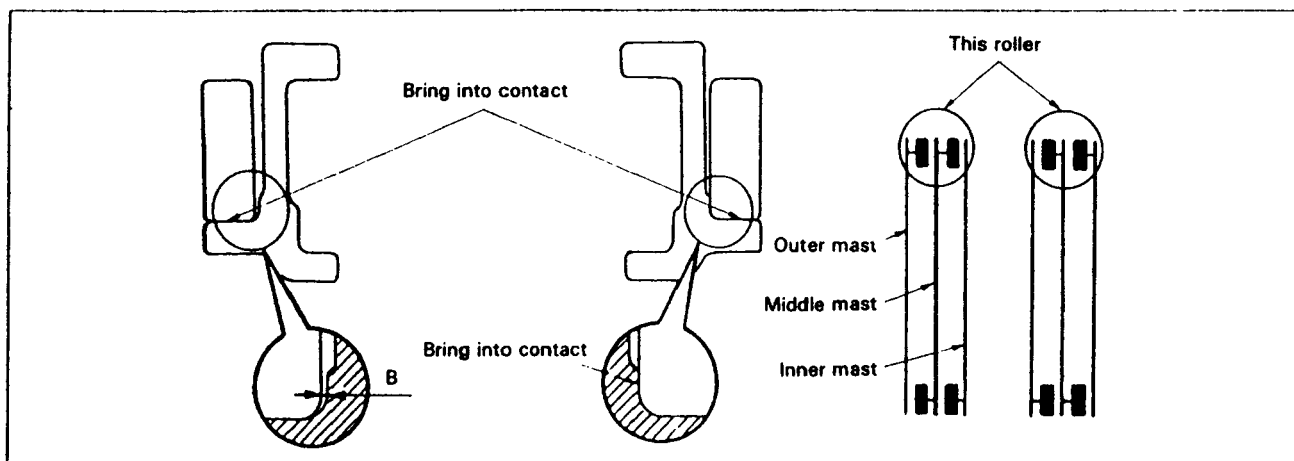
1. Inner mast roller and middle mast lower roller clearance adjustment

- (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
- (2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner mast roller shim and middle mast lower roller shim, respectively.

Standard clearance A = 0 ~ 0.8 mm (0 ~ 0.031 in)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (3) Distribute the shim thickness equally to the left and right rollers.
- (4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.



2. Outer mast roller and middle mast upper roller clearance adjustment

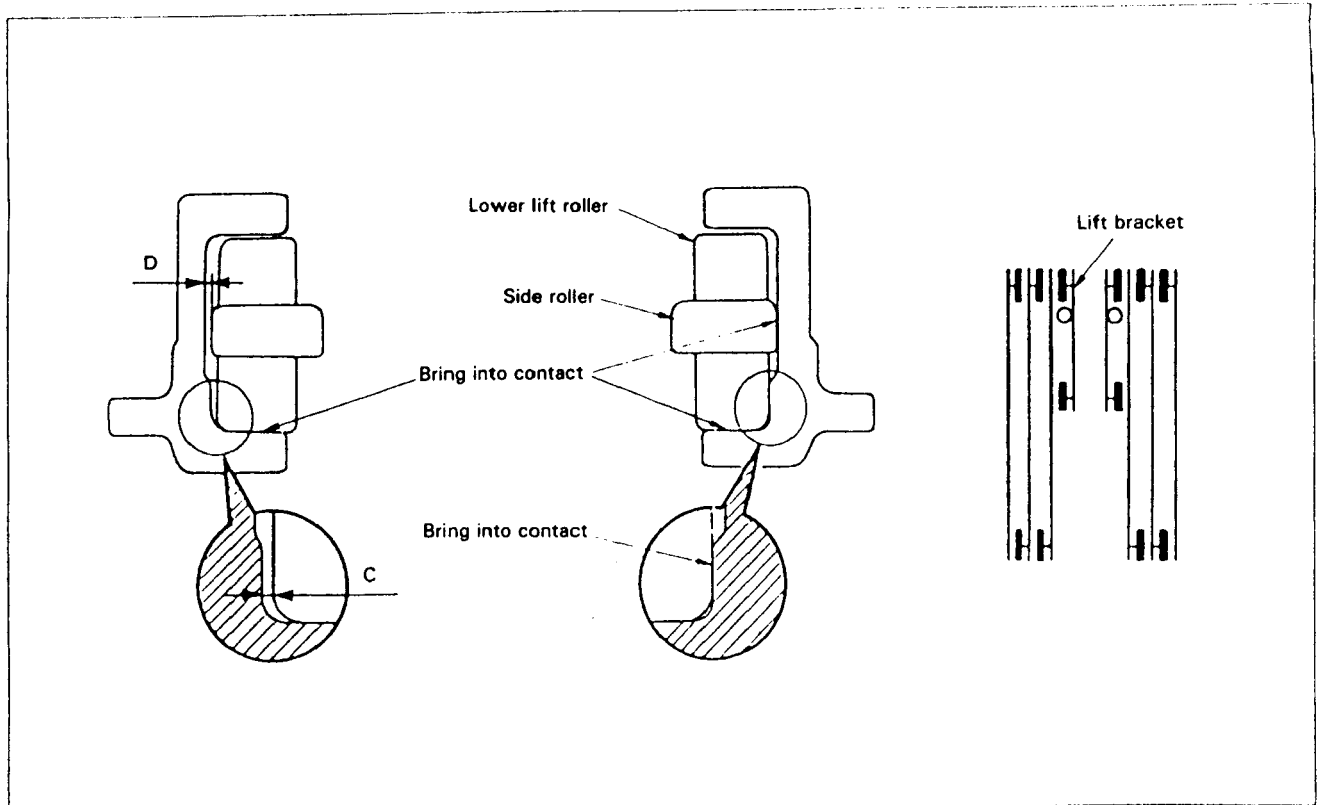
- (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
- (2) Shift the inner mast to one side to bring the roller into contact with the inner mast and middle mast, and adjust the clearance between the roller and mast at the closest position on the opposite side to the following value by inserting the outer mast roller shim and middle mast upper roller shim respectively.

Standard clearance B = 0 ~ 0.8 mm (0 ~ 0.031 in)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (3) Distribute the shim thickness equally to the left and right sides.
- (4) After the adjustment, check that the inner mast moves smoothly in the middle mast and the middle mast moves smoothly in the outer mast.

Lift Bracket Roller Adjustment (FSV & FSN)



1. Lift roller and side roller clearance adjustment

- (1) Measure the clearance with the lift bracket at the uppermost position.
- (2) The upper lift rollers need no adjustment because they are fixed by snap rings.
- (3) For the lower lift rollers, shift the lift bracket to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

Standard clearance $C = 0 \sim 0.5 \text{ mm}$ ($0 \sim 0.020 \text{ in}$)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (4) Distribute the shim thickness equally to the left and right rollers.
- (5) Adjust the side rollers after adjusting the lower lift rollers.
Bring the side roller on one side into contact with the mast side surface, and adjust the clearance between the side roller and inner mast side surface to the following value by inserting the side roller shim:

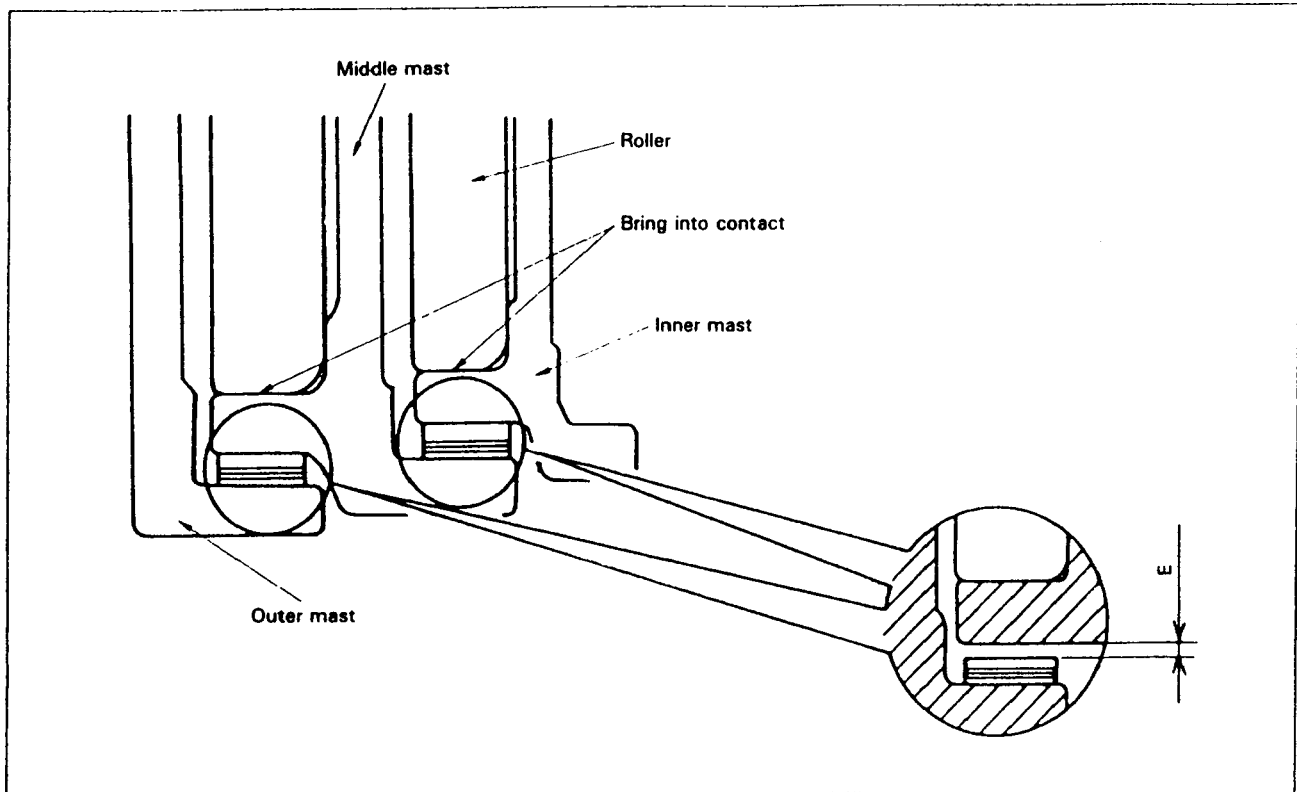
Standard clearance $D = 0 \sim 0.5 \text{ mm}$ ($0 \sim 0.020 \text{ in}$)

Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (6) Distribute the shim thickness equally to the left and right sides.

2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

Mast Strip Adjustment (FSV & FSN)



1. Mast strip clearance adjustment

- (1) Measure the clearance with the inner mast or middle mast at the bottom position.
- (2) With the inner mast in contact with the middle mast upper roller, adjust the clearance between the mast strip and inner mast to the value shown below by inserting the mast strip shim. Then, with the middle mast in contact with the outer mast roller, adjust the clearance between the mast strip and the middle mast to the value shown below by inserting the mast strip shim.

Standard clearance $E = 0.5 \sim 1.0 \text{ mm}$ (0.020 ~ 0.039 in)

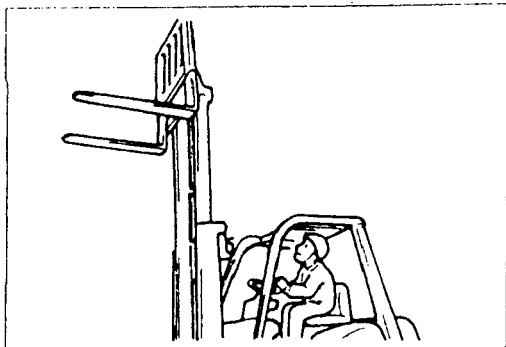
Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

- (3) After the adjustment, the mast should move smoothly.

LIFT CYLINDER ROD SHIM ADJUSTMENT (PREVENTION OF UNEVEN LIFTING)

Note:

- For double lift cylinders, inspection and adjustment are required to prevent uneven lifting on the left and right sides due to tolerances of parts, etc.
- The inspection and adjustments must be made whenever any of the following parts is replaced: Lift cylinder ASSY, lift cylinder rod SUB-ASSY, lift cylinder SUB-ASSY, mast ASSY, outer mast SUB-ASSY, and inner mast SUB-ASSY



1. Inspection method

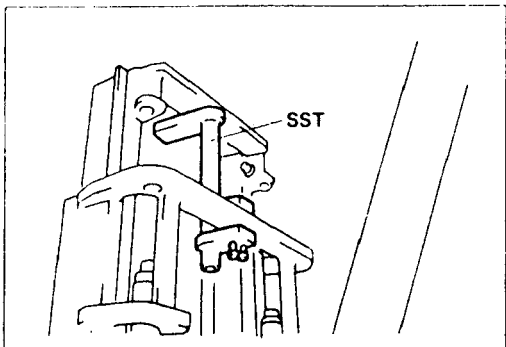
Slowly raise the inner mast, and observe the stopping states of the left and right cylinder rods at the moment when the inner mast reaches the maximum height.

(1) Normal case

Both the left and right rods stop almost simultaneously with almost no shaking of the inner mast.

(2) Abnormal case

The rods stop with slight difference and the top of the inner mast shakes at the time of stopping. To correct this, add shims to the cylinder that stops first.



2. Adjustment method

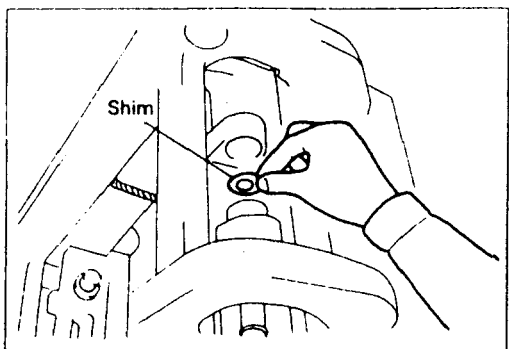
- (1) Raise the inner mast, set the SST to the outer mast tie beam, and lower the inner mast until it reaches the SST.

SST 09610-22000-71

- (2) Remove the set bolt of the cylinder rod end on the side requiring shim adjustment.
- (3) Slowly lower the lift cylinder rod and disconnect the cylinder rod end.
- (4) Place shims on the cylinder rod end. Slowly raise the cylinder rod end into the inner mast.
- (5) Fix the set bolt of the cylinder rod end.
- (6) Raise the inner mast for reinspection.
- (7) Repeat the inspection and adjustment until the number of shims is determined.

Shim thickness:

0.5 and 1.0 mm (0.020 and 0.039 in)



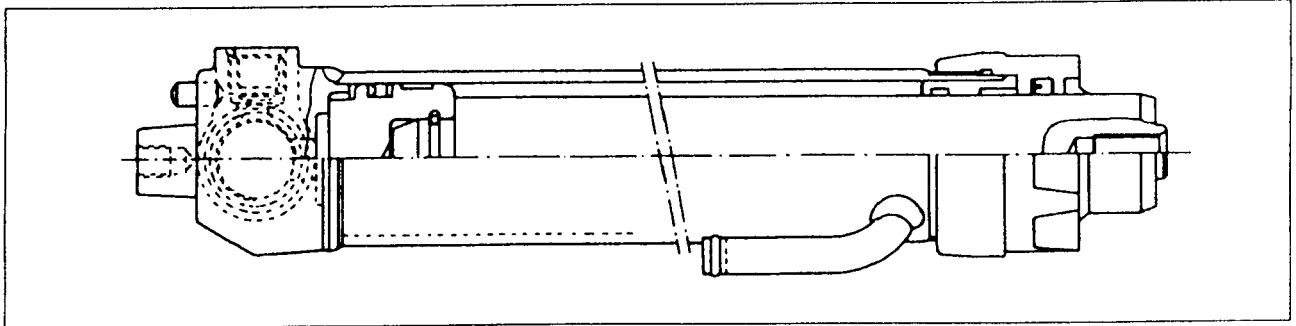
CYLINDERS

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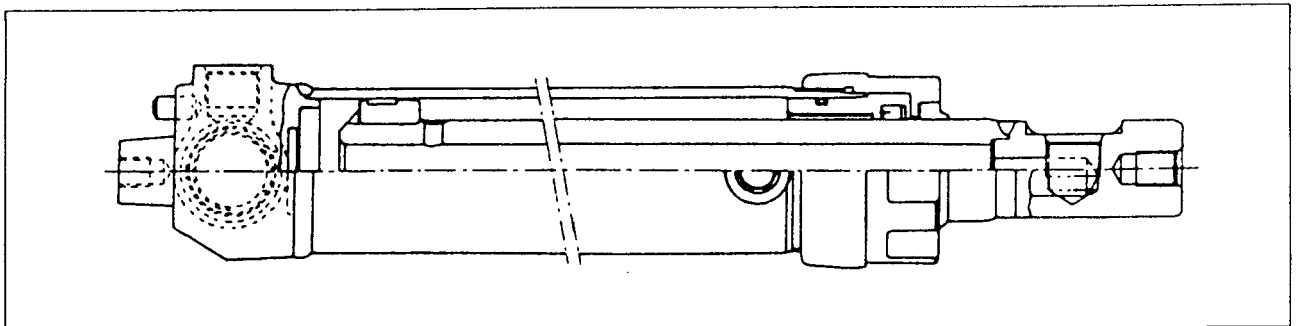
LIFT CYLINDER (V)·REAR LIFT CYLINDER (FV·FSV·FSN)

GENERAL

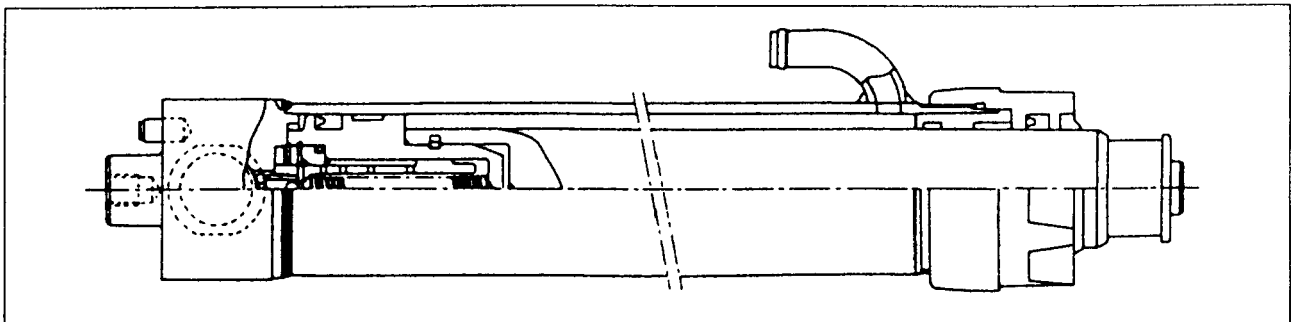
Lift Cylinder (V)



Rear Lift Cylinder (FV)



Rear Lift Cylinder (FSV & FSN)



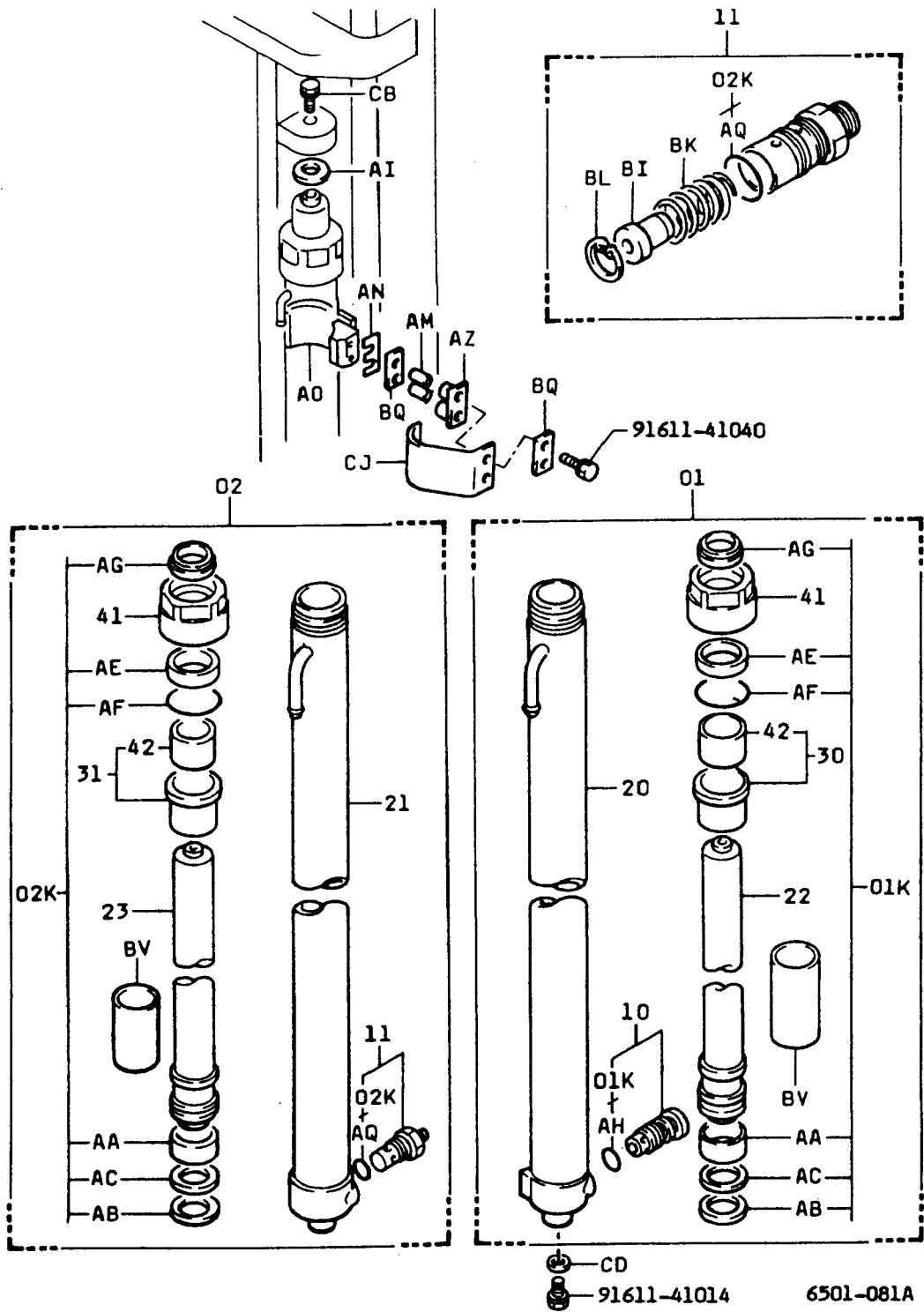
SPECIFICATIONS

Item	Lift Cylinder (V)	Rear Lift Cylinder (FV)	Rear Lift Cylinder (FSV & FSN)
Lift cylinder type	Single acting	←	←
Lift cylinder bore mm (in)	45 (1.77)	←	←
Lift cylinder rod outside diameter mm (in)	35 (1.38)	32 (1.26)	35 (1.38)
Piston seal type	U packing		U packing
Rod seal type	U packing	←	←
Others	With flow regulator valve (RH) With safety down valve (LH)	←	With safety down valve (RH)

COMPONENTS

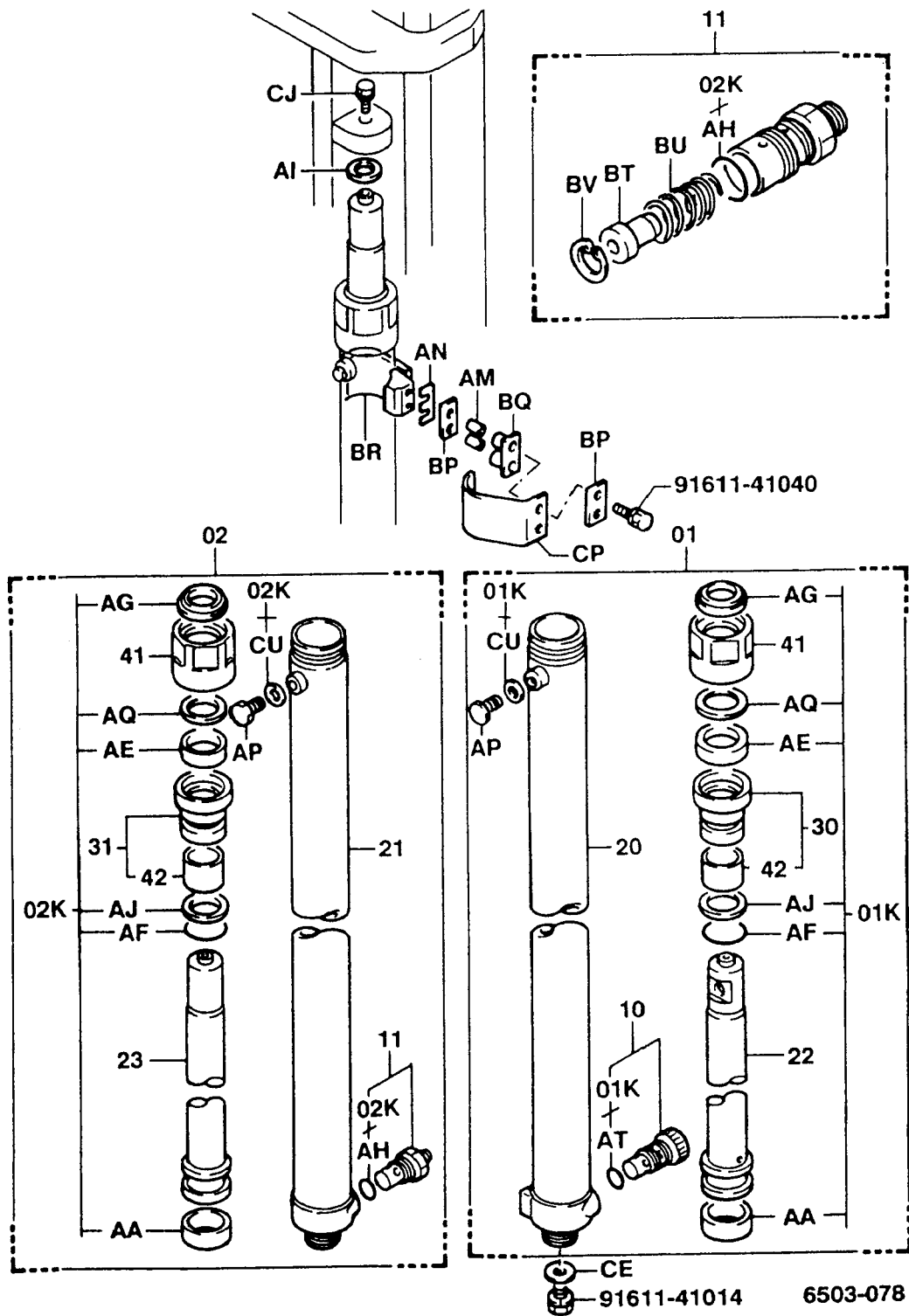
Lift Cylinder (V)

6501



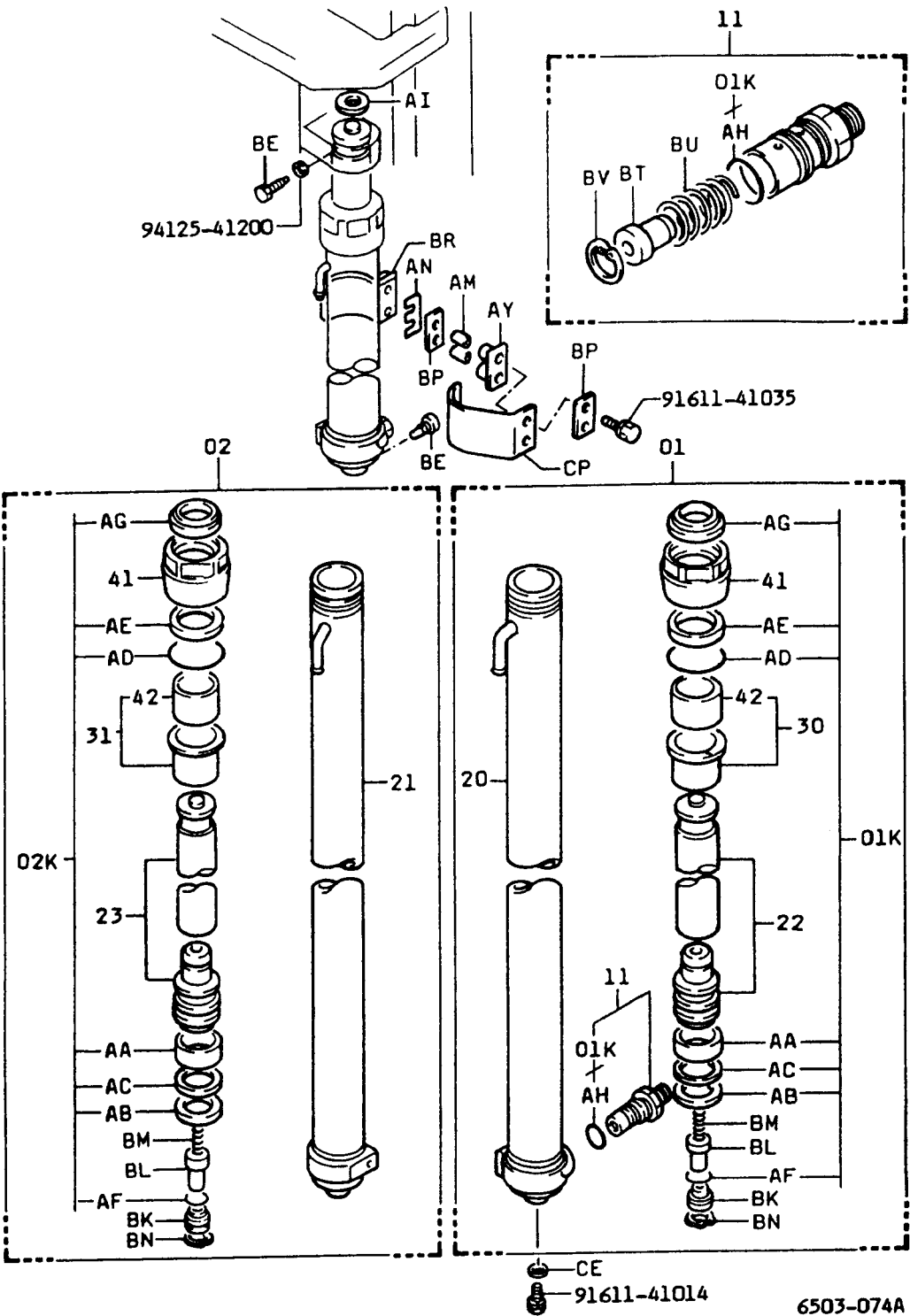
Rear Lift Cylinder (FV)

6503

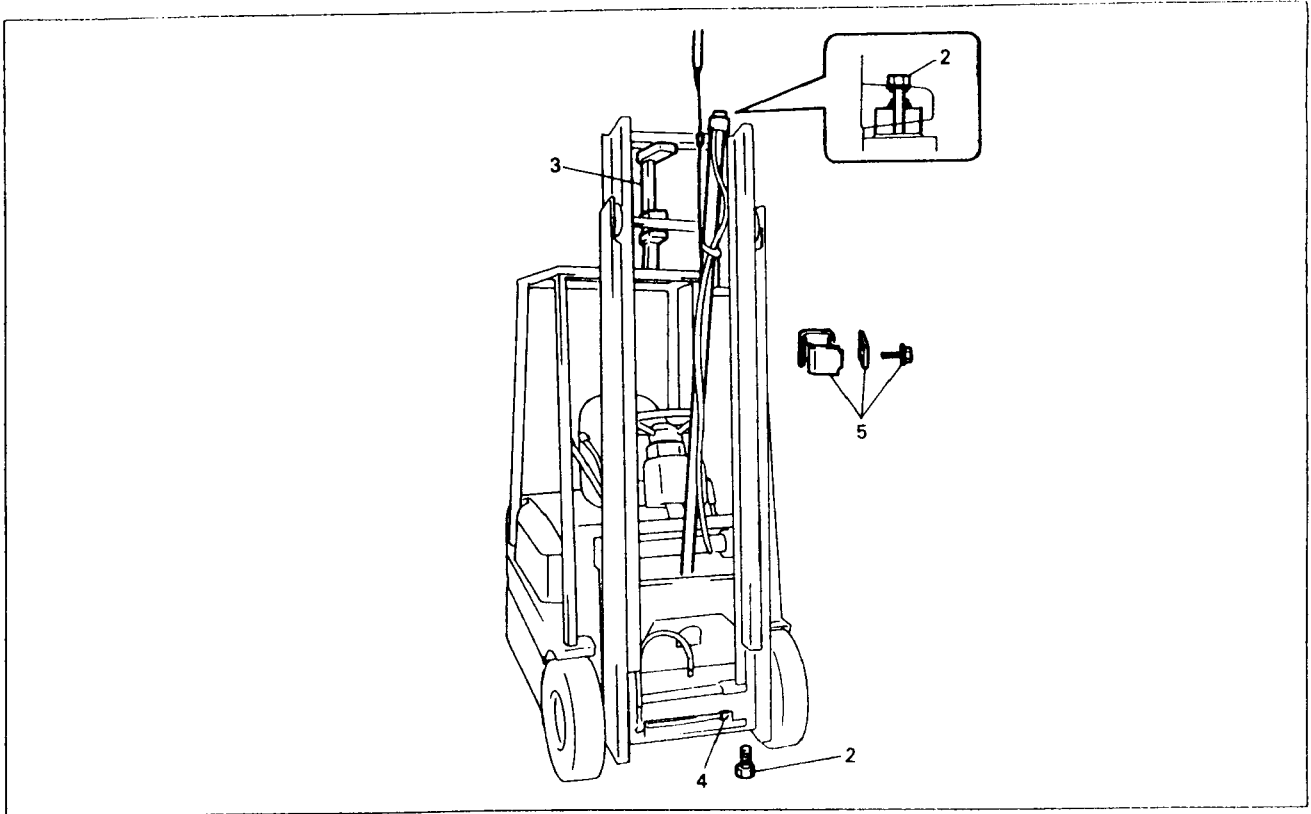


Rear Lift Cylinder (FSV & FSN)

6503



REMOVAL-INSTALLATION



Removal Procedure

- 1 Remove the lift bracket. (See removal procedure steps 1 to 4 in mast removal-installation section on page 10-5.)
- 2 Remove the cylinder rod end set bolt and cylinder bottom set bolt.
- 3 Disconnect the cylinder rod end. [Point 1]
- 4 Remove the hose cover.
- 5 Disconnect the hose.
- 6 Remove the lift cylinder support. [Point 2]
- 7 Remove the lift cylinder ASSY.

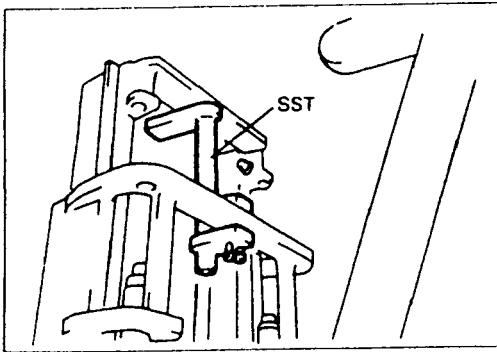
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:

Perform the following operations after installing the lift cylinder:

- Repeat lifting and lowering to stroke ends without load to bleed the air and to check normal operation.
- After the operation check, check the hydraulic oil level and add oil if insufficient.
- Inspect the lift cylinders for uneven movements and make adjustment if necessary. (See the lift cylinder rod shim adjustment section on page 10-8.)

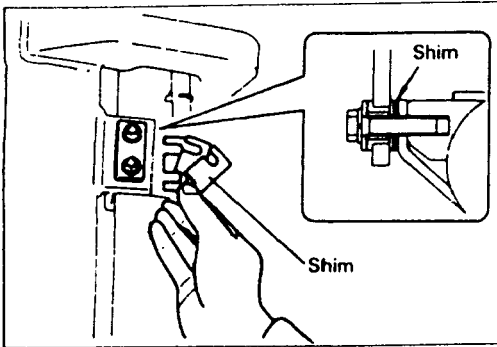


Point Operations

[Point 1]

Removal: Hoist the inner mast (middle mast) and set the SST to the inner mast (middle mast) tie beam. SST 09610-22000-71

Removal: Shim adjustment is made at the lift cylinder rod end to prevent uneven movements of the lift cylinders RH and LH. Take a note on which side the adjustment is made and the number of shims used.



[Point 2]

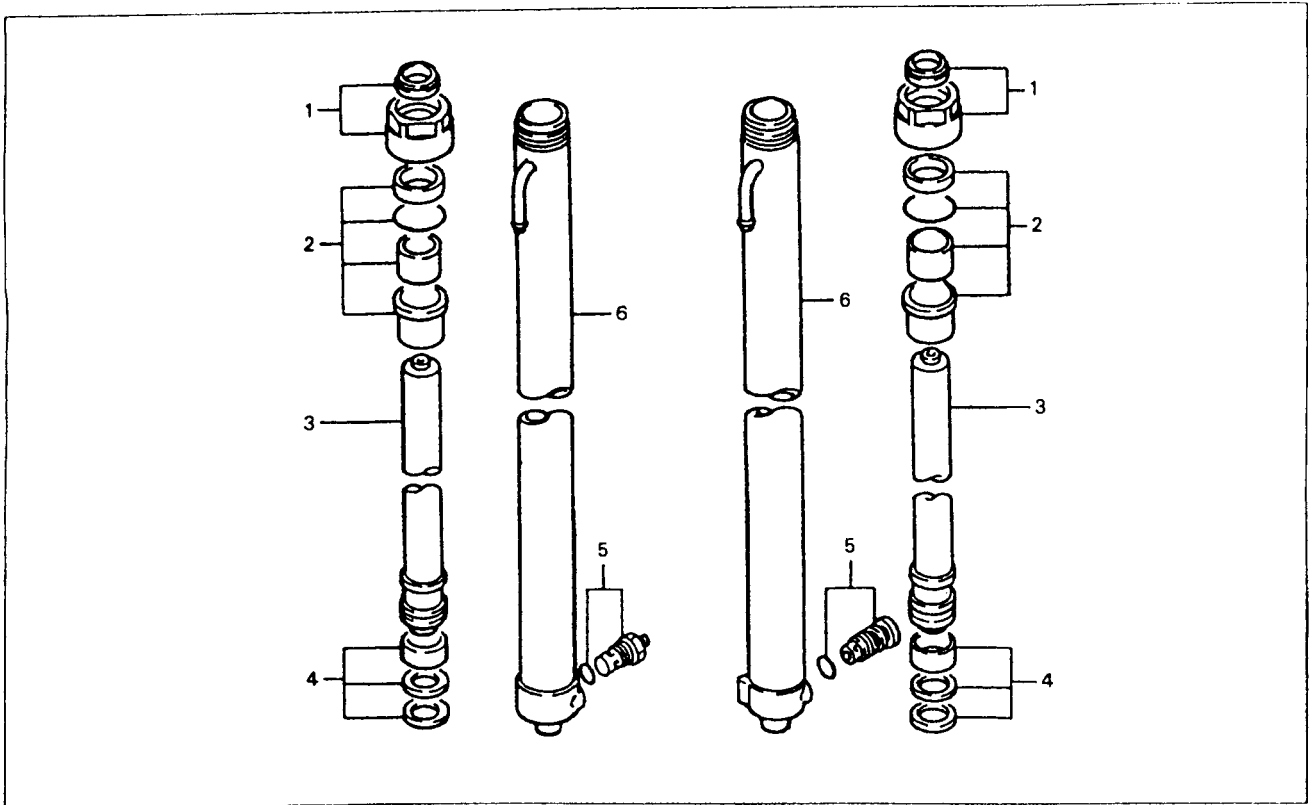
Installation: The cylinder support shall be tightened temporarily here and make shim adjustment after rod end connection.

Adjustment: With the rod end connected, insert shims between the cylinder support and outer mast to eliminate the clearance. The shim thickness shall be slightly on the thicker side.

DISASSEMBLY · INSPECTION · REASSEMBLY

Note:

- Oil will leak if the U packing or dust seal at the rod guide portion is defective.
- Natural drop will occur if the U packing at the piston portion is defective.



Disassembly Procedure

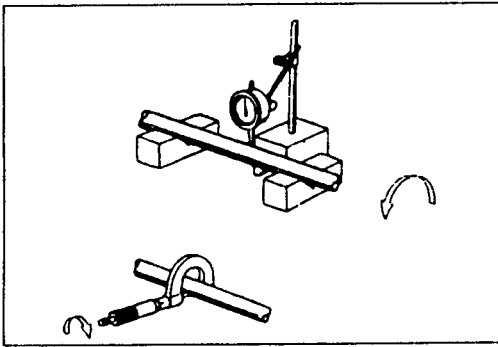
- 1 Remove the cylinder cover.
- 2 Remove the rod guide.
- 3 Remove the piston rod. [Point 1]
- 4 Remove the seals from the piston side.
- 5 Remove the flow regulator valve or safety down valve.
- 6 Remove the lift cylinder. [Point 2]

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

- Do not install dry parts but apply hydraulic oil before reassembly.
- Apply liquid packing (08833-00080) on the threaded portion of the cylinder cover before tightening.
- Cylinder cover tightening torque $T = 343.23 \sim 441.30 \text{ N} \cdot \text{m}$ (3500~4500 kgf-cm)[253.23~325.58 ft-lbf]



Point Operations

[Point 1]

Inspection: Measure the piston rod outside diameter.

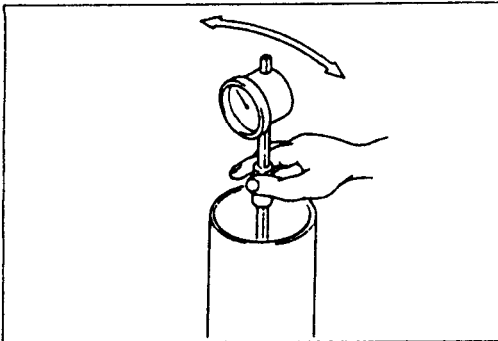
Standard:

V·FSV·FSN: 35 mm (1.38 in)

FV: 34.92 mm (1.3748 in)

Inspection: Measure the piston rod bend.

Limit bend: 2.0 mm (0.079 in)



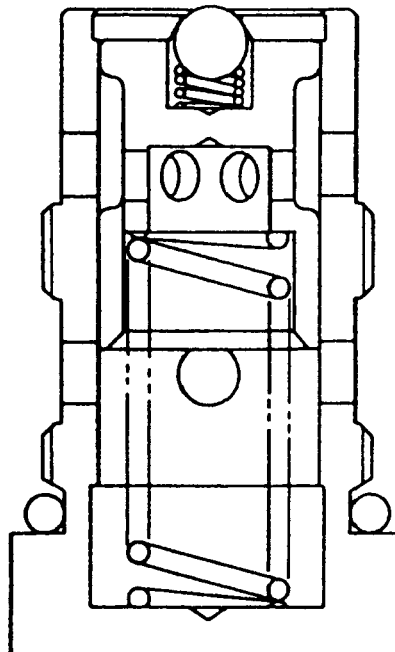
[Point 2]

Inspection: Measure the lift cylinder bore.

Standard: 45 mm (1.77 in)

Limit: 45.20 mm (1.7795 in)

FLOW REGULATOR VALVE (V·FV·FSV·FSN)



Lowering Speed Specifications

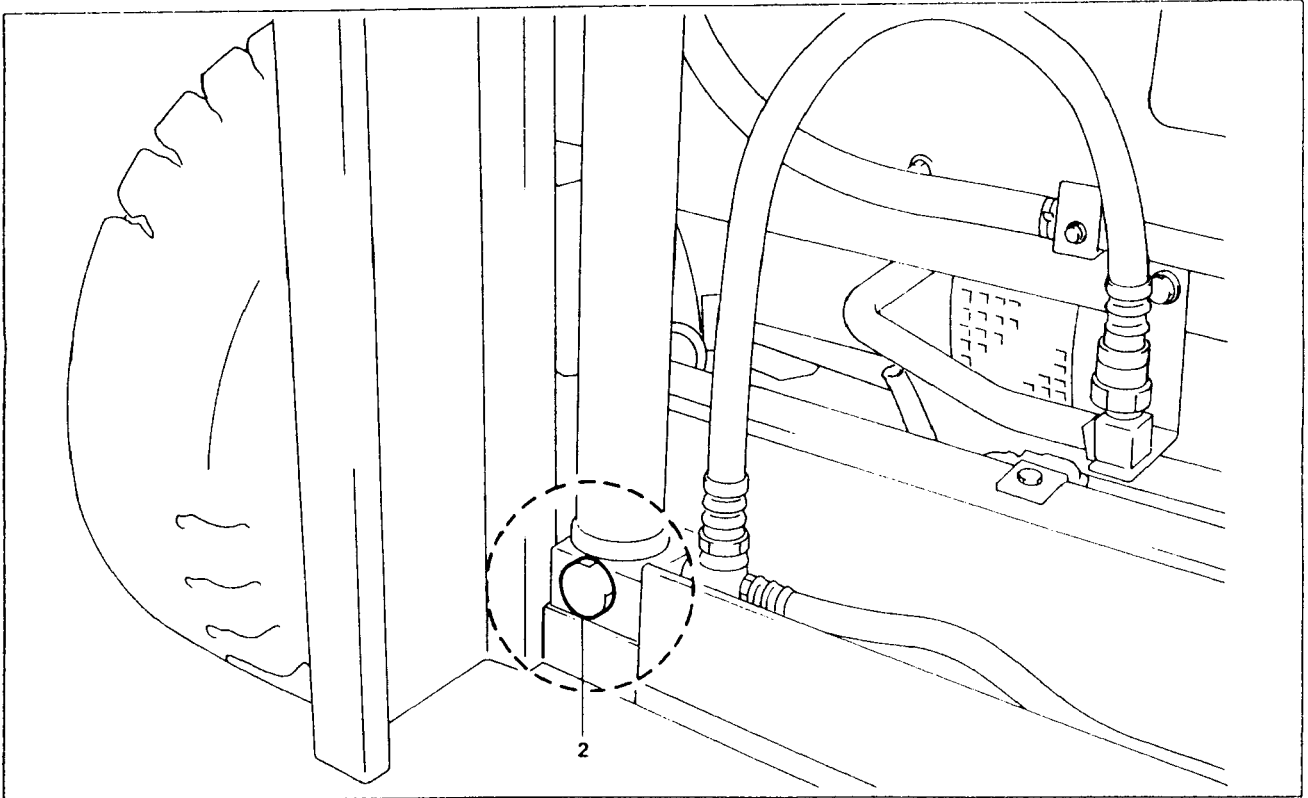
Unit: mm/sec (fpm)

Vehicle model \ Mast	V	FV	FSV·FSN
No load	550 (108)	420 (83)	450 (89)
Loaded	500 (98)	480 (94)	480 (94)

REMOVAL-INSTALLATION

Note:

- The description here is for the flow regulator valve for the V-FV mast.
- The flow regulator valve is installed on the outer mast side in case of the FSV mast.



Removal Procedure

- 1 Hoist the inner mast. [Point 1]
- 2 Remove the flow regulator valve.

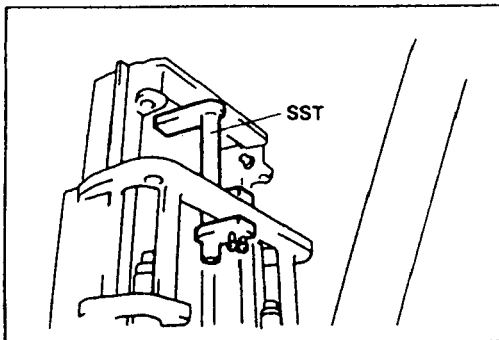
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:

Flow regulator valve tightening torque

$$T = 58.84 \sim 68.65 \text{ N}\cdot\text{m} (600 \sim 700 \text{ kgf}\cdot\text{cm}) [43.41 \sim 50.65 \text{ ft}\cdot\text{lbf}]$$



Point Operation

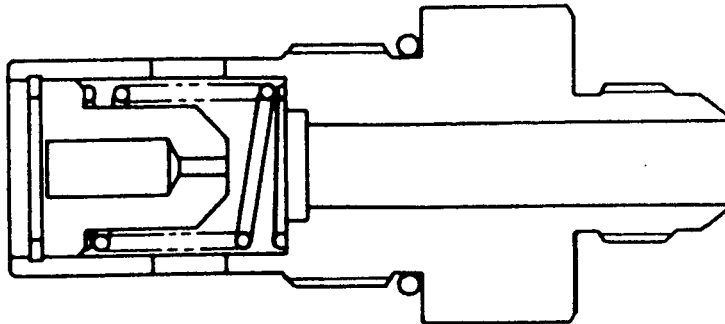
[Point 1]

Removal-installation: Sling the inner mast (middle mast) with a wire rope and hoist it. Set the SST on the inner mast (middle mast) tie beam and lower the inner mast until it comes into contact with the SST.

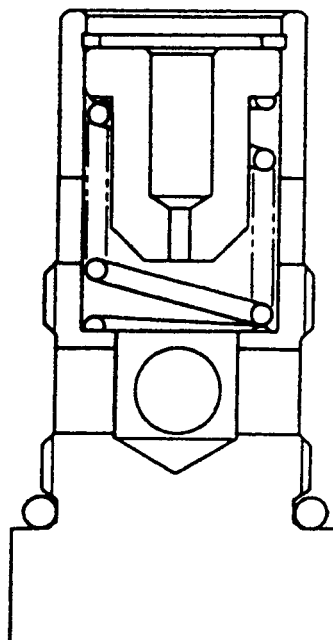
SST 09610-22000-71

SAFETY DOWN VALVE (V·FV·FSV·FSN)

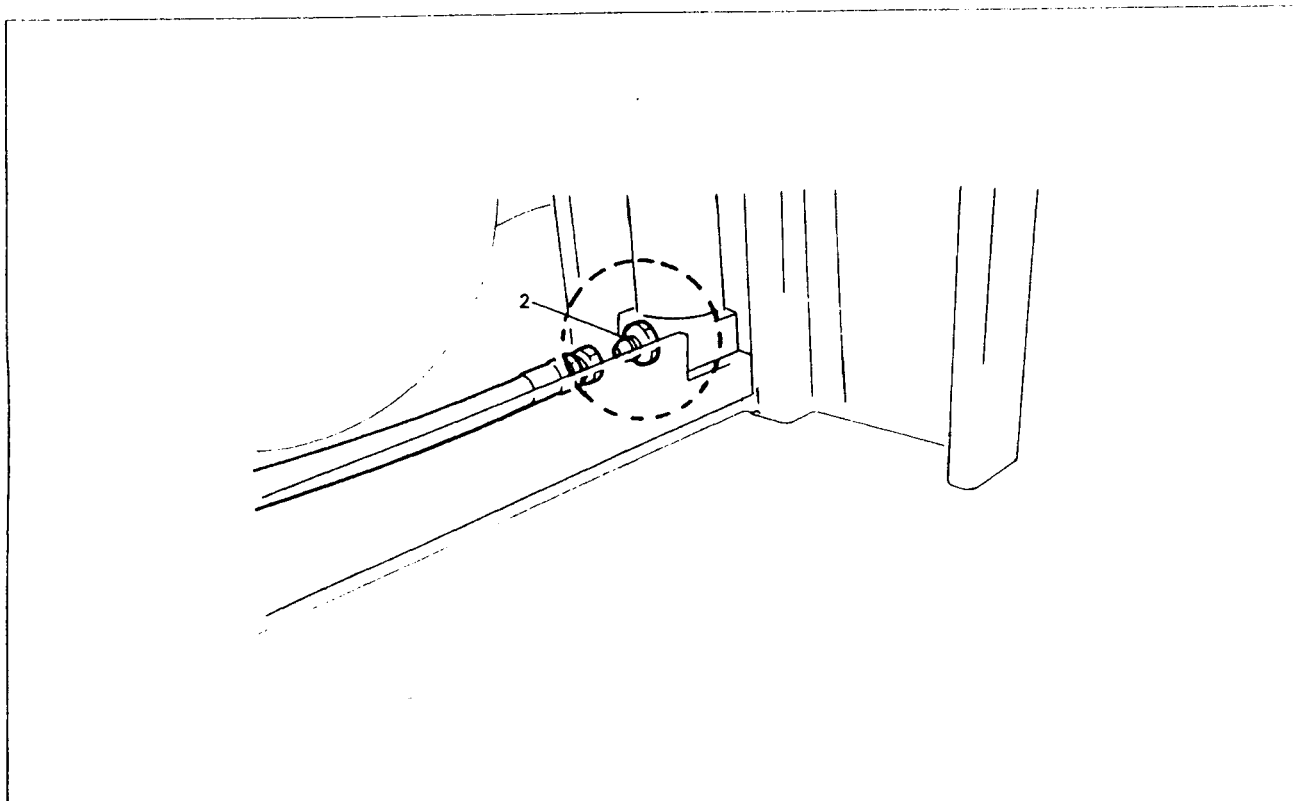
Safety Down Valve Sectional View (for V) (for FV·FSV·FSN Rear Lift Cylinder)



Safety Down Valve Sectional View (for FV·FSV·FSN Front Lift Cylinder)



REMOVAL-INSTALLATION



Removal Procedure

- 1 Hoist the inner mast. [Point 1]
- 2 Remove the safety down valve.

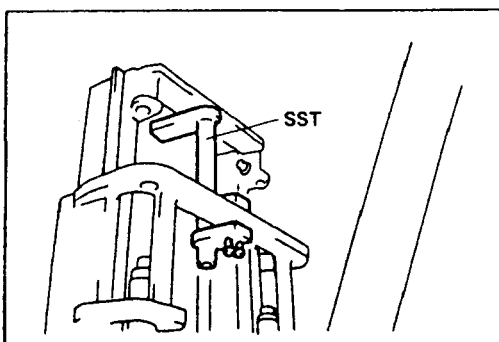
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:

Safety down valve tightening torque

$$T = 29.42 \sim 39.23 \text{ N}\cdot\text{m} (300 \sim 400 \text{ kgf}\cdot\text{cm}) [21.71 \sim 28.94 \text{ ft}\cdot\text{lbf}]$$



Point Operation

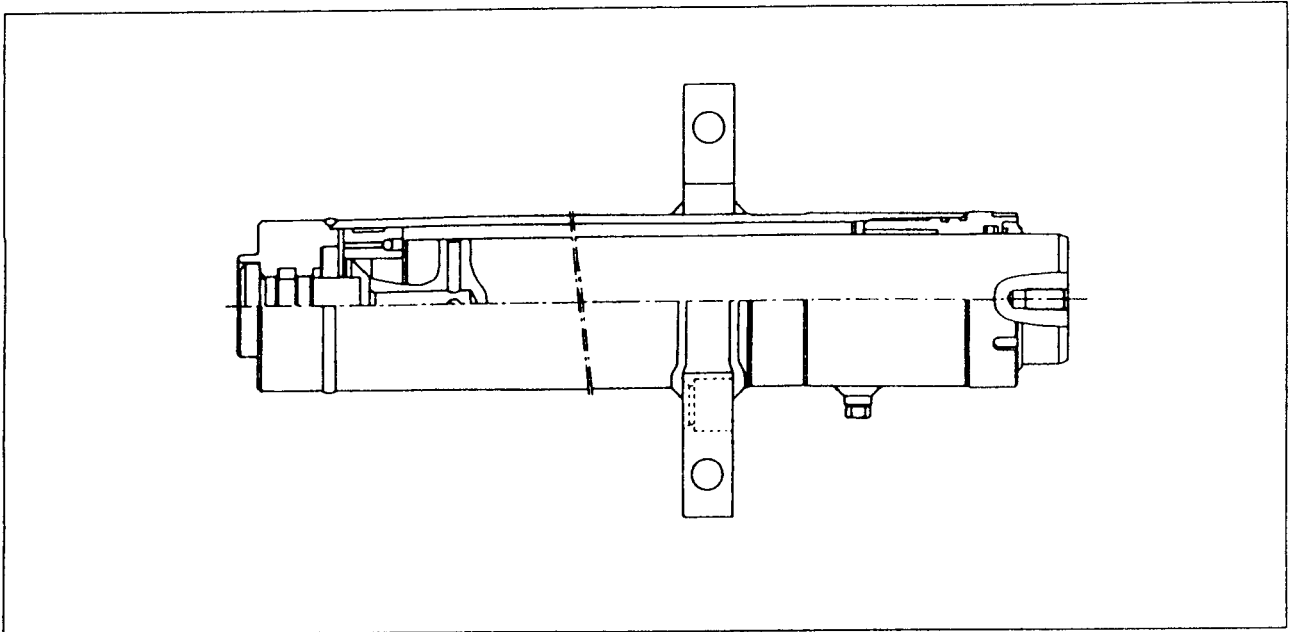
(Point 1)

Removal-installation: Sling the inner mast (middle mast) with a wire rope, and hoist it. Set the SST on the inner mast (middle mast) tie beam and lower the inner mast until it comes into contact with the SST.
SST 09610-22000-71

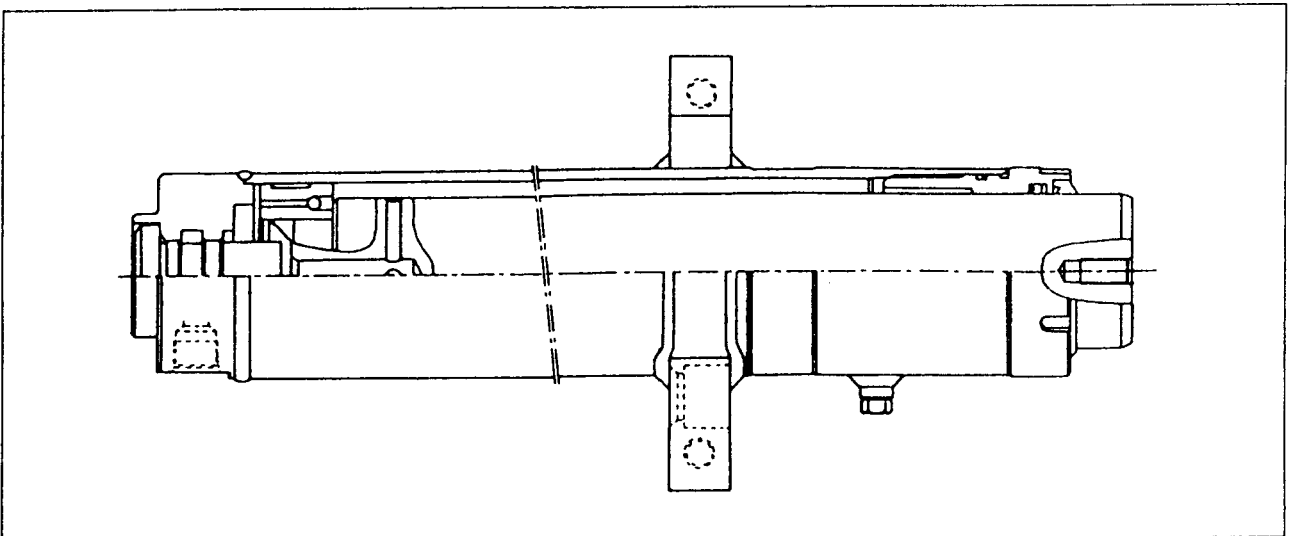
FRONT LIFT CYLINDER (FV·FSV·FSN)

GENERAL

Front Lift Cylinder (FV)



Front Lift Cylinder (FSV & FSN)

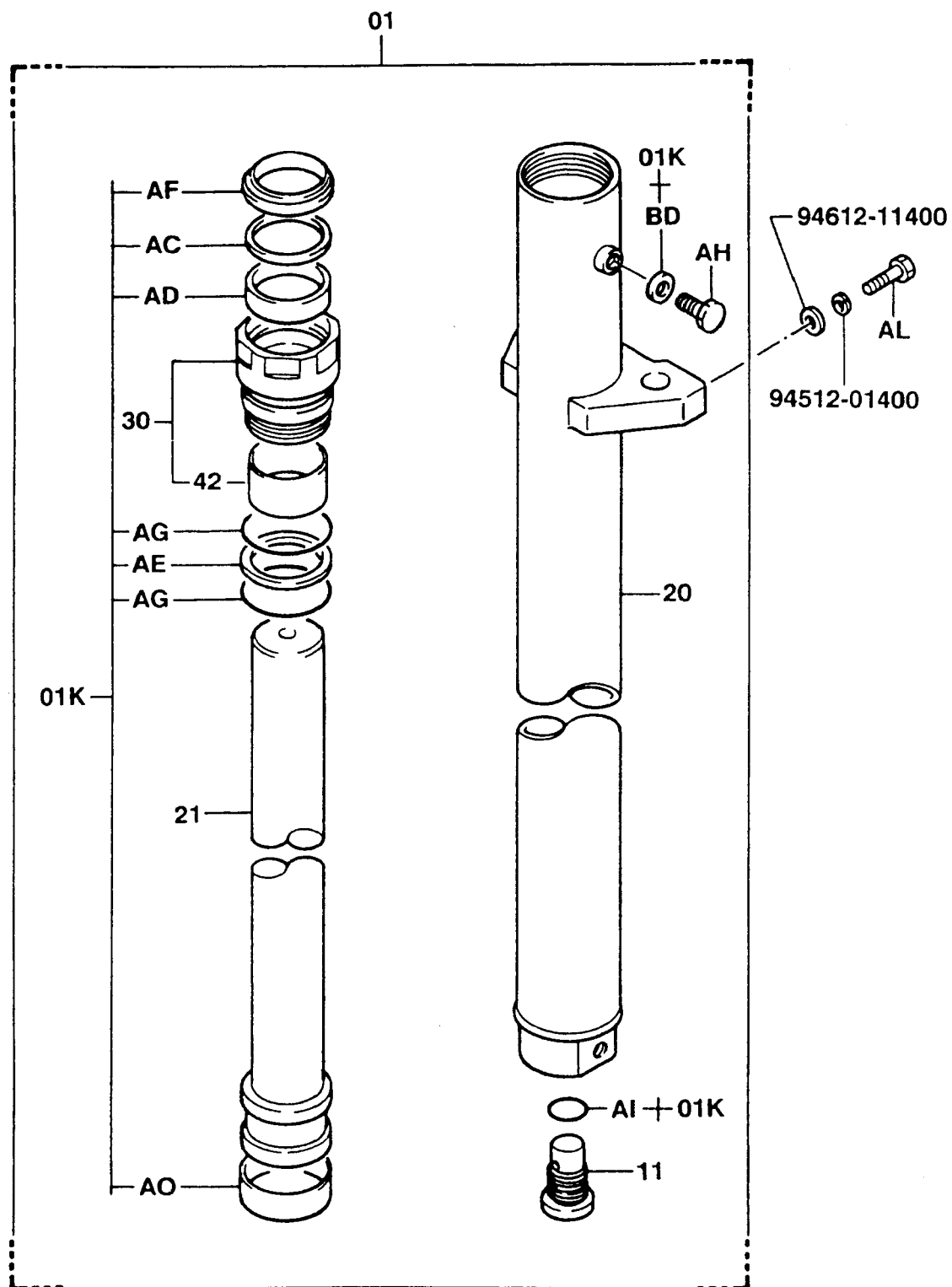


SPECIFICATIONS

Item	
Cylinder type	: Single acting
Lift cylinder bore mm(in)	: 85 (3.35)
Cylinder rod outside diameter mm(in)	: 70 (2.76)
Piston seal type	: Wear ring
Rod seal type	: U packing
Others	: With safety down valve

COMPONENTS

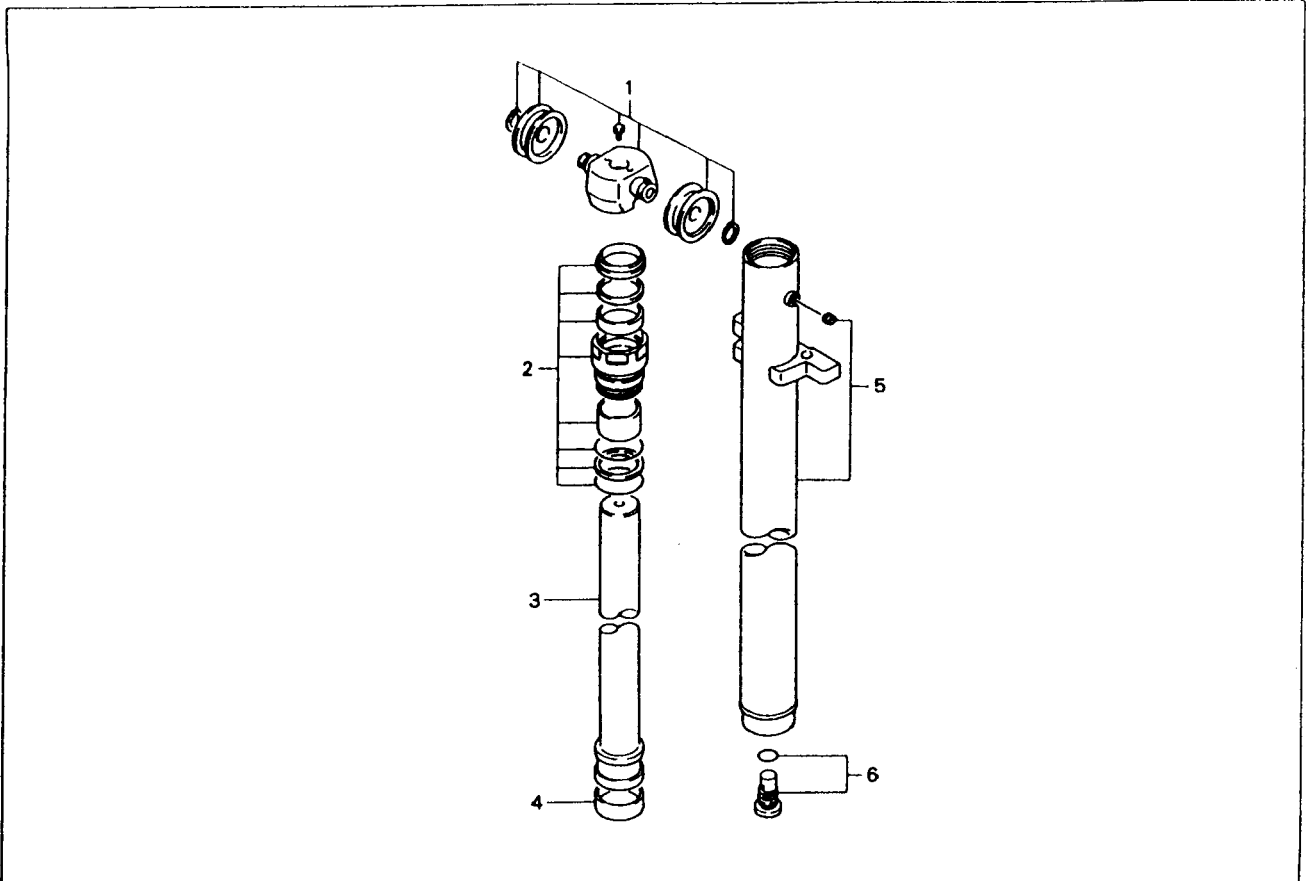
6502



6502-070

REMOVAL·INSTALLATION**Note:**

- See the lift cylinder ASSY (V) removal section for the removal of the front lift cylinder ASSY. Perform the following operations after installation:
- Repeat lifting and lowering to stroke ends without load for air bleeding and check normal operation.
- After the operation check, check the hydraulic oil level and add if insufficient.
- Adjust the lift chain tension equally on the left and right sides.

DISASSEMBLY·INSPECTION·REASSEMBLY**Disassembly Procedure**

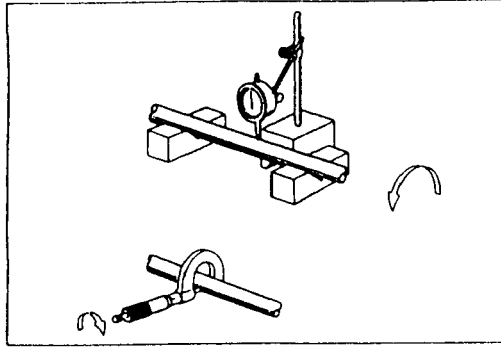
- 1 Remove the chain wheel supporter.
- 2 Remove the cylinder rod guide.
- 3 Remove the piston rod. [Point 1]
- 4 Remove the wear ring.
- 5 Remove the lift cylinder. [Point 2]
- 6 Remove the safety down valve.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

- Do not reassemble dry parts, but apply hydraulic oil before reassembly.
- Apply liquid packing (08833-00080) on the threaded portion of the rod guide.
- Rod guide tightening torque
 $T = 343.23 \sim 441.30 \text{ N}\cdot\text{m}$ (3500~4500 kgf-cm) [253.23~325.58 ft-lbf]



Point Operations

[Point 1]

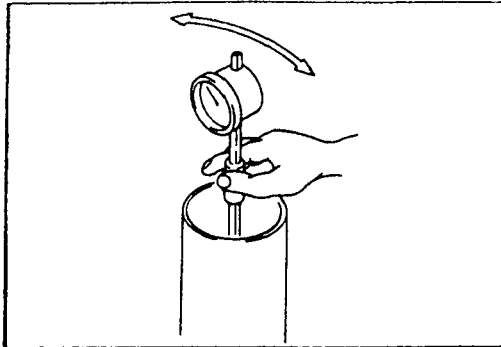
Inspection: Measure the piston rod outside diameter.

Standard: 70 mm (2.76 in)

Limit: 69.91 mm (2.7524 in)

Inspection: Measure the piston rod bend.

Limit bend: 2.0 mm (0.079 in)



[Point 2]

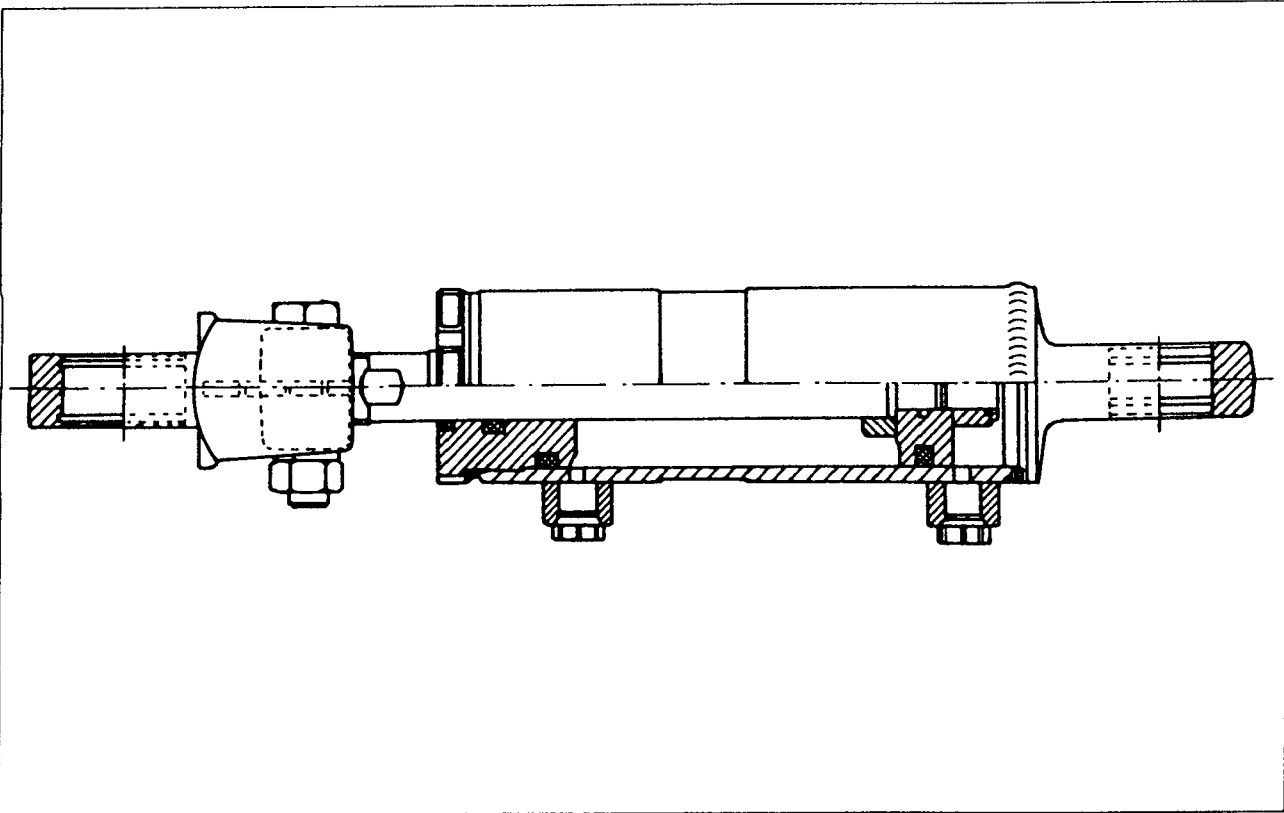
Inspection: Measure the lift cylinder bore.

Standard: 85 mm (3.35 in)

Limit: 85.40 mm (3.3622 in)

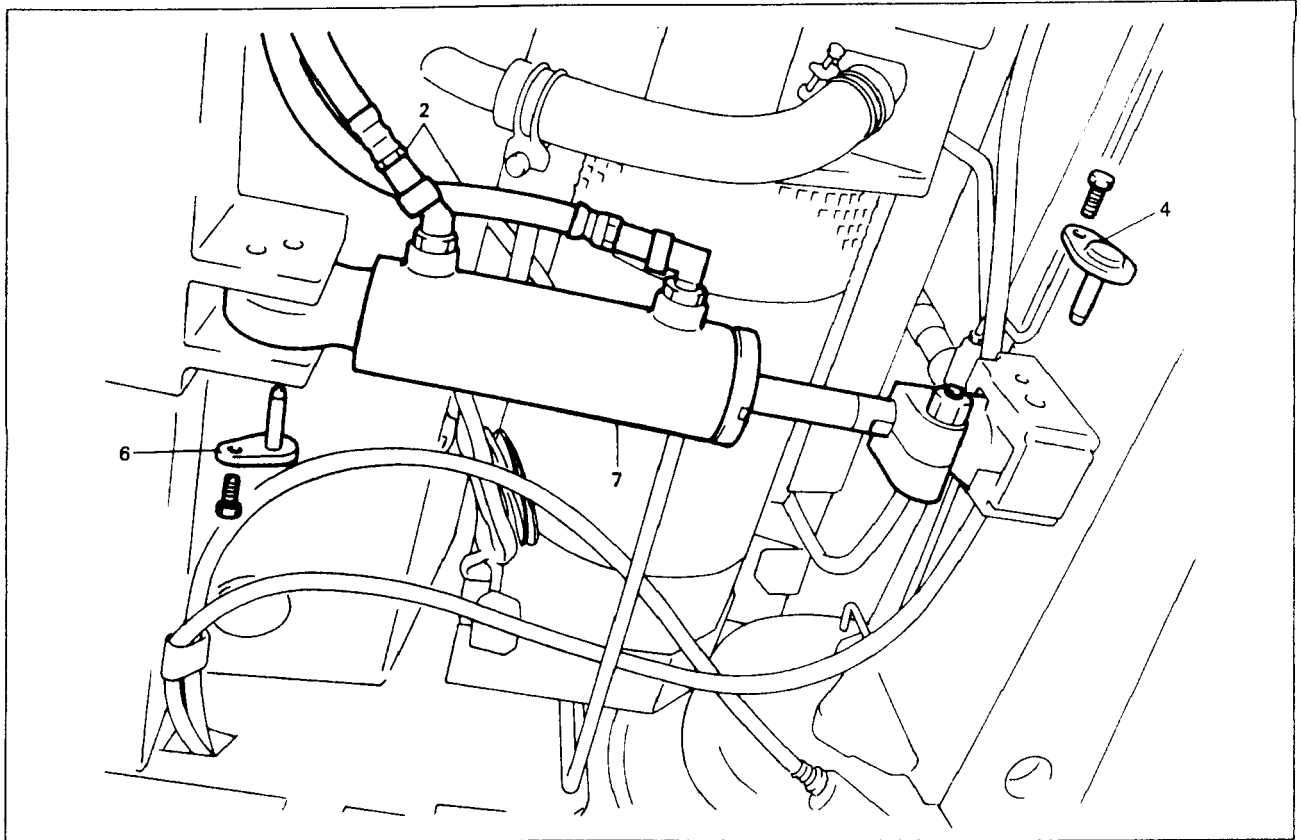
TILT CYLINDER (V·FV·FSV·FSN)

GENERAL



SPECIFICATIONS

Vehicle model		EC 10T-15T
Item		
Cylinder type		Double action
Number of cylinders		1 pcs.
Cylinder bore	mm (in)	55 (2.165)
Piston rod outside diameter	mm (in)	64 (2.520)

REMOVAL-INSTALLATION**Disassembly Procedure**

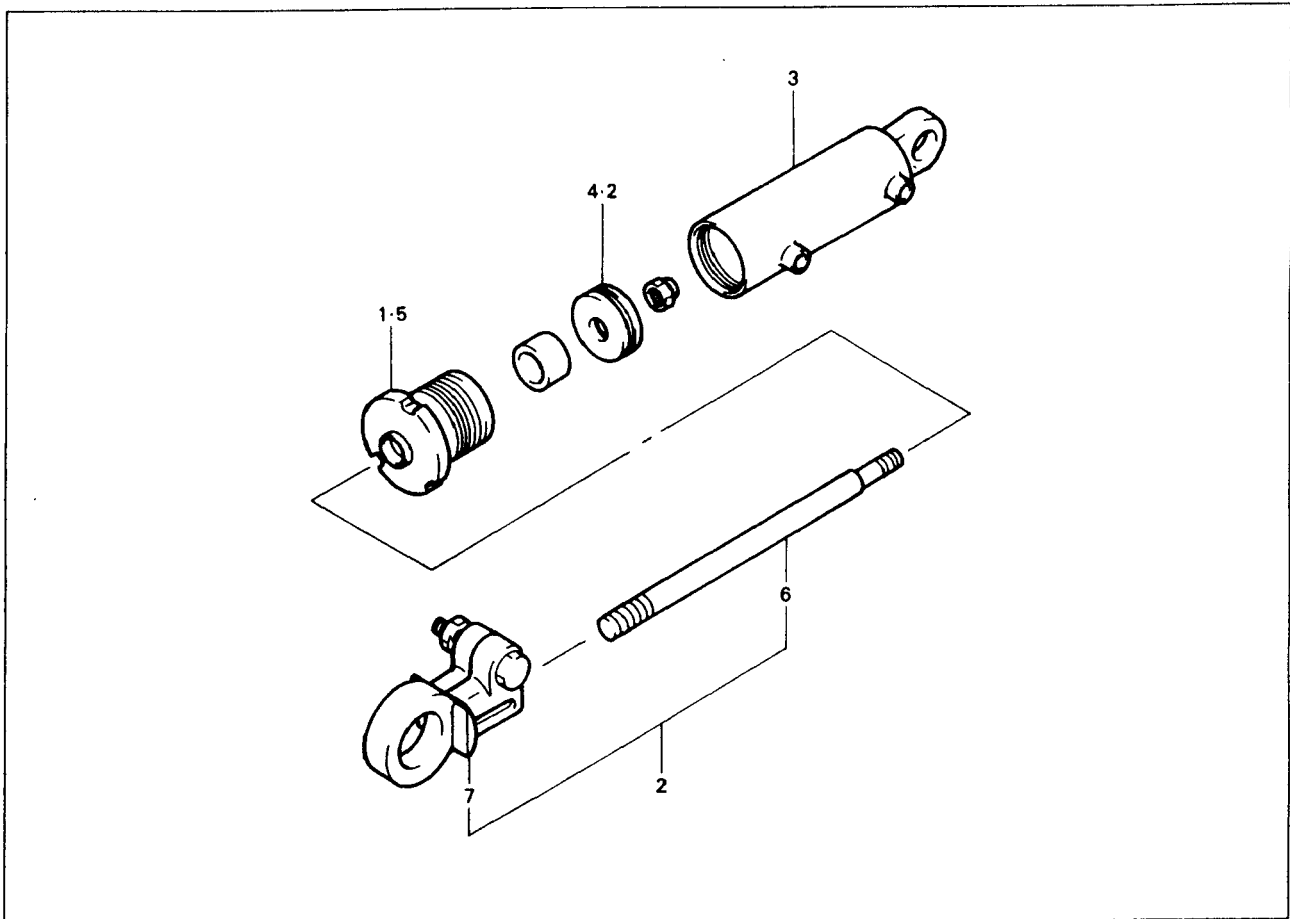
- 1 Tilt the mast forward and chock the rear wheels.
- 2 Disconnect the piping.
- 3 Gently hoist the mast by wire rope.
- 4 Remove the front pin.
- 5 Gradually tilt the mast backward by crane to disconnect the front.
- 6 Remove the rear pin.
- 7 Remove the tilt cylinder ASSY.

Installation Procedure

Installation is reverse of the removal procedure.

Note:

- Check the length when the rod joint is removed.
- Raise the fork about 200 mm and check and adjust the forward and backward tilt angles.
- Mark matching marks on the joint and rod with red paint.
- Slowly tilt the mast forward and backward to check that it operates correctly.
- Check the hydraulic oil level. Replenish, if necessary.
- Apply MP grease to the parts of front and rear pins which are to be inserted.
- Check the mast for wavy movement when it is tilted to the fully forward and backward positions. Tighten or loosen the rod joint screw to adjust any wavy movement.
- Apply molybdenum disulfide to the front and rear pin shafts when reassembling.

DISASSEMBLY·INSPECTION·REASSEMBLY**Disassembly Procedure**

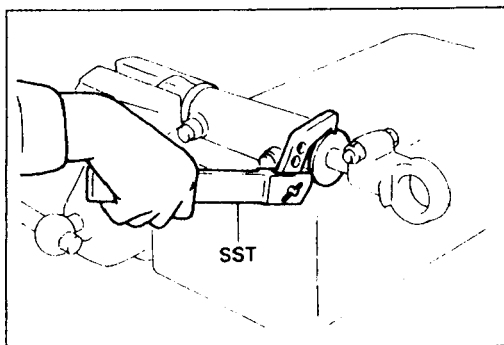
- 1 Loosen the rod guide. [Point 1]
- 2 Pull out the piston rod w/rod guide. [Point 2]
- 3 Remove the tilt cylinder. [Point 3]
- 4 Remove the piston from the piston rod.
- 5 Pull the rod guide off the piston rod.
- 6 Remove the piston rod. [Point 4]
- 7 Remove the piston rod joint. [Point 5]

Reassembly Procedure

Reassembly is reverse of the disassembly procedure.

Note:

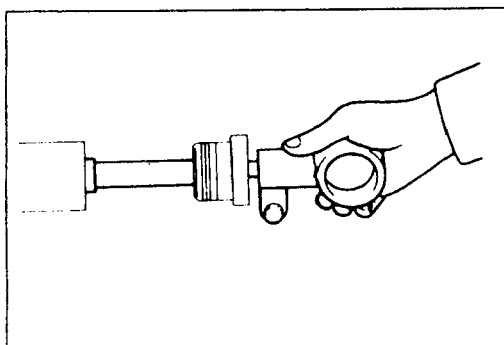
- Avoid reassembling dry components by applying hydraulic oil beforehand.
- Apply 08833-00070 or equivalent to threaded parts of the rod guide before reassembly.
- Apply MP grease or Castle Hydraulic Oil ISO VG 32 to all packings and O-rings before reassembly.



Point Operations

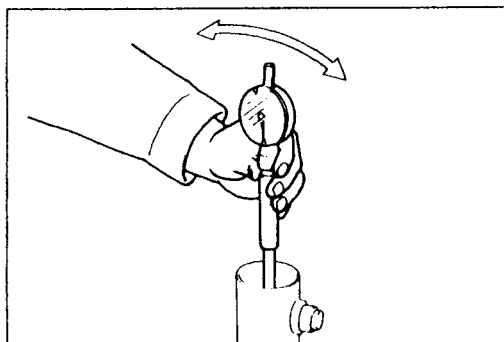
[Point 1]

Disassembly/Reassembly: SST 09620-10100-71



[Point 2]

Disassembly: Pull out the rod parallel with the cylinder, being careful not to damage it.

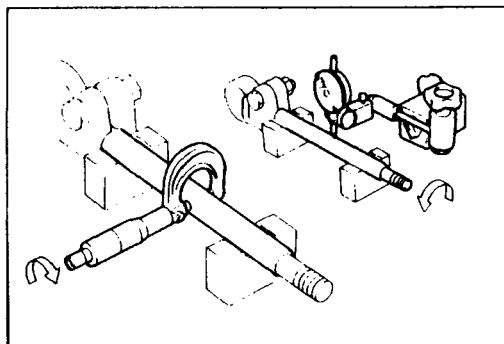


[Point 3]

Inspection: Measure the inside diameter of the cylinder.

Standard: 55.0 mm (2.17 in)

Limit: 55.35 mm (2.18 in)



[Point 4]

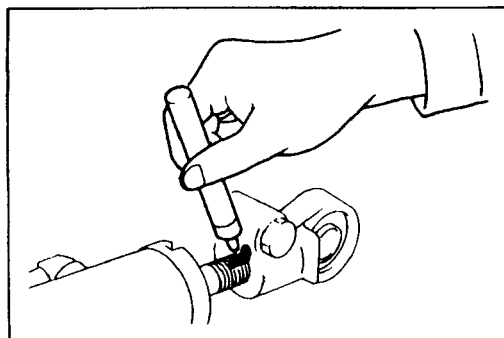
Inspection: Measure the outside diameter of the piston rod.

Standard: 22 mm (0.867 in)

Limit: 21.92 mm (0.863 in)

Inspection: Measure piston rod bend.

Limit: 1.0 mm (0.039 in)



[Point 5]

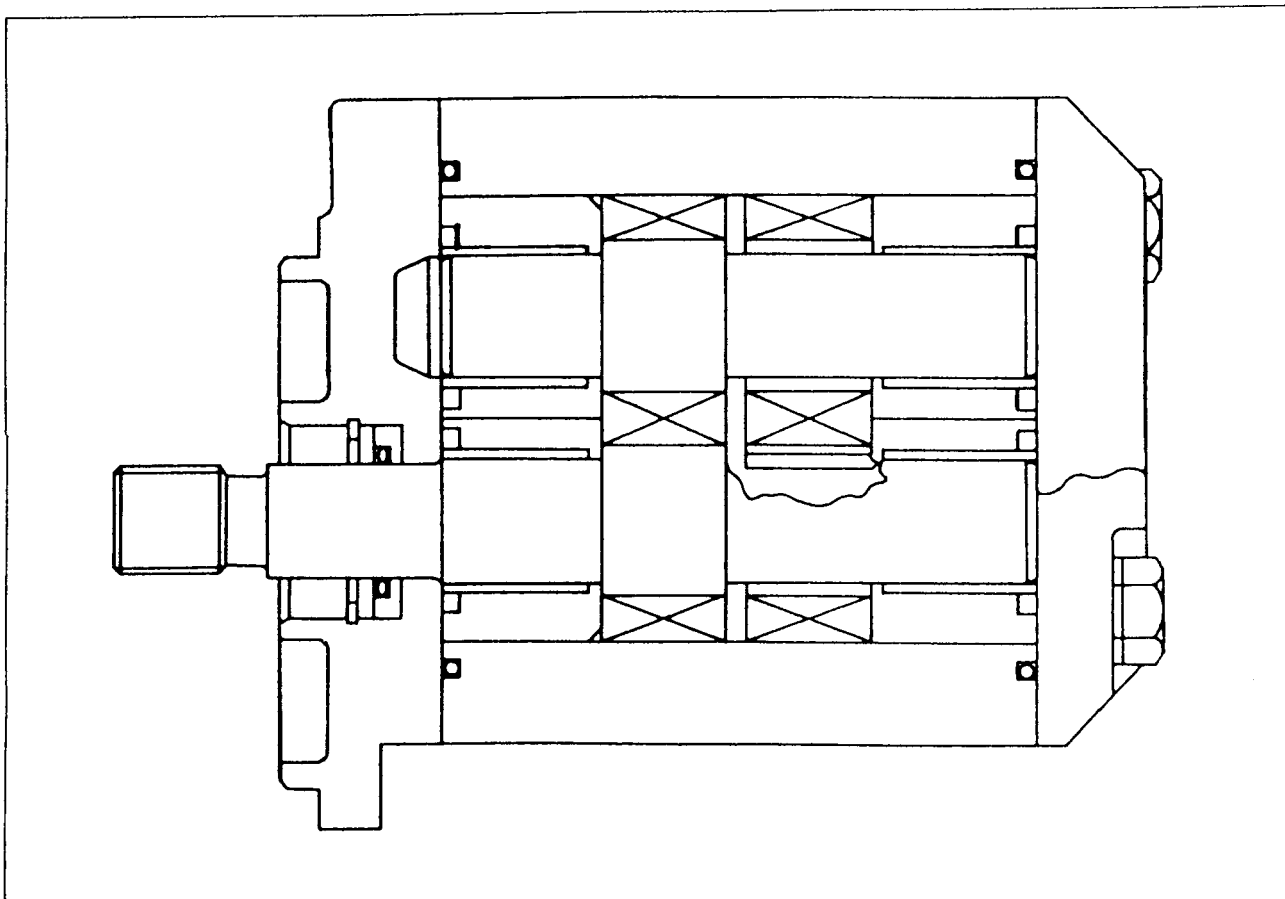
Disassembly: Mark matching marks.

Reassembly: Assemble by aligning the matching marks.

OIL PUMP

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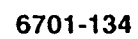
GENERAL



SPECIFICATIONS

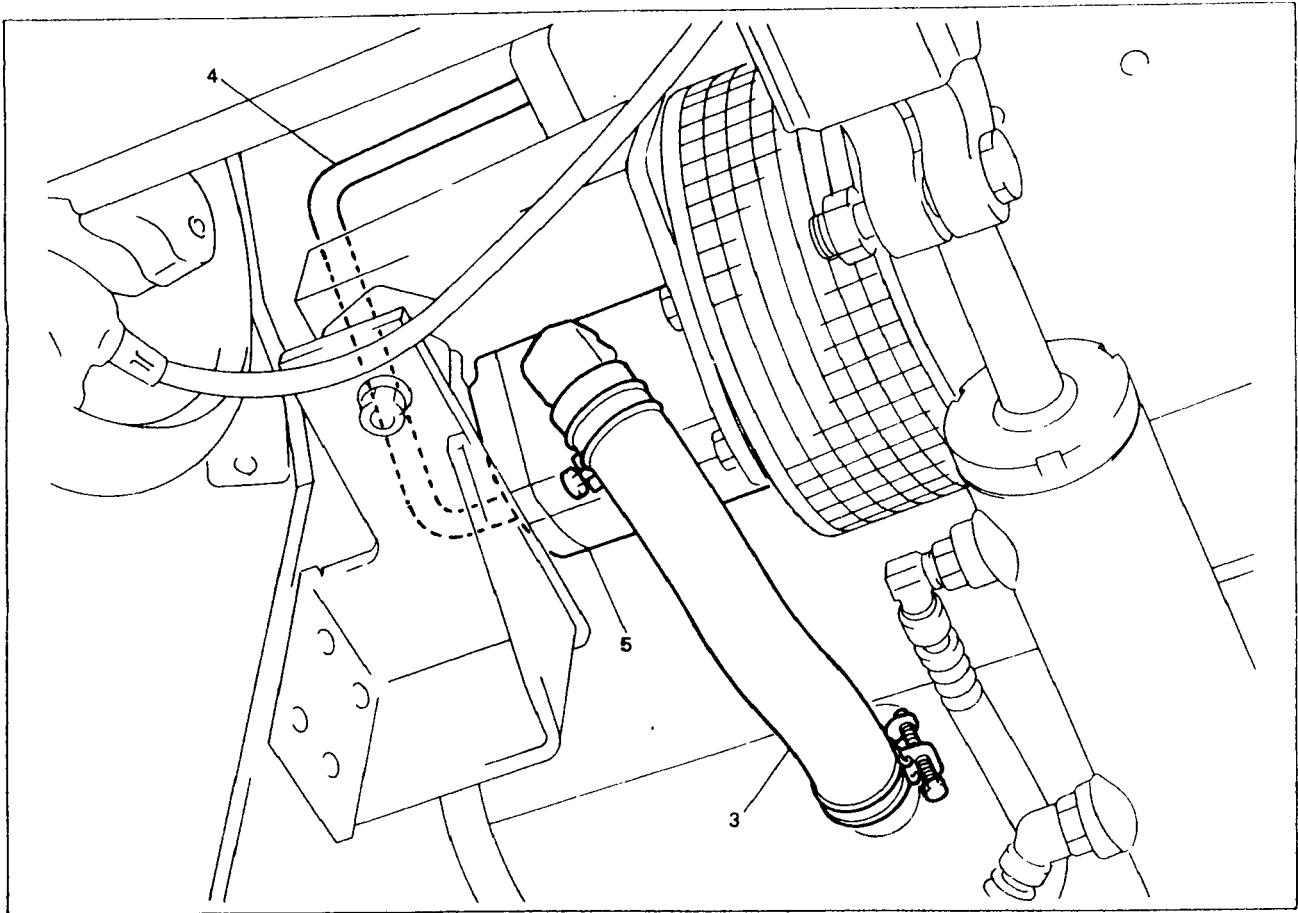
Output (1500 rpm) l/min: 22.0
Theoretical output cc/rev: 16.0
Drive method: motor-drive

6701



OIL PUMP ASSY

REMOVAL-INSTALLATION



Removal Procedure

- 1 Remove the front and rear toeboards.
- 2 Drain the hydraulic oil.
- 3 Disconnect the inlet hose.
- 4 Disconnect the high pressure hose.
- 5 Remove the oil pump.

Installation Procedure

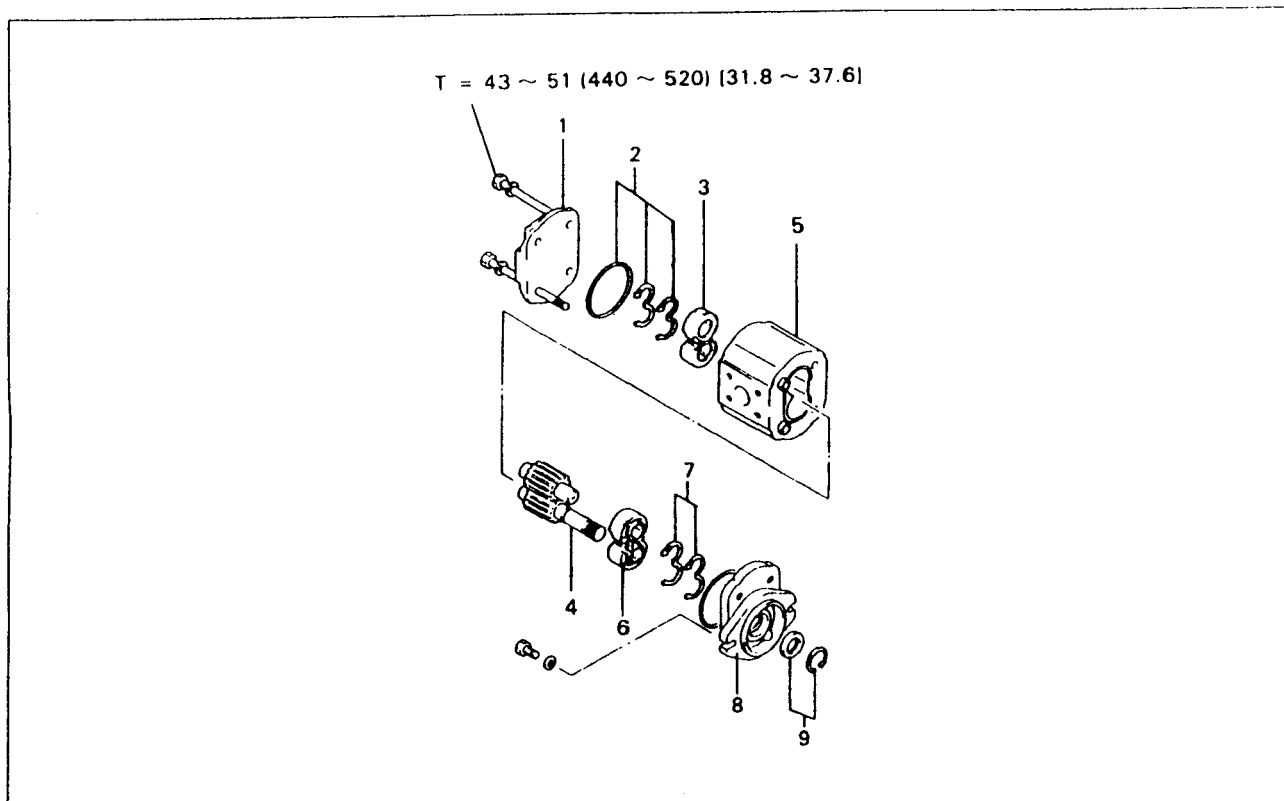
The installation procedure is the reverse of the removal procedure.

Note

- Apply grease (molybdenum disulfide grease) on the pump spline portion before installation.
- Clean the fitting mounting portion thoroughly to prevent damage to the O-ring.

DISASSEMBLY·INSPECTION·REASSEMBLY

T = N·m (kgf·cm) [ft·lbf]



Disassembly Procedure

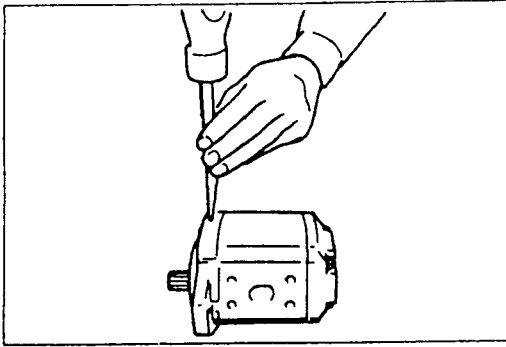
- 1 Remove the cover. [Point 1]
- 2 Remove the seals.
- 3 Remove the bushing set. [Point 2]
- 4 Remove the pump gear. [Point 3]
- 5 Remove the body. [Point 4]
- 6 Remove the bushing set. [Point 2]
- 7 Remove the seals.
- 8 Remove the cover (mounting flange).
- 9 Remove the oil seal.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

- Wash each part, blow with compressed air and apply hydraulic oil before reassembly.
- Use new seals for reassembly.

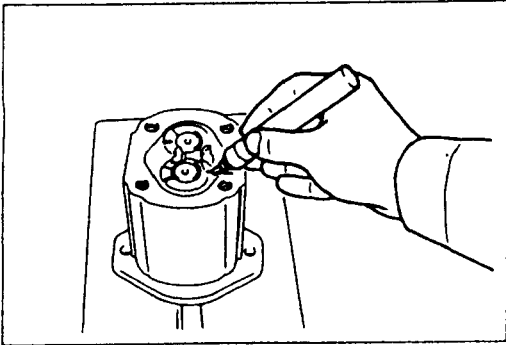


Point Operations

[Point 1]

Disassembly: Punch a match mark.

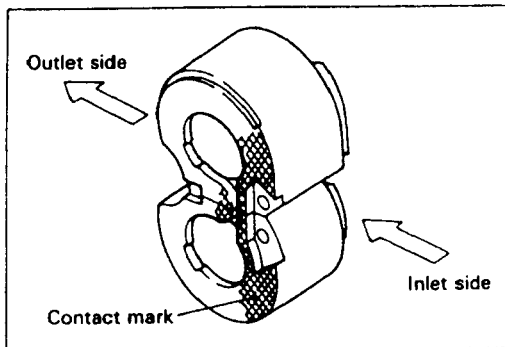
Reassembly: Align the match marks.



[Point 2]

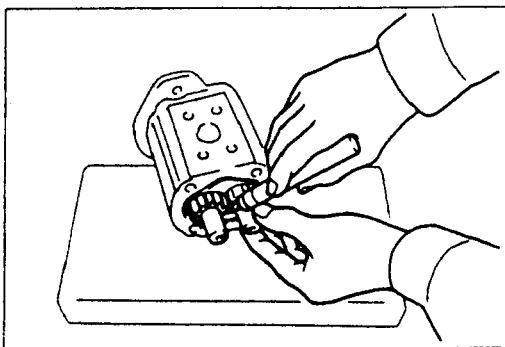
Disassembly: Make a match mark. Do not damage the bushing

Reassembly: Align the match marks.



Inspection: Inspect the inside surface in sliding contact.

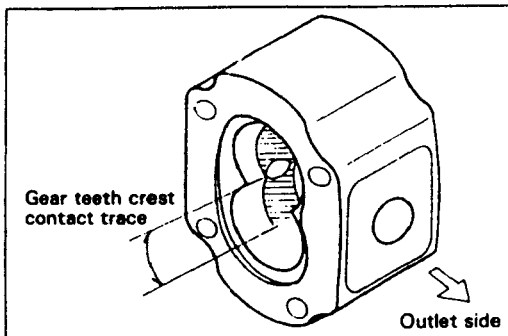
Normal = Glossy contact trace on about half on suction side.



[Point 3]

Disassembly: Make a match mark. Do not damage the gear.

Reassembly: Align the match marks.



[Point 4]

Inspection: Inspect the depth of flaw on the inside surface of the body.

Limit flaw depth: 0.08 mm (0.003 in)

TEST PROCEDURE

Note:

A bench test is required for strict inspection, but it is impossible in actual service. Install the oil pump on the actual vehicle and judge the properness of the oil pump state by checking the cylinder operation. Check on the battery indicator if the battery charge is sufficient.

Check if the oil control valve relief set pressure is as specified.

For further details, see "OIL CONTROL VALVE ADJUSTMENT".

Raise the hydraulic oil temperature to 50 to 55°C (122 to 131°F), and measure the lift cylinder full stroke operation time to calculate the lifting speed.

However, soft start supported by the material chopper circuit makes lifting speeds 10 to 20 mm/sec (2.0 to 3.9 fpm) lower than the values listed in the table below. To measure lifting speeds more accurately, measure them except during the soft start.

If any fault is found, disassemble and inspect the oil pump again.

Lifting Speed Table

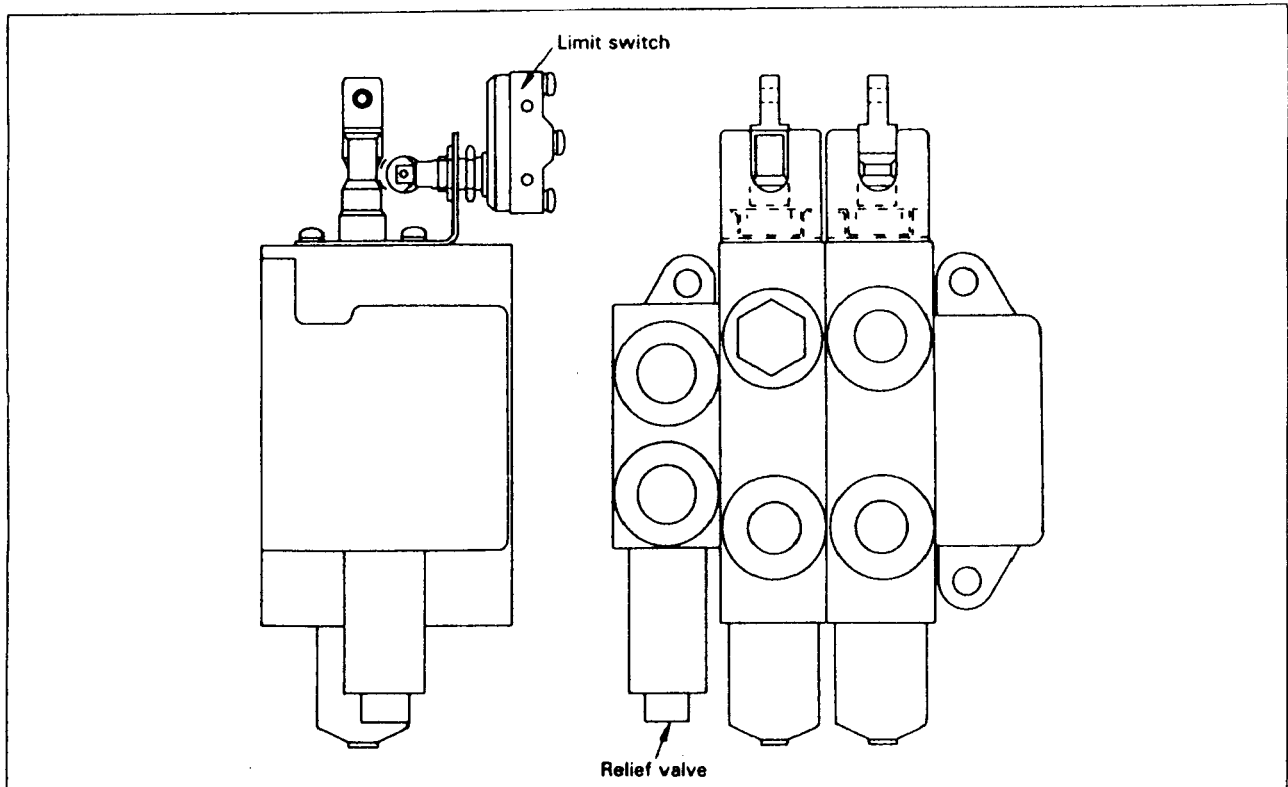
	Lifting speed mm/sec	
	No load	Loaded
EC 10T	490	300
EC 12T	490	280
EC 15T	490	270

OIL CONTROL VALVE

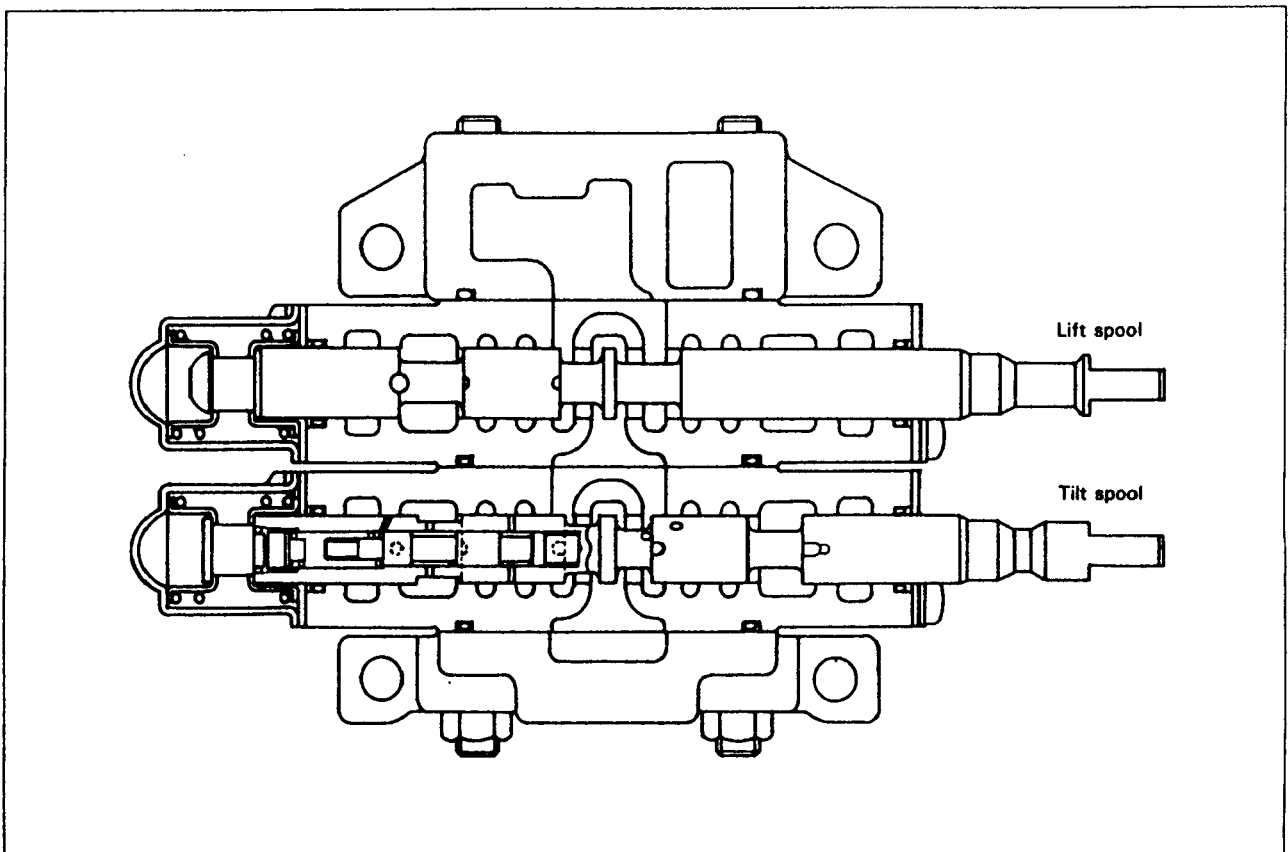
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REMOVAL INSTALLATION	13-7
DISASSEMBLY INSPECTION REASSEMBLY	13-8
RELIEF PRESSURE ADJUSTMENT	13-10

GENERAL

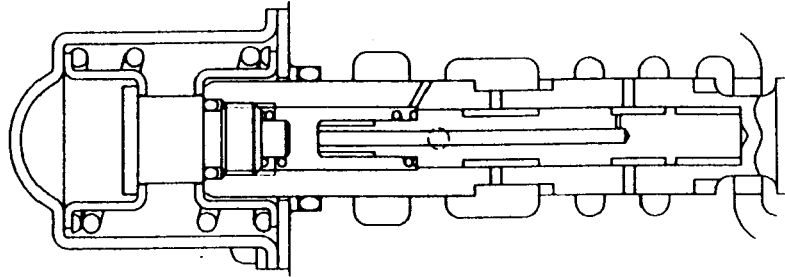
Oil Control Valve Appearance



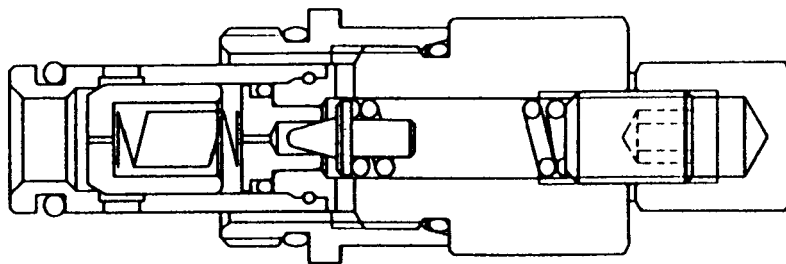
Oil Control Valve ASSY Sectional View



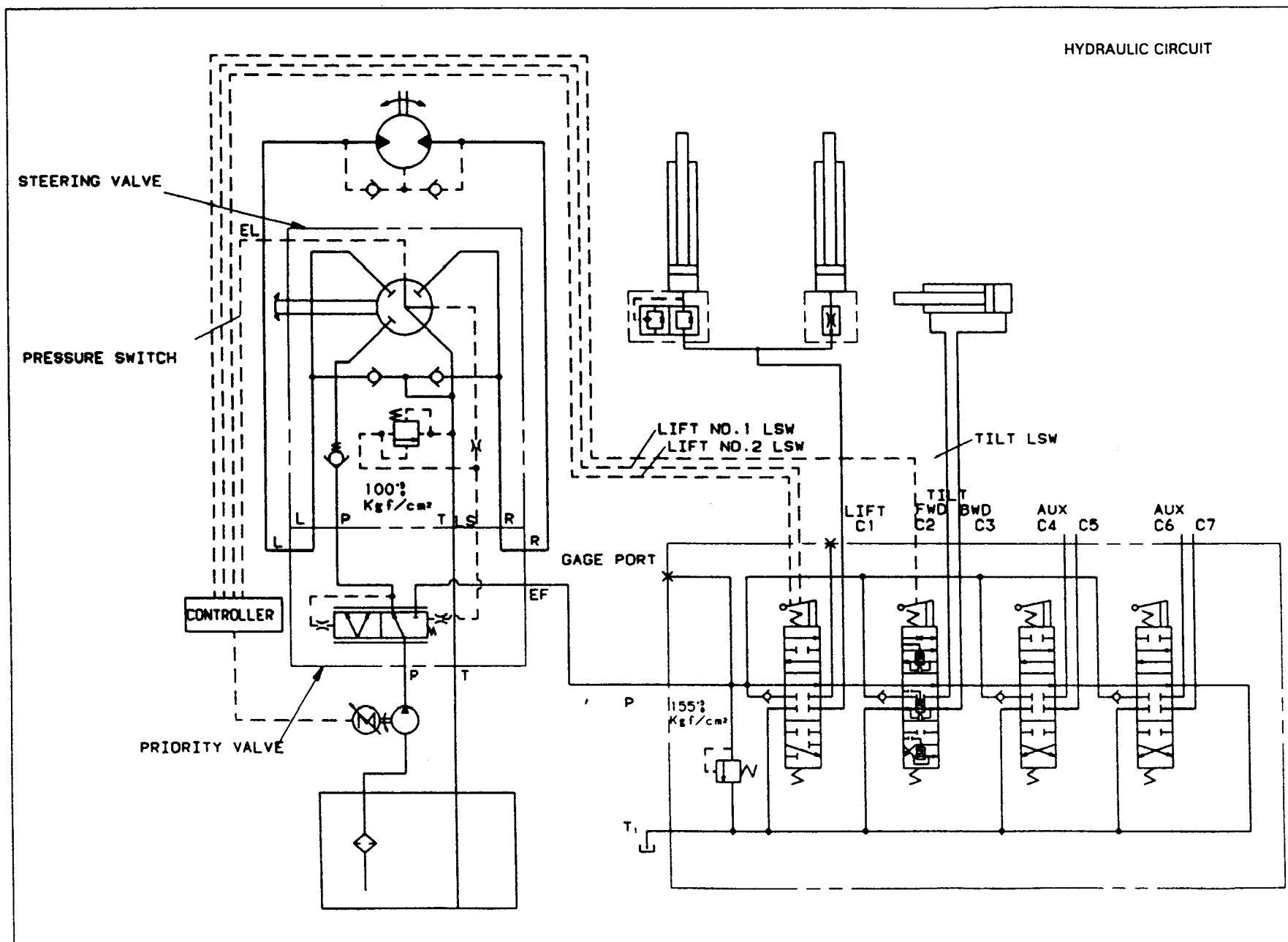
Tilt Lock Plunger Sectional View



Relief Valve Sectional View



HYDRAULIC CIRCUIT DIAGRAM

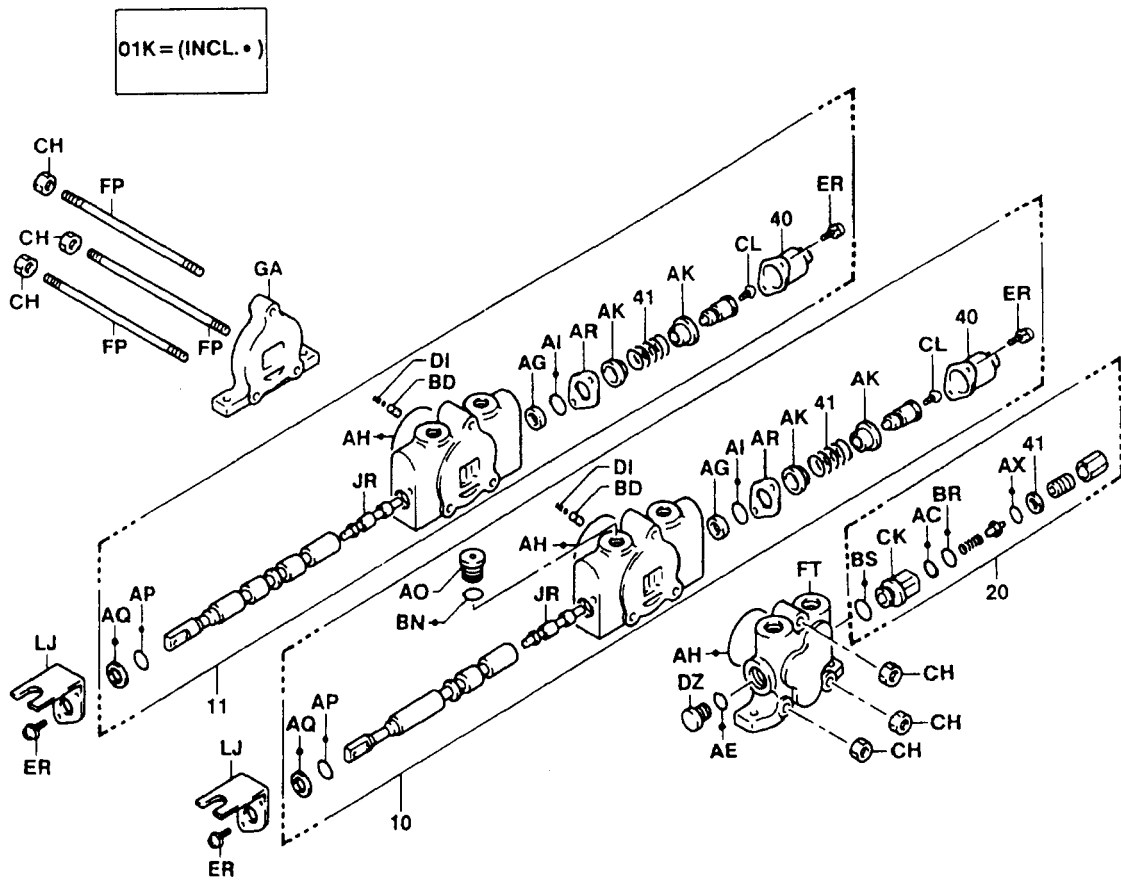


SPECIFICATIONS

Type	: Add-on type
Relief set pressure KPa(kgf/cm ²)	: 15200 (155)
Others	: Built-in tilt lock valve

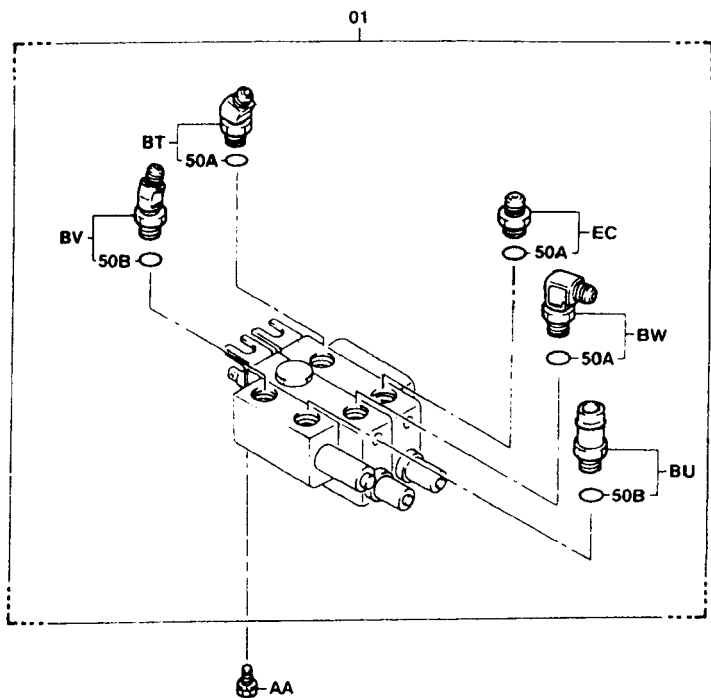
COMPONENTS

6705



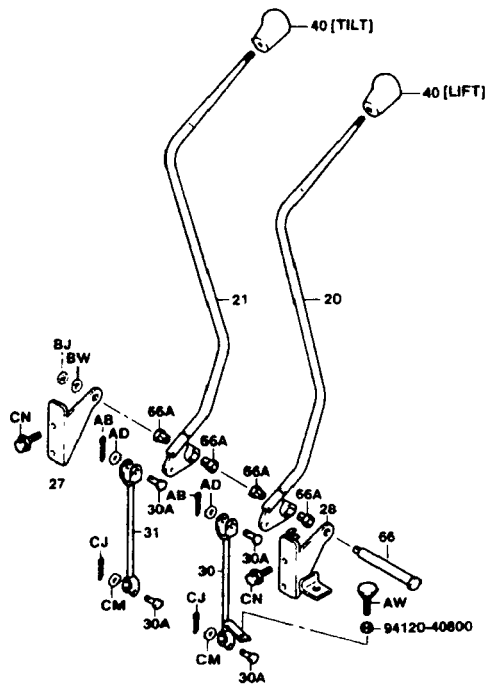
6705-725

6705



6705-720

6709



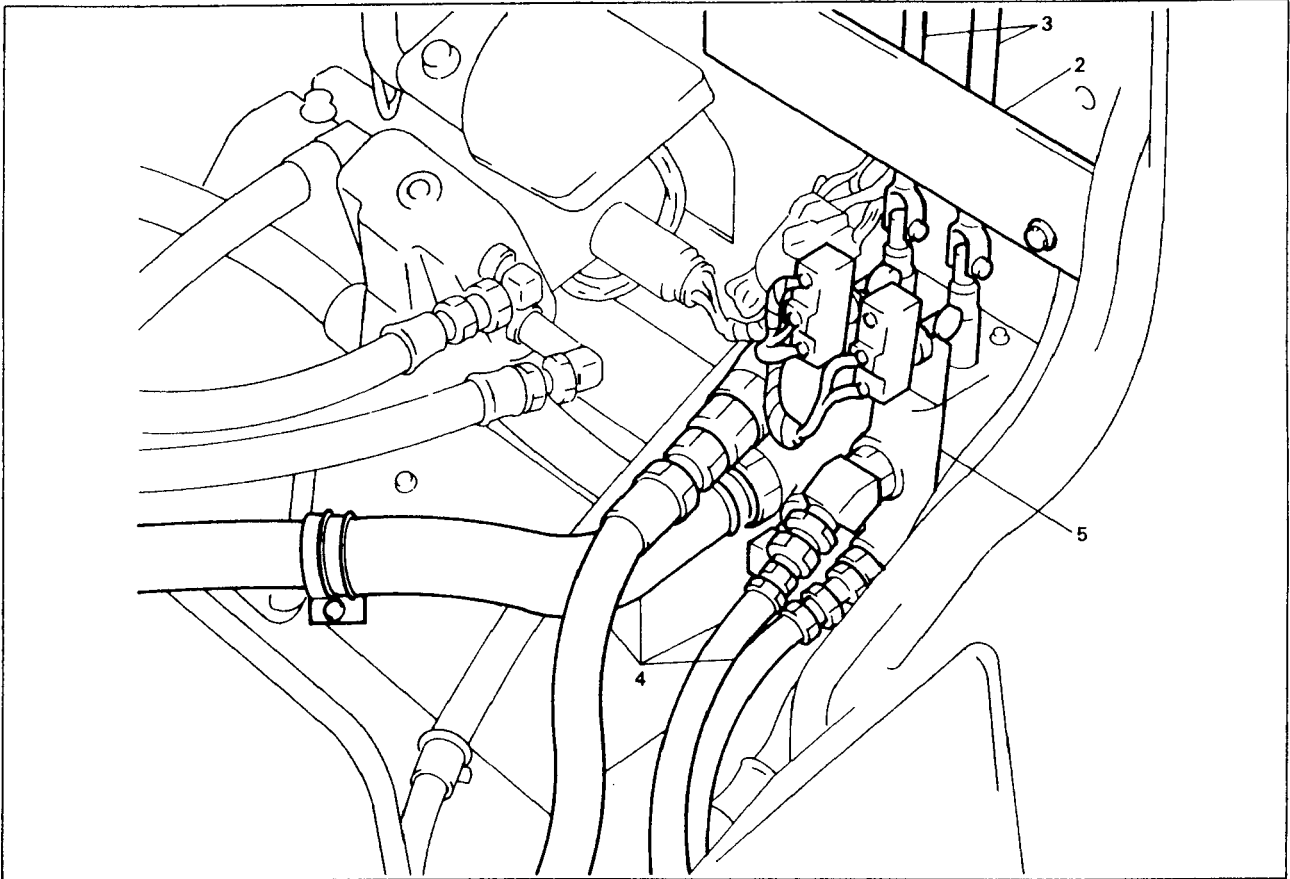
6709-287

OIL CONTROL VALVE ASSY

REMOVAL-INSTALLATION

Note:

Before disconnecting the control lever link, release the residual pressure in the material handling system piping by operating the control lever, set the mast in the neutral state and lowering the fork to the bottom position.



Removal Procedure

- 1 Remove the front toe board and rear toe board.
- 2 Remove the rubber cover.
- 3 Disconnect the control valve lever link.
- 4 Disconnect the piping.
- 5 Remove the oil control valve ASSY.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

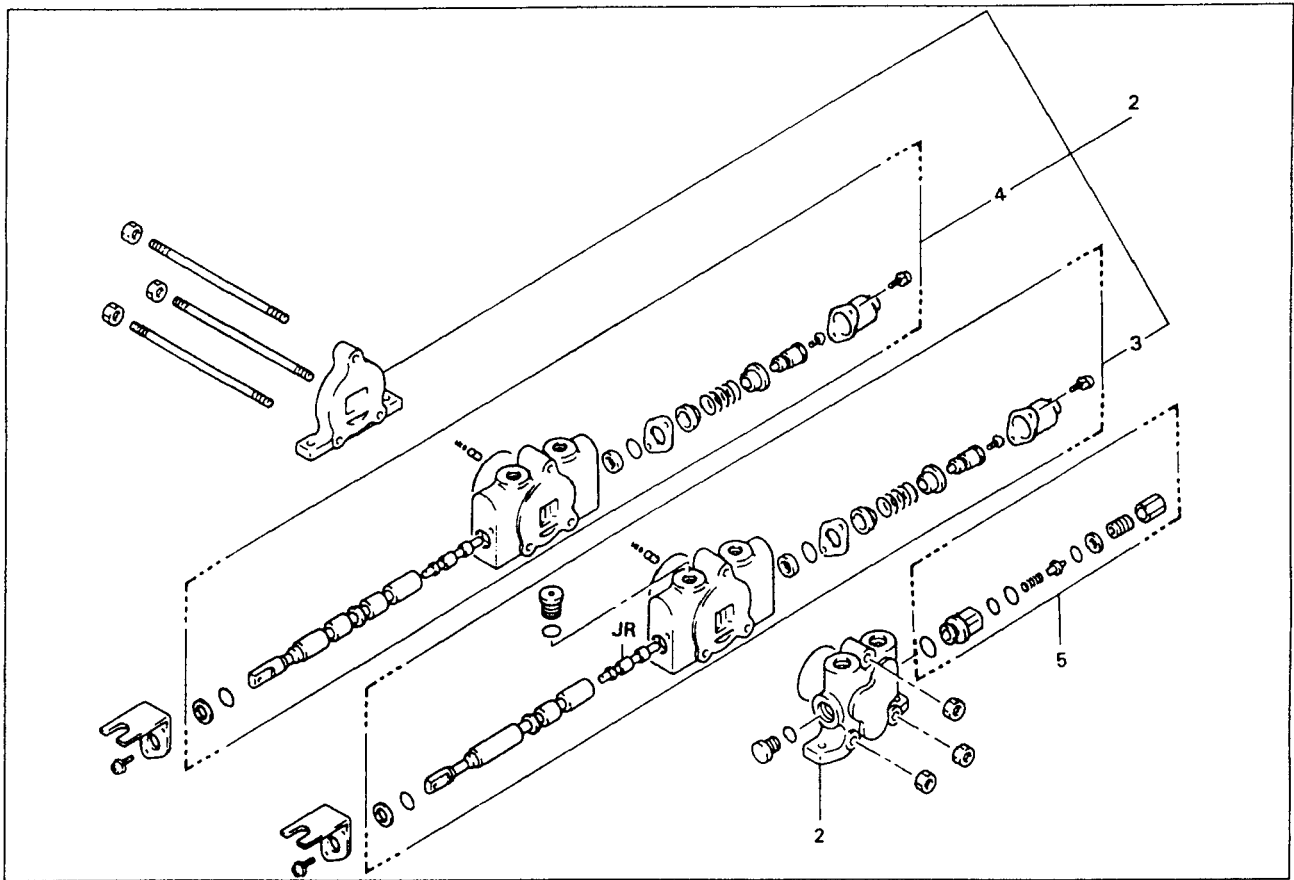
Note:

- Apply grease the oil control valve lever link parts.
- Check the hydraulic oil level, and add if insufficient.

DISASSEMBLY · INSPECTION · REASSEMBLY

Note:

- Select a clean location for operation.
- As every component part is finished with high precision, carefully operate during disassembly to prevent any damage.



Disassembly Procedure

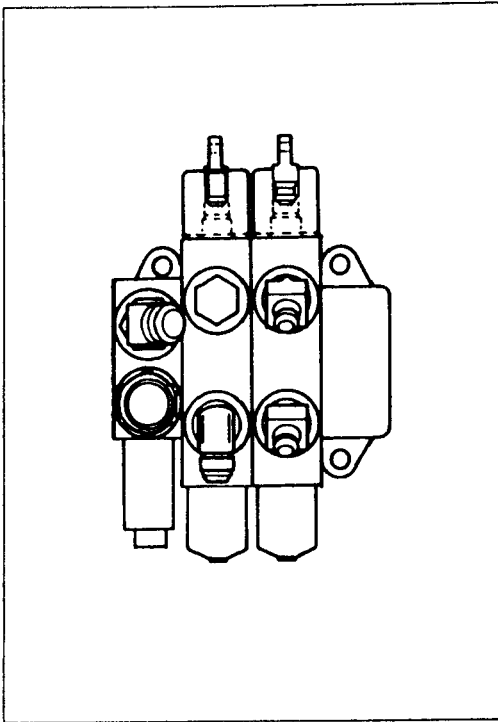
- 1 Remove the limit switch brackets. [Point 1]
- 2 Disassemble each valve block. [Point 2]
- 3 Disassemble the lift spool block. [Point 3]
- 4 Disassemble the tilt spool block. [Point 3]
- 5 Remove the relief valve. [Point 4]

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

- Before reassembly, thoroughly wash each part, blow compressed air, and coat hydraulic oil.
- Apply MP grease to the limit switch roller.



Point Operations

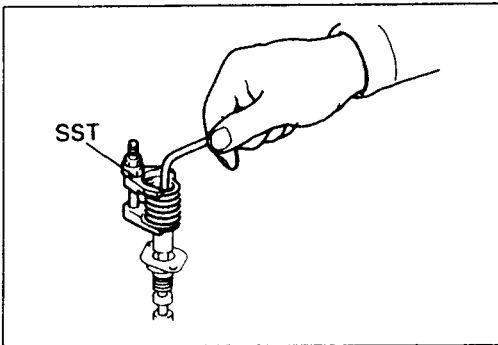
[Point 1]

Reassembly: Adjust limit switch positions when reassembling.

Adjust them so that each limit switch turns ON with the movement of the spool immediately after the associated lever has been operated. (See page 2-19.)

[Point 2]

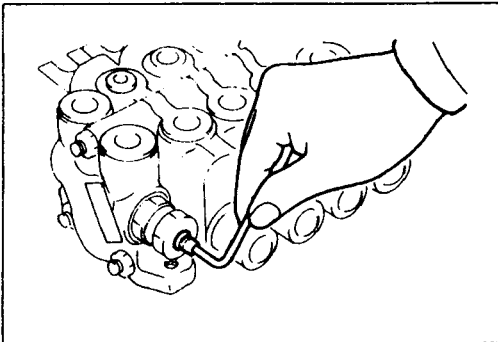
Reassembly: Fit to the illustrated positions.



[Point 3]

Disassembly-Reassembly: Disassemble and reassemble the spool spring using the following SST.

SST 09610-10160-71



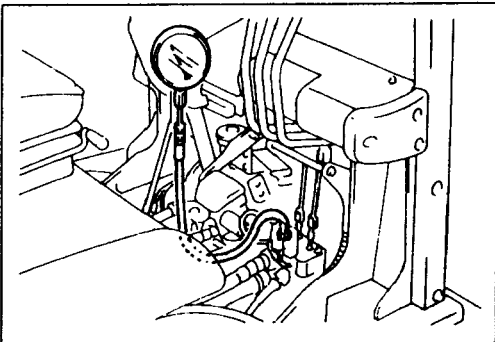
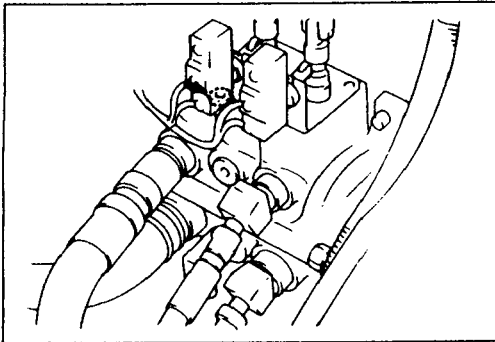
[Point 4]

Reassembly: When the relief valve is disassembled, remember to loosen the adjusting screw fully.

RELIEF PRESSURE ADJUSTMENT

Note:

- Always make adjustments according to the following procedure. Random adjustment may generate a high pressure that may damage the oil pump and other hydraulic equipment.
- No adjustment is required when the relief valve is not disassembled or is replaced with a new one.
- Before operation, check if the maximum unloaded revolving speed is as specified.



1. Oil pressure gage installation
Remove the detection plug (9/16-18UNF) and install an oil pressure gage.
2. Check the adjusting screw for looseness.
Loosen the lock nut and loosen the adjusting screw to a degree not coming off from the body.
3. Turn the key switch to ON.
4. Hydraulic pressure adjustment
 - (1) Set the control lever to the lift position and tighten the adjusting screw gradually before the fork starts rising.
 - (2) Set the lift lever fully to the lift position, lift the fork fully to the maximum height, and read the oil pressure gage.
Tighten the adjusting screw so that the pressure becomes normal, then tighten the lock nut to secure the adjusting screw.

Note:

If the specified hydraulic pressure is exceeded, return the lever to the neutral position immediately.
For the relief pressure, see "Specifications" on page 13-5.

5. Remove the oil pressure gage and tighten the plug.

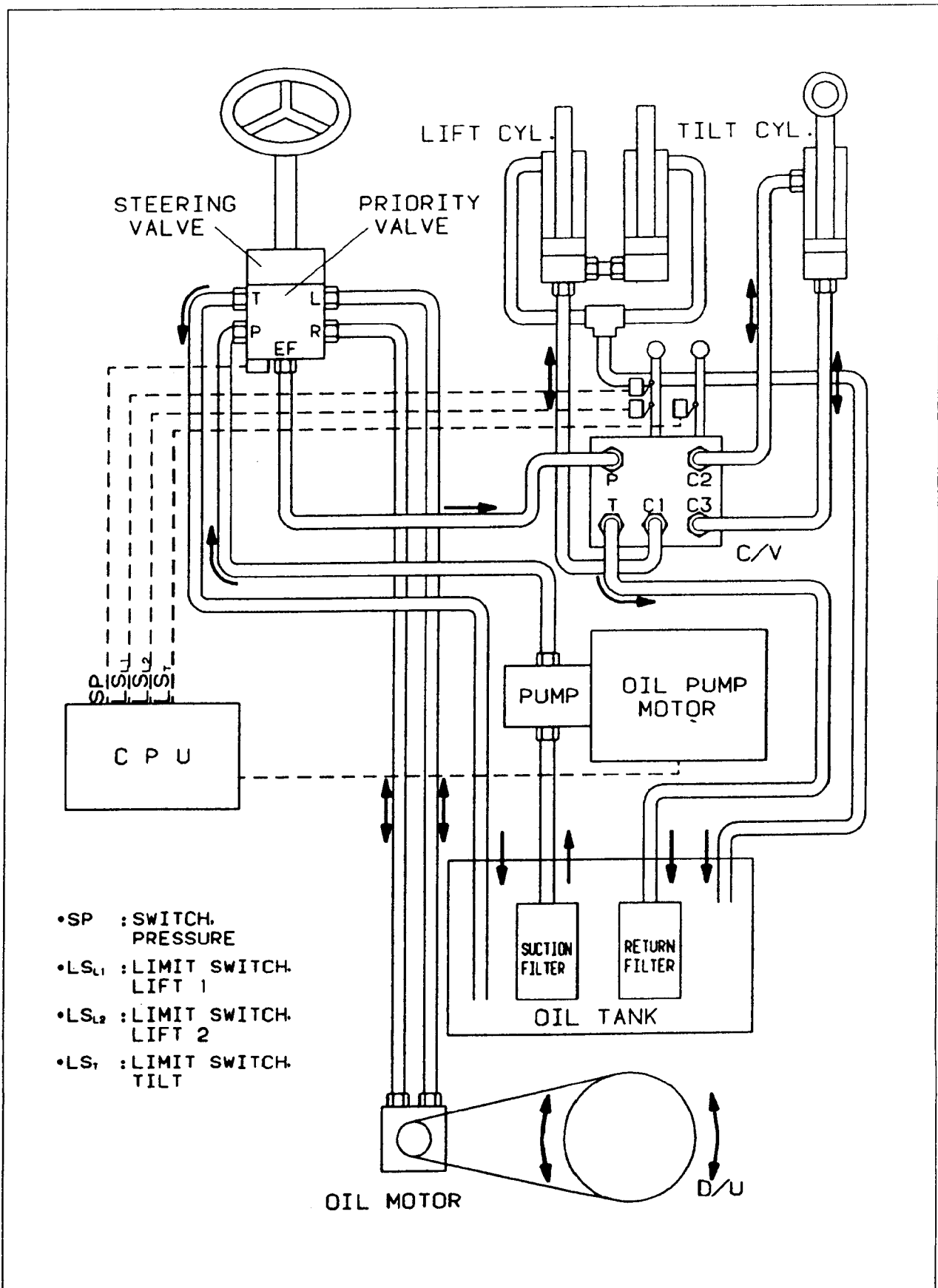
14-1

PIPING FOR HYDRAULIC

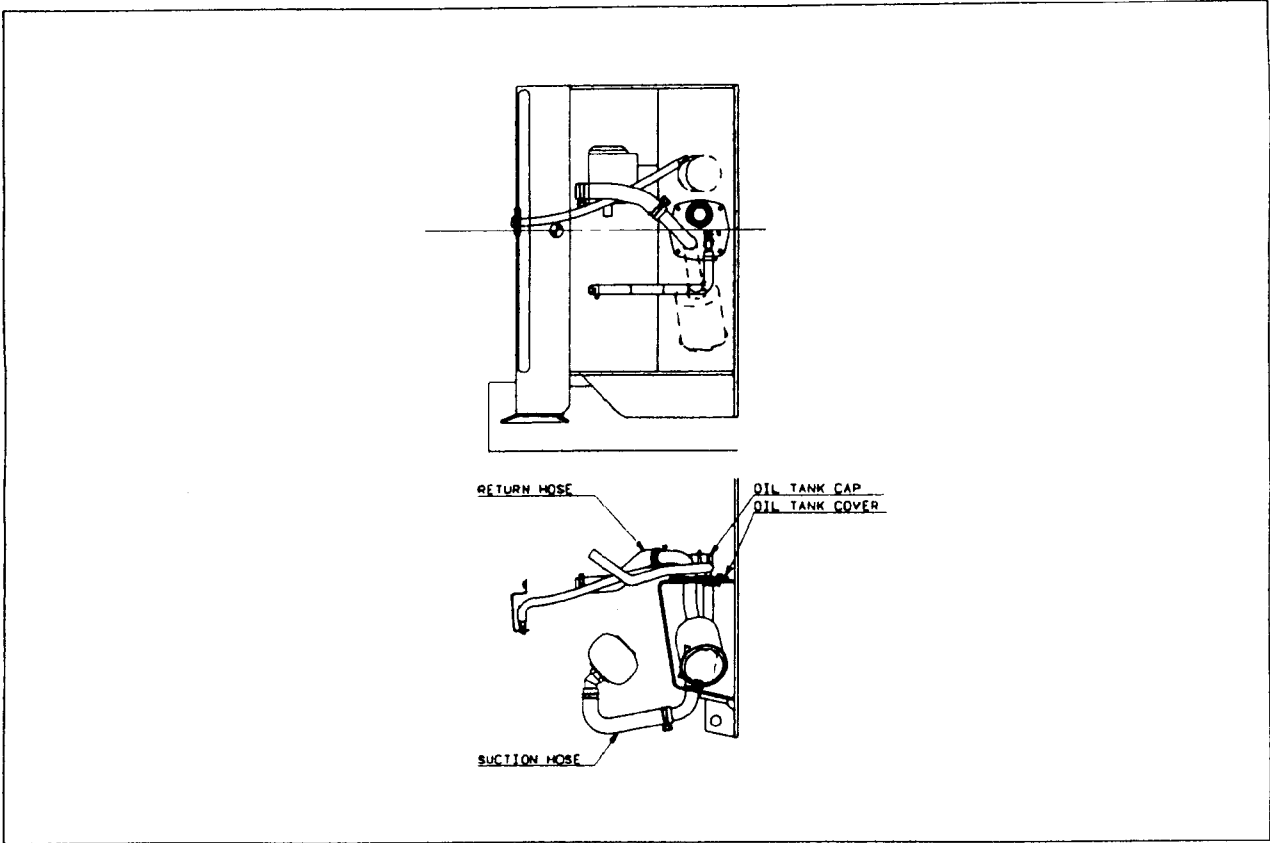
**GENERAL
SPECIFICATIONS
COMPONENTS**

**Page
14-2
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GENERAL



Oil Tank



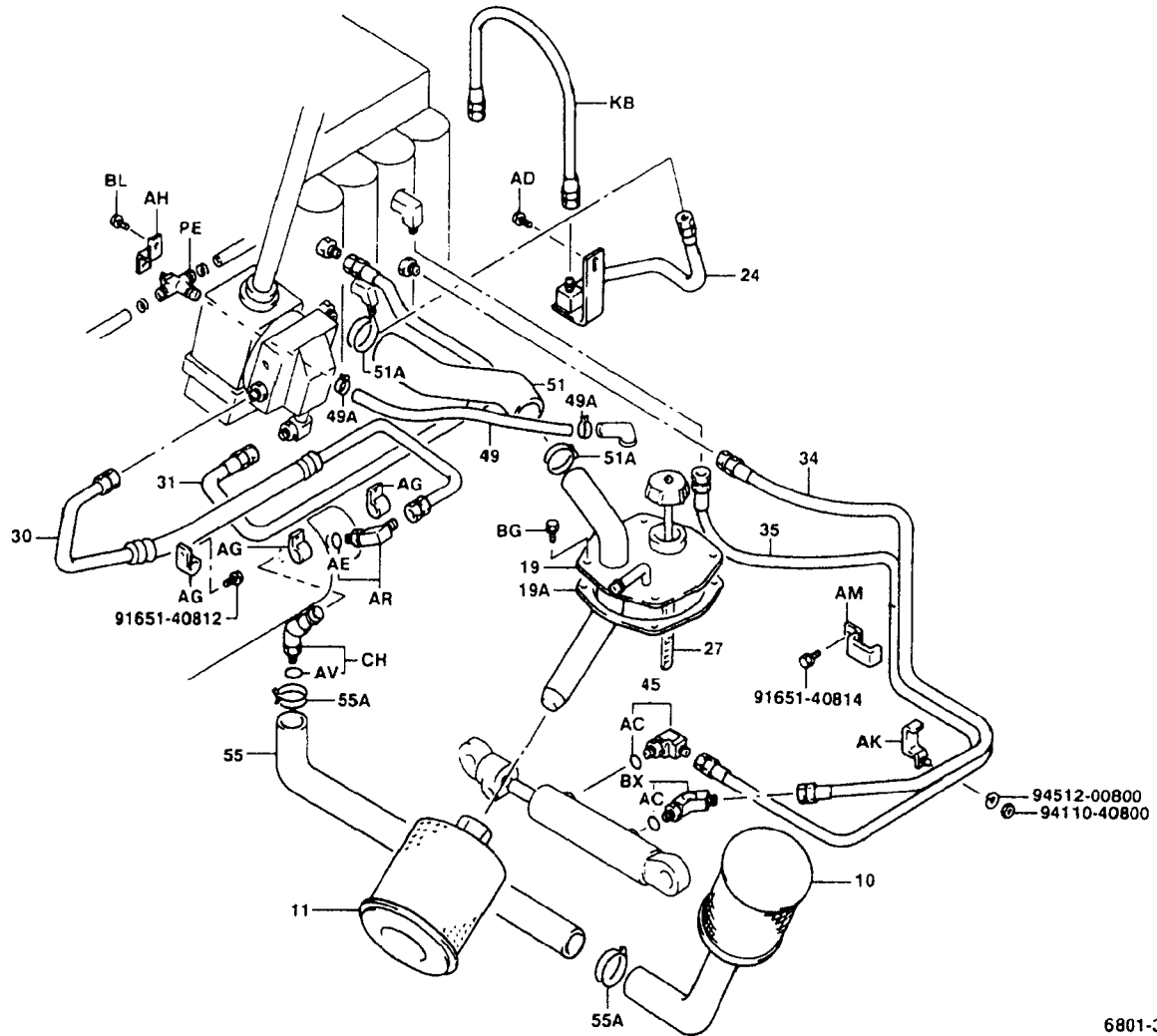
SPECIFICATIONS

Oil Filters

Suction filter	Type	Wire netting
	Filtration accuracy	100 mesh
	Filtration area	188 cm ²
Return filter	Type	Full flow
	Filtration accuracy	30 μ
	Filtration area	Approx. 2,000 cm ²

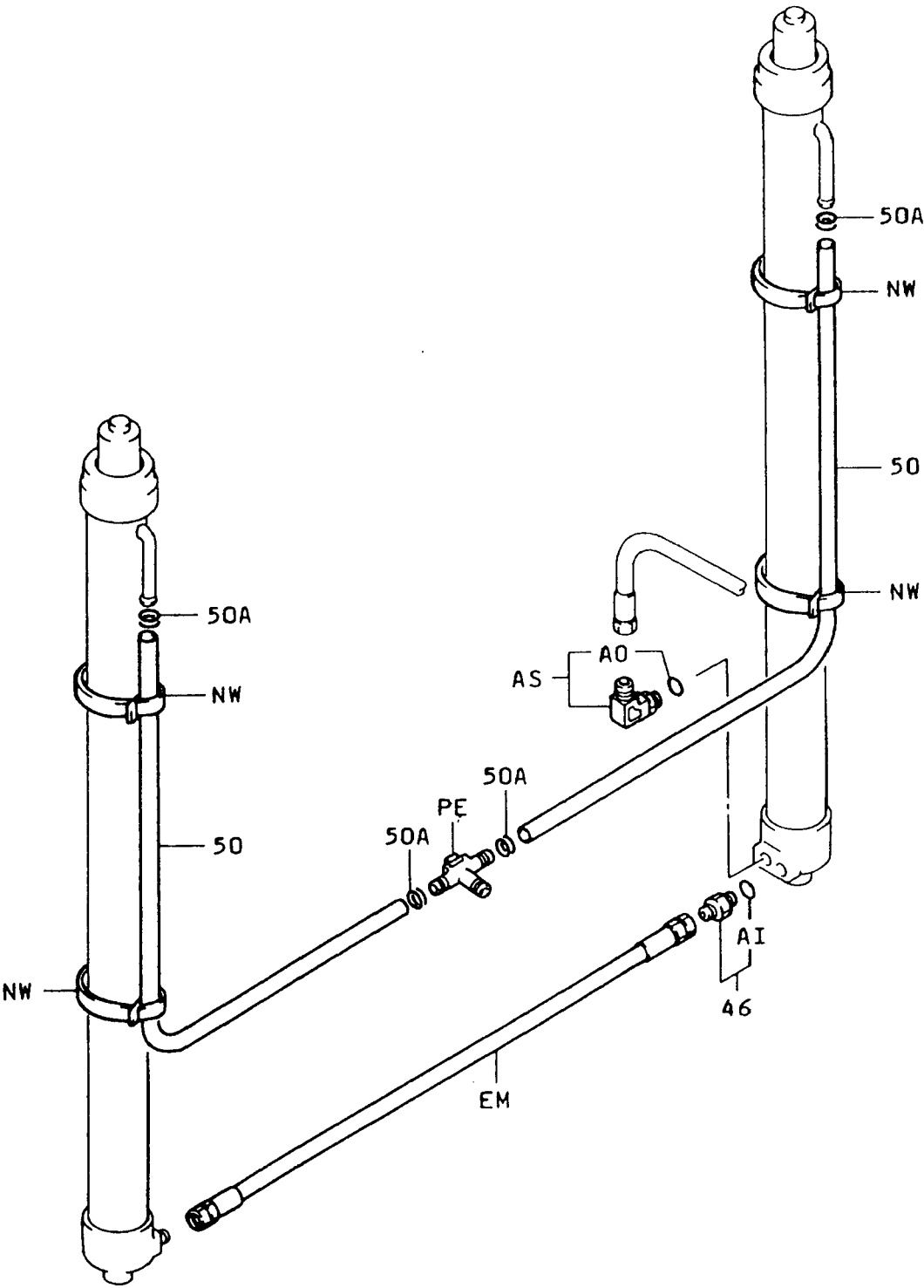
COMPONENTS

6801



6801-331

6801



6801-289

APPENDIXES

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SST LIST	15-2
LIST OF SERVICE STANDARDS	15-5
CONNECTOR DRAWING	15-11
CONNECTING DIAGRAM	15-14
WIRING DIAGRAM	15-16

SST LIST

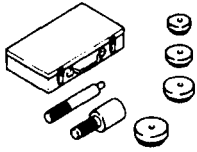
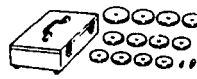
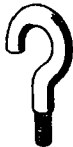
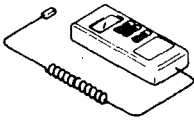
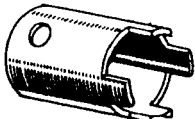
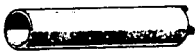
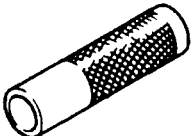
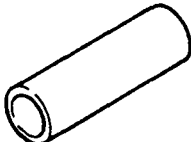
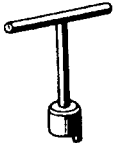
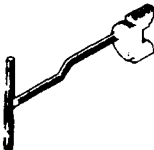
Illustration	Part No.	Part name	Section									
			1	3	4	5	6	7	8	10	11	13
	09608-30012	Front hub & drive pinion bearing tool set						○				
	09608-35014	Axle hub & drive pinion bearing tool set								○		
	09620-30010	Steering gear box replacer set			○							
	09718-20010	Brake shoe return spring replacer							○			
	09950-40010	Puller "B" set			○					○		
	09950-50010	Puller "C" set				○		○				
	09950-60010	Replacer set			○							
	09950-60020	Replacer set, No.2					○					
	09010-10260-71	Motor hook			○							
	09140-12460-71	I-bolt			○							

Illustration	Part No.	Part name	Section									
			1	3	4	5	6	7	8	10	11	13
	09230-F1060-71	Calibrator		○								
	09241-40530-71	I-bolt				○						
	09310-10330-71	Lock nut remover and replacer			○							
	09320-10330-71	Lock nut remover and replacer				○						
	09370-10170-71	Front axle bearing replacer					○					
	09381-41950-71	HST pump bearing replacer			○							
	09410-40120-71	Steering worm bearing replacer				○						
	09450-23610-71	Bearing remover						○				
	09510-20180-71	Brake shoe return spring remover							○			
	09510-31960-71	Brake hold down spring remover & replacer							○			

[illegible]

LIST OF SERVICE STANDARDS

Battery

Item	All models
Specific gravity upon full charging (at 20°C)	1.280 (20°C)
Specific gravity upon end of discharge (at 20°C)	1.150 (20°C)
Discharge end voltage	21.5 V
Insulation resistance	1MΩ or more

Controller

TMD continuity [Circuit tester range] [Ω×1k]	kΩ	P8⊖ ——— N1⊕	Approx. 3
		P8⊕ ——— N1⊖	Approx. 3
TMP continuity [Circuit tester range] [Ω×1k]	kΩ	P13⊖ ——— N1⊕	Approx. 3
		P13⊕ ——— N1⊖	Approx. 3
DF1 continuity [Circuit tester range Ω×1k]	kΩ	Forward	Anode (P8) ⊖ – Cathode (P1B) ⊕: Approx. 1
		Reverse	Anode (P8) ⊕ – Cathode (P1B) ⊖: Approx. 3
DF2 continuity [Circuit tester range Ω×1k]	kΩ	Forward	Anode (P7) ⊖ – Cathode (P1B) ⊕: Approx. 5
		Reverse	Anode (P7) ⊕ – Cathode (P1B) ⊖: Approx. 10
DF3 continuity [Circuit tester range Ω×1k]	kΩ	Forward	Anode (P13) ⊖ – Cathode (P1B) ⊕: Approx. 1
		Reverse	Anode (P13) ⊕ – Cathode (P1B) ⊖: Approx. 3
Contactors			
MB contactor coil resistance		Ω	Approx. 32
MF•MR contactor coil resistance		Ω	Approx. 15
Acceleration potentiometer			
Clearance between accelerator link stopper and toe board		mm	1.0: Switch shall be set to OFF.
		mm	2.0: Switch shall be set to ON.
Tightening torque			Unit: N•m (kgf•cm)
Set screw		1.57 ~ 2.35 (16 ~ 24)	

Material Handling System Switches

Item	All models
Material handling switch (LS _U) ON timing	mm
Material handling switch (LS _U) ON timing (from bracket to roller tip end) (reference value)	mm

Direction switch				
Lever position		Neutral	Forward	Reverse
Limit switch				
DS _F		$\infty \Omega$	0 Ω	$\infty \Omega$
DS _R		$\infty \Omega$	$\infty \Omega$	0 Ω
DS _{FU}		$\infty \Omega$	0 Ω	$\infty \Omega$
DS _{BU}		$\infty \Omega$	$\infty \Omega$	0 Ω

Motor

Item			All models
Drive motor			
Armature coil insulation resistance			1 MΩ or more
Commutator outside diameter	mm	Standard	90
		Limit	87
Commutator deviation	mm	Limit	0.02 mm or less
Undercut	mm	Standard	0.6
		Limit	0.3
Field coil resistance (Circuit tester range Ω×1 k)	Ω	E ——— F	0
Field coil insulation resistance	Yoke ——— E·F		1 MΩ or more
Brush length	mm	Standard	32
		Limit	13
Brush pressure		N (kg)	9.35±0.9 N (0.95±0.1)
Brush holder insulation resistance			1 MΩ or more
Pump motor			
Armature coil insulation resistance			1 MΩ or more
Commutator outside diameter	mm	Standard	80
		Limit	77
Commutator deviation	mm	Limit	0.02 mm or less
Undercut	mm	Standard	0.6
		Limit	0.3
Field coil resistance (Circuit tester range Ω×1 k)	Ω	E ——— F	0

Item		All models
Field coil insulation resistance	Yoke ——— E-F	1 MΩ or more
Brush length	mm	Standard
		Limit
Brush pressure	N (kg)	9.6±0.7 N (0.98±0.07)
Brush holder insulation resistance		1 MΩ or more

Drive Unit

Backlash between the drive pinion and bevel gear	mm	Standard	0.05 ~ 0.1 mm
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Front Axle

Item		All models
Front axle hub starting force (At hub bolt)	N (kgf)	19.6 ~ 24.5 (2 ~ 5.5)
Tightening torque		Unit: N·m (kgf·cm)
Front wheel hub nut		196.13 ~ 245.16 (2000 ~ 2500)

Rear Axle

Tightening torque		Unit: N·m (kgf·cm)
Rear wheel hub nut		196.13 ~ 245.16 (2000 ~ 2500)

Steering

Steering wheel play	mm	20~40
Steering chain tension (For applying a force of 10 kg)	mm	Standard
Relief valve set pressure	kPa (kgf/cm ²)	10600 ~ 11080 (108 ~ 113)
Tightening torque		Unit: N·m (kgf·cm)
Oil pressure switch		19.6 ~ 24.5 (200 ~ 250)
Priority valve set bolt		60.8 ~ 69.8 (620 ~ 710)
Steering valve	Relief valve plug	40 ~ 60 (408 ~ 612)
	End cover set bolt	24 ~ 36 (245 ~ 367)
Oil motor set bolt		47.1 ~ 70.6 (480 ~ 720)

Brake

Item		All models	
Front brake			
Brake drum inside diameter	mm	Standard	254
		Limit	256
Anchor to shoe spring free length	mm	Standard	102
		Limit	Replace if any coil clearance is found
Adjuster spring free length	mm	Standard	92
		Limit	Replace if any coil clearance is found
Shoe hold down spring free length	mm	Standard	20.4
		Limit	17
Strut-to-shoe spring		Standard	20
		Limit	17
Pole lever spring		Standard	43
		Limit	39
Brake shoe lining thickness	mm	Standard	6
		Limit	1
Wheel cylinder to piston clearance	mm	Standard	0.125
Brake pedal			
Brake pedal height (with pad)	mm	Standard	116 ~ 121
Brake pedal play	mm	Standard	3 ~ 5
Brake pedal depressed height	mm	Standard	20 or more

Material Handling System

Natural drop		mm/15 min	90 or less
Natural forward tilt		mm/15 min	40 or less
Oil leak test	Lift cylinder oil leak amount (full amount at lift port)	cc/min	6~16
	Tilt cylinder oil leak amount (lift + tilt leak amount)	cc/min	14~34

Mast

Mast adjustment (V mast)			
Mast rollers	Inner mast roller clearance	mm	Standard 0 ~ 0.8
	Outer mast roller clearance	mm	Standard 0 ~ 0.8

Item			All models
Lift bracket rollers	Middle and lower lift roller clearance mm	Standard	0 ~ 0.8
	Side roller clearance mm	Standard	0 ~ 0.6
Mast strip to inner mast clearance mm			Standard 0.5 ~ 1.0
Mast strip thickness mm			Limit 1.5
Fork			
Fork front end misalignment mm			Limit 10 or less
Tightening torque			Unit: N·m (kgf-cm)
Chain adjusting nut mm			Standard 49.03 ~ 78.45 (500 ~ 800)

Cylinder

Lift cylinder (V) Rear lift cylinder (FV, FSV & FSN)		
Lift cylinder bore mm	Standard	45
	Limit	45.2
Piston rod outside diameter mm	Standard	35
	Limit	34.92
Piston rod bend limit mm		2
Front cylinder (FV, FSV & FSN)		
Lift cylinder bore mm	Standard	85
	Limit	85.40
Piston rod outside diameter mm	Standard	70
	Limit	69.91
Piston rod bend limit mm		2
Tightening torque Unit: N·m (kgf-cm)		
Cylinder cover		343.23 ~ 441.30 (3500 ~ 4500)
Flow regulator valve		58.84 ~ 68.65 (600 ~ 700)
Safety down valve		29.42 ~ 39.23 (300 ~ 400)
Tilt cylinder		
Tilt cylinder bore mm	Standard	55
	Limit	55.35
Tilt cylinder rod outside diameter mm	Standard	22
	Limit	21.92
Tilt cylinder rod bend limit mm		1.0

Oil Pump

Body inside flaw depth	mm	Limit	0.08
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Lifting Speed (V Mast)

		EC 10T	EC 12T	EC 15T	
Lifting speed	mm/sec	Loaded	300	280	270
		No-load	490	490	490

Oil Control Valve

Item		All models
Relief set pressure	kPa (kgf/cm ²)	15200 (155)
		15200 (155)

CN1



TAB

NO	P	C	J
1	41	Y	J1
2	43	B-Y	CN25-1
3	N1	W-B	J4
4	N1	W-B	J5
5	171	G-W	CN102-20
6	43	B-Y	J2

REC

NO	P	C	J
1	41	V	HOOR METER
2	43	L	HOOR METER
3	N1	G	HOOR METER
4	N1	Y	BW1
5	171	O	BW1
6	43	R	BW1

CN11



TAB

NO	P	C	J
1	60	G-R	LS _L
3	68	G-W	LS _L
4	N1	R-L	COM ₁
5	63	G-B	LS _{ATT}
6	61	G-Y	LS _Y

REC

NO	P	C	J
1	60	G-Y	CN102-6
3	68	O	CN102-4
4	N1	W-B	J5
5	63	L	CN102-7
6	61	Y	CN102-3

CN21



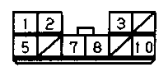
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NO	P	C	J
1	43	-	FAN
2	N1	-	FAN

REC

NO	P	C	J
1	43	B-Y	CN19-4
2	N1	W	J4

CN22



TAB

NO	P	C	J
1	108	BR	CN27-3
2	104	G	CN34-1
3	103	O	CN34-5
4	-	-	-
5	N1	W	CN34-2
6	-	-	-
7	107	V	CN26-1
8	111	SL	CN34-4
9	-	-	-
10	109	P	CN34-3

REC

NO	P	C	J
1	108	R-Y	J11
2	104	G-R	CN4-2
3	103	R-W	CN2-3
4	-	-	-
5	N1	W-B	J4
6	-	-	-
7	107	R-B	CN4-5
8	111	R-L	SW ₁₁
9	-	-	-
10	109	G-Y	J10

CN2



TAB

NO	P	C	J
1	N1	O	DSF
2	176	B	DSR
3	103	G	DSBU
4	48	W-O	DSR
5	45	W-BR	DSF
6	43	R	DSBU

REC

NO	P	C	J
1	N1	W-B	J5
2	176	G-W	PRS
3	103	R-W	CN22-3
4	48	G	CN102-14
5	45	W	CN102-13
6	43	B-Y	CN19-2

CN13



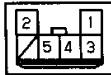
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NO	P	C	J
1	43	-	FRY
2	N1	-	FRY
3	110	-	FRY

REC

NO	P	C	J
1	43	B-Y	CN19-6
2	N1	W-B	J4
3	110	GR	CN3-3

CN3



TAB

NO	P	C	J
1	41	L	SW ₁
2	48	B	SW ₁
3	110	W	SW ₁
4	108	Y	SW ₁
5	109	G	SW ₁

REC

NO	P	C	J
1	41	Y	J1
2	48	P	H
3	110	GR	CN13-3
4	108	R-Y	CN15-4
5	109	G-Y	CN7-4

CN14



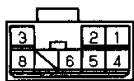
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NO	P	C	J
1	101	-	F4
2	P1	-	F4, F5
4	41	-	F5

REC

NO	P	C	J
1	101	R	CN4-1
2	P1	B	P13-37*
4	41	Y	CN4-3

CN4



TAB

NO	P	C	J
1	101	R	CN5-1
2	104	G-R	CN5-2
3	41	Y	CN6-1
4	102	R-G	CN5-3
5	107	R-B	CN5-4
6	43	B-Y	CN6-4
8	190	L	CN6-3

REC

NO	P	C	J
1	101	R	CN14-1
2	104	G-R	CN22-2
3	41	Y	CN14-3
4	102	R-G	CN7-3
5	107	R-B	CN22-7
6	43	B-Y	CN19-1
8	190	L	J7

CN15



TAB

NO	P	C	J
1	N1	W	CN31-2
3	102	Y	CN31-1
4	108	BR	LF-R

REC

NO	P	C	J
1	N1	W-B	J4
3	102	R-G	J9
4	108	R-Y	CN3-4

CN25



TAB

NO	P	C	J
1	43	B-Y	CN19-6

REC

NO	P	C	J
1	43	B-Y	CN1-2

CN26



TAB

NO	P	C	J
1	107	V	CN32-1
2	N1	W	CN32-2
3			
4			

REC

NO	P	C	J
1	107	V	CN22-7
2	N1	W	J15
3			
4			

CN5



NO	P	C	J
1	101	G	B
2	104	O	T
3	102	G-W	HS
4	107	G-B	HM



NO	P	C	J
1	101	R	CN4-1
2	104	G-R	CN4-2
3	102	R-G	CN4-4
4	107	R-B	CN4-5

CN6



NO	P	C	J
1	41	-	AM
3	190	-	ST
4	43	-	IG



NO	P	C	J
1	41	Y	CN4-3
3	190	L	CN4-8
4	43	B-Y	CN4-6

CN7



NO	P	C	J
1	N1	W	CN30-2
3	102	Y	CN30-1
4	109	BR	LF-L



NO	P	C	J
1	N1	W-B	N1
3	102	R-G	CN4-4
4	109	G-Y	CN3-5

CN8



NO	P	C	J
1	103	O	CN33-1
2	N1	W	CN33-2



NO	P	C	J
1	103	R-W	J12
2	N1	W-B	J4

CN9



NO	P	C	J
1	190	-	CN28-1



NO	P	C	J
1	190	L	CN23-1

CN10



NO	P	C	J
1	190	-	PL ₂
2	N1	-	PL ₂



NO	P	C	J
1	190	L	J7
2	N1	W-B	J4

CN33



NO	P	C	J
1	103	-	BZ
2	N1	-	BZ



NO	P	C	J
1	103	O	CN8-1
2	N1	W	CN8-2

CN34



NO	P	C	J
1	104	LT-L	
2	N1	GND	
3	109	LF-LR	
4	111	LST-L	
5	103	LBU-L	
6	-	-	-



NO	P	C	J
1	104	G	CN22-2
2	N1	W	CN22-5
3	109	PR	CN22-10
4	111	SL	CN22-8
5	103	O	CN22-3
6	-	-	-

CN35



NO	P	C	J
1	124	-	DM ₂
2	N1	-	DM ₂



NO	P	C	J
1	124	R-L	SW ₂
2	N1	W-B	CN16-1

CN16



NO	P	C	J
1	N1	B	CN35-2
2	-	-	-
3	43	R	F ₂



NO	P	C	J
1	N1	W-B	J4
2	-	-	-
3	43	B-Y	CN19-5

CN17



NO	P	C	J
1	52	GR	CN18-3
2	53	R-B	CN18-4
3	N1	R-L	CN18-1
4	64	R-Y	CN18-2

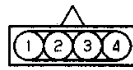


NO	P	C	J
1	52	GR	CN102-22
2	53	R-B	CN102-24
3	N1	W-B	J5
4	64	R-Y	CN102-15

CN18



NO	P	C	J
1	N1	-	ACCEL
2	64	-	ACCEL
3	52	-	ACCEL
4	53	-	ACCEL



NO	P	C	J
1	N1	R-L	CN17-3
2	64	R-Y	CN17-4
3	52	GR	CN17-1
4	53	R-B	CN17-2

CN19

(JOINT CONNECTOR)



NO	P	C	J
1	2	6	7
2	8	9	10

REC

NO	P	C	J
1	43	B-Y	CN4-6
2	43	B-Y	CN2-6
4	43	B-Y	CN21-1
5	43	B-Y	CN18-3
6	43	B-Y	CN13-1
7	43	B-Y	CN101-62
8	43	B-Y	CN25-1
9	-	-	-
10	-	-	-

CN20



NO	P	C	J
1	67	-	SW ₂
2	N1	-	SW ₂



NO	P	C	J
1	67	P	CN102-18
2	N1	W-B	J5

CN27



NO	P	C	J
1	104	-	LT-R
2	N1	-	GND
3	108	-	LF-RR
4	111	-	LST-R
5	103	-	LBU-R
6	-	-	-



NO	P	C	J
1	104	G	J3
2	N1	W	J15
3	108	BR	CN22-1
4	111	SL	J16
5	103	O	J14
6	-	-	-

CN28



NO	P	C	J
1	190	-	DM ₂



NO	P	C	J
1	190	-	CN9-1

CN29



NO	P	C	J
1	190	-	DM ₂
2	190	-	DM ₂



NO	P	C	J
1	190	-	CN23-1
2	190	-	CN23-1

CN30



NO	P	C	J
1	102	W	LH-L
2	N1	W	LH-L



NO	P	C	J
1	102	Y	CN7-3
2	N1	W	CN7-1

CN31



NO	P	C	J
1	102	W	LH-R
2	N1	W	LH-R



NO	P	C	J
1	102	Y	CN15-3
2	N1	W	CN15-1

CN32



NO	P	C	J
1	107	-	L ₂
2	N1	-	L ₂



NO	P	C	J
1	107	V	CN26-1
2	N1	W	CN26-2

CN101



REC

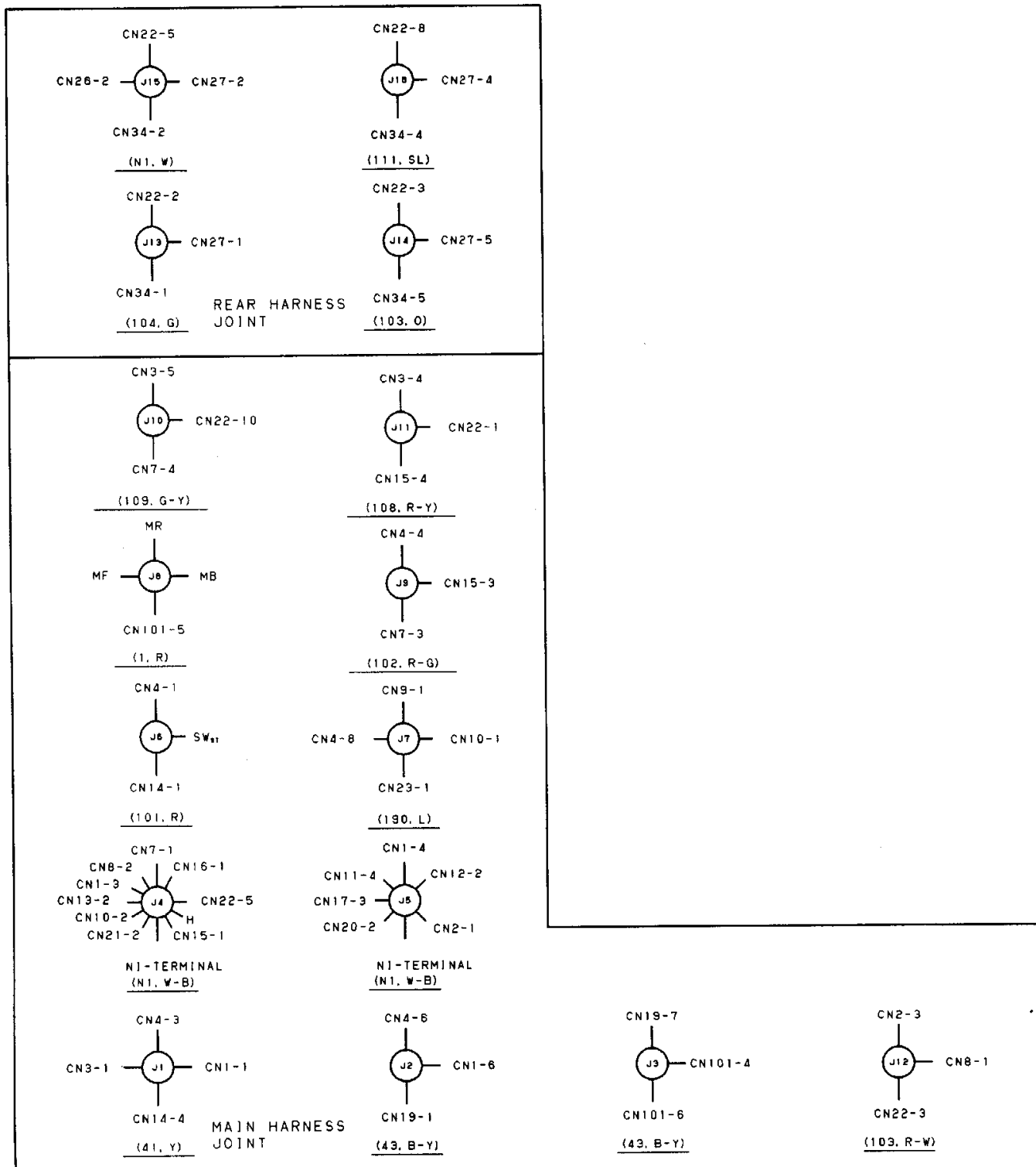
NO	P	C	J
4	43	B-Y	J3
5	1	R	MR
6	43	B-Y	CN19-1
7	5	W	MB
8	2	O	MF
9	3	BR	MR

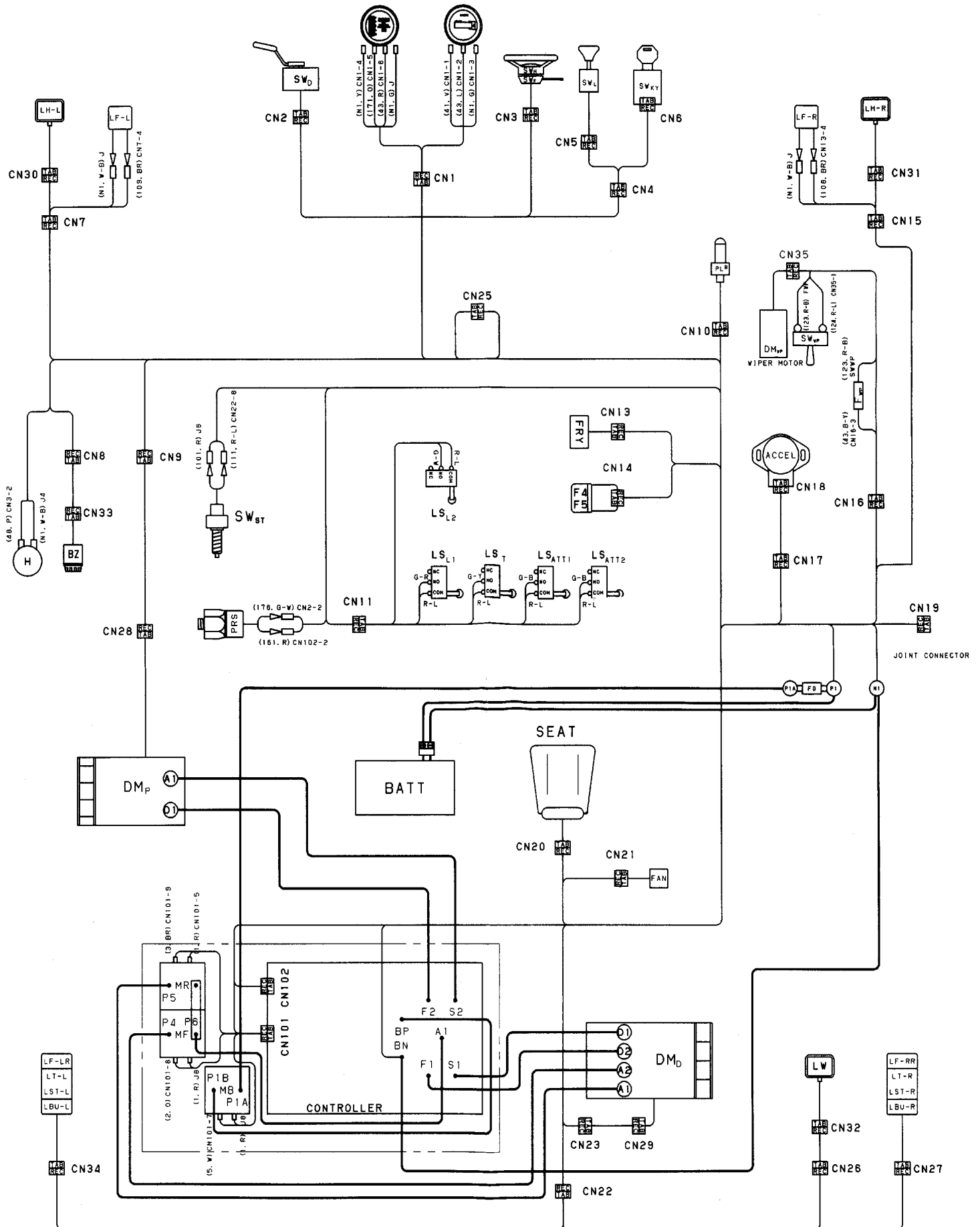
CN102



REC

NO	P	C	J
2	161	R	PRS
3	61	Y	CN11-6
4	68	O	CN11-3
6	60	G-Y	CN11-1
7	63	L	CN11-5
13	25	W	CN2-5
14	48	O	CN2-4
15	64	R-Y	CN17-4
16	67	P	CN20-1
20	171	G-W	CN1-5
22	52	GR	CN17-1
24	59	R-B	CN17-2

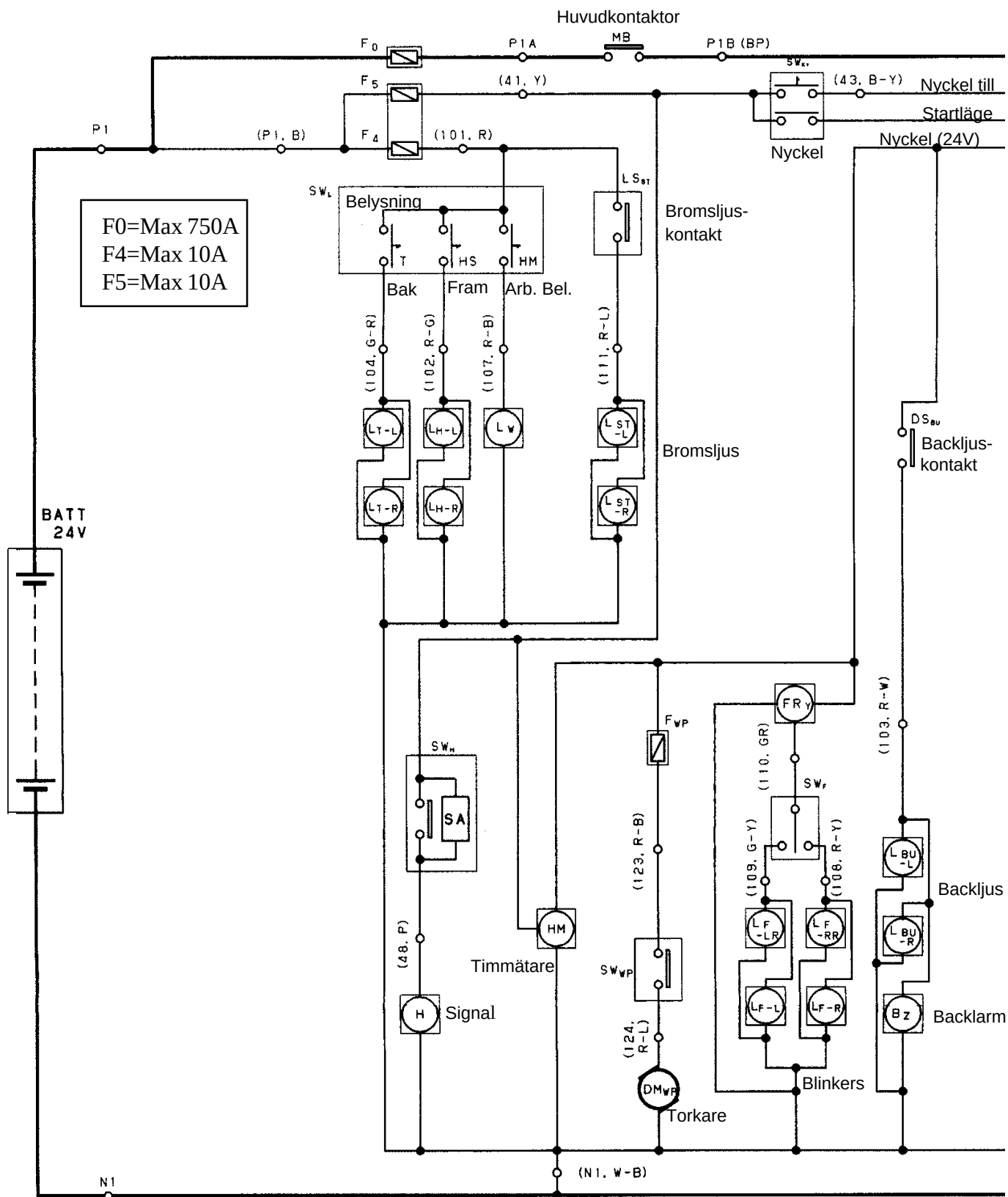




BATT	BATTERY
CS _d	CURRENT SENSOR, DRIVE
CS _p	CURRENT SENSOR, PUMP
F0	FUSE, MOTOR
F4	FUSE, LAMP
F5	FUSE, CONTROL CIRCUIT
F _{wp}	FUSE, WIPER
DM _d	MOTOR, DRIVE
DM _p	MOTOR, PUMP
DM _{wp}	MOTOR, WIPER
TMD	TRANSISTOR, MAIN, DRIVE
TMP	TRANSISTOR, MAIN, PUMP
VRAD	VARI-OHM, ACCEL, DRIVE
DF ₁	DIODE, FLY-WHEEL, NO.1
DF ₂	DIODE, FLY-WHEEL, NO.2
DF ₃	DIODE, FLY-WHEEL, NO.3

MF	CONTACTOR, FORWARD
MR	CONTACTOR, REVERSE
MB	CONTACTOR, BATTERY
DS _f	DIRECTION SWITCH, FORWARD
DS _r	DIRECTION SWITCH, REVERSE
DS _{bu}	DIRECTION SWITCH, BACK-UP
LS _{L1}	LIMIT SWITCH, LIFT NO.1
LS _{L2}	LIMIT SWITCH, LIFT NO.2
LS _t	LIMIT SWITCH, TILT
LS _{ATT1}	LIMIT SWITCH, ATTACHMENT1
LS _{ATT2}	LIMIT SWITCH, ATTACHMENT2
LS _{st}	LIMIT SWITCH, STOP LAMP
SW _s	SWITCH, SEAT
SW _{ky}	SWITCH, KEY
SW _L	SWITCH, LIGHT
SW _f	SWITCH, FLASHER
SW _h	SWITCH, HORN
SW _{wp}	SWITCH, WIPER
PRS	SWITCH, PRESSURE

PL _b	PILOT LAMP, BRUSH
L _{H-L}	LAMP, HEAD LH
L _{H-R}	LAMP, HEAD RH
L _{T-L}	LAMP, TAIL LH
L _{T-R}	LAMP, TAIL RH
L _w	LAMP, WORKING
L _{f-LR}	LAMP, FLASHER LH (REAR)
L _{f-RR}	LAMP, FLASHER RH (REAR)
L _{f-L}	LAMP, FLASHER LH
L _{f-R}	LAMP, FLASHER RH
L _{st-L}	LAMP, STOP LH
L _{st-R}	LAMP, STOP RH
L _{bu-L}	LAMP, BACK-UP LH
L _{bu-R}	LAMP, BACK-UP RH
B _z	BUZZER
H	HORN
FR _f	RELAY, FLASHER
HM	HOUR, METER
BDI	BATTERY DISCHARGE INDICATOR
FAN	FAN



Kabelfärger på elschema

L = Ljusblå W = Vit R = Röd B = Svart G = Grön P = Rosa Y = Gul
 BR = Brun LG = Ljusgrön DG = Mörkgrå PU = Lila O = Orange

