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MENU

FOREWORD

This workshop manual has been prepared to provide information regarding repair procedures on Hino Trucks.

Applicable for HINO 238, 258LP, 268, 338 series, equipped with J08E-VB and J08E-VC engine

When making any repairs on your vehicle, be careful not to be injured through improper procedures.
As for maintenance items, refer to the Driver's / Owner's Manual.
All information and specifications in this manual are based upon the latest product information available at the time of printing.
Hino Motors Sales U.S.A., Inc. reserves the right to make changes at any time without prior notice.

Please note that the publications below have also been prepared as relevant workshop manuals for the components and systems in these vehicles.

Manual Name	Pub. No.
Chassis Workshop Manual	S1-UNAE11A 2/2
J08E-VB, VC Engine Workshop Manual	S5-UJ08E11A
Trouble Shooting Workshop Manual	S7-UNAE11A 1/3 S7-UNAE11A 2/3 S7-UNAE11A 3/3

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CHAPTER REFERENCES REGARDING THIS WORKSHOP MANUAL

Use this chart to the appropriate chapter numbers for servicing your particular vehicle.

CHAPTER			
	MANUAL NO.	S1-UNAE11A 1/2 (U.S.A.), S1-CNAE11A 1/2 (CANADA)	
	MODELS	HINO 238, 258LP, 268, 338, 358	
	Production Model Code	NE8J, NF8J, NJ8J, NV8J	
GENERAL INTRODUCTION		GN02-001	
CLUTCH MAIN UNIT		CL02-001	CL02-002
CLUTCH CONTROL		CL03-001	
TRANSMISSION MAIN UNIT		TR02-001	
AUTOMATIC TRANSMISSION		TR04-001	TR04-002
TRANSMISSION/TRANSFER CONTROL		TR06-001	TR06-002
PROPELLER SHAFT		PP02-001	
DIFFERENTIAL CARRIER		DF02-001	
BRAKE EQUIPMENT		BR01-001	BR01-002
SERVICE BRAKE		BR02-001	BR02-002
ABS (ANTI-LOCK BRAKE SYSTEM)		BR03-001	BR03-002
EXHAUST BRAKE		BR05-001	
PARKING BRAKE		BR07-001	
STEERING EQUIPMENT		SR01-001	
STEERING UNIT		SR02-001	
POWER STEERING		SR03-001	
FRONT AXLE		AX02-001	
REAR AXLE		AX03-001	
WHEEL & TIRE		AX04-001	
SUSPENSION		SU02-001	
CHASSIS FRAME		FC02-001	
CAB		CA02-001	
ELECTRICAL EQUIPMENT		EL01-001	
ELECTRIC WIRE		EL02-001	

This manual does not contain items on half-tone dot meshing.

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HINO

WORKSHOP MANUAL

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CLUTCH MAIN UNIT

CLUTCH CONTROL

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TRANSMISSION MAIN UNIT

TRANSFER MAIN UNIT

AUTOMATIC TRANSMISSION

PTO (POWER TAKE-OFF)

TRANSMISSION / TRANSFER CONTROL

PROPELLER SHAFT EQUIPMENT

PROPELLER SHAFT

DIFFERENTIAL EQUIPMENT

DIFFERENTIAL CARRIER

BRAKE EQUIPMENT

SERVICE BRAKE

ABS

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GENERAL INTRODUCTION (CHASSIS)

GN02-001

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GENERAL INTRODUCTION

GENERAL PRECAUTIONS

EN00Z00020100001

Some recommended and standard maintenance services for your vehicle are included in this section. When performing maintenance on your vehicle be careful not to get injured by improper work. Improper or incomplete work can cause a malfunction of the vehicle which may result in personal injury and/or property damage. If you have any question about performing maintenance, please consult your Hino dealer.

WARNING

When working on your vehicle, observe the following general precautions to prevent death, personal injury and/or property damage in addition to the particular DANGERS, WARNINGS, CAUTIONS and NOTICES in each chapter.

- **Always wear safety glasses or goggles to protect your eyes.**
- **Remove rings, watches, ties, loose hanging jewelry and loose clothing before starting work on the vehicle.**
- **Bind long hair securely behind the head.**
- **When working on the vehicle, apply the parking brake firmly, place the gear shift lever in "Neutral" or "N" and block the wheels.**
- **Always turn off the starter switch to stop the engine, unless the operation requires the engine running. Removing the key from the switch is recommended.**
- **To avoid serious burns, keep yourself away from hot metal parts such as the engine, exhaust manifold, radiator, muffler, exhaust pipe and tail pipe.**
- **Do not smoke while working on the vehicle since fuel, and gas from battery are flammable.**
- **Take utmost care when working on the battery. It contains corrosive sulfuric acid.**
- **Large electric current flows through the battery cable and starter cable. Be careful not to cause a short which can result in personal injury and/or property damage.**
- **Read carefully and observe the instructions specified on the jack before using it.**
- **Use safety stands to support the vehicle whenever you need to work under it. It is dangerous to work under a vehicle supported only by a jack.**
- **If it is necessary to run the engine after the hood is raised (tilted), make sure that the parking brake is firmly applied, the wheels are blocked, and the gear shift lever is positioned in "Neutral" before staring the engine.**
- **Run the engine only in a well-ventilated area to avoid inhalation of carbon monoxide.**
- **Keep yourself, your clothing and your tools away from moving parts such as the cooling fan and V-belts when the engine is running.**
- **Be careful not to damage lines and hoses by stepping or holding your feet on them.**
- **Be careful not to leave any tool in the engine compartment. The tool may be hit by moving parts, which can cause personal injury.**

DEFINITION OF SAFETY TERMS

⚠ DANGER	**Indicates an extremely hazardous situation if proper procedures are not followed and could result in death or serious injury.**
⚠ WARNING	**Indicates a potential hazardous situation if proper procedures are not followed and could result in death or serious injury.**
⚠ CAUTION	**Indicates a hazardous situation if proper procedures are not followed and could result in serious injury or damage to parts/equipment.**
NOTICE	**Indicates the need to follow proper procedures and to pay attention to precautions so that efficient service is provided.**
HINT	**Provides additional information to help you to perform the repair efficiently.**

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TOWING

- When being towed, always place the gear shift lever in "Neutral" and release the parking brake completely. In order to protect the bumper, fit a protection bar against the lower edge of the bumper and put a wood block under the frame near the No. 1 cross member when attaching the towing chain. Never lift or tow the vehicle if the chain is in direct contact with the bumper.

1. Towing procedures

(1) Make sure that the propeller shaft of the vehicle to be towed is removed. When the differential gear or rear axle shaft is defective, remove both right and left rear axle shafts, then cover the hub opening to prevent loss of axle lubricant and entry of dirt or foreign matter.
(2) Use a heavy duty cable or rope when towing the vehicle. Fasten the cable securely to the towing hook on the frame.
(3) The angle of pulling direction of the cable fastened to the towing hook must not exceed 15° in horizontal and vertical directions from the straight ahead, level direction. Avoid using the hook in a way that subjects it to jerk, as in towing a vehicle trapped in a gutter.
(4) Keep the gear shift lever in Neutral.
(5) Make sure that the starter switch is kept in the "ON" position, if the engine is not running.
(6) Make sure that the engine of the towed vehicle is kept running. If the engine is off, no compressed air/ no vacuum will be available for the brake. This is dangerous, as the brake system does not function if the engine is not running.
In addition, the power steering system will not function. The steering wheel, therefore, will become unusually hard to turn, making it impossible to control the vehicle.
(7) Note that the engine brake and exhaust brake cannot be applied, if the propeller shaft is removed.
(8) Make a slow start to minimize shock. Towing speed should be less than 30 km/h {18 mile/h}.

2. If the engine of the towed vehicle is defective, make sure that the vehicle is towed only by a tow truck designed for that purpose.

(1) Front end towing (with front wheels raised off the ground)
When towing from the front end with the front wheels raised off the ground, remove the rear axle shafts to protect the transmission and differential gears from being damaged. The hub openings should be covered to prevent the loss of axle lubricant or the entry of dirt or foreign matter. The above-mentioned precautions should be observed for vehicles equipped with either manual or automatic transmission, and for even short distance towing. After being towed, check and refill the rear axle housing with lubricant if necessary.
(2) Rear end towing
When being towed with the rear wheels raised off the ground, fasten and secure the steering wheel in a straight-ahead position.

CLEAN AIR ACT

1. Heavy-duty engine rebuilding practices.
§ 86.004-40

- The provisions of this section are applicable to heavy-duty engines subject to model year 2004 or later standards and are applicable to the process of engine rebuilding (or rebuilding a portion of an engine or engine system). The process of engine rebuilding generally includes disassembly, replacement of multiple parts due to wear, and reassembly, and also may include the removal of the engine from the vehicle and other acts associated with rebuilding an engine. Any deviation from the provisions contained in this section is a prohibited act under section 203(a) (3) of the Clean Air Act (42 U.S.C. 7522(a) (3)).

(1) When rebuilding an engine, portions of an engine, or an engine system, there must be a reasonable technical basis for knowing that the resultant engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, specifications) and the model year(s) of the resulting engine configuration must be identified. A reasonable basis would exist if:
   a. Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of motor vehicle engines would reasonably believe that the parts perform the same function with respect to emissions control as the original parts; and
   b. Any parameter adjustment or design element change is made only:
      • In accordance with the original engine manufacturer's instructions; or
      • Where data or other reasonable technical basis exists that such parameter adjustment or design element change, when performed on the engine or similar engines, is not expected to adversely affect in-use emissions.
(2) When an engine is being rebuilt and remains installed or is reinstalled in the same vehicle, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine.

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(3) At time of rebuild, emissions-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes, regardless of whether the systems are installed to satisfy requirements in § 86.004-25 or for other reasons and regardless of form or interface. Diagnostic systems must be free of all such codes when the rebuilt engine is returned to service. Such signals may not be rendered inoperative during the rebuilding process.

(4) When conducting a rebuild without removing the engine from the vehicle, or during the installation of a rebuilt engine, all critical emissions-related components listed in § 86.004-25(2) not otherwise addressed by paragraphs (1) through (3) of this section must be checked and cleaned, adjusted, repaired, or replaced as necessary, following manufacturer recommended practices.

(5) Records shall be kept by parties conducting activities included in paragraphs (1) through (4) of this section. The records shall include at minimum the mileage and/or hours at time of rebuild, a listing of work performed on the engine and emissions-related control components including a listing of parts and components used, engine parameter adjustments, emissions-related codes or signals responded to and reset, and work performed under paragraph (4) of this section.

a. Parties may keep records in whatever format or system they choose as long as the records are understandable to an EPA enforcement officer or can be otherwise provided to an EPA enforcement officer in an understandable format when requested.

b. Parties are not required to keep records of information that is not reasonably available through normal business practices including information on activities not conducted by themselves or information that they cannot reasonably access.

c. Parties may keep records of their rebuilding practices for an engine family rather than on each individual engine rebuilt in cases where those rebuild practices are followed routinely.

d. Records must be kept for a minimum of two years after the engine is rebuilt.

2. Maintenance instructions.
§ 86.010-38

(1) For each new diesel-fueled engine subject to the standards prescribed in § 86.007-11, as applicable, the manufacturer shall furnish or cause to be furnished to the ultimate purchaser a statement that
"This engine must be operated only with ultra low-sulfur diesel fuel (meeting EPA specifications for highway diesel fuel, including a 15 ppm sulfur cap)."

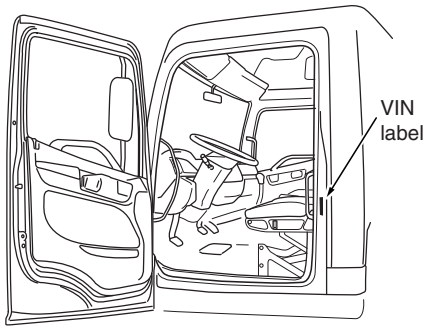
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IDENTIFICATION INFORMATION

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1. VEHICLE IDENTIFICATION NUMBER

- VEHICLE IDENTIFICATION NUMBER (VIN) is comprised of 17 digits and letters. The VIN label is affixed to the left pillar of the cab.
  These numbers are used for identification purposes when you have a vehicle registered or inspected. Please quote these numbers when ordering spare parts or reporting technical matter to receive prompt service attention.
- The following is an explanation of the items that are listed on the VIN label.



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(1) VIN
See VEHICLE IDENTIFICATION NUMBER (VIN) STRUCTURE on the following page.
(2) P.S. (PRODUCTION SERIES) AND VEHICLE COMPONENTS

MODEL (CLASS)	PRODUCTION CODE		CLUTCH SIZE	TRANSMISSION SERIES	TRANSMISSION RATIO							REAR AXLE SERIES	SERVICE BRAKE	PARKING BRAKE	SUSPENSION
	MODEL	SERIES			1st	2nd	3rd	4th	5th	6th	Rev.				
HINO238 (6)	NE8J	HBC	-	2200HS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145	H	D	L or A
												RS19-145			
				2200RDS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
				2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS17-145			
												RS19-145			
HINO258 (6)	NE8J	GBC	350mm	FS5406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS17-145	H	D	L or A
												RS19-145			
		HBC	-	2200HS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2200RDS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS17-145			
												RS19-145			
	NJ8J	JBC	350mm	FS5406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS17-145	F	W	A
												RS19-145			
		KBC	-	2200HS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145	F	W	L or A
												RS19-145			
			-	2200RDS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS17-145			
												RS19-145			
HINO268 (6)	NE8J	GBC	350mm	FS5406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS17-145	H	D	L or A
												RS19-145			
		HBC	-	2200HS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2200RDS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS17-145			
												RS19-145			

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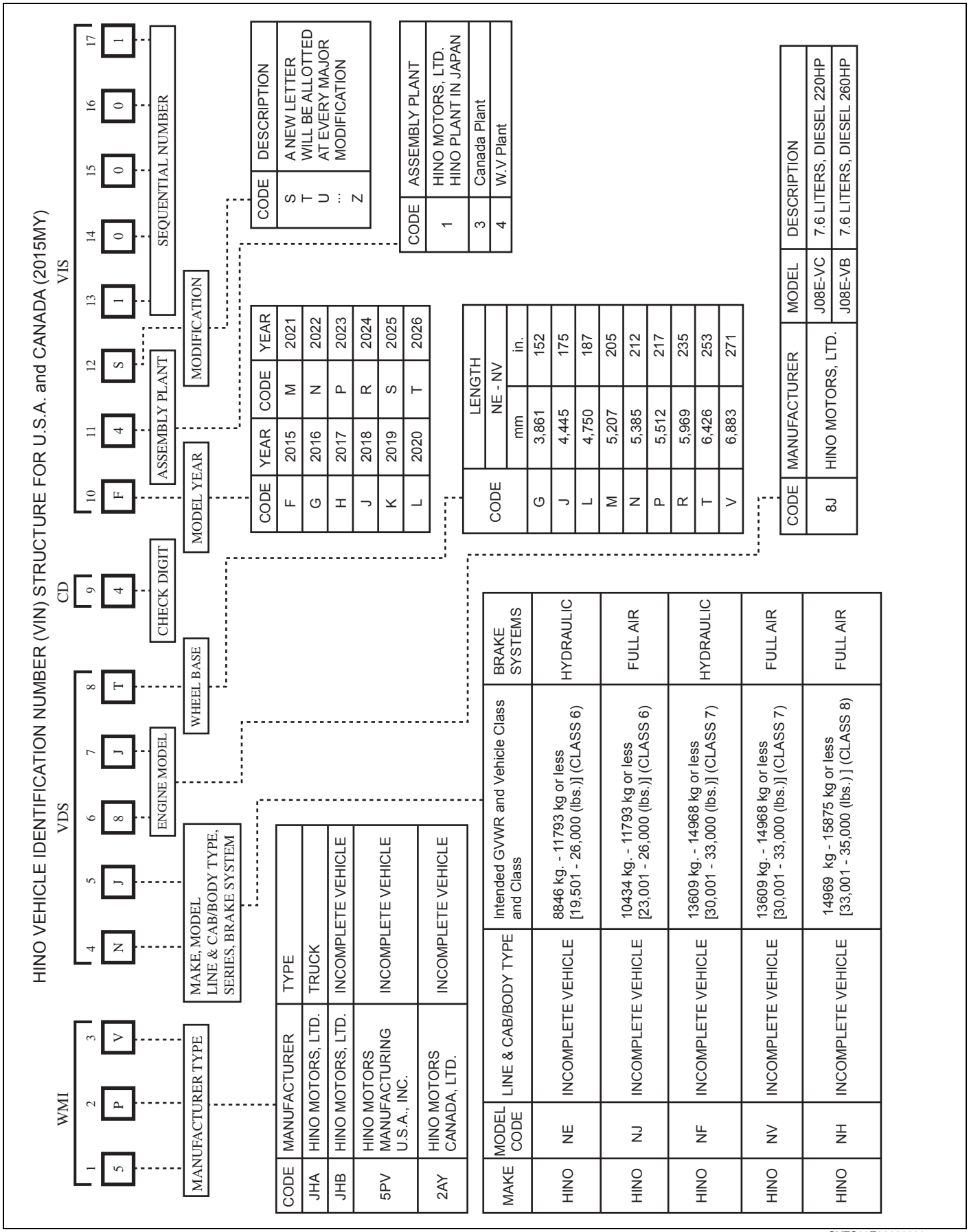
MODEL (CLASS)	PRODUCTION CODE		CLUTCH SIZE	TRANSMISSION SERIES	TRANSMISSION RATIO							REAR AXLE SERIES	SERVICE BRAKE	PARKING BRAKE	SUSPENSION
	MODEL	SERIES			1st	2nd	3rd	4th	5th	6th	Rev.				
HINO268 (6)	NJ8J	JBC	350mm	FS5406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS17-145	F	W	L or A
												RS19-145			
		KBC	-	2200HS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2200RDS	3.10	1.81	1.41	1.00	0.71	0.61	4.49	RS17-145			
												RS19-145			
			-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS17-145			
												RS19-145			
HINO268 (7)	NV8J	NBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS21-145			
												RS23-160			
		PBC	-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS21-145	F	W	L or A
												RS23-160			
			-	3000RDS	3.49	1.86	1.41	1.00	0.75	0.65	5.03	RS21-145			
												RS23-160			
			-	3500RDS	4.59	2.25	1.54	1.00	0.75	0.65	5.00	RS21-145			
												RS23-160			
		TBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS21-145			
												RS23-160			
		SBC	-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS21-145			
												RS23-160			
			-	3000RDS	3.49	1.86	1.41	1.00	0.75	0.65	5.03	RS21-145			
												RS23-160			
			-	3500RDS	4.59	2.25	1.54	1.00	0.75	0.65	5.00	RS21-145			
												RS23-160			
HINO338 (7)	NF8J	DBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS21-145	H	D	L or A
		EBC	-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS21-145			
	NV8J	NBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS21-145	F	W	
												RS23-160			

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MODEL (CLASS)	PRODUCTION CODE		CLUTCH SIZE	TRANSMISSION SERIES	TRANSMISSION RATIO							REAR AXLE SERIES	SERVICE BRAKE	PARKING BRAKE	SUSPENSION
	MODEL	SERIES			1st	2nd	3rd	4th	5th	6th	Rev.				
HINO338 (7)	NV8J	PBC	-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS21-145	F	W	L or A
												RS23-160			
			-	3000RDS	3.49	1.86	1.41	1.00	0.75	0.65	5.03	RS21-145			
												RS23-160			
			-	3500RDS	4.59	2.25	1.54	1.00	0.75	0.65	5.00	RS21-145			
												RS23-160			
		TBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS21-145			
												RS23-160			
		SBC	-	2500RDS	3.51	1.90	1.44	1.00	0.74	0.64	5.09	RS21-145			
												RS23-160			
			-	3000RDS	3.49	1.86	1.41	1.00	0.75	0.65	5.03	RS21-145			
												RS23-160			
			-	3500RDS	4.59	2.25	1.54	1.00	0.75	0.65	5.00	RS21-145			
												RS23-160			
HINO358 (8)	NH8J	NBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS23-160	F	W	L or A
		PBC	-	3000RDS	3.49	1.86	1.41	1.00	0.75	0.65	5.03	RS23-160			
			-	3500RDS	4.59	2.25	1.54	1.00	0.75	0.65	5.00	RS23-160			
		TBC	350mm	FS6406	9.01	5.27	3.22	2.04	1.36	1.00	8.63	RS23-160			
		SBC	-	3000RDS	3.49	1.86	1.41	1.00	0.75	0.65	5.03	RS23-160	F	W	L or A
			-	3500RDS	4.59	2.25	1.54	1.00	0.75	0.65	5.00	RS23-160			

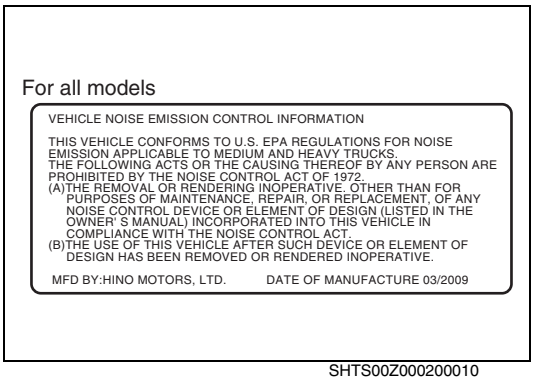
CODE	SERVICE BRAKE	PARKING BRAKE CONTROL CODE	SUSPENSION
	H: Hydraulic	D: ACTING ON DIFFERENTIAL	L: LEAF
	F: Full air	W: ACTING ON REAR WHEEL	A: AIR

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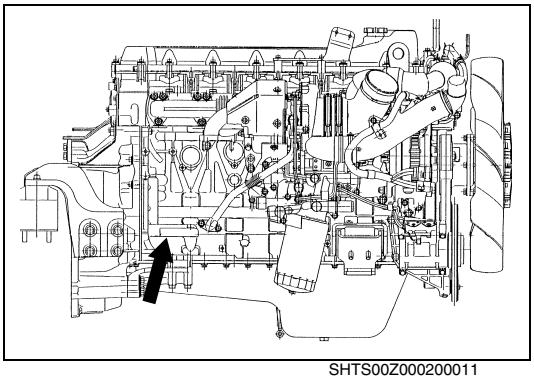
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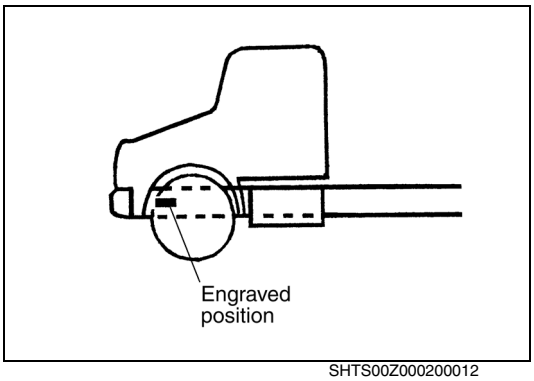
2. VEHICLE NOISE EMISSION CONTROL INFORMATION

- The Vehicle Noise Emission Control Information is affixed to the side of the left door. The name of manufacturer, production year and month, and noise emission applicable to medium and heavy trucks in conformity with U.S. EPA Regulations are displayed.


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3. ENGINE SERIAL NUMBERS.

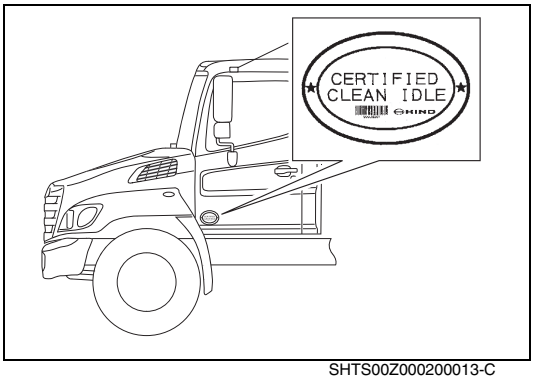
- Please quote these numbers when ordering spare parts or reporting technical matter to receive prompt service attention.
  The engine serial number is engraved on the engine cylinder block.



SHTS00Z000200012

4. CHASSIS SERIAL NUMBER

- Chassis serial number is engraved on the left side frame near the front wheel.



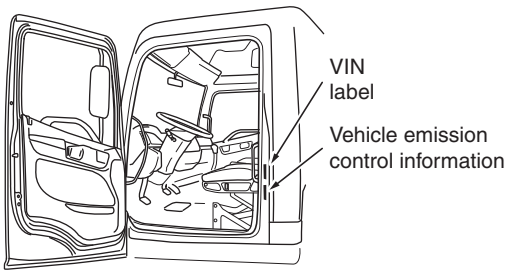
SHTS00Z000200013-C

5. CLEAN IDLE CERTIFIED LABEL FOR U.S.

- Make sure that the following clean engine idling certified label is affixed to the outside of the left door.
  By the CARB below, the label must be affixed there to prove that the new vehicle with diesel engine manufactured from Jan., 2008 conforms to this low.

CARB § 1956.8. Exhaust Emission Standard and Test Procedure (a) (b) Heavy-Duty Diesel Engine Idling Requirements

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GN02-13-1-0

For example

VEHICLE EMISSION CONTROL INFORMATION
Hino Motors, Ltd.
VEHICLE FAMILY NAME : FHMX2V0CVBNN
REGULATORY SUB-CATEGORY: VOCATIONAL VEHICLES:19,500<GVWR≤33,000 LBS.
EMISSION CONTROL SYSTEM : LRRA
THIS VEHICLE COMPLIES WITH U.S. EPA REGULATIONS
FOR 2015 MY HEAVY-DUTY VEHICLES.

GN02-13-1-1

6. VEHICLE EMISSION CONTROL INFORMATION

- The Vehicle Emission Control Information is affixed to the side of the left door. The name of manufacturer, production year and month, and emission applicable to medium and heavy trucks in conformity with U.S. EPA Regulations are displayed.

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HOW TO USE THIS WORKSHOP MANUAL

EN00Z00020200002

This workshop manual is designed as a guide for servicing the vehicle.
An INDEX is provided on the first page of each chapter.

TROUBLESHOOTING is dealt with in each chapter.
When beginning operations, refer to the TROUBLESHOOTING section for a guide to appropriate diagnosis.

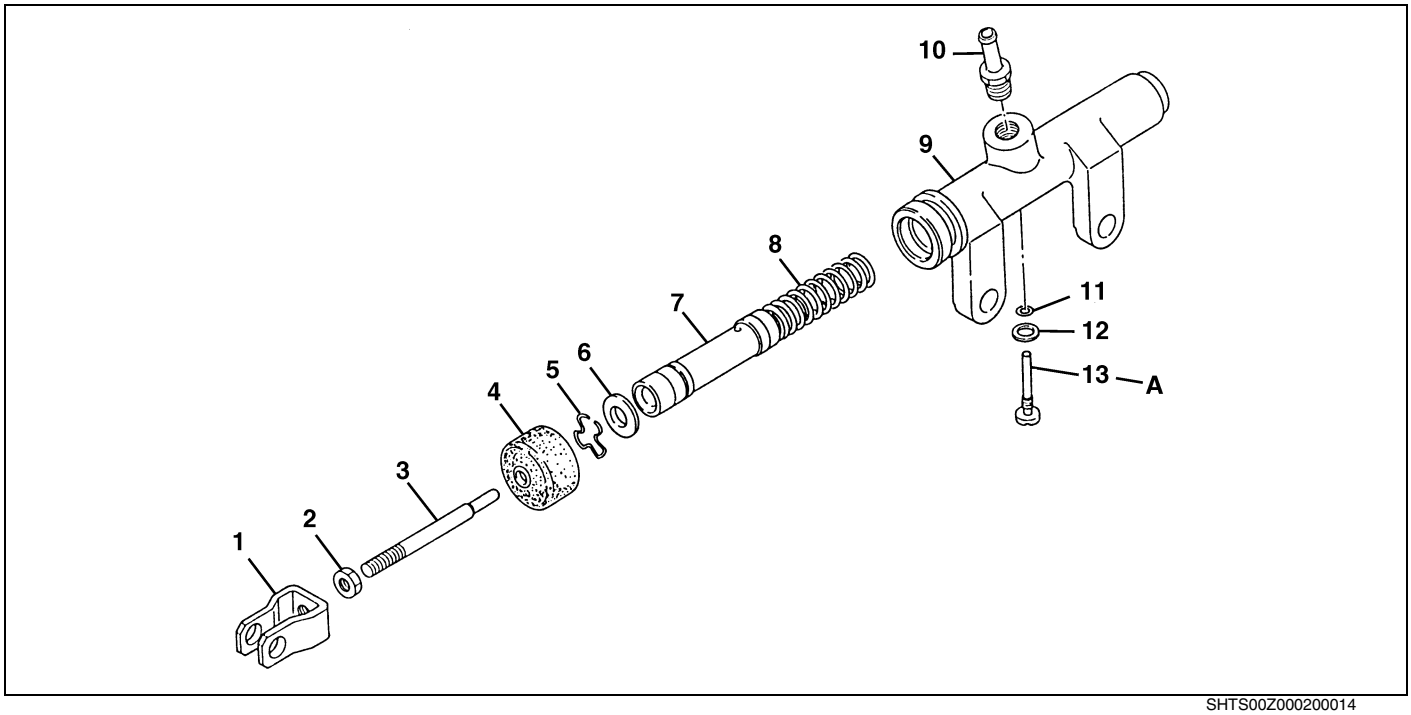
SPECIAL TOOL is dealt with in each chapter.
When ordering a special tool, confirm the part number with the applicable parts catalog.

- **RERAIR PROCEDURES**
  Repair procedures when self-explanatory, such as simple installation and removal of parts, have been omitted. Illustrations, such as the one below, have been provided to make such simple procedures clear. Only essential procedures requiring specific directions have been dealt with explicitly.

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MAIN CYLINDER

EXAMPLE:



SHTS00Z000200014

1	Clevis	8	Return spring
2	Lock nut	9	Body
3	Push rod	10	Hose joint
4	Boot	11	O-ring
5	Retainer ring	12	Soft washer
6	Thrust washer	13	Bolt
7	Piston		

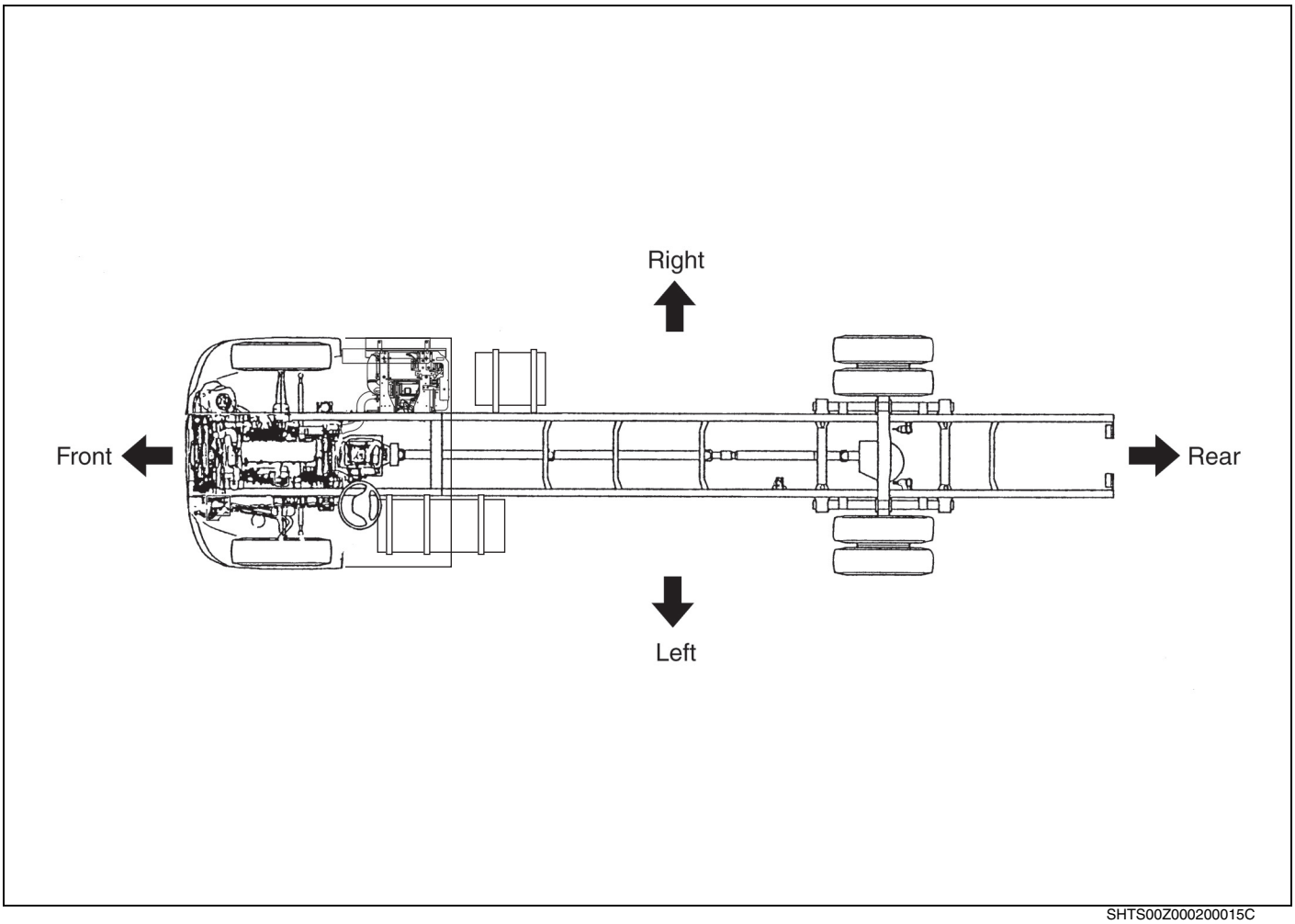
Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	2.5-4.4 {25-45, 1.8-3.2}	

In some cases, illustrations may be of parts which differ in some nonessential way from the parts found on your particular vehicle. In such cases, the principle or procedure being illustrated applies regardless of such nonessential differences.

- **DEFINITION OF TERMS**
  Definition of vehicle right and left.
  Right and left refers to the left and right sides of the vehicle as seen while looking down the center line from the rear towards the front.

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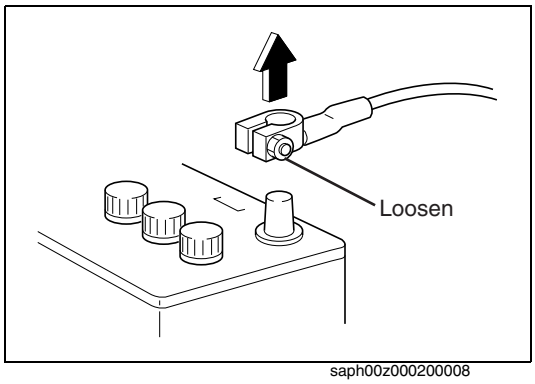


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PRECAUTIONS

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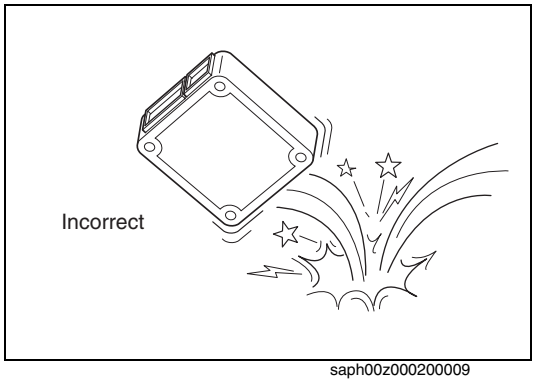
PRECAUTIONS FOR ELECTRICAL SYSTEM

1. REMOVING THE BATTERY CABLE

⚠ WARNING

- **Be sure to wait for at least ten minutes after the starter key is turned to "LOCK" position before you disconnect the battery terminals from the battery, as the vehicle data is recorded on ECU and DCU starts working for the exhaust gas after treatment after the starter key is turned to "LOCK" position. Otherwise, the vehicle data will not be recorded on ECU properly and DCU will not complete working properly, which may result in the malfunction of DPR system and DEF-SCR system.**
- **The MIL (malfunction indicator light) may come on when the starter key is turned to "ON" position again, even if you wait for at least ten minutes before disconnecting the battery terminals from the battery after the starter key is turned to "LOCK" position. In this case, use HINO DX II to clear the DTC (P204F and P068A), to turn off the MIL and to conduct DPR regeneration manually.**

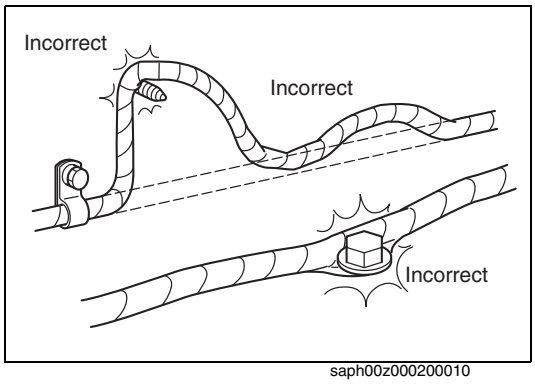
(1) Before electrical system work, remove the cable from the minus terminal of the battery in order to avoid burning caused by short-circuiting.
(2) To remove the battery cable, fully release the nut to avoid damage to the battery terminal. Never twist the terminal.



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2. HANDLING OF ELECTRONIC PARTS

(1) Never give an impact to electronic parts of a computer or relay.
(2) Keep electronic parts away from high temperatures and humidity.
(3) Never splash water onto electronic parts in washing the vehicle.
(4) Do not remove the harness connector, electric component box, and cover except for repair and inspection.
If removal is necessary, pay attention that water and foreign matters do not attach or enter to the connector, terminals, electric component box, and cover.
In restoration, make sure there is no attachment or entry of water and foreign matters and mount them properly, because it causes degradation of waterproof function.

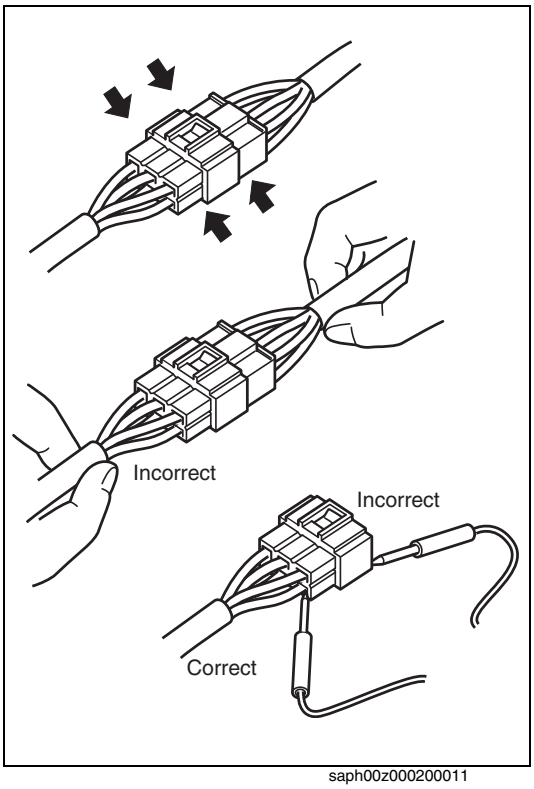


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3. HANDLING OF WIRE HARNESS

(1) Perform marking on a clamp and a clip and secure then in original position so that the wire harness will not interfere with the end and acute angle section of the body and a bolt.
(2) To attach a part, take care not to bite the wire harness.

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4. HANDLING OF CONNECTOR

(1) To remove a connector, hold the connector (indicated by an arrow in the figure) to pull it out. Never pull the harness.
(2) To remove a connector with lock, release the lock then pull it out.
(3) To connect a connector with lock, insert it until it clicks.
(4) To insert a test lead into the connector, insert it from behind the connector.
(5) In case it is difficult to insert a test lead from behind the connector, prepare a harness for inspection and perform inspection.

5. INSTALLATION OF BATTERY DISCONNECT SWITCH

⚠ WARNING

- **Installation of the battery disconnect switch on the power supply circuit for the dosing control unit of DEF-SCR (DCU) may damage or result in the malfunction of DEF-SCR system.**
- **Be sure to read and follow the procedures and instructions on the service bulletin before the installation of the battery disconnect switch.**

6. HANDLING OF BATTERY DISCONNECT SWITCH

⚠ WARNING

- **Wait for at least one minute before using the battery disconnect switch after the starter key is turned to "LOCK" position. Otherwise, the vehicle data will not be recorded on ECU properly, which may result in the malfunction of DPR system.**

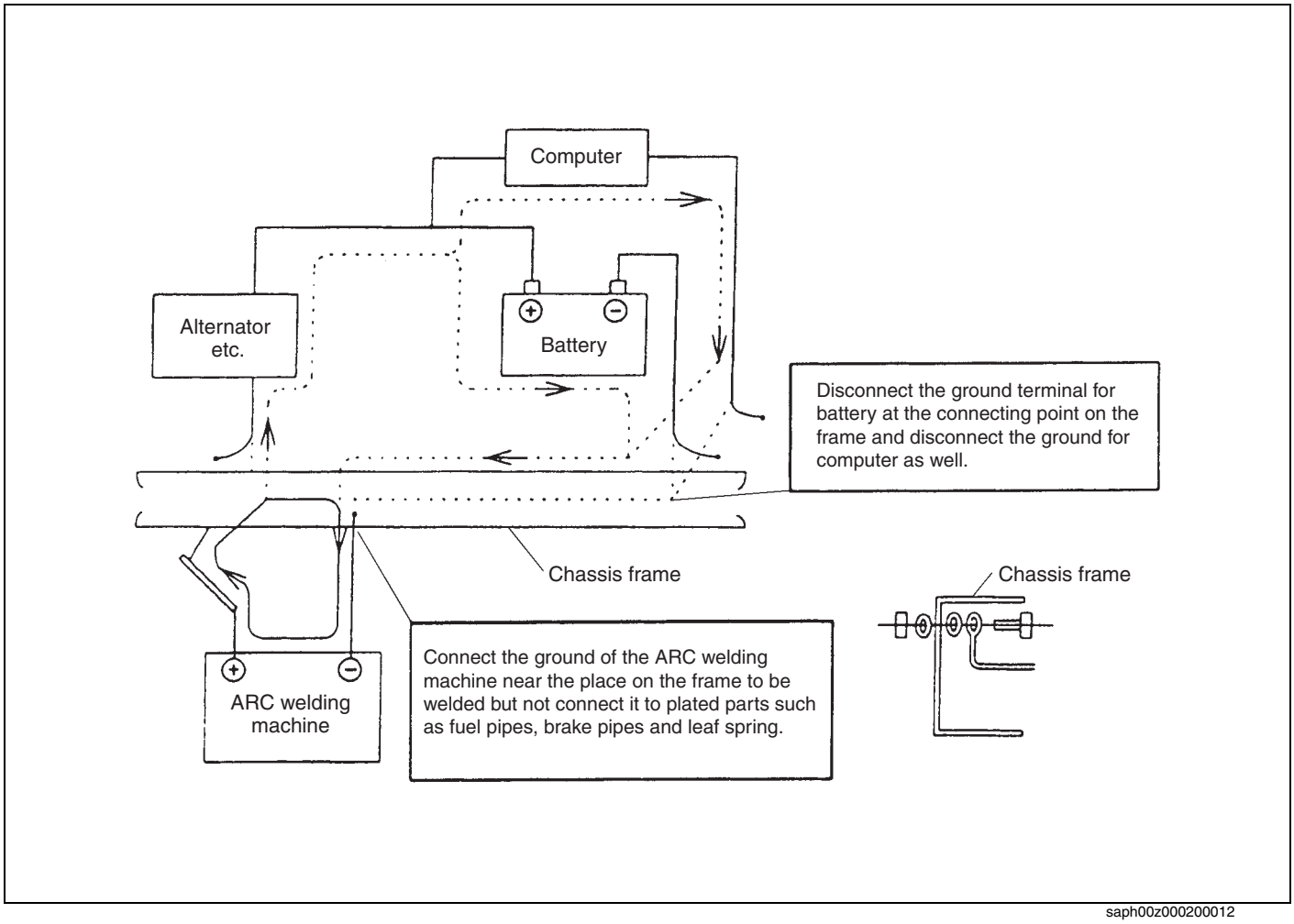
https://truckmanualshub.com/

PRECAUTIONS FOR ELECTRIC WELDING

1. PRECAUTION FOR ELECTRIC WELDING

Electrical components such as the alternator and tachograph are directly connected to the battery and one end is earthed to the chassis frame. Under these conditions, welding current will flow back along the earth circuit if electric welding is carried out and damage may be caused to the alternator, tachograph, electrical components, etc. Consequently, the following precautions are always to be taken during welding.

(1) Disconnect the earth terminal of the battery at the frame fitment and earth the welding equipment securely to the frame itself. (Do not fit the welding equipment earth to such things as the tire rims, brake pipes or fuel pipes and leaf spring, etc.)
   a. Turn the starter switch off.
   b. Disconnect the negative terminal of the battery.
   c. Earth welding equipment securely, near to the area to be welded.
   d. Put back battery negative ground as original condition.
   e. Finally check the functioning of all instruments.



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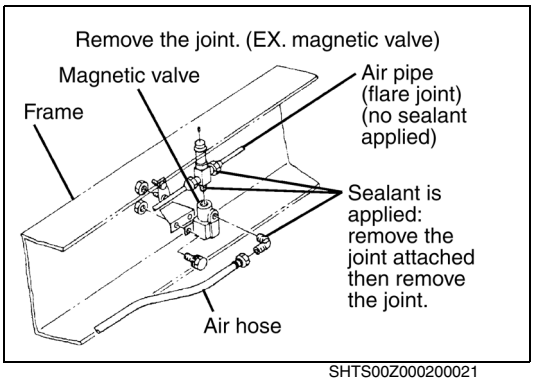
(2) In order to prevent damage to ancillary equipment components from sparks during welding, take steps such as putting fire-resistant covers over things like the engine, meters, steering wheel, hoses, tubes, leaf spring and tires.

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SEALANT ON THE TAPERED SCREW FOR PIPING

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To the tapered thread of the air pipe joint is applied the sealant "LOC-TITE #575". Follow the procedure below to remove/attach the piping.

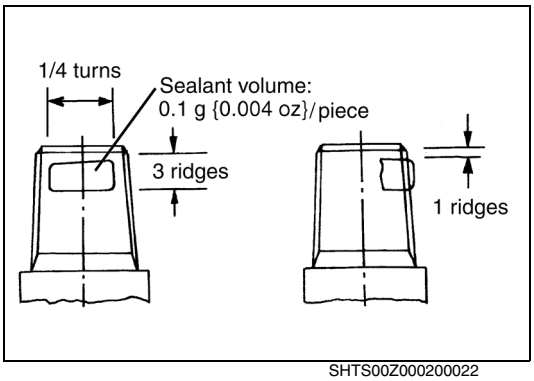


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1. REMOVAL

(1) The sealant (LOCTITE #575) has a high sealing capability. The return torque of taper joint is about 1.5 times as high as the initial tightening torque. To remove the joint, use a longer wrench.

(2) For replacement of joint in a place with poor workability, remove the auxiliaries with the joint attached then remove the joint.



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2. ATTACHING

(1) To apply sealant (LOCTITE #575), use waste and thinner to wipe the dirt off the sealing section, directly apply the sealant by a quarter turn (three ridges) starting from the second ridge from the tip, then assemble in accordance with the tightening torque table below.
Wipe dirt off the mating part (female screw) before tightening it.

⚠ WARNING

In case the sealant has entered your eye or attached to your skin, wash it away in running water.

Tightening torque of tapered joint Unit: N·m {kgf·cm, lbf·ft}

Screw diameter / Material	1/8	1/4	3/8	1/2
Steel	20±5 {200±50, 14.4±3.6}	49±10 {500±100, 36.2±7.2}	64±15 {650±150, 47±10}	
Aluminum, brass		25±5 {250±50, 18.1±3.6}	34±5 {350±50, 25.3±3.6}	44±5 {450±50, 32.5±3.6}

(2) To replace vulcanized tape with sealant, remove the tape beforehand, same as (1).

NOTICE

Take special care not to let dirt and foreign matters enter the piping.

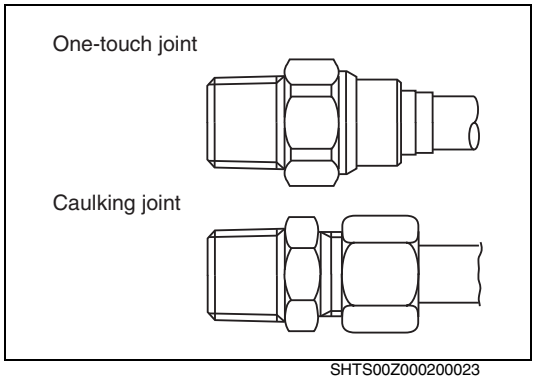
(3) In the event of air leakage after sealant is applied and piping attached, retightening cannot check the air leakage. Follow the steps (1) and (2) to reassemble the piping.

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NYLON TUBE REPLACEMENT METHOD

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NYLON TUBE REPLACEMENT METHOD

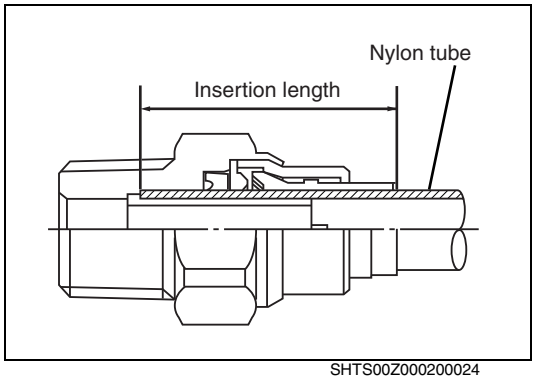


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- In this vehicle, nylon tubes are used for all the air tubes except those on the charge line and the rear axle, the tubing for the wheel power signal, a portion of the accessory system tubing, and for the unloader tubing, and it is also used in joints, depending on the connection conditions of the two types of joints; one-touch joints and caulking joints.

NOTICE

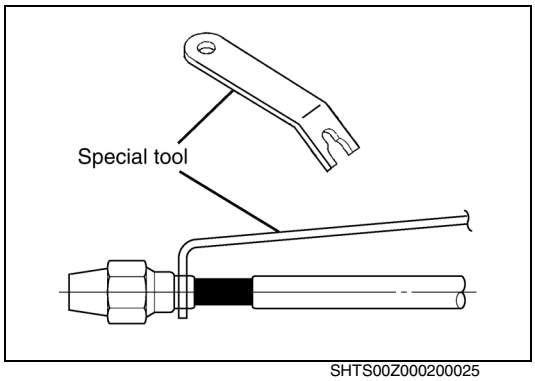
Since the function and quality of nylon tubes and joints are guaranteed as tube and joint sets, the use of parts other than Hino Genuine Parts must be avoided.



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1. ONE-TOUCH JOINT NYLON TUBE INSERTION LENGTH

DIAMETER (Outside diameter x inside diameter)	INSERTION LENGTH mm {in.}
1/4 in.	14-19 {0.55-0.75}
3/8 in.	18-23 {0.71-0.91}
1/2 in.	21-26 {0.83-1.02}

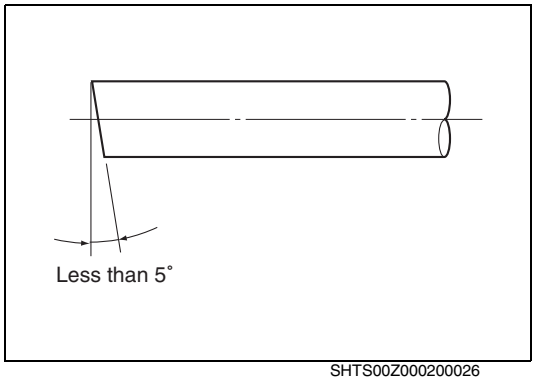


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2. REMOVAL OF A ONE-TOUCH JOINT

(1) Make sure there is no dirt or grease stuck to the connector end. If the end is dirty, clean it thoroughly by air blowing or other means.

(2) Using the special tool for removing the nylon tube to push the connector end, pull off the nylon tube with your hand in one stroke, without stopping partway, pulling the tube in the connector axial direction.
SST: Puller (S0942-11490)



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INSTALLATION OF A ONE-TOUCH JOINT AND CAULKING JOINT

- Make sure the joint interior is free of dirt grease. If the interior is dirty, clean it thoroughly by air blowing or other means.
- Cut off the tube end where the tube surface is scarred by the joint pinch marks, and make sure that the part of the tube inserted into the joint has no surface damage. If the tube is damaged, cut off the damaged part (provided that the tube length is more than sufficient).

NOTICE

Use the special nylon tube cutter when cutting the nylon tube, and cut the tube so that the angle of the cut end to the axial center is 85-95°.

1. INSTALLATION OF A ONE-TOUCH JOINT

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- Before inserting the tube, mark the insertion length on the tube with a white-out pen or similar implement, in accordance with the dimensions, "ONE-TOUCH JOINT NYLON TUBE INSERTION LENGTH." Then insert the tube firmly in place as far as the marked point.

2. INSTALLATION OF A CAULKING JOINT

- Press in the tube so that it does not move (will not come out), and tighten the sleeve nut with the tightening tool to the torque shown in the following table.

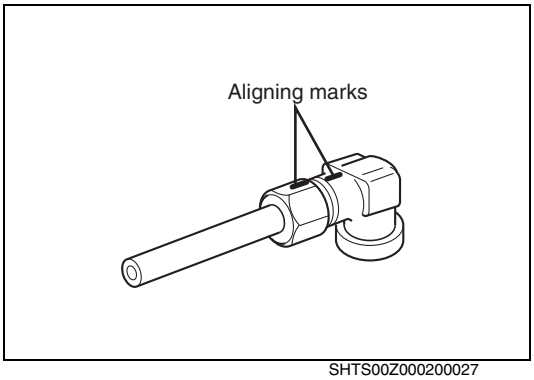
3. NYLON TUBE NUT TIGHTENING TORQUE

Unit: N·m {kgf·cm, lbf·ft}

NUT DIAMETERS	TIGHTENING TORQUE
ϕ1/4 in.	20-26 {200-270, 15-19}
ϕ3.8 in.	35-45 {350-460, 26-33}
ϕ1/2 in.	50-60 {500-610, 37-44}

NOTICE

Nuts must be tightened to 5°- 35°C.



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4. ASSEMBLING THE CAULKING JOINT (AFTER THE TUBE HAS FIRST BEEN REMOVED FROM THE JOINT AND THEN RE-INSTALLED IN THE SAME PLACE)

(1) Make aligning marks on the connector and union to mark their positions before loosening the nut.

(2) When re-assembling the joint, tighten the nut until the pre-disassembly position (position of aligning marks) is reached, and then tighten the nut 60° more.

(3) Always check air leakage after assembling the joint. If air is leaking from the joint, continue tightening the sleeve nut until the leak stops.

(4) If the air leak does not stop, replace the tube, sleeve, and insert with new parts. If the air leak still continues, replace the nut and connector / union.

NOTICE

- **During repair or other work, make sure the temperature limit of the nylon tube is within -40-90°C, especially during paint drying work.**
- **During boring, welding, sanding, and other work, protect nylon tubes from tools, cuts, heat sources, and sparks, or remove the nylon tubes beforehand.**
- **Do not attach a welding equipment clamp near the nylon tube.**
- **Do not pour battery fluid or other acidic fluid on the nylon tube.**
- **Do not bend the nylon tube beyond the nylon tube bending radius R values shown in the following table. Also, do not use the remaining portion of a tube that has broken due to overbending.**

OUTSIDE DIAMETER OF TUBE	MINIMUM BENDING RADIUS DURING HANDLING: R mm {in.}
ϕ1/2 in.	30 {1.18}
ϕ3/8 in.	65 {2.56}
ϕ1/2 in.	70 {2.76}

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METRIC INFORMATION

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METRIC FASTENERS

1. **Most threaded fasteners on the Hino trucks series are metric. Be careful not to mix them up with threaded fasteners using the inch system.**
   Mismatched or incorrect bolts, nuts and screws can cause damage or malfunction, resulting in personal injury and/or property damage.

2. **When bolts, nuts and screws are removed from the vehicle, they should be kept for reuse whenever possible.**
   If they are not re-usable, parts that are equivalent to the original parts in dimensions, strength, and thread pitch must be selected.

3. **Most original bolts are marked with identification numbers indicating the strength of the bolts. The markings are shown below.**

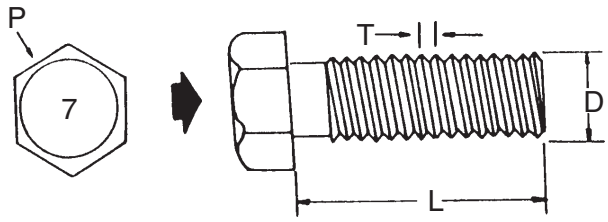
4. **When replacing bolts, be careful to use bolts with the same markings as the original bolts.**

Nomenclature for bolts

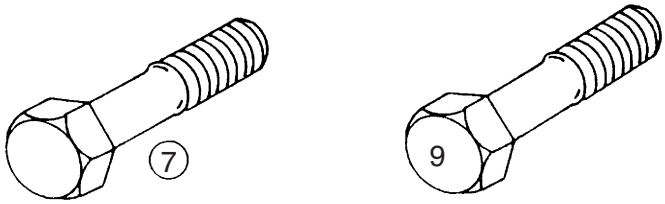
Metric system

Bolt M12-1.75 25

D T L



Bolt strength identification



D- Nominal Diameter (millimeters)
L- Length (millimeters)
P- Property Class (bolt strength)
T- Thread Pitch (thread width crest to crest millimeters)

Metric Bolts P Identification class numbers correspond to bolt strength. Increasing numbers represent increasing strength.

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DECIMAL AND METRIC EQUIVALENTS

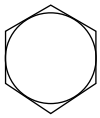
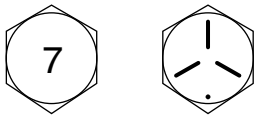
Fractions	Decimal In.	Metric mm.	Fractions	Decimal In.	Metric mm.
1/64	0.015625	0.397	33/64	0.515625	13.097
1/32	0.03125	0.794	17/32	0.53125	13.494
3/64	0.046875	1.191	35/64	0.546875	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.078125	1.984	37/64	0.578125	14.684
3/32	0.09375	2.381	19/32	0.59375	15.081
7/64	0.109375	2.778	39/64	0.609375	15.478
1/8	0.125	3.175	5/8	0.625	15.875
9/64	0.140625	3.572	41/64	0.640625	16.272
5/32	0.15625	3.969	21/32	0.65625	16.669
11/64	0.171875	4.366	43/64	0.671875	17.066
3/16	0.1875	4.763	11/16	0.6875	17.463
13/64	0.203125	5.159	45/64	0.703125	17.859
7/32	0.21875	5.556	23/32	0.71875	18.256
15/64	0.234375	5.953	47/64	0.734375	18.653
1/4	0.250	6.35	3/4	0.750	19.05
17/64	0.265625	6.747	49/64	0.765625	19.447
9/32	0.28125	7.144	25/32	0.78125	19.844
19/64	0.296875	7.54	51/64	0.796875	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.328125	8.334	53/64	0.828125	21.034
11/32	0.34375	8.731	27/32	0.84375	21.431
23/64	0.359375	9.128	55/64	0.859375	21.828
3/8	0.375	9.525	7/8	0.875	22.225
25/64	0.390625	9.922	57/64	0.890625	22.622
13/32	0.40625	10.319	29/32	0.90625	23.019
27/64	0.421875	10.716	59/64	0.921875	23.416
7/16	0.4375	11.113	15/16	0.9375	23.813
29/64	0.453125	11.509	61/64	0.953125	24.209
15/32	0.46875	11.906	31/32	0.96875	24.606
31/64	0.484375	12.303	63/64	0.984375	25.003
1/2	0.500	12.7	1	1.00	25.4

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SPECIFIED TORQUE FOR STANDARD BOLTS AND NUTS

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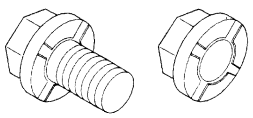
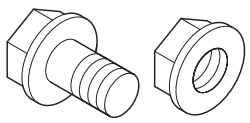
Unit: N·m {kgf·cm, lbf·ft.}

Class	4T	7T	9T
Representation / Diameter	 No Mark	 7	 q
M6	4.4-6.6 {45-67, 3.3-4.8}	7.2-10.8 {74-110, 5.4-7.9}	9.5-13.5 {94-140, 6.8-10.1}
M8	11.5-16.5 {114-172, 8.3-12.4}	18.0-26.0 {179-269, 13.0-19.4}	23.5-34.5 {237-355, 17.2-25.6}
M10	22.0-32.0 {221-331, 16.0-23.9}	34.5-51.5 {351-527, 25.4-38.1}	46.0-68.0 {466-698, 33.7-50.4}
M12	38.5-57.5 {392-588, 28.4-42.5}	61.0-91.0 {621-931, 44.9-67.3}	80.0-120.0 {816-1,224, 59.0-88.5}
M14	62.0-92.0 {629-943, 45.5-68.1}	96.0-144.0 {976-1,464, 70.6-105.8}	128.0-192.0 {1,304-1,956, 94.3-141.4}
M16	96.0-144.0 {976-1,464, 70.6-105.8}	152.0-228.0 {1,552-2,328, 112.3-168.3}	200.0-300.0 {2,040-3,060, 147.5-221.2}
M18	132.0-198.0 {1,344-2,016, 97.2-145.7}	208.0-312.0 {2,120-3,180, 153.3-229.9}	276.0-414.0 {2,816-4,224, 203.6-305.4}
M20	188.0-282.0 {1,920-2,880, 138.8-208.2}	296.0-444.0 {3,024-4,536, 218.7-327.9}	392.0-588.0 {4,000-6,000, 289.3-433.8}
M22	256.0-384.0 {2,616-3,924, 189.2-283.7}	405.0-605.0 {4,120-6,180, 297.9-446.8}	540.0-800.0 {5,470-8,210, 395.5-593.6}
M24	324.0-486.0 {3,304-4,956, 238.9-358.3}	515.0-765.0 {5,220-7,840, 377.5-566.8}	680.0-1,010.0 {6,900-10,340, 499.0-747.6}

SPECIFIED TORQUE FOR FLANGE BOLTS AND NUTS

EN00Z0002C100002

Unit: N·m {kgf·cm, lbf·ft.}

Class / Diameter	7T	9T	12T	Shape
M8	18.0-26.0 {184-265, 13.3-19.2}	—	—	
M10	41.5-61.5 {421-631, 30.5-45.6}	55.0-82.0 {560-840, 40.5-60.7}	—	
M12	73.0-109.0 {744-1,116, 53.8-80.7}	96.0-114.0 {979-1,469, 70.8-106.2}	—	
M14	—	—	86.0-142.0 {877-1,448, 63.4-104.7}	

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With new flange (w/o grooves)

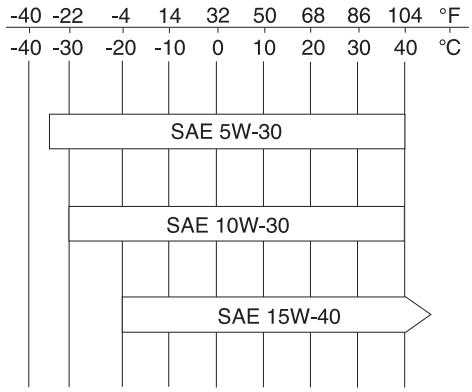
Unit: N·m {kgf·cm, lbf·ft.}

Class / Diameter	8.8T	10.9T	Shape
M8	21.7-40.3 {221-411, 16.0-29.7}	27.3-50.7 {278-517, 20.1-37.4}	
M10	24.5-45.5 {250-464, 18.1-33.6}	32.7-60.3 {333-615, 24.1-44.5}	
M12	44.1-81.9 {450-835, 32.5-60.4}	57.4-106.6 {585-1087, 42.3-78.6}	
M14	—	91-169 {928-1723, 67.1-124.6} 104-156* {106-1590, 76.7-115.1}	

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RECOMMENDED LUBRICANTS

EN00Z0002H600001

No.	LUBRICANTS	POSITONS	VISCOSITY RECOMENDATIONS (SAE)
1	Engine oil A.P.I.: CJ-4 JASO: DH-2 ACEA: E–6, E-9	Cylinder Block	

No.	LUBRICANTS	POSITONS	ATMOSPHERIC TEMP.	S.A.E. No
2	Heavy duty engine oil MIL-L-2104D, API-CD, or Cat TO-4	EATON Fuller® FS-5406A,FS-6406A	Above 10°F (–12°C)	50
			Above 10°F (–12°C)	40
			Below 10°F (–12°C)	30
	Automotive gear oil API-MT-1		Above 10°F (–12°C)	80W-90
			Below 10°F (–12°C)	75W
3	Mobil Delvac Synthetic Transmission Fluid 50, Shell SPIRAX GSX SAE 50, EATON Roadranger SAE 50, EATON Approved Synthetic Transmission oil, or equivalent (See Eaton Lubrication Manual for detail)	EATON Fuller® FS-5406A, FS-6406A	All	50
4	Automatic transmission fluid; TES 389-approved fluid	Allison® 2200HS, 2200RDS, 2500RDS, 3000RDS, 3500RDS	—	—
	Automatic transmission fluid; TES 295-approved fluid	Allison® 2200HS, 2200RDS, 2500RDS, 3000RDS, 3500RDS		
5	Axle lubricant Non- Extended Drain Lubricants (Petroleum with EP Additives) (A.P.I. GL-5) (MIL-PRF-2105E and SAE J2360)	Rear axle	Above 10°F (–12°C)	85W/140
			Above –15°F (–26°C)	80W/140
			Above –15°F (–26°C)	80W/90
			Above –40°F (–40°C)	75W/90
			From –40°F (–40°C) to –35°F (2°C)	75W
			Above –40°F (–40°C)	75W/140
	Axle lubricant Extended Drain Lubricants (Petroleum with EP Additives) (A.P.I. GL-5) (MIL-PRF-2105E and SAE J2360)		Above –15°F (–26°C)	80W/90
			Above –15°F (–26°C)	80W/90
			Above –40°F (–40°C)	75W/140
			Above –40°F (–40°C)	75W/90

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No.	LUBRICANTS	POSITONS
6	POWER STEERING FLUID (ATF DEXRON® 2 or 3)	Integral Power Steering Gear
7	BRAKE AND CLUTCH FLUID (DOT-3) or (DOT-4)	Brake & Clutch
8	WHEEL BEARING GREASE (MIL-G-10924B/18709A) (N.L.G.I.'s No.2 LITHIUM-SOAP)	Propeller Shaft Universal Joint and Slip Joint
9	HEAT RESISTANCE GREASE (MIL-G-22615/23549/21164) (N.L.G.I.'s No.2 or No.3)	Clutch Disc Hub Spline T/M Main Drive Shaft Spline Q-Plus Brake (Retainer Clip, Anchor Pin, Roller (Journal only), Camshaft, Automatic Slack Adjuster, Clevis Pin) Parking Brake (Camshaft, Anchor Pin, Shoe web)
10	SPECIAL GREASE (KLUBER GLKO)	B-Frame Disc Brake (Guide buss, Caliper body, Piston)
11	STARTER GREASE (N.L.G.I.'s No.2 LITHIUM-SOAP)	Bushing, Clutch, Drive Shaft, Pinion Shaft Lever & Reduction Gear
12	BEARING GREASE (N.L.G.I.'s No.2 LITHIUM-SOAP)	Clutch Release Sleeve Clutch Release Shaft Alternator Bearing Starter Bearing
13	CHASSIS GREASE (MIL-G-17740) (N.L.G.I.'s No.1 CALCIUM or LITHIUM-SOAP)	Chassis Grease Fitting
14	LONG LIFE COOLANT	Engine, Radiator
15	Mobil Synthetic 75W-90	Front Wheel Hub (Oil Lubricated Bearings)

No.	LUBRICANTS	POSITONS	SHEEL	MOBIL	EXXON
16	LITHIUM BASE DISULFIDE MOLYBDENUM GREASE	Drag Link & Tie Rod Ball Joint	Retinax AM	Mobil Grease Special	Beacon Q2

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VEHICLE LIFT AND SUPPORT LOCATIONS

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1. NOTICE ABOUT VEHICLE CONDITION WHEN JACKING UP

(1) As a rule, vehicle must be in an unloaded condition and never jack up or lift up the vehicle with things of heavy weight.

(2) If removing any things of heavy weight like the engine and transmission, the center of gravity of the vehicle moves. Therefore, place a balance weight so as to keep it from rolling, or hold the jacking support location using the transmission jack.

2. NOTICE FOR USING 4 POST LIFT

(1) Follow the instruction manual for a safety operation.

(2) Do not damage tires or wheels with a free wheel beam.

(3) Using a wheel stopper, fix the vehicle.

3. NOTICE FOR USING JACK AND SAFETY STAND

(1) Work in a flat place using a wheel stopper all the time.

(2) Support the specified location with a jack and safety stand accurately.

(3) Do not work or leave the vehicle supported only by a jack. Be sure to support the vehicle together with a safety stand.

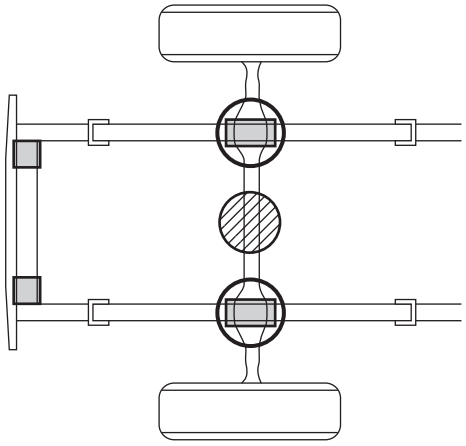
(4) Be careful and accurate in jacking up and down the vehicle.

(5) Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations.

- Cancel the parking brake on a level place and shift the transmission in Neutral.
- When jacking up the front wheels of the vehicle at first place stoppers behind the rear wheels.
- When jacking up the rear wheels of the vehicle at first place stoppers behind the front wheels.
- When either the front or rear wheels only should be jacked up, set safety stands and place stoppers in front and behind the other wheels on the ground.
- After the vehicle is jacked up, be sure to support it on the safety stands. It is extremely dangerous to perform any work on a vehicle raised on a jack alone, even for a small job that can be finished quickly.

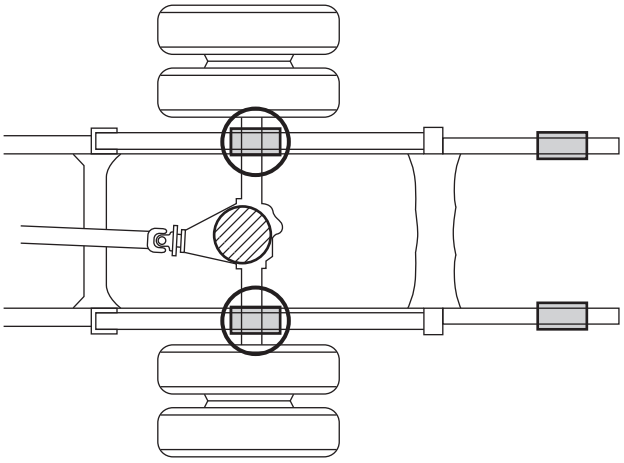
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Front

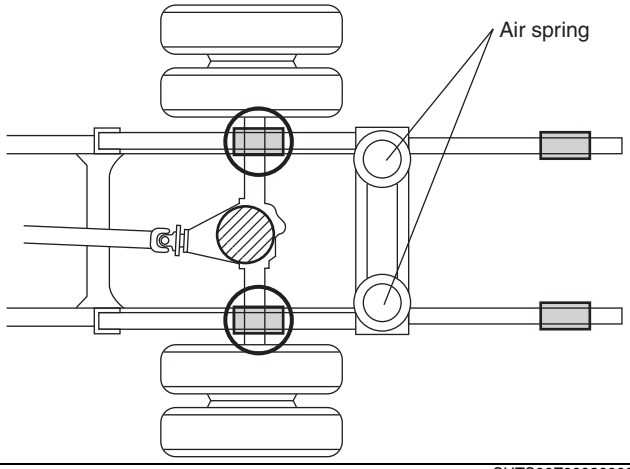


Rear

Leaf suspension



Air suspension



Garage jack position

Front --------- Center of front axle beam

Rear --------- Center of rear axle housing

Oil jack position

Support position

Safety stand ----------

If necessary, remove the front bumper.

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INFORMATION DISPLAY

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1. INFORMATION DISPLAY ITEMS

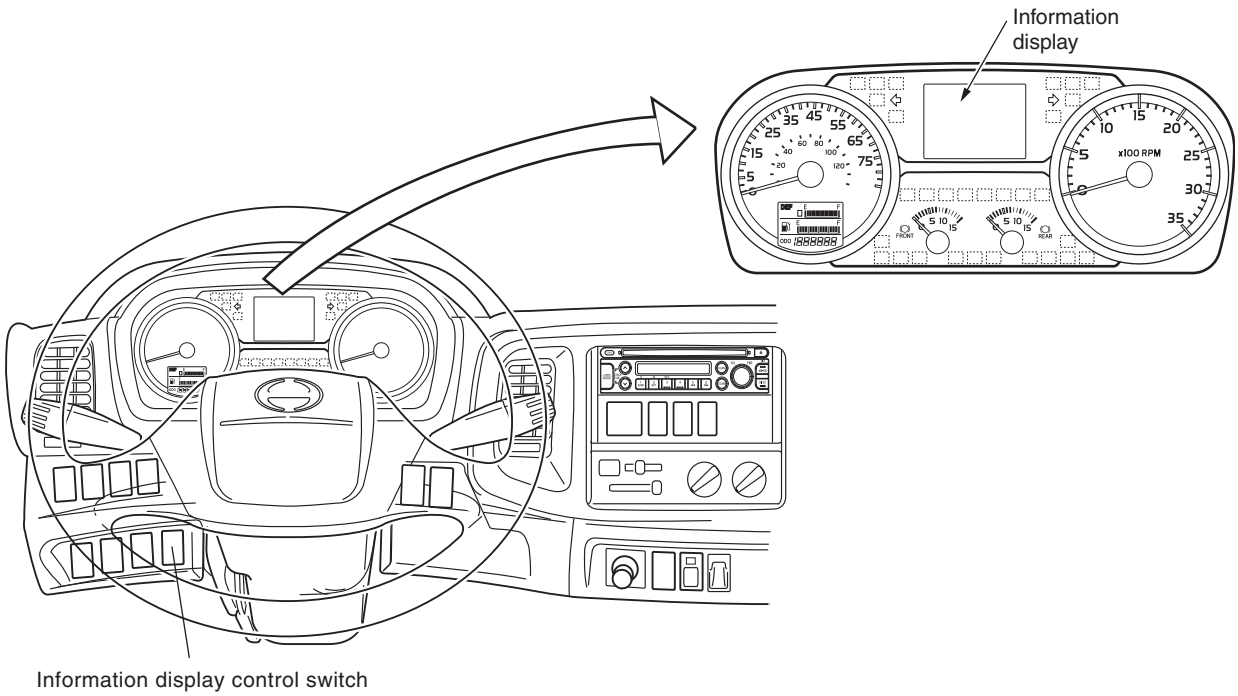
- Information display shows following items.

(1) Ordinary display
Trip meter, voltage, date, fuel consumption, average speed and engine or vehicle maintenance information etc.

(2) Warning display
The warning display is automatically displayed and shows messages.

NOTICE

- **When turn the key to "ON" position, display shows last message. But in case of device operating, the warning display is prior to ordinary display.**



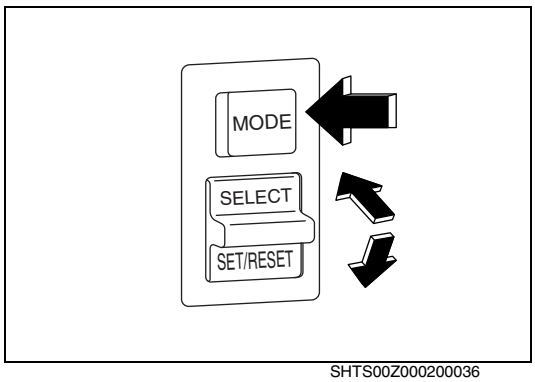
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2. INFORMATION DISPLAY CONTROL SWITCH

- The following information is shown with the key turned on. Each time you push the "MODE" button, the displayed information is changed.

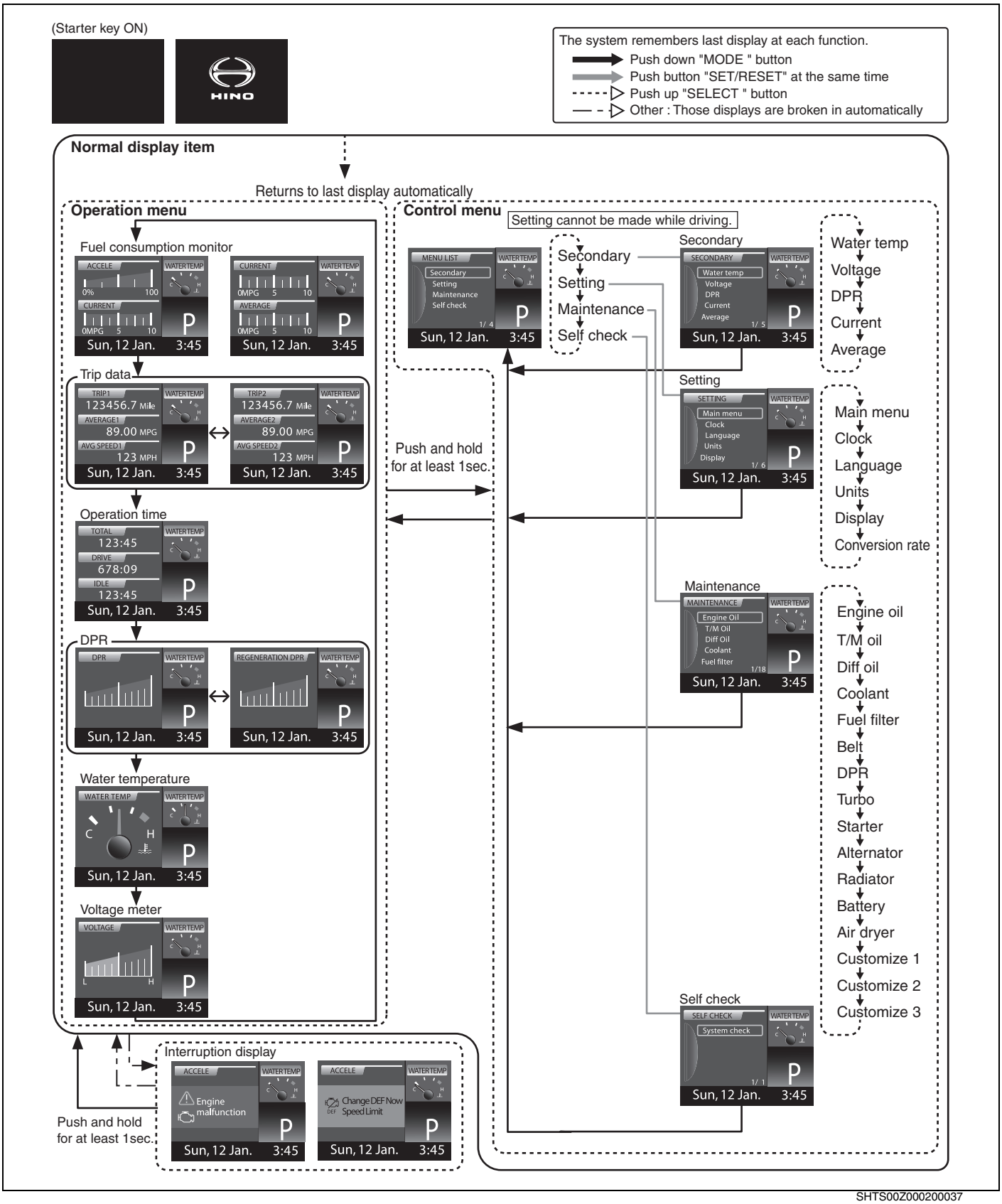
NOTICE

- **Diagram on the next page shows the operation method of the information display.**
- **If you push and hold "SET/RESET" button, as the display case, data may be reset.**
- **Press the "MODE" button more than 1 second to release the warning information.**



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3. WARNING DISPLAY

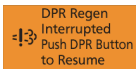
(1) Warning display

Display	Warning Display remarks
	Engine control system has malfunction. This is important and must be addressed immediately.
	DPR cleaner needs to be manually regenerated.

NOTICE

- **The display shows DPR MANUAL REGENERATE REQUIRED with the buzzer sound when DPR cleaner needs to be manually regenerated.**

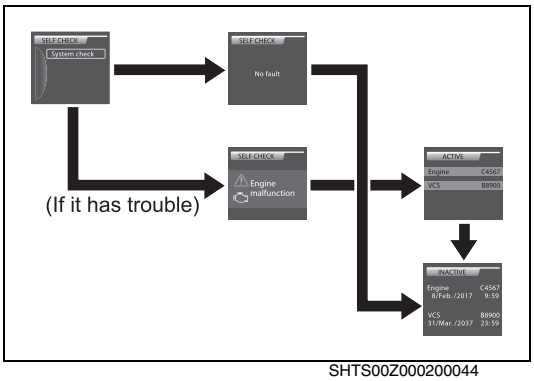
(2) Information display

Display	Display remarks
	Appears when idling is stopped due to emergency.
	DPR regenerate on time.
	DPR remaining for few minute.
	DPR regenerate completed.
	DPR regeneration interrupted, push DPR button to resume.

NOTICE

- **The DPR system automatically regenerates when the quantity of soot collected in the DPR cleaner exceeds a specific quantity. This prevents an abnormal accumulation of soot and keeps the DPR cleaner in good condition. Use of high-performance catalyst and an electronically controlled common rail fuel injection system has made it possible to burn (regenerate) the soot while driving.**

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4. SELF DIAGNOSIS SYSTEM

If the vehicle has fault, display shows the trouble.

(1) Select to "Self check" and push "SET/RESET" button.

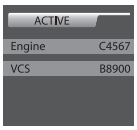
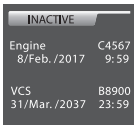
(2) Select to "System check" and push "SET/RESET" button, display shows "No fault" in case of no trouble. If it has trouble, display shows fault item.

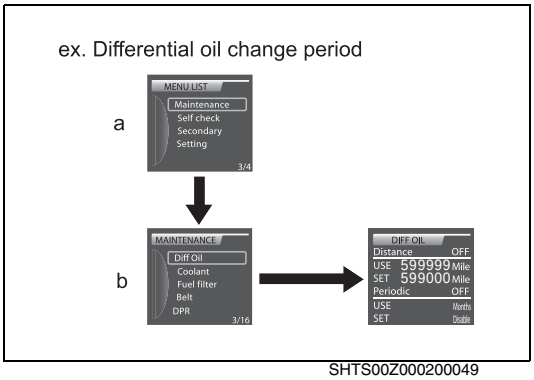
(3) If display shows trouble warning, Immediately get the vehicle checked and repaired at an authorized Hino dealer.

(4) In case of "Engine malfunction" displayed, push and hold "SELECT" button for more than 1 sec. until the display shows trouble code. Push "SELECT" button, display shows another trouble codes, if there are.

(5) Push and hold "SELECT" button for longer than 1 sec. to display the "Inactive".

(6) Trouble code display

Initial Display	Remarks
	It has no trouble.
	It has trouble.
	Yellow background. It has trouble code, now. Get the vehicle checked and repaired.
	It had trouble code, previously.



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5. RESETTING PROCEDURE

EX.Differential oil change period

(1) Scroll up and select "Maintenance" and push "SET/RESET" button.

(2) Scroll up and select the preferred setting item and push "SET/RESET" button.

(3) Push and hold "SET/RESET" button for longer than 1 sec.

NOTICE

- **In the case of the other item on trouble code, data may be reset as the same procedure.**
- **But, especially in the case of "DPR", push and hold "MODE" and "SET/RESET" button at the same time for more than 20sec. to reset. (Following to the low, use only at an authorized Hino dealer.)**

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6. AVAILABLE SETTING ITEMS

- Engine oil
- T/M oil
- Diff oil
- Coolant
- Fuel filter
- Belt
- DPR
- Turbo
- Starter
- Alternator
- Radiator
- Battery
- Air dryer
- Customize1
- Customize2
- Customize3

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SYMPTOM SIMULATION

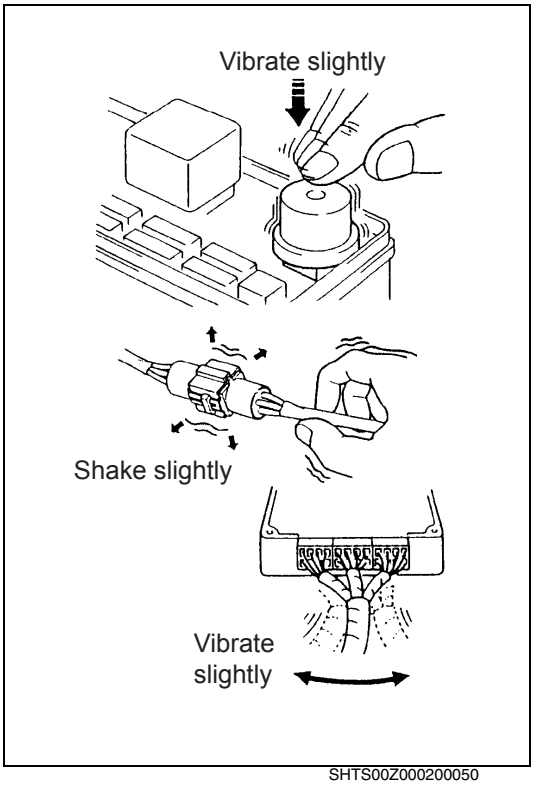
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HINT

The most difficult case in troubleshooting is when no problem symptoms occur. In such a case, a thorough problem analysis must be carried out. A simulation of the same or similar conditions and environment in which the problem occurred in the customer's vehicle should be carried out. No matter how much skill or experience a technician has, troubleshooting without confirming the problem symptoms will lead to important repairs being overlooked and mistakes or delays.

For example:

With a problem that only occurs when the engine is cold or as a result of vibration caused by the road during driving, the problem can never be determined if the symptoms are being checked on a stationary vehicle or a vehicle with a warmed-up engine. Vibration, heat or water penetration (moisture) is difficult to reproduce. The symptom simulation tests below are effective substitutes for the conditions and can be applied on a stationary vehicle. Important points in the symptom simulation test: In the symptom simulation test, the problem symptoms as well as the problem area or parts must be confirmed. First, narrow down the possible problem circuits according to the symptoms. Then, connect the tester and carry out the symptom simulation test, judging whether the circuit being tested is defective or normal. Also, confirm the problem symptoms at the same time. Refer to the problem symptoms table for each system to narrow down the possible causes.



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1. VIBRATION METHOD: When malfunction seems to occur as a result of vibration.

(1) PART AND SENSOR
Apply slight vibration with a finger to the part of the sensor suspected to be the cause of the problem, and check whether or not the malfunction occurs.

NOTICE

Applying strong vibration to relays may open relays

(2) CONNECTORS
Slightly shake the connector vertically and horizontally.

(3) WIRE HARNESS
Slightly shake the wire harness vertically and horizontally.

HINT

The connector joint and fulcrum of the vibration are the major areas that should be checked thoroughly.

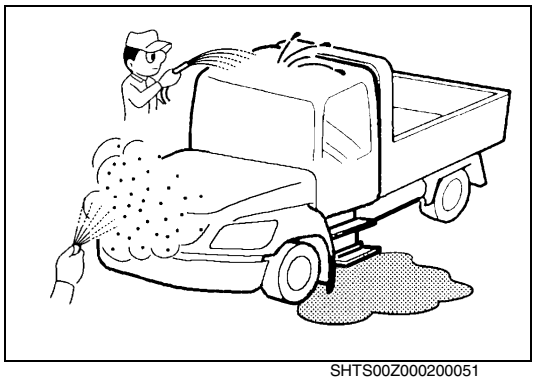
2. HEAT METHOD: When a malfunction seems to occur when the area in question is heated.

(1) Heat the component that is the possible cause of the malfunction with a hair dryer or similar device. Check if the malfunction occurs.

NOTICE

- **Do not heat to more than 60°C (140°F). Exceeding this temperature may damage components.**
- **Do not apply heat directly to the parts in the ECU.**

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3. WATER SPRINKLING METHOD: When a malfunction seems to occur on a rainy day or in high-humidity.

(1) Sprinkle water onto the vehicle and check if the malfunction occurs.

NOTICE

- **Never sprinkle water directly into the engine compartment. Indirectly change the temperature and humidity by spraying water onto the front of the radiator.**
- **Never apply water directly onto the electronic components.**

HINT

If the vehicle has or had a water leakage problem, the leakage may have damaged the ECU or connections. Look for evidence of corrosion or short circuits. Proceed with caution during water tests.

4. HIGH ELECTRICAL LOAD METHOD: When a malfunction seems to occur when electrical load is excessive.

(1) Turn on the heater blower, headlight, rear window defogger and all other electrical loads. Check if the malfunction reoccurs.

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GLOSSARY

DEFINITION OF ABBREVIATION IN THIS MANUAL

LIST OF ABBREVIATION

SAE ABBREVIATIONS	SAE TERMS
A/C	Air conditioner
ABS	Anti-lock Brake System
ACC	Accessory
AMT	Automated Manual Type
ATC	After Turbo catalyst
ATF	Automatic Transmission Fluid
CA	Crank Angle
CAN	Controller Area Network
CD-ROM	Compact Disc Read Only Memory
CPU	Central Processing Unit
dB	Decibel
DC	Direct Current
D-CAT	Diesel-Clean Advanced Technology System
DC motor	Direct Current Motor
DCU	Dosing Control Unit
DEF	Diesel Exhaust Fluid
DPR	Diesel Particulate active Reduction System
DSS	Driving Support System
ECU	Electronic Control Unit
EEPROM	Electronically Erasable and Programmable Read Only Memory
EGR	Exhaust Gas Recirculation
ELR	Emergency Locking Retractor
ENG	Engine
ES START	Easy and Smooth start system
F/A	Front axle
FCCB	Fuel Control Cylinder Balance
FCV	Fuel Cutoff Valve
FF Shift	Feather touch & Finger shift
FL	Fusible link
Fr	Front
FRP	Fiber Reinforces Plastic

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SAE ABBREVIATIONS	SAE TERMS
FUP	Front Underrun Protector
GND	Ground
GVW	Gross Vehicle Weight
Hi	High
HINO DX II	Hino Diagnostic eXplorer II
HVAC	Heating, Ventilating and Air-Conditioning unit
I.S.C.	Idle Speed Control
IC	Integrated Circuits
ID	Identification
IPD	Intelligent Power Device
IS	Idle Stop
ISO	International Organization for Standardization
JIS	Japanese Industrial Standards
LED	Light Emitting Diode
LEV	Low Emission Vehicle
LH	Left Hand
LLC	Long Life Coolant
Lo	Low
MAX	Maximum
MIN	Minimum
MS evaporator	Multi-rank and Super slim structure evaporator
No	Number
NOx	Nitrogen Oxide
NMR	No load Maximum Revolution
OHC	Over Head Camshaft
PC	Personal Computer
PCD	Pitch Circle Diameter
PCS	Pre-Crash Safety
PCV	Pump Control Valve
PCV valve	Positive Crankcase Ventilation valve
PM	Particulate Matter
PPG	Glass-fiber-reinforced Polypropylene
PPm	Parts Per Million
PS pump	Power Steering Pump

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SAE ABBREVIATIONS	SAE TERMS
PVD	Physical Vapor Deposit
PWR	Power
QE code	Quick Response Code
R/A	Rear axle
RH	Right Hand
SCR	Selective Catalytic Reduction
SW	Switch
T/M	Transmission

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GLOSSARY OF SAE AND HINO TERMS

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This glossary lists all SAE-J2403 terms and abbreviations used in this manual in compliance with SAE recommendation, as well as their HINO equivalents.

SAE ABBREVIATIONS	SAE TERMS	HINO TERMS ( )--ABBREVIATIONS
A/T	AUTOMATIC TRANSMISSION	Automatic transmission
AAT	AMBIENT AIR TEMPERATURE	Ambient Air Temperature
ACL	AIR CLEANER	Air cleaner
ACL Element	ACL (Air Cleaner) Element	Air Cleaner element
ACL Element	AIR CLEANER Element	Air Cleaner element
ACL Housing	AIR CLEANER Housing	Air cleaner body assembly
ACL Housing Cover	AIR CLEANER Housing Cover	Air Cleaner Housing Cover
AFTDEF	AFTERTREATMENT DIESEL EXHAUST FLUID	DEF
AFTDEFDU	AFTERTREATMENT DIESEL EXHAUST FLUID DOSING UNIT	DCU
AFTDOC	AFTERTREATMENT DIESEL OXIDATION CATALYST	DOC (Diesel Oxidation Catalyst)
AFTDOS	AFTERTREATMENT DOSER AFTDOS	DEF injector
AFTDPF	AFTERTREATMENT DIESEL PARTICULATE FILTER	DPR filter
AFTDPFDP	Aftertreatment Diesel Particulate Filter Differential Pressure	DPR differential pressure
AFTEGT	AFTERTREATMENT EXHAUST GAS TEMPERATURE	Exhaust gas temperature
AP	ACCELERATOR PEDAL	Accelerator pedal
AP Sensor	ACCELERATOR PEDAL Sensor	Accelerator Pedal Position Sensor
APP	ACCELERATOR PEDAL POSITION	Accelerator Pedal Position
CAC	CHARGE AIR COOLER	Intercooler
CPP Switch	CLUTCH PEDAL POSITION Switch	Clutch Switch
DCC	DIAGNOSTIC CONNECTOR, Cab	Diagnosis connector
DCU	DIAGNOSTIC CONNECTOR, Underhood	Diagnosis connector
DRIVER	DRIVER	driver
DTC	DIAGNOSTIC TROUBLE CODE	Diagnosis Trouble Code
DTM Switch	DIAGNOSTIC TEST MODE Switch	Diagnosis switch
EBP	EXHAUST BACK PRESSURE	Backpressure
EBP	EXHAUST BACK PRESSURE	Exhaust backpressure
EBP Sensor	EXHAUST BACK PRESSURE Sensor	Back Pressure Sensor

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SAE ABBREVIATIONS	SAE TERMS	HINO TERMS ( )--ABBREVIATIONS
EBPR Valve	EXHAUST BACK PRESSURE REGULATOR Valve	Exhaust control valve
EC	ENGINE CONTROL	Engine control
ECT	ENGINE COOLANT TEMPERATURE	Coolant Temperature
ECT	ENGINE COOLANT TEMPERATURE	Water Temperature
EFT	ENGINE FUEL TEMPERATURE	Fuel temperature
EFT Sensor	ENGINE FUEL TEMPERATURE Sensor	Fuel temperature sensor
EGR	EXHAUST GAS RECIRCULATION	EGR
EGR Valve	EXHAUST GAS RECIRCULATION Valve	EGR valve
EGRT	EXHAUST GAS RECIRCULATION TEMPERATURE	EGR temperature
EGRT Sensor	EXHAUST GAS RECIRCULATION TEMPERATURE Sensor	EGR exit temperature sensor
EGT	EXHAUST GAS TEMPERATURE	Exhaust gas temperature
EI	ELECTRONIC IGNITION	Ignition coil
EOP	ENGINE OIL PRESSURE	Oil Pressure
EOT	ENGINE OIL TEMPERATURE	Oil Temperature
FP	FUEL PUMP	Fuel pump
FUEL PRESSURE Sensor	FUEL PRESSURE Sensor	Fuel Pressure sensor
GLOW PLUG	GLOW PLUG	Glow plug
GND	GROUND	GROUND
IA	INTAKE AIR	Air Intake
IA System	INTAKE AIR System	Air Intake System
IAT	INTAKE AIR TEMPERATURE	Intake temperature
IAT Sensor	INTAKE AIR TEMPERATURE Sensor	Intake temperature sensor
IDLE	IDLE	idle
IMAT	INTAKE MANIFOLD AIR TEMPERATURE	Intake manifold Air temperature sensor
IMAT	INTAKE MANIFOLD TEMPERATURE	Intake manifold temperature sensor
INJ	INJECTOR	Injector
MAF Sensor	MASS AIR FLOW Sensor	Air flow sensor
MIL	MALFUNCTION INDICATOR LIGHT	MIL (Malfunction Indicator Light)
OSS Sensor	OUTPUT SHAFT SPEED Sensor	Output Speed Sensor
OSS Sensor	OUTPUT SHAFT SPEED Sensor	Speed Sensor
PC Solenoid Valve	PRESSURE CONTROL Solenoid Valve	Solenoid control valves
PCV	POS CRANKCASE VENTILATION	PCV (Positive Crankcase Vent)
PCV Valve	POS CRANKCASE VENTILATION Valve	PCV (Positive Crankcase Vent) Valve

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SAE ABBREVIATIONS	SAE TERMS	HINO TERMS ( )--ABBREVIATIONS
PCV Valve	POS CRANKCASE VENTILATION Valve	PCV Valve
PCV Valve	POSITIVE CRANKCASE VENT Valve	PCV Valve
PNP	PARK/NEUTRAL POSITION	Neutral position
PNP Switch	PARK/NEUTRAL POSITION Switch	Neutral switch
RFP	RAIL FUEL PRESSURE	Common rail Pressure
RFP Sensor	RAIL FUEL PRESSURE Sensor	Common rail pressure sensor
SPARK PLUG	SPARK PLUG	Spark plug
SRI	SERVICE REMINDER INDICATOR	Check engine
ST	SCAN TOOL	Diagnostic tool
TC	TURBOCHARGER	Turbocharger
TCC	TORQUE CONVERTER CLUTCH	Torque Converter
TP Sensor	THROTTLE POSITION Sensor	Throttle Sensor
TSS Sensor	TURBINE SHAFT SPEED Sensor	Turbine Speed Sensor
VAF Sensor	VOLUME AIR FLOW Sensor	Air flow sensor
VLS	VEHICLE LIMITING SPEED	Speed Limiter Upper Limit
VSS	VEHICLE SPEED SENSOR	Vehicle Speed sensor

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CLUTCH MAIN UNIT (EATON 1401)

CL02-001

CLUTCH ASSEMBLY
(EATON SAS1401)..... CL02-2
DATA AND SPECIFICATIONS CL02-2
DESCRIPTION CL02-2
TROUBLESHOOTING.....CL02-3
SPECIAL TOOL.....CL02-5
COMPONENT LOCATOR.....CL02-6
OVERHAUL CL02-7

CLUTCH ASSEMBLY
(EATON SOLO1401)..... CL02-14
DATA AND SPECIFICATIONS CL02-14
COMPONENT LOCATOR.....CL02-14
OVERHAUL CL02-15
INSPECTION AND REPAIR CL02-22

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CLUTCH ASSEMBLY (EATON SAS1401)

DATA AND SPECIFICATIONS

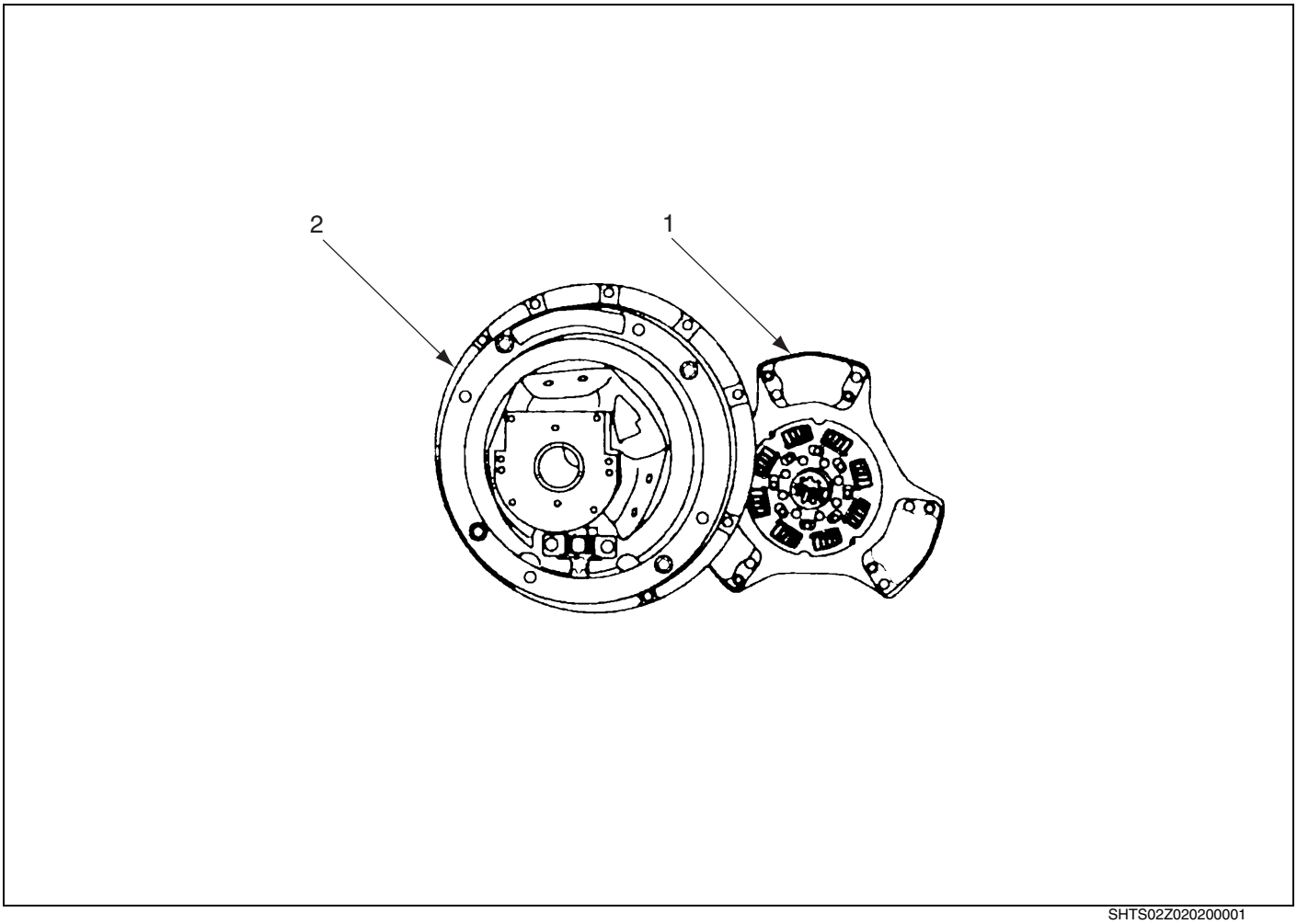
EN02Z0202I200001

CLUTCH FACING **Unit: mm {in.}**

Material	**Sintered metal (Ceramic metal)**
Type	**Dry single plate with damper spring**
Inside diameter	**222 {8.8}**
Outside diameter	**350 {13.8}**
Thickness	**11.5 {0.45}**

DESCRIPTION

EN02Z0202C100001



SHTS02Z020200001

1	**Clutch disc**	**2**	**Clutch cover**

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TROUBLESHOOTING

EN02Z0202F300001

Symptom	Possible cause	Remedy/Prevention
Clutch dragging.	Clutch disc distorted or warped.	Replace clutch disc.
	Transmission input shaft worn.	Replace input shaft and check clutch hub for excessive wear. If worn, replace disc. Check flywheel housing alignment.
	Excessive clutch control parts wear.	Replace control parts.
	Clutch control parts not functioning properly.	Replace control parts.
	Improper clutch control adjustment.	Adjust clutch control.
	Clutch disc assembly too thick.	Replace clutch disc.
Clutch slipping.	Release lever and release bearing clearance incorrectly adjusted.	Adjust clearance.
	Clutch disc facing gummed with oil or grease.	Replace disc assembly.
	Release bearing worn.	Replace bearing.
	Clutch pedal free-play incorrectly adjusted.	Adjust free-play.
	Compression spring weak.	Replace cover assembly.
	Clutch facing worn.	Replace disc assembly.
	Failing to remove plate from the clutch pressure plate assembly.	Remove plate.
	Driver riding clutch pedal.	Do not ride the clutch pedal.
Vehicle vibrates when starting.	Improper engine idling.	Adjust idling.
	Clutch control incorrectly adjusted.	Adjust clutch control
	Clutch disc facing gummed with oil or grease.	Replace disc assembly.
	Glazed flywheel friction surface.	Deglaze flywheel surface with coarse emery cloth, stroking parallel to machining lines.
	Clutch disc distorted or warped.	Replace disc.
	Improper clutch cover tightening.	Tighten bolts.
	Flywheel housing misalignment.	Replace flywheel housing.
Abnormal noise in transmission.	Malfunction of engine.	Tune up engine.
	Improper clutch disc used.	Replace proper clutch disc.
	Trouble in transmission.	Check transmission.
	The engine idle speed is low.	Increase the idle speed.

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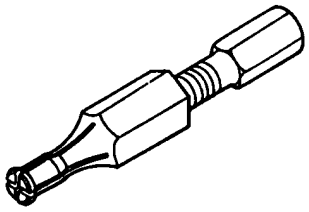
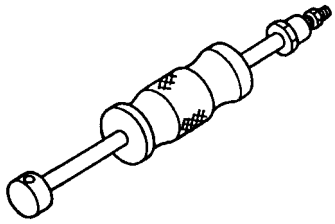
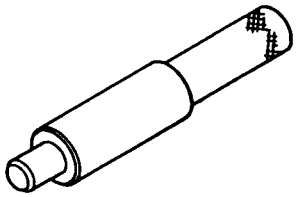
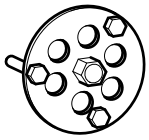
Symptom	Possible cause	Remedy/Prevention
Noisy clutch.	Release bearing worn or dried.	Replace release bearing.
	Pilot bearing worn or dried.	Replace pilot bearing.
	Clutch disc distorted or warped.	Replace clutch disc.
	Flywheel housing misalignment.	Replace flywheel housing.
	Transmission input shaft or clutch disc spline worn.	Clean and lubricate or replace.
	Insufficient lubrication of pedal and its accessories.	Lubricate.
	Insufficient lubrication of release shaft and release bearing hub.	Lubricate.
	Transmission input shaft retainer rusted or soiled.	Clean or replace if rusted.
	Clutch pedal free-play incorrectly adjusted.	Adjust free-Play.
Clutch pedal cannot be depressed.	Clutch control incorrectly adjusted.	Adjust clutch control.
	Insufficient lubricant release shaft and release bearing hub.	Lubricate.
Change in clutch pedal give.	Air trapped in clutch fluid.	Bleed air.

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SPECIAL TOOL

EN02Z0202K100001

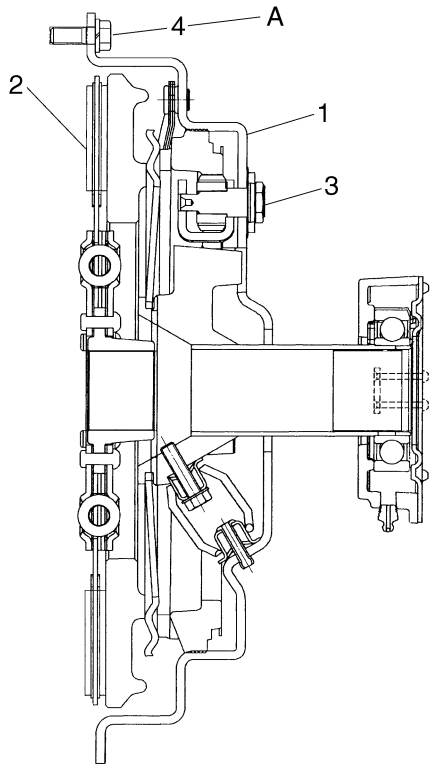
Prior to starting a clutch overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0965-01970	CLUTCH PILOT BEARING PULLER	
	S0942-01442	SLIDING HAMMER	
	S0966-21410	CLUTCH ALIGNING ARBOR	
	S0940-91200	CRANKING TOOL	

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COMPONENT LOCATOR

EN02Z0202D100001



SHTS02Z020200006

1	Clutch cover	3	Adjusting screw
2	Clutch disc	4	Bolt

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

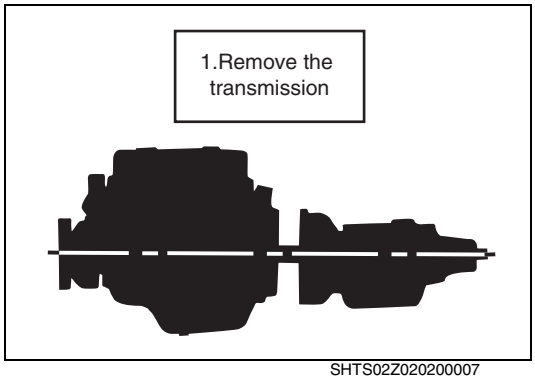
A	50-64 {510-655, 37-47}		

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OVERHAUL

EN02Z0202H200001

IMPORTANT POINT - DISMOUNTING



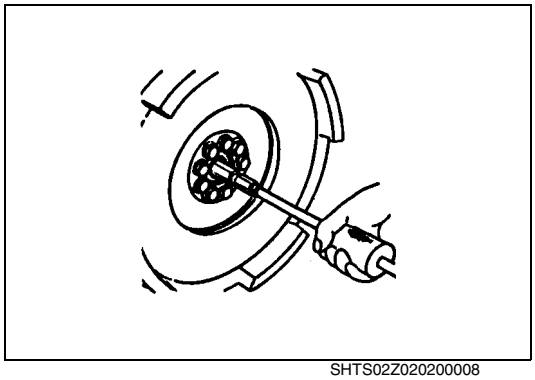
SHTS02Z020200007

1. REMOVE THE TRANSMISSION, SUPPORTING ITS WEIGHT TO PREVENT DAMAGE TO THE BEARING AND DISCS.

2. INSTALL TWO WOODEN SPACERS 1"-1-1/2" THICK BETWEEN RELEASE BEARING AND COVER ASSEMBLY.

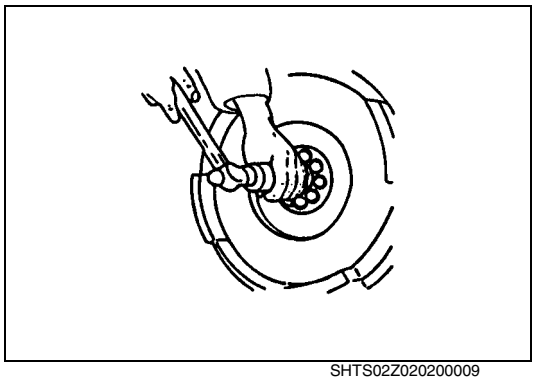
3. REMOVE THE CLUTCH FROM THE FLYWHEEL.

IMPORTANT POINT - INSPECTION AND REPLACEMENT


SHTS02Z020200008

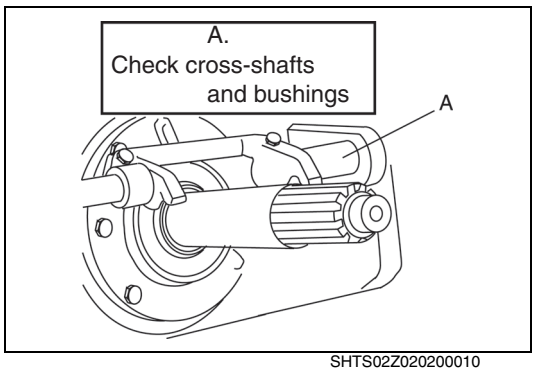
1. REPLACE THE PILOT BEARING.

(1) Remove the pilot bearing.
SST:
Pilot Bearing Puller (S0965-01970)
Sliding Hammer (S0942-01442)


SHTS02Z020200009

(2) Using a suitable tapping rod, install the pilot bearing.

NOTICE
After installing the pilot bearing, ensure that it rotates smoothly.



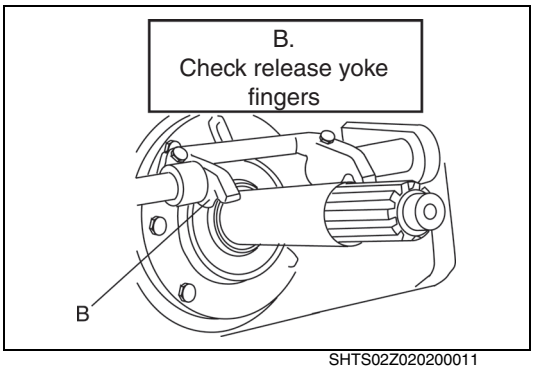
SHTS02Z020200010

2. CHECK THE FOLLOWING ITEMS FOR WEAR REPLACE ANY WORN COMPONENTS:

(1) Cross-shafts and bushings

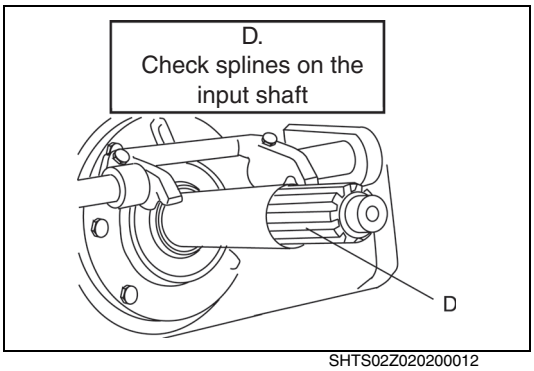
NOTICE
Excessive wear at these points can cause a side loading condition. Also, inspect the remaining pivot points of the linkage for excessive wear.

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SHTS02Z020200011

(2) Release yoke fingers



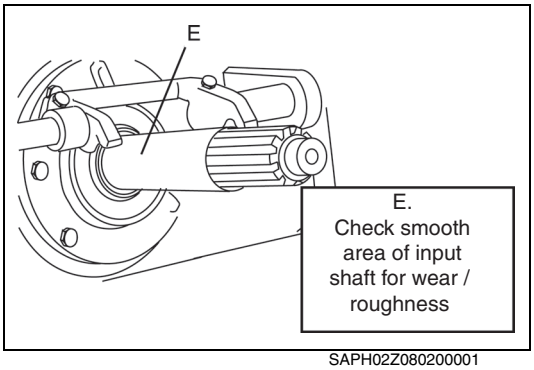
SHTS02Z020200012

(3) Splines on the input shaft

NOTICE

Any wear on the splines will prevent the newly installed driven discs from sliding freely, thus causing poor release (clutch drag). Select a disc out of the new installation and slide it full length on the transmission splines. This will detect a twisted input shaft. Replace input shaft if disc does not freely slide.

(4) Smooth area of input shaft



SAPH02Z080200001

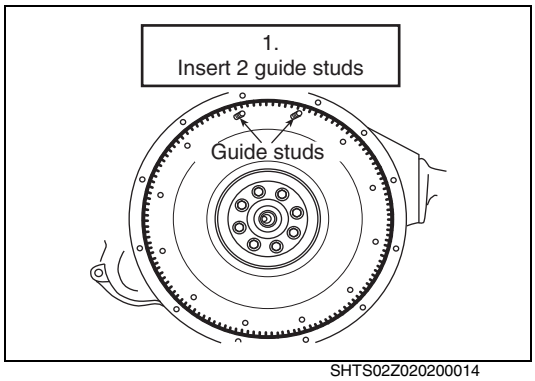
(5) Mating surfaces

NOTICE

Inspect the mating surfaces of both the transmission bell housing and the flywheel housing. Any appreciable wear on either housing will cause misalignment. Most wear will occur between the 3 and 8 o'clock positions.

Replace housings if worn.

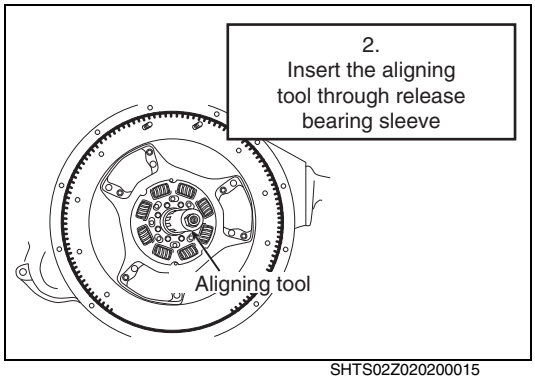
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SHTS02Z020200014

IMPORTANT POINT - MOUNTING

1. INSERT TWO (2) 3/8" x 16 UNC x 3" (76 MM) LONG GUIDE STUDS INTO THE TWO UPPER MOUNTING HOLES OF THE FLYWHEEL.

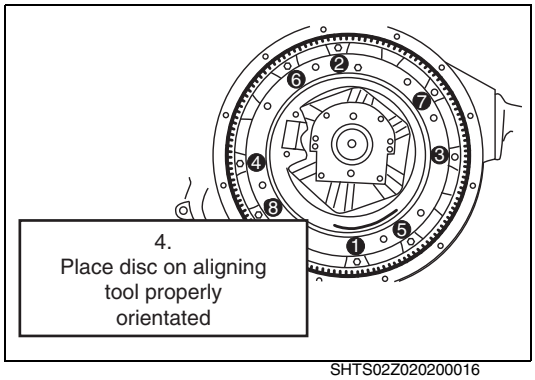


SHTS02Z020200015

2. INSTALL THE DISC BY INSERTING THE ALIGNING TOOL THROUGH THE DISC SPLINES AND THEN INTO THE PILOT BEARING.
SST: Clutch Aligning Arbor (S0966-21410)

NOTICE
Make sure the side marked "Pressure Plate Side" faces the pressure plate.

3. WITH THE ALIGNING TOOL STILL IN PLACE, CAREFULLY SLIDE THE CLUTCH ASSEMBLY OVER THE ALIGNING TOOL AND THE TWO (2) GUIDE STUDS WITH THE KWIK-ADJUST ALIGNED WITH THE ACCESS HOLE IN THE BELL HOUSING.



SHTS02Z020200016

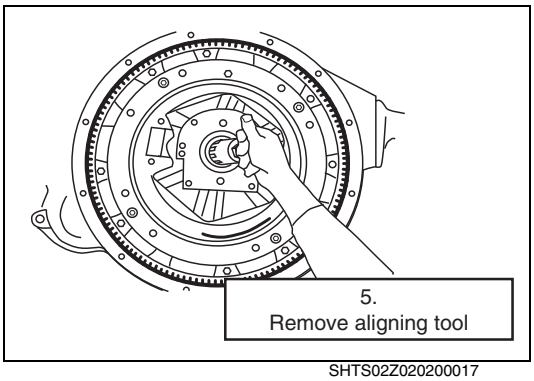
4. INSTALL LOCKWASHER AND SIX (6) 3/8" x 16 UNC GRADE 5 OR BETTER MOUNTING BOLTS AND HAND TIGHTEN.

(1) Remove the two (2) guide studs and replace with the remaining mounting bolts with lockwasher. Using a torque wrench, progressively tighten the eight (8) mounting bolts using the following crisis-cross pattern. Starting at lower left.
Remove the shipping blocks from between the release bearing and the cover assembly.
Tightening Torque:
50-64 N·m{510-665 kgf·cm, 37-47 lbf·ft}

⚠ CAUTION
Failure to tighten these bolts in this manner can:

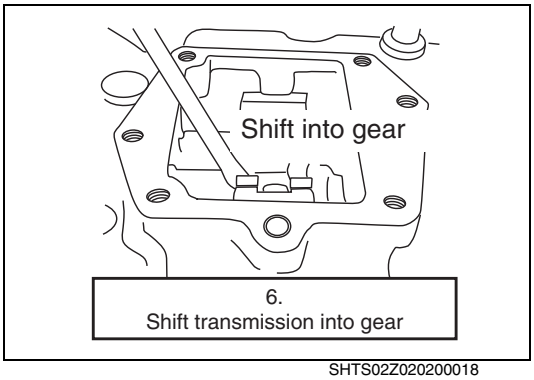
- **Prevent the clutch cover from "centering" into the pilot area of the flywheel.**
- **Cause permanent damage to the clutch cover (i.e. become cracked or broken).**
- **Cause the clutch assembly to be out-of balance with the flywheel.**

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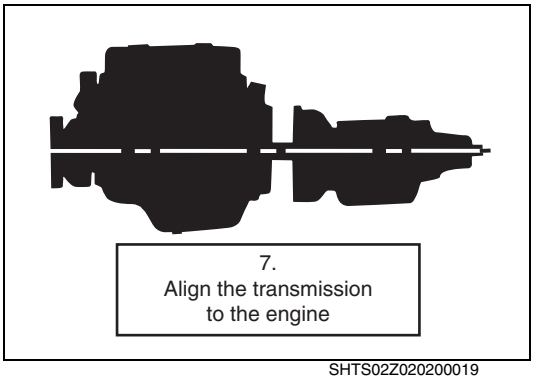
SHTS02Z020200017

5. REMOVE THE ALIGNING TOOL.



SHTS02Z020200018

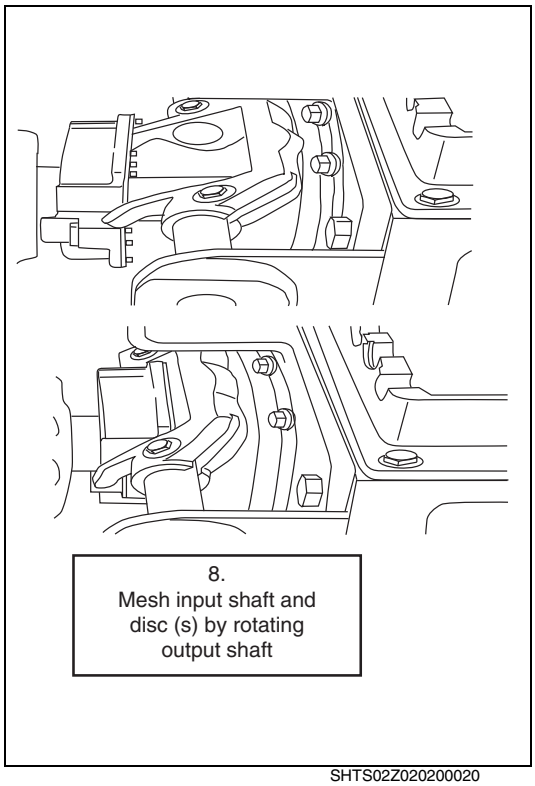
6. SHIFT THE TRANSMISSION INTO GEAR.



SHTS02Z020200019

7. POSITION THE TRANSMISSION SO THAT IT IS BOTH SQUARE TO AND ALIGNED WITH THE ENGINE.

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8.
Mesh input shaft and disc (s) by rotating output shaft

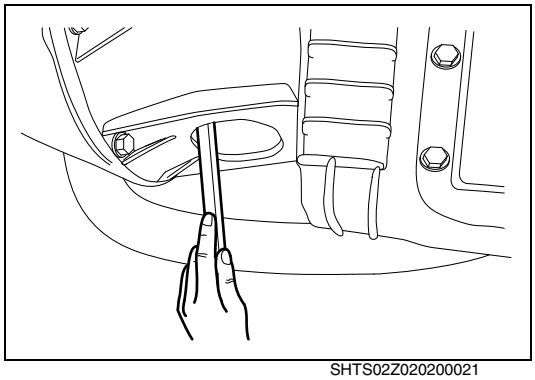
SHTS02Z020200020

8. WHILE MOVING THE TRANSMISSION FORWARD, ROTATE THE OUTPUT SHAFT OF THE TRANSMISSION UNTIL THE SPLINES OF BOTH THE INPUT SHAFT AND THE DISC(S) MESH WITH EACH OTHER. WHILE PERFORMING THIS TASK, YOU MUST ALSO ENSURE THAT THE YOKE FINGERS REMAIN IN THE UP POSITION UNTIL THEY CAN BE ROTATED OVER THE RELEASE BEARING HOUSING INTO THEIR FINAL POSITION.

⚠ CAUTION

- **Do not use the cross-shaft release lever (or a pipe over it) to pull the transmission into its final position.**
- **Do not excessively force the transmission into the clutch assembly or engine housing. If it does not enter freely, investigate the cause of the problem and make any necessary changes.**
- **If the input shaft will not slide into the discs, they may need to be repositioned. Do not let the transmission drop or hang unsupported in the driven discs.**
  This can cause the discs to become distorted and the clutch will not release.

9. INSTALL THE TRANSMISSION MOUNTING BOLTS AND TORQUE TO THE PROPER SPECIFICATION.
Tightening Torque:
37.5-48.5 N·m{382-494 kgf·cm, 28-35 lbf·ft}

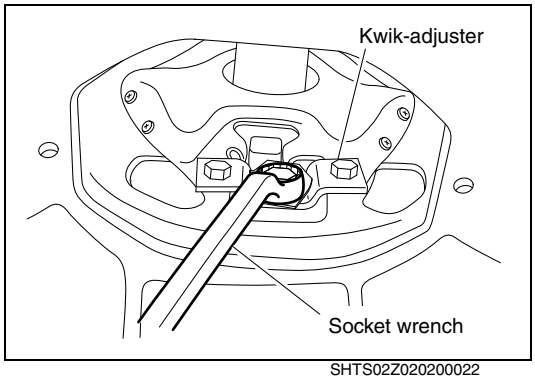


SHTS02Z020200021

IMPORTANT POINT - ADJUSTMENT

1. CHECK LOCATION OF THE KWIK-ADJUSTER®

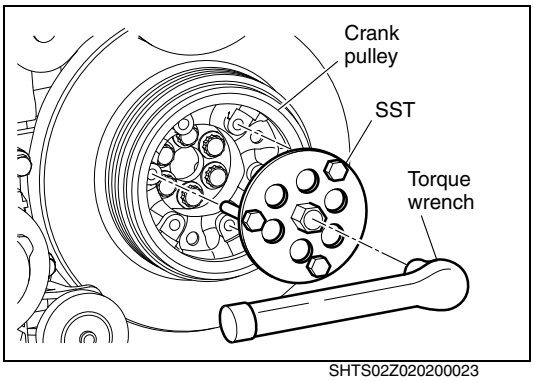
(1) Remove the cover of inspection hole at the bottom of the clutch housing.



SHTS02Z020200022

(2) If the Kwik-Adjuster exists in approachable position, adjustment can be performed.
If position of the Kwik-Adjuster cannot be identified, perform following procedure.

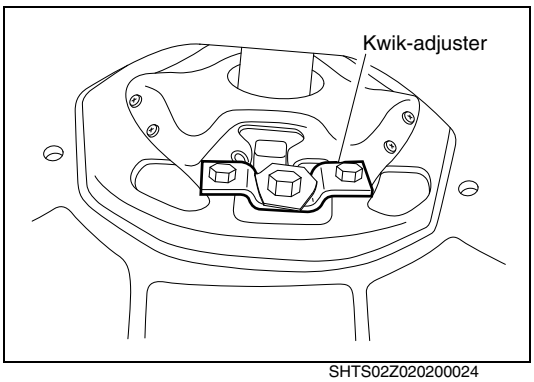
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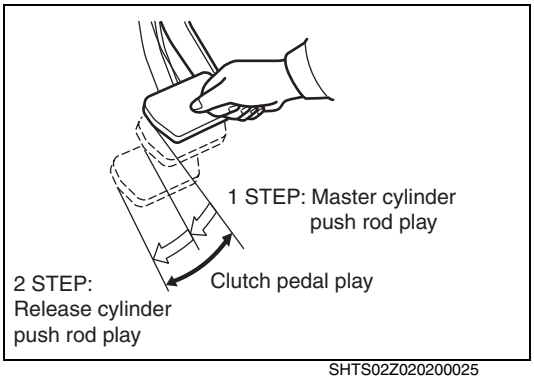
2. ARRANGE THE KWIK-ADJUSTER

(1) Set SST the crank pulley.
SST:
Cranking Tool (S0940-91200)



SHTS02Z020200024

(2) Turn the crank pulley till the Kwik-Adjuster matches the inspection hole.



SHTS02Z020200025

3. ADJUSTING PROCEDURES

(1) Adjust the release bearing position;

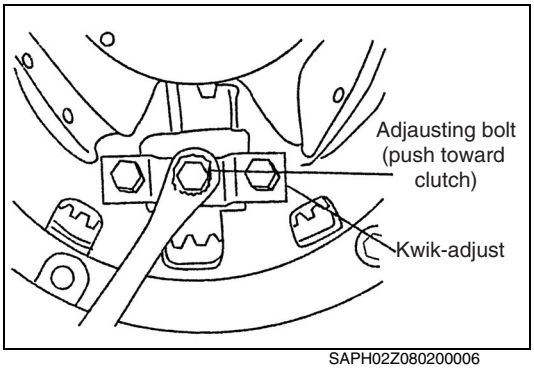
- When the clutch disc is worn (pedal play less than limit)
  Pedal play limit: 35 mm {1.38 in.}
- When the clutch disc replaced.

(2) Adjust the free travel by release cylinder push rod only;

- When the clutch disc or control linkage is replaced.

NOTICE

The above adjusting should be made after adjusting the release bearing position.



SAPH02Z080200006

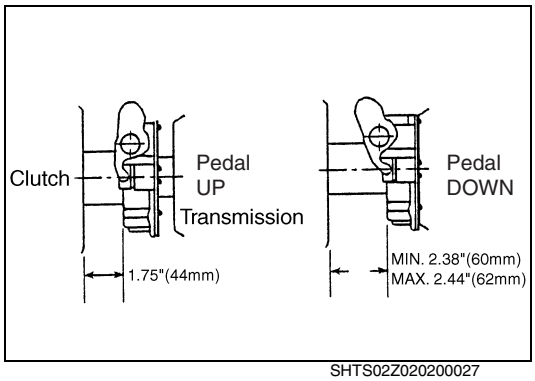
(3) Manual Adjust: Kwik-Adjust®

- Depress adjusting bolt and rotate.
  Kwik-Adjust will re-engage at 1/3 of a turn.

NOTICE

- **Open-end wrenches are not recommended.**
- **Internal adjustments are performed with pedal down (clutch released).**

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SHTS02Z020200027

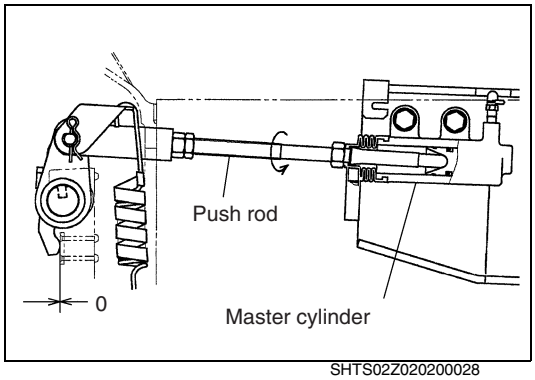
4. ADJUST THE RELEASE BEARING POSITION

(1) Set 1.75" (44 mm) dimension: With pedal down, turn adjusting ring to obtain approximately 1.75" (44 mm). Turning the adjusting ring clockwise moves the release bearing toward the transmission. Turning the adjusting ring counterclockwise moves the release bearing toward the engine.

(2) Check release travel dimensions with release yoke rotated toward release bearing, eliminating excess play in system. Having set this, depress pedal down fully releasing clutch and check release travel to settings shown.

NOTICE

It may be necessary to reduce the 1.75" (44 mm) settings to be able to achieve 0.500"-0.562" (13-14 mm) travel on some models of transmissions.

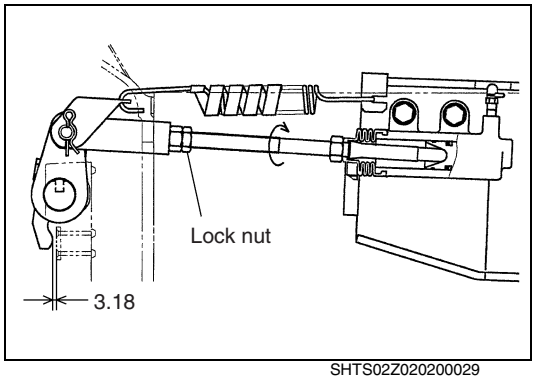


SHTS02Z020200028

5. ADJUST THE FREE TRAVEL

(1) Remove the return spring.

(2) Loosen the lock nut and turn the push rod counterclockwise until the release bearing contacts the release lever plate or release lever.



SHTS02Z020200029

(3) Turn the push rod clockwise about 3 1/3 turns.

Standard: Clearance between release bearing and release yoke: 3.18 mm {0.125 in.}

(4) Tighten the lock nut.

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CLUTCH ASSEMBLY (EATON SOLO1401)

DATA AND SPECIFICATIONS

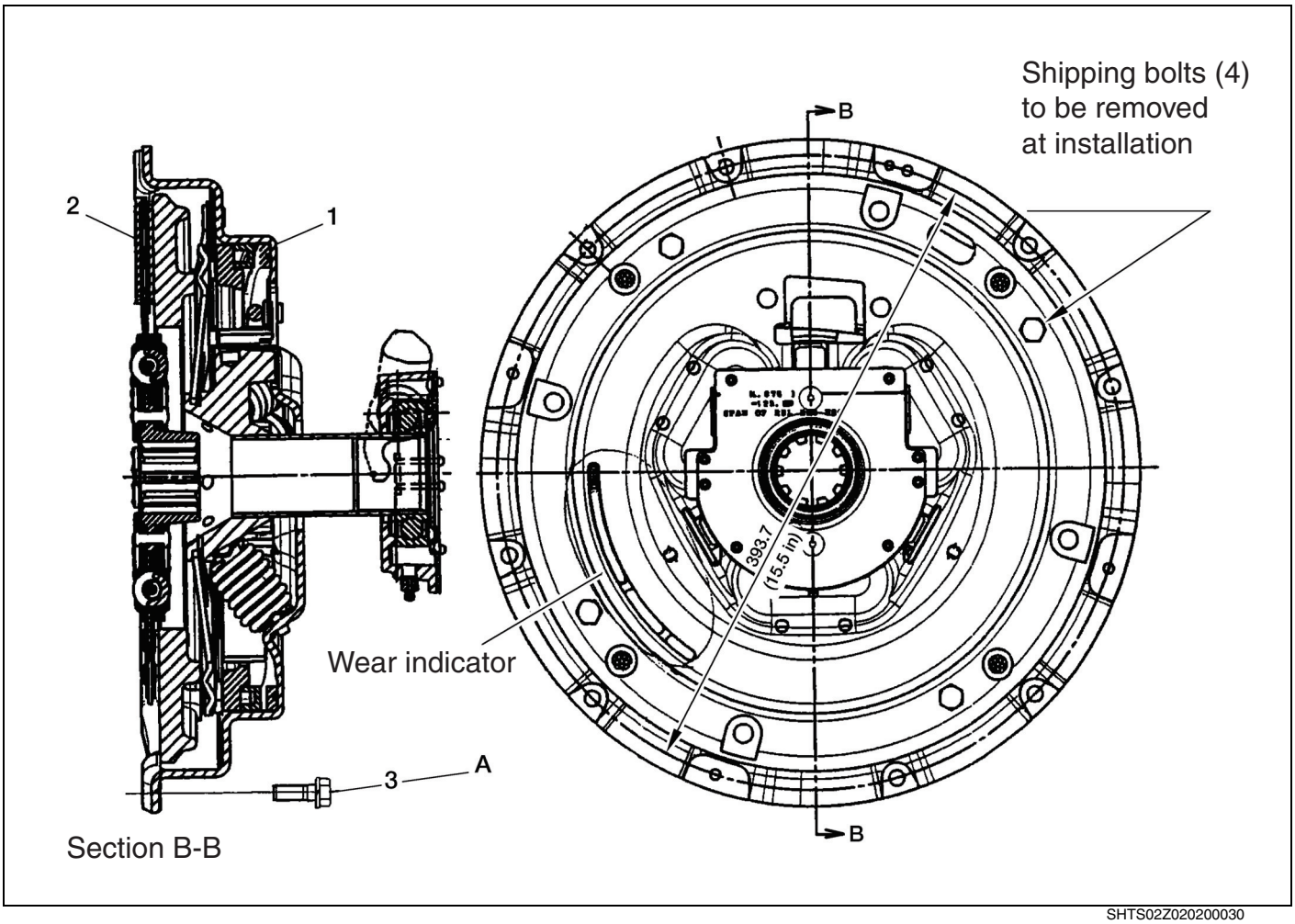
EN02Z0202I200002

CLUTCH FACING **Unit: mm {in.}**

Material	**Sintered metal (Ceramic metal)**
Type	**Dry single plate with damper spring**
Inside diameter	**222 {8.8}**
Outside diameter	**350 {13.8}**
Thickness	**11.5 {0.45} Adjustment-Free**

COMPONENT LOCATOR

EN02Z0202D100002



SHTS02Z020200030

1	**Clutch cover**	**3**	**Bolt**
2	**Clutch disc**		

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

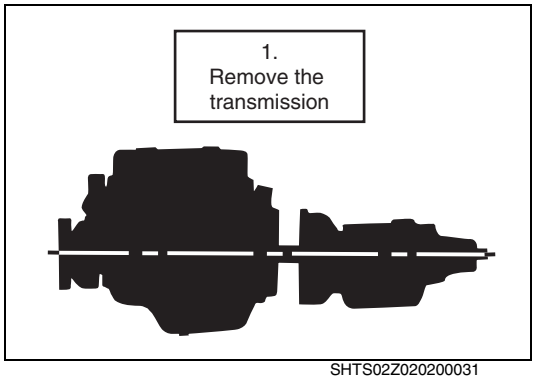
A	**50-64 {510-655, 37-47}**		

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OVERHAUL

EN02Z0202H200002

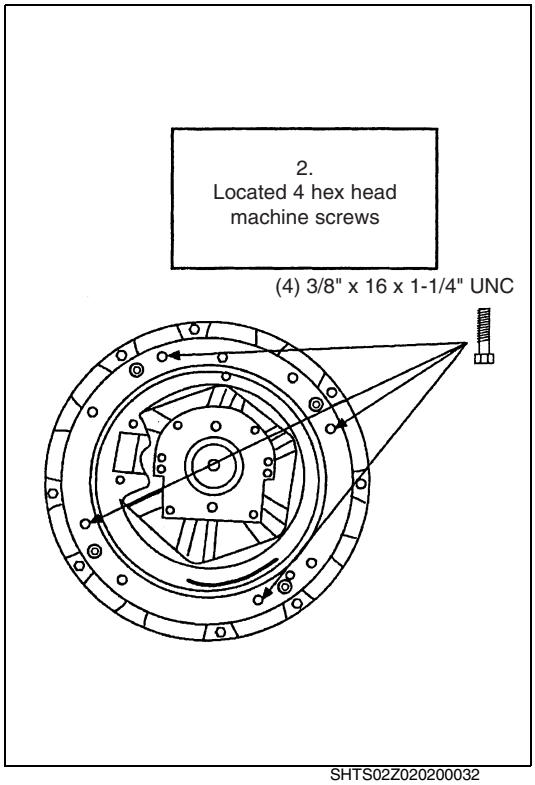
IMPORTANT POINT - DISMOUNTING



SHTS02Z020200031

1. REMOVE THE TRANSMISSION, SUPPORTING ITS WEIGHT TO PREVENT DAMAGE TO THE BEARING AND DISCS.

NOTICE
If a SOLO Clutch is to be removed and reinstalled on the flywheel, four (4) shipping bolts must be installed prior to unbolting the clutch (3/8" x 16 UNC x 1-1/4").

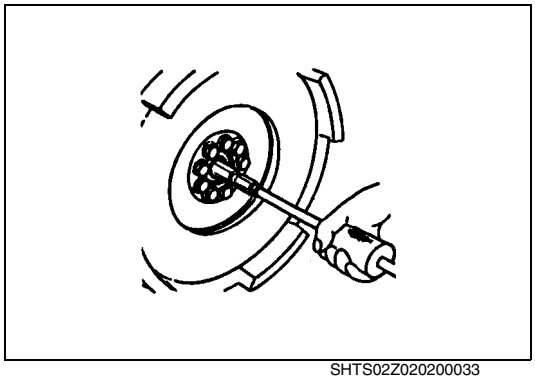


SHTS02Z020200032

2. LOCATE FOUR (4) 3/8" x 16 UNC x 1 - 1/4", HEX HEAD MACHINE SCREWS. INSTALL THEM IN THE 4 COVER HOLES, TURNING THEM ONE COMPLETE TURN AFTER THEY CONTACT THE COVER.

3. REMOVE THE CLUTCH FROM THE FLYWHEEL.

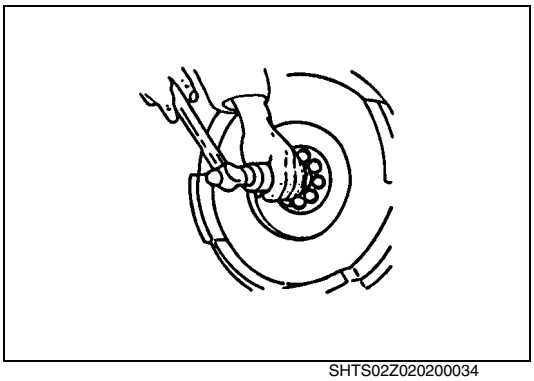
IMPORTANT POINT - INSPECTION AND REPLACEMENT


SHTS02Z020200033

1. REPLACE THE PILOT BEARING.

(1) Remove the pilot bearing.
SST:
Pilot Bearing Puller (S0965-01970)
Sliding Hammer (S0942-01442)

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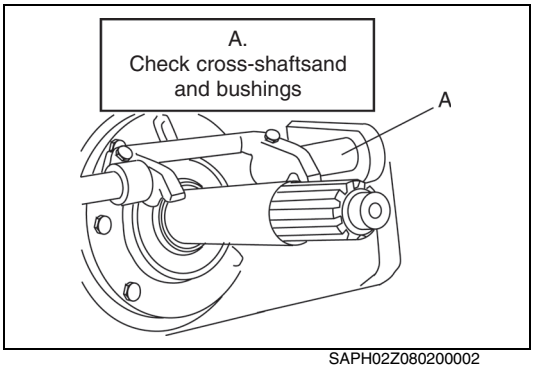


SHTS02Z020200034

(2) Using a suitable tapping rod, install the pilot bearing.

NOTICE
After installing the pilot bearing, ensure that it rotates smoothly.

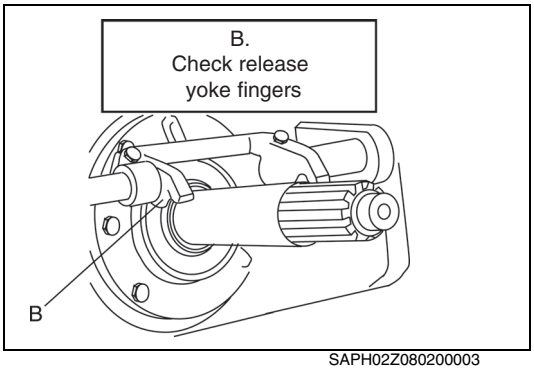
2. CHECK THE FOLLOWING ITEMS FOR WEAR REPLACE ANY WORN COMPONENTS.



SAPH02Z080200002

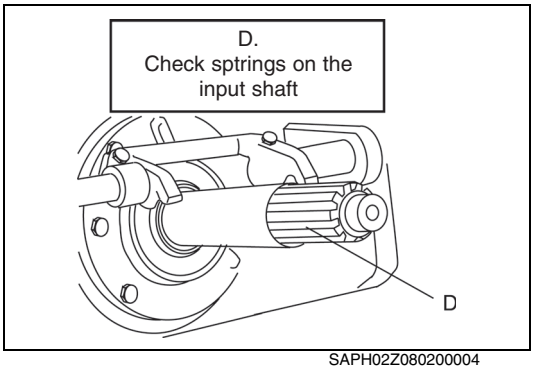
(1) Cross-shafts and bushings

NOTICE
Excessive wear at these points can cause a side loading condition. Also, inspect the remaining pivot points of the linkage for excessive wear.



SAPH02Z080200003

(2) Release yoke fingers

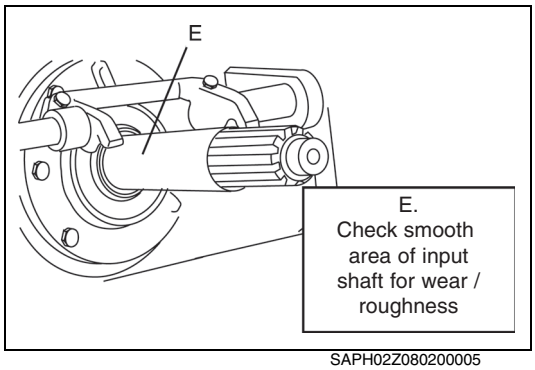


SAPH02Z080200004

(3) Splines on the input shaft

NOTICE
Any wear on the splines will prevent the newly installed driven discs from sliding freely, thus causing poor release (clutch drag). Select a disc out of the new installation and slide it full length on the transmission splines. This will detect a twisted input shaft. Replace input shaft if disc does not freely slide.

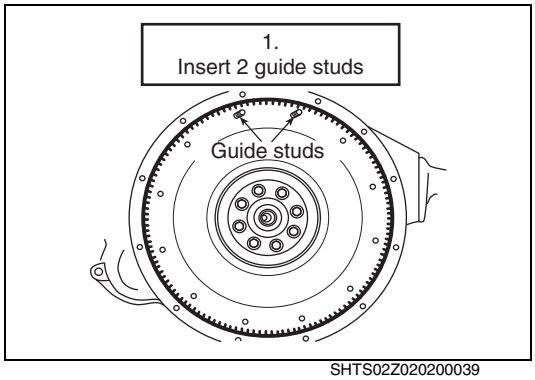
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SAPH02Z080200005

(4) Smooth area of input shaft
(5) Mating surfaces

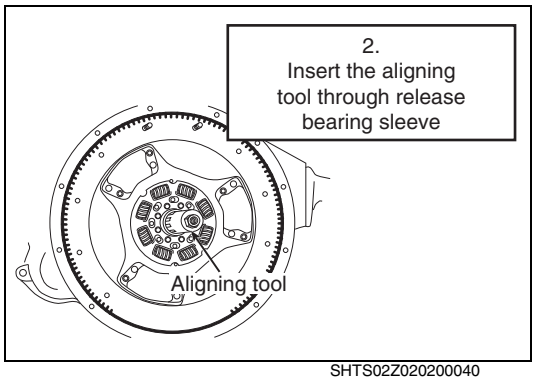
NOTICE
Inspect the mating surfaces of both the transmission bell housing and the flywheel housing. Any appreciable wear on either housing will cause misalignment. Most wear will occur between the 3 and 8 o'clock positions.
Replace housings if worn.



SHTS02Z020200039

IMPORTANT POINT - MOUNTING

1. INSERT TWO (2) 3/8" x 16 UNC x 3" (76 MM) LONG GUIDE STUDS INTO THE TWO UPPER MOUNTING HOLES OF THE FLYWHEEL.

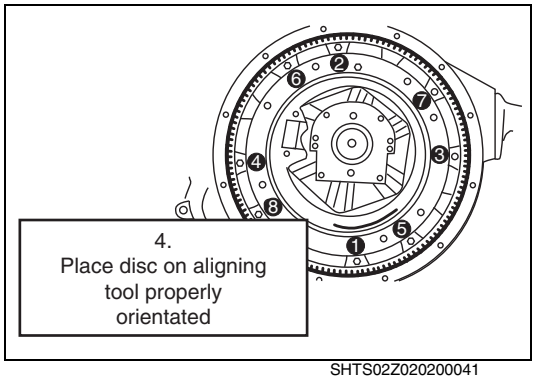


SHTS02Z020200040

2. INSTALL THE DISC BY INSERTING THE ALIGNING TOOL THROUGH THE DISC SPLINES AND THEN INTO THE PILOT BEARING.
SST: Clutch Aligning Arbor (S0966-21410)

NOTICE
Make sure the side marked "Pressure Plate Side" faces the pressure plate.

3. WITH THE ALIGNING TOOL STILL IN PLACE, CAREFULLY SLIDE THE CLUTCH ASSEMBLY OVER THE ALIGNING TOOL AND THE TWO (2) GUIDE STUDS.



SHTS02Z020200041

4. INSTALL LOCKWASHER AND SIX (6) 3/8" x 16 UNC MOUNTING BOLTS HAND TIGHTEN.
(1) Remove the two (2) guide studs and replace with the remaining mounting bolts with lockwasher. Using a torque wrench, progressively tighten the eight (8) mounting bolts using the following crisis-cross pattern. Starting at lower left.
Tightening Torque:
50-64 N·m{510-665 kgf·cm, 37-47 lbf·ft}

⚠ CAUTION
Failure to tighten these bolts in this manner can:
- **Prevent the clutch cover from "centering" into the pilot area of the flywheel.**
- **Cause permanent damage to the clutch cover (i.e. become cracked or broken).**
- **Cause the clutch assembly to be out-of balance with the flywheel.**

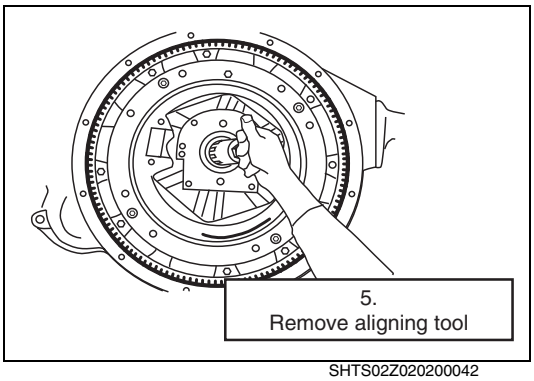
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(2) Remove the four (4) gold colored shipping bolts in a criss-cross pattern.

NOTICE

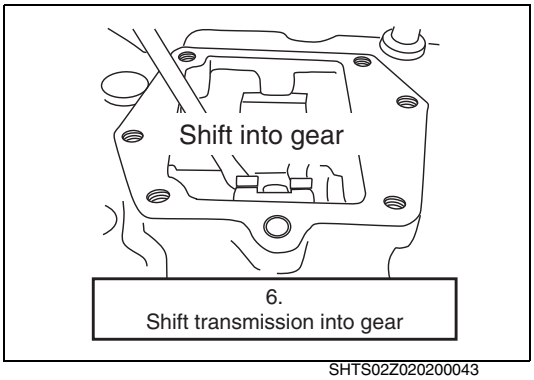
Save these four (4) bolts for future use in case you need to remove, then reinstall the SOLO Clutch.

5. REMOVE THE ALIGNING TOOL.



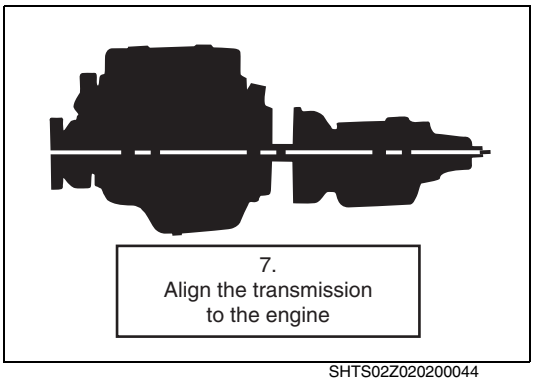
SHTS02Z020200042

6. SHIFT THE TRANSMISSION INTO GEAR.



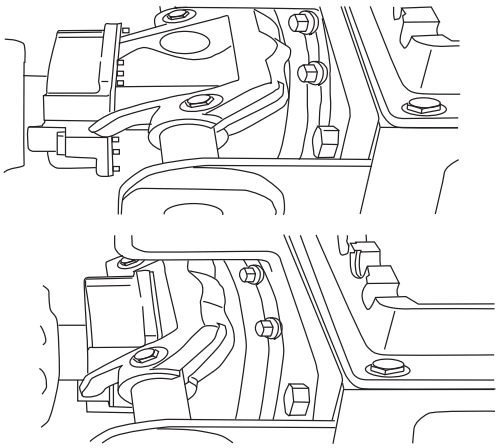
SHTS02Z020200043

7. POSITION THE TRANSMISSION SO THAT IT IS BOTH SQUARE TO AND ALIGNED WITH THE ENGINE.



SHTS02Z020200044

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8.
Mesh input shaft and disc (s) by rotating output shaft

SHTS02Z020200045

8. WHILE MOVING THE TRANSMISSION FORWARD, ROTATE THE OUTPUT SHAFT OF THE TRANSMISSION UNTIL THE SPLINES OF BOTH THE INPUT SHAFT AND THE DISC(S) MESH WITH EACH OTHER. WHILE PERFORMING THIS TASK, YOU MUST ALSO ENSURE THAT THE YOKE FINGERS REMAIN IN THE UP POSITION UNTIL THEY CAN BE ROTATED OVER THE RELEASE BEARING HOUSING INTO THEIR FINAL POSITION.

⚠ CAUTION

- **Do not use the cross-shaft release lever (or a pipe over it) to pull the transmission into its final position. Doing so may release the clutch and "overstroke" the release bearing. The SOLO will incorrectly "set" the release bearing position too close to the transmission and cause the wear indication tab to move to 1/3-1/2 the distance towards the "REPLACE" position.**
- **Do not excessively force the transmission into the clutch assembly or engine housing. If it does not enter freely, investigate the cause of the problem and make any necessary changes.**
- **If the input shaft will not slide into the discs, they may need to be repositioned. If the clutch is to be unbolted from the flywheel, reinstall the shipping bolts and tighten one turn past contact with the clutch. Now the installation shaft can be installed to reposition the discs and the clutch bolts re-torqued. Remove the shipping bolts to clamp the discs.**
- **Do not let the transmission drop or hang unsupported in the driven discs.**
  This can cause the discs to become distorted and the clutch will not release.

9. INSTALL THE TRANSMISSION MOUNTING BOLTS AND TORQUE TO THE PROPER SPECIFICATION.
Tightening Torque:
37.5-48.5 N·m{382-494 kgf·cm, 28-35 lbf·ft}

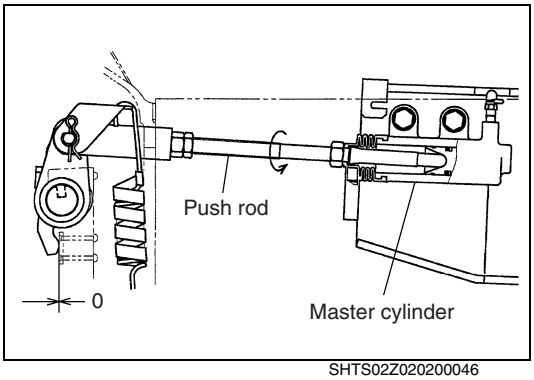
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IMPORTANT POINT-SET-UP

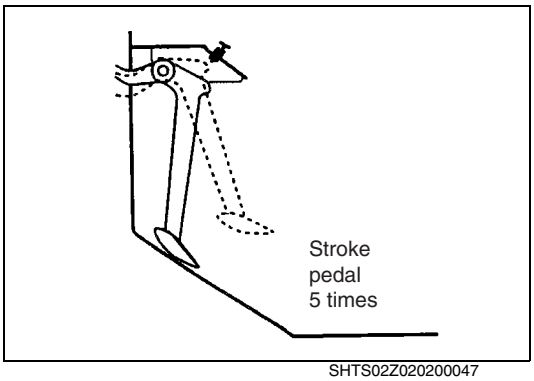
1. ADJUST LINKAGE

(1) Remove the return spring.

(2) Loosen the lock nut and turn the push rod counterclockwise until the release bearing contacts the release lever plate or release lever.



SHTS02Z020200046

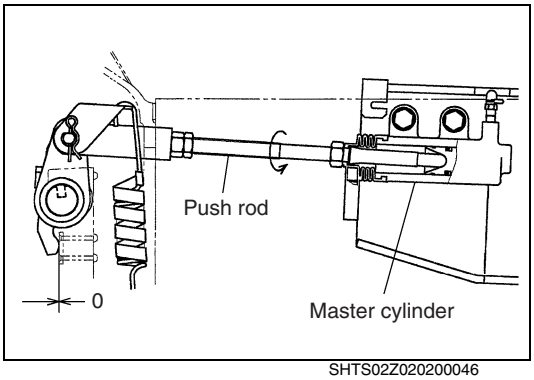


SHTS02Z020200047

(3) Fully press the pedal up to 5 times to move the release bearing slightly closer to the transmission and gain free-play in the cab.

2. ADJUST THE FREE TRAVEL

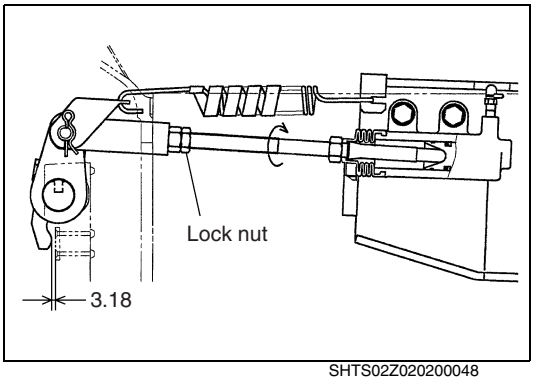
(1) Turn the push rod counterclockwise until the release bearing contacts the release lever plate or release lever.



SHTS02Z020200046

(2) Turn the push rod clockwise about 3 1/3 turns.

Standard: Clearance between release bearing and release yoke: 3.18 mm {0.125 in.}



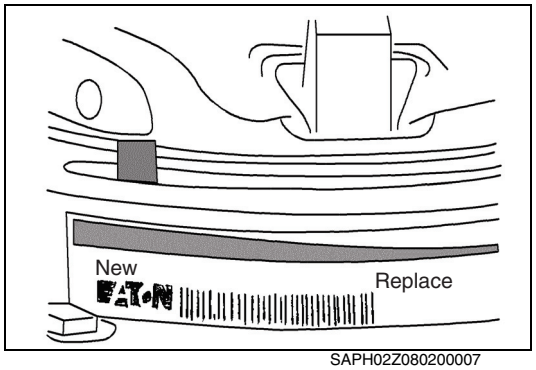
SHTS02Z020200048

(3) Tighten the lock nut.

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IMPORTANT POINT-CHECK WEAR INDICATOR

1. REMOVE THE COVER OF INSPECTION HOLE AT THE BOTTOM OF THE CLUTCH HOUSING.



SAPH02Z080200007

2. CHECK WEAR INDICATOR

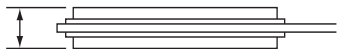
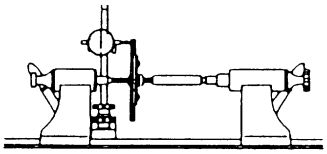
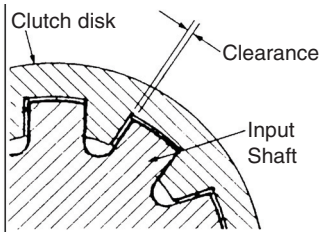
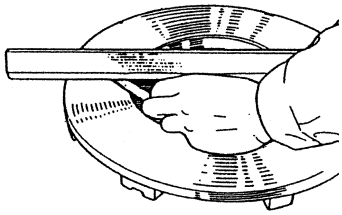
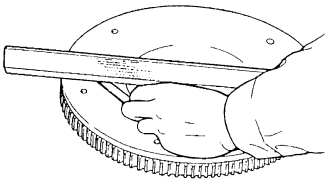
- Reflects clutch wear and indicates when it is time to replace clutch.
- When replacing clutch, should change clutch disc together with clutch cover.

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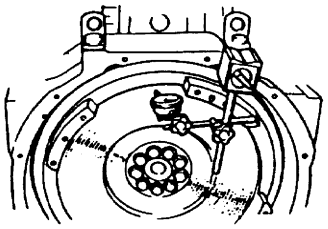
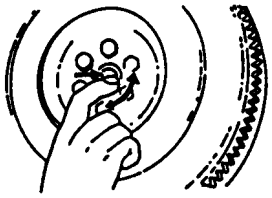
INSPECTION AND REPAIR

EN02Z0202H300001

EATON SAS1401 and SOLO1401 **Unit: mm {in.}**

Inspection item	Standard	Limit	Remedy	Inspection procedure
Clutch facing thickness	11.43 {0.45}	8.26 {0.33}	Replace disc assembly.	Measure 
Clutch disc misalignment	0-0.38 {0-0.0149}	0.38 {0.0149}	Replace.	Measure 
Oily facings, Loose rivets, Broken or loose damper springs	—	—	Replace disc assembly, if necessary.	Visual check
Clearance between clutch disc hub and transmission input shaft spline	0.05-0.15 {0.0020-0.0059}	0.5 {0.020}	Replace the clutch disc or the transmission input shaft.	Measure 
Pressure plate misalignment	0-0.102 {0-0.040}	0.76 {0.029}	Replace the clutch cover assembly	Measure 
Pressure plate friction surface scoring or heat cracking	—	—	Replace the clutch cover assembly. NOTICE Regrinding of the pressure plate is not possible.	Visual check
Flywheel misalignment	0.05 {0.0020} or less	1.0 {0.039}	Replace.	Measure 

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Inspection item	Standard	Limit	Remedy	Inspection procedure
Flywheel friction surface scoring or heat cracking	—	Grind limit 1.0 {0.039} Deflection limit 0.04 {0.00157}	Regrind the friction surface or replace, if necessary. NOTICE Do not grind the flywheel over the limit.	Visual check
Flywheel misalignment	—	0.15 {0.0059}	Regrind the friction surface or replace.	Measure 
Pilot bearing improper rotation	—	—	Replace, if necessary.	Visual check 

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LUBRICATION (EATON SAS1401 and SOLO1401)

1. RELEASE BEARING

(1) The cast iron bearing housing will be equipped with either a standard grease fitting or a lube tube extension. If a lube tube is not present, it is necessary to remove the inspection cover to gain access to the grease fitting. Apply grease until it purges from the rear of the housing.

2. RELEASE BEARING WEAR PADS

(1) Where the release fork contacts the bearing housing; there are small hardened steel pads. Apply a small amount of grease to the wear pads where the clutch release fork contacts.

3. CROSS-SHAFT BUSHINGS

(1) Lubricate both the left and the right cross-shaft bushings.

4. PILOT BEARING

(1) The pilot bearing inside the flywheel is a sealed for life bearing and requires no lubrication.

RECOMMENDED LUBRICATION

Use a lithium soap base E.P. (Extreme Pressure) grease with a minimum of +325 degree F operating range. It must meet the N.L.G.I.'s Grade 2 or 3 specs.

⚠ CAUTION

Incorrect grease and improper lube procedures will cause bearing failures, bushing wearout, yoke tip and bearing wear pad wear.

Recommended Lubrication			
Supplier	**Product**	**Supplier**	**Product**
American Oil Co.	**Amoco Uthium-M.P. Grease**	**Texaco**	**Multifak #2**
City Service Co.	**Citgo Premium Lithium Grease #2**	**Shell Oil Co.**	**Retinax A**
Fiske Refining Co.	**Lubriplate 630-2**	**Shell Oil Co.**	**Aivania #2**
Keystone Lubricating Co.	**#81 Ught**	***Chevron Oil Co.**	**S.R.I. 1~**
Mobil	**Mobilgrease M.P.**	***Texaco**	**Premium RB**
Humble Oil Co.	**Udok 2**	***Exxon**	**Unirex N3**
Atlantic Richfield Co.	**Arco M.P.**		
*** Approved for vendor prepack, other greases listed are for service only.**			

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CLUTCH MAIN UNIT (EATON 1402)

CL02-002

CLUTCH ASSEMBLY
(EATON SAS1402)..... CL02-2
DATA AND SPECIFICATIONS CL02-2
DESCRIPTION CL02-2
TROUBLESHOOTING.....CL02-3
SPECIAL TOOL.....CL02-5
COMPONENT LOCATOR.....CL02-6
OVERHAUL CL02-7

CLUTCH ASSEMBLY
(EATON SOLO1402)..... CL02-16
DATA AND SPECIFICATIONS CL02-16
COMPONENT LOCATOR.....CL02-16
OVERHAUL CL02-17
INSPECTION AND REPAIR CL02-27

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CLUTCH ASSEMBLY (EATON SAS1402)

DATA AND SPECIFICATIONS

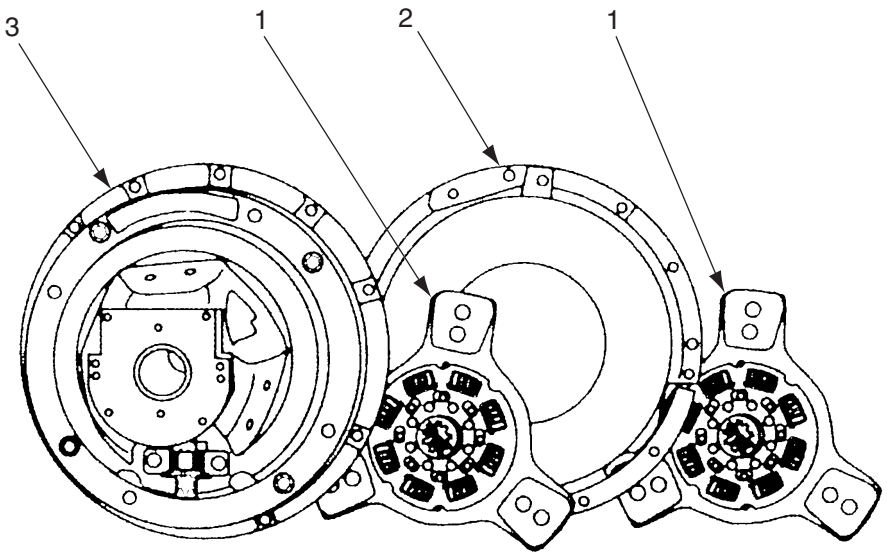
EN02Z0202I200001

CLUTCH FACING **Unit: mm {in.}**

Material	**Sintered metal (Ceramic metal)**
Type	**Dry two plate with damper spring**
Inside diameter	**222 {8.8}**
Outside diameter	**350 {13.8}**
Thickness	**11.5 {0.45}**

DESCRIPTION

EN02Z0202C100001



SHTS02Z020200001

1	**Clutch disc**	**3**	**Clutch cover**
2	**Intermediate plate**		

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TROUBLESHOOTING

EN02Z0202F300001

Symptom	Possible cause	Remedy/Prevention
Clutch dragging.	Clutch disc distorted or warped.	Replace clutch disc.
	Transmission input shaft worn.	Replace input shaft and check clutch hub for excessive wear. If worn, replace disc. Check flywheel housing alignment.
	Excessive clutch control parts wear.	Replace control parts.
	Clutch control parts not functioning properly.	Replace control parts.
	Improper clutch control adjustment.	Adjust clutch control.
	Clutch disc assembly too thick.	Replace clutch disc.
Clutch slipping.	Release lever and release bearing clearance incorrectly adjusted.	Adjust clearance.
	Clutch disc facing gummed with oil or grease.	Replace disc assembly.
	Release bearing worn.	Replace bearing.
	Clutch pedal free-play incorrectly adjusted.	Adjust free-play.
	Compression spring weak.	Replace cover assembly.
	Clutch facing worn.	Replace disc assembly.
	Failing to remove plate from the clutch pressure plate assembly.	Remove plate.
	Driver riding clutch pedal.	Do not ride the clutch pedal.
Vehicle vibrates when starting.	Improper engine idling.	Adjust idling.
	Clutch control incorrectly adjusted.	Adjust clutch control.
	Clutch disc facing gummed with oil or grease.	Replace disc assembly.
	Glazed flywheel friction surface.	Deglaze flywheel surface with coarse emery cloth, stroking parallel to machining lines.
	Clutch disc distorted or warped.	Replace disc.
	Improper clutch cover tightening.	Tighten bolts.
	Flywheel housing misalignment.	Replace flywheel housing.
Abnormal noise in transmission.	Malfunction of engine.	Tune up engine.
	Improper clutch disc used.	Replace proper clutch disc.
	Trouble in transmission.	Check transmission.
	The engine idle speed is low.	Increase the idle speed.

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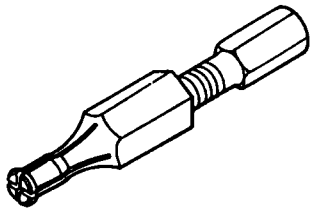
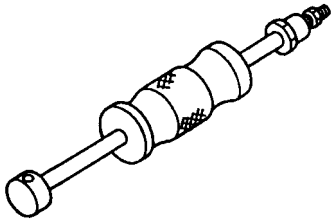
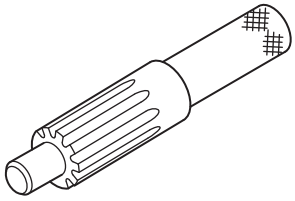
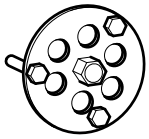
Symptom	Possible cause	Remedy/Prevention
Noisy clutch.	Release bearing worn or dried.	Replace release bearing.
	Pilot bearing worn or dried.	Replace pilot bearing.
	Clutch disc distorted or warped.	Replace clutch disc.
	Flywheel housing misalignment.	Replace flywheel housing.
	Transmission input shaft or clutch disc spline worn.	Clean and lubricate or replace.
	Insufficient lubrication of pedal and its accessories.	Lubricate.
	Insufficient lubrication of release shaft and release bearing hub.	Lubricate.
	Transmission input shaft retainer rusted or soiled.	Clean or replace if rusted.
	Clutch pedal free-play incorrectly adjusted.	Adjust free-Play.
Clutch pedal cannot be depressed.	Clutch control incorrectly adjusted.	Adjust clutch control.
	Insufficient lubricant release shaft and release bearing hub.	Lubricate.
Change in clutch pedal give.	Air trapped in clutch fluid.	Bleed air.

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SPECIAL TOOL

EN02Z0202K100001

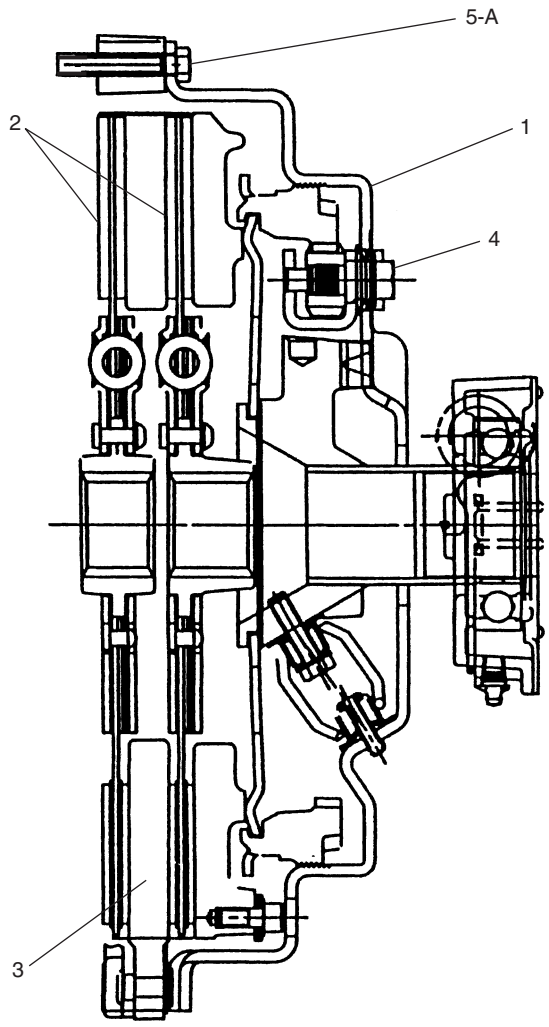
Prior to starting a clutch overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0965-01970	CLUTCH PILOT BEARING PULLER	
	S0942-01442	SLIDING HAMMER	
	S0966-21420	CLUTCH ALIGNING ARBOR	
	S0940-91200	CRANKING TOOL	

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COMPONENT LOCATOR

EN02Z0202D100001



SHTS02Z020200006

1	Clutch cover	4	Adjusting screw
2	Clutch disc	5	Bolt
3	Intermediate plate		

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

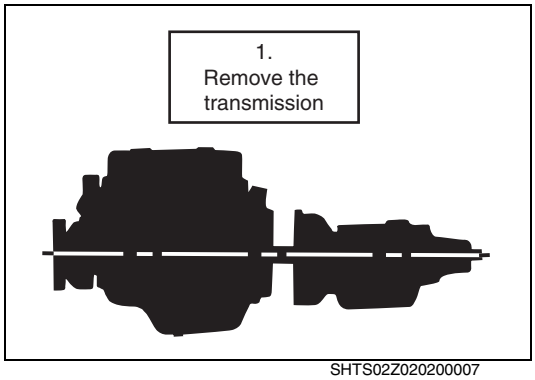
A	50-64 {510-655, 37-47}	

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OVERHAUL

EN02Z0202H200001

IMPORTANT POINT - DISMOUNTING



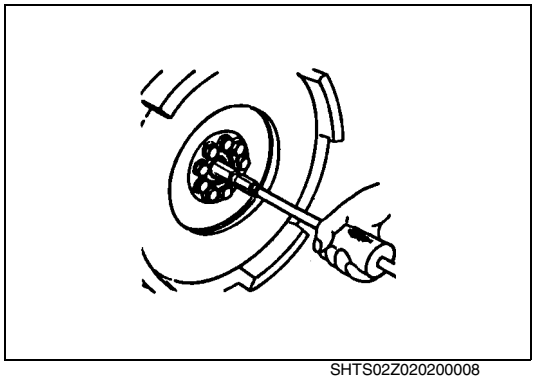
SHTS02Z020200007

1. REMOVE THE TRANSMISSION, SUPPORTING ITS WEIGHT TO PREVENT DAMAGE TO THE BEARING AND DISCS.

2. INSTALL TWO WOODEN SPACERS 1"-1-1/2" THICK BETWEEN RELEASE BEARING AND COVER ASSEMBLY.

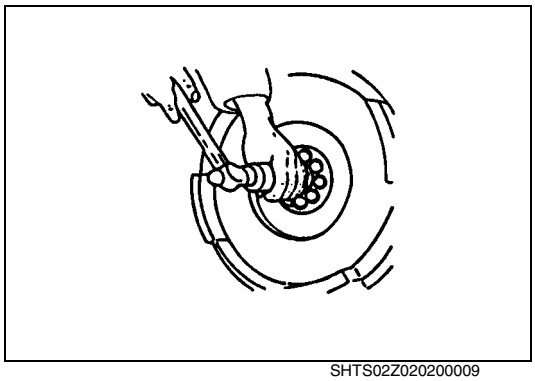
3. REMOVE THE CLUTCH FROM THE FLYWHEEL.

IMPORTANT POINT - INSPECTION AND REPLACEMENT


SHTS02Z020200008

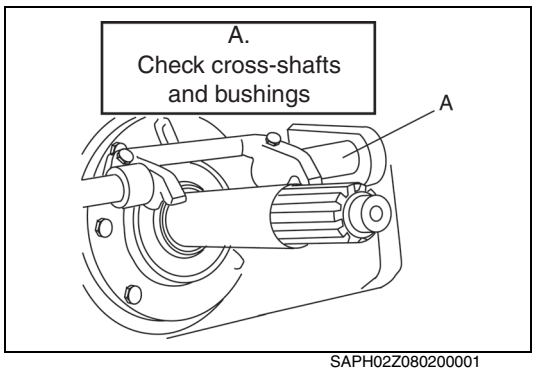
1. REPLACE THE PILOT BEARING.

(1) Remove the pilot bearing.
SST:
Pilot Bearing Puller (S0965-01970)
Sliding Hammer (S0942-01442)


SHTS02Z020200009

(2) Using a suitable tapping rod, install the pilot bearing.

NOTICE
After installing the pilot bearing, ensure that it rotates smoothly.



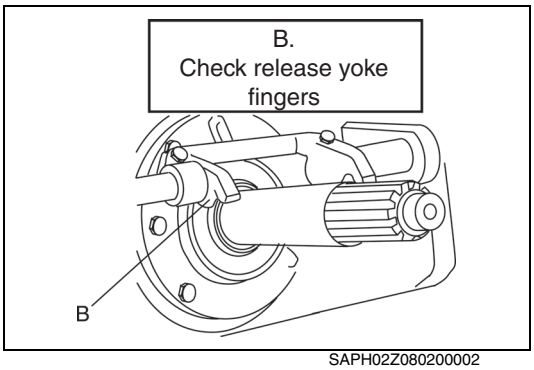
SAPH02Z080200001

2. CHECK THE FOLLOWING ITEMS FOR WEAR REPLACE ANY WORN COMPONENTS:

(1) Cross-shafts and bushings

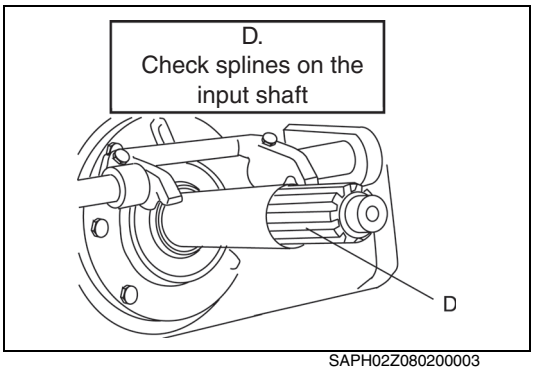
NOTICE
Excessive wear at these points can cause a side loading condition. Also, inspect the remaining pivot points of the linkage for excessive wear.

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SAPH02Z080200002

(2) Release yoke fingers

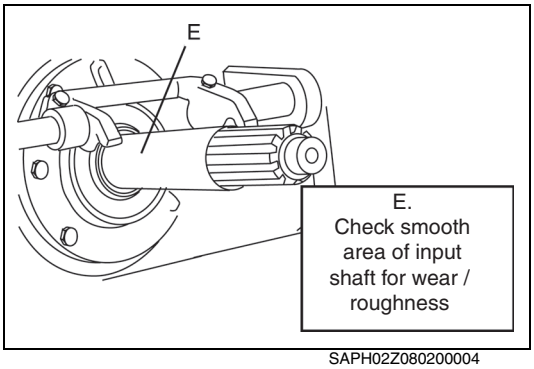


SAPH02Z080200003

(3) Splines on the input shaft

NOTICE

Any wear on the splines will prevent the newly installed driven discs from sliding freely, thus causing poor release (clutch drag). Select a disc out of the new installation and slide it full length on the transmission splines. This will detect a twisted input shaft. Replace input shaft if disc does not freely slide.



SAPH02Z080200004

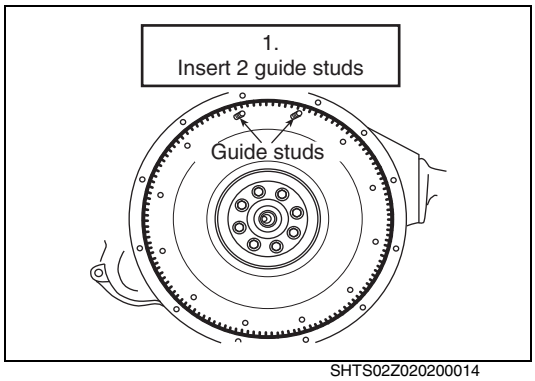
(4) Smooth area of input shaft
(5) Mating surfaces

NOTICE

Inspect the mating surfaces of both the transmission bell housing and the flywheel housing. Any appreciable wear on either housing will cause misalignment. Most wear will occur between the 3 and 8 o'clock positions.

Replace housings if worn.

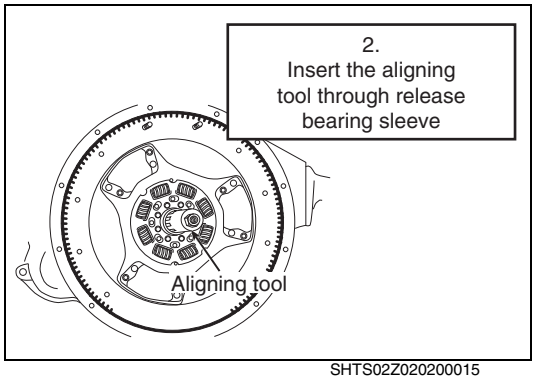
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IMPORTANT POINT - MOUNTING

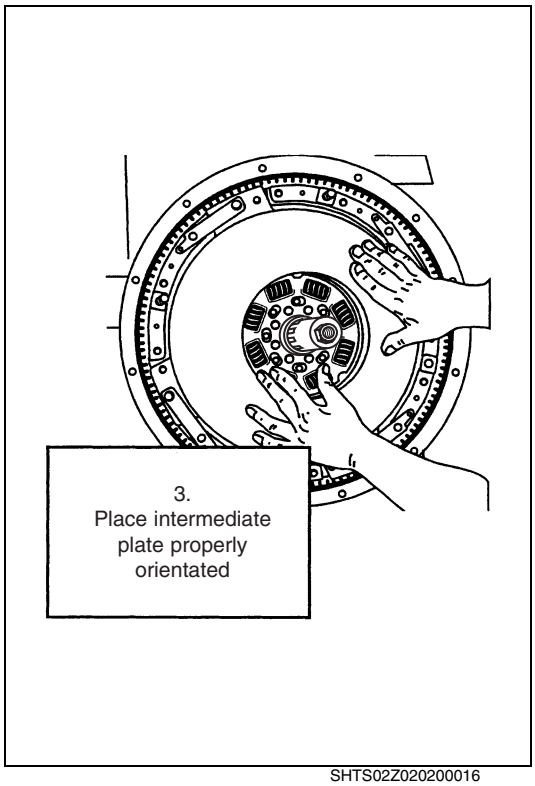
1. INSERT TWO (2) 3/8" x 16 UNC x 3" (76 MM) LONG GUIDE STUDS INTO THE TWO UPPER MOUNTING HOLES OF THE FLYWHEEL.



SHTS02Z020200015

2. INSTALL THE FRONT DISC BY INSERTING THE ALIGNING TOOL THROUGH THE DISC SPLINES AND THEN INTO THE PILOT BEARING.
SST:
Clutch Aligning Arbor (S0966-21420)

NOTICE
Make sure the side marked "Flywheel" faces the flywheel.

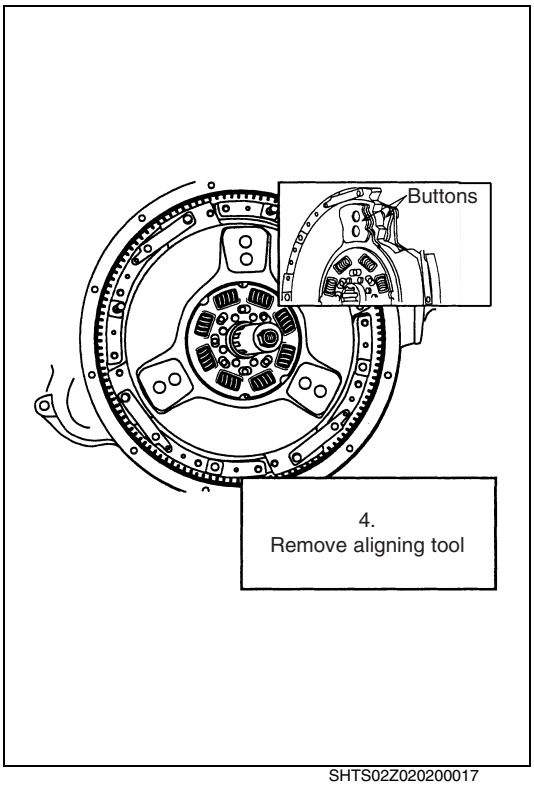


SHTS02Z020200016

3. INSTALL THE INTERMEDIATE PLATE ASSEMBLY OVER THE TWO (2) GUIDE STUDS AND SLIDE IT FORWARD UNTIL IT TOUCHES THE FLYWHEEL.

NOTICE
Make sure the side marked "Pressure Plate Side" is facing the pressure plate (the drive straps must face the pressure plate).

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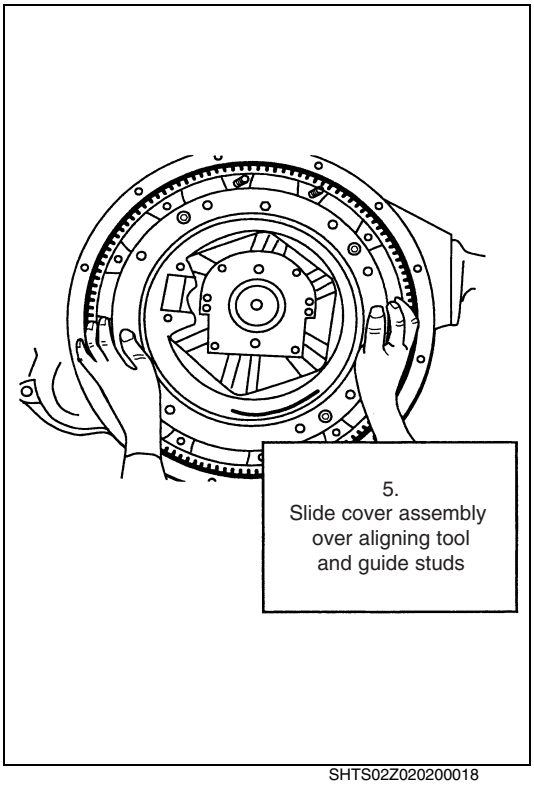


SHTS02Z020200017

4. REMOVE THE ALIGNING TOOL AND INSTALL IT THROUGH THE SPLINES OF THE REAR DISC, AND INSERT THE ALIGNING TOOL THROUGH THE FRONT DISC AND ALSO THE PILOT BEARING.

NOTICE

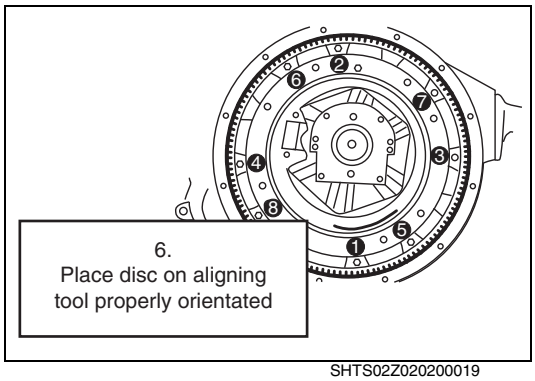
Make sure the side of the disc marked "Pressure Plate Side" is facing the pressure plate. As you complete this step, ensure that the ceramic buttons align with each other as closely as possible. Doing so will aid the function of the positive separator pins (roll pins).



SHTS02Z020200018

5. WITH THE ALIGNING TOOL STILL IN PLACE, SLIDE THE COVER ASSEMBLY OVER BOTH THE ALIGNING TOOL AND THE TWO (2) GUIDE STUDS UNTIL IT RESTS AGAINST THE INTERMEDIATE PLATE ASSEMBLY.

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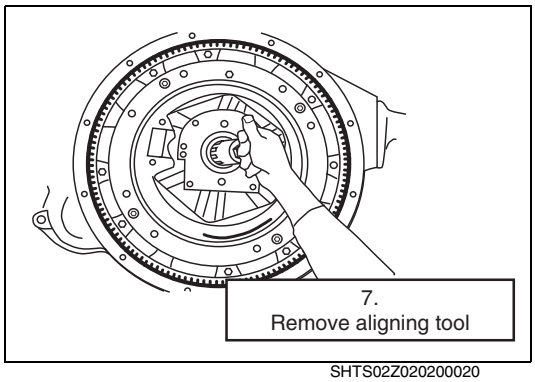
SHTS02Z020200019

6. INSTALL LOCKWASHER AND SIX (6) 3/8" x 16 UNC MOUNTING BOLTS HAND TIGHTEN.

(1) Remove the two (2) guide studs and replace with the remaining mounting bolts with lockwasher. Using a torque wrench, progressively tighten the eight (8) mounting bolts using the following criss-cross pattern. Starting at lower left.
Tightening Torque:
50-64 N·m{510-665 kgf·cm, 37-47 lbf·ft}

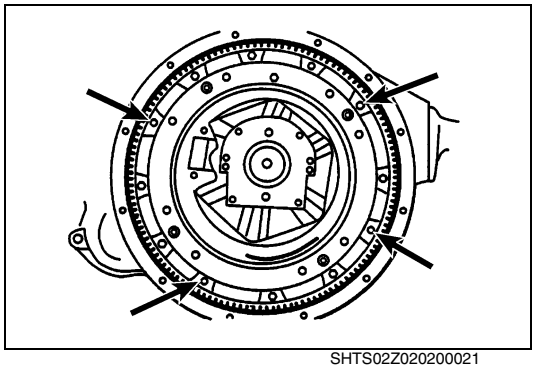
⚠ CAUTION
Failure to tighten these bolts in this manner can:

- **Prevent the clutch cover from "centering" into the pilot area of the flywheel.**
- **Cause permanent damage to the clutch cover (i.e. become cracked or broken).**
- **Cause the clutch assembly to be out-of balance with the flywheel.**



SHTS02Z020200020

7. REMOVE THE ALIGNING TOOL.

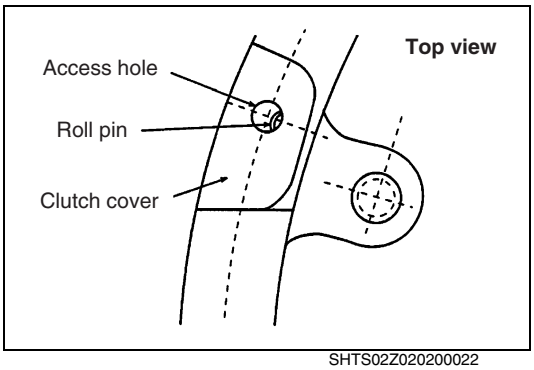

SHTS02Z020200021

8. USING A 1/4" (6 mm) DIAMETER FLAT NOSE PUNCH, LIGHTLY TAP EACH OF THE FOUR (4) POSITIVE SEPARATOR PINS TOWARD THE FLYWHEEL. PERFORMING THIS STEP WILL VERIFY THAT ALL FOUR (4) PINS ARE FLUSH AGAINST THE FLYWHEEL.

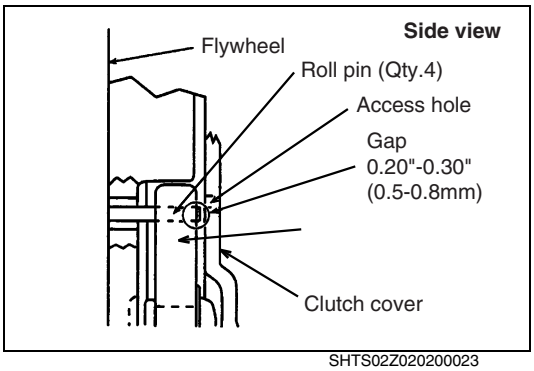
⚠ CAUTION
Failure to perform this step properly may cause the clutch to drag (clutch does not release). Excessive force can damage the pins and cause a release problem

NOTICE
The four (4) pins can also be set through the inspection opening of the transmission bell housing if they were not to set prior to transmission installation.

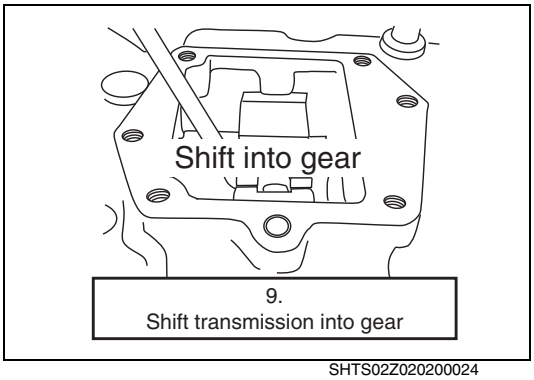
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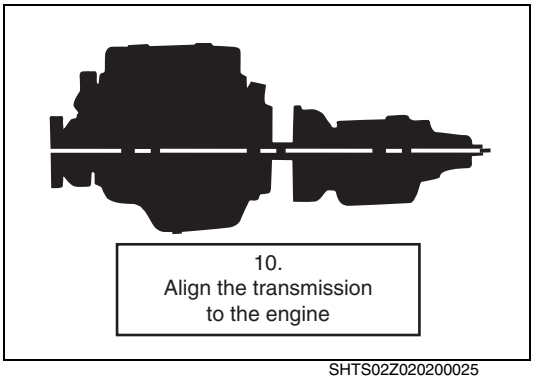


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SHTS02Z020200024

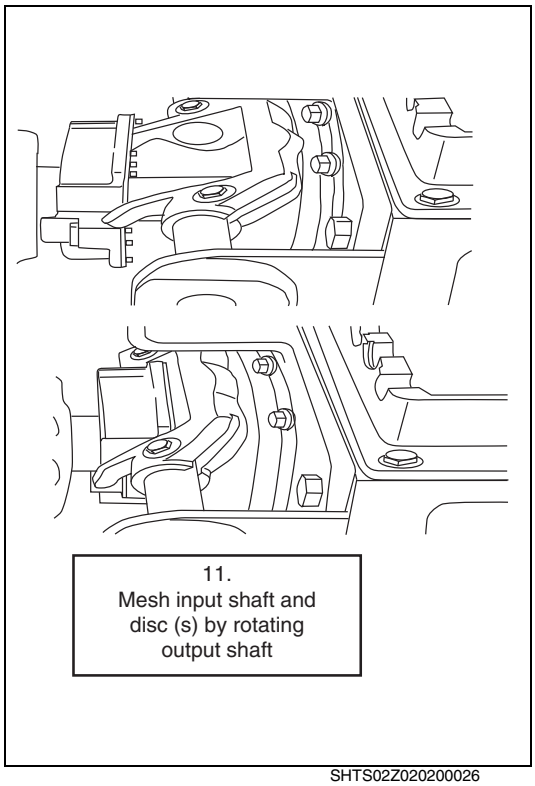
9. SHIFT THE TRANSMISSION INTO GEAR.



SHTS02Z020200025

10. POSITION THE TRANSMISSION SO THAT IT IS BOTH SQUARE TO AND ALIGNED WITH THE ENGINE.

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11.
Mesh input shaft and disc (s) by rotating output shaft

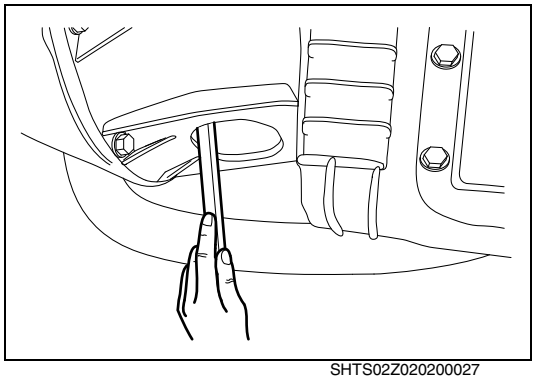
SHTS02Z020200026

11. WHILE MOVING THE TRANSMISSION FORWARD, ROTATE THE OUTPUT SHAFT OF THE TRANSMISSION UNTIL THE SPLINES OF BOTH THE INPUT SHAFT AND THE DISC(S) MESH WITH EACH OTHER. WHILE PERFORMING THIS TASK, YOU MUST ALSO ENSURE THAT THE YOKE FINGERS REMAIN IN THE UP POSITION UNTIL THEY CAN BE ROTATED OVER THE RELEASE BEARING HOUSING INTO THEIR FINAL POSITION.

⚠ CAUTION

- **Do not use the cross-shaft release lever (or a pipe over it) to pull the transmission into its final position.**
- **Do not excessively force the transmission into the clutch assembly or engine housing. If it does not enter freely, investigate the cause of the problem and make any necessary changes.**
- **If the input shaft will not slide into the discs, they may need to be repositioned. Do not let the transmission drop or hang unsupported in the driven discs.**
  This can cause the discs to become distorted and the clutch will not release.

12. INSTALL THE TRANSMISSION MOUNTING BOLTS AND TORQUE TO THE PROPER SPECIFICATION.
Tightening Torque:
37.5-48.5 N·m{382-494 kgf·cm, 28-35 lbf·ft}

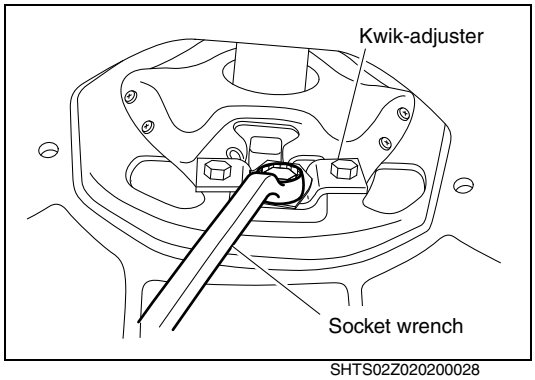


SHTS02Z020200027

IMPORTANT POINT - ADJUSTMENT

1. CHECK LOCATION OF THE KWIK-ADJUSTER®

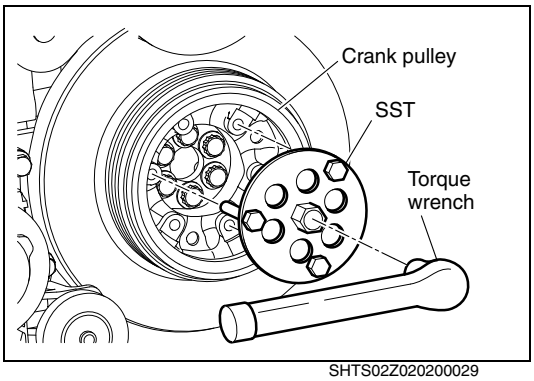
(1) Remove the cover of inspection hole at the bottom of the clutch housing.



SHTS02Z020200028

(2) If the Kwik-Adjuster exists in approachable position, adjustment can be performed.
If position of the Kwik-Adjuster cannot be identified, perform following procedure.

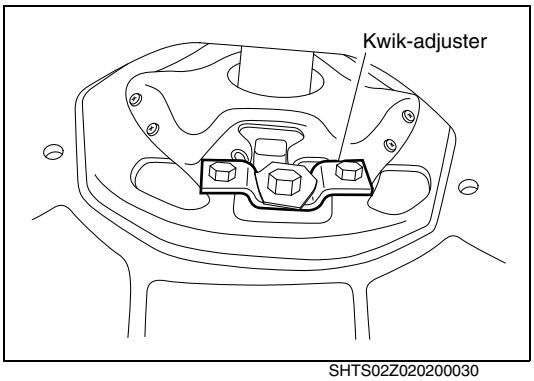
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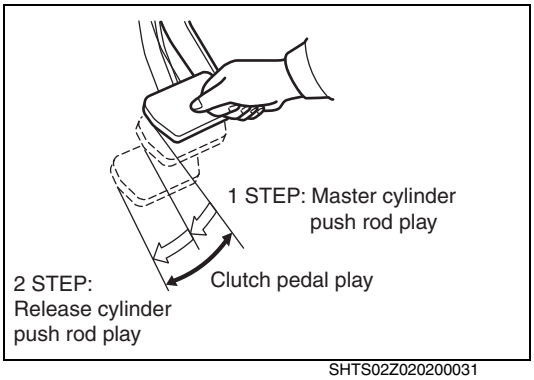
2. ARRANGE THE KWIK-ADJUSTER

(1) Set SST the crank pulley.
SST:
Cranking Tool (S0940-91200)



SHTS02Z020200030

(2) Turn the crank pulley till the Kwik-Adjuster matches the inspection hole.



SHTS02Z020200031

3. ADJUSTING PROCEDURES

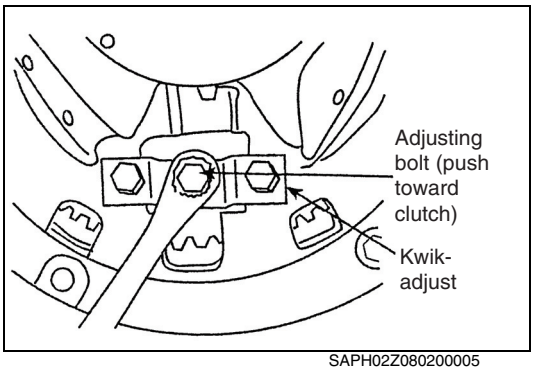
(1) Adjust the release bearing position;

- When the clutch disc is worn (pedal play less than limit)
  Pedal play limit; 35 mm {1.38 in.}
- When the clutch disc replaced.

(2) Adjust the free travel by release cylinder push rod only;

- When the clutch disc or control linkage is replaced.

NOTICE
The above adjusting should be made after adjusting the release bearing position.



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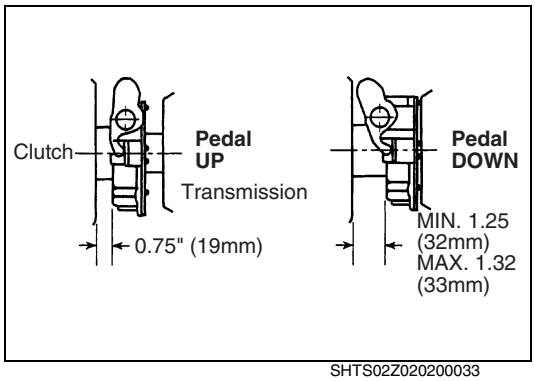
(3) Manual Adjust: Kwik-Adjust®

- Depress adjusting bolt and rotate.
  Kwik-Adjust will re-engage at 1/3 of a turn.

NOTICE

- **Open-end wrenches are not recommended.**
- **Internal adjustments are performed with pedal down (clutch released).**

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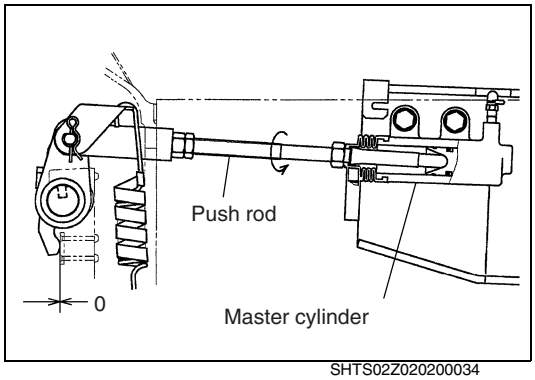
4. ADJUST THE RELEASE BEARING POSITION

(1) Set 0.75" (19 mm) dimension: With pedal down, turn adjusting ring to obtain approximately 0.75" (19 mm). Turning the adjusting ring clockwise moves the release bearing toward the transmission. Turning the adjusting ring counterclockwise moves the release bearing toward the engine.

(2) Check release travel dimensions with release yoke rotated toward release bearing, eliminating excess play in system. Having set this, depress pedal down fully releasing clutch and check release travel to settings shown.

NOTICE

It may be necessary to reduce the 0.75" (19 mm) settings to be able to achieve 0.500"-0.562" (13-14 mm) travel on some models of transmissions.

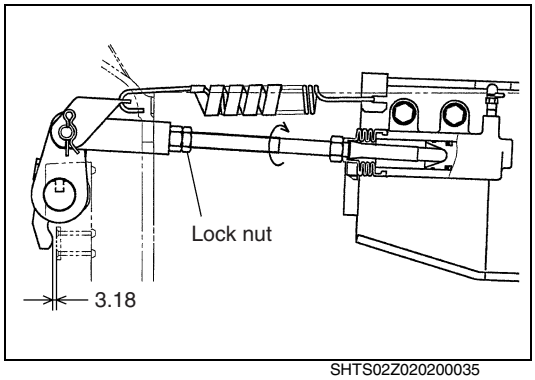


SHTS02Z020200034

5. ADJUST THE FREE TRAVEL

(1) Remove the return spring.

(2) Loosen the lock nut and turn the push rod counterclockwise until the release bearing contacts the release lever plate or release lever.



SHTS02Z020200035

(3) Turn the push rod clockwise about 3 1/3 turns.

Standard: Clearance between release bearing and release yoke: 3.18 mm {0.125 in.}

(4) Tighten the lock nut.

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CLUTCH ASSEMBLY (EATON SOLO1402)

DATA AND SPECIFICATIONS

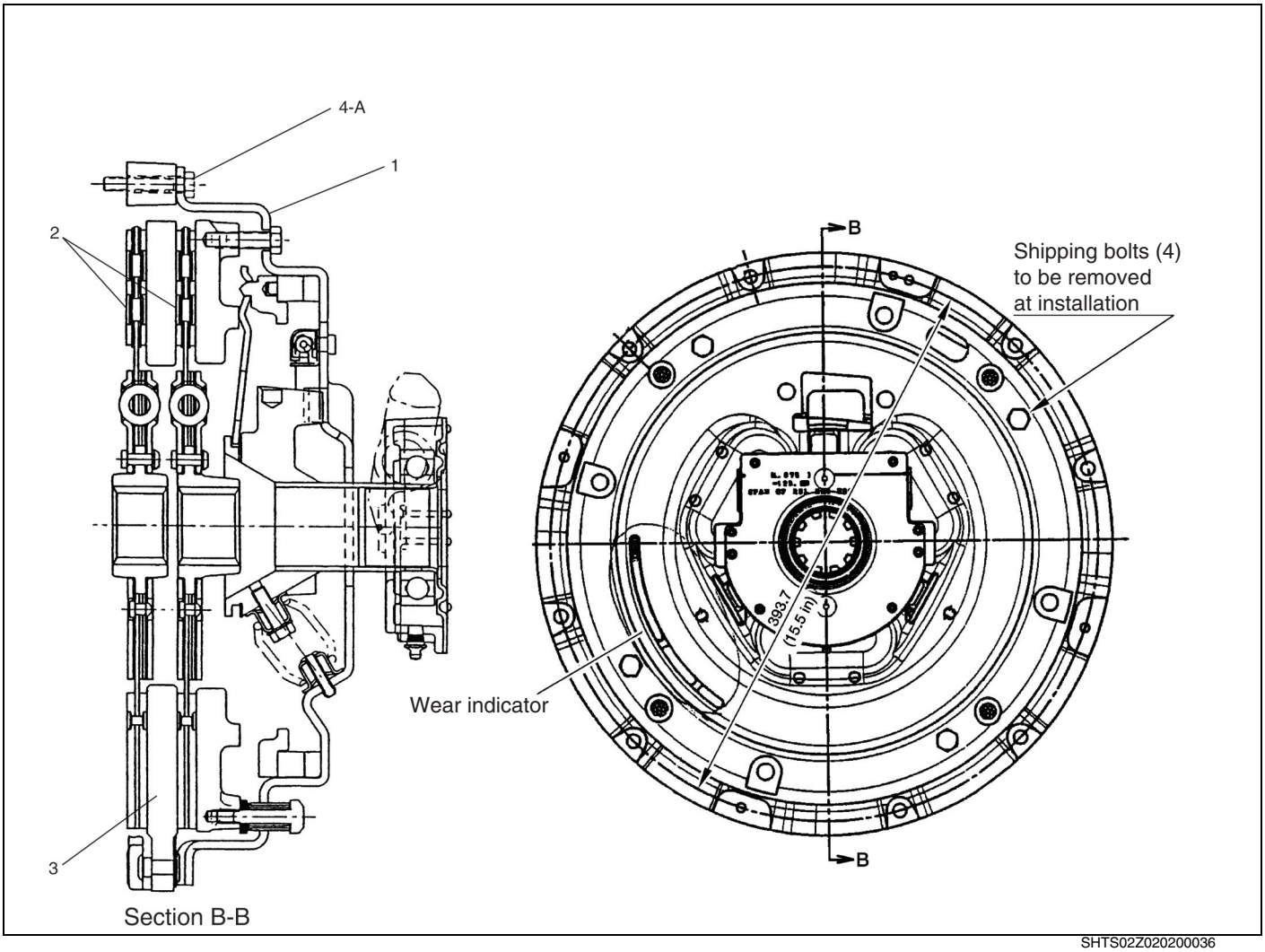
EN02Z0202I200002

CLUTCH FACING **Unit: mm {in.}**

Material	**Sintered metal (Ceramic metal)**
Type	**Dry two plate with damper spring**
Inside diameter	**222 {8.8}**
Outside diameter	**350 {13.8}**
Thickness	**11.5 {0.45} Adjustment-Free**

COMPONENT LOCATOR

EN02Z0202D100002



SHTS02Z020200036

1	**Clutch cover**	**3**	**Intermediate plate**
2	**Clutch disc**	**4**	**Bolt**

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

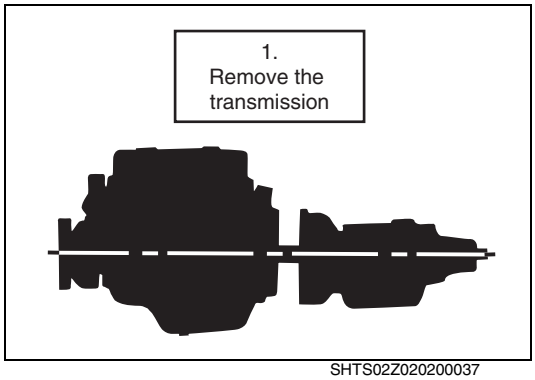
A	**50-64 {510-655, 37-47}**		

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OVERHAUL

EN02Z0202H200002

IMPORTANT POINT - DISMOUNTING

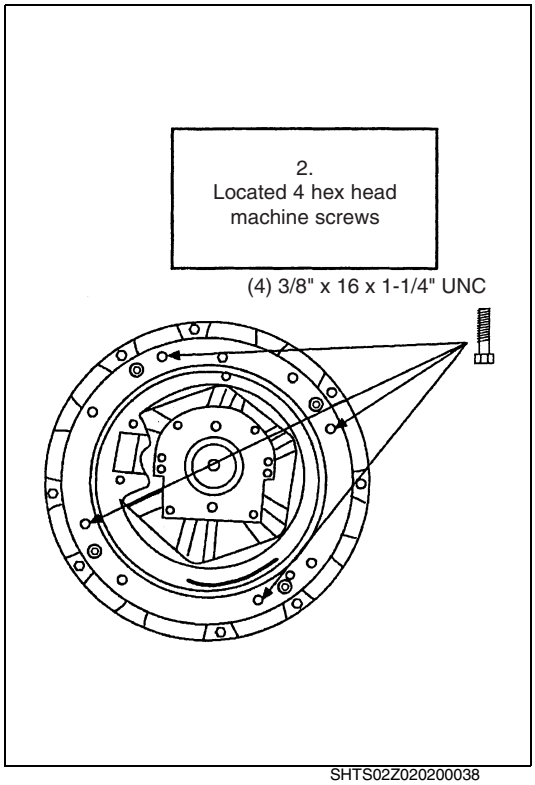


SHTS02Z020200037

1. REMOVE THE TRANSMISSION, SUPPORTING ITS WEIGHT TO PREVENT DAMAGE TO THE BEARING AND DISCS.

NOTICE

If a SOLO Clutch is to be removed and reinstalled on the flywheel, four (4) shipping bolts must be installed prior to unbolting the clutch (3/8" x 16 UNC x 1-1/4").



SHTS02Z020200038

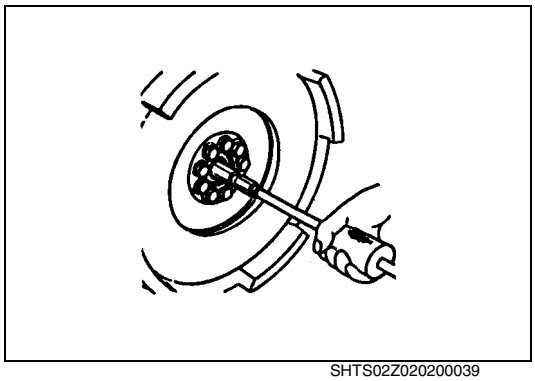
2. LOCATE FOUR (4) 3/8" x 16 x 1 - 1/4" UNC, HEX HEAD MACHINE SCREWS. INSTALL THEM IN THE 4 COVER HOLES, TURNING THEM ONE COMPLETE TURN AFTER THEY CONTACT THE COVER.

3. REMOVE THE CLUTCH FROM THE FLYWHEEL.

NOTICE

Mark the proper position of the discs and intermediate plate adapter ring (for reinstallation).

IMPORTANT POINT - INSPECTION AND REPLACEMENT


SHTS02Z020200039

1. REPLACE THE PILOT BEARING.

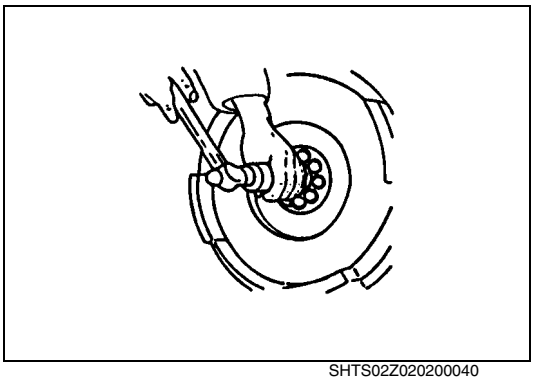
(1) Remove the pilot bearing.

SST:

Pilot Bearing Puller (S0965-01970)

Sliding Hammer (S0942-01442)

https://truckmanualshub.com/

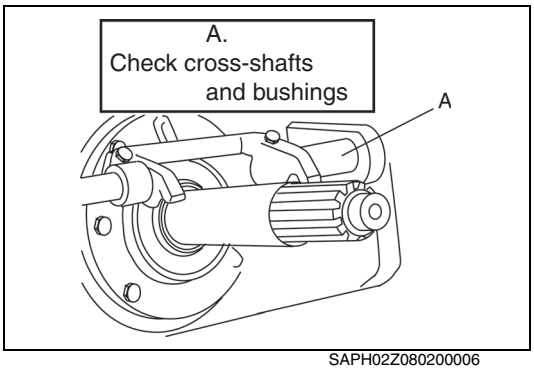


SHTS02Z020200040

(2) Using a suitable tapping rod, install the pilot bearing.

NOTICE

After installing the pilot bearing, ensure that it rotates smoothly.



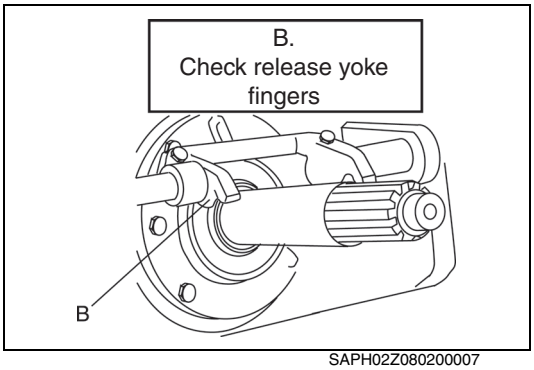
SAPH02Z080200006

2. CHECK THE FOLLOWING ITEMS FOR WEAR REPLACE ANY WORN COMPONENTS:

(1) Cross-shafts and bushings

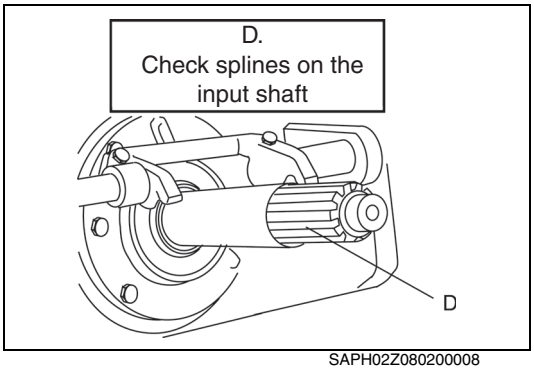
NOTICE

Excessive wear at these points can cause a side loading condition. Also, inspect the remaining pivot points of the linkage for excessive wear.



SAPH02Z080200007

(2) Release yoke fingers



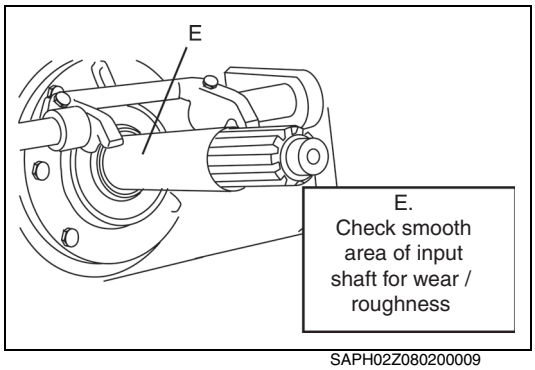
SAPH02Z080200008

(3) Splines on the input shaft

NOTICE

Any wear on the splines will prevent the newly installed driven discs from sliding freely, thus causing poor release (clutch drag). Select a disc out of the new installation and slide it full length on the transmission splines. This will detect a twisted input shaft. Replace input shaft if disc does not freely slide.

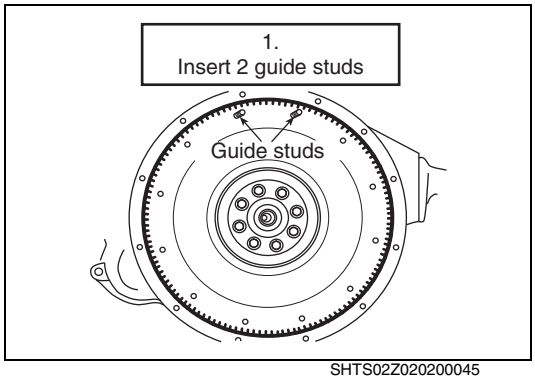
https://truckmanualshub.com/



SAPH02Z080200009

(4) Smooth area of input shaft
(5) Mating surfaces

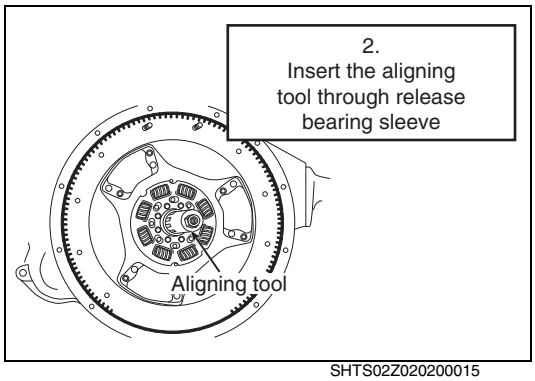
NOTICE
Inspect the mating surfaces of both the transmission bell housing and the flywheel housing. Any appreciable wear on either housing will cause misalignment. Most wear will occur between the 3 and 8 o'clock positions.
Replace housings if worn.



SHTS02Z020200045

IMPORTANT POINT - MOUNTING

1. INSERT TWO (2) 3/8" x 16 UNC x 3" (76 MM) LONG GUIDE STUDS INTO THE TWO UPPER MOUNTING HOLES OF THE FLYWHEEL.

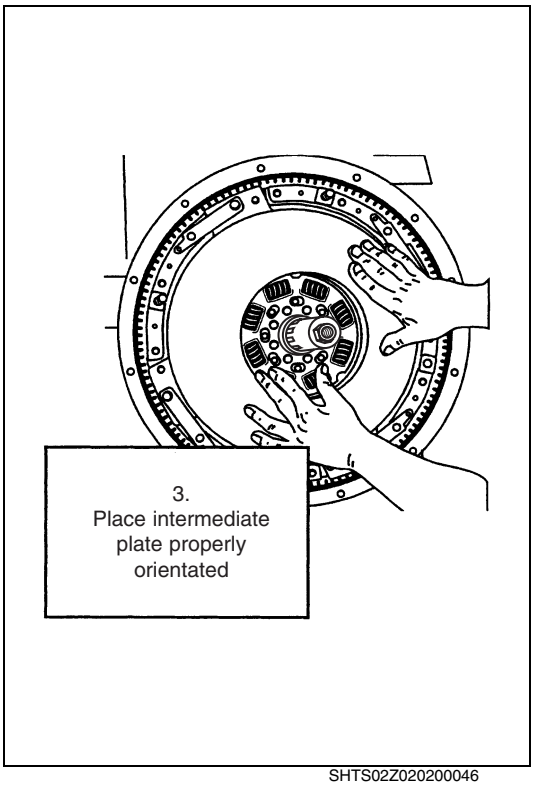


SHTS02Z020200015

2. INSTALL THE FRONT DISC BY INSERTING THE ALIGNING TOOL THROUGH THE DISC SPLINES AND THEN INTO THE PILOT BEARING.
SST:
Clutch Aligning Arbor (S0966-21420)

NOTICE
Make sure the side marked "Flywheel" faces the flywheel.

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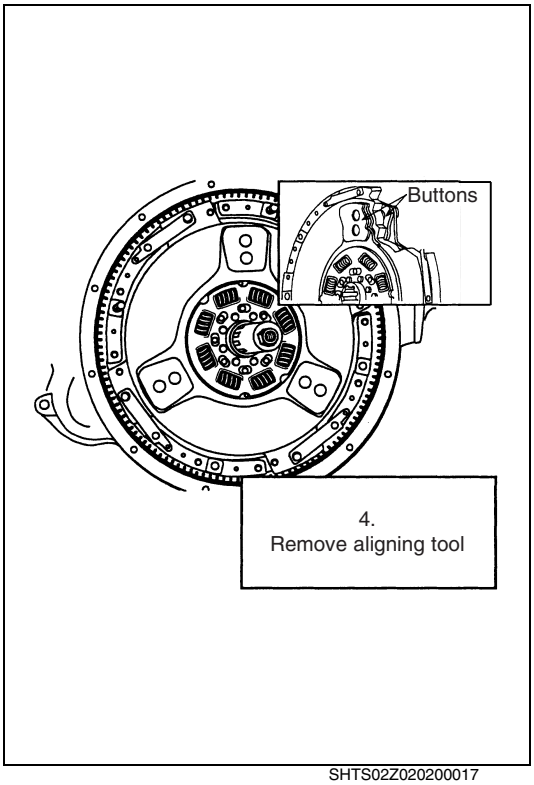


SHTS02Z020200046

3. INSTALL THE INTERMEDIATE PLATE ASSEMBLY OVER THE TWO (2) GUIDE STUDS AND SLIDE IT FORWARD UNTIL IT TOUCHES THE FLYWHEEL.

NOTICE

Make sure the side marked "Pressure Plate Side" is facing the pressure plate (the drive straps must face the pressure plate).



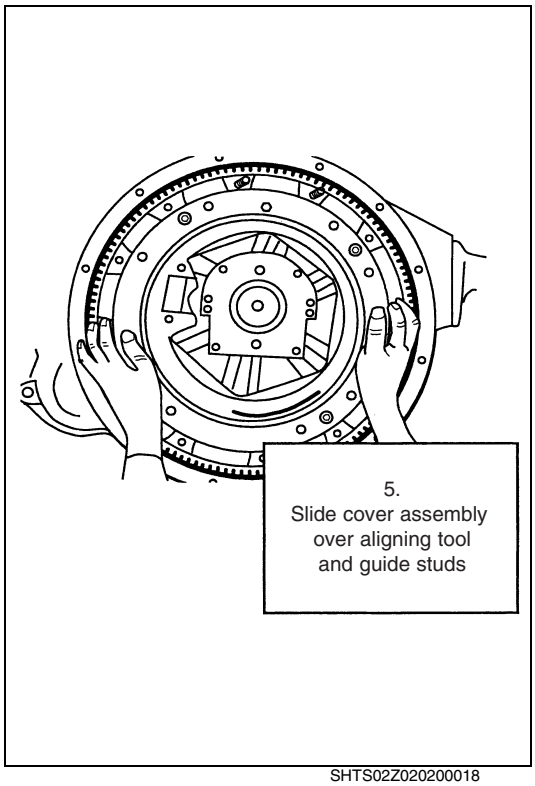
SHTS02Z020200017

4. REMOVE THE ALIGNING TOOL AND INSTALL IT THROUGH THE SPLINES OF THE REAR DISC, AND INSERT THE ALIGNING TOOL THROUGH THE FRONT DISC AND ALSO THE PILOT BEARING.

NOTICE

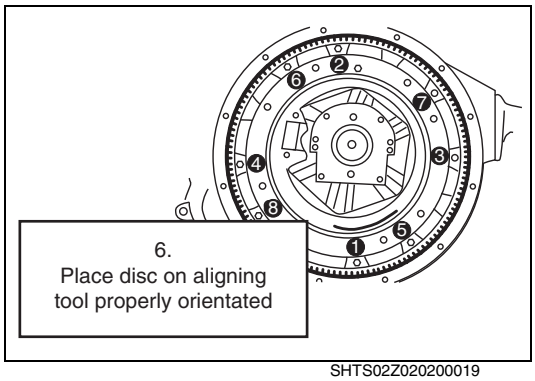
Make sure the side of the disc marked "Pressure Plate Side" is facing the pressure plate. As you complete this step, ensure that the ceramic buttons align with each other as closely as possible. Doing so will aid the function of the positive separator pins (roll pins).

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SHTS02Z020200018

5. WITH THE ALIGNING TOOL STILL IN PLACE, SLIDE THE COVER ASSEMBLY OVER BOTH THE ALIGNING TOOL AND THE TWO (2) GUIDE STUDS UNTIL IT RESTS AGAINST THE INTERMEDIATE PLATE ASSEMBLY.



SHTS02Z020200019

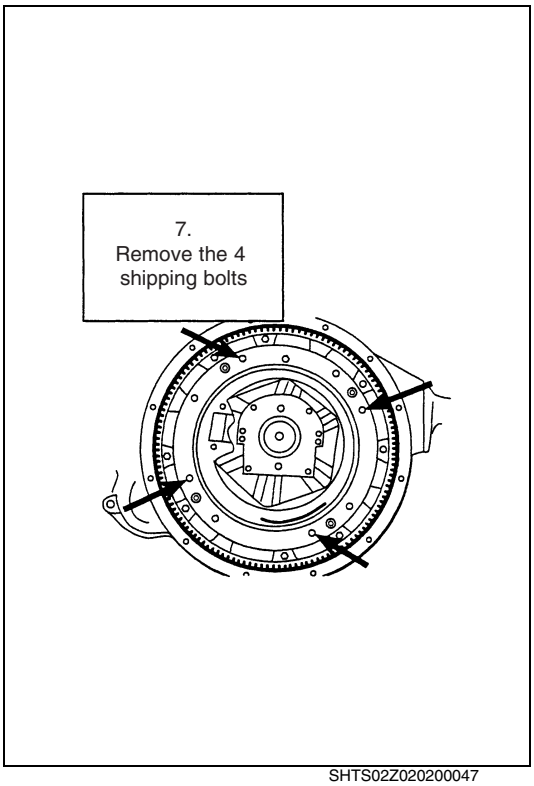
6. INSTALL LOCKWASHER AND SIX (6) 3/8" x 16 UNC MOUNTING BOLTS HAND TIGHTEN.

(1) Remove the two (2) guide studs and replace with the remaining mounting bolts with lockwasher. Using a torque wrench, progressively tighten the eight (8) mounting bolts using the following criss-cross pattern. Starting at lower left.
Tightening Torque:
50-64 N·m{510-665 kgf·cm, 37-47 lbf·ft}

⚠ CAUTION
Failure to tighten these bolts in this manner can:

- **Prevent the clutch cover from "centering" into the pilot area of the flywheel.**
- **Cause permanent damage to the clutch cover (i.e. become cracked or broken).**
- **Cause the clutch assembly to be out-of balance with the flywheel.**

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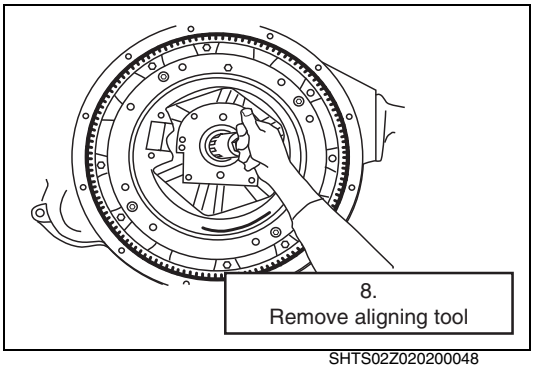


SHTS02Z020200047

7. REMOVE THE FOUR (4) GOLD COLORED SHIPPING BOLTS IN A CRISS-CROSS PATTERN.

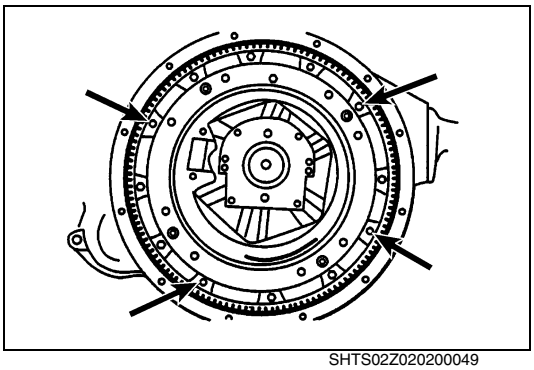
NOTICE

Save these four (4) bolts for future use in case you need to remove, then reinstall the SOLO Clutch.



SHTS02Z020200048

8. REMOVE THE ALIGNING TOOL.


SHTS02Z020200049

9. USING A 1/4" (6 mm) DIAMETER FLAT NOSE PUNCH, LIGHTLY TAP EACH OF THE FOUR (4) POSITIVE SEPARATOR PINS TOWARD THE FLYWHEEL. PERFORMING THIS STEP WILL VERIFY THAT ALL FOUR (4) PINS ARE FLUSH AGAINST THE FLYWHEEL.

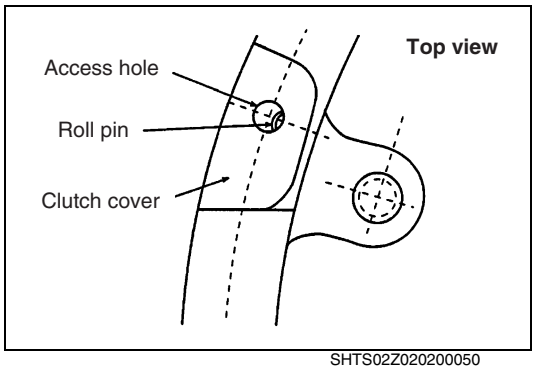
⚠ CAUTION

Failure to perform this step properly may cause the clutch to drag (clutch does not release). Excessive force can damage the pins and cause a release problem

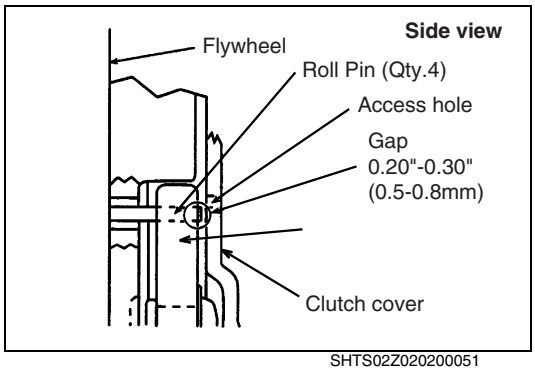
NOTICE

The four (4) pins can also be set through the inspection opening of the transmission bell housing if they were not to set prior to transmission installation.

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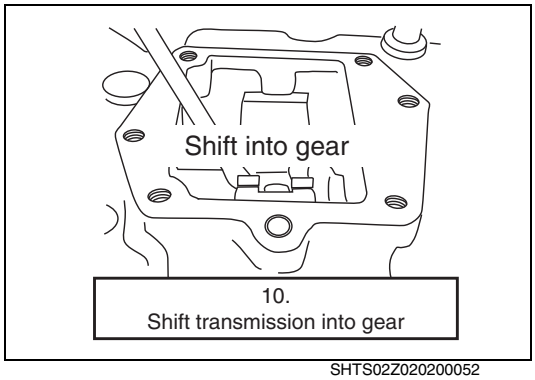


SHTS02Z020200050



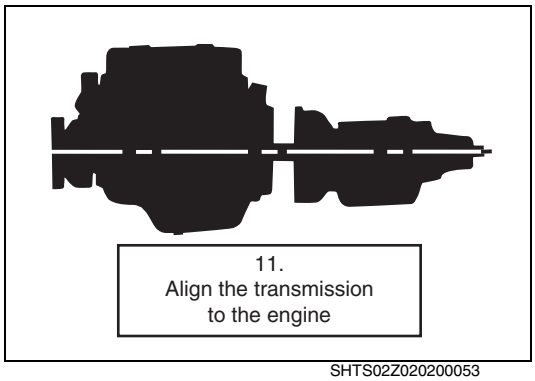
SHTS02Z020200051

10. SHIFT THE TRANSMISSION INTO GEAR.



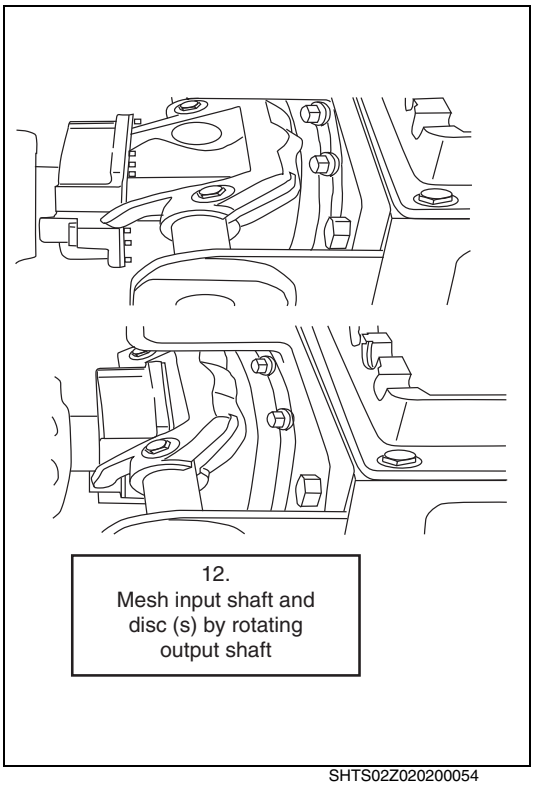
SHTS02Z020200052

11. POSITION THE TRANSMISSION SO THAT IT IS BOTH SQUARE TO AND ALIGNED WITH THE ENGINE.



SHTS02Z020200053

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12.
Mesh input shaft and disc (s) by rotating output shaft

SHTS02Z020200054

12. WHILE MOVING THE TRANSMISSION FORWARD, ROTATE THE OUTPUT SHAFT OF THE TRANSMISSION UNTIL THE SPLINES OF BOTH THE INPUT SHAFT AND THE DISC(S) MESH WITH EACH OTHER. WHILE PERFORMING THIS TASK, YOU MUST ALSO ENSURE THAT THE YOKE FINGERS REMAIN IN THE UP POSITION UNTIL THEY CAN BE ROTATED OVER THE RELEASE BEARING HOUSING INTO THEIR FINAL POSITION.

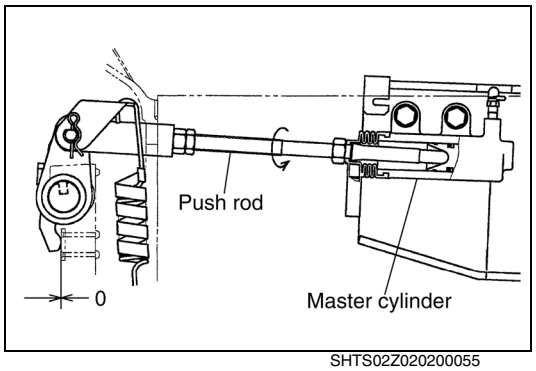
⚠ CAUTION

- **Do not use the cross-shaft release lever (or a pipe over it) to pull the transmission into its final position. Doing so may release the clutch and "overstroke" the release bearing. The SOLO will incorrectly "set" the release bearing position too close to the transmission and cause the wear indication tab to move to 1/3-1/2 the distance towards the "REPLACE" position.**
- **Do not excessively force the transmission into the clutch assembly or engine housing. If it does not enter freely, investigate the cause of the problem and make any necessary changes.**
- **If the input shaft will not slide into the discs, they may need to be repositioned. If the clutch is to be unbolted from the flywheel, reinstall the shipping bolts and tighten one turn past contact with the clutch. Now the installation shaft can be installed to reposition the discs and the clutch bolts re-torqued. Remove the shipping bolts to clamp the discs.**
- **Do not let the transmission drop or hang unsupported in the driven discs.**
  This can cause the discs to become distorted and the clutch will not release.

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13. INSTALL THE TRANSMISSION MOUNTING BOLTS AND TORQUE TO THE PROPER SPECIFICATION.
Tightening Torque:
37.5-48.5 N·m{382-494 kgf·cm, 28-35 lbf·ft}

IMPORTANT POINT-SET-UP

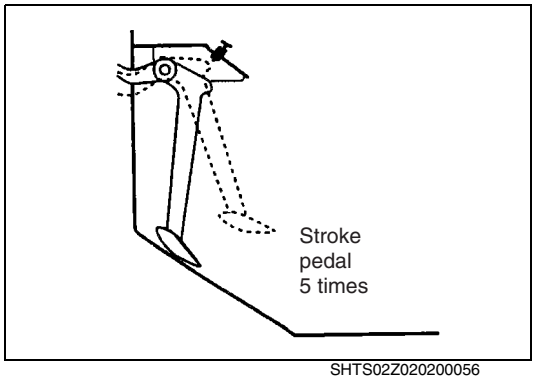


SHTS02Z020200055

1. ADJUST LINKAGE

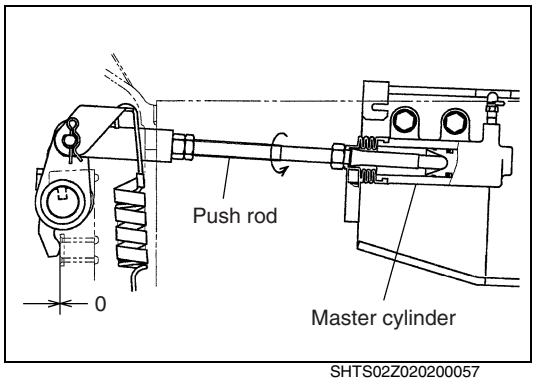
(1) Adjust the clutch linkage until the yoke fingers contact the release bearing (zero free-play in the cab).

(2) Loosen the lock nut and turn the push rod counterclockwise until the release bearing contacts the release lever plate or release lever.



SHTS02Z020200056

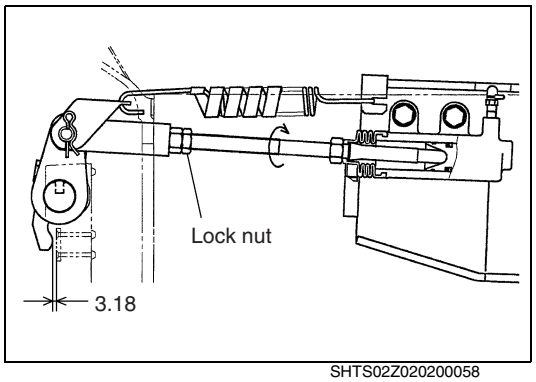
(3) Fully press the pedal up to 5 times to move the release bearing slightly closer to the transmission and gain free-play in the cab.



SHTS02Z020200057

2. ADJUST THE FREE TRAVEL

(1) Turn the push rod counterclockwise until the release bearing contacts the release lever plate or release lever.



SHTS02Z020200058

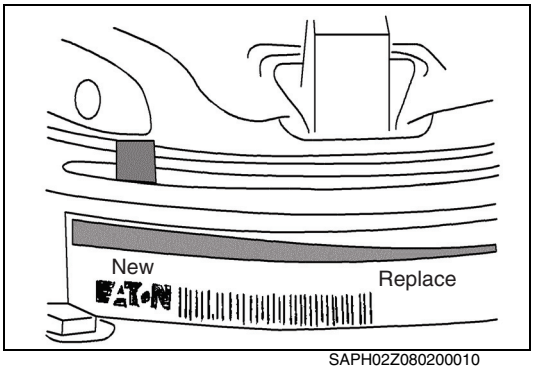
(2) Turn the push rod clockwise about 3 1/3 turns.
Standard: Clearance between release bearing and release yoke: 3.18 mm {0.125 in.}

(3) Tighten the lock nut.

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IMPORTANT POINT-CHECK WEAR INDICATOR

1. REMOVE THE COVER OF INSPECTION HOLE AT THE BOTTOM OF THE CLUTCH HOUSING.



SAPH02Z080200010

2. CHECK WEAR INDICATOR

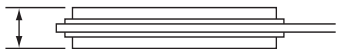
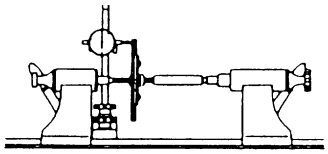
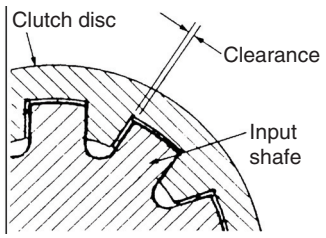
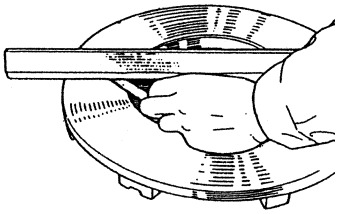
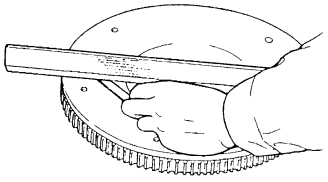
- Reflects clutch wear and indicates when it is time to replace clutch.
- When replacing clutch, should change clutch disc together with clutch cover.

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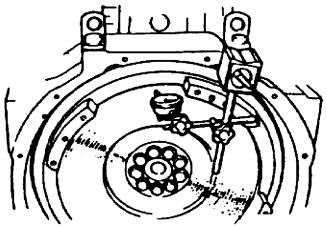
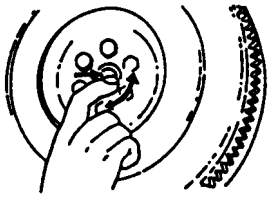
INSPECTION AND REPAIR

EN02Z0202H300001

EATON SAS1402 and SOLO1402 **Unit: mm {in.}**

Inspection item	Standard	Limit	Remedy	Inspection procedure
Clutch facing thickness	11.43 {0.45}	8.26 {0.33}	Replace disc assembly.	Measure 
Clutch disc misalignment	0-0.38 {0-0.0149}	0.38 {0.0149}	Replace.	Measure 
Oily facings, Loose rivets, Broken or loose damper springs	—	—	Replace disc assembly, if necessary.	Visual check
Clearance between clutch disc hub and transmission input shaft spline	0.05-0.15 {0.0020-0.0059}	0.5 {0.020}	Replace the clutch disc or the transmission input shaft.	Measure 
Pressure plate misalignment	0-0.102 {0-0.040}	0.76 {0.029}	Replace the clutch cover assembly	Measure 
Pressure plate friction surface scoring or heat cracking	—	—	Replace the clutch cover assembly. NOTICE Regrinding of the pressure plate is not possible.	Visual check
Flywheel misalignment	0.05 {0.0020} or less	1.0 {0.039}	Replace.	Measure 

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Inspection item	Standard	Limit	Remedy	Inspection procedure
Flywheel friction surface scoring or heat cracking	**—**	**Grind limit 1.0 {0.039} Deflection limit 0.04 {0.00157}**	**Regrind the friction surface or replace, if necessary.** **NOTICE** **Do not grind the flywheel over the limit.**	**Visual check**
Flywheel misalignment	**—**	**0.15 {0.0059}**	**Regrind the friction surface or replace.**	**Measure** 
Pilot bearing improper rotation	**—**	**—**	**Replace, if necessary.**	**Visual check** 

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LUBRICATION (EATON SAS1402 and SOLO1402)

1. RELEASE BEARING

(1) The cast iron bearing housing will be equipped with either a standard grease fitting or a lube tube extension. If a lube tube is not present, it is necessary to remove the inspection cover to gain access to the grease fitting. Apply grease until it purges from the rear of the housing.

2. RELEASE BEARING WEAR PADS

(1) Where the release fork contacts the bearing housing; there are small hardened steel pads. Apply a small amount of grease to the wear pads where the clutch release fork contacts.

3. CROSS-SHAFT BUSHINGS

(1) Lubricate both the left and the right cross-shaft bushings.

4. PILOT BEARING

(1) The pilot bearing inside the flywheel is a sealed for life bearing and requires no lubrication.

RECOMMENDED LUBRICATION

Use a lithium soap base E.P. (Extreme Pressure) grease with a minimum of +325 degree F operating range. It must meet the N.L.G.I.'s Grade 2 or 3 specs.

⚠ CAUTION

Incorrect grease and improper lube procedures will cause bearing failures, bushing wearout, yoke tip and bearing wear pad wear.

Recommended Lubrication			
Supplier	**Product**	**Supplier**	**Product**
American Oil Co.	Amoco Uthium-M.P. Grease	Texaco	Multifak #2
City Service Co.	Citgo Premium Lithium Grease #2	Shell Oil Co.	Retinax A
Fiske Refining Co.	Lubriplate 630-2	Shell Oil Co.	Aivania #2
Keystone Lubricating Co.	#81 Ught	*Chevron Oil Co.	S.R.I. 1~
Mobil	Mobilgrease M.P.	*Texaco	Premium RB
Humble Oil Co.	Udok 2	*Exxon	Unirex N3
Atlantic Richfield Co.	Arco M.P.		
* Approved for vendor prepack, other greases listed are for service only.			

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CLUTCH CONTROL

CL03-001

CLUTCH CONTROL UNIT CL03-2
DESCRIPTION CL03-2
INSPECTION AND ADJUSTMENT CL03-3

CLUTCH PEDAL AND RELEASE UNIT... CL03-6
COMPONENT LOCATOR.....CL03-6
OVERHAUL CL03-7
INSPECTION AND REPAIR CL03-9

CLUTCH MASTER CYLINDER CL03-10
COMPONENT LOCATOR.....CL03-10
OVERHAUL CL03-11
INSPECTION AND REPAIR CL03-11

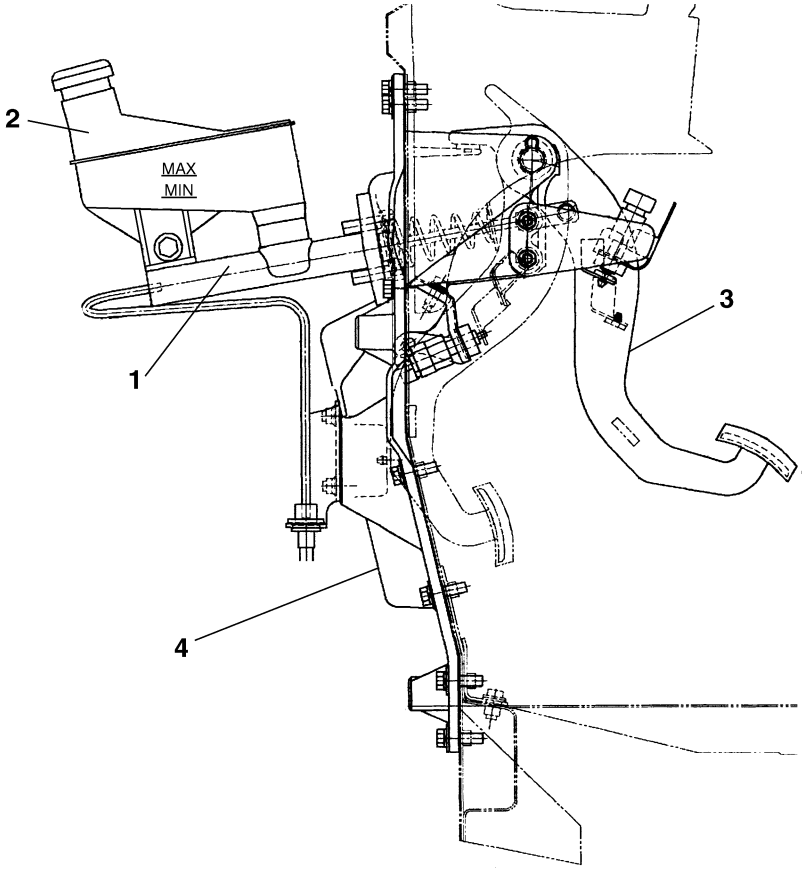
https://truckmanualshub.com/

CLUTCH CONTROL UNIT

DESCRIPTION

EN02Z0203C100001

CLUTCH RELEASE UNIT



SHTS02Z020300001

1	Clutch master cylinder	3	Clutch pedal
2	Reservoir tank	4	Pedal bracket

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INSPECTION AND ADJUSTMENT

EN02Z0203H300001

AIR BLEEDING

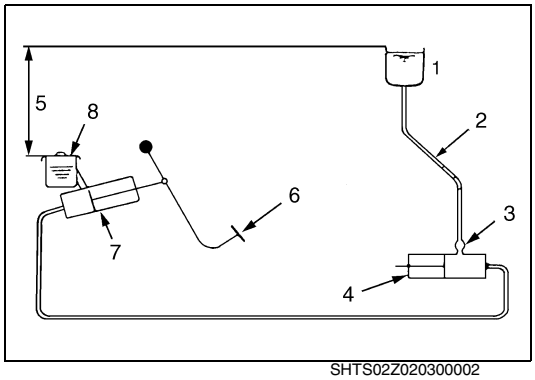
1. BLEED THE AIR FROM HYDRAULIC LINE.

NOTICE

- **Do not mix the clutch fluid with different types or brands.**
- **Be careful not to spill clutch fluid from the reservoir tank or from the air bleeder during air bleeding. Clutch fluid can damage the paint finish on the body or floor.**
- **There are two methods of bleeding, gravity bleeding and manual air bleeding.**

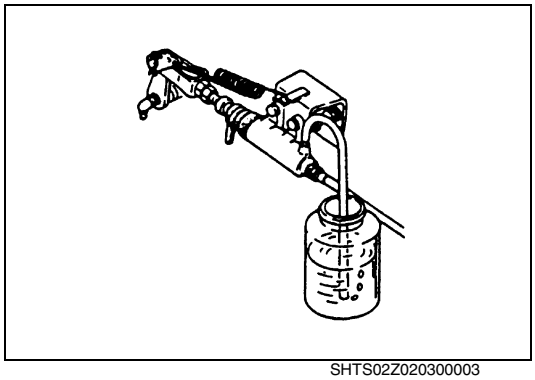
2. GRAVITY BLEEDING

(1) Connect a funnel to a vinyl tube.
(2) Connect the other end of the vinyl tube to the bleeder screw.
(3) Hold the funnel about 1.5 m {4.92 ft} higher than the reservoir tank.
(4) Loosen the bleeder screw and pour the clutch fluid into the funnel.
(5) Observe the flow of clutch fluid into the reservoir tank.
(6) When the air bubbles cease, close the bleeder screw.
(7) Check the fluid level. If necessary, add or remove clutch fluid in order to match the "MAX" level.



SHTS02Z020300002

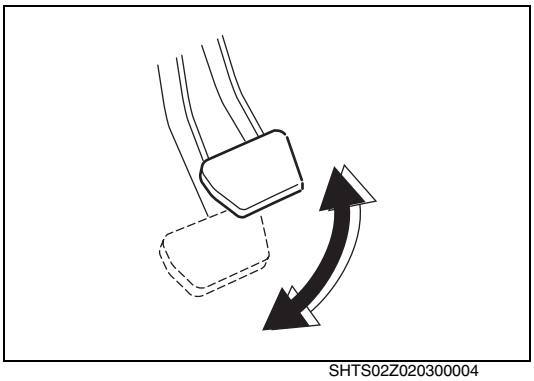
1. Funnel filled with clutch fluid
2. Vinyl tube (inside diameter: 6 mm)
3. Bleeder
4. Slave cylinder
5. About 1.5 m {4.92 ft}
6. Clutch pedal
7. Master cylinder
8. Reservoir tank


SHTS02Z020300003

3. MANUAL BLEEDING

(1) Fill the reservoir with clutch fluid.
(2) Connect the bleeder tube to the slave cylinder bleeder screw. Place the other end of tube in a container half-filled with clutch fluid.

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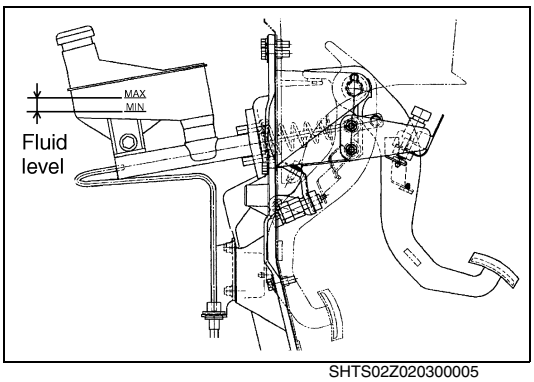


SHTS02Z020300004

(3) Slowly pump the clutch pedal several times. While pressing on the pedal, loosen the bleeder screw. Repeat this procedure until there are no more air bubbles in the fluid.

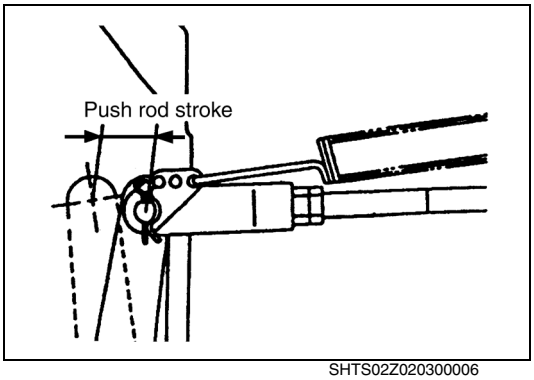
NOTICE

- **Do not return the clutch pedal before closing the bleeder screw.**
- **Keep the reservoir filled with clutch fluid.**
- **Re-bleeding will be necessary if the reservoir is emptied during bleeding operation.**



SHTS02Z020300005

(4) Check the fluid level. If necessary, add or remove clutch fluid in order to match the "MAX" level.



SHTS02Z020300006

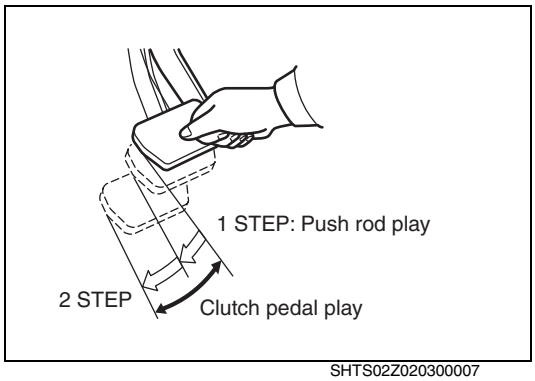
4. AFTER BLEEDING, MAKE SURE THE PUSH ROD STROKE IS AS SPECIFIED.

(1) Depress the clutch pedal fully and measure the push rod stroke. If the stroke is less than standard, re-bleed the hydraulic system.

Standard:

Model	Standard
HINO 238 (NE), 258 (NE, NJ), 268 (NE, NF, NJ), 338 (NF, NV), 358 (NH)	**More than 22.5 mm {0.886 in.}**

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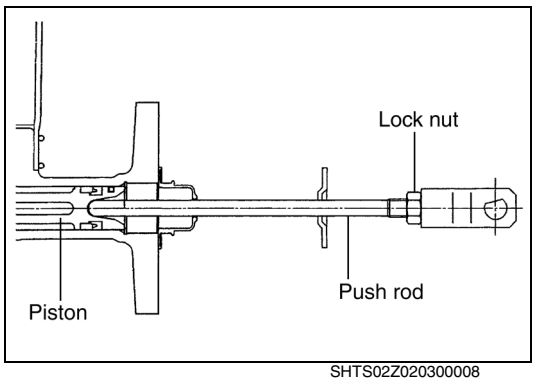
SHTS02Z020300007

CHECK AND ADJUSTMENT

1. CHECK AND ADJUST THE CLUTCH PEDAL PLAY.

(1) Check the push rod play.

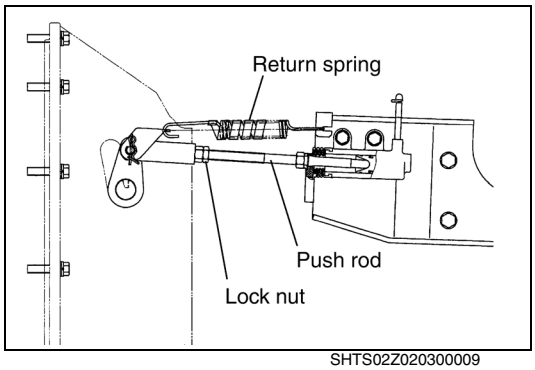
a. If necessary, adjust the push rod play.



SHTS02Z020300008

b. Loosen the lock nut and turn the master cylinder push rod until the push rod play is correct.
Standard:
Clearance between push rod and piston:
0.5 mm {0.0197 in.}
Push rod play at pedal top: 2-4 mm {0.079-0.157 in.}

c. Tighten the lock nut.



SHTS02Z020300009

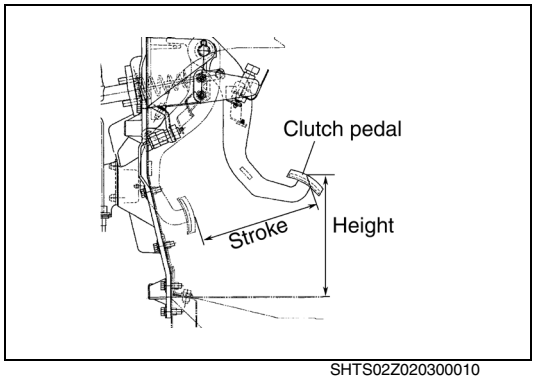
(2) Check the clutch pedal play.

a. Push the pedal until the beginning of clutch resistance is felt.

Assembly Standard:

Model	Standard	Limit
HINO 238 (NE), 258 (NE, NJ), 268 (NE, NF, NJ), 338 (NF, NV), 358 (NH)	**44-59 mm {1.73-2.32 in.}**	**35 mm {1.38 in.}**

NOTICE
For adjustment of clutch, refer to the chapter "CLUTCH MAIN UNIT".



SHTS02Z020300010

2. CHECK THE CLUTCH PEDAL HEIGHT AND STROKE.

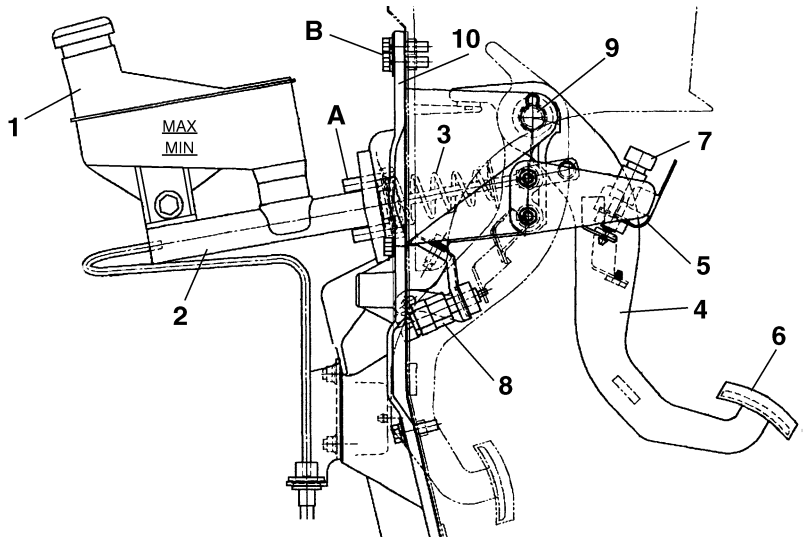
	Assembly Standard:
Pedal Height	**205-215 mm {8.07-8.46 in.}**
Pedal Stroke	**205-215 mm {8.07-8.46 in.}**

https://truckmanualshub.com/

CLUTCH PEDAL AND RELEASE UNIT

COMPONENT LOCATOR

EN02Z0203D100001



SHTS02Z020300011

1	Reservoir tank	6	Pedal pad
2	Master cylinder	7	Switch (For cruise control)
3	Return spring	8	Switch (For clutch on start)
4	Clutch pedal	9	Pedal shaft
5	Bracket	10	Pedal bracket

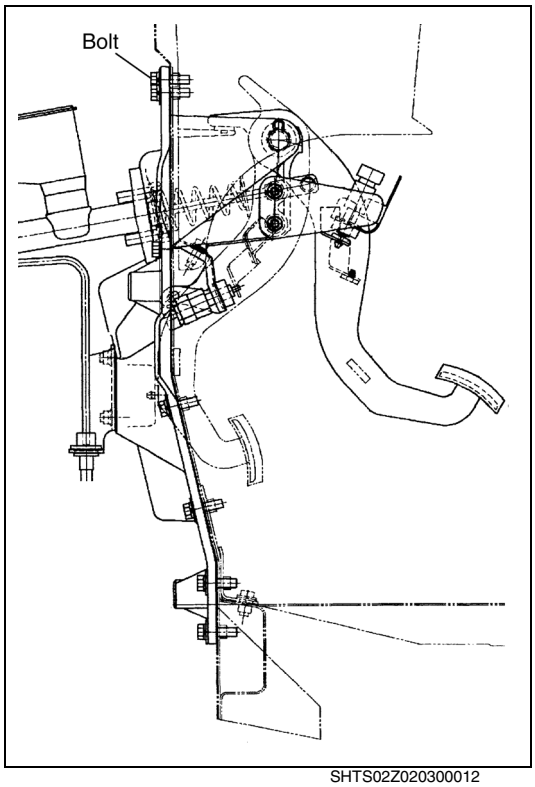
Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	41.5-61.5 {424-627, 30-46}	B	18-26 {184-265, 14-19}

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OVERHAUL

EN02Z0203H200001



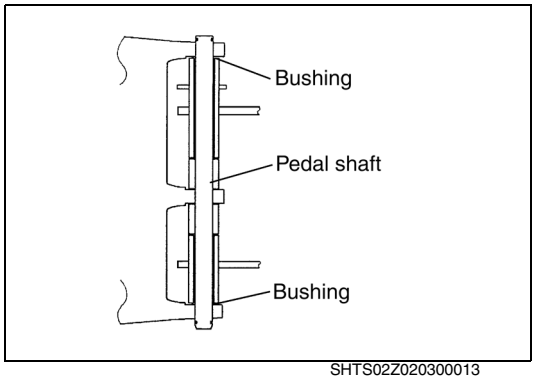
SHTS02Z020300012

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE PEDAL UNIT ASSEMBLY.

(1) Remove the 10 bolts and 2 nuts and dismount the pedal bracket assembly from the vehicle.

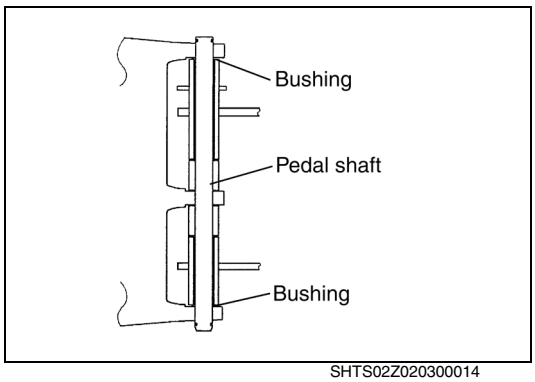
NOTICE
Be careful not to damage the vehicle.



SHTS02Z020300013

2. REMOVE THE CLUTCH PEDAL.

(1) Remove the clip, and tap the pedal shaft lightly to remove the clutch pedal using a brass bar and a hammer.



SHTS02Z020300014

IMPORTANT POINT - MOUNTING

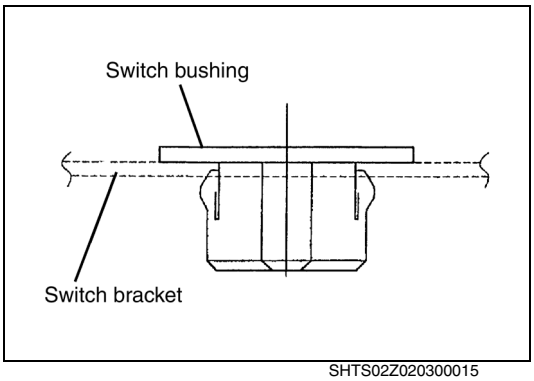
1. INSTALL THE CLUTCH PEDAL.

(1) Apply lithium grease to the inner side and outer periphery of the bushing, and install the bushing to the inserting hole on the shaft part of the clutch pedal.

(2) Install the clutch pedal to the installing axle for pedal shaft and install the pedal shaft to the pedal bracket using a plastic hammer.

2. INSTALL THE PEDAL UNIT ASSEMBLY.

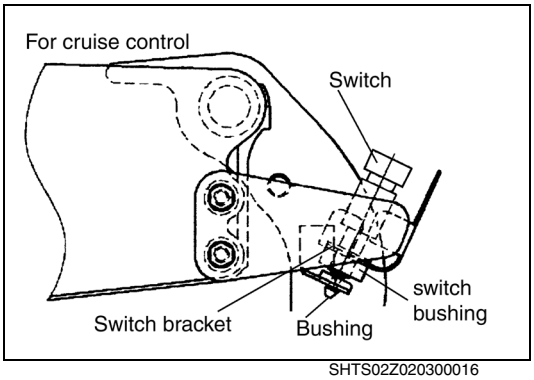
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SHTS02Z020300015

3. INSTALL THE SWITCH FOR CRUISE CONTROL AND CLUTCH ON START.

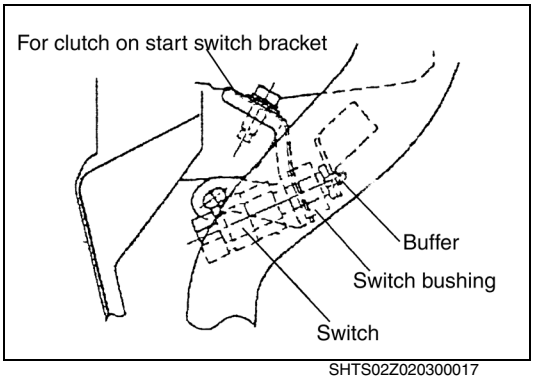
(1) Install the switch bushing into the switch bracket.



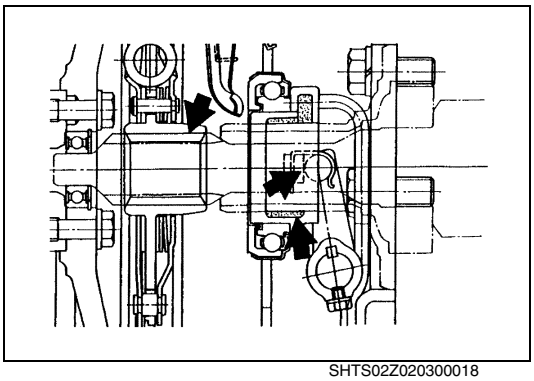
SHTS02Z020300016

(2) Push the switch into the switch bushing until the switch pounds the buffer, then fix the switch by turning if clockwise.

NOTICE
Check that the switch body does not contact the buffer and also that the switch rightly functions.



SHTS02Z020300017


SHTS02Z020300018

IMPORTANT POINTS - ASSEMBLY

1. APPLY BEARING GREASE OR HEAT RESISTANCE GREASE.

(1) Apply bearing grease to the following parts.
   a. The release fork and the release bearing hub contact point.
   b. The release bearing hub inner groove.

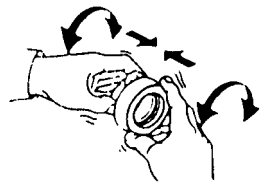
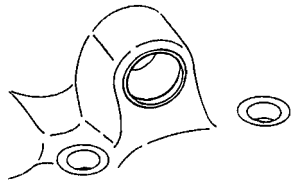
(2) Apply heat resistance grease to the transmission input shaft spline.

NOTICE
Apply a small amount of grease to the spline.

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INSPECTION AND REPAIR

EN02Z0203H300002

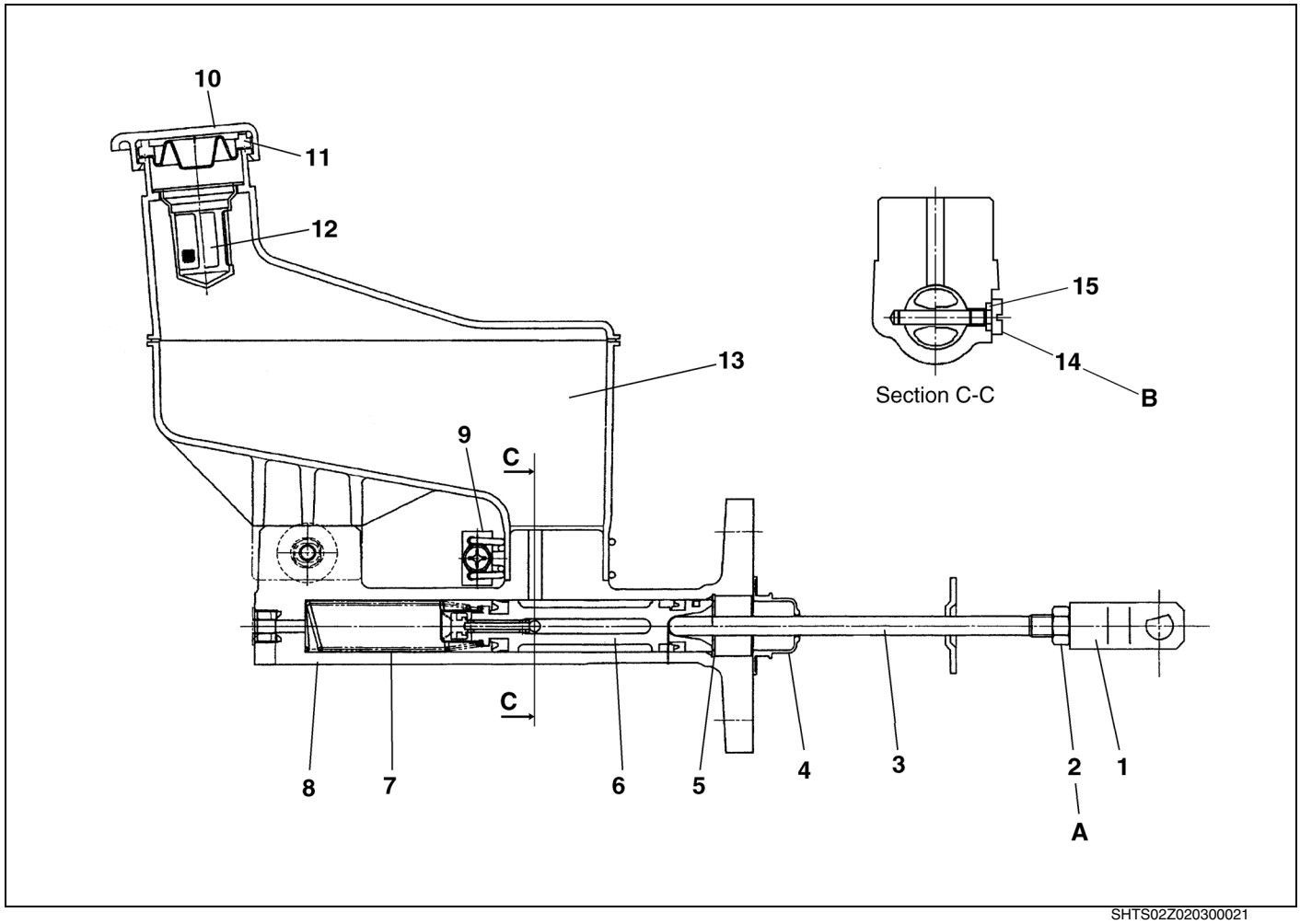
Inspection item	Standard	Limit	Remedy	Inspection procedure
Release bearing improper rotation	—	—	Replace release bearing, if necessary.	Visual check 
Release fork and release hub: Wear and damage	—	—	Replace the parts, if necessary.	Visual check
Release shaft bush: Wear and damage	Bush inner diameter 25.48-25.52 mm (1.003-1.005 in.)	—	Replace the bush, if necessary. After pressing in a new bush, grind inner diameter of the bush to be fitted to standard specification.	Visual check 

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CLUTCH MASTER CYLINDER

COMPONENT LOCATOR

EN02Z0203D100002



SHTS02Z020300021

1	Clevis	9	Clamp
2	Lock nut	10	Reservoir cap
3	Push rod	11	Gasket
4	Boot	12	Oil reservoir strainer
5	Retainer ring	13	Reservoir tank
6	Piston	14	Stopper bolt
7	Return spring	15	O-ring
8	Body		

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	11.5-16.9 {118-172, 8.5-12.4}	B	2.4-4.4 {24-45, 1.8-3.2}

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OVERHAUL

EN02Z0203H200002

IMPORTANT POINT - DISMOUNTING

1. REMOVE THE MASTER CYLINDER.

NOTICE

- **Before removing the master cylinder, drain the clutch fluid from the hydraulic line.**
- **Place a small drain pan under the master cylinder to catch the hydraulic fluid. Do not let the clutch fluid remain on a painted floor. Wash it off immediately.**

IMPORTANT POINT - ASSEMBLY

1. INSTALL THE RETURN SPRING AND PISTON TO THE CYLINDER.

NOTICE

Lubricate the cylinder bore and piston with clean clutch fluid.

INSPECTION AND REPAIR

EN02Z0203H300003

Inspection item	Standard	Limit	Remedy	Inspection procedure
Piston seal and cup: Wear and damage Cylinder body bore: Scoring and corrosion	—	—	Replace the piston assembly and/or cylinder body, if necessary.	Visual check

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TRANSMISSION MAIN UNIT (EATON FS 5406/6406)

TR02-001

TRANSMISSION ASSEMBLY..... TR02-2
DATA AND SPECIFICATION..... TR02-2
DISMOUNTING AND MOUNTING TR02-3

https://truckmanualshub.com/

TRANSMISSION ASSEMBLY

DATA AND SPECIFICATION

EN03Z0302I200001

Type	**Six forward speeds, one reverse 1, 2, 3, 4, 5, 6th Synchromesh, Reverse, Constant mesh**	
Gear ratios	**1st**	**9.01**
	2nd	**5.27**
	3rd	**3.22**
	4th	**2.04**
	5th	**1.36**
	6th	**1.00**
	Reverse	**8.63**
Number of teeth: input shaft	**24**	
Number of teeth: counter shaft	**1st gear**	**10**
	2nd gear	**16**
	3rd gear	**25**
	4th gear	**31**
	5th gear	**38**
	6th gear	**46**
	Reverse gear	**10**
Number of teeth: main shaft	**1st gear**	**47**
	2nd gear	**44**
	3rd gear	**42**
	4th gear	**33**
	5th gear	**27**
	6th gear	**24**
	Reverse gear	**45**
Number or teeth: reverse idle gear	**21**	
Oil capacity: gear box	**Approx. 9.2 liters {2.02 Imp.gal/2.44 US gal.}**	

NOTICE
For other details, refer to EATON manuals.

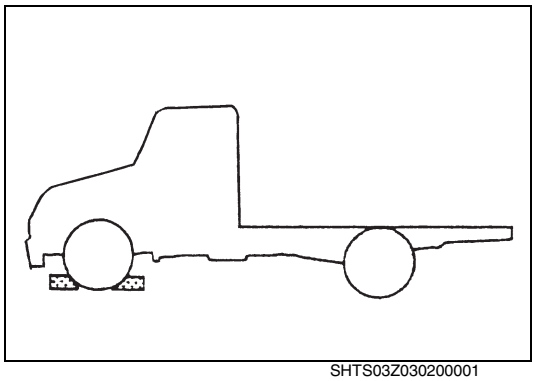
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DISMOUNTING AND MOUNTING

EN03Z0302H100001

IMPORTANT POINTS-DISMOUNTING

⚠ WARNING
Do not work on the transmission while it is hot. This can result in personal injury.


SHTS03Z030200001

1. BLOCK THE WHEELS

2. DRAIN THE TRANSMISSION OIL

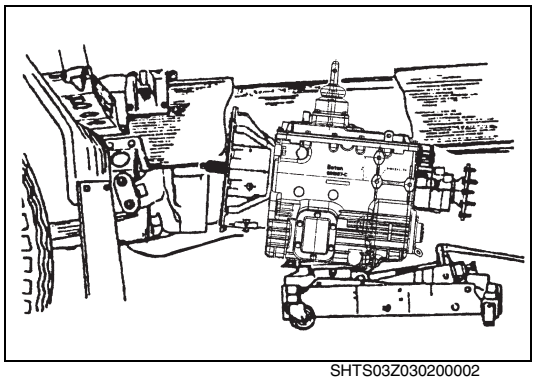
3. DISCONNECT THE PROPELLER SHAFT

4. DISCONNECT THE ELECTRIC HARNESS AND OTHER ATTACHMENTS.

5. DISCONNECT THE TRANSMISSION CONTROL LEVER

6. DISCONNECT THE CLUTCH SLAVE CYLINDER

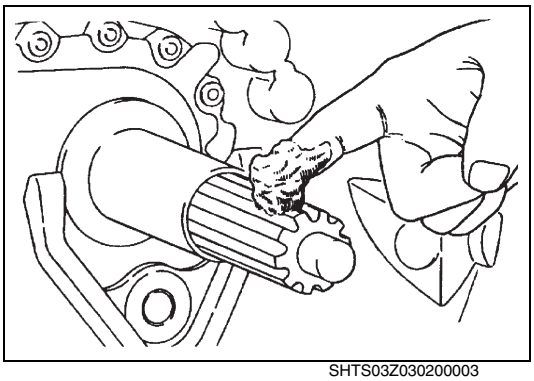
NOTICE
Do not remove the clutch control piping unless absolutely necessary. Air bleeding is not required when reassembling.


SHTS03Z030200002

7. REMOVE THE TRANSMISSION.

(1) Remove the lower bolts around the clutch housing.
(2) Support the transmission using a transmission jack or lifting wires to prevent it from falling.
(3) Remove the remaining bolts around the clutch housing.
(4) Remove the transmission.

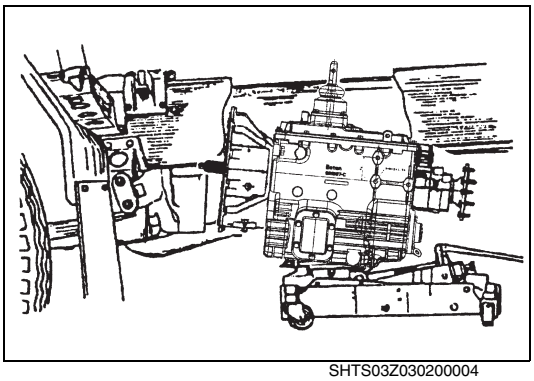
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SHTS03Z030200003

IMPORTANT POINTS-MOUNTING

1. APPLY HEAT-RESISTANT GREASE TO THE INPUT SHAFT SPLINE.

Grease:
Refer to RECOMMENED LUBRICATION in the chapter "CLUTCH MAIN UNIT."

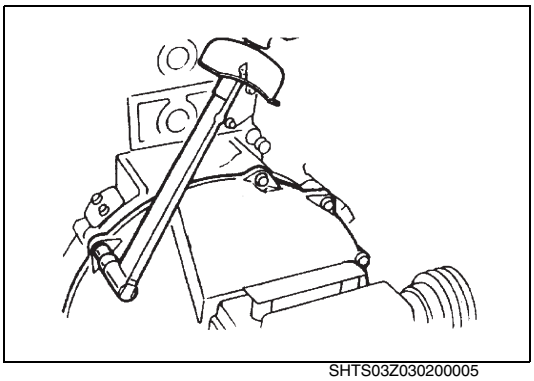

SHTS03Z030200004

2. INSTALL THE TRANSMISSION.

(1) Jack up the transmission until the input shaft spline and the clutch disc spline align.

NOTICE
Do not let the rear of the transmission drop and do not let the transmission hang unsupported in the spline hubs of the driven discs because it distorts them and could cause poor clutch operation or clutch release problems.

(2) Install the upper nuts or bolts around the clutch housing.
(3) Lower the transmission jack and pull the jack out from under the vehicle.


SHTS03Z030200005

(4) Install the remaining nuts or bolts around the clutch housing.
Tightening Torque:
37.5-48.5 N·m {382-494 kgf·cm, 28-35 lbf·ft}

3. INSTALL THE CLUTCH SLAVE CYLINDER.

4. CONNECT THE TRANSMISSION CONTROL LEVER.

5. CONNECT THE ELECTRIC HARNESS AND OTHER ATTACHMENTS.

6. CONNECT THE PROPELLER SHAFT.

7. FILL THE TRANSMISSION OIL.

DISASSENBLY AND ASSEMBLY

NOTICE
When disassembling and assembling the transmission, refer to the MANUFACTURE ORIGINAL MANUAL.

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AUTOMATIC TRANSMISSION (ALLISON 2200RDS, 2500RDS, 2200HS) TR04-001

AUTOMATIC TRANSMISSION ASSEMBLY TR04-2

TROUBLESHOOTING TR04-2
SPECIAL TOOL TR04-2
DISMOUNTING AND MOUNTING TR04-2

https://truckmanualshub.com/

AUTOMATIC TRANSMISSION ASSEMBLY

TROUBLESHOOTING

EN03Z0304F300001

NOTICE
When diagnosing transmission problems, refer to the Allison Shop Manual or troubleshooting procedures for detailed information on items that could be causing the problem.

SPECIAL TOOL

EN03Z0304K100001

Prior to removal and installing of automatic transmission, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0965-71370	SPACER COUPLING GUIDE	

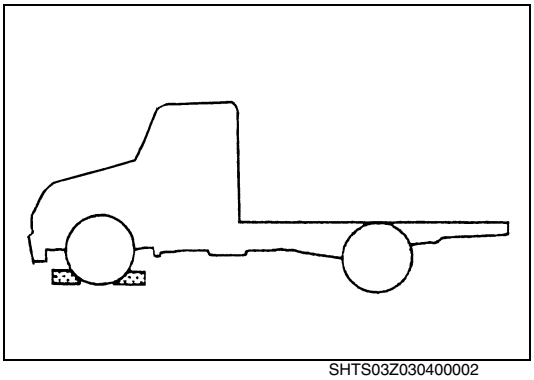
DISMOUNTING AND MOUNTING

EN03Z0304H100001

IMPORTANT POINTS - DISMOUNTING

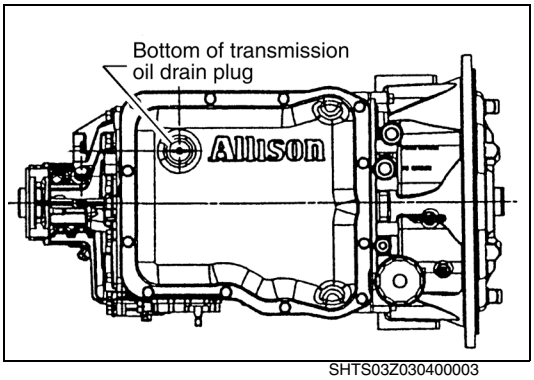
NOTICE
Allison transmission repairs are to be performed by an authorized Allison service dealer.

⚠ WARNING
Do not work on the transmission while it is hot. This can result in personal injury.


SHTS03Z030400002

1. BLOCK THE WHEELS.
(1) Park the vehicle on level ground.
(2) Block the wheels.

NOTICE
Be sure to apply wheel stoppers at the front tires.

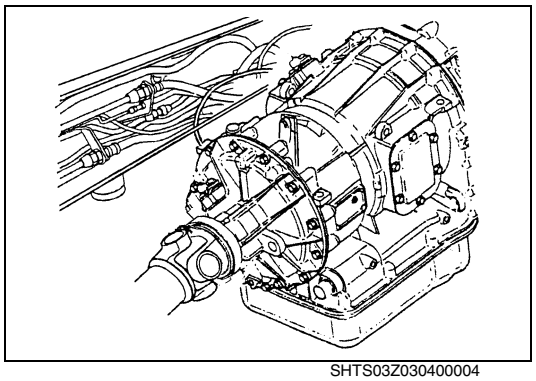


SHTS03Z030400003

2. DRAIN THE AUTOMATIC TRANSMISSION FLUID.

(1) Place the drain pan under the transmission.
(2) Remove the drain plug from the transmission and allow the fluid to drain.

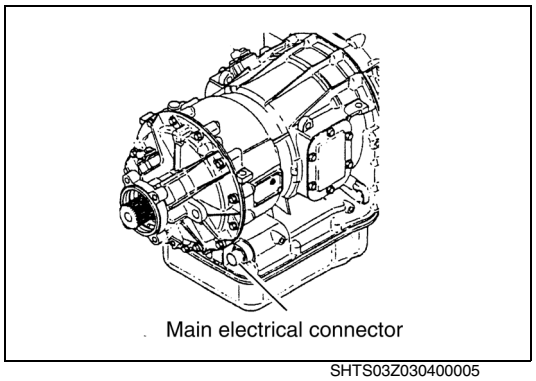
https://truckmanualshub.com/


SHTS03Z030400004

3. REMOVE THE PROPELLER SHAFTS.

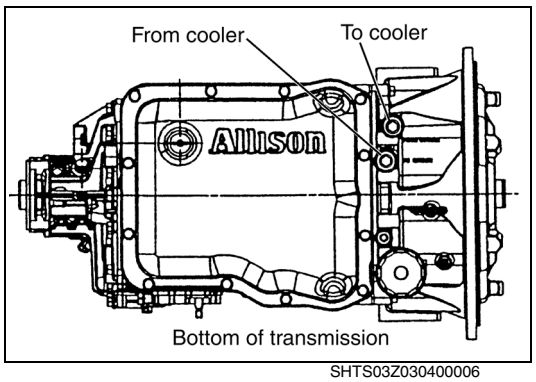
(1) Disconnect the yoke from the propeller spider and remove the center bearing holder.

(2) Move the forward end of the propeller shaft out of the way.



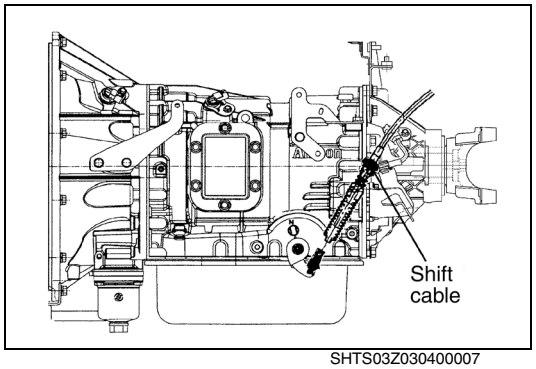
SHTS03Z030400005

4. DISCONNECT THE ELECTRICAL HARNESS FROM THE REAR OF THE TRANSMISSION.



SHTS03Z030400006

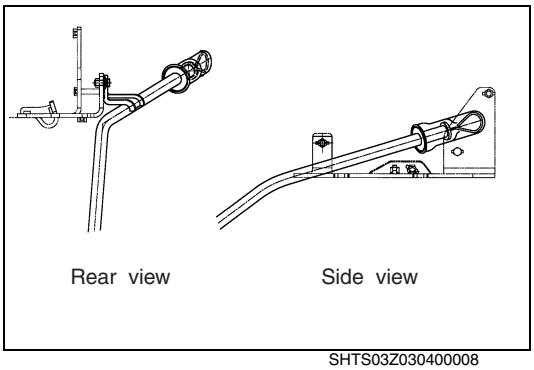
5. DISCONNECT THE OIL COOLER LINES AT THE TRANSMISSION.



SHTS03Z030400007

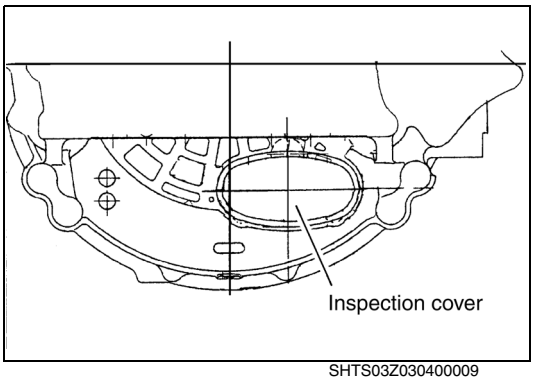
6. DISCONNECT THE SHIFT CABLE FROM THE MANUAL LEVER AT THE TRANSMISSION.

https://truckmanualshub.com/



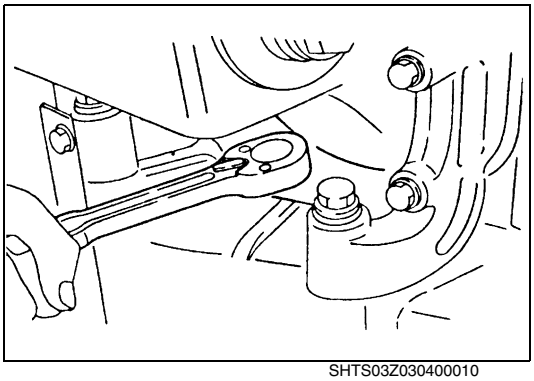
SHTS03Z030400008

7. REMOVE THE SUPPORT OF THE OIL LEVER GAUGE FROM THE ENGINE CYLINDER BLOCK.



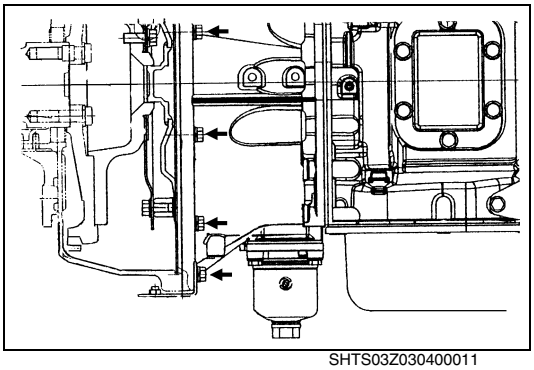
SHTS03Z030400009

8. REMOVE INSPECTION COVER FROM THE BOTTOM FRONT SIDE OF THE FLYWHEEL HOUSING.


SHTS03Z030400010

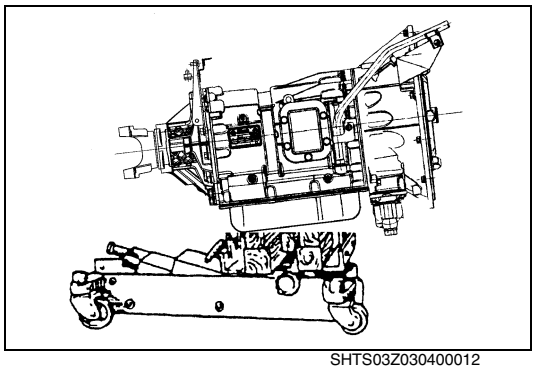
9. REMOVE THE SIX COUPLING BOLTS FROM THE FLYWHEEL.

(1) Turn the flywheel manually to match the attaching bolt to the slot on the inspection opening at the bottom front side of the flywheel housing.
(2) Remove the coupling bolts one by one.


SHTS03Z030400011

10. REMOVE THE CONVERTER HOUSING ATTACHING BOLTS.

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SHTS03Z030400012

11. POSITION A TRANSMISSION JACK UNDER THE TRANSMISSION AND SECURE THE TRANSMISSION TO THE JACK WITH A SAFETY CHAIN OR WIRE CABLE.

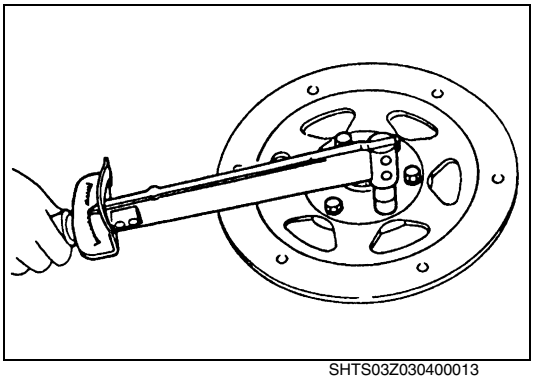
12. REMOVE THE REMAINING CONVERTER HOUSING FROM THE FLYWHEEL HOUSING ATTACHING BOLTS.

13. PULL OUT THE TRANSMISSION BACKWARDS.

⚠ WARNING
Do not lower the front end of the transmission. If lowered, the torque converter may slide out of the transmission and you may be injured.

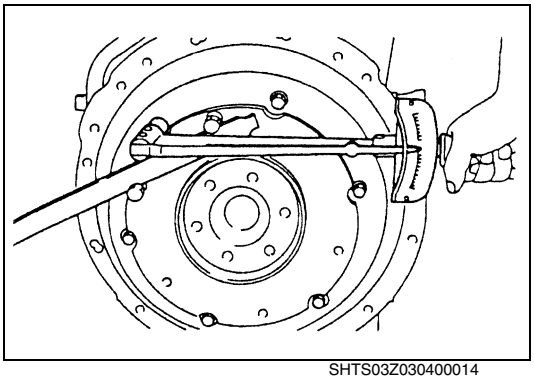
https://truckmanualshub.com/

IMPORTANT POINTS - MOUNTING

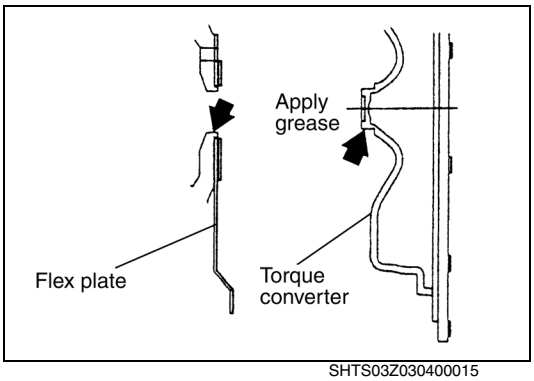

SHTS03Z030400013

1. TIGHTEN THE FLEX PLATE, SPACER COUPLING AND WEAR PLATE.
Tightening Torque:
78.5-87.5 N·m {801-893 kgf·cm, 58-64.5 lbf·ft}

NOTICE
Before tightening, face the chamfered outer rim of the wear plate to the flex plate. If assembled to the contrary, the wear plate edge hits the flex plate and its strength is reduced. Painted surface of the wear plate should be located facing the transmission side.

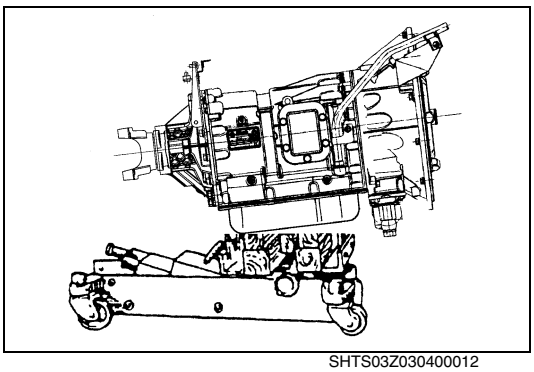

SHTS03Z030400014

2. TIGHTEN THE TORQUE CONVERTER AND THE FLEX PLATE.
Tightening Torque:
57-68 N·m {582-693 kgf·cm, 42-50 lbf·ft}



SHTS03Z030400015

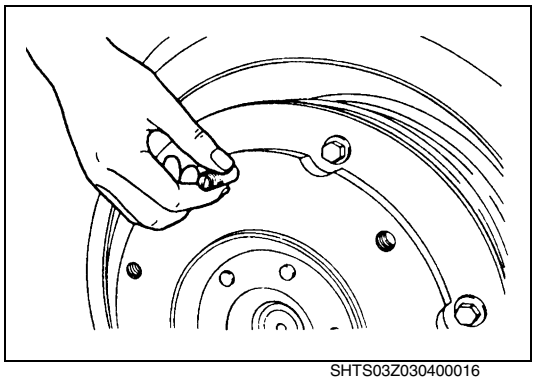
NOTICE
Apply grease containing molybdenum disulfide to the boss at the end of the torque converter before assembling. Without grease, the flex plate will not slide well and abnormal force will be generated, causing the flex plate to break.


SHTS03Z030400012

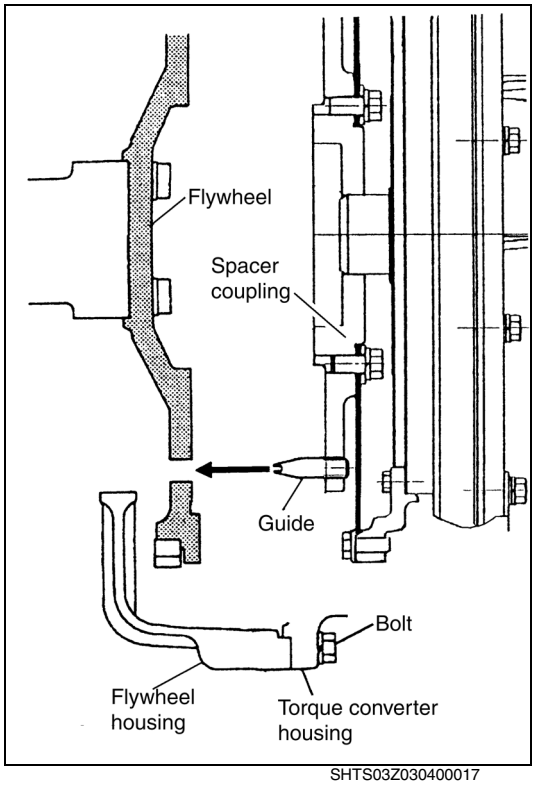
3. MOUNT THE TRANSMISSION ASSEMBLY ON A TRANSMISSION JACK. THEN MOVE THE ASSEMBLY INTO THE POSITION.

⚠ WARNING
Do not lower the front end of the transmission. If lowered, the torque converter may slide out of the transmission and you can be injured.

https://truckmanualshub.com/


SHTS03Z030400016

4. SCREW THE SPECIAL TOOL "GUIDE" BY HAND INTO THE SPACER COUPLING OF THE TRANSMISSION ASSEMBLY. ROTATE THE TORQUE CONVERTER SO THAT THE GUIDE FACES DOWNWARD.
SST: Spacer coupling guide (S0965-71370)



SHTS03Z030400017

5. ROTATE THE ENGINE TO ALIGN THE FITTING HOLE OF THE ENGINE FLYWHEEL AND SPACER COUPLING WITH THE INSPECTION HOLE ON THE FRONT OF THE FLYWHEEL HOUSING.

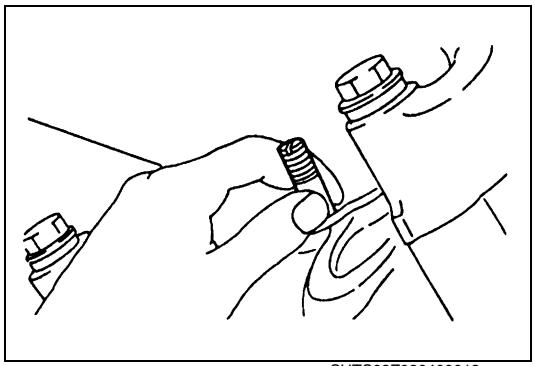
NOTICE
First switch off the power so that the engine will not start.

6. MOVE THE TRANSMISSION JACK SLOWLY AND INSERT THE GUIDE INTO THE FITTING HOLE OF THE FLYWHEEL.

⚠ WARNING
Do not lower the front side of the transmission. If lowered, the torque converter may slide out of the transmission and you may be injured.

7. MOVE THE TRANSMISSION JACK SLOWLY AND ADJUST BY BRINGING THE FITTING FACES OF THE TORQUE CONVERTER HOUSING AND THE FLYWHEEL HOUSING.

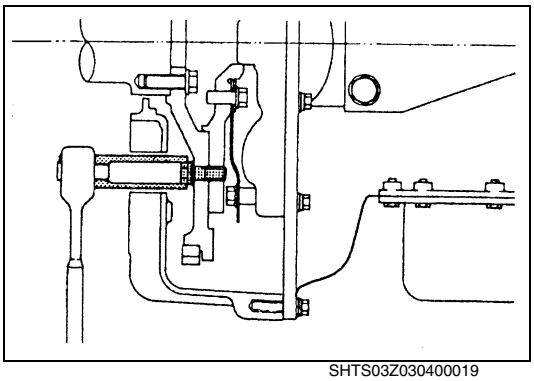
8. TIGHTEN THE BOLTS TO JOIN THE TORQUE CONVERTER HOUSING AND THE FLYWHEEL HOUSING.
Tightening Torque:
37-57 N·m {378-581 kgf·cm, 28-42 lbf·ft}


SHTS03Z030400018

9. LOWER AND REMOVE THE TRANSMISSION JACK.

10. TAKE THE GUIDE OUT OF THE INSPECTION HOLE ON THE FLYWHEEL HOUSING FRONT WITH A SCREW DRIVER.

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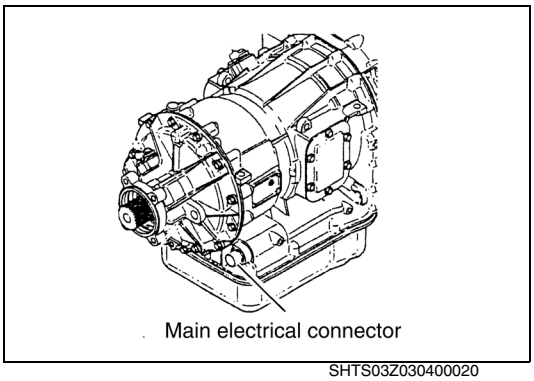

SHTS03Z030400019

11. LIGHTLY TIGHTEN THE BOLTS JOINING THE FLYWHEEL AND THE SPACER COUPLING THROUGH THE INSPECTION HOLE. IN ORDER TO TIGHTEN THE BOLTS, TURN THE RING GEAR WITH A SCREW DRIVER THROUGH THE TIMING ADJUSTMENT HOLE ON THE UPPER PART OF THE FLYWHEEL HOUSING.

NOTICE

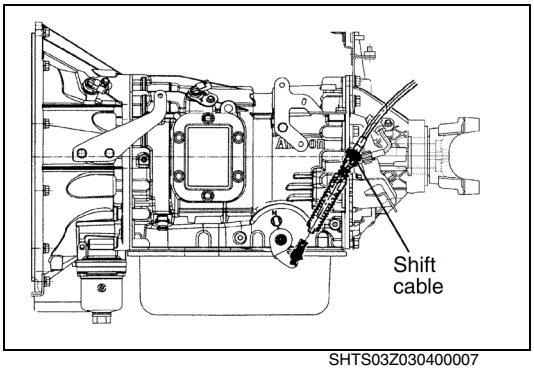
If the ring gear does not turn smoothly with a screw driver, remove the transmission and repeat the procedure again from 5 above, because the hub ends of the flywheel and the spacer coupling do not fit well. Tightening bolts in such a condition will cause damage to the bolts and jamming of the engine.

12. TIGHTEN THE BOLTS PRETIGHTENED IN STEP 11.
Tightening Torque:
64-85 N·m {653-867 kgf·cm, 48-62 lbf·ft}



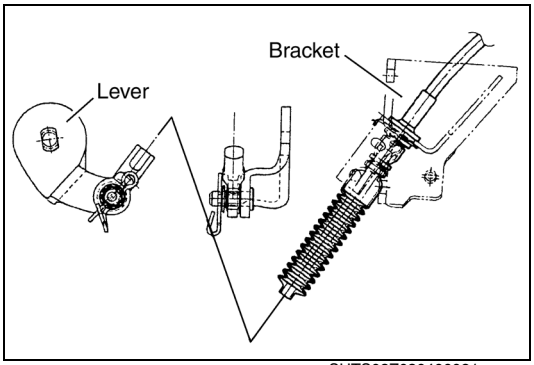
SHTS03Z030400020

13. CONNECT THE ELECTRICAL HARNESS TO THE REAR PART OF THE TRANSMISSION.



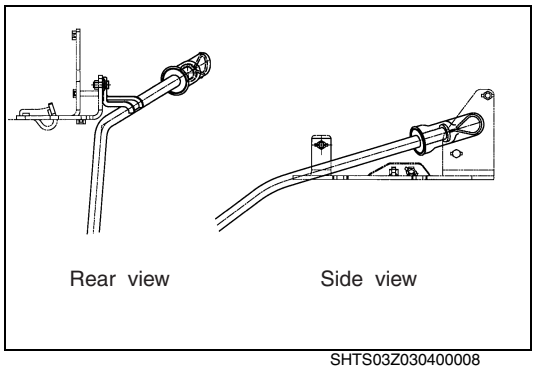
SHTS03Z030400007

14. INSTALL THE SHIFT CABLE TO THE LEVER AND BRACKET.



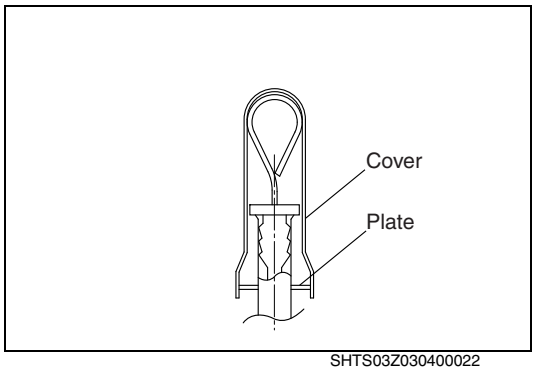
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https://truckmanualshub.com/

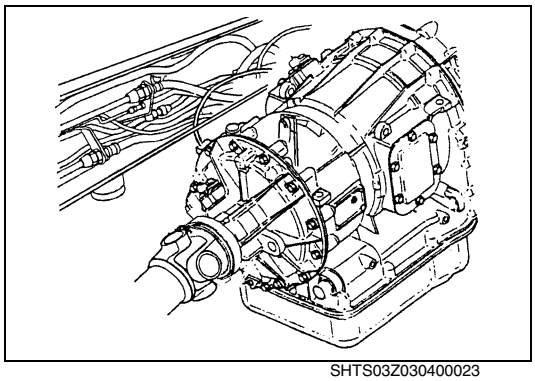


SHTS03Z030400008

15. INSTALL THE SUPPORT OF THE OIL LEVEL GAUGE TO THE ENGINE CYLINDER BLOCK.



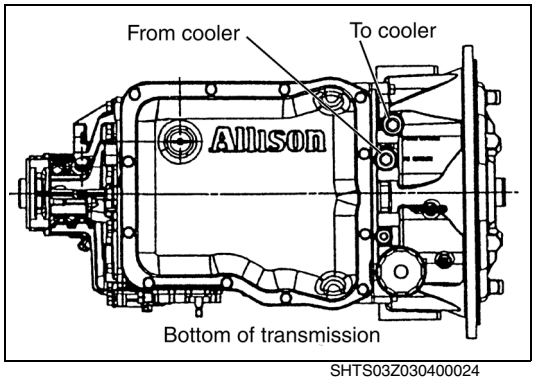
SHTS03Z030400022


SHTS03Z030400023

16. INSTALL THE PROPELLER SHAFT YOKE TO THE TRANSMISSION YOKE.

Tightening Torque:
61-81 N·m {622-826 kgf·cm, 45-60 lbf·ft}

17. INSTALL THE CENTER BEARING HOLDER TO THE FRAME.



SHTS03Z030400024

18. CONNECT THE OIL COOLER LINE.

(1) For connecting the transmission case and joints, insert O-rings in the grooves of the joints before tightening.

NOTICE
Apply automatic transmission fluid to the O-rings when inserting them. If the fluid is not applied, the O-rings will not be inserted smoothly and will thus be damaged, causing oil to leak.

19. REMOVE THE CAP OF THE OIL FILLER TUBE AND POUR AUTOMATIC TRANSMISSION FLUID INTO THE TUBE.

Automatic transmission fluid:
Refer to RECOMMENDED LUBRICANTS LIST in the chapter "GENERAL INTRODUCTION (CHASSIS)."

NOTICE
For further details, consult your nearest ALLISON representative or ALLISON service station.

https://truckmanualshub.com/

AUTOMATIC TRANSMISSION (ALLISON 3000RDS, 3500RDS)

TR04-002

AUTOMATIC TRANSMISSION ASSEMBLY TR04-2

TROUBLESHOOTING TR04-2
SPECIAL TOOL TR04-2
DISMOUNTING AND MOUNTING TR04-2

https://truckmanualshub.com/

AUTOMATIC TRANSMISSION ASSEMBLY

TROUBLESHOOTING

EN03Z0304F300001

NOTICE
When diagnosing transmission problems, refer to the Allison Shop Manual or troubleshooting procedures for detailed information on items that could be causing the problem.

SPECIAL TOOL

EN03Z0304K100001

Prior to removal and installing of automatic transmission, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0965-71370	SPACER COUPLING GUIDE	

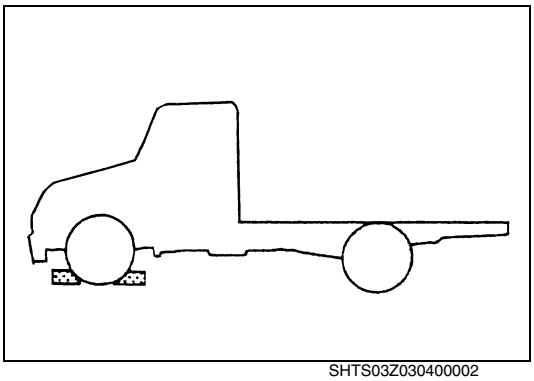
DISMOUNTING AND MOUNTING

EN03Z0304H100001

IMPORTANT POINTS - DISMOUNTING

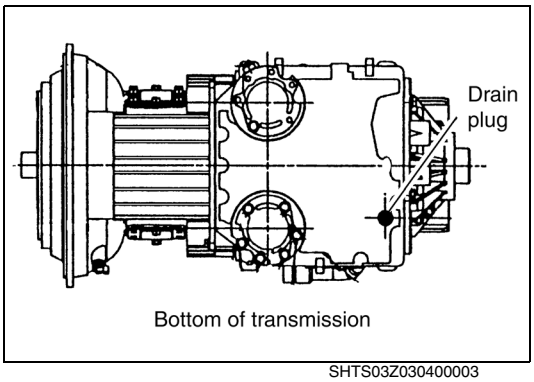
NOTICE
Allison transmission repairs are to be performed by an authorized Allison service dealer.

⚠ WARNING
Do not work on the transmission while it is hot. This can result in personal injury.


SHTS03Z030400002

1. BLOCK THE WHEELS.
(1) Park the vehicle on level ground.
(2) Block the wheels.

NOTICE
Be sure to apply wheel stoppers at the front tires.

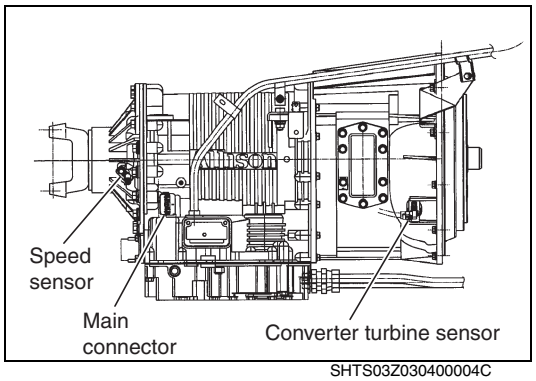


SHTS03Z030400003

2. DRAIN THE AUTOMATIC TRANSMISSION FLUID.
(1) Place the drain pan under the transmission.
(2) Remove the drain plug from the transmission and allow the fluid to drain.

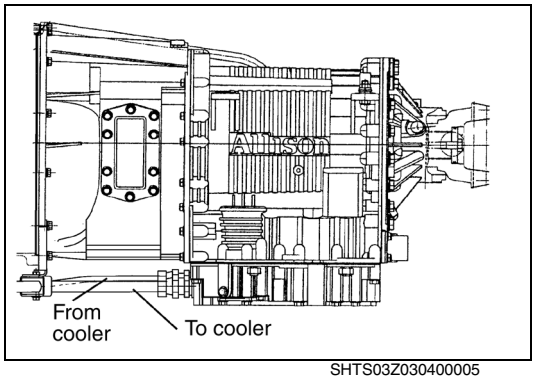
3. REMOVE THE PROPELLER SHAFTS.
(1) Disconnect the yoke from the propeller spider and remove the center bearing holder.
(2) Move the forward end of the propeller shaft out of the way.

https://truckmanualshub.com/



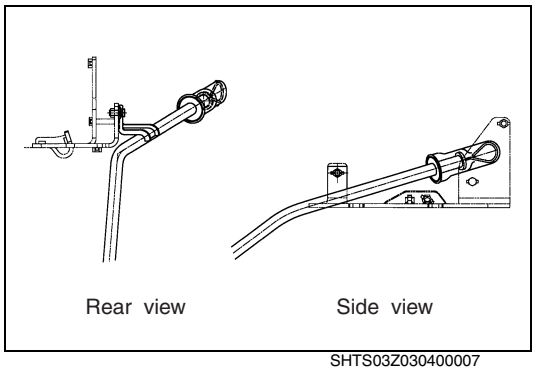
SHTS03Z030400004C

4. REMOVE THE CONNECTORS OF MAIN CONNECTOR, SPEED SENSOR AND CONVERTER TURBINE SENSOR.



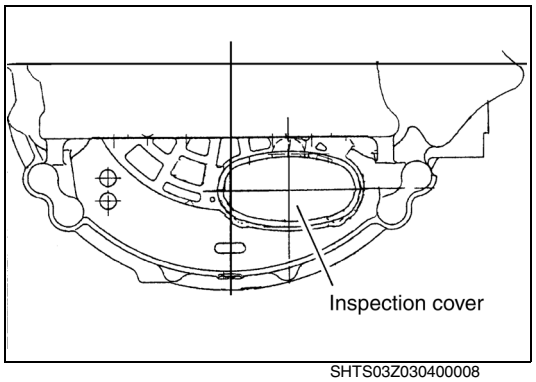
SHTS03Z030400005

5. DISCONNECT THE OIL COOLER LINES AT THE TRANSMISSION.



SHTS03Z030400007

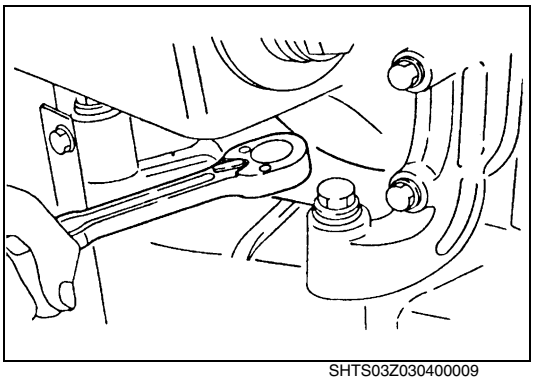
6. REMOVE THE SUPPORT OF THE OIL LEVEL GAUGE FROM THE ENGINE CYLINDER BLOCK.



SHTS03Z030400008

7. REMOVE INSPECTION COVER FROM THE BOTTOM FRONT SIDE OF THE FLYWHEEL HOUSING.

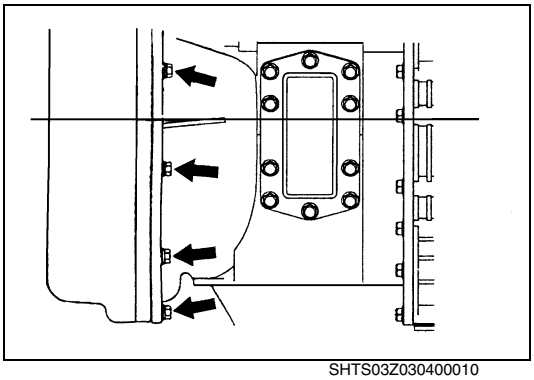
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SHTS03Z030400009

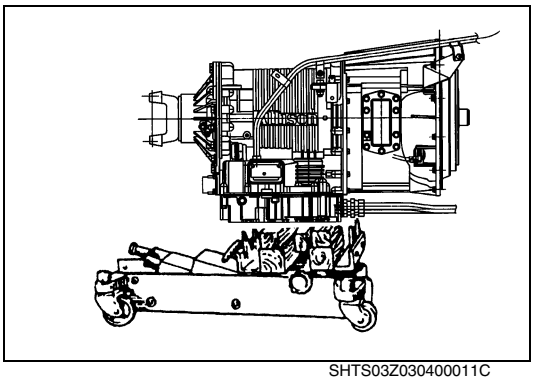
8. REMOVE THE SIX COUPLING BOLTS FROM THE FLYWHEEL.

(1) Turn the flywheel manually to match the attaching bolt to the slot on the inspection opening at the bottom front side of the flywheel housing.

(2) Remove the coupling bolts one by one.


SHTS03Z030400010

9. REMOVE THE CONVERTER HOUSING ATTACHING BOLTS LOWER THE TRANSMISSION.


SHTS03Z030400011C

10. POSITION A TRANSMISSION JACK UNDER THE TRANSMISSION AND SECURE THE TRANSMISSION TO THE JACK WITH A SAFETY CHAIN OR WIRE CABLE.

11. REMOVE THE REMAINING CONVERTER HOUSING FROM THE FLYWHEEL HOUSING ATTACHING BOLTS.

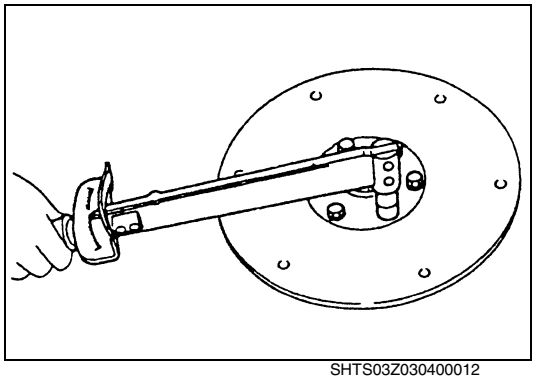
12. PULL OUT THE TRANSMISSION BACKWARDS.

⚠ WARNING

Do not lower the front end of the transmission. If lowered, the torque converter may slide out of the transmission and you can be injured.

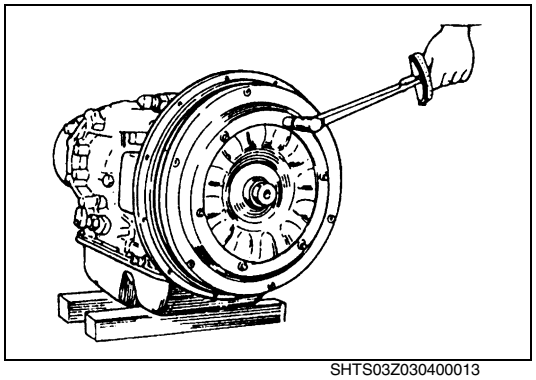
https://truckmanualshub.com/

IMPORTANT POINTS - MOUNTING


SHTS03Z030400012

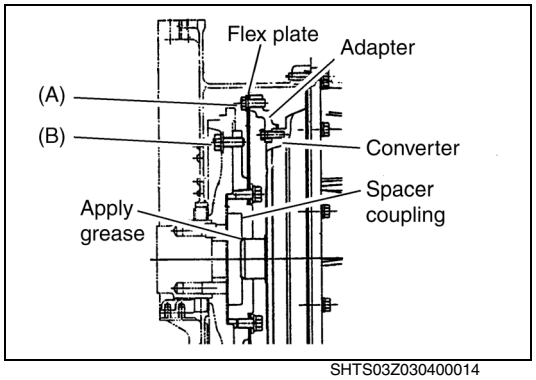
1. TIGHTEN THE FLEX PLATE, SPACER COUPLING AND WEAR PLATE.
Tightening Torque:
64-85 N·m {653-867 kgf·cm, 48-62 lbf·ft}

NOTICE
Before tightening, face the chamfered outer rim of the wear plate to the flex plate. If assembled to the contrary, the wear plate edge hits the flex plate and its strength is reduced. Painted surface of the wear plate should be located facing the transmission side.


SHTS03Z030400013

2. TIGHTEN THE TORQUE CONVERTER AND THE ADAPTER.
Tightening Torque:
33.5-38.5 N·m {342-392 kgf·cm, 25-28 lbf·ft}

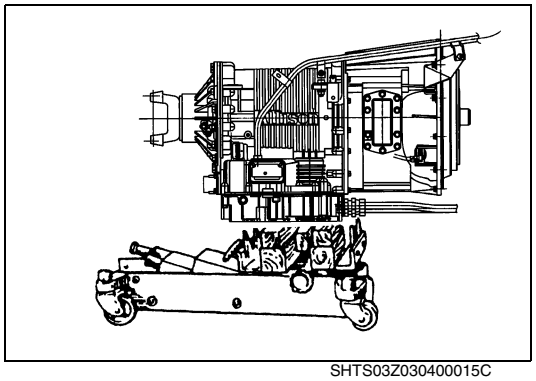
NOTICE
Apply grease containing molybdenum disulfide to the boss at the end of the torque converter before assembling. Without grease, the flex plate will not slide well and abnormal force will be generated, causing the flex plate to break.



SHTS03Z030400014

3. INSTALL THE FLEX PLATE, SPACER COUPLING AND WEAR PLATE. THEN TIGHTEN THE FLEX PLATE AND ADAPTER TOGETHER.
Tightening Torque:
63-73 N·m {643-744 kgf·cm, 47-53 lbf·ft}

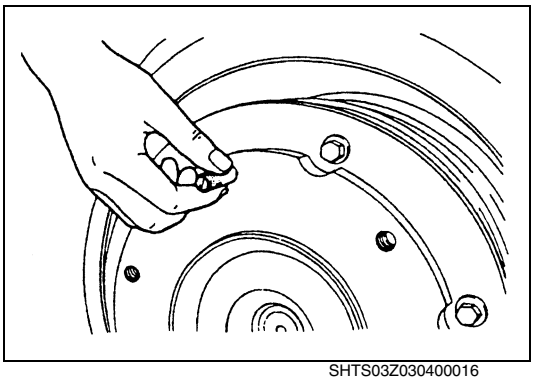
NOTICE
Flex plate's hole (A) and spacer's hole (B) must be same position (by this, lock the flywheel and (A)'s bolt is suitable)


SHTS03Z030400015C

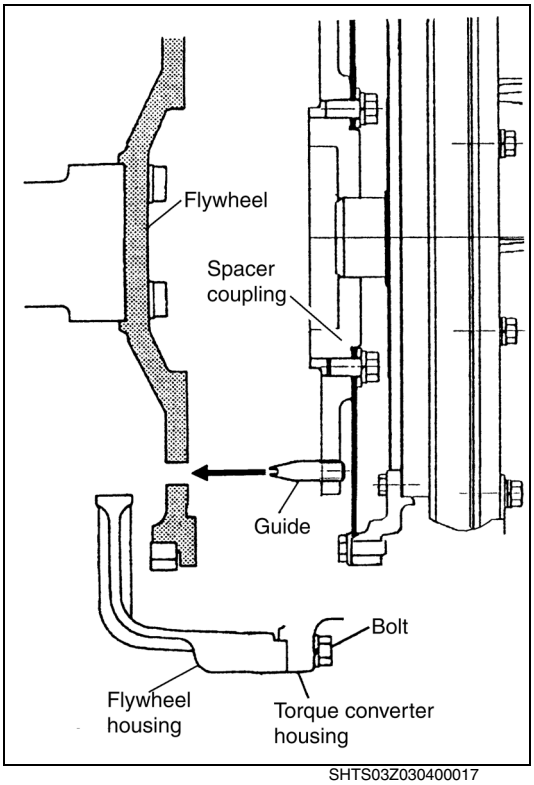
4. MOUNT THE TRANSMISSION ASSEMBLY ON A TRANSMISSION JACK. THEN MOVE THE ASSEMBLY INTO THE POSITION.

⚠ WARNING
Do not lower the front end of the transmission. If lowered, the torque converter may slide out of the transmission and you can be injured.

https://truckmanualshub.com/


SHTS03Z030400016

5. SCREW THE SPECIAL TOOL "GUIDE" BY HAND INTO THE SPACER COUPLING OF THE TRANSMISSION ASSEMBLY. ROTATE THE TORQUE CONVERTER SO THAT THE GUIDE FACES DOWNWARD.
SST: Spacer coupling guide (S0965-71370)



SHTS03Z030400017

6. ROTATE THE ENGINE TO ALIGN THE FITTING HOLE OF THE ENGINE FLYWHEEL AND SPACER COUPLING WITH THE INSPECTION HOLE ON THE FRONT OF THE FLYWHEEL HOUSING.

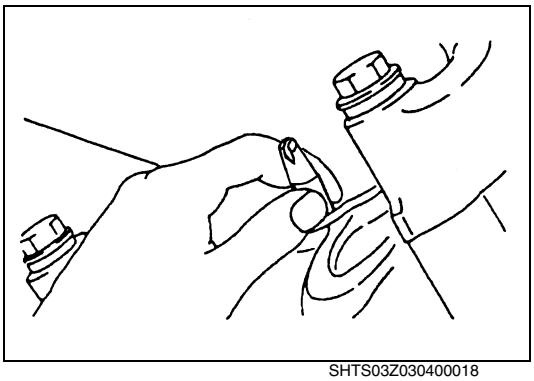
NOTICE
First switch off the power so that the engine will not start.

7. MOVE THE TRANSMISSION JACK SLOWLY AND INSERT THE GUIDE INTO THE FITTING HOLE OF THE FLYWHEEL.

⚠ WARNING
Do not lower the front side of the transmission. If lowered, the torque converter may slide out of the transmission and you can be injured.

8. MOVE THE TRANSMISSION JACK SLOWLY AND ADJUST BY BRINGING THE FITTING FACES OF THE TORQUE CONVERTER HOUSING AND THE FLYWHEEL HOUSING.

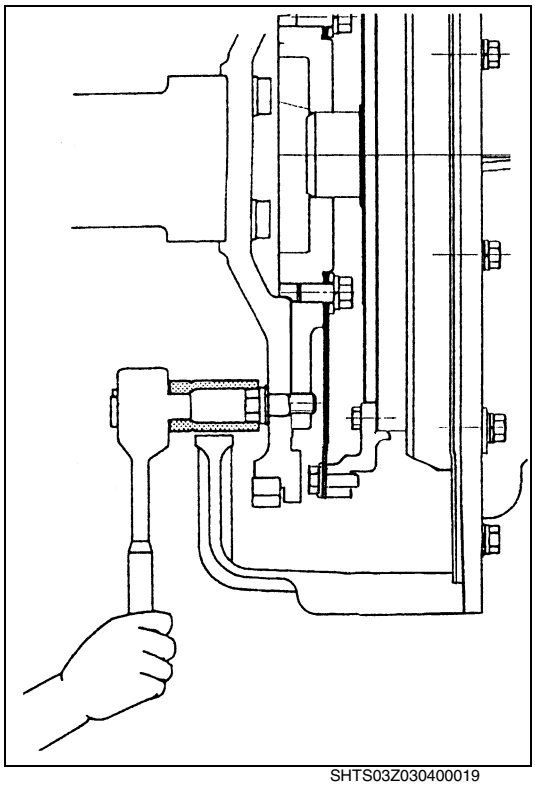
9. TIGHTEN THE BOLTS TO JOIN THE TORQUE CONVERTER HOUSING AND THE FLYWHEEL HOUSING.
Tightening Torque:
37-57 N·m {439-520 kgf·cm, 32-38 lbf·ft}


SHTS03Z030400018

10. LOWER AND REMOVE THE TRANSMISSION JACK.

11. TAKE THE GUIDE OUT OF THE INSPECTION HOLE ON THE FLYWHEEL HOUSING FRONT WITH A SCREW DRIVER.

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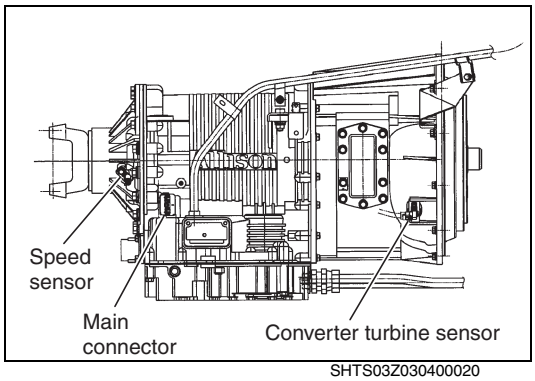

SHTS03Z030400019

12. LIGHTLY TIGHTEN THE BOLTS JOINING THE FLYWHEEL AND THE SPACER COUPLING THROUGH THE INSPECTION HOLE. IN ORDER TO TIGHTEN THE BOLTS, TURN THE RING GEAR WITH A SCREW DRIVER THROUGH THE TIMING ADJUSTMENT HOLE ON THE UPPER PART OF THE FLYWHEEL HOUSING.

NOTICE

If the ring gear does not turn smoothly with a screw driver, remove the transmission and repeat the procedure again from 6 above, because the hub ends of the flywheel and the spacer coupling do not fit well. Tightening bolts in such a condition will cause damage to the bolts and jamming of the engine.

13. TIGHTEN THE BOLTS PRETIGHTENED IN STEP 12.
Tightening Torque:
64-85 N·m {653-867 kgf·cm, 48-62 lbf·ft}



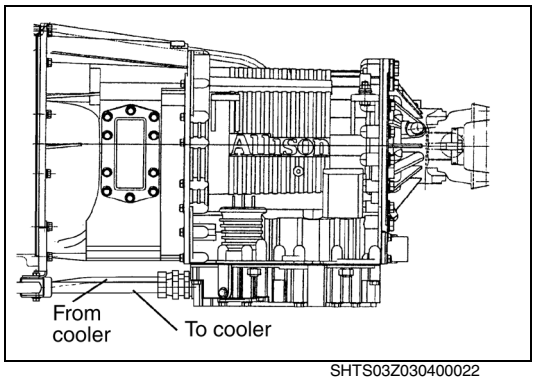
SHTS03Z030400020

14. INSTALL THE SPEED SENSOR HARNESS TO THE REAR PART OF THE TRANSMISSION.

15. CONNECT THE CONNECTORS OF WIRING.

16. INSTALL THE PROPELLER SHAFT YOKE TO THE TRANSMISSION YOKE.

17. INSTALL THE CENTER BEARING HOLDER TO THE FRAME.



SHTS03Z030400022

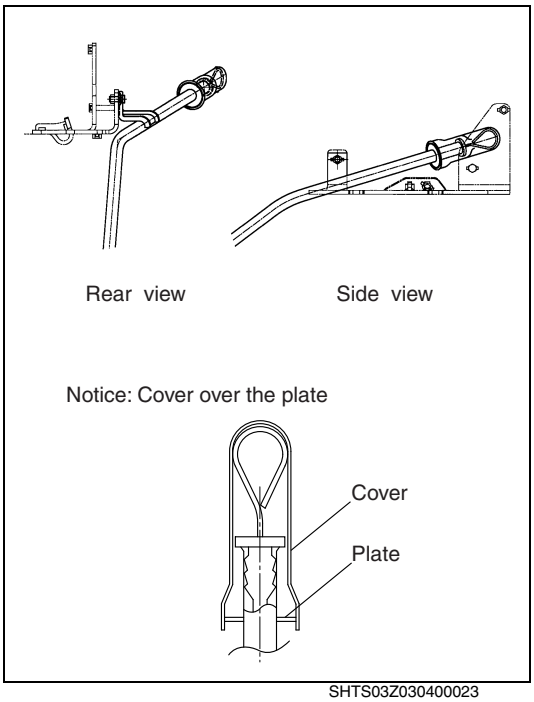
18. CONNECT THE OIL COOLER LINE.

(1) For connecting the transmission case and joints, insert O-rings in the grooves of the joints before tightening.

NOTICE

Apply automatic transmission fluid to the O-rings when inserting them. If the fluid is not applied, the O-rings will not be inserted smoothly and will thus be damaged, causing oil to leak.

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SHTS03Z030400023

19. INSTALL THE SUPPORT OF THE OIL LEVEL GAUGE TO THE ENGINE CYLINDER BLOCK.

20. REMOVE THE CAP OF THE OIL FILLER TUBE AND POUR AUTOMATIC TRANSMISSION FLUID INTO THE TUBE.

Automatic transmission fluid:
Refer to RECOMMENDED LUBRICANTS LIST in the chapter "GENERAL INTRODUCTION (CHASSIS)."

NOTICE
For further details, consult your nearest ALLISON representative or ALLISON service station.

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TRANSMISSION/TRANSFER CONTROL (EATON MANUAL TRANSMISSION)

TR06-001

TRANSMISSION CONTROL UNIT TR06-2

TROUBLESHOOTING TR06-2
COMPONENT LOCATOR TR06-3
OVERHAUL TR06-4

https://truckmanualshub.com/

TRANSMISSION CONTROL UNIT

TROUBLESHOOTING

EN03Z0306F300001

1. MANUAL TRANSMISSION

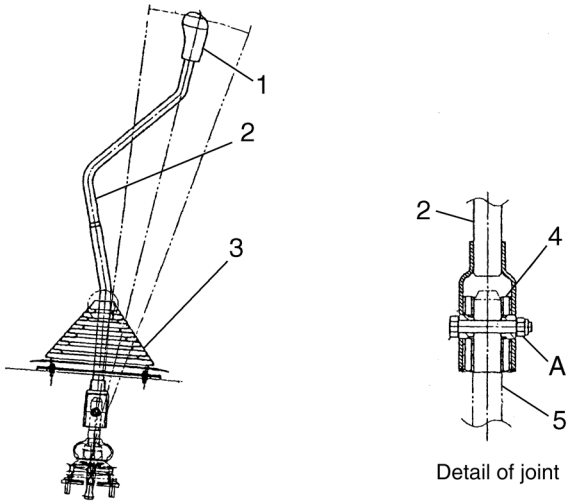
Symptom	Possible cause	Remedy/Prevention
Unable to shift the gear or very difficult to shift when the engine is turned off.	Damaged shift lever assembly	Replace shift lever.
	Damaged or broken transmission upper cover (lever, spring, etc.)	Replace.
	The looseness of tightening bolt and nut	Inspect and tighten each bolt and nut.
Gear disengages when driving on bumpy roads.	Loose control lever joint	Tighten or replace.
The play of the lever is excessive.	A joint is seriously worn	Replace the joint.
	The looseness of tightening bolt and nut	Inspect and tighten each bolt and nut.

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COMPONENT LOCATOR

EN03Z0306D100001

1. MANUAL TRANSMISSION CONTROL



SHTS03Z030600001

1	Knob	4	Isolator
2	Shift lever	5	Stub lever
3	Boot		

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	14-16 {143-163, 10-11.8}	

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OVERHAUL

EN03Z0306H200001

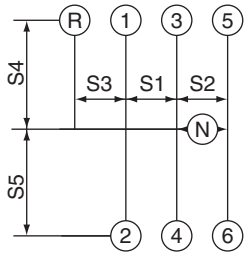
IMPORTANT POINT - ASSEMBLY

1. MANUAL TRANSMISSION CONTROL

(1) When you connect the shift lever and the stub lever, tighten the nut with the isolator steadily.
Tightening Torque:
14-16 N·m {143-163 kgf·cm, 10-11.8 lbf·ft}

(2) Check the shift and select stroke.

[FS5406, 6406]



SHTS03Z030600002

Unit: mm {in.}

TM	FS5406, 6406
S1	70-90 (2.76-3.54)
S2	70-90 (2.76-3.54)
S3	70-90 (2.76-3.54)
S4	100-120 (3.93-4.72)
S5	100-120 (3.93-4.72)

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TRANSMISSION/TRANSFER CONTROL (ALLISON AUTOMATIC TRANSMISSION) TR06-002

TRANSMISSION CONTROL UNIT TR06-2

TROUBLESHOOTING TR06-2
COMPONENT LOCATOR TR06-2
OVERHAUL TR06-4

https://truckmanualshub.com/

TRANSMISSION CONTROL UNIT

TROUBLESHOOTING

EN03Z0306F300001

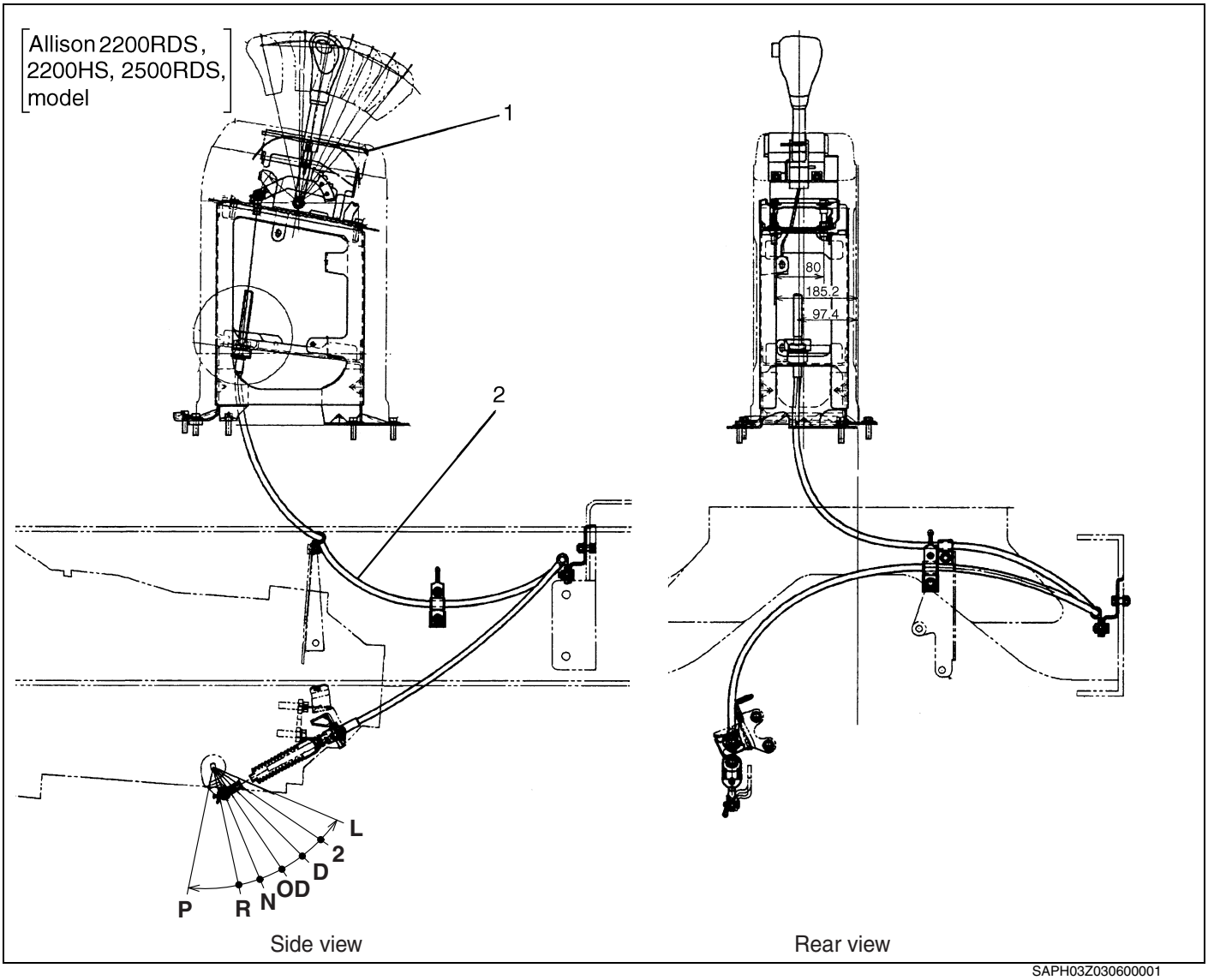
1. AUTOMATIC TRANSMISSION

(1) Allison 2200RDS, 2200HS, 2500RDS, 3000RDS, 3500RDS auto-transmission problem, refer to the Allison shop manual or troubleshooting procedures for detailed information on items that could be causing the problem.

COMPONENT LOCATOR

EN03Z0306D100001

1. AUTOMATIC TRANSMISSION CONTROL

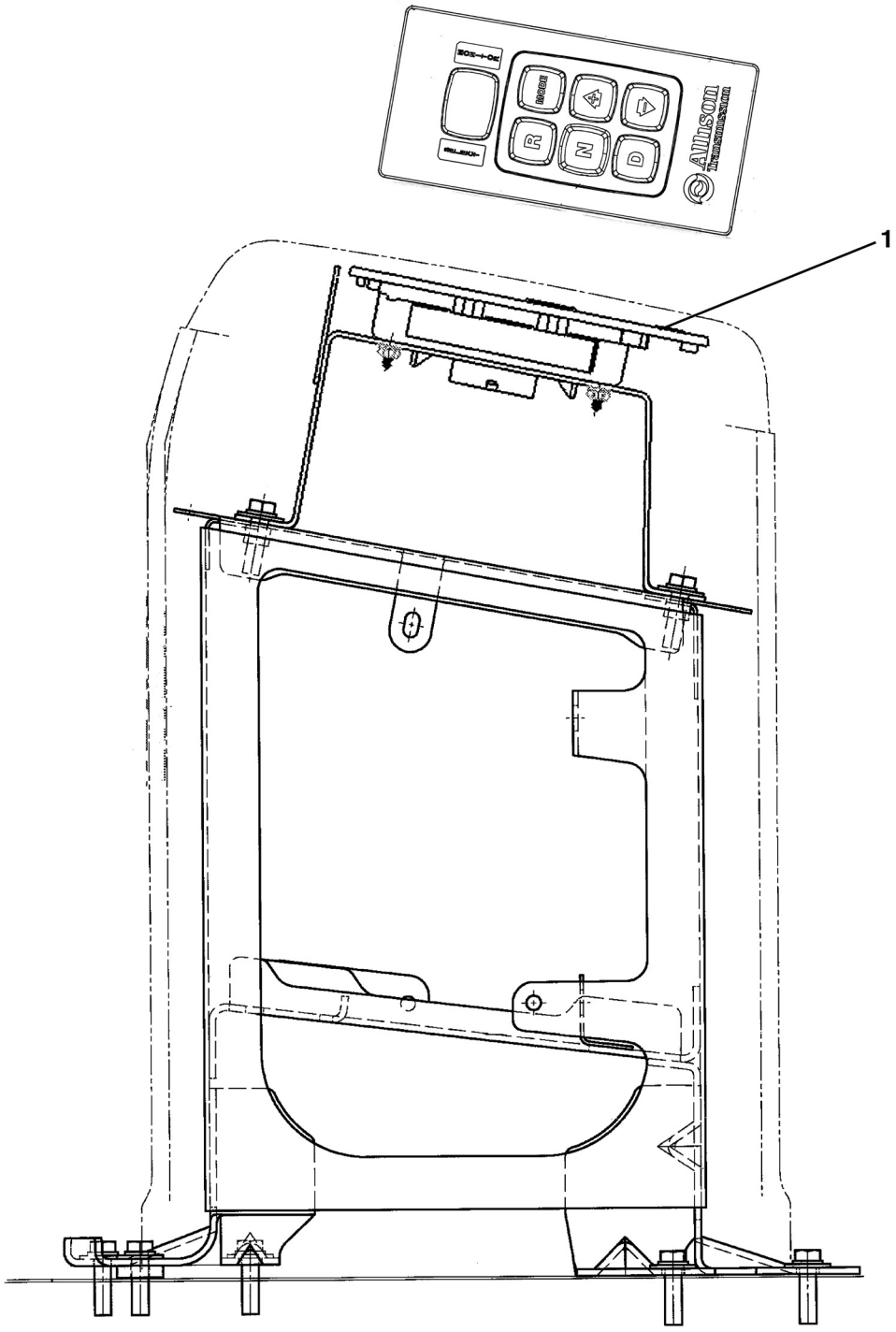


SAPH03Z030600001

1	Selector assembly	2	Shift cable assembly

https://truckmanualshub.com/

[Allison 3000RDS,3500RDS button-type]



SAPH03Z030600002

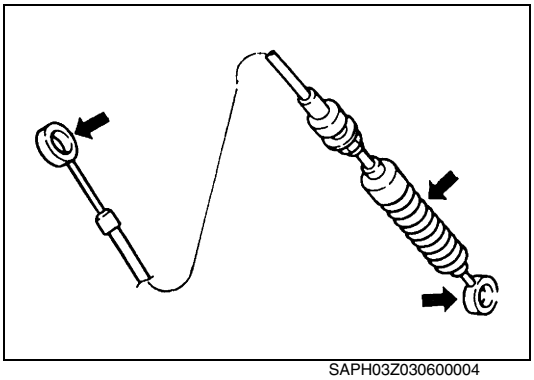
1 Selector assembly	

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OVERHAUL

EN03Z0306H200001

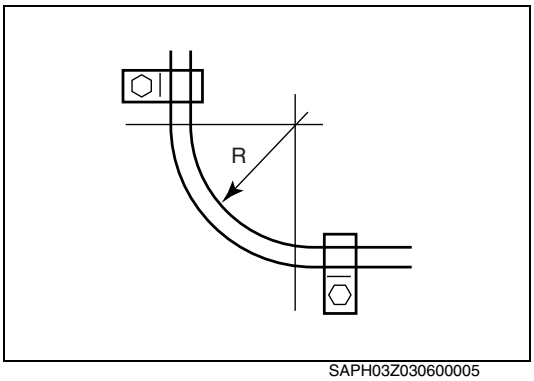
IMPORTANT POINT - ASSEMBLY



SAPH03Z030600004

1. AUTOMATIC TRANSMISSION CONTROL [Allison 2200RDS, 2200HS, 2500RDS MODEL]

(1) Before installation the cable, check the shift cable for wear and damage, if necessary, replace the parts.



SAPH03Z030600005

(2) When you install the shift cable, it should not bent sharply. Any looping should have a radius of more than 150 mm (5.91 in.).

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PROPELLER SHAFT (SPL 100, 140)

PP02-001

PROPELLER SHAFT ASSEMBLY PP02-2

DATA AND SPECIFICATIONS PP02-2
DESCRIPTION PP02-2
TROUBLESHOOTING PP02-3
COMPONENT LOCATOR PP02-3
OVERHAUL PP02-5

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PROPELLER SHAFT ASSEMBLY

DATA AND SPECIFICATIONS

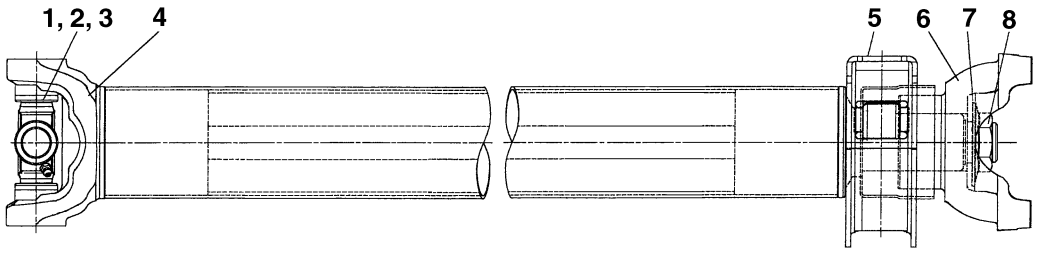
EN04Z0402I200001

Manufacturer	**Spicer**
Type	**Tubular shaft type**
Universal joint	**All metal, round bearing type with needle roller bearing**

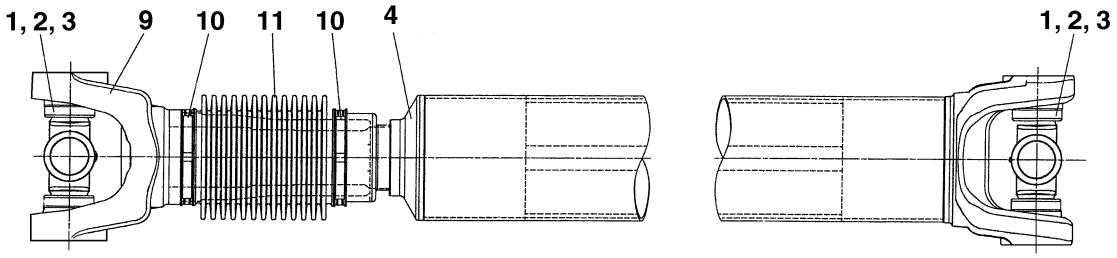
DESCRIPTION

EN04Z0402C100001

FRONT



REAR



SHTS04Z040200001

1	Bearing assembly	7	Washer
2	Cross assembly	8	Nut
3	Snap ring	9	Slip yoke assembly
4	Yoke shaft assembly	10	Clamp
5	Center bearing assembly	11	Boot
6	End yoke		

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TROUBLESHOOTING

EN04Z0402F300001

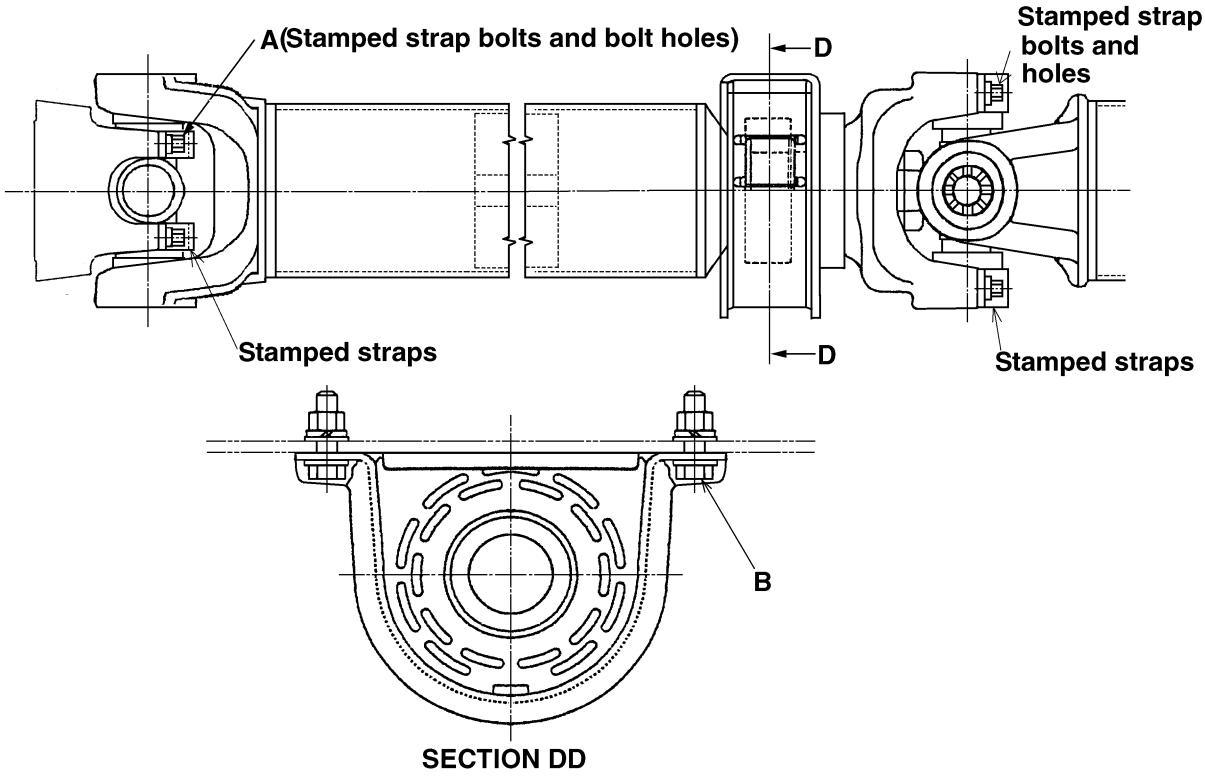
Symptom	Possible cause	Remedy/Prevention
Abnormal vibration when driving.	Looseness of universal joint yoke and flange tightening nuts.	Tighten the nuts.
	Looseness of universal joint flange lock nut.	Replace the lock nut with new one, then tighten the lock nut with specified torque and caulk the nut securely.
	Excessively bent propeller shaft.	Replace the shaft.
	Worn or damaged universal joint.	Replace the universal joint.
	Worn or damaged center bearing.	Replace the bearing.
	Worn or damaged center bearing rubber cushion.	Replace the rubber cushion.
	Incorrect phasing of the yokes.	Match the phasing arrows correctly.

COMPONENT LOCATOR

EN04Z0402D100001

SPL 100

FOR Eaton FS5406 MANUAL TRANSMISSION
AND ALLISON 2200HS/ 2200RDS/2500RDS AUTOMATIC TRANSMISSION



SHTS04Z040200002

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	**61-81 {625-825, 45-60}**	**B**	**128-156 {1,300-1,600, 95-115}**

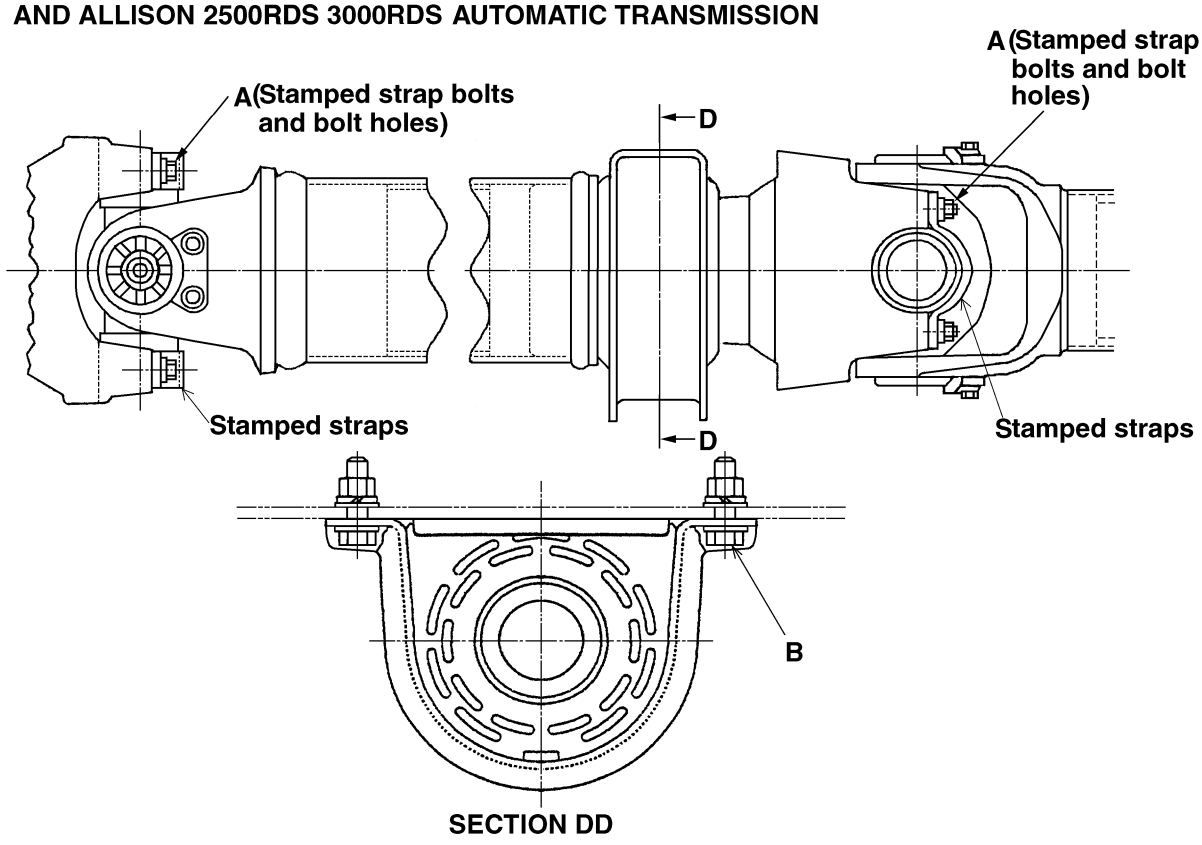
⚠ WARNING

Never allow grease and oil to adhere stamped straps, stamped strap bolts and bold holes. The grease and/or oil which adhere to the stamped retainer bolts, stamped straps, stamped strap bolts, damaged bearing retainers or used inferior grade bolts can cause driveline failure, which can result in separation of driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

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SPL 140

FOR Eaton FS6406 MANUAL TRANSMISSION AND ALLISON 2500RDS 3000RDS AUTOMATIC TRANSMISSION



SHTS04Z040200003

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	**143-169 {1,457-1,723, 105-125}**	**B**	**128-156 {1,300-1,600, 95-115}**

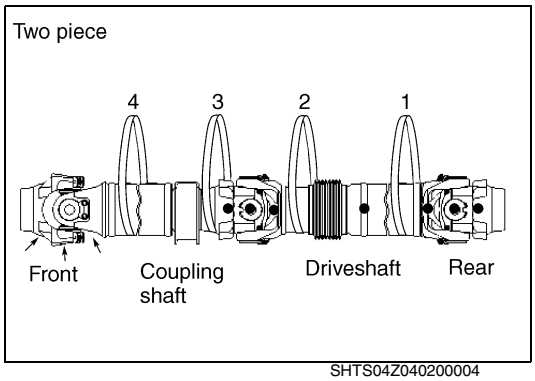
⚠ WARNING

Never allow grease and oil to adhere stamped straps, stamped strap bolts and bold holes. The grease and/or oil which adhere to the stamped retainer bolts, stamped straps, stamped strap bolts, damaged bearing retainers or used inferior grade bolts can cause driveline failure, which can result in separation of driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

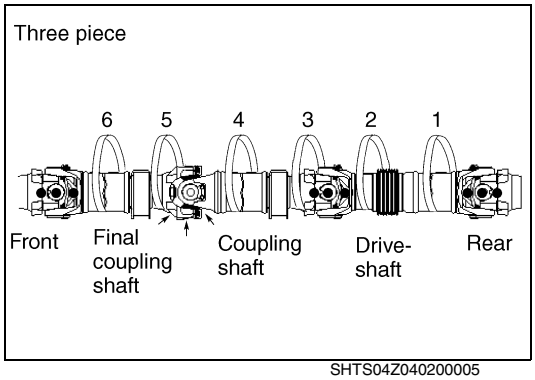
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OVERHAUL

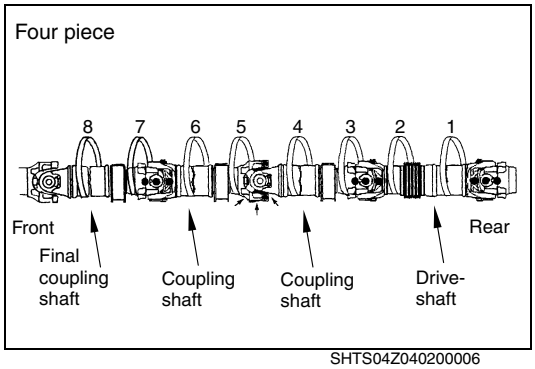
EN04Z0402H200001



SHTS04Z040200004



SHTS04Z040200005



SHTS04Z040200006

IMPORTANT POINT - DISMOUNTING

1. DISCONNECT THE PROPELLER SHAFT FROM THE ALL CONNECTING POINTS.

(1) Park the vehicle on level ground, apply the parking brake and apply wheel stoppers at the front or rear tires.

(2) Make aligning marks on all bearing positions, spline positions, shaft locations and all bearing retainers.

(3) Working from the rear end, support the propeller shaft with support straps as illustrated in Figure. Be sure to support the shaft assembly at the rear, at the slip member, behind the center bearing end fitting and in front of center bearing, with support straps.

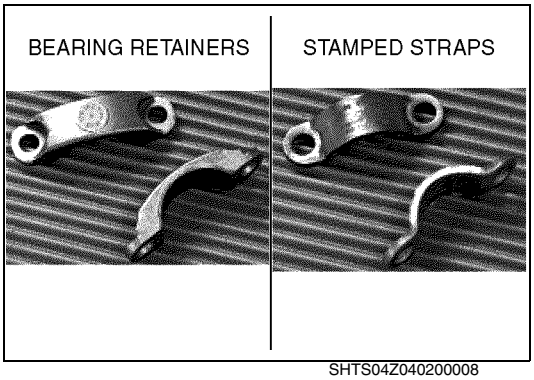
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SHTS04Z040200007

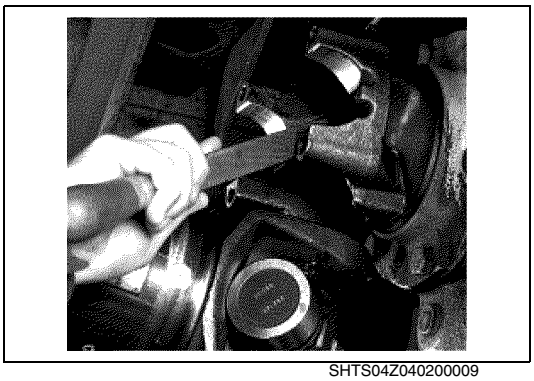
(4) Remove the bearing retainers or stamped straps and bolts at rear end. Discard bolts. Discard stamped straps (if applicable).

⚠ WARNING

- **Bearing retainers CAN be reused if there is no damage. If damaged, replace.**
- **Stamped straps CANNOT be reused.**
- **DO NOT reuse bearing retainer bolts, stamped strap bolts.**
- **DO NOT reuse bearing retainer bolts, stamped straps, stamped strap bolts, damaged bearing retainers, or use inferior grade bolts. Reuse of bearing retainer bolts, stamped straps, stamped strap bolts, damaged bearing retainers or the use of inferior grade bolts can cause driveline failure, which can result in separation of driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.**



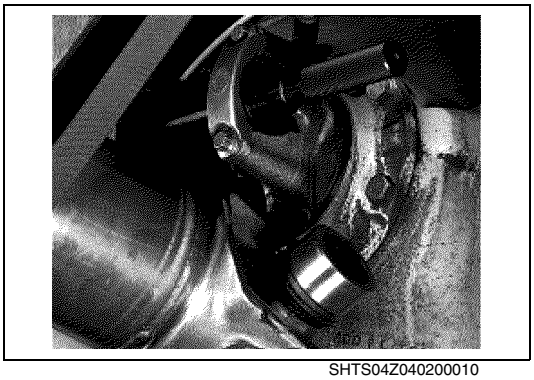
SHTS04Z040200008


SHTS04Z040200009

(5) Inspect all end yoke cross hole surfaces and bolt hole threads for damage. If the bolt hole threads are damaged, the yoke must be replaced.
Raised metal or fretting on open yoke cross holes can be removed with a fine-toothed file and/or emery cloth.

⚠ WARNING

DO NOT deform yoke cross holes by removing excessive metal. Raised metal or deformed yoke cross holes can be a cause of cross and bearing failure, which can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.


SHTS04Z040200010

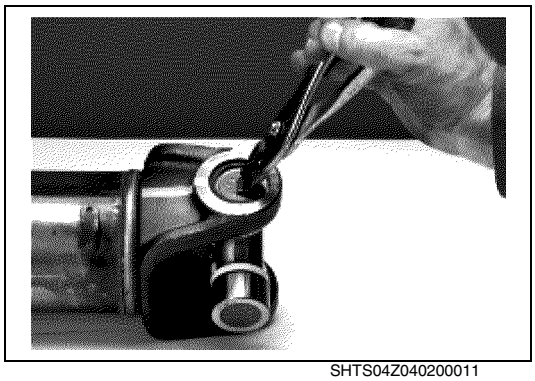
(6) Inspect the end yoke cross holes for distortion using the appropriate Spicer alignment bar. Slide alignment bar through both cross holes simultaneously. If alignment bar will not pass through both cross holes simultaneously, cross holes are distorted and yoke must be replaced.

⚠ WARNING

Failure to replace damaged driveline components can cause driveline failure, which can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.

Refer to the Chapter transmission, parking brake or rear axle for removal procedures.

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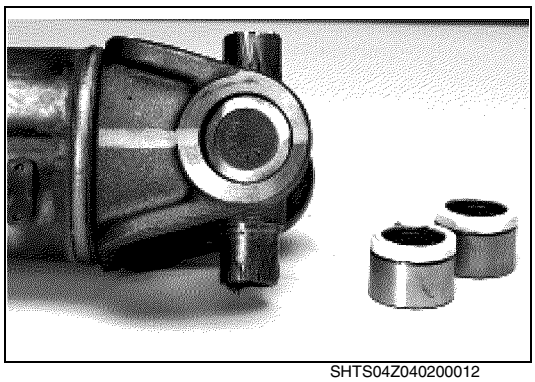

SHTS04Z040200011

IMPORTANT POINTS - DISASSEMBLY

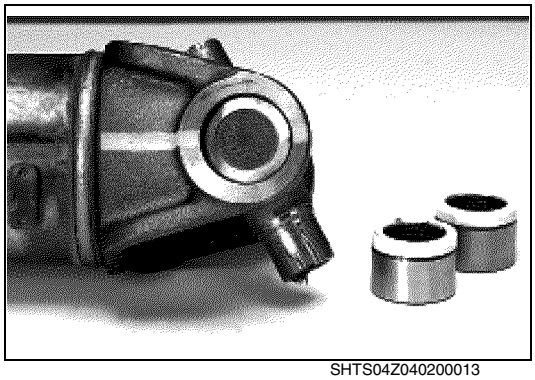
1. DISASSEMBLE THE UNIVERSAL JOINT ASSEMBLY (SNAP RING STYLE).

(1) Using snap-ring pliers, remove all snap rings. If snap rings are severely corroded or out-of-round, snap rings must be replaced.

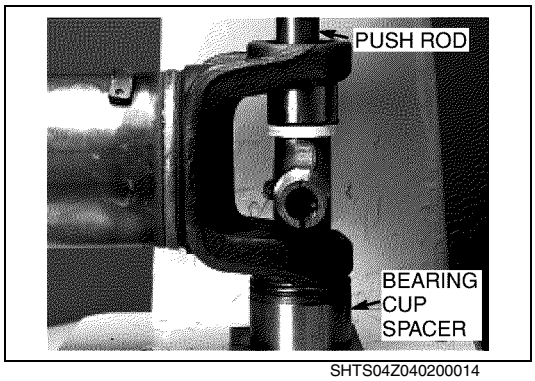
⚠ WARNING
DO NOT reuse severely corroded or out-of-round snap rings. Reuse of snap rings can cause universal joint failure and can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.


SHTS04Z040200012

(2) Remove the outboard bearing cup assemblies.


SHTS04Z040200013

(3) Make sure the universal joint cross assembly is not tilted in yoke.

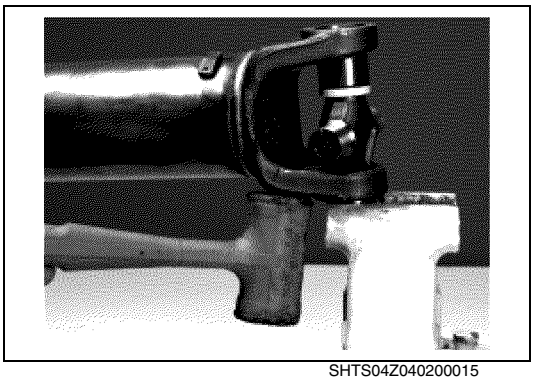


SHTS04Z040200014

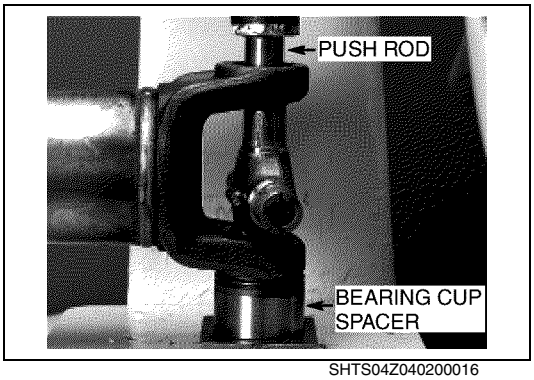
(4) Place bearing cup spacer onto the base of the arbor press and under the yoke. If the arbor is larger than the bearing cup diameter, a smaller diameter push rod will be needed to avoid damage to the yoke or bearing.
Using the arbor press, press down on the upper bearing cup assembly until the shoulder of the journal cross makes contact with the inside of the yoke ear. Bearing cup is not designed to drop out of yoke.

⚠ CAUTION
DO NOT over press the bearing cup and journal cross. This can damage the inside of the yoke ear.

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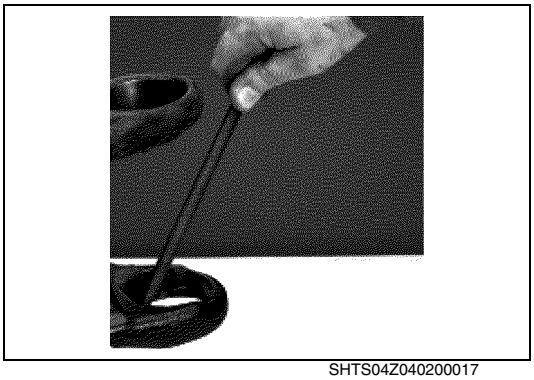

SHTS04Z040200015

(5) Grip the bearing cup in bench vise. Strike the yoke ear with a soft-faced hammer until bearing is removed.



SHTS04Z040200016

(6) Place the yoke in the arbor press with remaining bearing cup face down. Using a push rod, press on the end of journal cross trunnion. Continue to press down on journal cross trunnion until the shoulder of the journal cross makes contact with the inside of yoke ear. Bearing cup is not designed to drop out of yoke. Repeat step (5).
(7) Remove journal cross from yoke.


SHTS04Z040200017

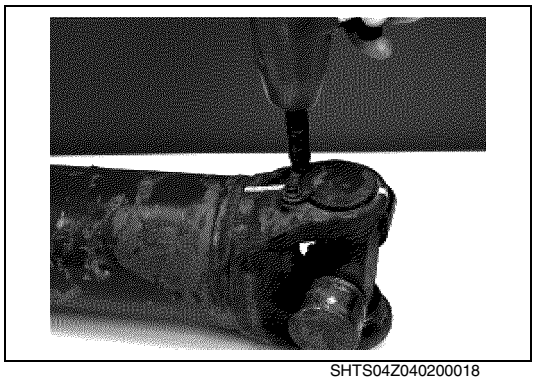
(8) Inspect the tube yoke and flange yoke (if applicable) cross hole surfaces for damaged or raised metal. Raised metal or fretting can be removed from yoke cross holes with a fine-toothed file and/or emery cloth.

⚠ WARNING
DO NOT deform yoke cross holes by removing excessive metal. Raised metal or deformed yoke cross holes can be a cause of cross and bearing problems and can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.

(9) Inspect the yoke for distorted cross holes using the appropriate Spicer alignment bar. Slide alignment bar through both cross holes simultaneously. If alignment bar will not pass through both cross holes simultaneously, cross holes are distorted and the shaft assembly must be replaced.

⚠ WARNING
Failure to replace a damaged driveline can cause driveline failure, which can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.

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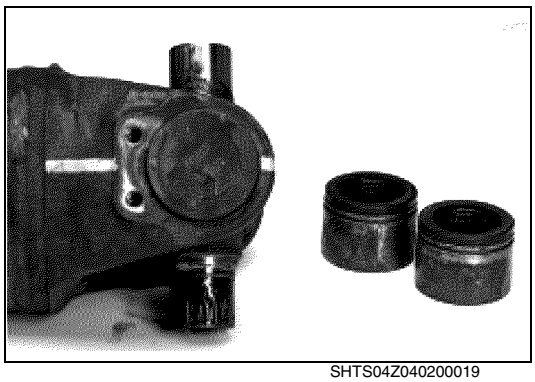

SHTS04Z040200018

2. DISASSEMBLE THE UNIVERSAL JOINT ASSEMBLY (SPRING TAB STYLE)

(1) Remove and discard spring tabs and bolts.

⚠ WARNING

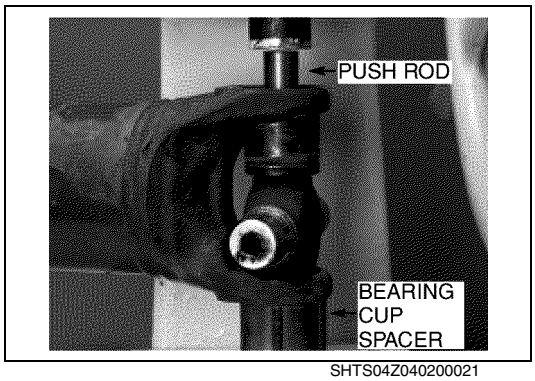
DO NOT reuse spring tabs, spring tab bolts or use inferior grade bolts. Reuse of spring tabs, spring tab bolts and use of inferior grade bolts, can cause driveline failure, which can result in separation of driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.


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(2) Remove the outboard bearing cup assemblies.


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(3) Make sure universal joint cross assembly is not tilted in the yoke.



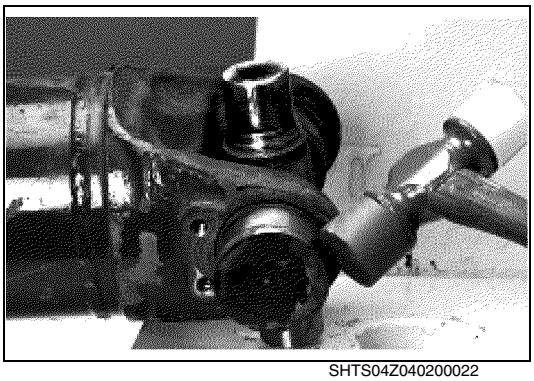
SHTS04Z040200021

(4) Place bearing cup spacer onto the base of the arbor press and under the yoke. If the arbor is larger than the bearing cup diameter, a smaller diameter push rod will be needed to avoid damaging the yoke or bearing.
Using an arbor press, press down on the upper bearing cup assembly until the shoulder of the journal cross makes contact with the inside of the yoke ear.

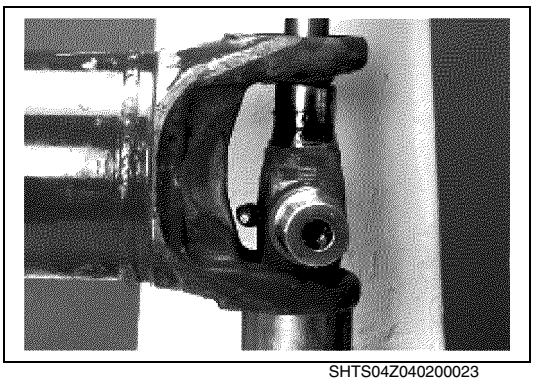
⚠ CAUTION

DO NOT over press the bearing cup and journal cross. This can damage the inside of the yoke ear.

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(5) The bearing cup is not designed to drop out of the yoke. It will be necessary to use a soft-faced hammer to tap the partially pressed-out bearing cup from side to side, to "walk" the bearing cup out of the yoke ear.

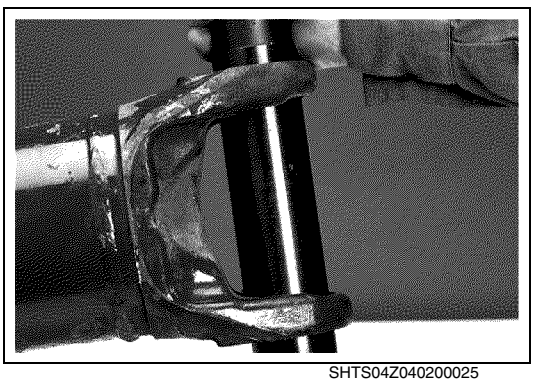

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(6) Place the yoke in the press, with the remaining bearing cup face down. Using a push rod, press on end of the journal cross trunnion. Continue to press down on the journal cross trunnion until the shoulder of the journal cross makes contact with the inside of the yoke ear.
(7) Repeat step (5).
(8) Remove the journal from the yoke.


SHTS04Z040200024

(9) Inspect the tube yoke cross hole surfaces for damage or raised metal. Raised metal or fretting can be removed from yoke cross holes with a fine-toothed file and/or emery cloth.

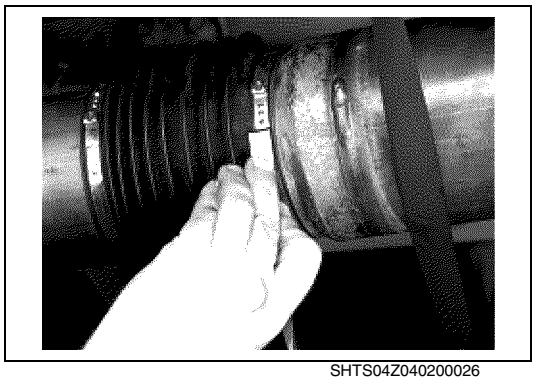
⚠ WARNING
DO NOT deform yoke cross holes by removing excessive metal. Raised metal or deformed yoke cross holes can be a cause of cross and bearing problems and can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.


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(10) Inspect the tube yoke or flange yoke (if applicable) for distorted cross holes using an appropriate Spicer alignment bar. Slide alignment bar through both cross holes simultaneously. If alignment bar will not pass through both cross holes simultaneously, the cross holes are distorted and the shaft assembly must be replaced.

⚠ WARNING
Failure to replace a damaged driveline can cause driveline failure, which can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.

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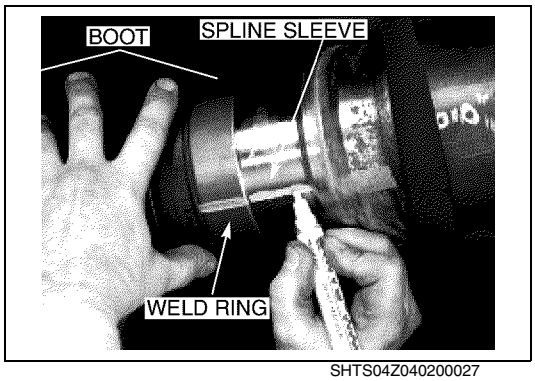
3. REMOVE THE MEMBER BOOT

⚠ CAUTION
Seal can style slip member assemblies are NOT serviceable. If seal can or seal is damaged, replacement of the complete driveshaft assembly is necessary.

(1) Remove and discard both boot clamps. Clamps may be separated using a chisel to disengage locking hooks. DO NOT reuse clamps.

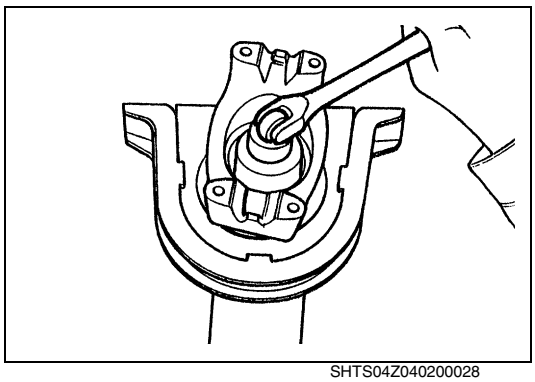
⚠ WARNING
- **Reuse of boot clamps could allow intrusion of contaminants into slip member and can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.**
- **The following step is an additional marking process to that described in step one. Be sure to mark as directed.**

(2) Completely collapse the boot toward the yoke shaft to expose weld ring and spline sleeve area. Wipe weld ring and spline sleeve areas clean.
(3) Mark spline sleeve and end of weld ring with a marking stick, paint marker or other legible marking device. This assures that the slip member can be reassembled in its original phased condition.



SHTS04Z040200027

⚠ WARNING
Reassembly of a driveline out of original phase can cause vibration and failure of the driveline and attaching components. Failure of a driveline can result in separation of driveline from the vehicle, which can result in death, serious personal injury or property damage.


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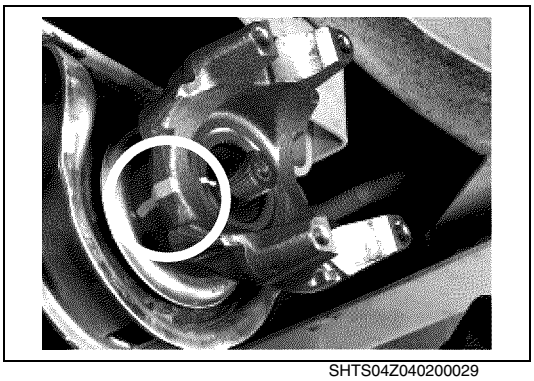
4. REMOVE THE CENTER BEARING

(1) Remove midship nut. Reference midship nut. Discard nut. If washer is damaged, discard and replace. Otherwise, reuse washer.

⚠ WARNING
DO NOT reuse midship nut. Reuse of midship nut can cause driveline failure, which can result in separation of driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

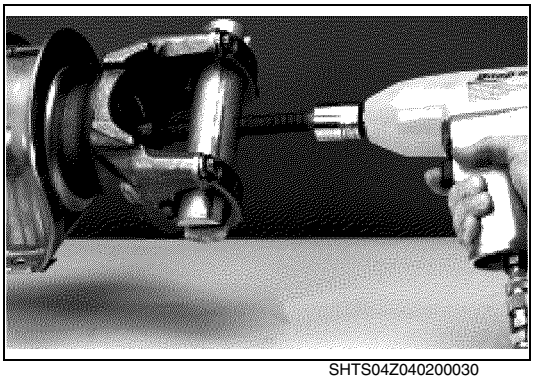
⚠ CAUTION
The following step (2) is an additional marking process to that described in step (1). Be sure to mark as directed.

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(2) Mark the counterbore of end yoke to midship "nose" with marking stick, paint marker or other legible marking device. This assures proper reassembly of the center bearing end yoke in its original phased position.

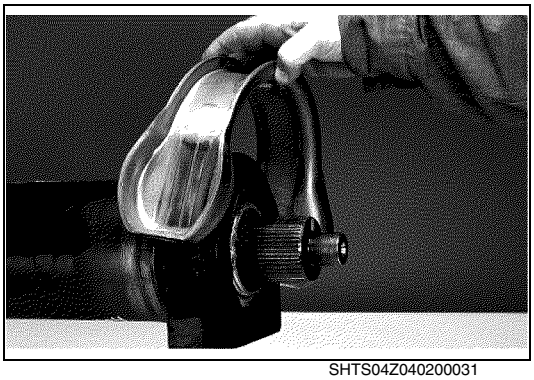
⚠ WARNING
Reassembly of a driveline out of original phase can cause vibration and failure of the driveline and attaching components. Failure of a driveline can result in separation of driveline from the vehicle, which can result in death, serious personal injury or property damage.

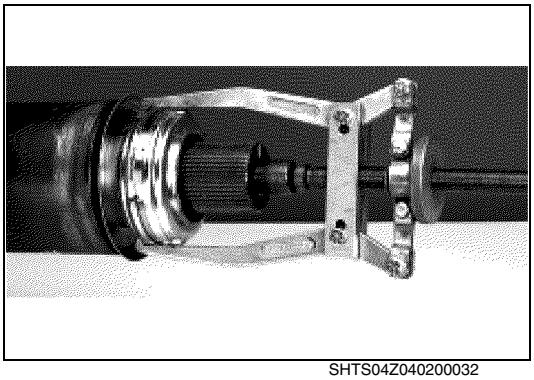

SHTS04Z040200030

(3) Using a puller, remove the yoke. The yoke has a press fit and should NOT be removed with a hammer. If the yoke is loose enough to be removed by hand, the entire coupling shaft must be replaced. Remove and discard slinger from the yoke.

⚠ WARNING
Failure to replace damaged driveline components can cause driveline failure, which can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.

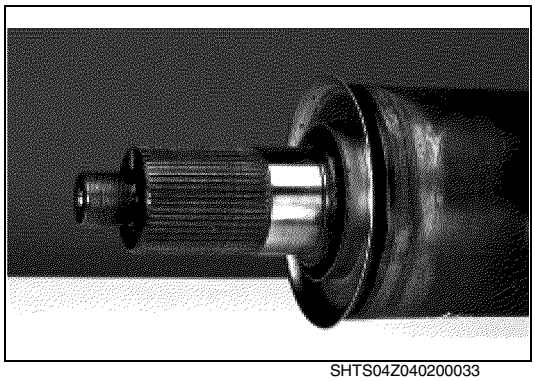
(4) Visually inspect the splines of the center bearing end yoke. If the yoke splines are damaged, missing or twisted, the yoke must be replaced. If the yoke hub is cracked, the yoke must be replaced. See warning, step (3).
(5) Visually inspect the midship splines and threads. If the splines or threads are damaged, missing or twisted, replacement of the entire coupling shaft is necessary. See warning, step (3).
(6) Remove and discard center bearing bracket. Remove and discard rubber cushion.


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(7) Use a puller to remove the bearing assembly from the midship. Discard the center bearing.

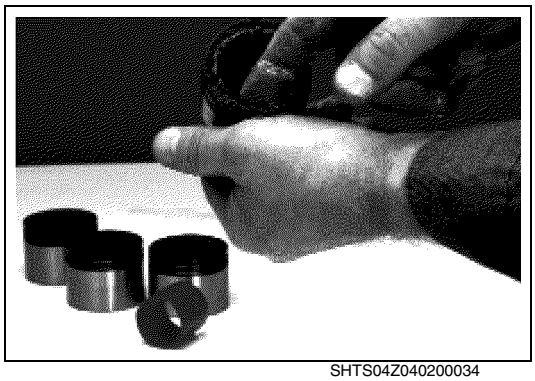
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SHTS04Z040200033

(8) Inspect midship for wear on the bearing diameter. If the midship is damaged from a seized bearing, replacement of the entire coupling shaft is necessary.

⚠ WARNING
Failure to replace damaged driveline components can cause driveline failure, which can result in separation of driveline from vehicle. A separated driveline can result in death, serious personal injury or property damage.

(9) If no damage is apparent, remove slinger.


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IMPORTANT POINTS - ASSEMBLY

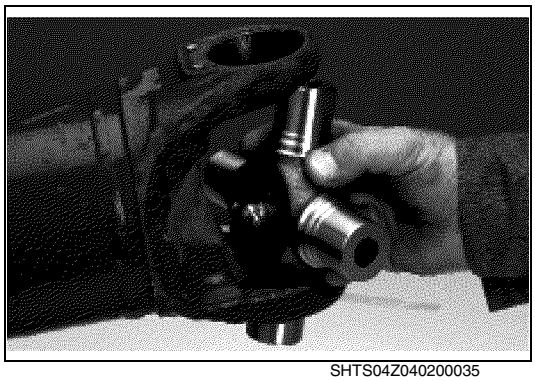
1. ASSEMBLE THE UNIVERSAL JOINT ASSEMBLY (SPRING TAB STYLE).

(1) Remove needle retaining plugs from all bearing cup assemblies. Using a high-quality, N.L.G.I.*, E. P. Grade 2 lubricating grease, wipe each bearing cup assembly with grease. Fill all cavities between the needle rollers. Also apply a liberal coating of grease on the bottom of each bearing cup assembly and on the lip of the seal.
*National Lubricating Grease Institute

⚠ WARNING
Inadequate lubrication can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

⚠ CAUTION
DO NOT Wipe the outside of bearing cup assemblies or yoke cross holes with grease, oil or silicone-based sprays. This could cause bearing cup assembly rotation in yokes.

⚠ WARNING
Rotating bearing cup assemblies can result in yoke cross hole wear and distortion. Distorted yokes can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.


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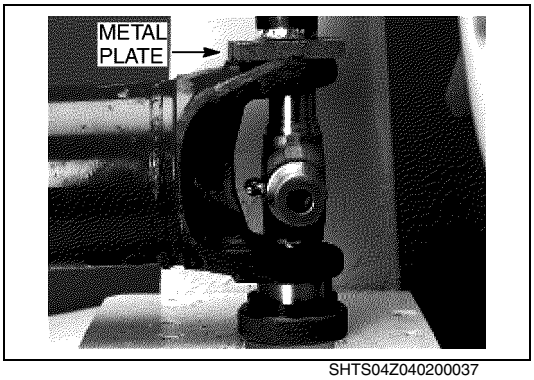
(2) Position the journal cross into the yoke cross holes with the grease zerk (nipple) fitting inward toward tubing. The double-headed, grease zerk (nipple) fitting should be perpendicular to the yoke cross holes. Failure to properly position the universal joint will result in the inability to grease the universal joint. See warning, step (1), regarding inadequate lubrication.

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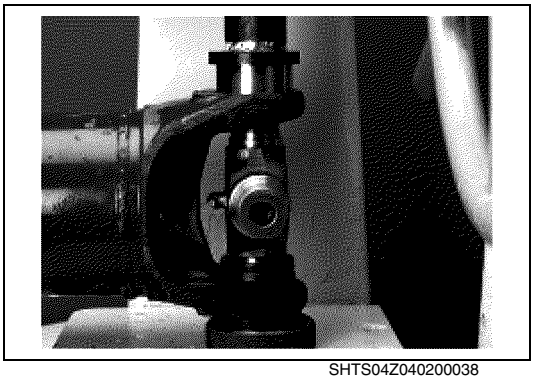
SHTS04Z040200036

(3) Move one end of the journal cross to cause a trunnion to project through the cross hole beyond the outer machined face of the yoke ear. Take one bearing cup assembly and position an installation height tool on the end of the bearing cup assembly. Place the bearing cup assembly over the protruding trunnion diameter and align it to the yoke cross hole.

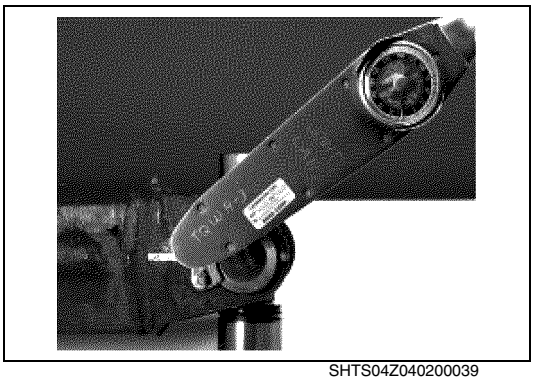


SHTS04Z040200037

(4) Align the yoke in an arbor press with the bearing assembly resting on the base of the press. (See photo 109, left.) Cover the yoke ear with a metal plate that has 0.25 inch (6.4 mm) minimum thickness. Push the yoke onto the bearing cup assembly until the installation height tool is flush with the cross hole face. Do not remove the installation height tool.


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(5) Flip yoke 180 degrees. Position the remaining installation height tool on the end of another bearing cup assembly. Place bearing cup assembly over trunnion diameter and align it to the yoke cross hole. Push the bearing cup assembly until both installation height tools are flush with the cross hole face. Remove and discard both installation height tools.

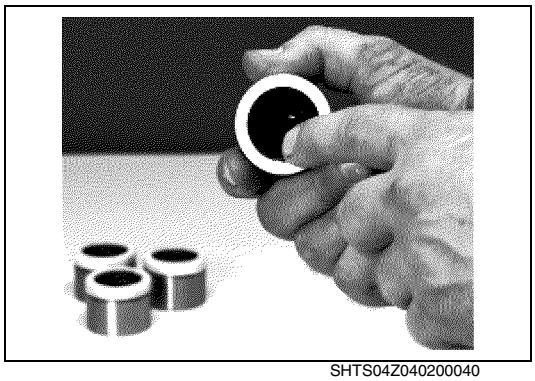

SHTS04Z040200039

(6) Install new spring tabs and 8 mm thread bolts. Make sure that no grease or foreign material is present between the contact areas of the spring tabs, bearing cups and yoke cross hole faces. Tighten bolts to the required torque. See spring tab bolt torque specification Table below.

SPRING TAB BOLT SPECIFICATIONS					
SERIES	THREAD SIZE	HEAD SIZE	BOLT TORQUE		KIT P/N*
			N·m	LB. FT.	
SPL140	8 mm x 1.00	8 mm, 6 point	35-40	25-30	211941X
* Bolts are specially heat-treated. DO NOT substitute inferior grade bolts.					

⚠ WARNING
Reuse of spring tabs or spring tab bolts or failure to properly tighten spring tab bolts to required specifications can cause the driveline to loosen and separate from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

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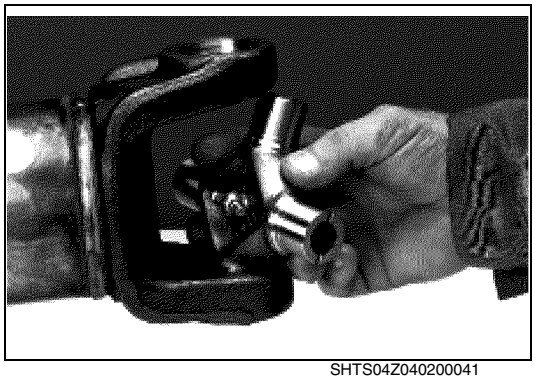
2. ASSEMBLE THE UNIVERSAL JOINT ASSEMBLY (SNAP RING STYLE).

(1) Using a high quality N.L.G.I.*, E. P. Grade 2 lubricating grease, wipe each bearing cup assembly with grease. Fill all cavities between the needle rollers. Also apply a liberal coating of grease on the bottom of each bearing cup assembly and on the lip of the seal.
*National Lubricating Grease Institute

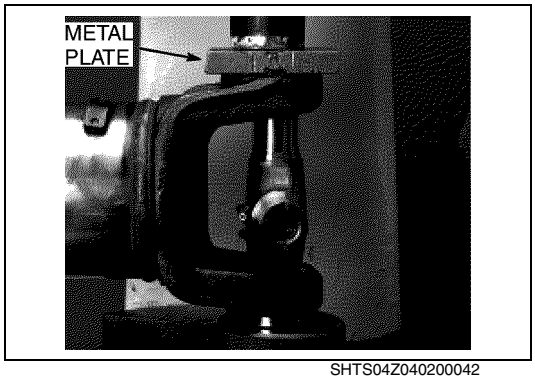
⚠ WARNING
Inadequate lubrication can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

⚠ CAUTION
DO NOT Wipe the outside of bearing cup assemblies or yoke cross holes with grease, oil or silicone-based sprays. This could cause bearing cup assembly rotation in yokes.

⚠ WARNING
Rotating bearing cup assemblies can result in yoke cross hole wear and distortion. Distorted yokes can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.


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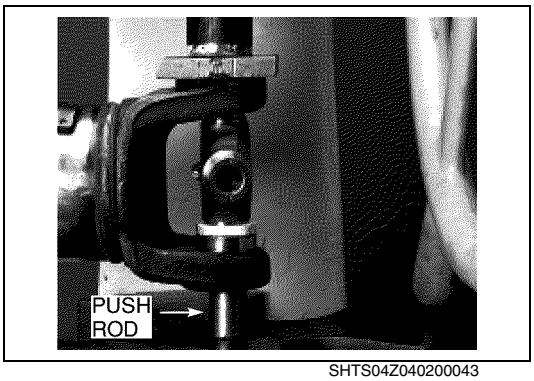
(2) Position the journal cross into the yoke cross holes with grease zerk (nipple) fitting inward toward tubing. The double-headed, grease zerk (nipple) fitting should be perpendicular to the yoke cross holes.
Failure to properly position the universal joint kit will result in the inability to grease the universal joint. See warning step (1), regarding inadequate lubrication.



SHTS04Z040200042

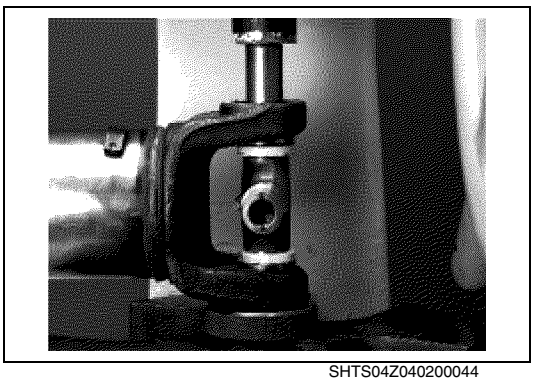
(3) Move one end of the journal cross to cause a trunnion to project through the cross hole beyond the outer machined face of the yoke ear. Place the bearing cup assembly over the protruding trunnion diameter and align it to the yoke cross hole.
Align the yoke in an arbor press with the bearing assembly resting on the base of the press. Cover the yoke ear with a metal plate that has 0.25 inch (6.4 mm) minimum thickness. Push the yoke onto the bearing cup assembly until it is flush with the cross hole face.

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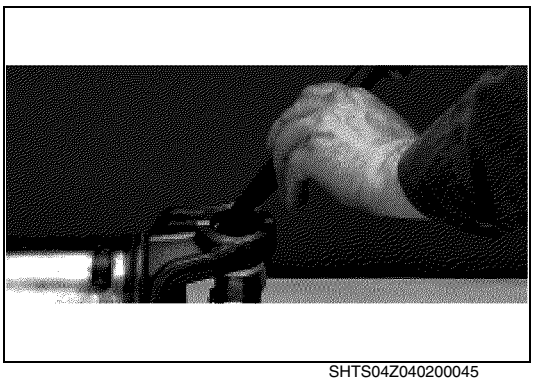


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(4) Place a push rod that is smaller than the diameter of the bearing cup assembly under the bearing cup assembly and continue pressing into the yoke cross hole until it is far enough to install a snap ring.
(5) Remove yoke from arbor press. Install a snap ring using snap ring pliers.


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(6) Flip yoke 180 degrees. Place another bearing cup assembly over trunnion diameter and align it to yoke cross hole. Align yoke in arbor press with previously installed bearing cup assembly resting on base of press. Place a push rod that is smaller than the bearing cup assembly on top of the bearing cup assembly. Press bearing cup assembly into the yoke cross hole until far enough to install a snap ring.
(7) Remove yoke from arbor press. Install a snap ring using snap ring pliers.

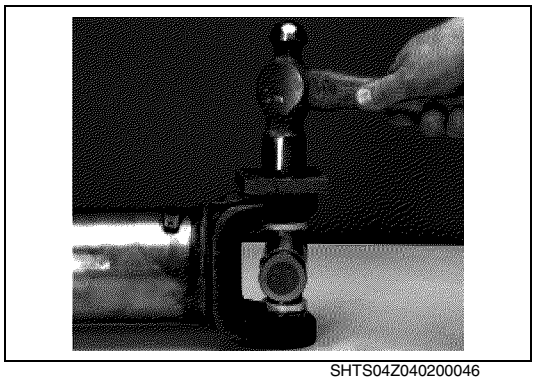

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(8) Seat the snap rings into grooves using a small chisel or punch. Companion flange style proceed to step (9). Without flange style proceed to (18).
(9) Position flange yoke cross holes over remaining trunnions.
(10) Place a bearing cup assembly over a protruding trunnion diameter and align it to the flange yoke cross hole.
(11) Align the yoke in an arbor press with the bearing assembly resting on the base of the press. Cover the yoke ear with a metal plate that has 0.25 inch (6.4 mm) minimum thickness. Push the yoke onto the bearing cup assembly until it is flush with the cross hole face.
(12) Place a push rod that is smaller than the diameter of the bearing cup assembly under the bearing cup assembly and continue pressing into the flange yoke cross hole until it is far enough to install a snap ring.
(13) Remove yoke from arbor press. Install a snap ring using snap ring pliers.
(14) Flip yoke 180 degrees. Place remaining bearing cup assembly over trunnion diameter and align it to flange yoke cross hole. Align yoke in arbor press with previously installed bearing cup assembly resting on base of press. Place a push rod that is smaller than the bearing cup assembly on top of the bearing cup assembly. Press bearing cup assembly into the yoke cross hole until it is far enough to install a snap ring.
(15) Remove yoke from arbor press. Install a snap ring using snap ring pliers.
(16) Seat the snap rings into grooves using a small chisel or punch.

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(17) Flex the journal cross to make sure it moves freely in bearings. If the joint is stiff, place a plate on the yoke ear and hit the plate with a hammer to seat the bearing cup assemblies.

⚠ WARNING
When using hammer, TO PREVENT eye injury, always wear safety glasses when performing maintenance or service. Failure to wear safety glasses could result in death, serious personal injury or property damage.


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(18) Flex the journal cross to make sure it moves smoothly and freely in bearings. If not, disassemble and inspect the journal and bearing assemblies for skewed or dropped needle rollers. Reference removal procedures for universal joints, snap ring style.


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3. INSTALL THE SLIP MEMBER BOOT.

(1) Clean ALL grease from yoke shaft and spline sleeve. Make sure grease-cutting solvent does not intrude into the tube through the vent hole in the spline sleeve plug. Be sure the phasing marks made during disassembly are not removed.


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(2) After all traces of grease-cutting solvent have been removed from yoke shaft and spline sleeve, apply enough N.L.G.I*, E. P. Grade 2 grease (provided in slip member boot replacement kit) to fill the entire length of all teeth in the spline sleeve. Wipe any excess grease on the teeth of the yoke shaft.
*National Lubricating Grease Institute

⚠ WARNING
Inadequate lubrication can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

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(3) Measure and place a mark 2.25 inches (55-60mm) from yoke shaft shoulder with a marking stick, paint marker or other legible marking device.

(4) Position a clamp on each end of the new boot. Slide the boot onto the grease-free yoke shaft shoulder.

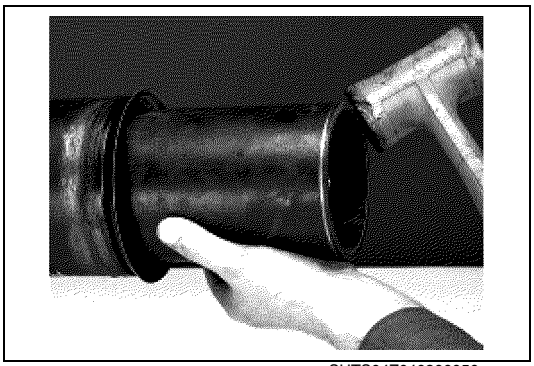
(5) Collapse the boot and insert the yoke shaft into the splined sleeve, making sure phasing marks are in line. Position the end of the boot at the 2.25 inches (55-60mm) mark made on the yoke shaft shoulder and tighten boot clamps to the specified torque. Yoke shaft shoulder must be clean, dry and grease-free. See boot clamp torque specification.

BOOT CLAMP SPECIFICATIONS			
SERIES	CLAMP P/N	CLAMP TORQUE	
		N·m	LB. FT.
SPL100	TBD	TBD	TBD
SPL140	232757	136-180	100-130

⚠ WARNING
Failure to properly install and tighten boot clamps could allow intrusion of contaminants and can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

(6) Before the driveshaft is completely installed in the vehicle, slowly collapse and extend the driveshaft to make sure the boot clamps are stationary. If the clamps are not stationary, recheck for proper clamp torque. If clamps still are not stationary, repeat disassembly and assembly procedure. DO NOT reuse clamps.

⚠ WARNING
Reuse of boot clamps or failure to properly tighten boot clamps to required specifications could allow intrusion of contaminants onto slip member and can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.


SHTS04Z040200050

4. INSTALL THE CENTER BEARING.

(1) Wipe the bearing surface of the midship tube shaft with a fine emery cloth.

(2) Install a new slinger (included in center bearing replacement kit) on the midship tube shaft using a section of tubing to avoid damaging slinger. Make sure the slinger is completely seated against the midship tube shaft shoulder.

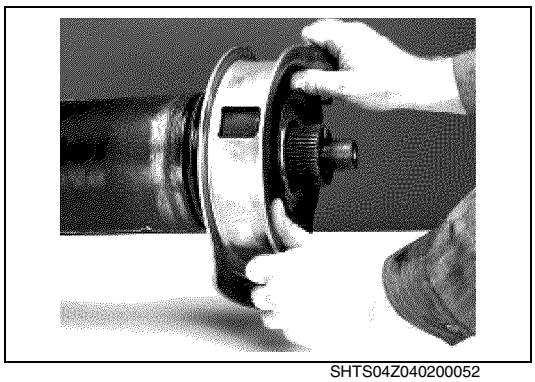
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SHTS04Z040200051

(3) Before installing the new center bearing assembly, be sure to fill the entire cavity around the bearing with waterproof lubricant. (See photo 131, above.) Enough lubricant must be applied to fill the cavity to the extreme edge of the slinger surrounding the bearing. Lubricants must be water proof. See Table, below for recommended lubricants.

⚠ WARNING
Inadequate lubrication can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

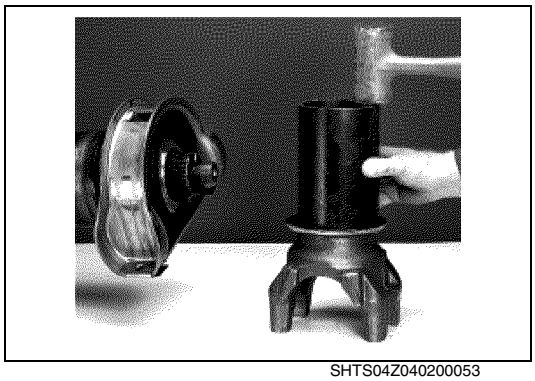
RECOMMENDED CENTER BEARING LUBRICANTS	
LUBRICANTS	**SOURCE**
Rykon Premium No. 3	**Amoco Oil Company**
Amolith 8516	**Amoco Oil Company**
Van Talgar No. 4	**Exxon Company**


SHTS04Z040200052

(4) Carefully align the new center bearing assembly with the ground surface of the midship tube shaft. Physically push the center bearing onto the midship tube shaft.

(5) Press remaining slinger on end yoke using a section of tubing to avoid damaging slinger.

(6) Using a soft-faced hammer, tap the yoke onto midship tube shaft, making sure phasing marks from driveshaft removal procedure are in line. Continue to tap the yoke until it is completely seated against the center bearing.

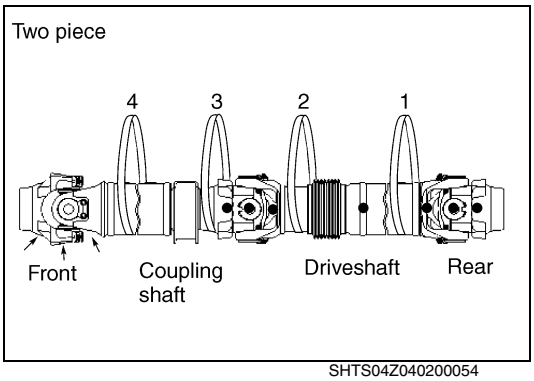

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(7) Install a washer (if required) and new midship nut and torque nut to specifications. See midship nut specifications, Table.

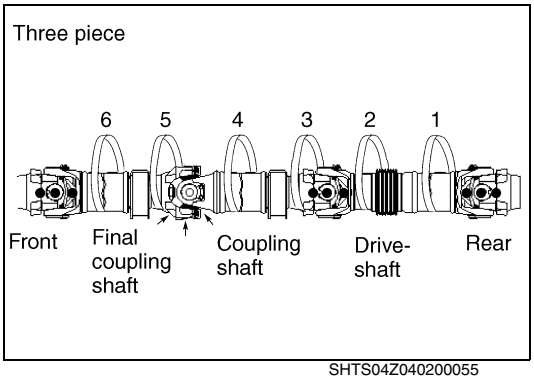
⚠ WARNING
Failure to torque midship nut to required specifications can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

MIDSHIP NUT SPECIFICATIONS					
SERIES	**NUT P/N**	**WASHER P/N**	**HEAD SIZE***	**NUT TORQUE**	
				N·m	**LB. FT.**
SPL100	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**
SPL140	**250-74-11**	**230123-6**	**41mm***	**644-712**	**475-525**
*** A 1 5/8" socket may be used.**					

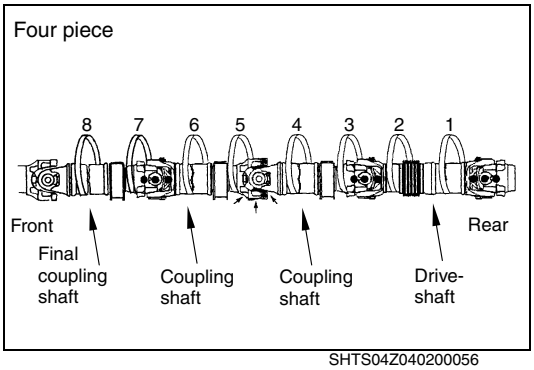
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SHTS04Z040200055



SHTS04Z040200056

IMPORTANT POINT - MOUNTING

1. CONNECT THE PROPELLER SHAFT TO THE ALL CONNECTING POINTS.

(1) Position support straps to make sure that the driveshaft will be properly supported at the slip member, behind the center bearing end fittings and in front of center bearing, with support straps.

(2) Working from the front end, use a soft-faced hammer to tap the universal joint into the front end yoke. Make sure to align the universal joint in the front end yoke, matching up phasing marks made during removal to ensure the driveshaft is reinstalled in its original orientation.

(3) Install the bearing retainers or new stamped straps and new bolts. Torque the bolts down evenly and to required specifications. Check to make sure the bearing cup assemblies are fully seated in yoke ears.

⚠ WARNING

- **Improperly seated bearing cup assemblies can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline could result in death, serious personal injury or property damage.**
- **Failure to install new stamped straps and new bolts and to torque bolts to specification can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.**

BOLT SPECIFICATIONS				
SERIES	THREAD SIZE	HEAD SIZE	BOLT TORQUE	
			N·m	LB. FT.
SPL100	0.375 in. x 24UNF	3/8 in. 12 point	61-81	45-60
SPL140	12 mm x 1.25	1/2 in. 12 point	143-169	105-125
* Bolts are specially heat-treated. DO NOT substitute inferior grade bolts.				

(4) Install proper center bearing bracket bolts.

⚠ WARNING

Failure to torque bolts to specification can cause driveline failure, which can result in separation of the driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

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DIFFERENTIAL CARRIER (MERITOR RS17.19.21&23)

DF02-001

DIFFERENTIAL CARRIER ASSEMBLY ... DF02-2

DATA AND SPECIFICATIONS DF02-2
DESCRIPTION DF02-4
TROUBLESHOOTING DF02-7
SPECIAL TOOL DF02-8
COMPONENT LOCATOR DF02-10
OVERHAUL DF02-14
INSPECTION AND REPAIR DF02-54

DRIVER-CONTROLLED MAIN DIFFERENTIAL LOCK DF02-63

OVERHAUL DF02-63
INSPECTION AND REPAIR DF02-66

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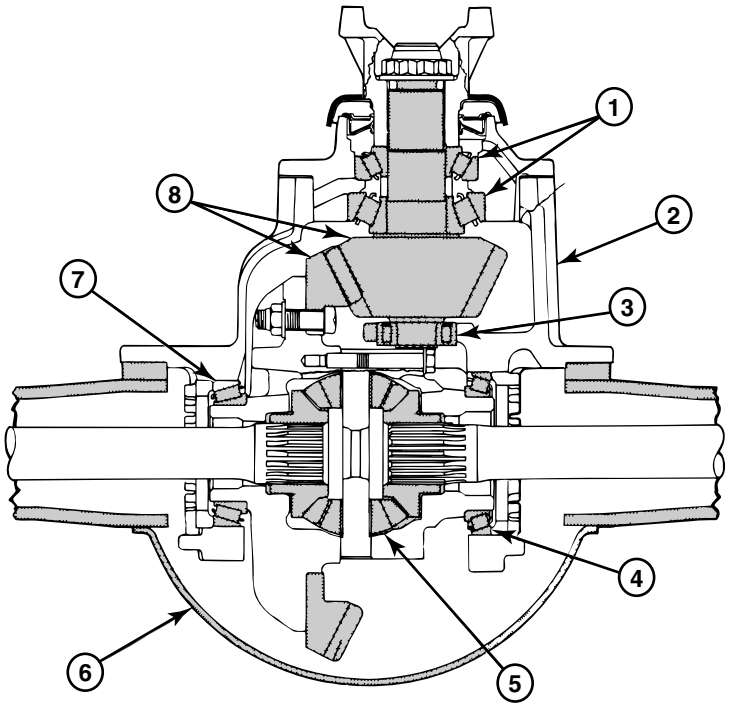
DIFFERENTIAL CARRIER ASSEMBLY

DATA AND SPECIFICATIONS

EN05Z0502I200001

MODEL	AXLE MODEL	GEAR RATIOS	CAPACITY	
			U.S. Pints	Liters
HINO 238 (NE8J), HINO 258 (NE8J, NJ8J)	RS17-145	3.07, 3.90, 4.11, 4.88, 5.13, 5.29	33.6	15.9
HINO 268 (NE8J, NJ8J)	RS19-145	3.73, 3.90, 4.11, 4.88, 5.13, 5.29, 5.57	33.2	15.7
HINO 338 (NF8J, NV8J)	RS21-145	3.90, 4.11, 4.33, 4.63, 4.88, 5.13, 5.29, 5.57, 5.86, 6.14	32.3	15.3
HINO 358 (NH8J)	RS23-160	3.91, 4.10, 4.56, 4.89, 5.38, 5.63, 6.14	39.5	18.7

Single-Reduction Differential Carrier

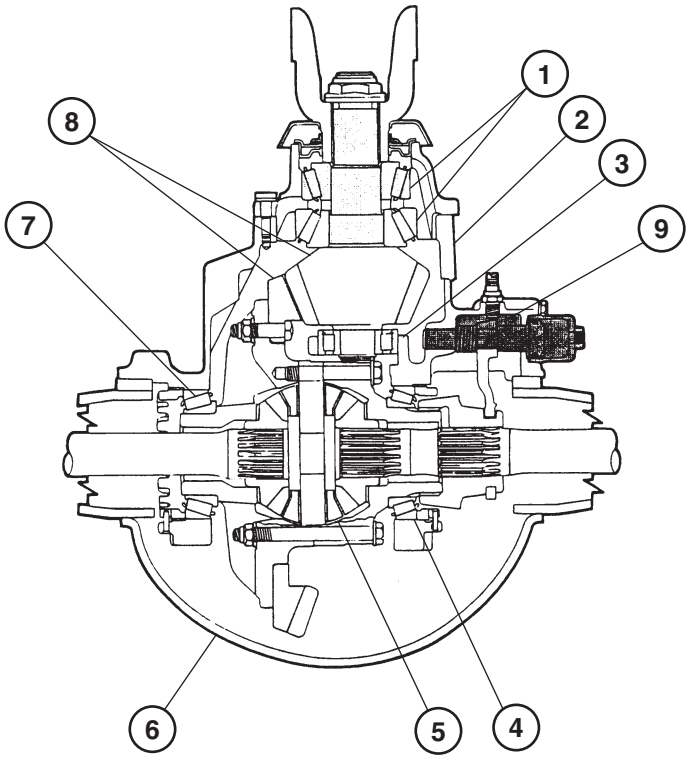


SHTS05Z050200001

1	TAPERED ROLLER BEARINGS	5	BEVEL DIFFERENTIAL GEARS
2	CARRIER	6	HOUSING
3	STRAIGHT ROLLER BEARING	7	TAPERED ROLLER BEARING
4	TAPERED ROLLER BEARING	8	HYPOID DRIVE PINION AND RING GEAR

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Single-Reduction Differential carrier with Differential Lock



SHTS05Z050200002

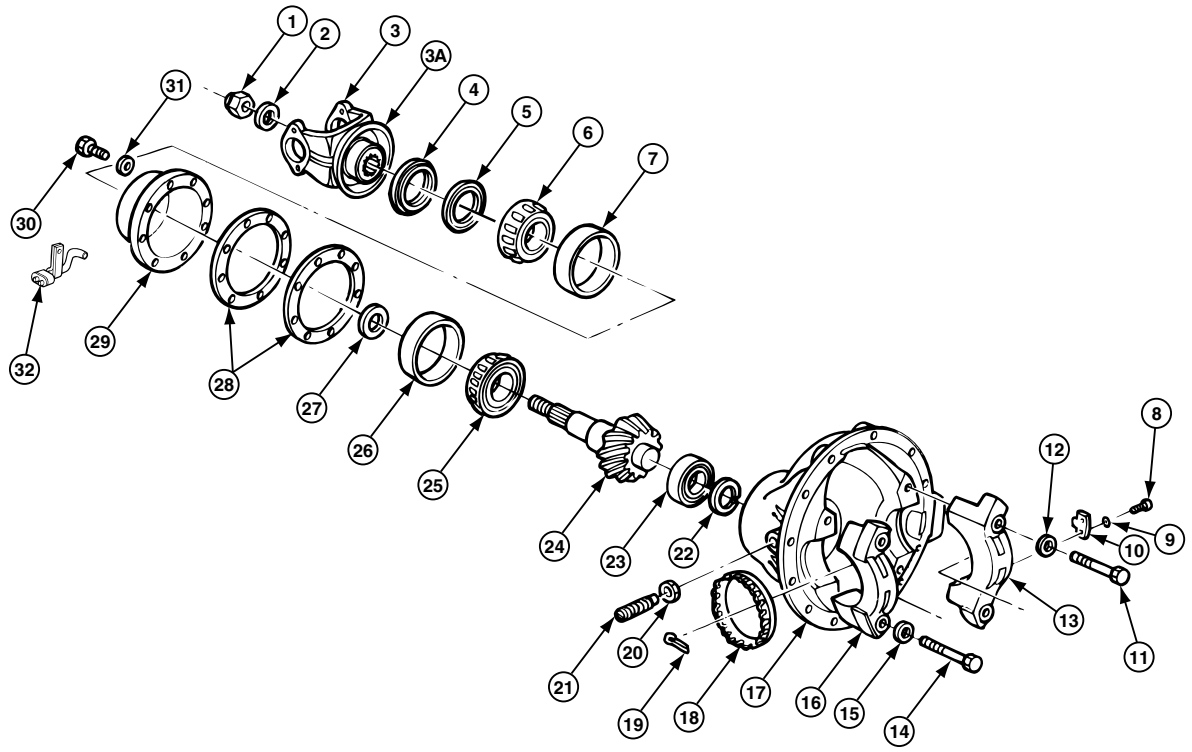
1	TAPERED ROLLER BEARINGS	6	HOUSING
2	CARRIER	7	TAPERED ROLLER BEARING
3	STRAIGHT ROLLER BEARING	8	HYPOID DRIVE PINION AND RING GEAR
4	TAPERED ROLLER BEARING	9	DIFFERENTIAL LOCK ASSEMBLY
5	BEVEL DIFFERENTIAL GEARS		

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DESCRIPTION

EN05Z0502D100001

Single-Reduction Differential Carrier

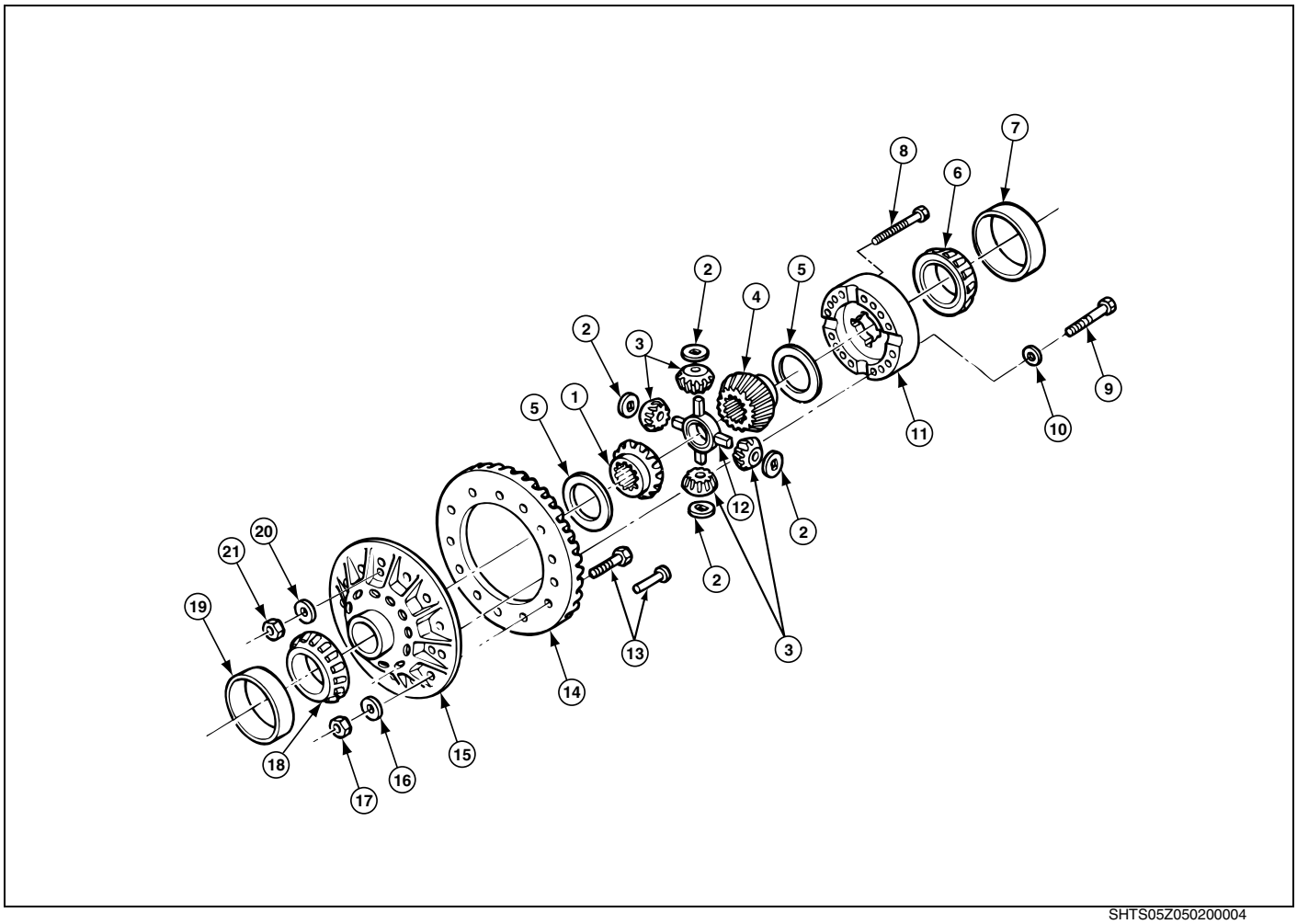


SHTS05Z050200003

1	Nut —Drive Pinion*	17	Carrier
2	Washer — Drive Pinion*	18	Adjusting Ring
3	Input Yoke* or Flange*	19	Cotter Pin — Adjusting Ring
3A	Deflector	20	Jam Nut* — Thrust Screw*
4	POSE^{TM} seal	21	Thrust Screw*
5	Triple Lip (Main) Seal	22	Snap Ring
6	Bearing Cone — Outer	23	Spigot Bearing
7	Bearing Cup — Inner	24	Drive Pinion
8	Capscrews* — Lock Plate*	25	Bearing Cone — Pinion Inner
9	Washers* — Lock Plate*	26	Bearing Cup — Pinion Inner
10	Lock Plate — Adjusting Ring	27	Spacer — Pinion Bearing
11	Capscrews — Differential Bearing Cap	28	Shims
12	Washers	29	Bearing Cage — Drive Pinion
13	Caps — Differential Bearing	30	Capscrew — Bearing Cage
14	Capscrews — Differential Bearing Cap	31	Washer
15	Washers	32	Clip and Cable Holder
16	Caps — Differential Bearing		

***Some Meritor carriers do not have these described parts.**

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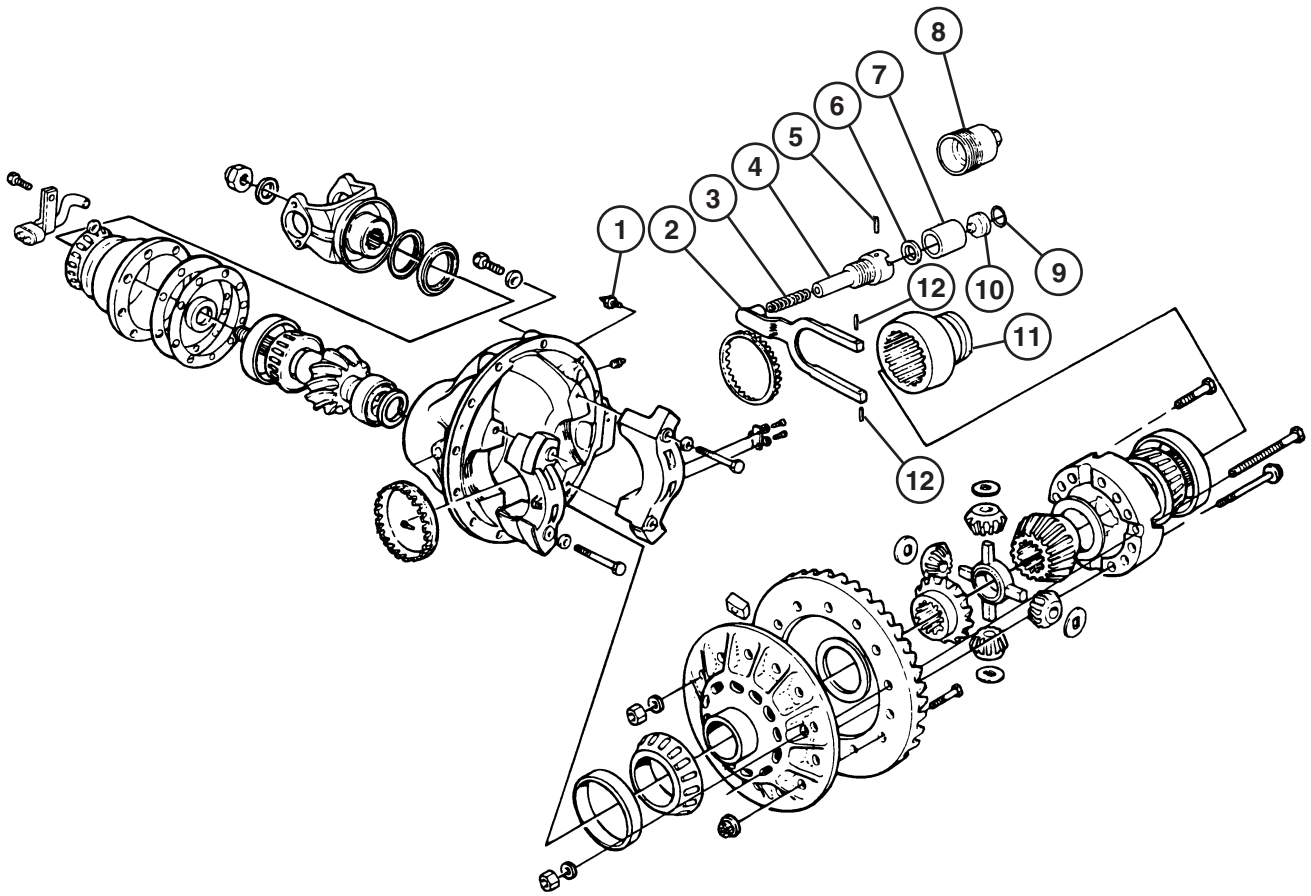
SHTS05Z050200004

1	Side Gears — Differential	12	Spider — Differential
2	Thrust Washers — Differential Pinion	13	Bolts* or Rivets* — Ring Gear and Case Half
3	Pinions — Differential	14	Ring Gear (Pinion Drive Gear)
4	Differential — Side Gears	15	Case Half — Flange
5	Thrust Washers — Differential Side Gear	16	Washers — Case Half
6	Cone — Differential Bearing	17	Nuts* —Case Half
7	Cup — Differential Bearing	18	Bearing Cone — Differential L.H.
8	"Thru" Bolt	19	Bearing Cup — Differential L.H.
9	Bolts* — Differential Case	20	Washer for "Thru" Bolt
10	Washers — Differential Case	21	Nut for "Thru" Bolt
11	Case Assembly — Main Differential		

***Some Meritor carriers do not have these described parts.**

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Differential lock assembly



SHTS05Z050200005

1	SENSOR SWITCH	7	AIR CYLINDER TUBE
2	SHIFT FORK	8	SCREW-IN DIFFERENTIAL LOCK
3	SHIFT SHAFT SPRING	9	PISTON O-RING
4	SHIFT SHAFT	10	PISTON
5	SPRING RETAINING PIN	11	SHIFT COLLAR
6	FLAT WASHER, OR SILASTIC AS REQUIRED	12	SHIFT FORK ROLL PINS

***Some Meritor carriers do not have these described parts.**

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TROUBLESHOOTING

EN05Z0502F300001

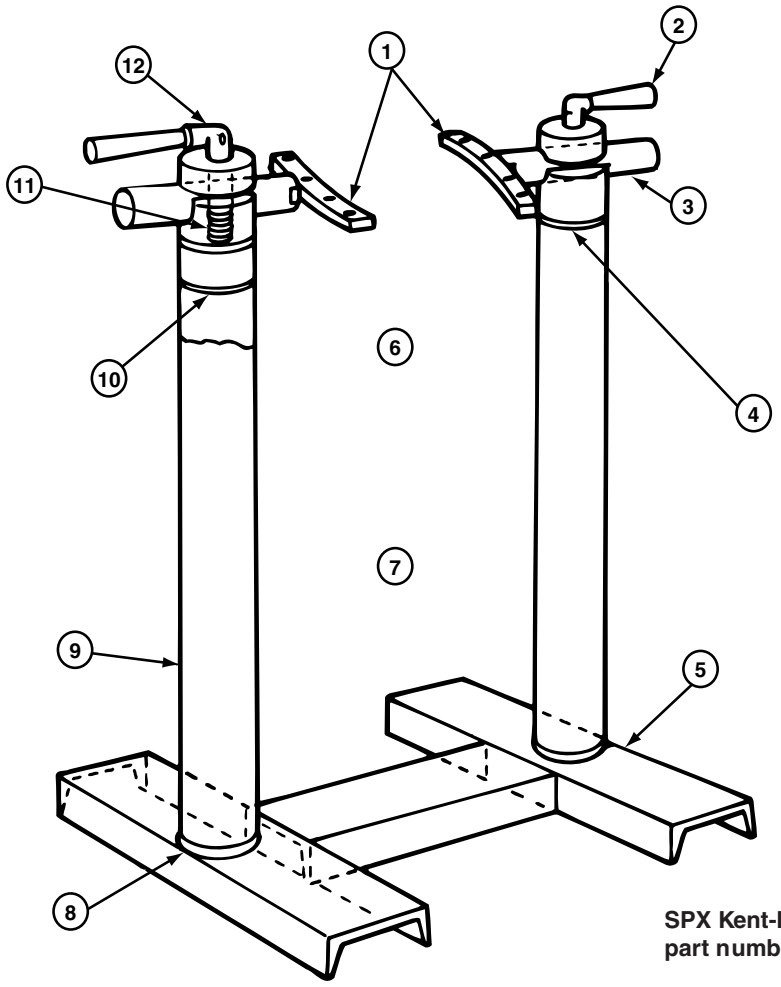
Symptom	Possible cause	Remedy/Prevention
Abnormal noise (Bearing system)	Worn or damaged pinion bearings	Replace bearings.
	Worn or damaged differential side bearings	Replace bearings.
	Loose pinion bearings	Adjust bearing preload.
	Loose differential side bearings	Adjust bearing preload.
Abnormal noise (Gear system)	Inadequate backlash on ring gear and pinion gear	Adjust backlash.
	Worn thrust washers	Replace.
	Worn differential spider	Replace.
	Worn or damaged ring gear and pinion	Replace.
	Worn or damaged differential side gear and pinion	Replace.
	Loose ring gear bolts	Tighten bolts.
	Inadequate tooth contact of ring gear and pinion gear	Replace or adjust tooth contact.
	Worn opinion spline	Replace.
Abnormal noise (rear axle system)	Worn rear axle shaft spline	Replace.
	Worn hub bearings	Replace.
	Loose hub bearings	Adjust bearing preload.
	Loose differential case tightening bolts	Tighten bolts.
Abnormal noise (Oil system, etc.)	Insufficient oil	Add oil, check for leakage.
	Poor oil quality	Change oil.
	Abnormal propeller shaft noise	Refer to chapter **"PROPELLER SHAFT"**.

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SPECIAL TOOL

EN05Z0502K100001

Prior to starting a differential carrier overhaul, it is necessary to have these special tools.

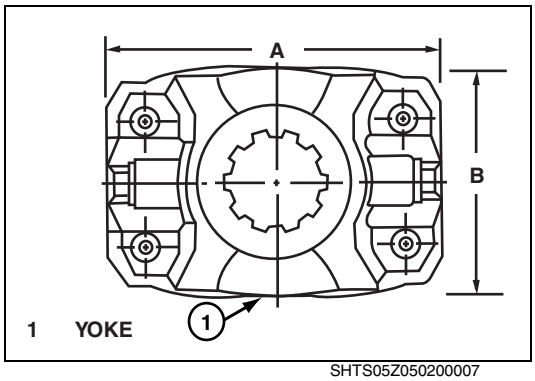


SPX Kent-Moore
part number J-3409-D

SHTS05Z050200006

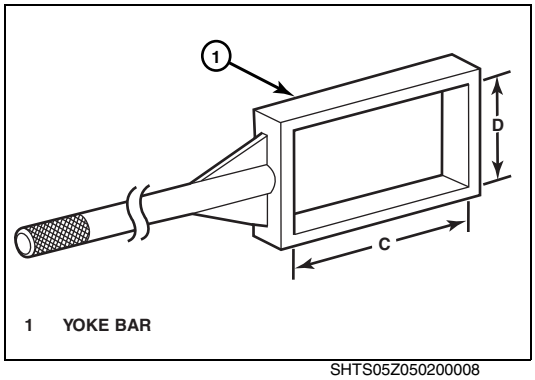
1	PLATES 8' LONG X 3/4" THICK X 1-1/4" WIDE WITH A TONGUE TO FIT SLOT IN BAR WELD PLATES TO BAR	7	23-1/2" CENTER TO CENTER OF PIPE
2	HANDLE 7" LONG WITH SLOT IN ONE END TO FIT CLAMP SCREW	8	CHAMFER END OF PIPE FOR WELDING
3	BAR 2" DIAMETER X 9" LONG WITH ONE END SLOTTED TO FIT PLATE	9	4" DIAMETER PIPE
4	WELD ALL AROUND AFTER PRESSING PLUG IN PIPE	10	PLUG 4" DIAMETER X 7" LONG WITH ONE END TURNED 3" LONG TO FIT PIPE. DRILL 2" HOLE AND MILL 3/16" WIDE SLOT 2" FROM TOP
5	WELD	11	SCREW 3-1/2" LONG X 5/8" DIAMETER WITH FLATS ON END TO FIT HANDLE AND 2-1/2" LENGTH OF THREAD ON OTHER END
6	SHAPE AND SIZE OF HOLES TO FIT CARRIER	12	DRILL 3/8" HOLE THROUGH HANDLE AND SCREW

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1 YOKE

SHTS05Z050200007



1 YOKE BAR

SHTS05Z050200008

1. HOW TO MAKE A YOKE BAR

(1) Measure dimensions A and B of the yoke you are servicing.

(2) Calculate dimensions C and D of the yoke bar by adding 0.125-0.250-inch to dimensions A and B of the yoke.

⚠ WARNING

Wear safe clothing and eye protection when you use welding equipment. Welding equipment can burn you and cause serious personal injury. Follow the operating instructions and safety procedures recommended by the welding equipment manufacturer.

(3) To make the box section, cut and weld 1.0-inch x 2.0-inch mild steel square stock according to dimensions C and D.

(4) Cut a 4.0-foot x 1.25-inch piece of mild steel round stock to make the yoke bar handle. Center weld this piece to the box section.

- To increase yoke bar rigidity: Weld two angle pieces onto the handle.

2. HOW TO ORDER TOOLS AND SUPPLIES SPECIFIED IN THIS MANUAL

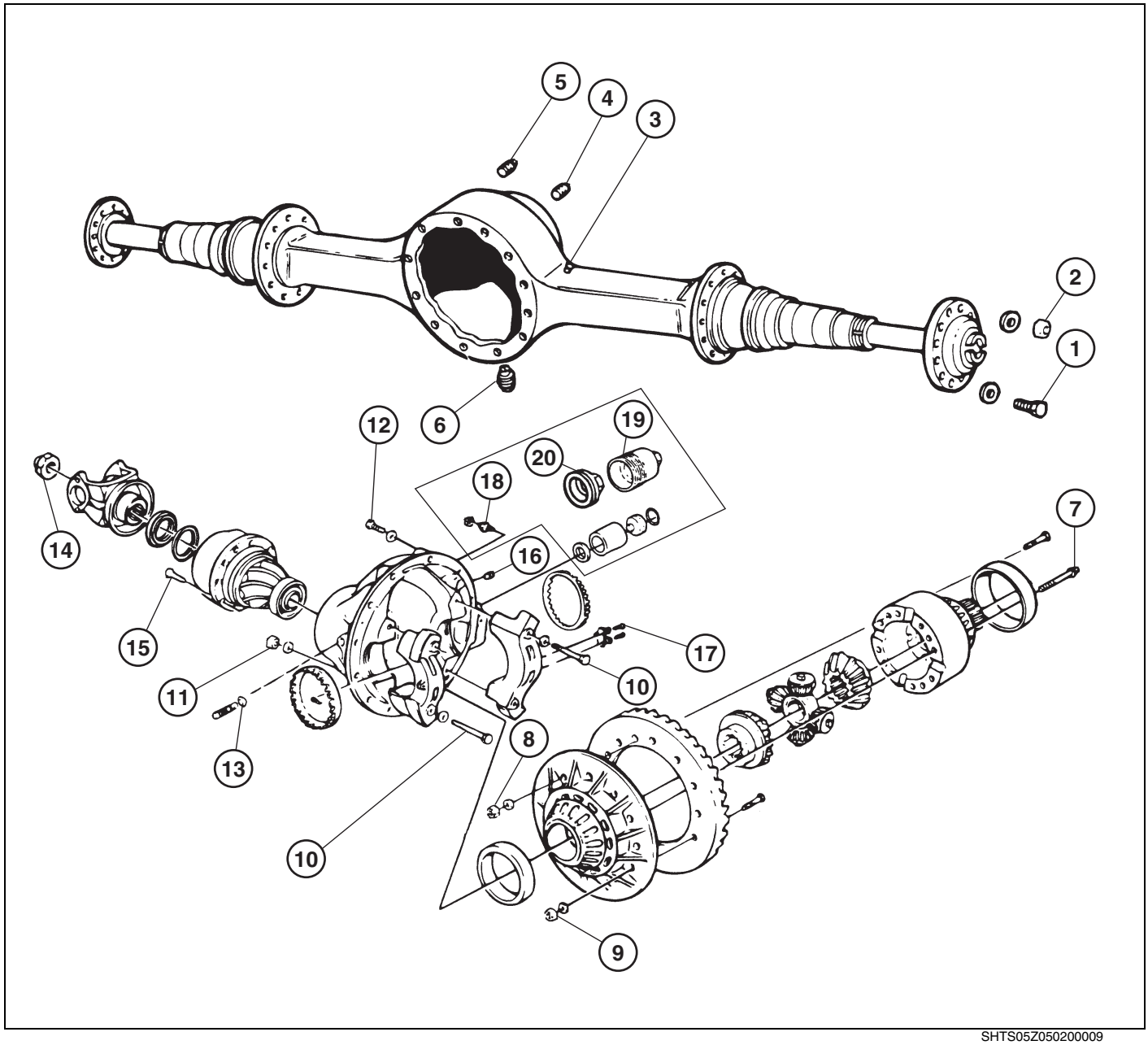
Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to order Meritor tools and supplies.

SPX Kent-Moore, 28635 Mound Road, Warren, Michigan, 48092. Call the company's customer service center at 800-345-2233, or visit their website at spxkentmoore.com.

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COMPONENT LOCATOR

EN05Z0502D100002



SHTS05Z050200009

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Fastener		Thread Size	Torque Value lb-ft (N·m)	
1.	Capscrew, Axle Shaft	.31-24 .50-13	18-24 85-115	(24-33) (115-156)
2.	Nut, Axle Shaft Stud	Plain Nut .44-20 .50-20 .56-18 .62-18 Lock Nut .44-20 .50-20 .56-18 .62-18	50-75 75-115 110-165 150-230 40-65 65-100 100-145 130-190	(68-102) (102-156) (149-224) (203-312) (54-88) (88-136) (136-197) (176-258)
3.	Breather	.38-18	20 minimum (27 minimum)	
4.	Plug, Oil Fill, Housing	.75-14	35 minimum (47.5 minimum)	
5.	Plug, Heat Indicator	.50-14	25 minimum (34 minimum)	
6.	Plug, Oil Drain	.50-14	25 minimum (34 minimum)	
7.	Capscrew, Differential Case Grade 10.9 Flange Head Grade 10.9 Standard Hex Head Grade 12.9 Standard Hex Head Grade 12.9 Flange Head Grade 12.9 Standard Head	.38-16 .44-14 .50-13 .56-12 .62-11 M12 x 1.75 M12 x 1.75 M12 x 1.75 M16 x 2 M16 x 2	35-50 60-75 85-115 130-165 180-230 85-103 74-96 105-125 203-251 220-310	(48-68) (81-102) (115-156) (176-224) (244-312) (115-140) (100-130) (143-169) (275-340) (300-420)
8.	Nut, Differential Case Bolt	.50-13 .50-20 .62-11 .62-18 M12 x 1.75 M16 x 2	75-100 85-115 150-190 180-230 74-96 220-310	(102-136) (115-156) (203-258) (244-312) (100-130) (300-420)
9.	Nut, Ring Gear Bolt Flange Head Standard Hex Head	.50-13 .50-20 .62-11 .62-18 M12 x 1.25 M12 x 1.75 M16 x 1.5 M16 x 1.5	75-100 85-115 150-190 180-230 66-81 77-85 192-214 196-262	(102-136) (115-156) (203-258) (244-312) (90-110) (104-115) (260-290) (265-355)
10.	Capscrew, Bearing Cap	.56-12 .62-11 .75-10 .88-14 .88-9 M16 x 2 M20 x 2.5 M22 x 2.5	110-145 150-190 270-350 360-470 425-550 181-221 347-431 479-597	(149-197) (203-258) (366-475) (488-637) (576-746) (245-300) (470-585) (650-810)
11.	Nut, Housing to Carrier Stud	.44-20 .50-20 .56-18 .62-18	50-75 75-115 110-165 150-230	(68-102) (102-156) (149-224) (203-312)

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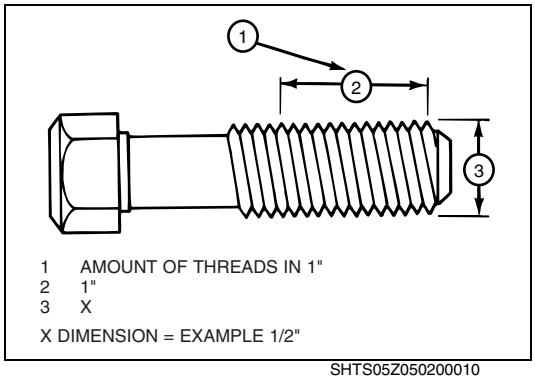
Fastener		Thread Size	Torque Value lb-ft (N·m)	
12.	Capscrew, Carrier to Housing	.44-14 .50-13 .56-12 .62-11 .75-10 M12 x 1.75 M16 x 2	50-75 75-115 110-165 150-230 270-400 74-89 181-221	(68-102) (102-156) (149-224) (203-312) (366-542) (100-120) (245-300)
13.	Jam Nut, Thrust Screw	.75-16 .88-14 1.12-16 M22 x 1.5 M30 x 1.5	150-190 150-300 150-190 148-210 236-295	(203-258) (203-407) (203-258) (200-285) (320-400)
14.	Input Yoke-to-Input Shaft Nut	Refer to page DF02-12.		
15.	Capscrew, Bearing Cage	.38-16 .44-14 .50-13 .56-12 .62-11 M12 x 1.75	30-50 50-75 75-115 110-165 150-230 70-110	(41-68) (68-102) (102-156) (149-224) (203-312) (90-150)
16.	Plug, Oil Fill, Carrier	.75-14 1.5-11.5 M24 x 1.5	25 minimum (34 minimum) 120 minimum (163 minimum) 35 minimum (47 minimum)	
17.	Capscrew, Lock Plate	.31-18 M8 x 1.25	20-30 21-26	(27-41) (28-35)
18.	Lock Nut, Sensor Switch	M16 x 1.0	25-35	(35-45)
19.	Air Cylinder	M60 x 2.0	80-100	(109-136)
20.	Screw-in DCDL Cylinder Plug or Cup	M60 x 2.0	80-100	(109-136)

Input and Output Yoke Pinion Nut Fastener Torque Specifications Single Axles

Axle Model / Pinion Nut Location	RS-145		RS-160	
	Fastener Size	Torque value lb-ft (N·m)	Fastener Size	Torque value lb-ft (N·m)
Carrier input yoke	M39 x 1.5	920-1130 (1250-1535)	M45 x 1.5	1000-1230 (1350-1670)

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TORQUE VALUES FOR FASTENERS



1 AMOUNT OF THREADS IN 1"
2 1"
3 X
X DIMENSION = EXAMPLE 1/2"

SHTS05Z050200010

1. GENERAL INFORMATION

(1) The torque values on page DF02-11–12 are for fasteners that have a light application of oil on the threads.

- **If the fasteners are dry:** Increase the torque values by 10%.
- **If the fasteners have a heavy application of oil on the threads:** Decrease the torque values by 10%.

(2) If you do not know the size of the fastener that is being installed, measure the fastener. Use the following procedure.

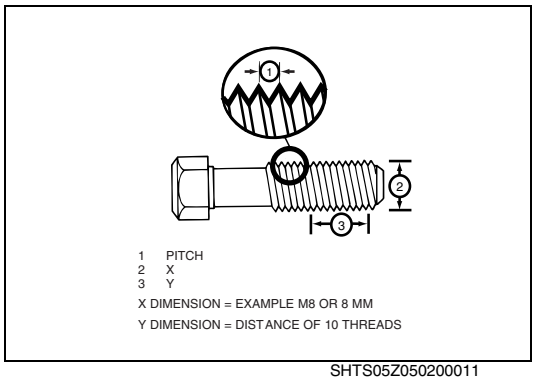
2. AMERICAN STANDARD FASTENERS

a. Measure the diameter of the threads in inches, dimension X.

b. Count the amount of threads in 1-inch.

Example

- American Standard size fastener is 0.50-13.
- 0.50 is the diameter of the fastener in inches or dimension X.
- 13 is the amount of threads in 1-inch.



1 PITCH
2 X
3 Y
X DIMENSION = EXAMPLE M8 OR 8 MM
Y DIMENSION = DISTANCE OF 10 THREADS

SHTS05Z050200011

3. METRIC FASTENERS

a. Measure the diameter of the threads in millimeters (mm), dimension X.

b. Measure the distance of 10 threads, point to point in millimeters (mm), dimension Y. Make a note of dimension Y.

c. Divide dimension Y by 10. The result will be the distance between two threads or pitch.

Example

- Metric size fastener is M8 x 1.25. M8 is the diameter of the fastener in millimeters (mm) or dimension X.
- 1.25 is the distance between two threads or pitch.

(1) Compare the size of fastener measured in 1. (2) above to the list of fasteners on page DF02-11–12 to find the correct torque value.

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OVERHAUL

EN05Z0502H200001

BEFORE YOU BEGIN

This manual provides instructions for the Meritor RS-Series axles. Before you begin procedures:

1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Caution and Warning safety alerts that precede instructions or procedures you will perform. These alerts help to avoid damage to components, serious personal injury, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

1. SAFETY ALERTS, TORQUE SYMBOL AND NOTES

⚠ **WARNING**	A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury.
⚠ **CAUTION**	A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.
NOTICE	A Note provides information or suggestions that help you correctly service a component.

2. ACCESS PRODUCT AND SERVICE INFORMATION ON OUR WEBSITE

Visit the DriveTrain Plus™ by ArvinMeritor Tech Library at arvinmeritor.com to access and order product and service information.

3. TO ORDER INFORMATION BY PHONE

Call ArvinMeritor's Customer Service Center at 800-535-5560 to order the following publications.

- Lubrication
- Single-Reduction Differential Carriers

https://truckmanualshub.com/

IMPORTANT POINTS - DISMOUNTING

⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

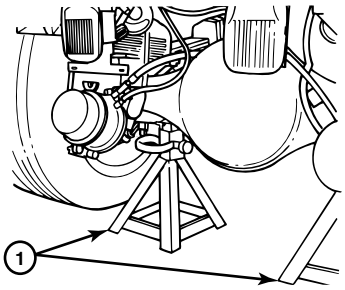
Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

1. REMOVAL OF DIFFERENTIAL CARRIER FROM THE AXLE HOUSING

(1) Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.

(2) Use a jack or other lifting tool to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.

(3) Place a drain pan under the rear axle.



1 SAFETY STANDS

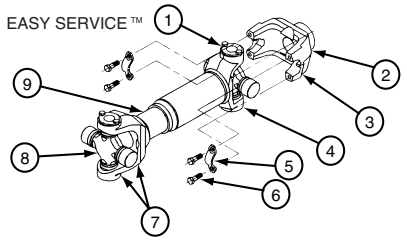
SHTS05Z050200012

(4) Remove the plug from bottom of axle housing. Drain lubricant from the assembly.

(5) Disconnect the driveline universal joint from the pinion input yoke or flange on the carrier.

(6) Remove the capscrews and washers or stud nuts and washers, if equipped, from the flanges of both axle shafts.

(7) Loosen the tapered dowels, if equipped, in the axle flanges of both axle shafts using one of the following methods.



1 FULL ROUND BEARING CUPS
2 END YOKE
3 YOKE SADDLE
4 WELD YOKE
5 BEARING STRAP
6 CAPSCREWS
7 EASY-SERVICE BEARING CUPS
8 U-JOINT CROSS
9 SLIP YOKE

For details,
Refer to the
Propeller shaft chapter.

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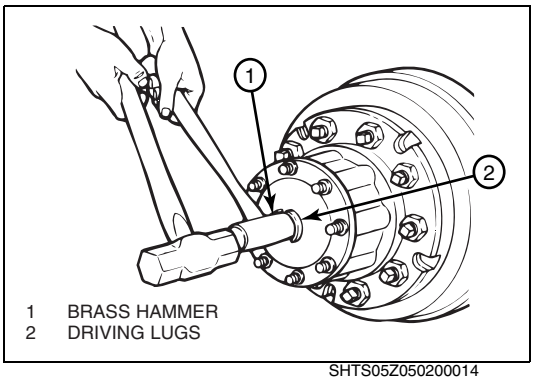
(8) Brass Drift Method

⚠ WARNING
Do not strike the round driving lugs on the flange of an axle shaft. Pieces can break off and cause serious personal injury.

a. Hold a 1-1/2-inch diameter brass drift or brass hammer against the center of the axle shaft, inside the round driving lugs.

b. Strike the end of the drift with a large hammer, five to six pounds, and the axle shaft and tapered dowels will loosen.

c. Mark each axle shaft before it is removed from the axle assembly.

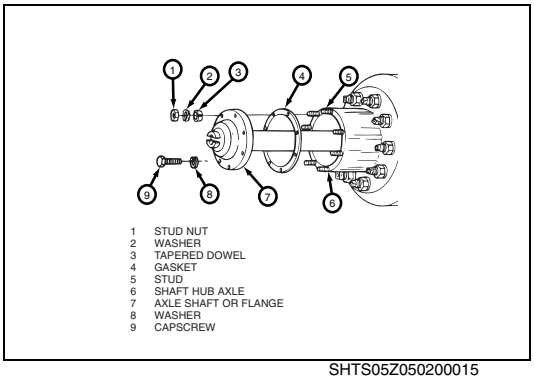


1 BRASS HAMMER
2 DRIVING LUGS

SHTS05Z050200014

d. Remove the tapered dowels and separate the axle shafts from the main axle hub assembly.

e. Install a cover over the open end of each axle assembly hub where an axle shaft was removed.



1 STUD NUT
2 WASHER
3 TAPERED DOWEL
4 GASKET
5 STUD
6 SHAFT HUB AXLE
7 AXLE SHAFT OR FLANGE
8 WASHER
9 CAPSCREW

SHTS05Z050200015

(9) Air Hammer Vibration Method

⚠ WARNING
Wear safe eye protection when using an air hammer. When using power tools, axle components can loosen and break off causing serious personal injury.

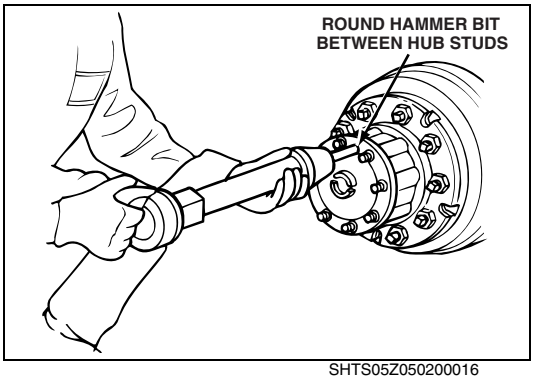
⚠ CAUTION
Do not use a chisel or wedge to loosen the axle shaft and tapered dowels. Using a chisel or wedge can result in damage to the axle shaft, the gasket and seal, and the axle hub.

a. Use a round hammer bit and an air hammer to loosen tapered dowels and axle shaft.

b. Place the round hammer bit against the axle shaft or flange between the hub studs. Operate the air hammer at alternate locations between the studs to loosen the tapered dowels and axle shaft from the hub.

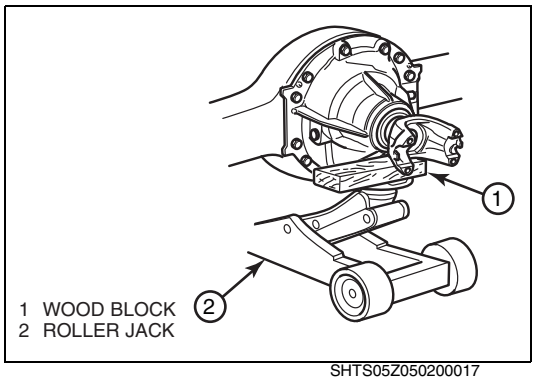
c. Mark each axle shaft before it is removed from the axle assembly.

d. Remove the tapered dowels and separate the axle shaft from the main axle hub assembly.



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1 WOOD BLOCK
2 ROLLER JACK

SHTS05Z050200017

2. CARRIER FROM THE AXLE

(1) Place a hydraulic roller jack under the differential carrier to support the assembly.

(2) Remove all but the top two carrier to housing capscrews or stud nuts and washers.

(3) Loosen the top two carrier-to-housing fasteners and leave attached to the assembly. The fasteners will hold the carrier in the housing.

(4) Loosen the differential carrier in the axle housing. Use a leather mallet to hit the mounting flange of carrier at several points.

(5) After the carrier is loosened, remove the top two fasteners.

⚠ CAUTION

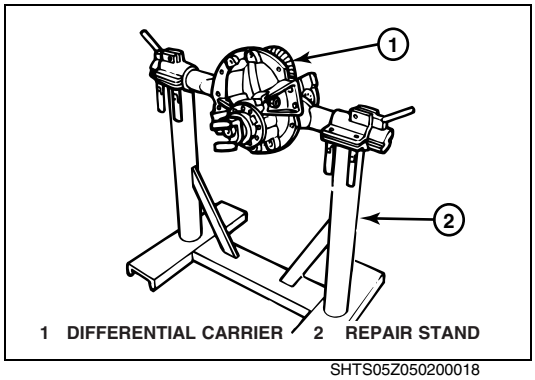
When using a pry bar, be careful not to damage the carrier or housing flange. Damage to these surfaces will cause oil leaks.

(6) Use the hydraulic roller jack to remove the carrier from the axle housing. Use a pry bar that has a round end to help remove the carrier from the housing.

NOTICE

A carrier stand is available from SPX Kent-Moore. Refer to DF02-8–9

(7) Use a lifting tool to lift the differential carrier by the input yoke or flange and place the assembly in a repair stand. Do not lift by hand.



1 DIFFERENTIAL CARRIER 2 REPAIR STAND

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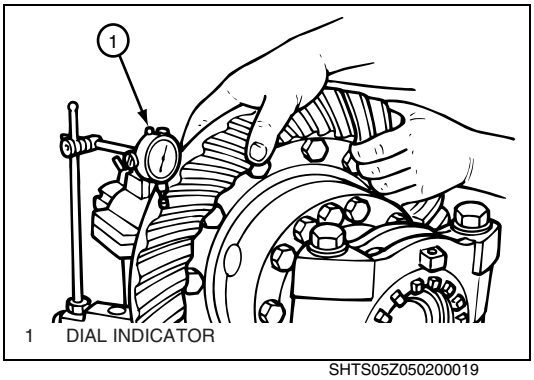
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IMPORTANT POINTS - DISASSEMBLY

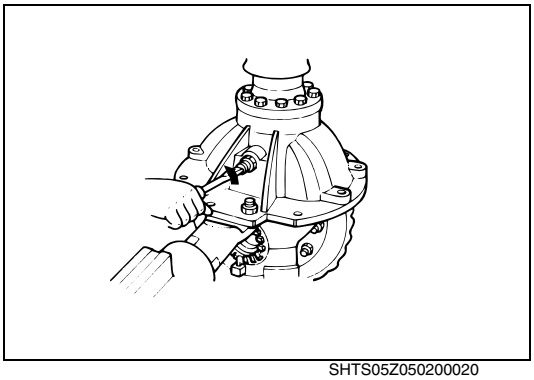
1. DIFFERENTIAL AND RING GEAR FROM THE CARRIER

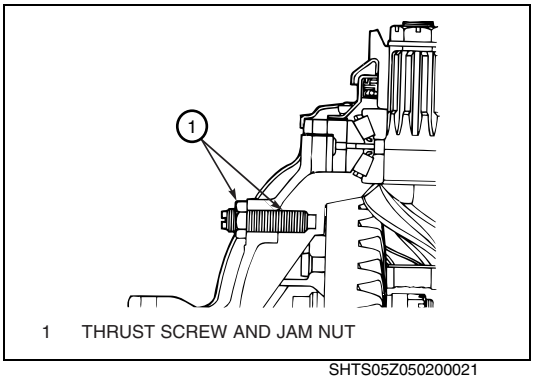
NOTICE
Before working on the differential carrier, inspect the hypoid gear set for damage. If inspection shows no damage, the same gear set can be used again. Measure the backlash of the gear set and make a record of the dimension. Refer to page DF02-44.

(1) Loosen the jam nut on the thrust screw, if equipped.
(2) Remove the thrust screw and jam nut, if equipped, from the differential carrier.



1 DIAL INDICATOR
SHTS05Z050200019

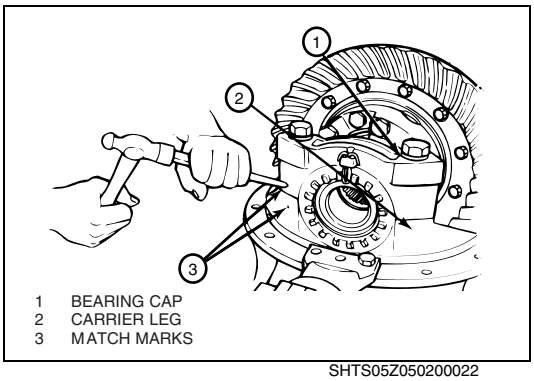

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1 THRUST SCREW AND JAM NUT
SHTS05Z050200021

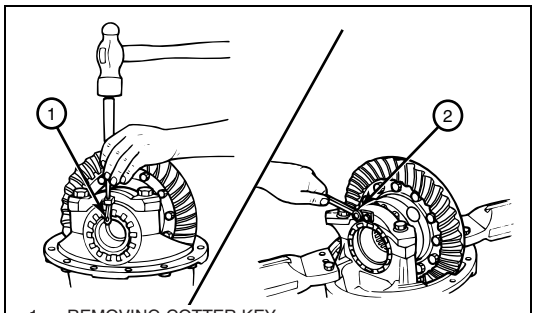
(3) Rotate the differential carrier in the repair stand until the ring gear is at the top of the assembly.

(4) Mark one carrier leg and bearing cap to correctly match the parts during carrier assembly. Mark the parts using a center punch and hammer.



1 BEARING CAP
2 CARRIER LEG
3 MATCH MARKS
SHTS05Z050200022

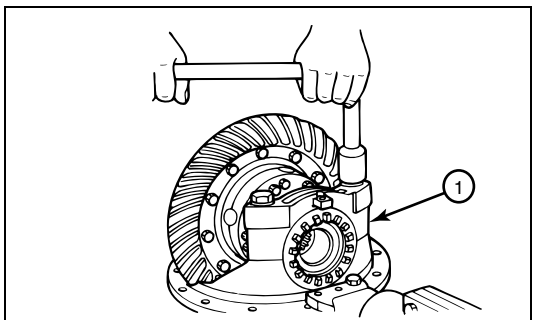
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1 REMOVING COTTER KEY
2 REMOVING LOCK PLATE

SHTS05Z050200023

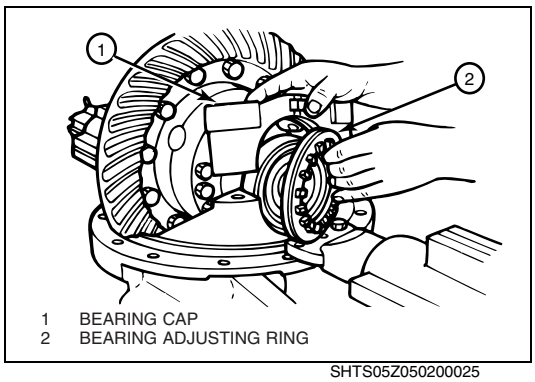
(5) Remove the cotter keys, pins or lock plates, if equipped, that hold the bearing adjusting rings in position. Use a small drift and hammer to remove pins. Each lock plate is held in position by two capscrews.



1 BEARING CAP

SHTS05Z050200024

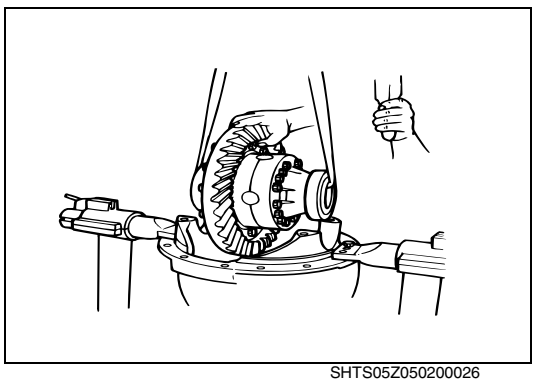
(6) Remove the capscrews and washers that hold the two bearing caps on the carrier. Each cap is held in position by two capscrews and washers.



1 BEARING CAP
2 BEARING ADJUSTING RING

SHTS05Z050200025

(7) Remove the bearing caps and bearing adjusting rings from the carrier.



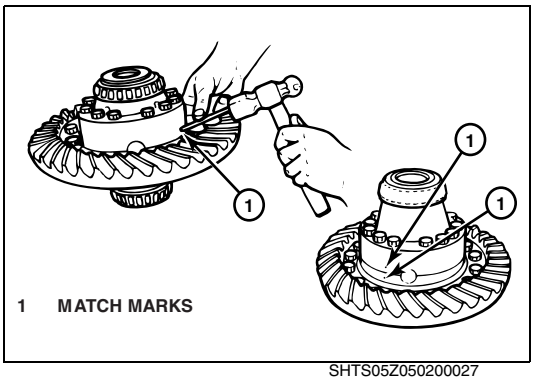
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(8) Safely lift the main differential and ring gear assembly from the carrier. Place the assembly on a work bench.

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2. DISASSEMBLY OF DIFFERENTIAL AND RING GEAR ASSEMBLY

⚠ WARNING
Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.



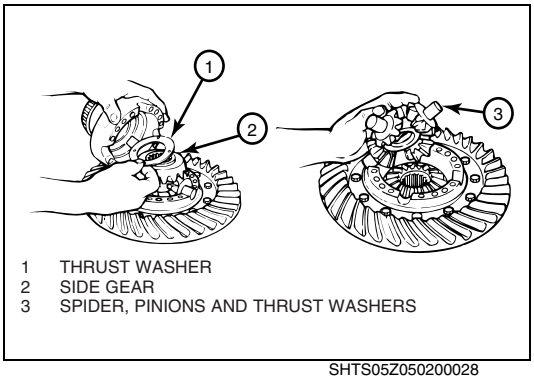
1 MATCH MARKS

SHTS05Z050200027

(1) If the match marks on the case halves of the differential assembly are not visible, mark each case half with a center punch and hammer.

(2) Remove the capscrews and washers or bolts, nuts and washers, if equipped, that hold the case halves together.

(3) Separate the case halves. If necessary, use a brass, plastic or leather mallet to loosen the parts.



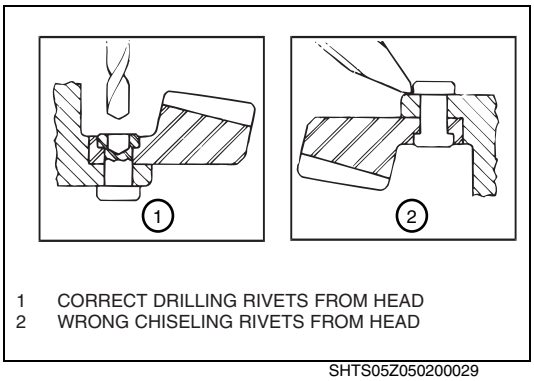
1 THRUST WASHER
2 SIDE GEAR
3 SPIDER, PINIONS AND THRUST WASHERS

SHTS05Z050200028

(4) Remove the differential spider or cross, four pinion gears, two side gears and six thrust washers from inside the case halves.

(5) If the ring gear needs to be replaced, remove the bolts, nuts, and washers, if equipped, that hold the gear to the flange case half.

⚠ CAUTION
Do not remove the rivets or rivet heads with a chisel and hammer. Using a flat edge tool can cause damage to the flange case.



1 CORRECT DRILLING RIVETS FROM HEAD
2 WRONG CHISELING RIVETS FROM HEAD

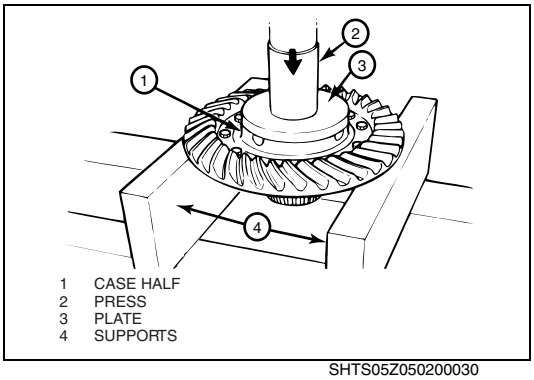
SHTS05Z050200029

(6) If rivets hold the ring gear to the flange case half, remove the rivets as follows.

a. Carefully center punch each rivet head in the center, on the ring gear side of the assembly. Do not use a chisel and hammer.

b. Drill each rivet head on the ring gear side of the assembly to a depth equal to the thickness of one rivet head. Use a drill bit that is 0.03125-inch (0.79375 mm) smaller than the body diameter of the rivets.

c. Press the rivets through holes in the ring gear and flange case half. Press from the drilled rivet head.

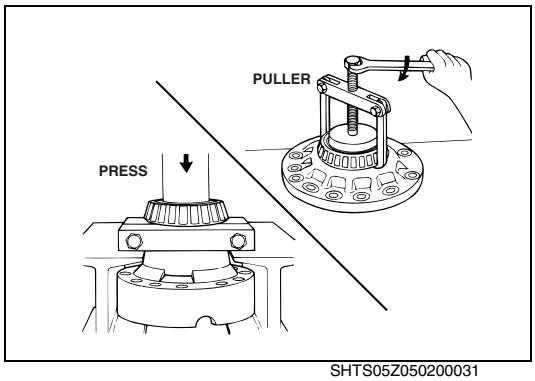


1 CASE HALF
2 PRESS
3 PLATE
4 SUPPORTS

SHTS05Z050200030

(7) Use a press to separate the case half and ring gear. Support the assembly under the ring gear with metal or wood blocks. Press the case half through the gear.

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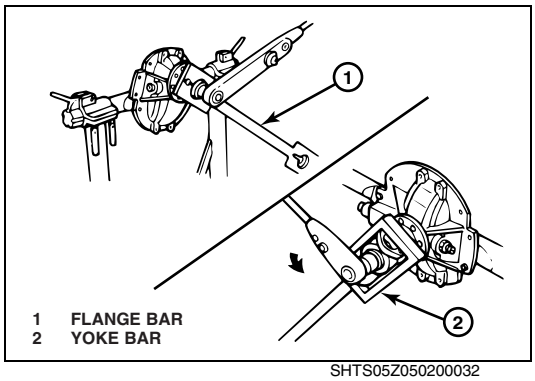
(8) If the differential bearings need to be replaced, use a bearing puller or press to remove the bearing cones from the case halves.

3. REMOVAL OF DRIVE PINION AND BEARING CAGE FROM THE CARRIER

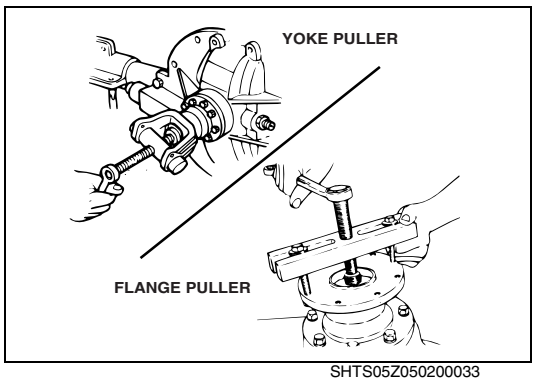
(1) Fasten a flange bar to the input yoke or flange. When the nut is removed, the bar will hold the drive pinion in position.

(2) Remove the nut and washer, if equipped, from the drive pinion.
(3) Remove the yoke or flange bar.

⚠ CAUTION
Do not use a hammer or mallet to loosen and remove the yoke or flange. A hammer or mallet can damage the parts and cause driveline runout, or driveline imbalance problems after carrier to driveline assembly.



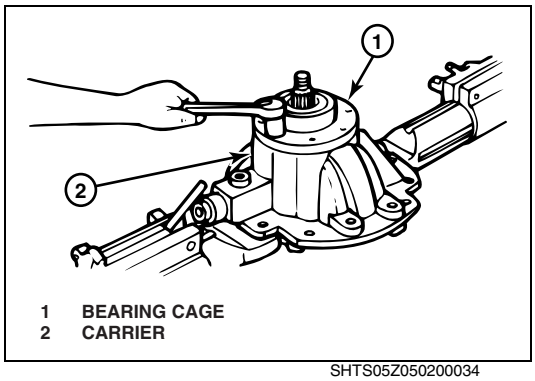
1 FLANGE BAR
2 YOKE BAR
SHTS05Z050200032



SHTS05Z050200033

(4) Remove the yoke or flange from the drive pinion. Do not use a hammer or mallet.

- **If the yoke or flange is tight on the pinion:**
  Use a puller for removal.

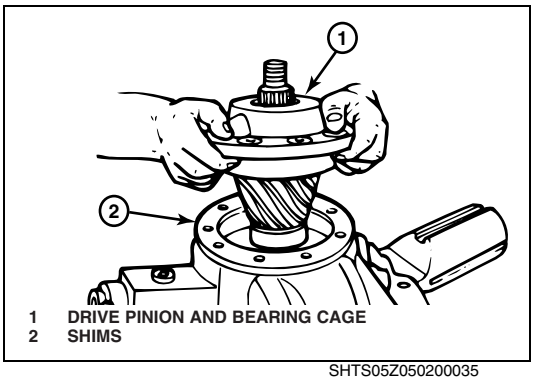


1 BEARING CAGE
2 CARRIER
SHTS05Z050200034

(5) Remove the capscrews and washers that hold the bearing cage in the carrier.

⚠ CAUTION
Do not use a pry bar to remove the bearing cage from the carrier. A pry bar can damage the bearing case, shims and carrier.

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1 DRIVE PINION AND BEARING CAGE
2 SHIMS

SHTS05Z050200035

(6) Remove the drive pinion, bearing cage and shims from the carrier. Do not use a pry bar.

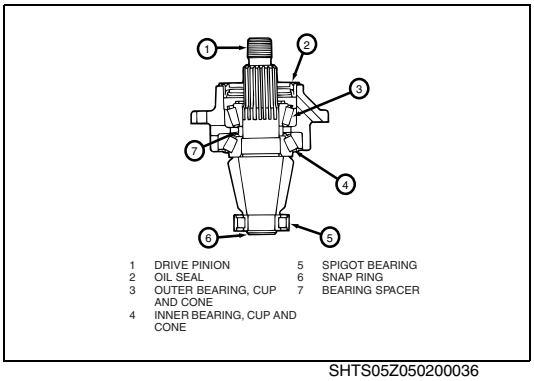
- **If the bearing cage is tight in the carrier:** Hit the bearing cage at several points around the flange area with a leather, plastic or rubber mallet.

(7) If the shims are in good condition, keep the shims together to use when the carrier is assembled.

(8) If shims are to be discarded because of damage, first measure the total thickness of the pack. Make a note of the dimension. The dimension will be needed to calculate the depth of the drive pinion in the carrier when the gear set is installed.

4. DISASSEMBLY OF DRIVE PINION AND BEARING CAGE

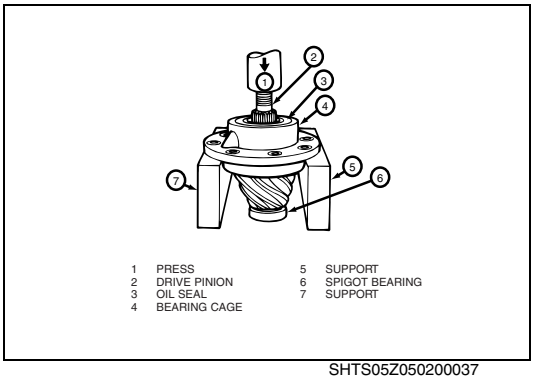
⚠ WARNING
Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.



1 DRIVE PINION
2 OIL SEAL
3 OUTER BEARING, CUP AND CONE
4 INNER BEARING, CUP AND CONE
5 SPIGOT BEARING
6 SNAP RING
7 BEARING SPACER

SHTS05Z050200036

(1) Place the drive pinion and bearing cage in a press. The pinion shaft must be toward the top of the assembly.



1 PRESS
2 DRIVE PINION
3 OIL SEAL
4 BEARING CAGE
5 SUPPORT
6 SPIGOT BEARING
7 SUPPORT

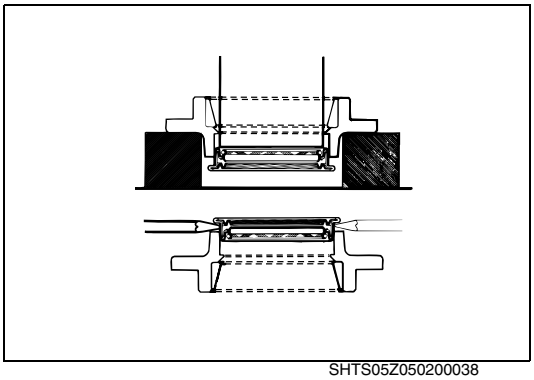
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(2) Support the bearing cage under the flange area with metal or wood blocks.

(3) Press the drive pinion through the bearing cage. The inner bearing cone and bearing spacer will remain on the pinion shaft.

- **If a press is not available:** Use a leather, plastic or rubber mallet to drive the pinion through the bearing cage.

⚠ CAUTION
Be careful when removing the seal. Do not damage the wall of bore. Damage to the bore wall can result in oil leaks.

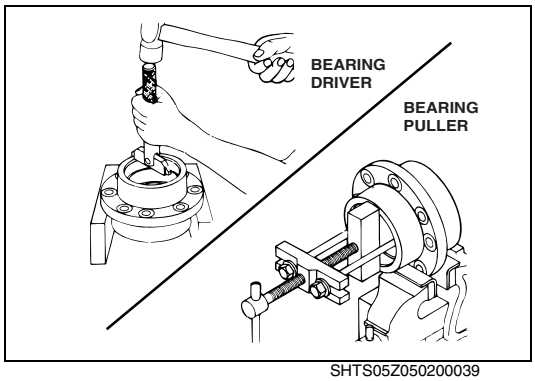


SHTS05Z050200038

(4) Use a press and a sleeve to remove the triple-lip or unitized oil seal from the bearing cage.

- **If a press is not available:** Place a tool with a flat blade under the flange to remove the oil seal from the cage.

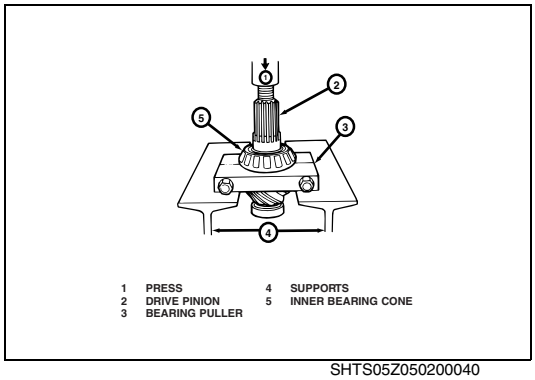
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SHTS05Z050200039

(5) If the pinion bearings need to be replaced, remove the inner and outer bearing cups from the inside of cage. Use a press and sleeve, bearing puller or a small drift hammer. The type of tool used depends on the design of the bearing cage.

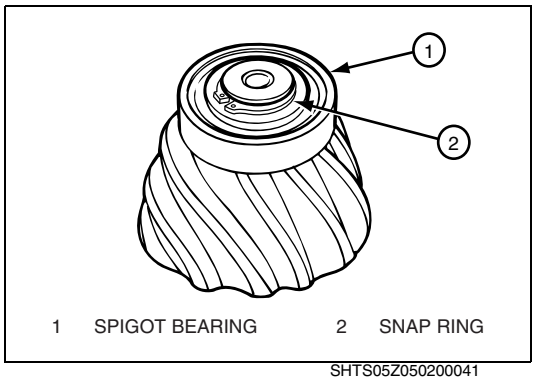
When a press is used, support the bearing cage under the flange area with metal or wood blocks.



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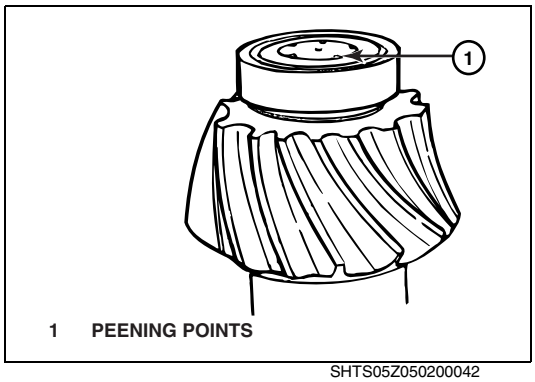
(6) If the pinion bearings need to be replaced, remove the inner bearing cone from the drive pinion with a press or bearing puller. The puller MUST fit under the inner race of the cone to remove the cone correctly without damage.

(7) If the spigot bearing needs to be replaced, place the drive pinion in a vise. Install a soft metal cover over each vise jaw to protect the drive pinion.



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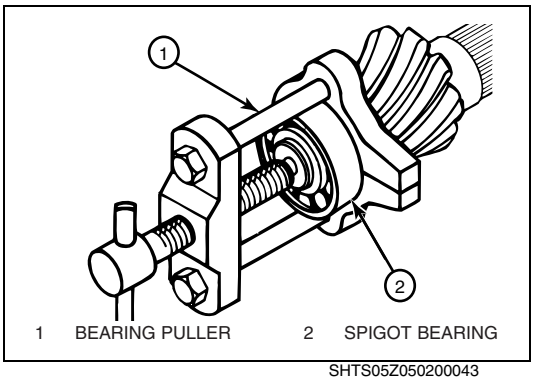
(8) Remove the snap ring, if equipped, from the end of drive pinion with snap ring pliers that expand.



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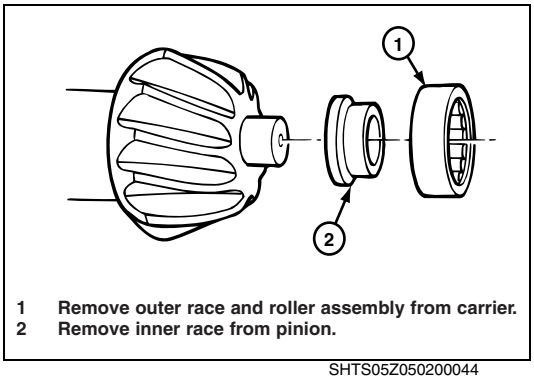
(9) Remove the spigot bearing from the drive pinion with a bearing puller. Some spigot bearings are fastened to the drive pinion with a special peening tool.

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1 BEARING PULLER 2 SPIGOT BEARING

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1 Remove outer race and roller assembly from carrier.
2 Remove inner race from pinion.

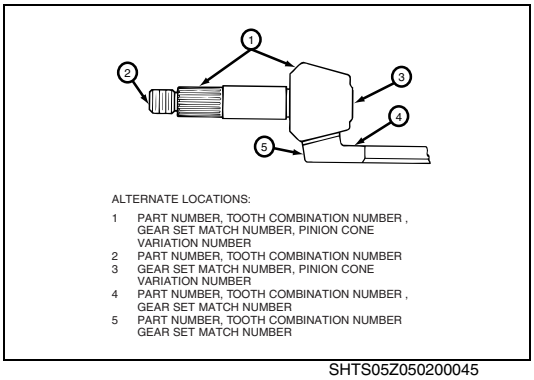
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(10) If the spigot bearings are a two-piece assembly, remove the inner race from the pinion with a bearing puller. Remove the outer race and roller assembly from the carrier with a drift or a press.

5. GEAR SETS

Refer to the following examples for information on identifying gear sets with matched parts. Always check match numbers to verify that the gear set you will install has matched parts.

(1) Gear Set



ALTERNATE LOCATIONS:

1 PART NUMBER, TOOTH COMBINATION NUMBER , GEAR SET MATCH NUMBER, PINION CONE VARIATION NUMBER
2 PART NUMBER, TOOTH COMBINATION NUMBER
3 GEAR SET MATCH NUMBER, PINION CONE VARIATION NUMBER
4 PART NUMBER, TOOTH COMBINATION NUMBER , GEAR SET MATCH NUMBER
5 PART NUMBER, TOOTH COMBINATION NUMBER GEAR SET MATCH NUMBER

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Parts	Number	Location
Conventional ring gear	**36786**	**On the front face or outer diameter**
Conventional drive pinion	**36787**	**At the end at threads**
Generoid ring gear	**36786 K or 36786 K2**	**On the front face or outer diameter**
Generoid drive pinion	**36787 K or 36787 K2**	**At the end at threads**

(2) Gear Set Tooth Combination Number

Gear Set Teeth	Drive Pinion Location	Ring Gear Location
5-37 = gear set has a five-tooth drive pinion and a 37-tooth ring gear	**At the end at threads**	**On the front face or outer diameter**

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(3) Gear Set Match Number

NOTICE

Meritor's drive pinions and ring gears are only available as matched sets. Each gear in a set has an alpha-numeric match number.

Match Number	Drive Pinion Location	Ring Gear Location
M29	At the end of the gear head	On the front face or outer diameter

(4) Pinion Cone Variation Number

NOTICE

Don't use the pinion cone variation number when you check for a matched gear set. Use this number when you adjust the pinion depth in the carrier. Refer to page DF02-34.

Pinion Cone (PC) Variation Number	Drive Pinion Location	Ring Gear Location
PC+3 +2 +0.01 mm PC-5 -1	At the end of the pinion gear head	At the end of the pinion gear head

IMPORTANT POINTS - ASSEMBLY

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.

1. ASSEMBLY OF DRIVE PINION, BEARINGS AND BEARING CAGE

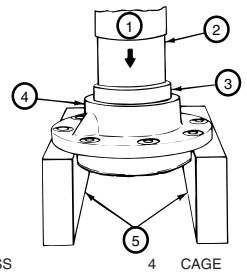
(1) Place the bearing cage in a press.

(2) Support the bearing cage with metal or wood blocks.

(3) Press the bearing cup into the bore of bearing cage until cup is flat against bottom of the bore. Use a sleeve of the correct size to install bearing cup.

NOTICE

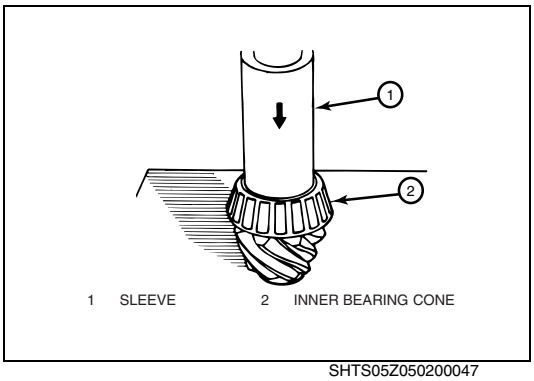
Use the same procedure for both bearing cups.



1 PRESS
2 SLEEVE
3 BEARING CUP
4 CAGE
5 SUPPORTS

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1 SLEEVE 2 INNER BEARING CONE

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(4) Place the drive pinion in a press with the gear head or teeth toward the bottom.

(5) Press the inner bearing cone on the shaft of the drive pinion until the cone is flat against the gear head. Use a sleeve of the correct size against the bearing inner race.

NOTICE

Spigot bearings are usually fastened to the drive pinion with a snap ring. Some are fastened with a peening tool, and some are a two-piece bearing assembly with the inner race pressed on the nose of the pinion and the outer race pressed into its bore in the carrier.

(6) Install the spigot bearing using one of the following three procedures.

2. INSTALLATION OF ONE-PIECE SPIGOT BEARING ON THE DRIVE PINION WITH SNAP RING

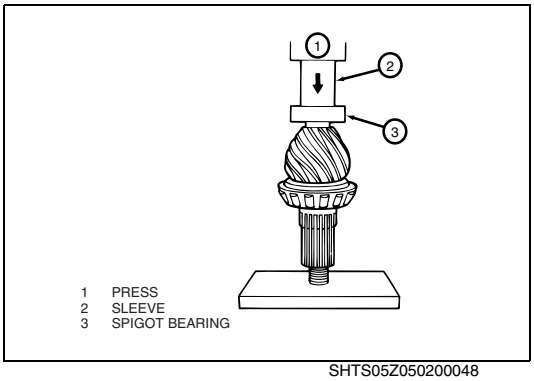
NOTICE

The following procedure applies to all axles except:

- Some 160 Series single axles may use snap rings.

(1) Place the drive pinion in a press with the gear head or the teeth toward the top.

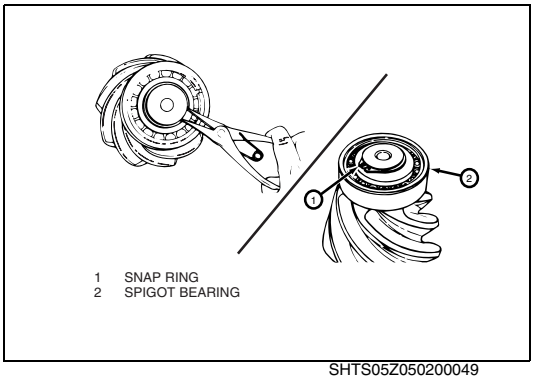
(2) Press the spigot bearing on the end of drive pinion. The bearing must be flat against the gear head. Use a sleeve of the correct size against the bearing inner race.



1 PRESS
2 SLEEVE
3 SPIGOT BEARING

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(3) Use snap ring pliers to install the snap ring, if equipped, into the groove in the end of the drive pinion.



1 SNAP RING
2 SPIGOT BEARING

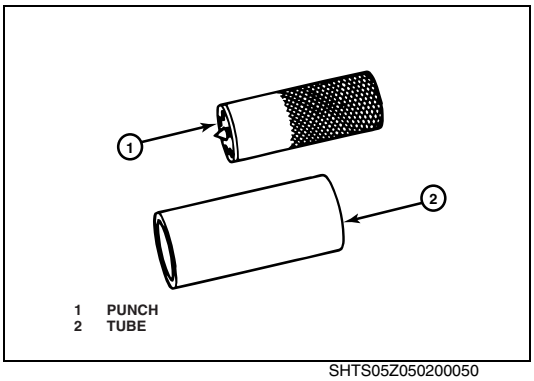
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3. INSTALLATION OF ONE-PIECE SPIGOT BEARING ON THE DRIVE PINION WITHOUT SNAP RING

NOTICE

The following procedure applies to existing snap ring components.

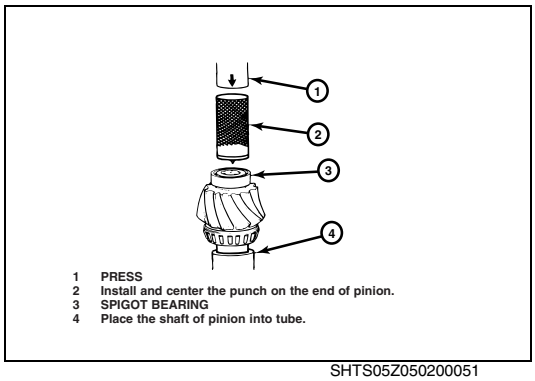
For ordering information about the staking tool, refer to page DF02-9.



1 PUNCH
2 TUBE

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1 PRESS
2 Install and center the punch on the end of pinion.
3 SPIGOT BEARING
4 Place the shaft of pinion into tube.

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(1) Place the drive pinion and the tube of the staking tool in a press with the spigot bearing toward the top.

(2) When using a staking tool and press, apply 6,614 lb (3,000 kg) force on a 0.375-inch (10 mm) ball. Calculate the force required on the tool as follows.

6,614 lb (3,000 kg) x amount of balls in tool = pounds or kilograms

Example

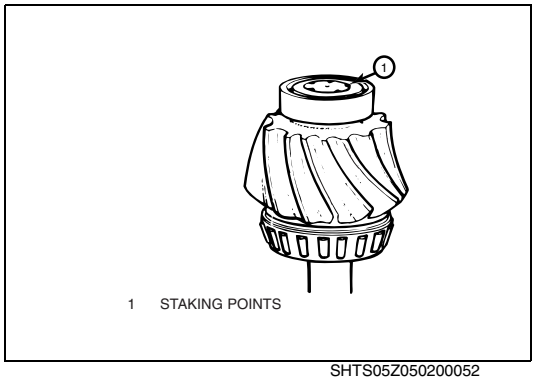
6,614 lb (3,000 kg) x 3 balls = 19,842 pounds (9,000 kg)

(3) Place the punch of the staking tool over the end of the pinion and spigot bearing. Apply the required amount of force on the punch.

⚠ CAUTION
Do not align new points with the grooves in the end of the drive pinion or in old points. If the new staked points are placed in the wrong areas, the spigot bearing will not be held correctly on the pinion shaft.

NOTICE
If a three-ball stake tool is used, rotate the tool 180 degrees.

(4) Stake the end of the drive pinion at a minimum of five points. Rotate the punch as many times as required for a minimum of five points. Repeat Step (3) for each point.



1 STAKING POINTS

SHTS05Z050200052

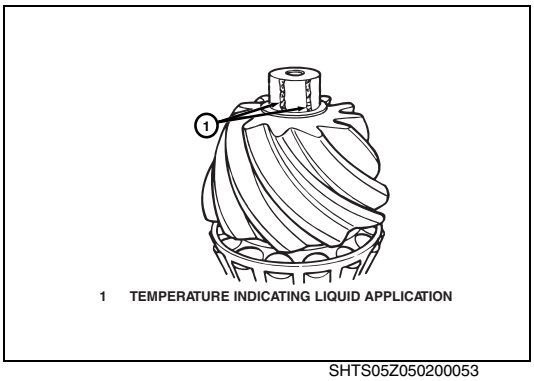
4. INSTALLATION OF TWO-PIECE SPIGOT BEARING ON THE DRIVE PINION

NOTICE
This procedure applies to some 160 Series single rear axles. These axles may also use a one-piece spigot bearing with a snap ring retainer.

The inner race of two-piece spigot bearings must be staked in place on RS-160 series rear axles. Before you stake the pinion, you must heat the pinion stem to soften it.

SPX Kent-Moore kit number J-39039 includes the staking tool, temperature indicating liquid, heat shield and plastigage needed for this procedure. To obtain this kit, refer to the page DF02-9.

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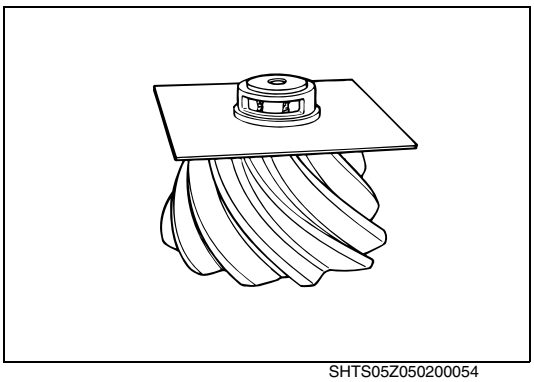


1 TEMPERATURE INDICATING LIQUID APPLICATION

SHTS05Z050200053

(1) Apply two stripes of temperature indicating liquid on the pinion stem from the top to the bottom. Apply a green stripe to indicate 400°F (205°C) and a blue stripe to indicate 500°F (260°C).

⚠ CAUTION
You must use the heat shield when you heat the pinion stem. Do not heat the pinion stem without the heat shield in place. Damage to components can result.



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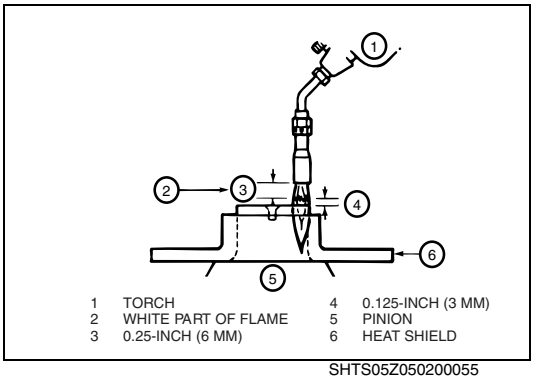
(2) Place the heat shield over the pinion stem so that you can see the temperature indicating liquid through the hole in the shield.

⚠ WARNING
Read the manufacturer's instructions before using a torch. Always wear safe clothing, gloves and eye protection when working with a torch for heating parts to prevent serious personal injury during assembly.

(3) Put on safe clothing, gloves and eye protection.

⚠ CAUTION
Do not overheat the pinion stem or you will weaken the metal. Damage to components can result.

NOTICE
Correct heating will take approximately 25-35 seconds, depending on how hot the torch is.



1 TORCH
2 WHITE PART OF FLAME
3 0.25-INCH (6 MM)
4 0.125-INCH (3 MM)
5 PINION
6 HEAT SHIELD

SHTS05Z050200055

(4) Light and adjust the torch until the white part of the flame is approximately 0.25-inch (6 mm) long. Keep the white part of the flame approximately 0.125-inch (3 mm) from the top of the stem. Move the flame around the outer diameter of the top of the pinion stem. The green temperature indicating liquid will turn black before the blue liquid does. Heat the stem until the blue liquid turns black at a point in the middle of the window.

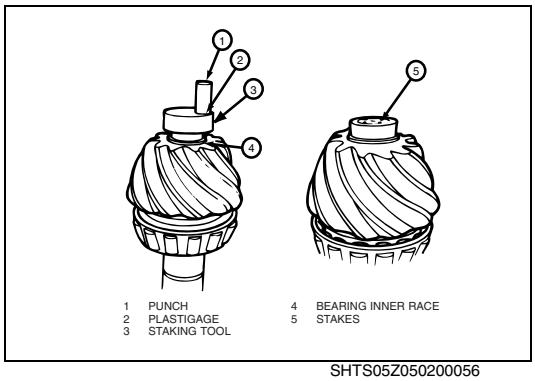
(5) Remove the flame and the heat shield from the pinion. Let the pinion air cool for 10 minutes. Use a razor blade to remove the temperature indicating liquid.

⚠ CAUTION
Do not press or directly strike the new inner race. Damage to the bearing will result.

(6) Use a press, if available, or a brass hammer to install the new inner race. Use the old inner race as a sleeve. The face is completely seated when you cannot fit a 0.002-inch (0.0508 mm) feeler gauge between the race and the pinion shoulder.

NOTICE
To hold the races in place, use a staking tool, not the old race, to start the new race on the stem. The old race can be used to completely seat the new race.

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1 PUNCH
2 PLASTIGAGE
3 STAKING TOOL
4 BEARING INNER RACE
5 STAKES

SHTS05Z050200056

(7) Place the staking tool over the bearing race. Cut a 1-inch (25 mm) piece from the green plastigage strip and place in between the punch and the staking tool. You do not need to use the plastigage for every stake. Use the plastigage until you are sure you are hitting the punch with the correct amount of force.

(8) Strike the punch with a 2-3 pound (0.9-1.4 kg) brass hammer to upset the end of the pinion stem. Remove the strip and measure its thickness against the gauge on the strip's wrapper. The strip must not be less than 0.003-inch (0.0762 mm) thick. This thickness indicates that you are using enough force when you hit the punch. If the strip is too thin, then you must hit the punch harder so the stake will hold the race in place. Rotate the tool and repeat this procedure until there are six evenly spaced stake marks around the stem.

(9) With a press or a soft mallet and sleeve, install the outer race and roller assembly into its bore in the carrier. Use a sleeve that is the same size as the outer race. Press the bearing until it is squarely against the shoulder in the bottom of its bore.

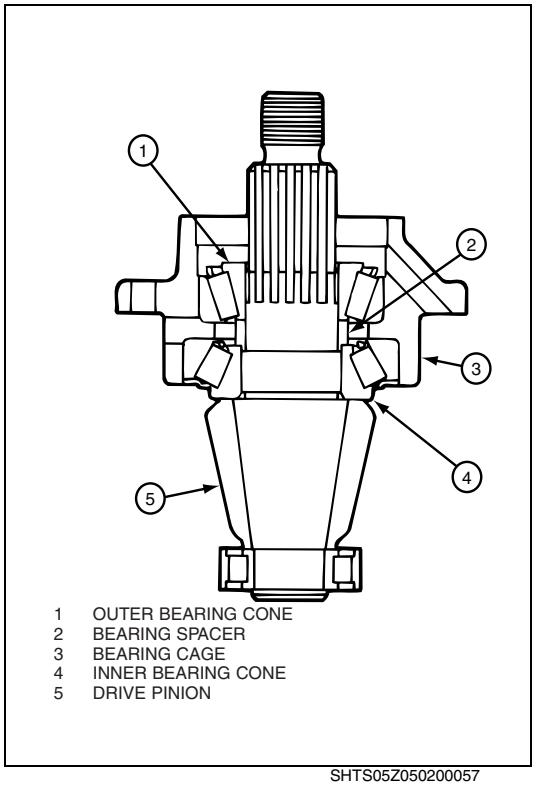
5. INSTALLATION OF DRIVE PINION

(1) Apply axle lubricant to the bearing cups and to the bearing cones in the cage.

(2) Install the drive pinion into the bearing cage.

(3) Install the bearing spacer or spacers onto the pinion shaft against the inner bearing cone. The spacer or spacers control the preload adjustment of the drive pinion bearings.

(4) Install the outer bearing cone onto the pinion shaft against the spacer. Do not install the pinion seal in the bearing cage.



1 OUTER BEARING CONE
2 BEARING SPACER
3 BEARING CAGE
4 INNER BEARING CONE
5 DRIVE PINION

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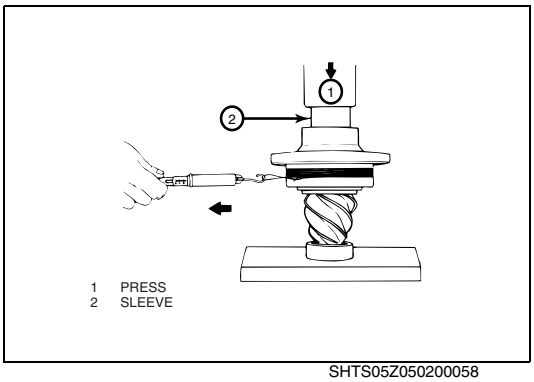
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6. ADJUSTMENT OF PINION BEARING PRELOAD BY PRESS METHOD

If a press is not available, or the press does not have a pressure gauge, use the yoke or flange method to adjust pinion bearing preload. Refer to DF02-31.

NOTICE

Do not read starting torque. Read only the torque value after the cage starts to rotate. Starting torque will give an incorrect reading.



1 PRESS
2 SLEEVE

SHTS05Z050200058

(1) Place the drive pinion and cage assembly in a press, gear head or teeth toward the bottom.

(2) Install a sleeve of the correct size against the inner race of the outer bearing.

(3) Apply and hold the correct amount of pressure to the pinion bearings. Refer to table below. As pressure is applied, rotate the bearing cage several times so that the bearings make normal contact.

Thread Size of Pinion Shaft	Press Pressure Needed on Bearings for Correct Preload		Torque Value Needed on Pinion Nut for Correct Bearing Preload	
	pounds/ tons	(kg/metric-tons)	lb-ft	(N·m)
7/8"-20	22,000/1	(9979/10)	200-275	(271-373)
1"-20	30,000/15	(13 608/13.6)	300-400	(407-542)
1-1/4"-12	54,000/27	(24 494/24.5)	700-900	(949-1220)
1-1/4"-18	54,000/27	(24 494/24.5)	700-900	(949-1220)
1-1/2"-12	54,000/27	(24 494/24.5)	800-1100	(1085-1491)
1-1/2"-18	54,000/27	(24 494/24.5)	800-1100	(1085-1491)
1-3/4"-12	50,000/25	(22 680/22.7)	900-1200	(1220-1627)
2"-12	50,000/25	(22 680/22.7)	1200-1500	(1627-2034)

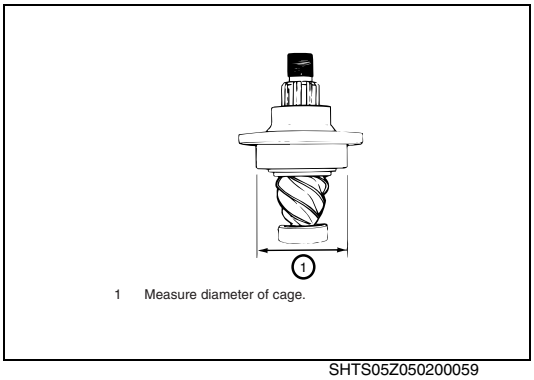
(4) While pressure is held against the assembly, wind a cord around the bearing cage several times.

(5) Attach a spring scale to the end of the cord.

(6) Pull the cord on a horizontal line. As the bearing cage rotates, read the value indicated on the scale. Record the reading.

(7) Measure the diameter of the bearing cage where the cord was wound. Measure in inches or centimeters.

(8) Divide the dimension in half to get the radius. Record the radius dimension.



1 Measure diameter of cage.

SHTS05Z050200059

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(9) Use the following procedure to calculate the bearing preload or torque.

- Pounds Pulled x Radius (inches) = lb-in Preload
  —Preload x 0.113 = N·m Preload
- Kilograms Pulled x Radius (cm) = kg·cm lb-in Preload
  —Preload x 0.098 = N·m Preload
  or

Example

- Reading from spring scale = 7.5 pounds (3.4 kg)
- Diameter of bearing cage = 6.62-inches (16.8 cm)
- Radius of bearing cage = 3.31-inches (8.4 cm)
  7.5 lb x 3.31 in = 24.8 in-lb Preload
  Preload x 0.113 = 2.8 N·m Preload
  or
  3.4 kg x 8.4 cm = 28.6 kg·cm Preload
  Preload x 0.098 = 2.8 N·m Preload

(10) If the preload or torque of pinion bearings is not within 5-45 lb-in (0.56-5.08 N·m) for new pinion bearings or 10-30 lb-in (1.13-3.39 N·m) for used pinion bearings in good condition, adjust the spacer and repeat Steps (1) to (9).

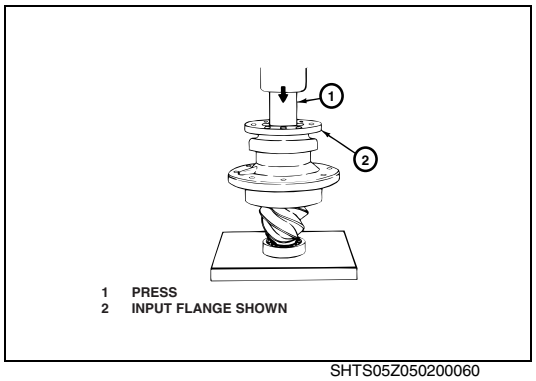
- **To increase preload:** Install a thinner bearing spacer.
- **To decrease preload:** Install a thicker bearing spacer.

(11) Check the bearing preload with the drive pinion and cage assembly installed in the carrier. Follow the procedures to adjust pinion bearing preload, yoke or flange method.

7. ADJUSTMENT OF PINION BEARING PRELOAD BY YOKE OR FLANGE METHOD

⚠ CAUTION
Do not install tight-fitting yokes or flanges on shafts using a hammer or mallet. A hammer or mallet will damage the yoke or flange.

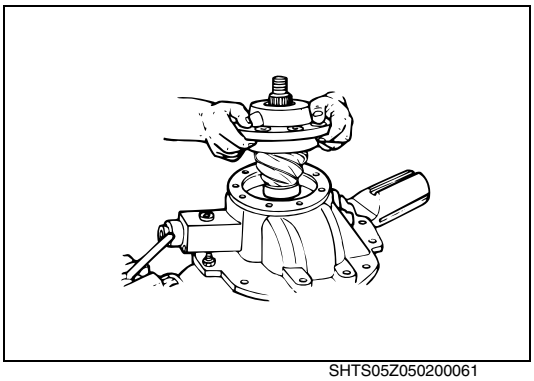
(1) Use a press to install the input yoke or flange, nut and washer, if equipped, onto the drive pinion. The yoke or flange must be seated against the outer bearing.



1 PRESS
2 INPUT FLANGE SHOWN

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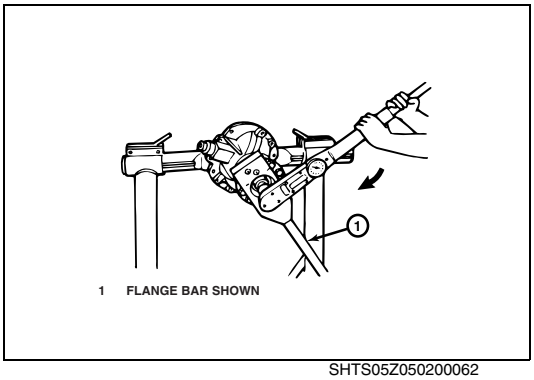
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(2) Install the drive pinion and cage assembly into the carrier. Do not install shims under the bearing cage.

(3) Install the bearing cage-to-carrier capscrews. Washers are not required at this time. Hand-tighten the capscrews.



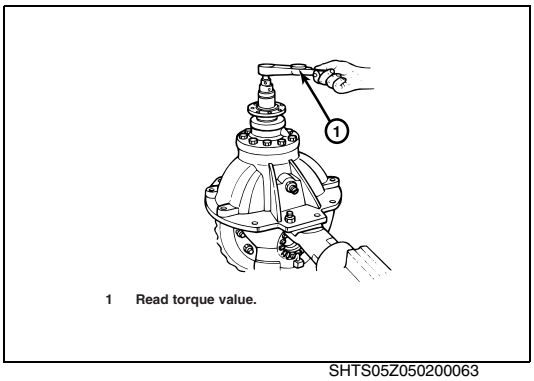
1 FLANGE BAR SHOWN

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(4) Fasten a yoke or flange bar to the input yoke or flange. The bar will hold the drive pinion in position when the nut is tightened.

(5) Tighten the drive pinion nut to the correct torque value. Refer to page DF02-30.

(6) Remove the yoke or flange bar.



1 Read torque value.

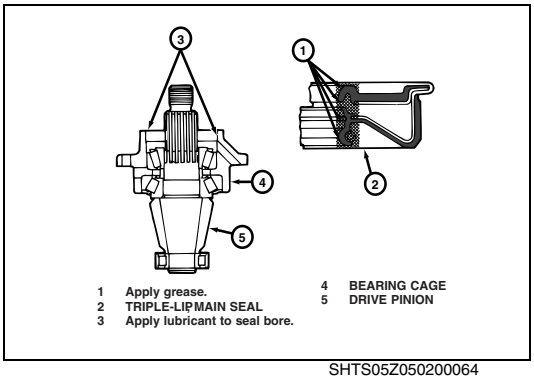
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(7) Attach a torque wrench on the drive pinion nut. Rotate the drive pinion and read the value indicated on torque wrench.

(8) If the pinion bearing preload or torque is not within 5-45 lb-in (0.56-5.08 N·m) for new pinion bearings or 10-30 lb-in (1.13-3.39 N·m) for used pinion bearings in good condition, remove the pinion and cage assembly from the carrier. Adjust the spacer and repeat Steps (1) to (7).

- **To increase preload:** Install a thinner bearing spacer.
- **To decrease preload:** Install a thicker bearing spacer.

(9) After adjusting pinion bearing preload, remove the drive pinion and bearing cage from the carrier. Refer to page DF02-21.



1 Apply grease.
2 TRIPLE-LIP MAIN SEAL
3 Apply lubricant to seal bore.
4 BEARING CAGE
5 DRIVE PINION

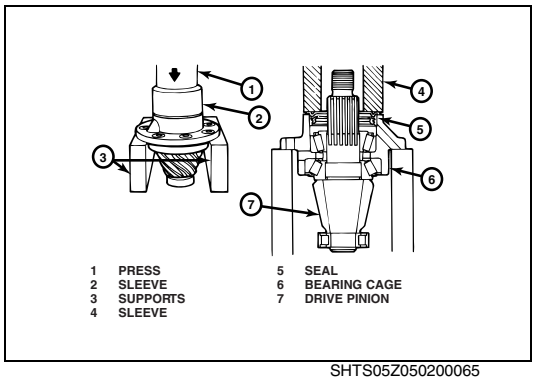
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(10) Install a new triple-lip seal.

⚠ CAUTION
The seal lips must be clean. Dirt and particles may cause a leak between the yoke and the seal.

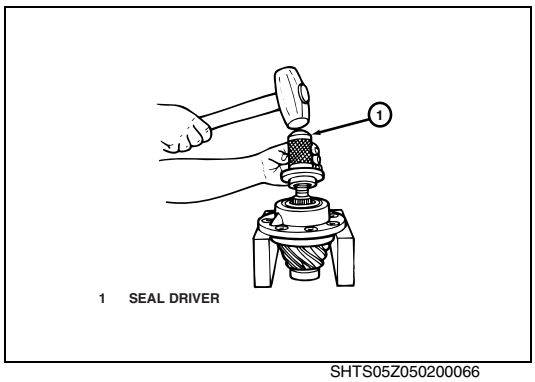
a. Apply the same lubricant used in the axle housing to the outer surface of the seal and the seal bore in the bearing cage.
b. Place the drive pinion and cage assembly in a press with the seal bore toward the top.

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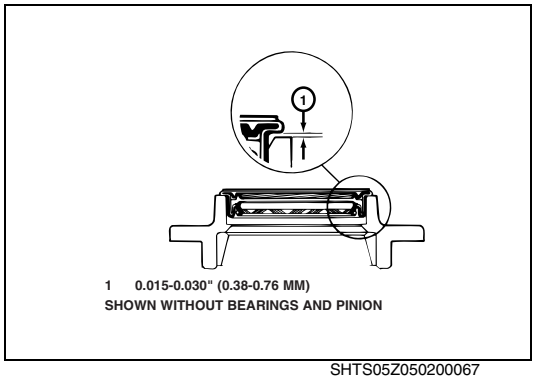
1 PRESS
2 SLEEVE
3 SUPPORTS
4 SLEEVE
5 SEAL
6 BEARING CAGE
7 DRIVE PINION

SHTS05Z050200065



1 SEAL DRIVER

SHTS05Z050200066



1 0.015-0.030" (0.38-0.76 MM)
SHOWN WITHOUT BEARINGS AND PINION

SHTS05Z050200067

c. Press the seal into the bearing cage. The seal flange must be flat against the top of the bearing cage. Use a sleeve or seal driver of the correct size that fits against the metal seal flange. The diameter of the sleeve or driver must be larger than the flange diameter.

- **If a press is not available:** Use a mallet and the sleeve or driver to install the seal.

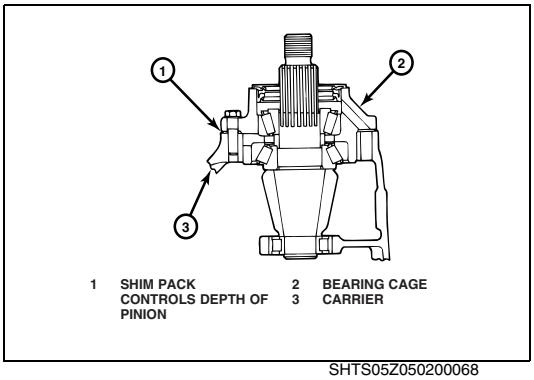
d. After the triple-lip seal is installed, a gap of approximately 0.015-0.030-inch (0.38-0.76 mm) between the flange and bearing cage is normal.
e. Check the gap with a feeler gauge at several points around the seal. The gap must be within 0.015-0.030-inch (0.38-0.76 mm). The difference between the largest and smallest gap measurement must not exceed 0.010-inch (0.0254 mm).

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8. ADJUSTMENT OF SHIM PACK THICKNESS FOR A NEW DRIVE PINION

NOTICE

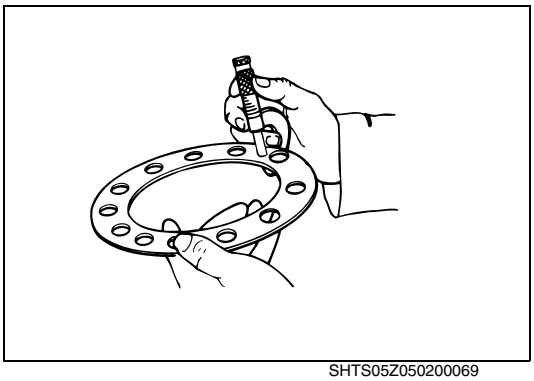
Use this procedure if you'll install a new drive pinion and ring gear set, or if you have to adjust the depth of the drive pinion.



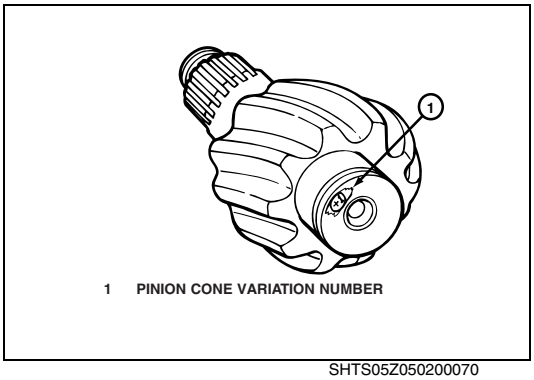
1 SHIM PACK CONTROLS DEPTH OF PINION
2 BEARING CAGE
3 CARRIER

SHTS05Z050200068

(1) Use a micrometer to measure the thickness of the shim pack that was removed from under the pinion cage. Record the measurement.



SHTS05Z050200069



1 PINION CONE VARIATION NUMBER

SHTS05Z050200070

(2) Find the pinion cone (PC) variation number on the drive pinion you'll replace. Record the number. The pinion cone number can be one of the following values.

- PC +3, PC -3, +3 or -3 = 0.003-inch
- PC +.03, PC 0.03 mm, +0.03 mm or -0.03 = 0.03 mm

(3) If you can't find the PC number or it's unreadable, install a new shim pack of the same thickness that you measured in 8. (1).

(4) If the old pinion cone number is a plus (+) number, subtract the number from the old shim pack thickness that was measured in 8. (2).

(5) If the old pinion cone number is a minus (-) number, add the number to the old shim pack thickness that was measured in 8. (2).

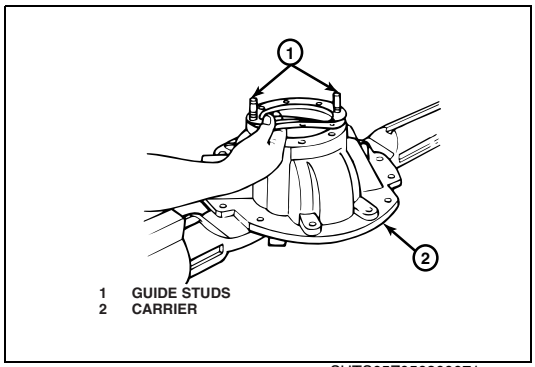
(6) Find the pinion cone (PC) variation number on the new drive pinion that will be installed. Record the number.

(7) If the new pinion cone number is a plus (+) number, add the number to the standard shim pack thickness that was calculated in 8. (4) or 8. (5). Use new shims to make a shim pack to the correct thickness. Refer to page DF02-35.

(8) If the new pinion cone number is a minus (-) number, subtract the number from the standard shim pack thickness that was calculated in 8. (4) or 8. (5). Use new shims to make a shim pack to the correct thickness. Refer to page DF02-35.

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Example	Inches	mm
1. Old Shim Pack Thickness. Old PC Number, PC +2 inches (+0.05 mm) Standard Shim Pack Thickness. New PC Number, PC +5 inches (+0.13 mm) New Shim Pack Thickness	0.030-0.002 = 0.028+0.005 = 0.033	0.760-0.050 = 0.710+0.130 = 0.840
2. Old Shim Pack Thickness Old PC Number, PC -2 inches (-0.05 mm) Standard Shim Pack Thickness. New PC Number, PC +5 inches (+0.13 mm) New Shim Pack Thickness	0.030+0.002 = 0.032+0.005 = 0.037	0.760+0.050 = 0.810+0.130 = 0.940
3. Old Shim Pack Thickness Old PC Number, PC -2 inches (-0.05 mm) Standard Shim Pack Thickness. New PC Number, PC -5 inches (-0.13 mm) New Shim Pack Thickness	0.030-0.002 = 0.032-0.005 = 0.023	0.760-0.050 = 0.710-0.130 = 0.580
4. Old Shim Pack Thickness Old PC Number, PC -2 inches (-0.05 mm) Standard Shim Pack Thickness. New PC Number, PC -5 inches (-0.13 mm) New Shim Pack Thickness	0.030+0.002 = 0.032-0.005 = 0.027	0.760+0.050 = 0.810-0.130 = 0.680



1 GUIDE STUDS
2 CARRIER

SHTS05Z050200071

9. INSTALLATION OF DRIVE PINION, BEARING CAGE AND SHIM PACK INTO THE CARRIER

NOTICE

If a new drive pinion and ring gear set is installed, or if the depth of the drive pinion has to be adjusted, calculate the thickness of the shim pack. Refer to the procedure Shim Pack Thickness for a New Drive Pinion on page DF02-34.

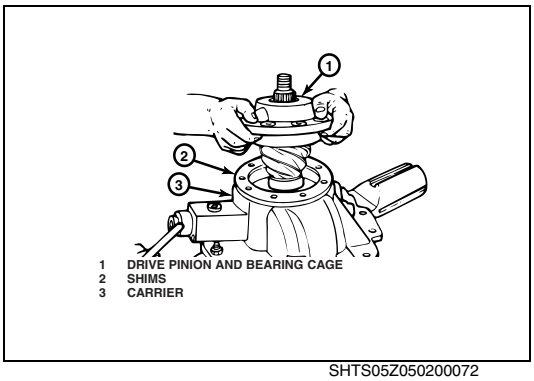
(1) Select the correct shim pack and install it between the bearing cage and carrier.

(2) Apply Loctite® 518 Gasket Eliminator to the carrier face.

(3) Align the oil slots in the shims with oil slots in the bearing cage and carrier. Use guide studs to help align the shims.

(4) Apply Loctite® 518 Gasket Eliminator to the top of the shim pack.

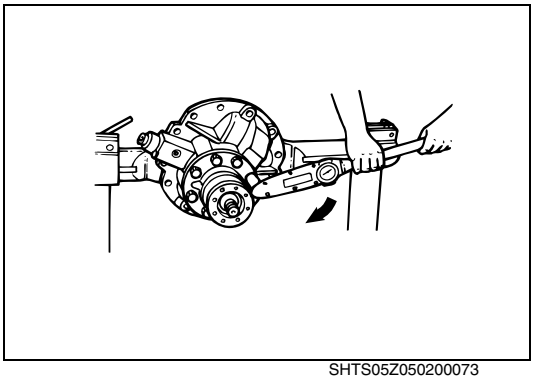
https://truckmanualshub.com/



1 DRIVE PINION AND BEARING CAGE
2 SHIMS
3 CARRIER

SHTS05Z050200072

(5) Install the drive pinion and bearing cage into the carrier. If necessary, use a rubber, plastic or leather mallet to hit the assembly into position.



SHTS05Z050200073

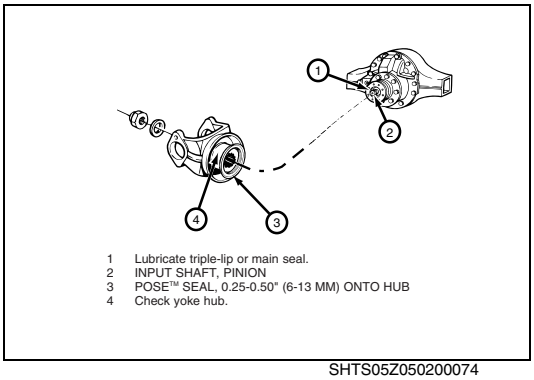
(6) Install the bearing cage-to-carrier capscrews and washers. Tighten the capscrews to the correct torque value. Refer to page DF02-12.

10. INSTALLATION OF TIGHT FIT YOKES AND POSE™ SEAL

⚠ CAUTION
Do not install tight fit yokes on shafts using a hammer or mallet. Using a hammer or mallet can damage the yoke.

The seal lips must be clean. Dirt and particles may cause a leak between the yoke and the POSE™ seal.

NOTICE
Do not install POSE™ seal all the way against the yoke shoulder. This seal is designed to position itself as yoke is installed.



1 Lubricate triple-lip or main seal.
2 INPUT SHAFT, PINION
3 POSE™ SEAL, 0.25-0.50" (6-13 MM) ONTO HUB
4 Check yoke hub.

SHTS05Z050200074

(1) Apply axle lubricant on the yoke seal.

(2) Check all surfaces of the yoke hub for damage.

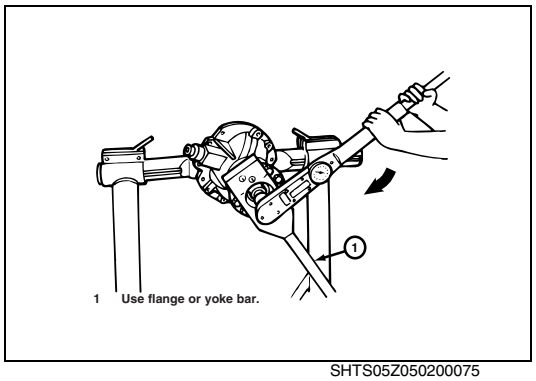
(3) If the carrier uses a POSE™ seal element, install a new POSE™ seal.
   a. Lightly lubricate the yoke journal with the same lubricant used in the axle housing.
   b. Partially install the POSE™ seal onto the yoke 0.25-0.5-inch (6-13 mm).
   c. Before installing the yoke onto the drive pinion, lubricate the yoke with the same lubricant used in the axle housing.

(4) Slide the yoke over the input shaft pinion. Align the yoke splines with the shaft splines.

⚠ CAUTION
Do not use a hammer or mallet to install the yoke to the input pinion shaft. Using a hammer or mallet can damage the yoke or flange.

(5) Install the input yoke flange onto the drive pinion shaft. The yoke or flange must be fully seated against the outer differential bearing before the nut is tightened to specifications.

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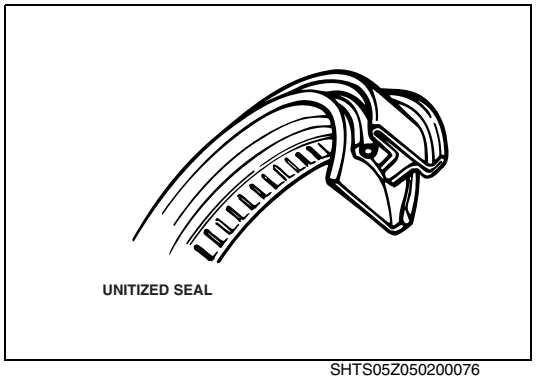
(6) Install the drive pinion nut and washer on the input pinion shaft and against the yoke collar. Tighten the nut against yoke collar to torque specifications. Refer to page DF02-12.

11. INSTALLATION OF ANY TYPE YOKE WITH A UNITIZED PINION SEAL (UPS)

NOTICE

Once the yoke is partially or fully installed and then removed for any reason, the unitized pinion seal will be damaged and unusable. If the yoke and unitized pinion seal are removed after partial or full installation, remove and discard the original unitized pinion seal and replace it with another new unitized pinion seal.

If the inner sleeve of the seal is removed, the seal is not usable. A new seal is required. This will occur if a yoke is installed into the seal and then removed.



SHTS05Z050200076

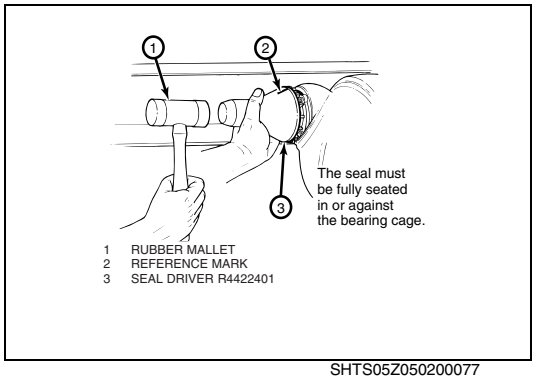
(1) Remove the replacement unitized seal from the package.

(2) Select the correct seal driver from page DF02-38. Each seal driver is designed to correctly install a specific diameter seal. To determine the yoke seal diameter, measure the yoke journal. Refer to page DF02-38.

(3) Position the seal on the driver.

⚠ CAUTION

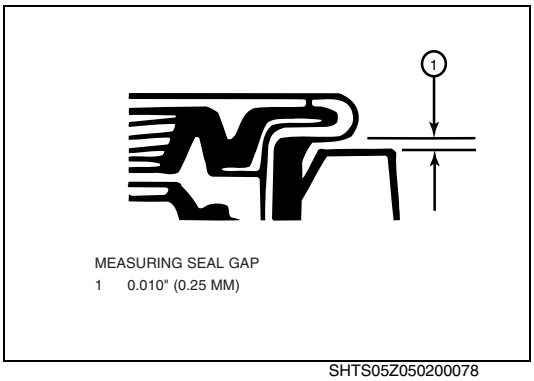
Use a rubber mallet to install the seal. Do not use a steel, brass or plastic hammer. Damage to the seal and driver tool can result.



SHTS05Z050200077

(4) Use a rubber mallet to drive the seal into or against the bearing cage. The seal must fully seat into or against the bearing cage.

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MEASURING SEAL GAP
1 0.010" (0.25 MM)

SHTS05Z050200078

(5) Use a 0.010-inch (0.25 mm) shim to check for clearance between the entire seal flange circumference and the bearing cage.

- **If the 0.010-inch (0.25 mm) shim slides between the seal flange and bearing cage:** Correctly position the seal driver and drive the seal into the bore until the 0.010-inch (0.25 mm) shim cannot slide between the seal flange and bearing cage at any point around the seal flange.

Unitized Pinion Seals and Seal Drivers

Single Models	Meritor Unitized Pinion Seal	Seal Installation Location	Meritor Seal Driver	Yoke Seal Diameter Inches
RS17-145 RS19-145 RS21-145 RS23-160	A-1205-N-2588	Single Rear Input — 145 models	R4422401	3.000 3.005
	A-1205-Q-2591	Single Rear Input — 160 models	R4422402	3.250 3.225
To obtain Meritor seal driver KIT 4454, refer to page DF02-9				

12. CLEAN, INSPECT AND INSTALL THE YOKE AFTER INSTALLING A UNITIZED PINION SEAL

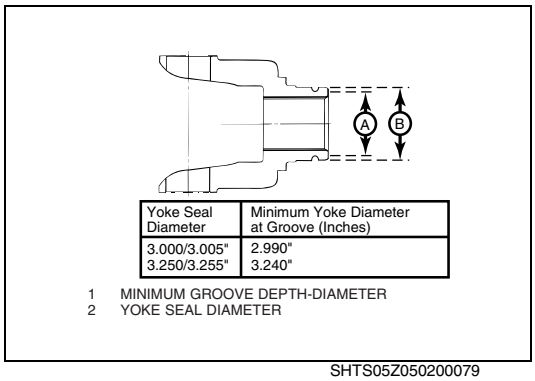
⚠ WARNING
Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, and emulsion-type and petroleum-base cleaners. Read the manufacturer's instructions before using a solvent cleaner, then carefully follow the instructions. Also follow the procedures below.

- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.**
- **You must use hot solution tanks or alkaline solutions correctly. Read the manufacturer's instructions before using hot solution tanks and alkaline solutions. Then carefully follow the instructions. safe eye protection.**

(1) Use a clean shop towel and a safe cleaning solvent to clean the ground and polished surface of the yoke journal. Do not use gasoline, abrasive cleaners, towels, or scrubbers to clean the yoke. Do not attempt to polish the yoke.

NOTICE
The unitized seal features a rubber inner sleeve that is designed to seal and rotate with the yoke. This feature allows you to reuse a yoke with minor grooves.

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Yoke Seal Diameter	Minimum Yoke Diameter at Groove (Inches)
3.000/3.005"	2.990"
3.250/3.255"	3.240"

1 MINIMUM GROOVE DEPTH-DIAMETER
2 YOKE SEAL DIAMETER

SHTS05Z050200079

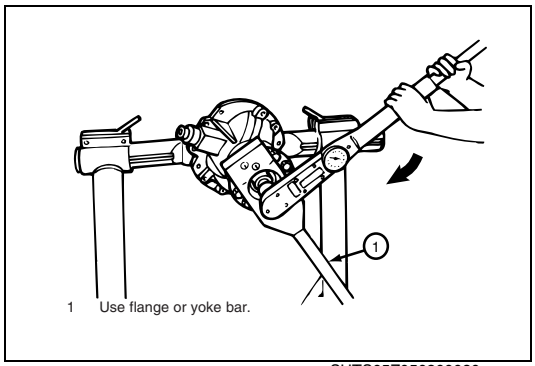
(2) Inspect the yoke seal surface for grooves.

- **If you find grooves on the yoke:** Use calipers to measure the groove diameters. If any groove diameter measures less than the dimensions shown in figure, replace the yoke.

⚠ CAUTION
Do not install a POSE™ seal after you install a unitized pinion seal. The use of a POSE™ seal will prevent correct seating of the unitized pinion seal on the yoke and can result in lubricant leakage at the seal. POSE™ seal installation is recommended only for triple lip and other previous design seals. Damage to components can result.

Do not use thin metal wear sleeves to refresh the yoke surface. Wear sleeves pressed onto the yoke can prevent correct seating of the pinion seal, damage the pinion seal assembly and can cause the seal to leak. Damage to components can result.

(3) Before you install the yoke, lightly lubricate or coat the yoke seal journal with axle oil.
(4) Align the yoke splines with the shaft splines. Slide the yoke over the shaft spline.



1 Use flange or yoke bar.

SHTS05Z050200080

⚠ CAUTION
Do not use a hammer or mallet to install the yoke to the input pinion shaft. Using a hammer or mallet can damage the yoke or flange.

(5) Install the input yoke flange onto the drive pinion shaft. The yoke or flange must be fully seated against the outer differential bearing before the nut is torqued to specifications.
(6) Install the drive pinion nut, and washer if required, on the input pinion shaft and against the yoke collar. Tighten the nut against yoke collar to torque specifications. Refer to page DF02-12.

13. ASSEMBLY OF MAIN DIFFERENTIAL AND RING GEAR ASSEMBLY

⚠ CAUTION
Heat the ring gear before seating it onto the differential case. Do not press a cold ring gear on the flange case half. A cold ring gear will damage the case half because of the tight fit.

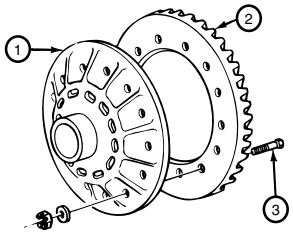
(1) Heat the ring gear in a tank of water to a temperature of 160°F-180°F (71°C-82°C) for 10 to 15 minutes.

⚠ WARNING
Wear safe clothing and gloves when working with the hot ring gear to prevent serious personal injury.

(2) Use a lifting tool to safely lift the ring gear from the tank of water.
(3) Install the ring gear on the flange case half immediately after the gear is heated.

- If the ring gear does not fit easily on the case half: Heat the gear again.

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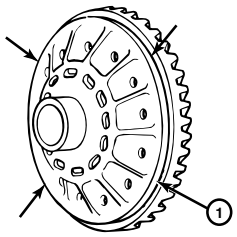
1 FLANGE CASE HALF
2 RING GEAR
3 BOLT HEAD AGAINST GEAR

SHTS05Z050200081

(4) Align the ring gear and the flange case half fastener holes. Rotate the ring gear as necessary.

NOTICE
If rivets were used to hold the ring gear to the flange case half, replace them with bolts, nuts and washers.

(5) Install the bolts, nuts and washers that hold the ring gear to the flange case half. Install the bolts from the gear side of the assembly. The bolt heads must be against the ring gear.



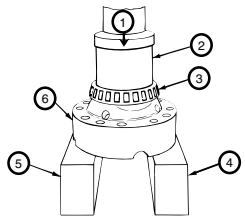
1 Check for 0.003" (0.08 mm) gap at four locations.

SHTS05Z050200082

(6) Tighten the bolts and nuts to the correct torque value. Refer to page DF02-12.

(7) Use a 0.003-inch (0.08 mm) feeler gauge to check for gaps between the back surface of the ring gear and the case flange. Check for gaps at four points around the assembly.

- **If the gaps exceed specifications:** Check the flange case half and ring gear for the problem that causes the gap. Repair or replace parts. Assemble the ring gear on the flange case half. Repeat the procedure in Tight Fit Yokes and POSE^{TM} Seal. Refer to page DF02-36.



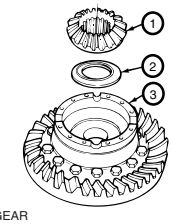
1 PRESS
2 SLEEVE
3 BEARING CONE
4 SUPPORT
5 SUPPORT
6 CASE HALF

SHTS05Z050200083

(8) Use a press and the correct size sleeve to install the bearing cones on both of the case halves.

(9) Apply axle lubricant on the inside surfaces of both case halves, spider or cross, thrust washers, side gears and differential pinions.

(10) Place the flange case half on a bench with the ring gear teeth toward the top.



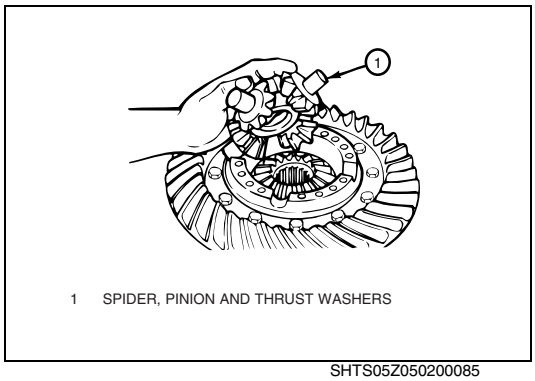
1 SIDE GEAR
2 THRUST WASHER
3 FLANGE CASE HALF

SHTS05Z050200084

(11) Install one thrust washer and side gear into the flange case half.

⚠ CAUTION
The side gears in some carrier models have hubs of different lengths. Install the correct length side gear into the flange case half. Otherwise, damage to components can result.

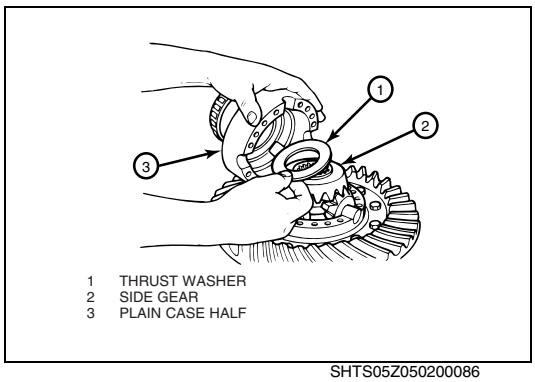
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1 SPIDER, PINION AND THRUST WASHERS

SHTS05Z050200085

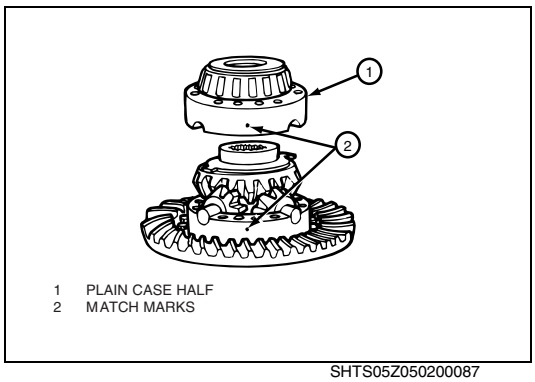
(12) Install the spider or cross, differential pinions and thrust washers into the flange case half.



1 THRUST WASHER
2 SIDE GEAR
3 PLAIN CASE HALF

SHTS05Z050200086

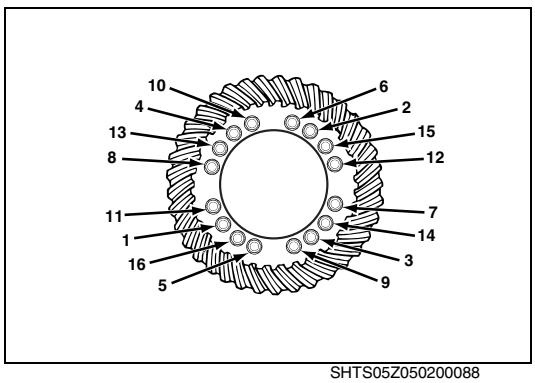
(13) Install the second side gear and thrust washer over the spider and differential pinions.



1 PLAIN CASE HALF
2 MATCH MARKS

SHTS05Z050200087

(14) Place the plain half of the differential case over the flange half and gears. Rotate the plain half to align the match marks.



SHTS05Z050200088

(15) Install Dri-Loc fasteners into the case halves. Refer to page DF02-58.

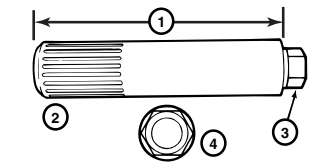
a. Install four capscrews and washers or bolts, nuts and washers, if equipped, into the case halves. The distance between the fasteners must be equal. Tighten the fasteners to the correct torque value in a progressive criss-cross pattern opposite each other. Refer to page DF02-12.
b. Install the other fasteners into the case halves. Tighten the fasteners to the correct torque value. Refer to page DF02-12.

(16) Check the differential gears rotating resistance.

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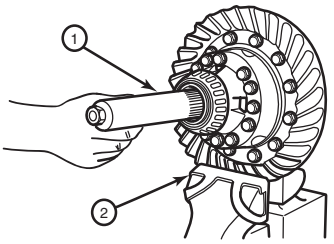
14. DIFFERENTIAL GEARS ROTATING RESISTANCE CHECK

(1) Make an inspection tool using an axle shaft that matches the spline size of the differential side gear. Cut the shaft to approximately 12-inches (304.8 mm). Weld a nut onto the end of the shaft.



1 APPROXIMATELY 12" (304.8 MM)
2 SIDE VIEW
3 Weld nut to end of shaft.
4 END VIEW

SHTS05Z050200089

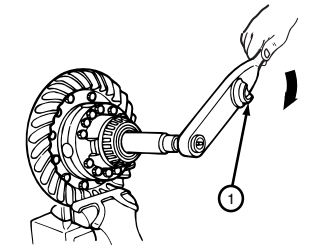


1 TOOL FOR CHECKING RESISTANCE
2 SOFT METAL COVER

SHTS05Z050200090

(2) Place the differential and ring gear assembly in a vise. Install soft metal covers over vise jaws to protect the ring gear.

(3) Install the tool into the differential until the splines of the tool are engaged with one side gear.



1 Read torque value.

SHTS05Z050200091

(4) Place a torque wrench onto the nut of the tool and rotate the differential gears. As the differential gears rotate, read the value indicated on the torque wrench.

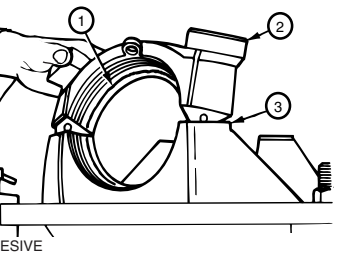
- **If the torque value exceeds 50 lb-ft (67.8 N·m):** Disassemble the differential gears from the case halves. Inspect the case halves, spider, gears and thrust washers. Repair or replace parts. Assemble the parts and repeat 14. (2) to (4).

15. INSTALLATION OF DIFFERENTIAL AND RING GEAR ASSEMBLY

(1) Clean and dry the bearing cups and bores of the carrier legs and bearing caps.

(2) Apply axle lubricant on the inner diameter of the bearing cups and on both bearing cones that are assembled on the case halves.

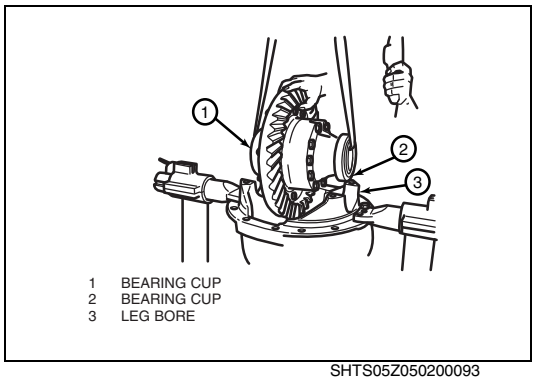
(3) Apply adhesive into the bearing bores of the carrier legs and bearing caps. Adhesive must not contact the adjusting ring threads. Refer to page DF02-59.



1 ADHESIVE
2 BEARING CAP
3 CARRIER LEG

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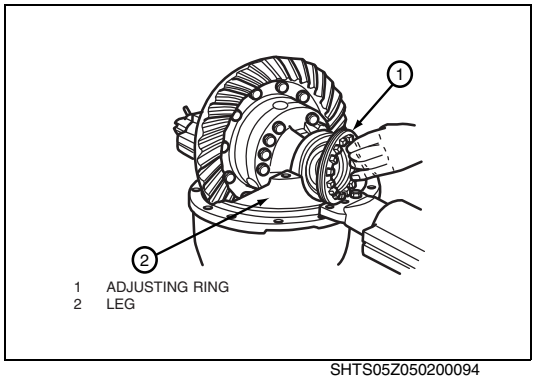


1 BEARING CUP
2 BEARING CUP
3 LEG BORE

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(4) Install the bearing cups over the bearing cones that are assembled on the case halves.

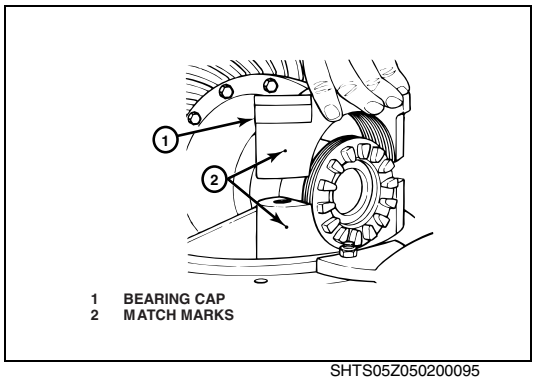
(5) Safely lift the differential and ring gear assembly and install it into the carrier. The bearing cups must be flat against the bores between the carrier legs.



1 ADJUSTING RING
2 LEG

SHTS05Z050200094

(6) Install both of the bearing adjusting rings into position between the carrier legs. Turn each adjusting ring hand-tight against the bearing cup.



1 BEARING CAP
2 MATCH MARKS

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(7) Install the bearing caps over the bearings and adjusting rings. Align the match marks you made when you removed the caps.

⚠ CAUTION
If bearing caps are not installed in correct locations, the bores and threads in caps will not match the carrier. You will have problems assembling the caps on the carrier and damage to parts can occur. Do not force the bearing caps into position.

(8) Seat each bearing cap with a light leather, plastic or rubber mallet. The caps must fit easily against the bearings, adjusting rings and carrier. Do not force the bearing caps into position.

- **If bearing caps do not correctly fit into position:** Check the alignment of match marks between caps and carrier. Remove the caps and repeat 15. (6) to (8).

(9) Install the capscrews and washers that hold bearing caps to the carrier. Hand-tighten the capscrews four to six turns. Tighten the capscrews to the correct torque value. Refer to page DF02-12.

NOTICE
Do not install the cotter keys, pins or lock plates, if equipped, that hold the bearing adjusting rings in position.

(10) Adjust differential bearing preload and hypoid gear backlash. Check the tooth contact patterns.

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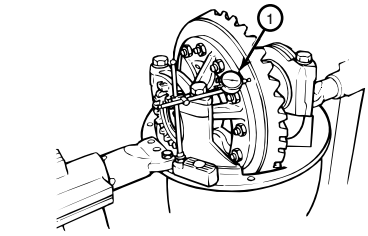
16. ADJUST DIFFERENTIAL BEARING PRELOAD

Differential Bearing Preload	**All Carrier Models**	**15-35 lb-in (1.7-3.9 N·m)**
Expansion between bearing caps	**RS-145 and RS-160 carrier models**	**0.002-0.009-inch (0.05-0.229 mm)**

17. METHOD 1

(1) Attach a dial indicator onto the carrier mounting flange so that the plunger or pointer is against the ring gear back surface.

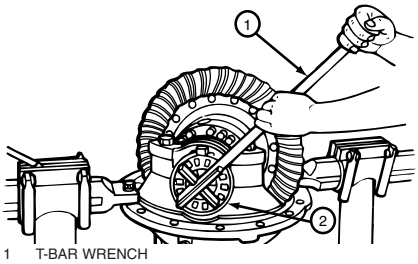
⚠ CAUTION
When you turn the adjusting rings, always use a tool that engages two or more opposite notches in the ring. A T-bar wrench can be used for this purpose. If the tool does not correctly fit into the notches, damage to the lugs will occur.



1 DIAL INDICATOR

SHTS05Z050200096

(2) Use a T-bar wrench to loosen the bearing adjusting ring that is opposite the ring gear. A small amount of end play will show on the dial indicator.



1 T-BAR WRENCH
2 ADJUSTING RING OPPOSITE RING GEAR

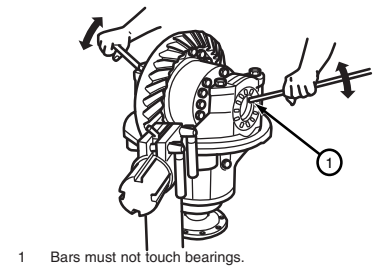
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(3) Use one of the following methods to move the differential and ring gear to the left and right while you read the dial indicator.

a. Insert two pry bars between the bearing adjusting rings and ends of the differential case. The pry bars must not touch the differential bearings.
b. Insert two pry bars between the differential case or ring gear and the carrier at locations other than described in (3) a. The pry bars must not touch the differential bearings.

(4) Tighten the bearing adjusting ring until the dial indicator reads ZERO end play. Move the differential and ring gear to the left and right as needed. If necessary, repeat (3) a. or b.

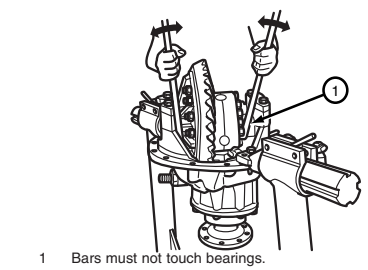
(5) Tighten each bearing adjusting ring one notch from ZERO.



1 Bars must not touch bearings.

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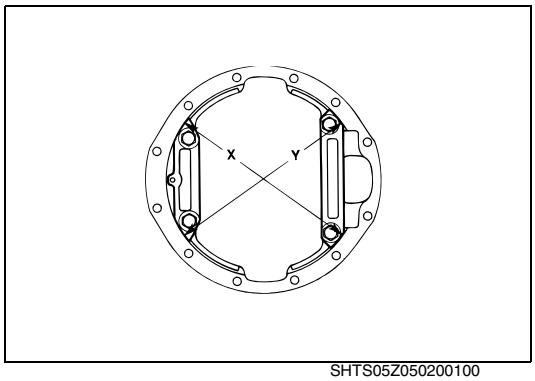
(6) Proceed to check ring gear runout.



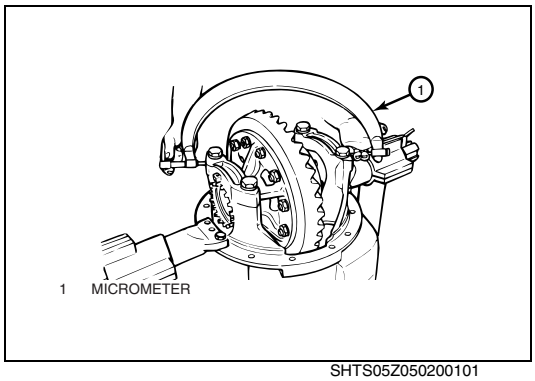
1 Bars must not touch bearings.

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18. METHOD 2

(1) Hand-tighten both adjusting rings against the differential bearings.

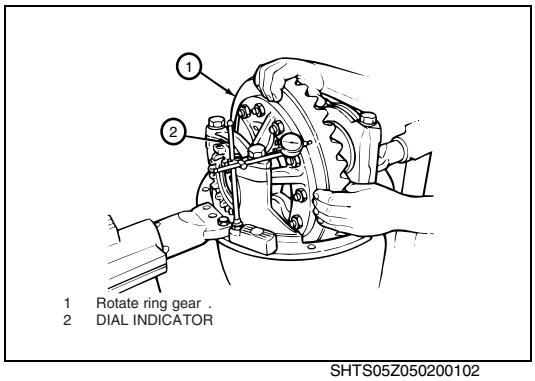
(2) Use a micrometer to measure distance X or Y between the opposite surfaces of the bearing caps. Record the measurement.

(3) Tighten each bearing adjusting ring one notch.

(4) Measure distance X or Y again. Compare the measurement with the one you obtained in 18. (2). The difference between the two dimensions is the amount the bearing caps have expanded.

Example

- Measurements of RS-145 carrier
- Distance X or Y
  — before tightening adjusting rings = 13.927-inch (353.74 mm).
- Distance X or Y
  — after tightening adjusting rings = 13.936-inch (353.97 mm).
- 13.936-inch – 13.927-inch = 0.009-inch 0.23 mm) difference.
- **If the dimension is within specifications:**
  Continue by checking ring gear runout.
- **If the dimension is less than specifications:**
  Repeat 18(3) and 18(4) as needed.



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19. CHECK RING GEAR RUNOUT

(1) Attach a dial indicator onto the carrier mounting flange.

(2) Adjust the dial indicator so that the plunger or pointer is against the back surface of the ring gear. Set the dial indicator to ZERO.

(3) Rotate the differential and ring gear. Read the dial indicator. Runout must not exceed 0.008-inch (0.20 mm).

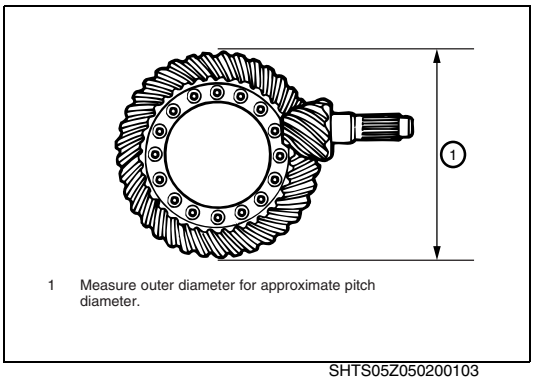
- **If runout exceeds specifications:** Remove the differential and ring gear assembly from the carrier. Refer to Differential and Ring Gear from the Carrier on page DF02-18 and 19. (4) and (5).
- **If runout is within specifications:** Proceed to Ring Gear Backlash Adjustment.

(4) Check the differential parts including the carrier for wear and damage. Repair or replace parts.

(5) Install the differential and ring gear into the carrier. Refer to page DF02-42. Repeat the preload adjustment of the differential bearings.

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20. RING GEAR BACKLASH ADJUSTMENT



1 Measure outer diameter for approximate pitch diameter.

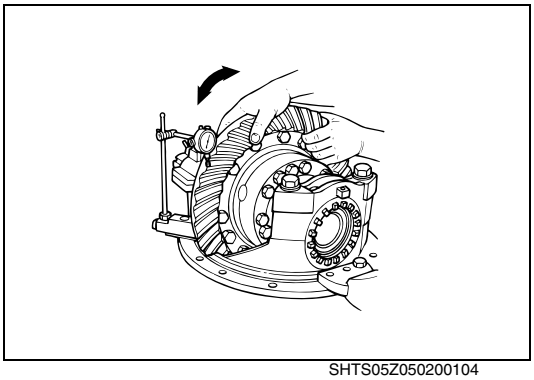
SHTS05Z050200103

Ring Gear Pitch Diameter	Range of Backlash Setting	Backlash Setting for New Gear Sets
Less than 17-inches (431.8 mm)	0.008-0.018-inch (0.20-0.46 mm)	0.012-inch (0.30 mm)
Greater than 17-inches (431.8 mm)	0.010-0.020-inch (0.25-0.51 mm)	0.015-inch (0.38 mm)

Measure the outer diameter of ring gear for approximate pitch diameter.

- **If the old gear set is installed:** Adjust the backlash to the setting that was measured before the carrier was disassembled.
- **If a new gear set is installed:** Adjust the backlash to the correct specification for new gear sets.

After checking the tooth contact patterns, the backlash can be adjusted within specification limits, if needed. To change the location of the pattern use the following procedures.



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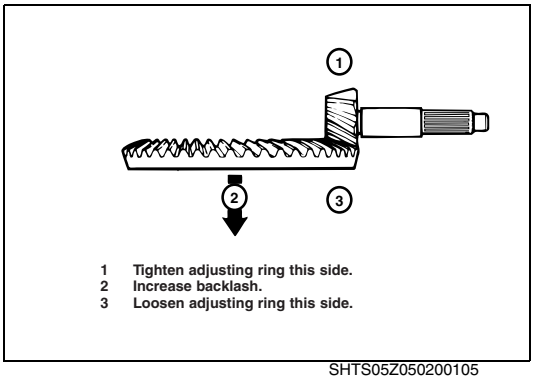
(1) Attach a dial indicator onto the mounting flange of the carrier.

(2) Adjust the dial indicator so that the plunger or pointer is against the tooth surface.

(3) Adjust the indicator dial to ZERO. Hold the drive pinion in position.

(4) After reading the dial indicator, rotate the differential and ring gear a small amount in both directions against the drive pinion teeth.

- **If the backlash reading is within specifications:** Check the tooth contact patterns.
- **If the backlash reading is not within specifications:** Adjust backlash as needed.

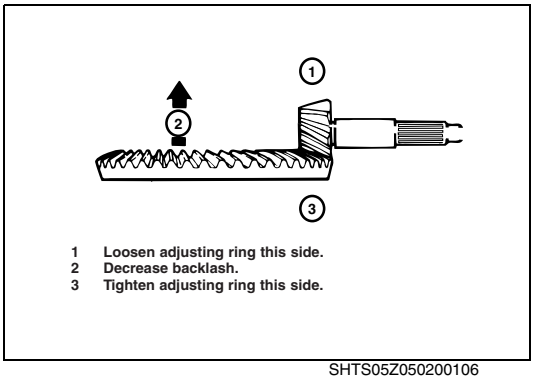


1 Tighten adjusting ring this side.
2 Increase backlash.
3 Loosen adjusting ring this side.

SHTS05Z050200105

(5) Loosen one bearing adjusting ring one notch then tighten the opposite ring the same amount.

- **To increase backlash:** Move the ring gear away from the drive pinion.



1 Loosen adjusting ring this side.
2 Decrease backlash.
3 Tighten adjusting ring this side.

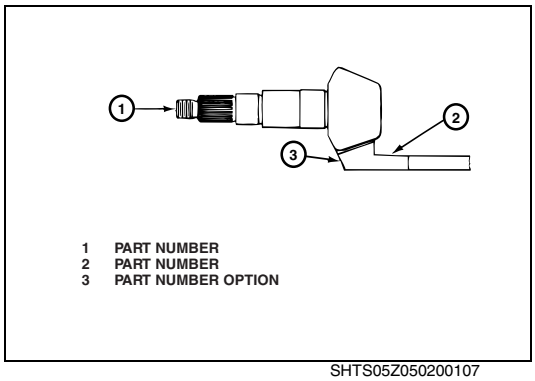
SHTS05Z050200106

- **To decrease backlash:** Move the ring gear toward the drive pinion.

NOTICE
When you adjust backlash, move the ring gear only. Do not move the drive pinion.

(6) Repeat 20. (2) to (5) until the backlash is within specifications.

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1 PART NUMBER
2 PART NUMBER
3 PART NUMBER OPTION

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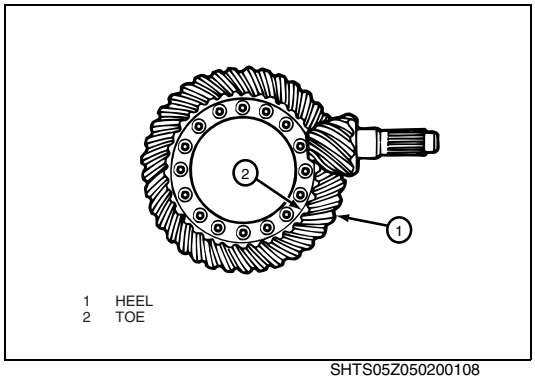
21. CHECK GEAR SET TOOTH CONTACT PATTERNS (BACKLASH)

Some Meritor carriers have a generoid hypoid gear set. The tooth contact patterns for each type of gear set are different. Check the part numbers to determine what type of gear set is in the carrier.Refer to figure for the location of part numbers.

Example

Part numbers for generoid gear sets

- 36786-K or 36786-K2 for the ring gear
- 36787-K or 36787-K2 for the drive pinion

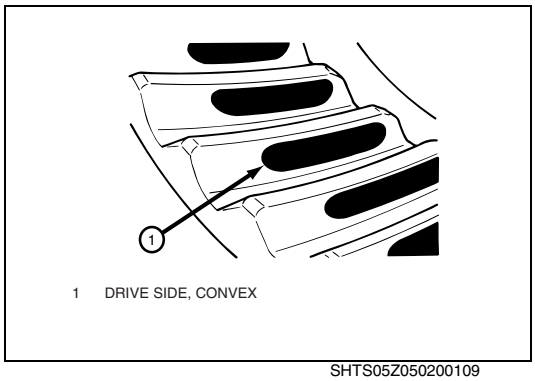


1 HEEL
2 TOE

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In the following procedures, movement of the contact pattern in the length of the tooth is indicated as toward the heel or toe of the ring gear.

Always check tooth contact patterns on the drive side of the gear teeth.



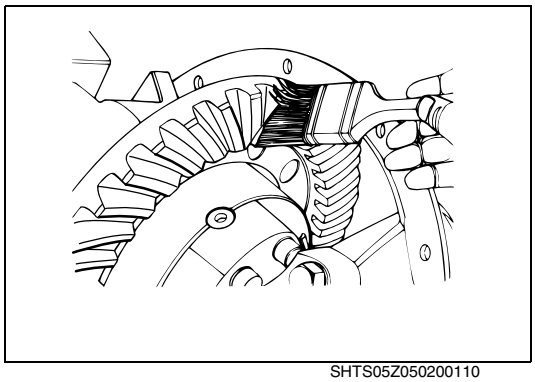
1 DRIVE SIDE, CONVEX

SHTS05Z050200109

(1) Adjust the backlash of a new gear set to either 0.012-inch (0.305 mm) or 0.015-inch (0.380 mm) depending on the size of the ring gear. Adjust the backlash of an old gear set to the setting that you measured before the carrier was disassembled. Refer to page DF02-46.

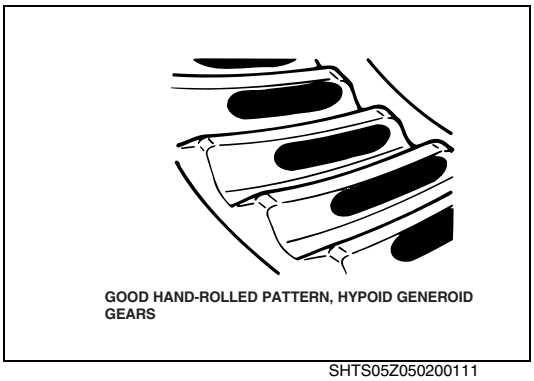
(2) Apply a marking compound onto approximately 12 gear teeth of the ring gear. Rotate the ring gear so that the 12 gear teeth are next to the drive pinion.

(3) Rotate the ring gear forward and backward so that the 12 gear teeth go past the drive pinion six times to get the contact patterns. Repeat if needed to get a clearer pattern.



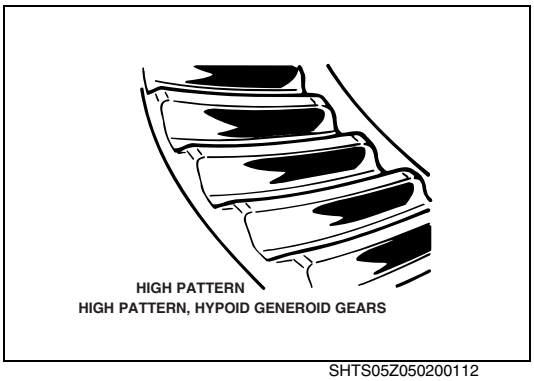
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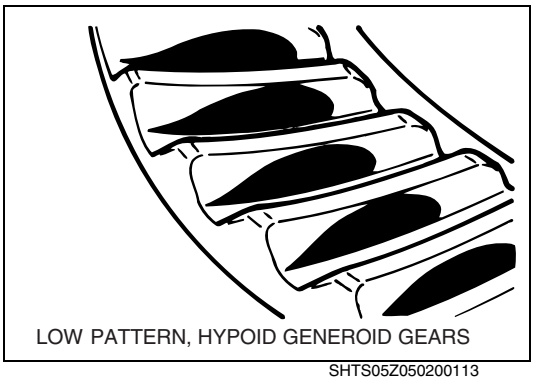
GOOD HAND-ROLLED PATTERN, HYPOID GENEROID GEARS

SHTS05Z050200111



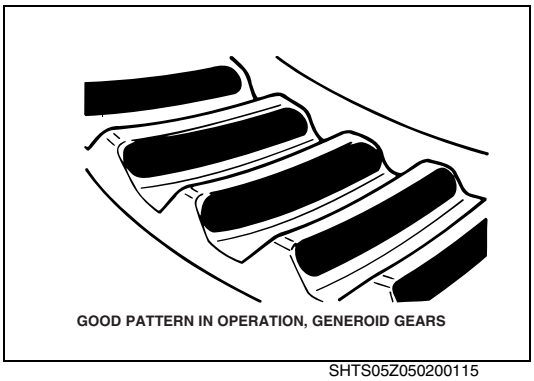
HIGH PATTERN
HIGH PATTERN, HYPOID GENEROID GEARS

SHTS05Z050200112



LOW PATTERN, HYPOID GENEROID GEARS

SHTS05Z050200113



GOOD PATTERN IN OPERATION, GENEROID GEARS

SHTS05Z050200115

(4) Look at the contact patterns on the ring gear teeth. Compare the patterns to figures.

The location of good hand-rolled contact patterns for new conventional and generoid gear sets is toward the toe of the gear tooth and in the center between the top and bottom of the tooth.

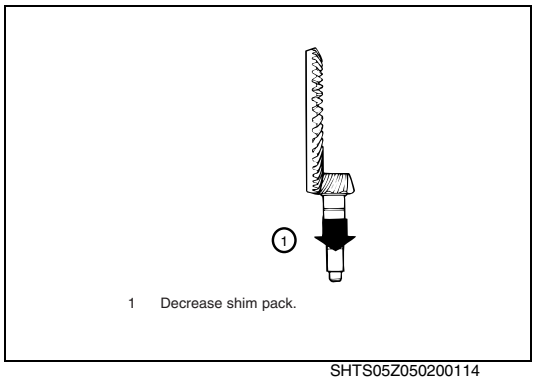
When the carrier is operated, a good pattern will extend approximately the full length of the gear tooth. The top of the pattern will be near the top of the gear tooth.

The location of a good hand-rolled contact pattern for an old gear set must match the wear pattern in the ring gear. The new contact pattern will be smaller in area than the old wear pattern.

A high contact pattern indicates that the drive pinion was not installed deep enough into the carrier. A low contact pattern indicates that the drive pinion was installed too deep in the carrier.

- **If the contact patterns require adjustment:** Continue by following 21. (5) to move the contact patterns between the top and bottom of the gear teeth.
- **If the contact patterns are in the center of the gear teeth:** Continue by following 21. (6).

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1 Decrease shim pack.

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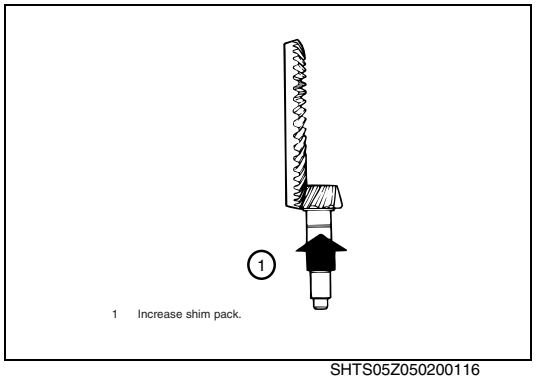
(5) Change the thickness of the shim pack under the bearing cage to move the contact patterns between the top and bottom of the gear teeth. Use the following procedure.

a. Remove the drive pinion and bearing cage from the carrier. Refer to Drive Pinion and Bearing Cage from the Carrier on page DF02-21.

- **To correct a high contact pattern:** Decrease the thickness of the shim pack under the bearing cage. When decreasing the thickness of the shim pack, the drive pinion will move toward the ring gear.
- **To correct a low contact pattern:** Increase the thickness of shim pack under the bearing cage. When increasing the thickness of the shim pack, the drive pinion will move away from the ring gear.

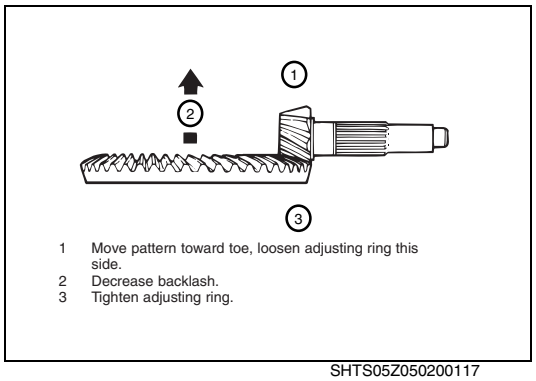
b. Install the drive pinion, bearing cage and shims into the carrier. Refer to page DF02-34 in this section.

c. Repeat 21. (2) to (5) until the contact patterns are in the center between the top and bottom of the gear teeth.



1 Increase shim pack.

SHTS05Z050200116



1 Move pattern toward toe, loosen adjusting ring this side.
2 Decrease backlash.
3 Tighten adjusting ring.

SHTS05Z050200117

(6) Adjust backlash of the ring gear within the specification range to move the contact patterns to the correct location in the length of the gear teeth. Refer to page DF02-46.

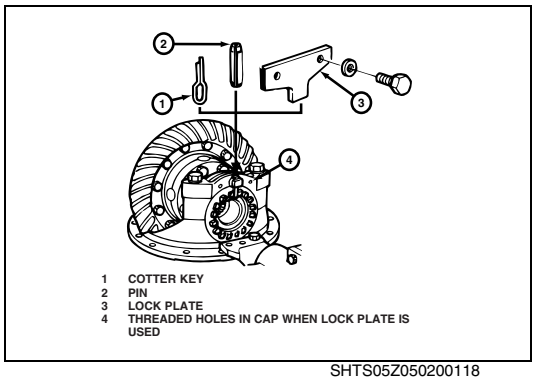
a. Decrease backlash to move the contact patterns toward the toe of the ring gear teeth.

b. Increase backlash to move the contact patterns toward the heel of the ring gear teeth.

c. Repeat 21. (2) to (4) and 21. (6) until the contact patterns are at the correct location in the length of the gear teeth.

⚠ CAUTION

If the carrier has cotter keys, lock the adjusting rings only with cotter keys. If the carrier has roll pins, reuse the roll pins or lock the adjusting rings with cotter keys. Do not force a roll pin into a cotter key hole. Damage to components can result.



1 COTTER KEY
2 PIN
3 LOCK PLATE
4 THREADED HOLES IN CAP WHEN LOCK PLATE IS USED

SHTS05Z050200118

(7) Install the cotter keys, pins, or lock plates, if equipped, that hold the two bearing adjusting rings in position. Use the following procedures.

a. Install cotter keys between the lugs of the adjusting ring and through the boss of the bearing cap. Bend the two ends of the cotter key around the boss.

b. Use a drift and hammer to install the pin through the boss of the bearing cap until the pin is between the lugs of the adjusting ring.

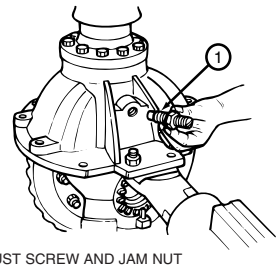
c. Install the lock plate on the bearing cap so that the tab is between the lugs of the adjusting ring. Install the two capscrews that hold the lock plate to the bearing cap. Tighten the capscrews to correct torque value. Refer to page DF02-12.

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22. ADJUST THE THRUST SCREW

(1) Rotate the carrier in the repair stand until the back surface of ring gear is toward the top.

(2) Install the jam nut on the thrust screw, if equipped, one half the distance between both ends.

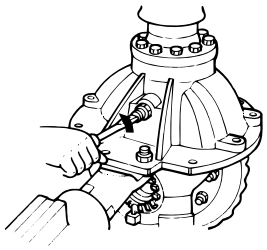


1 THRUST SCREW AND JAM NUT

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(3) Install the thrust screw. Clearance between the thrust screw and the ring gear must be 0.025-0.045-inch (0.65-1.14 mm).

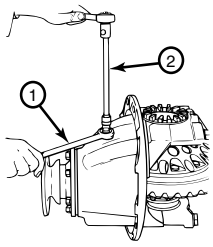
(4) Loosen the thrust screw 1/2 turn, 180 degrees.



1 Loosen thrust screw 1/2 turn.

SHTS05Z050200120

(5) Tighten the jam nut, if equipped, to the correct torque value against the carrier. Refer to page DF02-12.



1 Hold thrust screw in position.
2 Tighten jam nut to correct torque value.

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23. INSTALLATION OF DIFFERENTIAL CARRIER INTO AXLE HOUSING

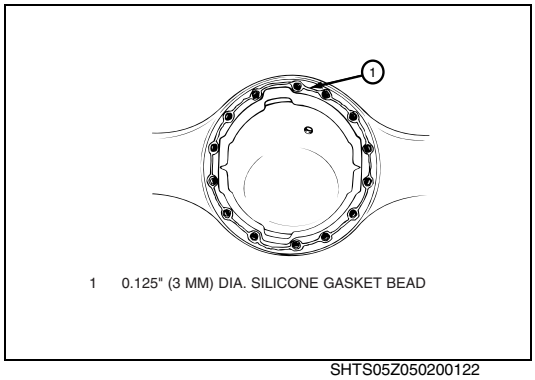
⚠ WARNING

When you apply some silicone gasket materials, a small amount of acid vapor is present. To prevent serious personal injury, ensure that the work area is well-ventilated. Read the manufacturer's instructions before using a silicone gasket material, then carefully follow the instructions. If a silicone gasket material gets into your eyes, follow the manufacturer's emergency procedures. Have your eyes checked by a physician as soon as possible.

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, and emulsion-type and petroleum-base cleaners. Read the manufacturer's instructions before using a solvent cleaner, then carefully follow the instructions. Also follow the procedures below.

- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.**
- **You must use hot solution tanks or alkaline solutions correctly. Read the manufacturer's instructions before using hot solution tanks and alkaline solutions. Then carefully follow the instructions.**

(1) Use a cleaning solvent and rags to clean the inside of the axle housing and the carrier mounting surface. Refer to page DF02-54.
(2) Inspect the axle housing for damage. Repair or replace the axle housing.
(3) Check for loose studs, if equipped, in the mounting surface of the housing where the carrier fastens. Remove and clean the studs that are loose.
(4) Apply liquid adhesive to the threaded holes. Install the studs into axle housing. Refer to page DF02-58. Tighten the studs to correct torque value. Refer to page DF02-11.
(5) Apply silicone gasket material to the mounting surface of the housing where the carrier fastens. Refer to DF02-59.



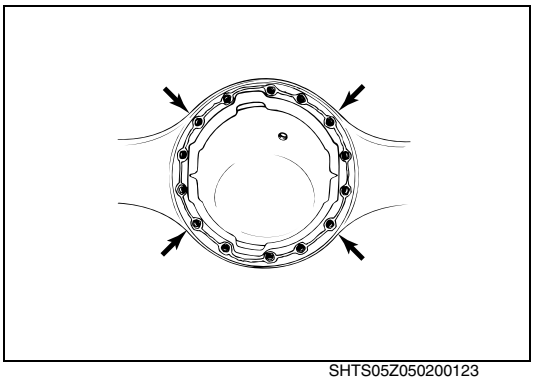
1 0.125" (3 MM) DIA. SILICONE GASKET BEAD

SHTS05Z050200122

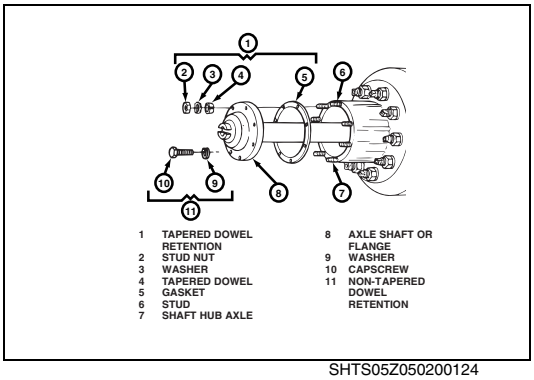
⚠ CAUTION

Do not install the carriers using a hammer or mallet. A hammer or mallet will damage the mounting flange of carrier and cause oil leaks.

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SHTS05Z050200123



SHTS05Z050200124

(6) Use a hydraulic roller jack or a lifting tool to install the carrier into the axle housing.

(7) Install nuts and washers or capscrews and washers, if equipped, in the four corner locations around the carrier and axle housing. Hand-tighten the fasteners.

(8) Carefully push the carrier into position. Tighten the four fasteners two or three turns each in a pattern opposite each other.

(9) Repeat 23. (8) until the four fasteners are tightened to the correct torque value. Refer to page DF02-11.

(10) Install the other fasteners and washers that hold the carrier in the axle housing. Tighten fasteners to the correct torque value. Refer to page DF02-11.

(11) Connect the driveline universal joint to the pinion input yoke or flange on the carrier.

(12) Install the gaskets and axle shafts into the axle housing and carrier. The gasket and flange of the axle shafts must fit flat against the wheel hub.

24. INSTALLATION OF STRAIGHT HOLES, NUTS AND HARDENED WASHERS

(1) Clean the mating surfaces of the axle shaft and the wheel hub.

(2) If silicone gasket material is used, apply a 0.125-inch (3 mm) diameter bead of the gasket material around the mating surface of the hub and around the edge of each fastener hole.

(3) Install the gasket and the axle shaft into the housing. The gasket and the flange of the axle shaft must fit flat against the wheel hub.

(4) Install the Grade 8 nuts and hardened washers on the stud. Lock washers are an acceptable alternative. Tighten the stud nuts to the torque specified.

Shaft-to-Hub Torque Fastener Chart — Non-Tapered Dowel Applications

Fastener	Thread Size	Torque Value — Grade 8 Nuts lb-ft (N·m)	
		Plain Nut	Lock Nut
Stud Nut, Axle Shaft	0.62-18	150-230 (244-312)	130-190 (203-258)
	0.75-16	310-400 (420-542)	270-350 (366-475)
Studs	All	Install the course thread end of stud into hub and tighten to last thread.	

25. INSTALLATION OF TAPERED DOWEL, HARDENED WASHER AND HARDENED NUT

(1) Clean the mating surfaces of the axle shaft and the wheel hub.

(2) If silicone gasket material is used, apply a 0.125-inch (3 mm) diameter bead of the gasket material around the mating surface of the hub and around the edge of each fastener hole.

(3) Install the gasket and the axle shaft into the housing. The gasket and the flange of the axle shaft must fit flat against the wheel hub.

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(4) Install solid tapered dowels over each stud and into the flange of the axle shaft. Use a punch or a drift and hammer, if necessary.
(5) Install the Grade 8 nuts and hardened washers on the stud. Lock washers are an acceptable alternative. Tighten the stud nuts to the torque specified.

Shaft-to-Hub Torque Fastener Chart Tapered Dowel Applications

Fastener	Thread Size	Torque Value — Grade 8 Nuts lb-ft (N·m)	
		Plain Nut	Lock Nut
Stud Nut, Axle Shaft	0.44-20	50-70 (81-102)	40-65 (67-88)
	0.50-20	75-115 (115-156)	65-100 (102-136)
	0.56-18	110-165 (176-224)	100-145 (149-197)
	0.62-18	150-230 (244-312)	130-190 (203-258)
Studs	All	Install the course thread end of stud into hub and tighten to last thread.	

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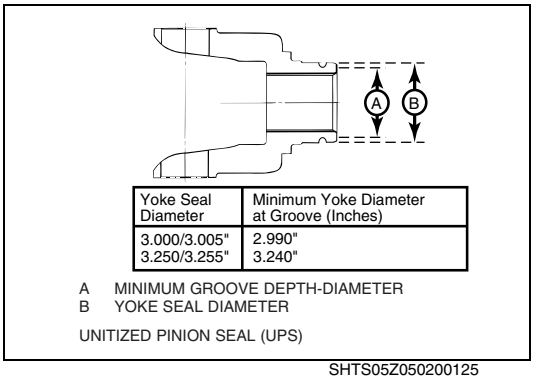
INSPECTION AND REPAIR

EN05Z0502H300001

1. CLEAN AND INSPECT YOKES

⚠ CAUTION
Do not install a press on shaft excluder or POSE™ seal after installation of a unitized pinion seal. The use of a POSE™ seal will prevent correct seating of the unitized pinion seal on the yoke and will result in lubricant leakage at the seal. POSE™ seal installation is recommended only for triple lip and other previous design seals.

Do not use thin metal wear sleeves to refresh the yoke surface. Wear sleeves pressed onto the yoke will prevent correct seating of the pinion seal and damage the pinion seal assembly. Wear sleeve usage will cause the seal to leak.



Yoke Seal Diameter	Minimum Yoke Diameter at Groove (Inches)
3.000/3.005"	2.990"
3.250/3.255"	3.240"

A MINIMUM GROOVE DEPTH-DIAMETER
B YOKE SEAL DIAMETER

UNITIZED PINION SEAL (UPS)

SHTS05Z050200125

(1) Clean the ground and polished surface of the yoke journal using a clean shop towel and a safe cleaning solvent. Do not use abrasive cleaners, towels, or scrubbers to clean yoke or flange surface. Do not use gasoline.

(2) Inspect the yoke seal surface for any grooves.

a. If grooves are present on yoke hubs used with single or triple lip seals, the yokes must be replaced.

b. If grooves are present, use calipers to measure the groove diameters. If any of the yoke grooves measure less than the dimensions in, replace the yoke.

2. CLEAN GROUND AND POLISHED PARTS

(1) Use a cleaning solvent to clean ground or polished parts or surfaces. Kerosene or diesel fuel oil can be used for this purpose. Do not use gasoline.

(2) Use a tool with a flat blade if required, to remove sealant material from parts. Be careful not to damage the polished or smooth surfaces.

⚠ CAUTION
Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts can result.

(3) Do not clean ground or polished parts with water or steam. Do not immerse ground or polished parts in a hot solution tank or use strong alkaline solutions for cleaning, or the smooth sealing surface may be damaged.

3. CLEAN ROUGH PARTS

(1) Clean rough parts with the same method as cleaning ground and polished parts.

(2) Rough parts can be cleaned in hot solution tanks with a weak or diluted alkaline solution.

(3) Parts must remain in hot solution tanks until heated and completely cleaned.

(4) Parts must be washed with water until all traces of the alkaline solution are removed.

4. CLEAN AXLE ASSEMBLIES

(1) A complete axle assembly can be steam cleaned on the outside to remove dirt.

(2) Before the axle is steam cleaned, close or place a cover over all openings in the axle assembly. Examples of openings are breathers or vents in air chambers.

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5. DRY PARTS AFTER CLEANING

(1) Parts must be dried immediately after cleaning and washing.

(2) Dry the parts using soft, clean paper or cloth rags.

⚠ CAUTION

Damage to bearings can result when they are rotated and dried with compressed air.

(3) Except for bearings, parts can be dried with compressed air.

6. PREVENT CORROSION ON CLEANED PARTS

(1) Apply axle lubricant to cleaned and dried parts that are not damaged and are to be assembled.

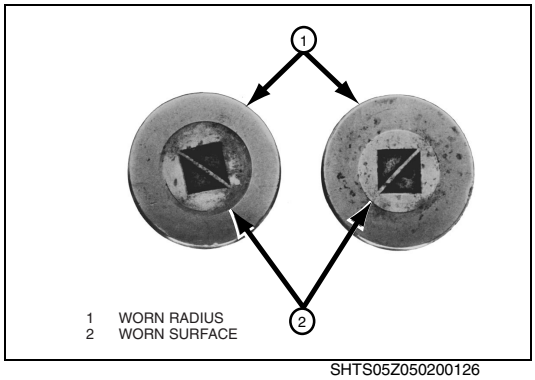
(2) To store parts, apply a special material that prevents corrosion to all surfaces. Wrap cleaned parts in a special paper that will protect the parts from moisture and prevent corrosion.

7. INSPECT PARTS

It is very important to inspect all parts carefully and completely before the axle or carrier is assembled. Check all parts for wear and replace damaged parts.

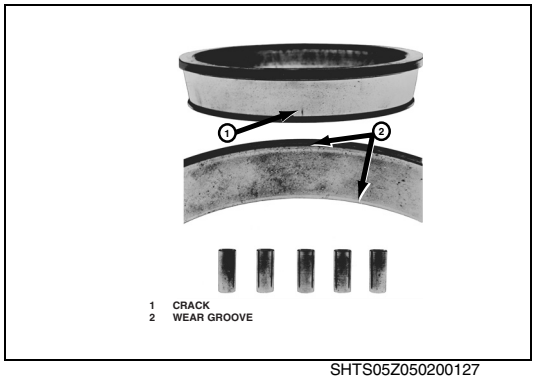
(1) Inspect the cup, cone, rollers and cage of all tapered roller bearings in the assembly. If any of the following conditions exist, replace the bearing.

- The center of the large-diameter end of the rollers is worn level with or below the outer surface.
- The radius at the large-diameter end of the rollers is worn to a sharp edge.



1 WORN RADIUS
2 WORN SURFACE

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1 CRACK
2 WEAR GROOVE

SHTS05Z050200127

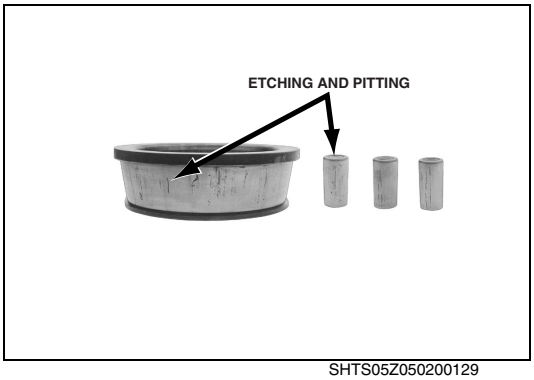
- There is a visible roller groove in the cup or cone inner race surfaces. The groove can be seen at the small- or large-diameter end of both parts.
- There are deep cracks or breaks in the cup, cone inner race or roller surfaces.

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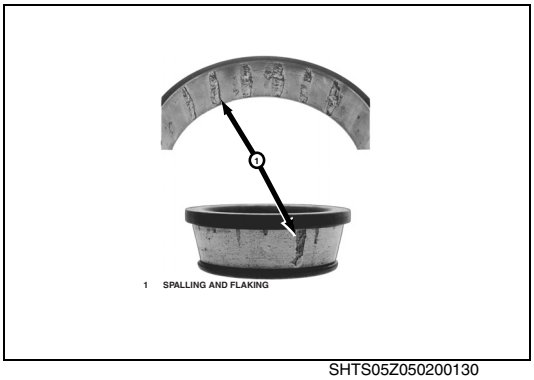
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- There are bright wear marks on the outer surface of the roller cage.



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- There is damage on the rollers and on the surfaces of the cup and cone inner race that touch the rollers.

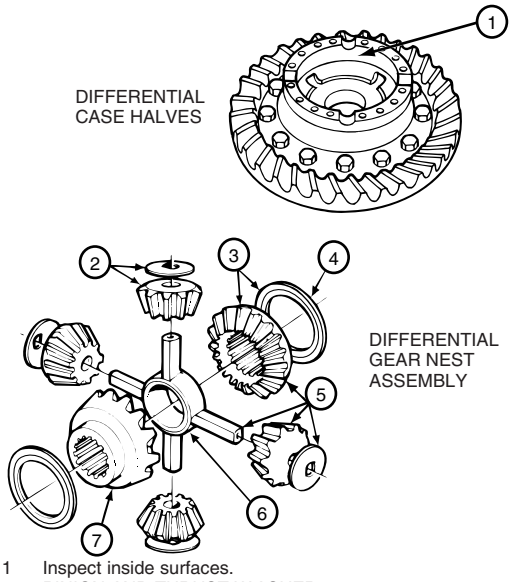


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- There is damage on the cup and cone inner race surfaces that touch the rollers.

⚠ CAUTION
A drive pinion and ring gear are machined as a matched set. When you replace either a drive pinion or a ring gear, you must replace both parts as a matched set. Do not mix old and new parts. Damage to components can result.

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1 Inspect inside surfaces.
2 PINION AND THRUST W ASHER
3 SIDE GEAR AND THRUST WASHER
4 Inspect.
5 Inspect.
6 SPIDER OR CROSS
7 Inspect.

SHTS05Z050200131

(2) Inspect hypoid pinions and gears for wear and damage. Replace gears that are worn or damaged.

⚠ CAUTION
A thrust washer, differential side gear and pinion gear are machined as a matched set. When you replace any of these parts, you must install a new matched set. Do not mix old and new parts. Damage to components can result.

(3) Inspect the following main differential assembly parts for wear or stress. Replace parts that are damaged.

- Inside surfaces of both case halves
- Both surfaces of all thrust washers
- The four trunnion ends of the spider or cross
- Teeth and splines of both differential side gears
- Teeth and bore of all differential pinions

(4) Inspect axle shafts for wear and cracks at the flange, shaft and splines. Replace the axle shafts, if required.

(5) Inspect the breather.

a. Remove the breather from the axle housing.

b. Clean the breather. If the breather remains dirty after cleaning, replace the breather.

c. Apply compressed air to the breather. If compressed air does not pass through the breather, replace the breather.

d. Install the breather in the axle housing.

8. REPAIR OR REPLACE PARTS

NOTICE
Threads must be without damage and clean so that accurate adjustments and correct torque values can be applied to fasteners and parts.

(1) Replace any fastener if corners of the head are worn.
(2) Replace washers if damaged.
(3) Replace gaskets, oil seals or grease seals at the time of axle or carrier repair.
(4) Clean parts and apply new silicone gasket material where required when axle or carrier is assembled.
(5) Remove nicks, mars and burrs from parts with machined or ground surfaces. Use a fine file, India stone, emery cloth or crocus cloth.
(6) Clean and repair threads of fasteners and holes. Use a die or tap of the correct size or a fine file.

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FASTENERS

1. REMOVING FASTENERS SECURED WITH ADHESIVE

If it is difficult to remove fasteners secured with Dri-Loc®, Meritor adhesive or Loctite® 277 adhesive, use the following procedure.

When you remove fasteners secured with adhesive, slowly heat the fastener to 350°F (177°C). Do not exceed this temperature, or heat fasteners quickly. Damage to components can result.

(1) Heat the fastener for three to five seconds. Try to loosen the fastener with a wrench. Do not use an impact wrench or hit the fastener with a hammer.
(2) Repeat step (1) until you can remove the fastener.

2. NEW FASTENERS WITH PRE-APPLIED ADHESIVE

NOTICE
No drying time is required for fasteners with pre-applied adhesive.

(1) Use a wire brush to clean the oil and dirt from threaded holes.
(2) Install new fasteners with pre-applied adhesive to assemble parts. Do not apply adhesives or sealants to fasteners with pre-applied adhesive, or to fastener holes.
(3) Tighten the fasteners to the required torque value for that size fastener.

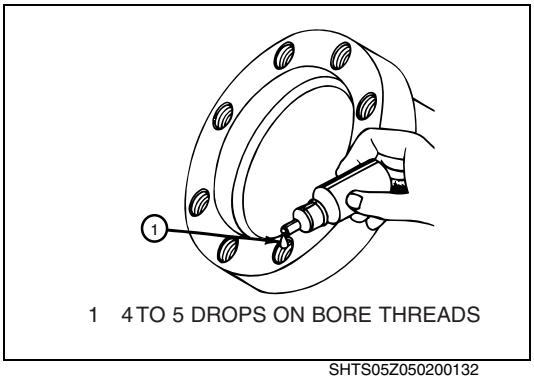
3. ORIGINAL OR USED FASTENERS

(1) Use a wire brush to clean the oil, dirt and old adhesive from all threads and threaded holes.

NOTICE
There is no drying time required for Meritor liquid adhesive 2297-C-7049, Loctite® 680 liquid adhesive or equivalent.

(2) Apply four or five drops of Meritor liquid adhesive, Loctite® 680 liquid adhesive or equivalent inside each threaded hole or bore. Do not apply adhesive directly to the fastener threads.

(3) Tighten the fasteners to the required torque value for that size fastener.



1 4TO 5 DROPS ON BORE THREADS

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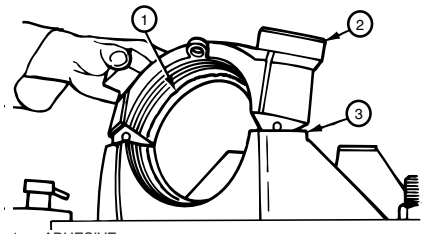
APPLYING ADHESIVE AND SILICONE GASKET MATERIAL

1. MERITOR SPECIFICATION 2297-T-4180 ADHESIVE IN DIFFERENTIAL BEARING BORES

NOTICE
Use Meritor specification 2297-T-4180 adhesive for all axles.

(1) Clean the oil and dirt from outer diameters of bearing cups and bearing bores in the carrier and bearing caps. There is no special cleaning required.
(2) Apply axle lubricant to the bearing cones and the inner diameters of the bearing cups of the main differential. Do not get oil on the outer diameter of the bearing cup and do not permit oil to drip onto the bearing bores.

NOTICE
Meritor specification 2297-T-4180 adhesive will dry in approximately two hours. You must complete the procedure within two hours from the time you apply the adhesive. If two hours have passed since application, clean the adhesive from the parts and apply new adhesive.



1 ADHESIVE
2 BEARING CAP
3 CARRIER LEG

SHTS05Z050200133

(3) Apply a single continuous bead of the adhesive to the bearing bores in the carrier and bearing caps. Apply the adhesive around the circumference of the smooth, ground surfaces only. Do not place adhesive on threaded areas.
(4) Install the main differential assembly, bearing cups and bearing caps into the carrier. Refer to page DF02-42.
(5) Adjust preload of the differential bearings, backlash and tooth contact patterns of the gear set as required. Refer to page DF02-44, 46.

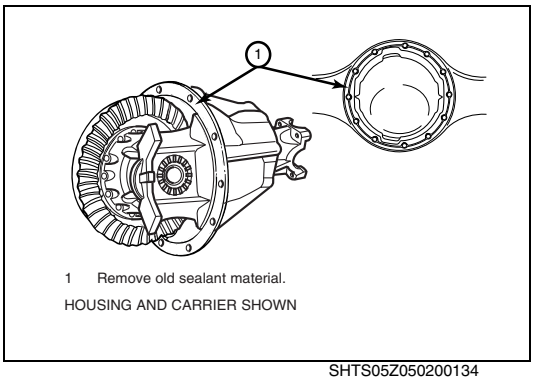
2. THREE BOND 1216, OR EQUIVALENT, SILICONE GASKET MATERIAL

⚠ WARNING
When you apply some silicone gasket materials, a small amount of acid vapor is present. To prevent serious personal injury, ensure that the work area is well-ventilated. Read the manufacturer's instructions before using a silicone gasket material, then carefully follow the instructions. If a silicone gasket material gets into your eyes, follow the manufacturer's emergency procedures. Have your eyes checked by a physician as soon as possible.

NOTICE
The following silicone gasket products or equivalent can be used for Meritor components:

- **Three Bond Liquid Gasket TB 1216 (Grey)**
- **Loctite® Ultra Grey Adhesive/sealant #18581**
- **From Meritor: Ten-ounce tubes, part number 2297-F-7052**

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1 Remove old sealant material.
HOUSING AND CARRIER SHOWN

SHTS05Z050200134

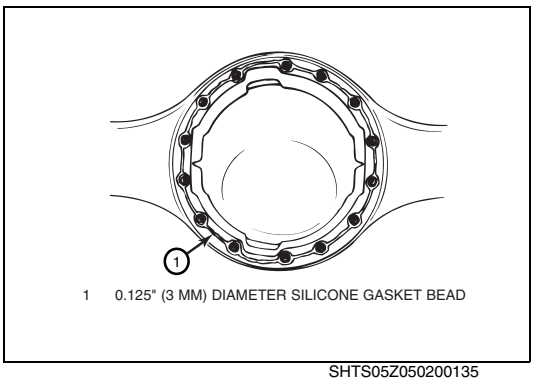
(1) Use a tool with a flat blade, if required, to remove all old gasket material from surfaces.

(2) Use a cleaning solvent to clean the surfaces where you will apply silicone gasket material. Remove all oil, grease, dirt and moisture without damaging the mating surfaces.

(3) Dry surfaces.

⚠ CAUTION

Apply silicone gasket material in a continuous 0.125-inch (3 mm) bead. If you use more than this amount, gasket material can break off and plug lubrication passages. Damage to components can result.



1 0.125" (3 MM) DIAMETER SILICONE GASKET BEAD

SHTS05Z050200135

(4) Apply 0.125-inch (3 mm) diameter continuous bead of the silicone gasket material around one surface. Also apply the gasket material around the edge of all fastener holes on that surface.

(5) Assemble the components immediately to permit the silicone gasket material to compress evenly between the parts. Tighten fasteners to the required torque value for that size fastener. Refer to page DF02-12.

(6) Wait 20 minutes before filling the assembly with lubricant.

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CARRIER-TO-HOUSING JOINT

1. REPAIR

(1) Remove the carrier from the housing. Refer to page DF02-15.
(2) Remove all debris from inside the housing.
(3) Use a rotary tool with a ScotchBrite™ pad to clean all silicone residue from the housing and carrier faces. Surfaces must be clean, dry and free of foreign matter. The surfaces must not be oily to the touch.



CLEANING HOUSING FACE WITH ROTARY TOOL AND SCOTCHBRITE™ PAD

SHTS05Z050200136

(4) Remove metal filings from the magnets inside the housing.
(5) Use solvent to clean the inside of the housing.
(6) Use Loctite® ODC Free cleaner or brake cleaner to clean the housing and carrier faces.
(7) Dry the housing and carrier faces.
(8) Use a rotary wire brush to remove any nylon patch material and clean the carrier-to-housing capscrew threads. Use a clean cloth to wipe the threads.
(9) Use a tap to clean the internal threads in the housing.

⚠ WARNING

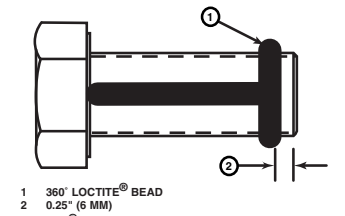
When you apply some silicone gasket materials, a small amount of acid vapor is present. To prevent serious personal injury, ensure that the work area is well-ventilated. Read the manufacturer's instructions before using a silicone gasket material, then carefully follow the instructions. If a silicone gasket material gets into your eyes, follow the manufacturer's emergency procedures. Have your eyes checked by a physician as soon as possible.

(10) Apply a 0.25-inch (6 mm) bead of Loctite® 5699 silicone gasket material to the housing face. Do not use Three Bond 1216E silicone products.
(11) Install two long studs in the carrier to guide the carrier into the housing.
(12) Immediately install the carrier into the housing to permit the silicone gasket material to compress evenly between the faces.

⚠ CAUTION

Apply silicone gasket material in a continuous 0.125-inch (3 mm) bead. If you use more than this amount, gasket material can break off and plug lubrication passages. Damage to components can result.

(13) Apply a 0.125-inch (3 mm) bead of Loctite® 242 threadlocker around the capscrew threads approximately 0.25-inch (6 mm) from the end. Apply a 0.125-inch (3 mm) bead of LoctiteR242 threadlocker across the length of the threads.



1 360˚ LOCTITE® BEAD
2 0.25" (6 MM)
LOCTITE® 242 THREADLOCKER APPLICATION

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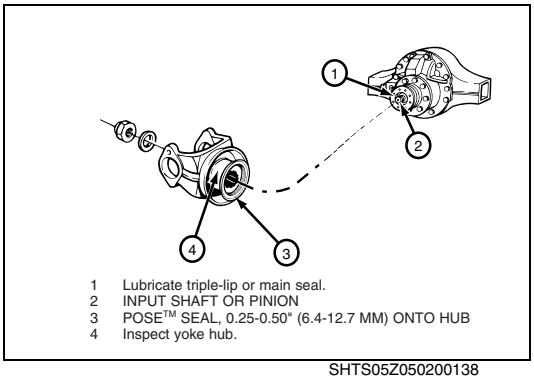
(14) Install the capscrews. Use a crossing pattern to tighten the capscrews evenly. The capscrews must be tightened within 10 minutes of initial application of Loctite® 242 threadlocker.

- Tighten 1/2-inch capscrews to 140 lb-ft (190 N·m).
- Tighten 5/8-inch capscrews to 225 lb-ft (306 N·m).

(15) Wait a minimum of 60 minutes before filling the assembly with lubricant.

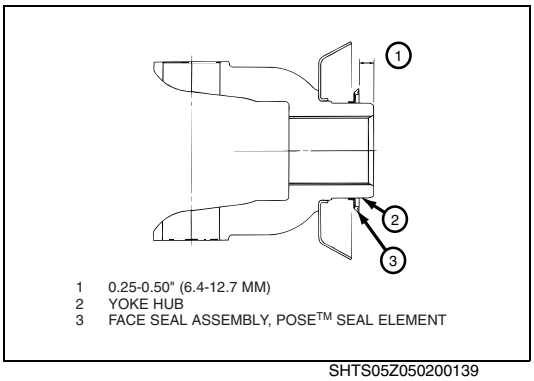
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INSTALLING TIGHT FIT YOKES AND POSE™ SEAL



1 Lubricate triple-lip or main seal.
2 INPUT SHAFT OR PINION
3 POSE™ SEAL, 0.25-0.50" (6.4-12.7 MM) ONTO HUB
4 Inspect yoke hub.

SHTS05Z050200138



1 0.25-0.50" (6.4-12.7 MM)
2 YOKE HUB
3 FACE SEAL ASSEMBLY, POSE™ SEAL ELEMENT

SHTS05Z050200139

1. INSTALLATION

(1) Apply the same lubricant used in the axle housing to the hub of the yoke or flange.

(2) Inspect and verify that the lips of the POSE™ seal and the outer retainer of the triple-lip seal or main seal are clean and free from dirt and particles that may cause lubricant leakage between the seals.

(3) Install the POSE™ seal on the hub of the yoke or flange by hand. The lips of the seal must face toward the end of the hub or the opposite shoulder. Slide the POSE™ seal on the hub until the lips are from 0.25-0.50-inch (6.4-12.7 mm) from the end of the hub. Do not install the POSE™ seal against the shoulder.

NOTICE
The POSE™ seal will position itself correctly as the yoke or flange is pressed on the shaft.

(4) Before you install the yoke or flange on the shaft, apply the same lubricant used in the axle housing to the hub.

(5) Install the yoke or flange using the correct procedure. The yoke must be completely seated before tightening the pinion nut to the input shaft.

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DRIVER-CONTROLLED MAIN DIFFERENTIAL LOCK

OVERHAUL

EN05Z0502H200002

IMPORTANT POINTS - DISMOUNTING

⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

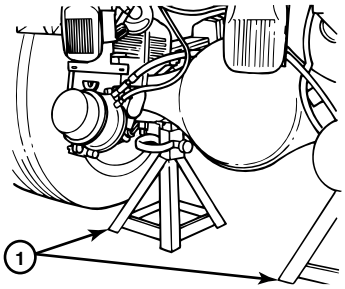
Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

1. REMOVAL OF DIFFERENTIAL CARRIER FROM THE AXLE HOUSING

(1) Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.

(2) Use a jack or other lifting tool to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.

(3) Place a drain pan under the rear axle.



1 SAFETY STANDS

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(4) Remove the plug from bottom of axle housing. Drain lubricant from the assembly.

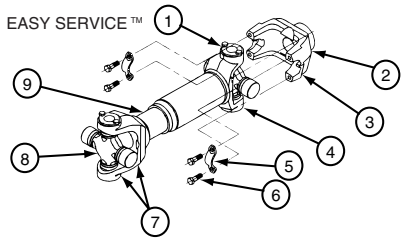
(5) Disconnect the driveline universal joint from the pinion input yoke or flange on the carrier.

(6) Remove the capscrews and washers or stud nuts and washers, if equipped, from the flanges of both axle shafts.

(7) Loosen the tapered dowels, if equipped, in the axle flanges of both axle shafts using one of the following methods.

(8) Brass Drift Method. (Refer to DF02-16)

(9) Disconnect the vehicle air line from the differential lock actuator assembly.



1 FULL ROUND BEARING CUPS
2 END YOKE
3 YOKE SADDLE
4 WELD YOKE
5 BEARING STRAP
6 CAPSCREWS
7 EASY-SERVICE BEARING CUPS
8 U-JOINT CROSS
9 SLIP YOKE

For details, Refer to the Propeller shaft chapter.

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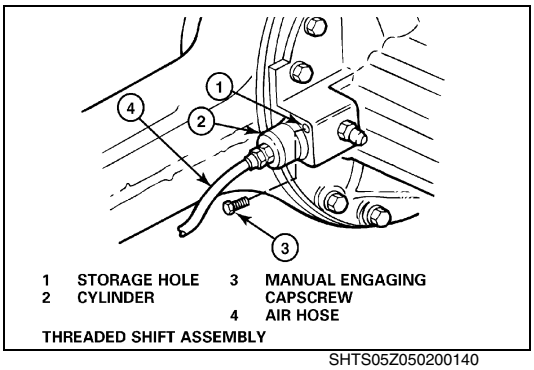
IMPORTANT POINTS-DISASSEMBLY

1. SCREW-IN STYLE DIFFERENTIAL LOCK CYLINDER

Use the following manual engaging method to lockout the screw-in DCDL assembly.

(1) Follow Steps 1-5 of Axle Setup for DCDL Disassembly in this section.

(2) Remove the manual engaging capscrew from the storage hole in the carrier casting, next to the cylinder.



1 STORAGE HOLE
2 CYLINDER
3 MANUAL ENGAGING CAPSCREW
4 AIR HOSE

THREADED SHIFT ASSEMBLY

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(3) Remove air line and fitting. Install the manual engaging capscrew into the threaded hole in the center of the cylinder cover.

(4) Turn the manual adjusting capscrew to the right until the head is approximately 0.25-inch(6 mm) from the cylinder cover. Do not turn the capscrew beyond its normal stop. The capscrew is now in the service position and the main differential lock is completely engaged.

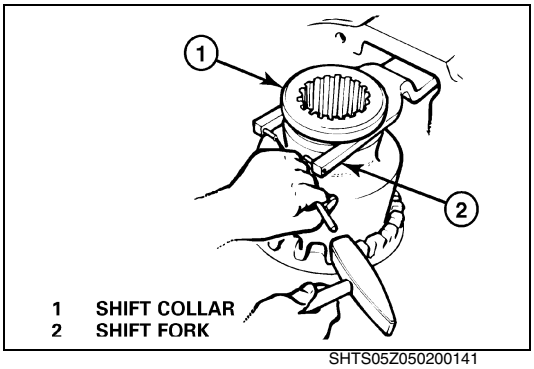
(5) Remove the carrier from the axle housing as described in steps 1-7 of page DF02-17.

2. REMOVAL OF THE DIFFERENTIAL LOCK SLIDING COLLAR

(1) Carriers with roll pins, tap out the two retainer roll pins, if equipped, until they are level with the inner face of the shift fork. Release the differential lock if it is manually engaged.

(2) For carriers without roll pins, snap out collar from fork.

(3) If required, remove the DCDL assembly at this time.



1 SHIFT COLLAR
2 SHIFT FORK

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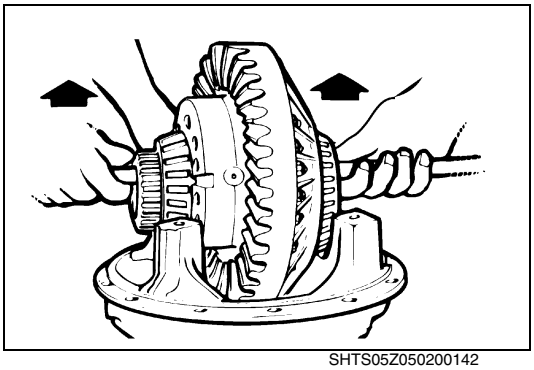
3. REMOVAL OF THE DIFFERENTIAL LOCK ASSEMBLY

(1) Removal of the lock cylinder
   a. Remove the sensor switch.
   b. Remove the cylinder by turning hex nut at the top of the cylinder with a wrench. The cylinder may be secured to the carrier casting with Loctite® adhesive or equivalent pre-applied liquid adhesive. To brake down these secured fasteners follow the heating procedure. Refer to page DF02-58.
   c. Remove the shift shaft, spring and shift fork.

(2) Remove the cotter keys, pins or lock plates that hold the two bearing adjusting rings in position. Use a small drift and hammer to remove pins. Each lock plate is held in position by two capscrews.

(3) Mark one bearing cap and one carrier leg so that these parts will be assembled in the correct positions. Remove the bearing cap capscrews and washers, the bearing caps and the adjusting rings.

(4) Lift the differential and gear assembly from the carrier. Tilt the assembly as required to permit the ring gear to clear the support for the pinion spigot bearing.

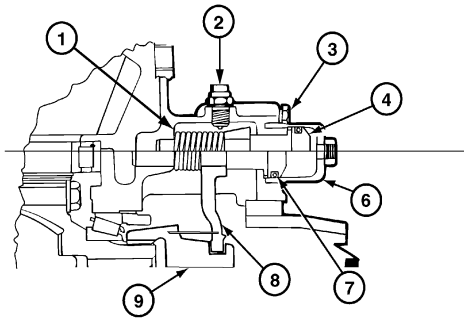


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Further disassembly of these carries is the same as axles without the driver-controlled main differential lock. To continue disassembly, follow the procedures starting with "remove the differential and ring gear from the carrier." (Refer to page DF02-18)

Prepare parts for assembly, adjustments, and carrier assembly (up to the point if "install differential carrier into axle housing (Refer to page DF02-51)") are also the same for both axles.

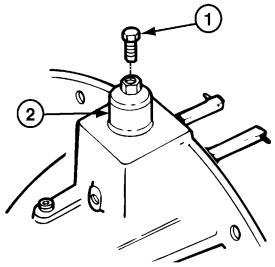
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1 SHIFT SHAFT AND SPRING
2 ELECTRIC CONNECTION FOR SENSOR
3 PISTON
4 DISENGAGED
6 CYLINDER
7 O-RING
8 SHIFT FORK
9 COLLAR

SCREW-IN STYLE

SHTS05Z050200143



1 MANUAL ACTUATION CAPSCREW
2 SCREW-IN CYLINDER 80-100 LB-FT (109-136 N•m)

SCREW-IN STYLE

SHTS05Z050200144

IMPORTANT POINTS-ASSEMBLY

1. SCREW-IN STYLE DIFFERENTIAL LOCK ASSEMBLY INTO CARRIER

Install the differential shift assembly after the differential carrier is assembled and the gear and bearing adjustments are completed.

(1) Install the shift spring and fork into the correct position in the carrier case. Compress the spring slightly while installing the fork.

(2) Install the shift shaft into the shaft bore of the carrier. Slide the shaft through the shift fork bore and shift spring inside diameter.

(3) Inspect the piston O-ring. Replace the O-ring if there is any evidence of cuts, cracks, abrasion or wear.

(4) Lightly lubricate the O-ring and DCDL cylinder bore with the same lubricant used in the axle housing.

(5) Install the piston and O-ring assembly into the DCDL cylinder. Slide the piston to the port end of the cylinder.

(6) Coat the DCDL cylinder threads with Loctite®518 Gasket Eliminator.

(7) Screw the DCDL cylinder in place. Tighten the cylinder to 80-100 lb-ft (109-136 N·m) torque.

(8) Snap the shift collar into the fork. Engage the shift collar splines with the splines of the differential case. Use the manual actuation capscrew to move the shift collar splines into the differential case splines.

(9) Install the sensor switch into its hole. Tighten the switch to 25-35 lb-ft (35-45 N·m).

(10) Connect a battery or bulb tester to the sensor switch. With the DCDL engaged, the tester light should go on.

- If the light does not go on, perform the following steps:

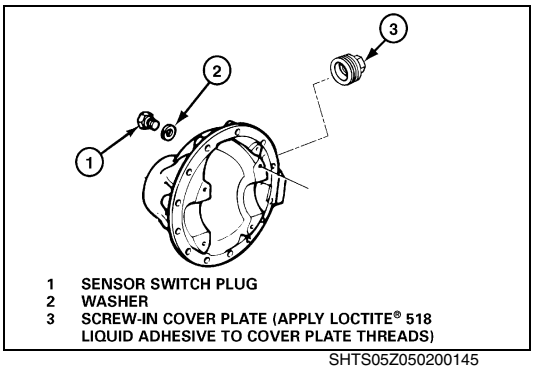
a. Verify fork position - Is it aligned with the sensor switch when in engaged position?

b. Loose connection - Is the electrical wiring connector tightly seated?

c. Sensor switch position - Is it fully seated against spot face of carrier?

- If light fails to go on after these checks, the sensor switch should be replaced.

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1 SENSOR SWITCH PLUG
2 WASHER
3 SCREW-IN COVER PLATE (APPLY LOCTITE® 518 LIQUID ADHESIVE TO COVER PLATE THREADS)

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2. Differential Lock Assembly Cover Plates

NOTICE

For carriers without the differential lock or air shift, assemble the sensor switch plug and cover plate as follows.

(1) Apply Loctite®518 liquid adhesive to the plate threads.

NOTICE

- **When the carrier is to be installed into the axle housing, the shift collar must be held in the engaged position. This can be done using the manual engaging bolt. Failure to keep the differential in the locked (engaged) position will make it impossible to install the carrier assembly into the axle housing.**
- **After the carrier is installed into the axle housing, shift the differential into the unlocked (disengaged) position to permit the installation of the right-hand axle shaft.**

INSPECTION AND REPAIR

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1. Check the Differential Lock

(1) Shift the vehicle transmission to neutral. Start the engine to get the system air pressure to the normal level.

⚠ WARNING

During DCDL disassembly, when the DCDL is in the locked or engaged position and one of the vehicle's wheels is raised from the floor, do not start the engine and engage the transmission. The vehicle can move and cause serious personal injury.

(2) Place the differential lock switch, in the cab of the vehicle, in the unlocked or disengaged position.

(3) Drive the vehicle at 5-10 mph (8-16 km/h) and check the differential lock indicator light. The light must be off when the switch is in the unlocked or disengaged position.

(4) Continue to drive the vehicle and place the differential lock switch in the locked or engaged position. Let up on the accelerator to remove the driveline torque and permit the shift. The light must be on when the switch is in the locked position.

- If the indicator light remains ON with the switch in the unlocked position: The differential is still in the locked position. Verify that the manual engaging capscrew was removed from the cylinder cover of the actuator assembly.

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BRAKE EQUIPMENT (MODELS WITH HYDRAULIC BRAKE)

BR01-001

SERVICE BRAKE ASSEMBLY.....BR01-2
DESCRIPTION BR01-2
DIAGRAM BR01-3
TROUBLESHOOTING..... BR01-5
BRAKE SYSTEM AIR BLEEDING..... BR01-9
POWER STEERING SYSTEM
AIR BLEEDING..... BR01-11
BRAKE TEST BR01-12

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SERVICE BRAKE ASSEMBLY

DESCRIPTION

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Type of service brake	Hydraulic disc type wheel brake with ABS and hydraulic booster (HYDRO-MAX)
HYDRO-MAX	The Hydro-Max is a hydraulically powered brake booster which provides power assist for applying hydraulic brakes. The booster reduces the pedal effort required to apply the brakes as compared to a non-power system. The hydraulic booster is comprised of an open center valve and reaction feed back mechanism, a power piston, a 12 volt backup pump and an integral flow switch. It is powered by either the power steering pump or other hydraulic source. The backup pump provides a secondary power source for the hydraulic booster and is controlled by the integral flow switch. The master cylinder is a split system type with separate fluid chambers, pistons and outlet ports for the front and rear brake circuits. A differential pressure switch is equipped. Refer to DIAGRAM on page BR01-3
ABS (Anti-Lock Braking System)	The ABS system comprises of sensor rings mounted on the wheels. The ABS computer receives signals from wheel sensors that monitor the rotational speed of the wheels and sends out signals to maintain the appropriate braking force. The ABS modulator maintains the appropriate braking force based on the control signals.
Hydraulic disc brake	Model: HINO 238, 258, 268 (NE8J) and 258 (NF8J), 338 Four-Piston fixed mount Caliper.

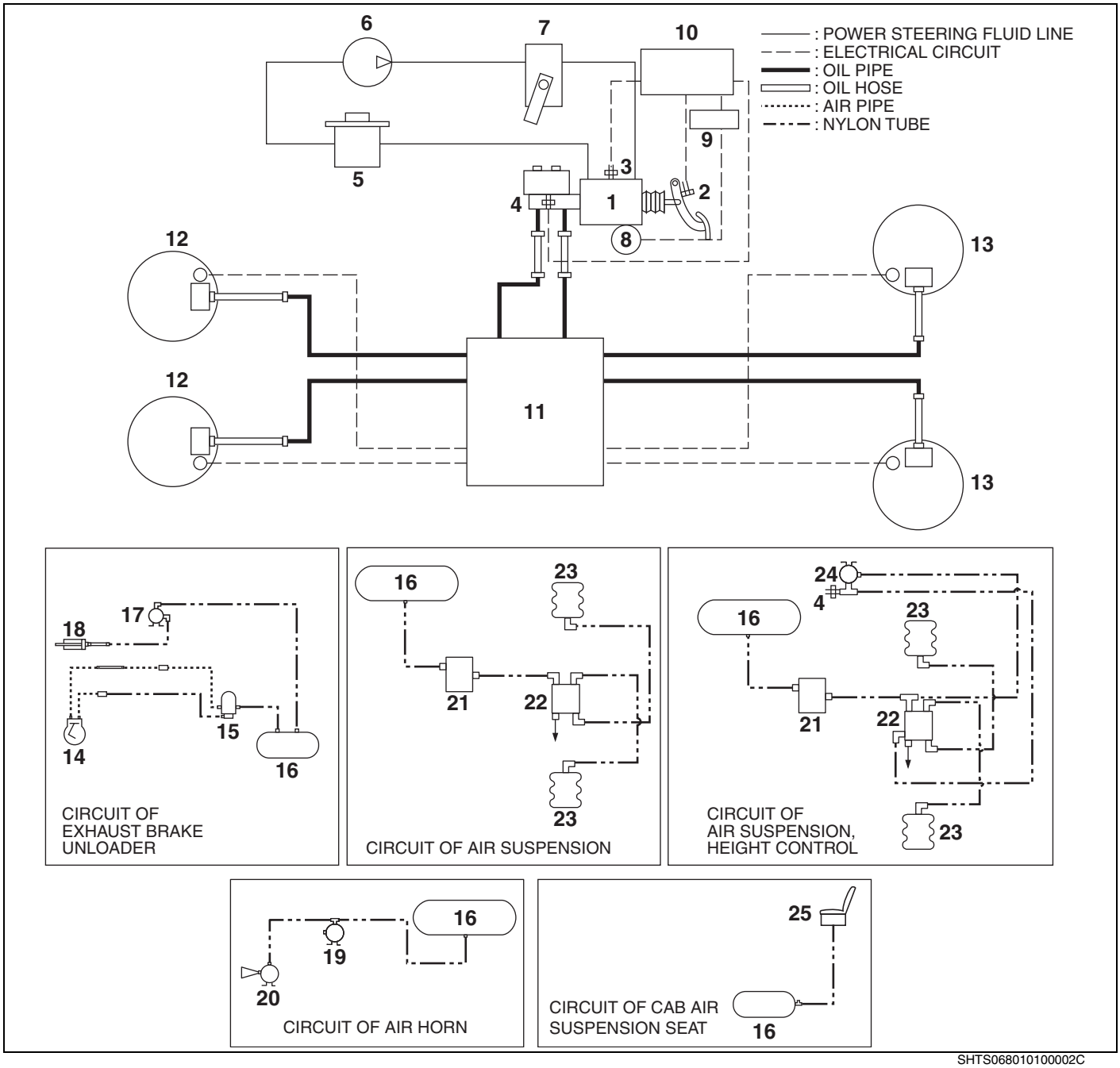
NOTICE
Above components were made by the following manufacturer's;
HYDRO-MAX: BOSCH
ABS MODULATOR: MERITOR WABCO
DISC BRAKE CALIPER: MERITOR

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DIAGRAM

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MODEL: HINO238(NE8J), 258(NE8J/NF8J), 268(NE8J) AND 338(NF8J) HYDRAULIC BRAKE (E version)



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1	Hydro-Max booster and master cylinder	15	Air dryer
2	Stop light switch	16	Air tank
3	Flow switch	17	Magnetic valve
4	Pressure switch	18	Exhaust brake
5	Power steering oil reservoir	19	Magnetic valve
6	Power steering pump	20	Air horn (if so equipped)
7	Power steering gear	21	Air suspension protection valve
8	Backup pump & motor	22	Leveling valve
9	Relay	23	Air suspension bellows
10	Hydro max controller	24	Magnetic valve (if so equipped)
11	ABS modulator and ECU	25	Air suspension seat
12	Speed sensor-front		
13	Speed sensor-rear		
14	Air compressor		

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TROUBLESHOOTING

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Symptom	Possible cause	Remedy/Prevention
No response upon working the pedal or there is the feeling of stepping on sponge (Air trapped in the brake lines)	Insufficient seal of master cylinder secondary cup	Replace master cylinder assembly.
	Insufficient air bleeding	Bleed air from brake line.
No response upon working the pedal or there is the feeling of stepping on sponge	Vapor lock in brake system	Bleed air from brake.
	Leakage of fluid from brake system	Tighten further or replace gasket, O-ring, cup, etc.
	Poor quality brake fluid or improper fluid (low boil point)	Drain the system, flush and refill with the recommended fluid.
Brake fluid decreases	Leakage of brake fluid from brake system	Tighten further or replace gasket, O-ring, etc.
	Leakage of brake fluid from master cylinder	Replace master cylinder assembly.
	Worn pad	Replace pad if it is worn to limit. Refill brake fluid.
Excessive pedal travel (though there is response upon working the pedal)	Insufficient brake fluid in the master cylinder	Search the cause of insufficient fluid, repair or replace it.Then refill fluid and bleed air.
	Air trapped in the brake lines	Bleed air from brake lines.
	Leakage of fluid from brake system	Check the leak point, repair or replace.
	Poor quality brake fluid or improper fluid	Drain the system, flush and refill with the recommended fluid.
	Contamination of the brake fluid	Replace the brake system and refill with the recommended fluid.
	Insufficient seal of the master cylinder cup	Replace master cylinder assembly.
Unequal or unstable braking	Pad is wet with grease or fluid	Replace the pad.
	Defective pad material (improper combination)	Replace the pad.
	Non-uniform pad contact	Correct.
	Excessive abrasion loss of rotors	Correct or replace.
	Distorted rotors	Correct or replace.
	Loose hub bearing	Adjust or replace the bearing.
	Improper or unequal pneumatic pressure of tire	Adjust to proper pneumatic pressure.
	Clogging of brake system	Replace, the pipe, hose, etc.
	Abnormal piston operation of the disc brake	Check the piston seal.

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Symptom	Possible cause	Remedy/Prevention
Brake drags or does not release	Improper return of master cylinder piston	Replace master cylinder assembly.
	Clogging of brake system	Replace the pipe, hose, etc.
	Constricted master cylinder reservoir vent	Clean vent passage in reservoir cap.
	Self applied booster (fluid flow too high)	Repair or replace power steering pump.
	Soft or swollen master cylinder seals due to brake fluid contamination	Flush out old brake fluid then replace master cylinder and add new brake fluid.
	Clogging compensating valve of master cylinder	Replace master cylinder assembly.
	Improper return of brake pedal	Repair or replace.
	Improper return of brake booster piston	Replace booster assembly.
	Improper installation pad	Check the installed condition of the pad. Repair.
	Improper return of caliper piston	Repair or replace.
Not enough braking, or too much pedal resistance (Wheel brake and rotor)	Pad is wet with grease or fluid	Replace the pad.
	Improper contact of rotor and pad	Correct.
	Improper pad material or glazed pad	Correct.
	Deformation or hardening of rotor	Correct or replace.
	Excessively worn pad	Replace.
	Glazed rotor	Correct.
Not enough braking, or too much pedal resistance (Control system pipings)	Leakage of brake fluid from brake system	Tighten further or replace gasket.
Not enough braking, or too much pedal resistance (Lack of power steering pump pressure)	Improper operation of power steering pump	Repair or replace.
	Clogging of brake system	Replace pipe, hose, etc.
Not enough braking, or too much pedal resistance (Not enough power steering pump pressure or rise of power steering pump pressure)	Check the pipe joints for tightness	Repair.
	There is a rupture or twist in the pipe leading to the power steering pump	Replace.
	The hose is ruptured or collapsed	Replace.
	Power steering pump relief valve setting too low	Replace power steering pump.
	Fluid contamination	Drain, flush and refill system, replace booster or master cylinder as appropriate and power steering reservoir filter as necessary.
Not enough braking, or too much pedal resistance	Lack of brake fluid	Supply brake fluid periodically.
	Improper power steering pump	Replace.
	Stuck piston in the master cylinder	Replace master cylinder assembly.
	Insufficient power steering fluid	Refill to proper level.
	Air trapped in the power steering fluid or brake fluid	Search the cause, refill the fluid and bleed air.
	Binding brake pedal linkage	Overhaul and lubricate.
	Worn or damaged brake booster	Replace booster assembly.
	Leakage around the check ball in the backup pump	Replace the backup pump.

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Symptom	Possible cause	Remedy/Prevention
Brake squeal	Improper pad material or glazed pad	Replace pad.
	Pad back plate contact with rotor	Replace pad.
	Deformation or wear of rotor	Repair or replace.
	Intrusion of foreign matter between rotor and pad	Clean the surface of pad or replace.
	Loose hub bearing	Adjust or replace bearing.
	Hardening of pad surface	Replace pad.
	Different pad	Replace proper pad.
	Rotor is wet with grease, fluid and dust	Check the leakage position and repair. Clear the rotor.
Impossible to bleed air completely	Piston cup of master cylinder sucks in air	Replace master cylinder assembly.
	Improper tightness of joints of brake system	Tighten further or replace gasket.
Pulsating brake pedal	ABS operation	Feature of ABS operation (No problem).
	Wheel bearings loose or worn	Readjust or replace.
	Excessive rotor thickness variation	Repair or replace.
Decreasing pedal travel	Clogging of the compensating valve of master cylinder	Replace master cylinder assembly.
	Swollen pressure seals of master cylinder	Replace master cylinder assembly.
	Improper return of the master cylinder piston	Replace master cylinder assembly.
Delay pedal return	Broken return spring	Replace master cylinder assembly.
	Restricted fluid return line of the power steering or hydraulic pump	Remove the obstruction and replace the line.
	Swollen power piston seal of the booster	Replace booster assembly.
Backup pump operates continuously	Abnormal brake switch	Replace.
	Abnormal monitor module	Replace.
	Abnormal relay	Replace.
	Abnormal flow switch	Remove switch components, clean and inspect for damage or contamination and replace if necessary.
	Binding pedal linkage	Disassemble and lubricate.
Backup pump does not operate	Abnormal brake switch	Replace.
	Abnormal monitor module	Replace.
	Abnormal relay	Replace.
	Abnormal flow switch	Remove switch components, clean and inspect for damage or contamination and replace if necessary.
	Binding pedal linkage	Disassemble and lubricate.
	Abnormal backup pump	Replace backup pump.
	Abnormal battery	Recharge or replace.

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Symptom	Possible cause	Remedy/Prevention
Power steering pump is noisy	Insufficient power steering fluid	Refill proper level.
	Air trapped in the power steering fluid	Bleed air from power steering system.
	Contamination in the power steering fluid	Replace power steering pump and fluid.
Severe reaction to pedal pressure (Grabby brakes)	Throttle valve cut in spring defective	Replace booster assembly.
	Binding brake pedal linkage	Disassemble and lubricate.
	Incorrect pads, or pads loose on plate	Replace pads. Be sure pads are tight on caliper.
	Grease or brake fluid on pad	Repair grease seal or caliper as required. Replace pads in axle sets.
	Loose caliper on caliper mounting bracket	Retighten.
Leakage between booster and master cylinder	Primary pressure seal or backup ring of the master cylinder is worn or damaged	Replace master cylinder assembly.
	Seal or O-ring of the booster end cap assembly is worn or damaged	Replace booster assembly.
Leakage from booster or power steering pump	Seal between backup pump and booster is worn or damaged	Replace the seals.
	Backup pump mounting screw is loose	Retighten.
	Booster housing or power steering pump is worn or damaged	Replace booster assembly or power steering pump.
	Backup pump is worn or damaged	Replace backup pump.
	Seal of the booster flow switch is worn or damaged	Replace flow switch seals.

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BRAKE SYSTEM AIR BLEEDING

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1. PREPARATION

(1) Apply the parking brake and block the wheels.
Turn the starter switch to "LOCK" position and disconnect the battery terminals.

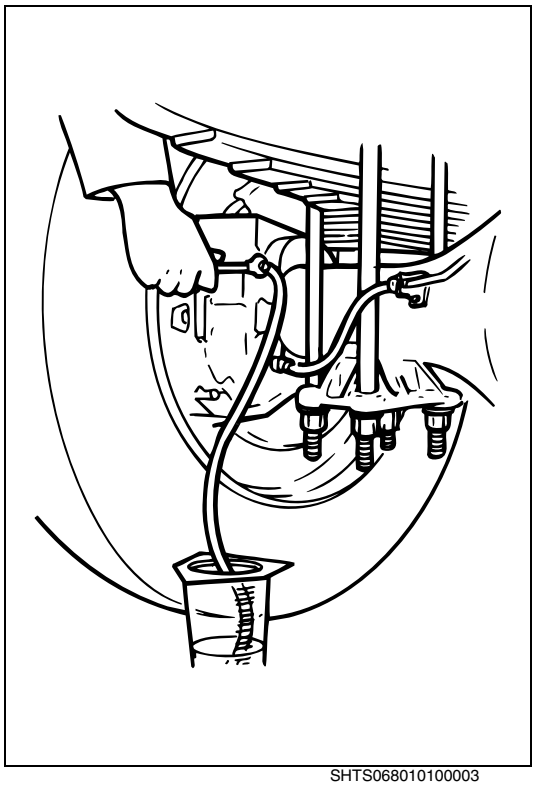
NOTICE
The starter switch must remain at "LOCK" position for the entire bleeding procedure.

(2) Fill the reservoir with new DOT 3 or DOT 4 hydraulic brake fluid.

2. AIR BLEEDING

(1) Depress the brake pedal five times using the stroke between 1/3 travel and maximum travel in 5 seconds.
(2) Release the pedal for 5 to 10 seconds. Air bubbles will rise the reservoir while depressing and releasing pedal.
(3) Repeat Steps (1) and (2) another three times, or until sufficient pedal resistance is felt.

⚠ WARNING
Do not let the brake master cylinder fluid get below the minimum level during the bleeding operation. Failure to keep the brake reservoir level above minimum could result in more air entering system, making it impossible to effectively bleed the system.



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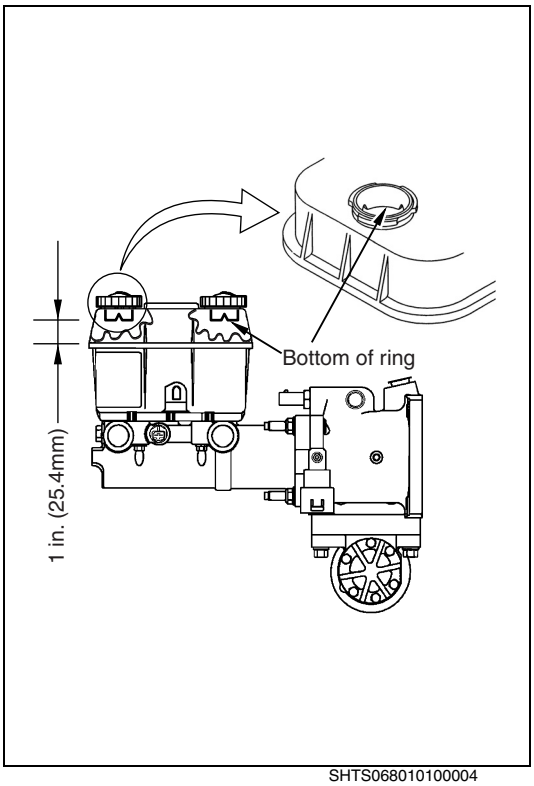
(4) Bleed the brake system. Put a wrench on the brake actuator bleeder fitting. Start with the farthest from the modulator, (typically the right rear), then attach a length of clear plastic tubing to the bleeder fitting. Make sure the tube fits snugly.

(5) Submerge the tubing in a container of clean brake fluid.

NOTICE
Both the tubing and container must be able to withstand the effects of brake fluid.

(6) Depress the brake pedal 10 to 15 times, using the maximum available stroke.
(7) Loosen the bleeder fitting until the fluid begins to flow, (about 3/4 turn), while depressing the brake pedal through its maximum available stroke.
(8) Tighten the fitting firmly prior to releasing the brake pedal.
(9) Repeat Steps (4) through (6) several times until the discharged fluid is free of air bubbles.
(10) Repeat Steps (1) through (7) to bleed the remaining three brake actuators. Bleed in sequence of the longest to the shortest circuit from the modulator.

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(11) Check the travel of the brake pedal. If a firm resistance is felt the manual bleeding procedure is complete.

(12) Check the fluid level in reservoir and fill if required. Replace reservoir cap and dispose of used brake fluid.

NOTICE

- **The brake fluid level shall be within the range of 1 in.(25.4mm) below bottom of ring. Fill to bottom of ring if brake fluid is more than 1 in. (25.4mm) below bottom of ring.**
- **Remove the excess brake fluid from the reservoir when the worn brake pads are replaced, otherwise there is a possibility the brake fluid will overflow from the master cylinder reservoir.**

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POWER STEERING SYSTEM AIR BLEEDING

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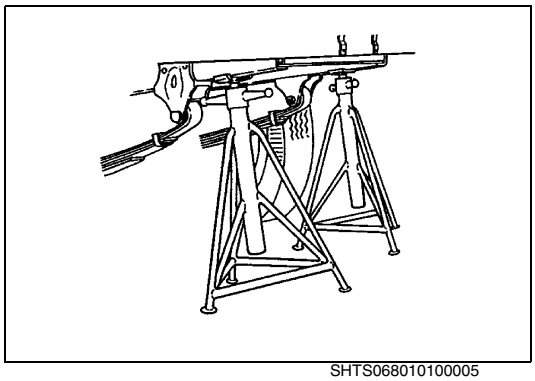
1. FILL THE OIL RESERVOIR WITH POWER STEERING FLUID.

NOTICE

- **Use only specified fluid.**
- **Do not overfill the oil reservoir.**
- **Replace old fluid with new fluid after overhauling power steering gear unit or power steering pump.**
- **Specified fluid....Refer to recommended lubricant list.**

⚠ WARNING

Do not use brake fluid. Mixing brake fluid with power steering fluid will damage the seals and O-rings in the Hydro-Max booster, the power steering pump and power steering gear unit, resulting in possible steering loss.

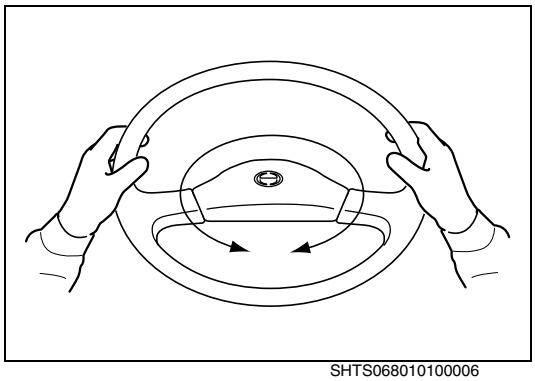


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2. JACK UP THE FRONT AXLE AND SUPPORT THE FRAME WITH STANDS.

NOTICE

Block the rear wheels.



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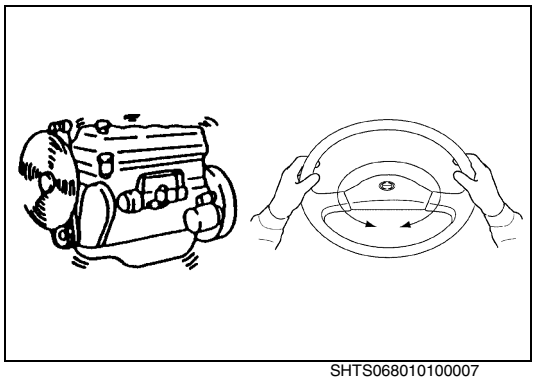
3. TURN THE STEERING WHEEL FULLY IN BOTH DIRECTIONS SEVERAL TIMES.

4. CHECK THE FLUID LEVEL IN THE OIL RESERVOIR.

(1) Add fluid, if necessary.

⚠ WARNING

When checking the fluid level of the power steering reservoir or adding fluid to the reservoir, be careful not to contaminate fluid with dirt in the reservoir. Fluid contaminated with dirt can result in a shorter life of the pump, and can result in personal injury and/or property damage due to improper operation of relief valve, central valve, etc.



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5. START THE ENGINE AND TURN THE STEERING WHEEL FULLY IN BOTH DIRECTIONS SEVERAL TIMES WITH ENGINE IDLING.

NOTICE

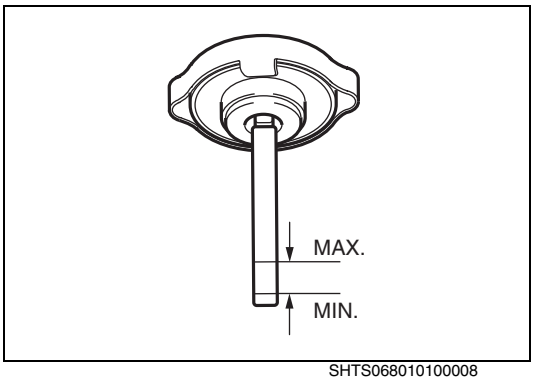
The fluid in the oil reservoir should be continuously replenished while air bleeding so that the oil reservoir never becomes empty.

6. RETURN THE STEERING WHEEL TO STRAIGHT AHEAD.

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7. CHECK THE BRAKE OPERATION.

(1) Release the parking brake.
(2) Turn the starter switch to "ON" position (engine is not running). The brake pressure warning light and buzzer should come on. Depress the brake pedal, and the backup pump should start.
(3) Start the engine and depress the brake pedal. The brake pressure warning light and buzzer should not come on, and the backup pump should not start. If they come on there is a malfunction. See trouble-shooting to find the problem.



SHTS068010100008

8. RECHECK THE FLUID LEVEL WHEN THE ENGINE IS STOPPED.

(1) If necessary, add or decrease the power steering fluid to match between "MAX" and "MIN".

⚠ CAUTION
If air bleeding is not done properly, and the engine is stopped, power steering fluid could overflow from the reservoir.

BRAKE TEST

EN0680101F300003

Measure the braking effect of each wheel on the brake tester. If no brake tester is on hand, perform the brake test from low speed 5—10 km/h (3.1—3.6 miles/h) and check the braking performance. Also check to see that there are no irregularities in general.

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BRAKE EQUIPMENT (MODELS WITH FULL AIR BRAKE)

BR01-002

SERVICE BRAKE ASSEMBLY.....BR01-2
DESCRIPTION BR01-2
DATA AND SPECIFICATIONS BR01-3
DIAGRAM BR01-4
TROUBLESHOOTING BR01-5

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SERVICE BRAKE ASSEMBLY

DESCRIPTION

EN0680201C100001

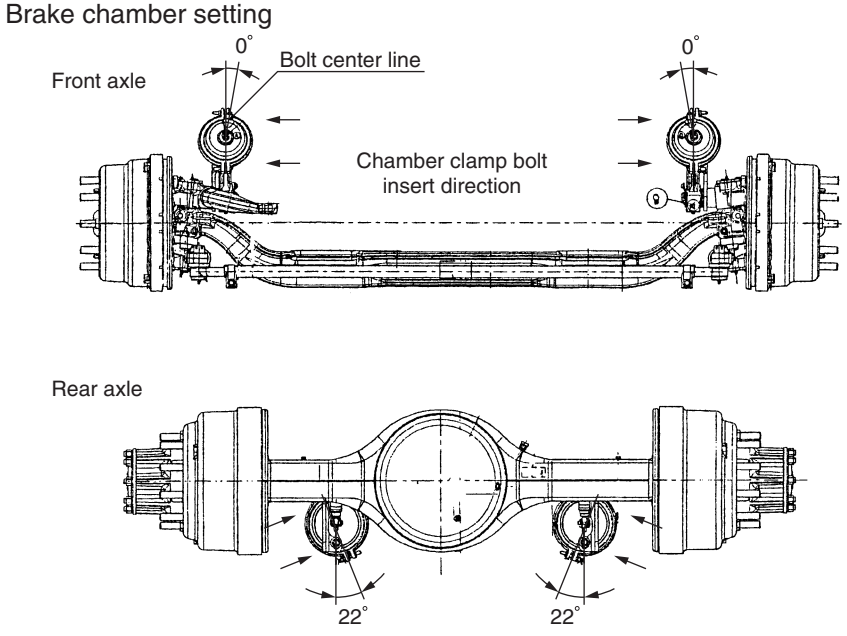
Type of service brake	Full air, S-cam brake (Q-plus) with automatic adjuster.
Air charging system	Air charging is from piston type air compressor and air flow is directed and controlled by a pressure regulator, the necessary valves, and lines as required. Pressure sensor and air pressure warning switch are used for indicating the pressure level in the system.
Service brake control system	Two independent lines for front and rear wheels with air flow controlled by a brake valve, and each line comprises of a group of valves and brake chambers (one/wheel). Two stop light switches (one/line) are used to operate the stop lights.
Spring brake control system	Single line for rear spring brake chambers. The line comprises a control valve which controls air flow, the other necessary valve and spring brake chambers. A parking brake switch is used to turn OFF the warning buzzer and to turn ON the parking brake warning light.
ABS (Anti-Lock Braking System)	The ABS system comprises sensor rings mounted on the wheels, the ABS ECU which receives signals from wheel sensors that monitor the rotational speed of the wheels and sends out signals to maintain the appropriate braking force, the ABS control valves which increase or decrease the braking force based on the control signals.

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DATA AND SPECIFICATIONS

EN0680201I200001

Parts name	Maker	Model · specification
Front axle wheel brake	MERITOR	15 x 4 Q-Plus Cam Brake with Cast Spider, automatic slack adjuster (Slack length: 5.5, type: handed) Drum: 15 in. Outboard mounted
Front Brake chamber	MGM	C20 20 x 2.25 in. standard
Rear axle wheel brake	MERITOR	16.5 x 7 or 15 x 8.625 Q-Plus Cam Brake with Cast Spider, automatic slack adjuster (Slack length: 5.5 or 6.0, type: handed) Drum: 16.5 in. Outboard mounted
Rear Spring brake chamber	MGM	TR3030 3030 x 2.50 in. standard
Brake valve	Bendix	E-8P
Check valve	Bendix	SC-3
Spring brake control valve	Bendix	PP-DC
Spring brake modulating valve	Bendix	SR-7
Rear relay valve	Bendix	R-14 (No.102860)
Air dryer	Bendix	AD-IS



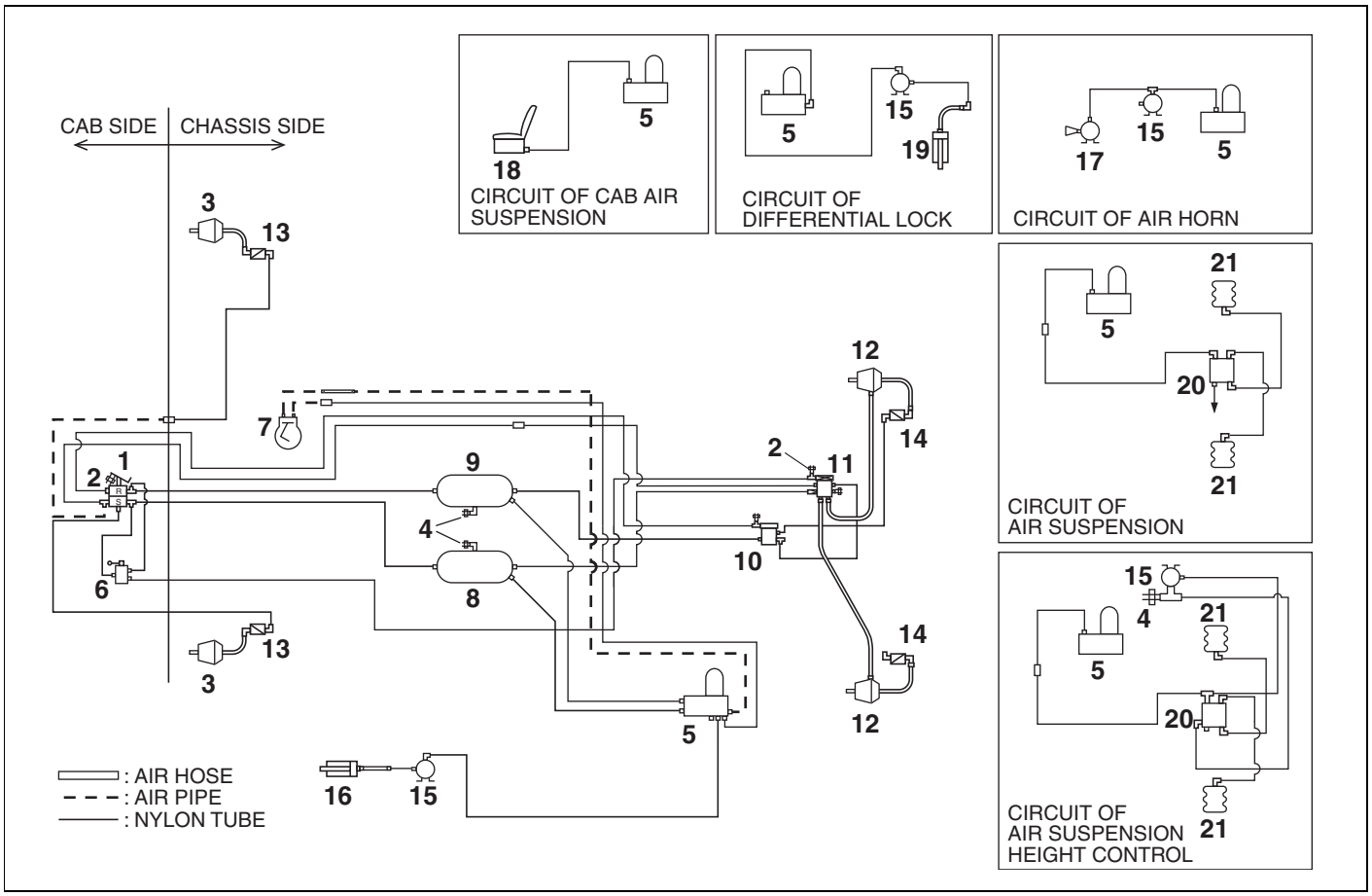
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DIAGRAM

EN0680201J100001

MODEL: HINO 258, 268 (NJ8J), 338 (NV8J), AND 358 (NH8J) FULL AIR BRAKE



SHTS068020100002

1	Brake valve	12	Brake chamber-Rear
2	Stop light switch	13	ABS control valve - Front
3	Brake chamber - Front	14	ABS control valve - Rear
4	Air pressure sensor	15	Magnetic valve
5	Air dryer	16	Exhaust brake
6	Spring brake control valve	17	Air horn (if so equipped)
7	Air compressor	18	Air suspension seat
8	Air tank - Front	19	Differential lock
9	Air tank - Rear	20	Leveling valve
10	Relay valve (for service brake)	21	Air suspension bellows
11	Spring brake modulating valve		

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TROUBLESHOOTING

EN0680201F300001

Symptom	Possible cause	Remedy/Prevention
Not enough braking (Wheel brake and drum)	Lining is wet with grease or oil	Replace lining.
	Improper contact of drum and lining	Correct.
	Improper lining material or hardening lining	Replace lining.
	Deformation or hardening of drum	Correct or replace.
	Excessively worn lining	Replace.
	Improper adjustment of shoe clearance	Check automatic slack adjuster.
Not enough braking (Control system)	Leakage of compressed air from brake system	Tighten further or replace gasket.
	Lack of compressed air pressure due to excessive use	Use properly.
	Improper operation of air compressor	Repair or replace.
	Improper operation of brake valve	Repair or replace.
	Improper operation of relay valve	Repair or replace.
	Improper operation of spring brake control valve	Repair or replace.
	Improper operation of spring brake chamber	Repair or replace.
	Clogging of brake system	Replace pipe, hose, etc.
Unequal or unstable braking (Wheel brake and drum)	Lining is wet with grease or oil	Replace lining.
	Defective lining material (Improper combination)	Replace lining.
	Non-uniform lining contact	Correct.
	Non-uniform brake chamber rod stroke	Check automatic slack adjuster.
	Distorted drums	Correct or replace.
	Excessive abrasion of drums	Correct or replace.
Unequal or unstable braking (Control system)	Clogging of brake system	Replace pipe, hose, etc.
Unequal or unstable braking (Others)	Loose hub bearing	Adjust or replace bearing.
	Improper or unequal pneumatic pressure of tire	Adjust to proper pneumatic pressure.
Brake drags or does not release (Wheel brake and drum)	Improper adjustment of shoe clearance	Check automatic slack adjuster.
	Defective shoe return spring	Replace.
Brake drags or does not release (Control system)	Lack of pedal play	Adjust.
	Improper return of brake pedal	Repair or replace.
	Improper operation of brake valve	Repair or replace.
	Improper operation of relay valve	Repair or replace.
	Leakage of air pressure from brake system	Tighten connections further or replace gaskets.
	Improper operation of spring brake control valve	Repair or replace.
	Improper operation of spring brake chamber	Repair or replace.
	Improper operation of air compressor	Repair or replace.
	Clogging of brake system	Replace pipe, hose, etc.

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Symptom	Possible cause	Remedy/Prevention
Brake squeal (Wheel brake and drum)	Improper lining material or glazed lining	Replace lining.
	Loose lining rivet	Replace or tighten the rivet further.
	Lining rivet in contact with drum	Replace lining and rivet.
	Deformation or wear of drum	Repair or replace.
	Intrusion of foreign matter between drum and lining	Clean the surface of lining or replace.
Brake squeal (Others)	Loose hub bearing	Adjust or replace bearing.

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SERVICE BRAKE (HYDRAULIC BRAKE) BR02-001

HYDRAULIC BRAKE BR02-2
INSPECTION AND ADJUSTMENT BR02-2

HYDRO-MAX HYDRAULIC BRAKE BOOSTER AND MASTER CYLINDER BR02-5
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WHEEL BRAKE (TYPE: 4 PISTON)..... BR02-20
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DESCRIPTION BR02-21
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HYDRAULIC BRAKE

INSPECTION AND ADJUSTMENT

EN1680102H600001

1. REMAINING THICKNESS OF PAD

Inspect the pad thickness. If the pad thickness is less than the service limit or if it is foreseen that it may be worn to the service limit before the next inspection, replace it with a new one.
Four piston type
Assembly Standard: 18.5 mm {0.728 in.}
Service Limit: 3.2 mm {0.125 in.}

⚠ WARNING
If a pad which has become thinner than the limit is left unreplaced, the rotor may be damaged by the pad back-plate and the braking force will be badly degraded. Be sure to check carefully the worn state of the brake pad of all wheels.

2. BRAKE FLUID LEAK AND POWER STEERING FLUID LEAK

(1) Check for fluid leaks.

a. Fluid leaks from lines.
With the brake pedal depressed, visually check for leaks of brake fluid from the brake hydraulic line including the pipes, connection, hoses, etc. If any leak is found, repair or replace with the corresponding parts.

b. When checking for leaks, check also the following items and repair or replace with the corresponding parts as required.
a) Check that the pipes and hoses are not hitting or rubbing other parts. Check that the pipe clips are not loose.
b) Check that the pipes have no cracks and that they have not become rusty.
c) Check that the hoses are not deteriorated, deformed, or swollen.

NOTICE
As a general rule, the brake hoses should be replaced with new ones every 36,000 miles (60,000 km) or 12 months. When any defects as above have been found, replace immediately with new ones.

c. Fluid leaks from components other than lines.
If the pedal stroke gradually increases as the brake pedal is kept pressed (in the worst case the brake pedal reaches the cab floor), a probable cause is that there is an internal leak in any one of the following components;

- Master cylinder
- Hydraulic booster
- Caliper piston in wheel brake

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3. BRAKE FLUID

When the brake fluid is used for a long time, water may get into the brake fluid and its boiling point may become low, thereby causing a possibility of vapor lock which is very dangerous. Replace old brake fluid with fresh brake fluid (Use DOT3 or DOT4 brake fluid) every 36,000 miles (60,000 km) or 12 months.

(1) Hydraulic brake fluid color check

- Check the color of the brake fluid in the brake fluid reservoir.
- Check that the color is as specified by FMVSS116 (transparent or amber).
- Replace the brake fluid if it has become discolored.
- Probable causes of discoloration are as follows:

a. Thermal load

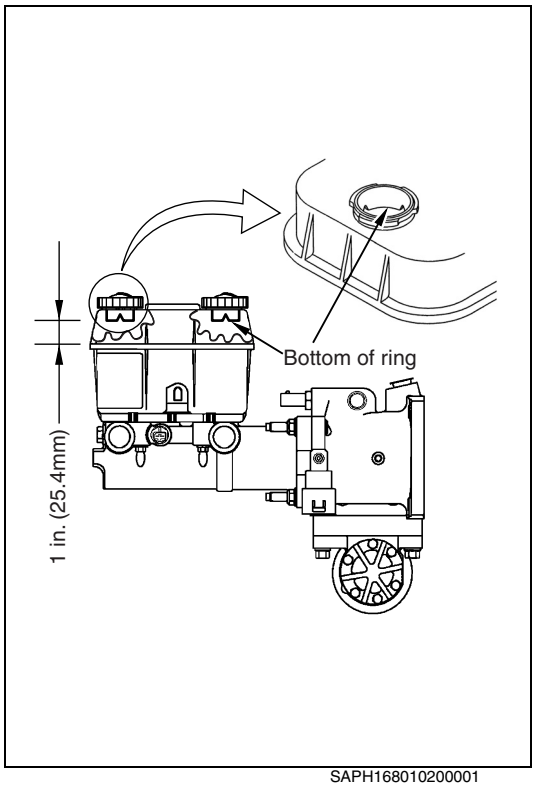
b. Aging

c. Oxidation

d. Ingression of mineral oil

(2) Brake fluid level check.

Check the fluid level of the brake fluid reservoir which is located under the hood on the driver side of the vehicle. Fluid level should be within 1 inch below bottom of ring. Replenish reservoir with DOT3 or DOT4 brake fluid to bottom of ring if fluid level drops below 1 inch.



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⚠ WARNING

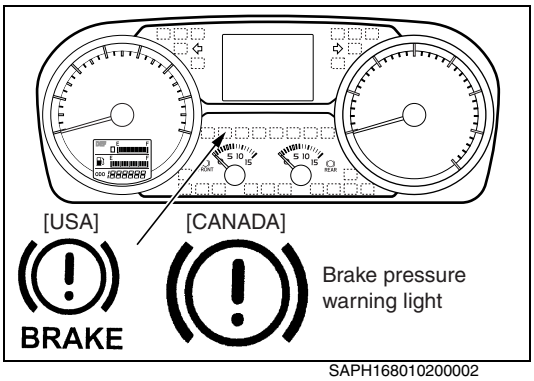
- **Remove the excess brake fluid from the reservoir when the worn brake pads are replaced, otherwise there is a possibility the brake fluid will overflow from the master cylinder reservoir.**

NOTICE

Be sure to use clean brake fluid. Note that if a foreign substance is mixed with the brake fluid, components of the brake line may be damaged and their functions may be degraded, thereby causing insufficient braking force.

- **Before removing the brake fluid reservoir cap, clean the vicinity of the cap.**
- **If foreign matter has settled on the bottom of the reservoir, clean the reservoir.**
- **Check that the container and tools used for brake fluid replenishment are clean. If they are dusty or dirty, clean them.**
- **Be sure to clean the strainer of the reservoir when replacing the brake fluid.**
- **Brake fluid is highly hygroscopic, and absorbs moisture. Be sure to securely tighten the caps of the containers to prevent entry of moisture.**
- **Do not leave the reservoir cap removed for a long time.**
- **When replenishing or replacing brake fluid outdoors on a rainy day, exercise care so that no water gets into the brake fluid.**
- **Pay attention that no mineral oil is mixed into brake fluid. Mineral oil will cause swelling of the rubber parts of the brake line, causing insufficient braking force.**
- **Do not mix different types of brake fluid.**

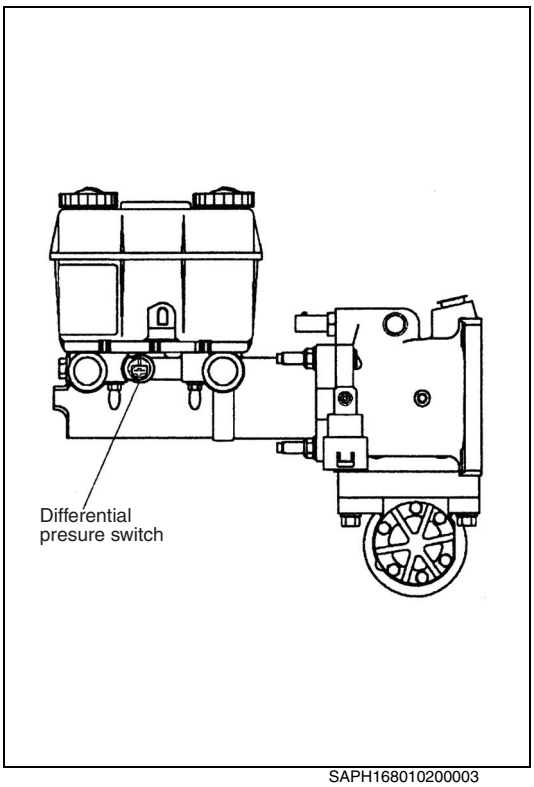
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4. BRAKE PRESSURE WARNING LIGHT

(1) Check for brake pressure warning light failure.
If the brake pressure warning light does not turn on when the starter switch is turned to the ON position, the light has burned out. Replace any burned out light with a new one.



SAPH168010200003

(2) Check the differential pressure switch.
Purposely loosen either the front or rear brake line.
Start the engine, depress the brake pedal and confirm that the warning lights up. Confirm warning light condition with other brake line (front and rear). If in both conditions the warning light comes on, the differential pressure switch is normal.

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HYDRO-MAX HYDRAULIC BRAKE BOOSTER AND MASTER CYLINDER

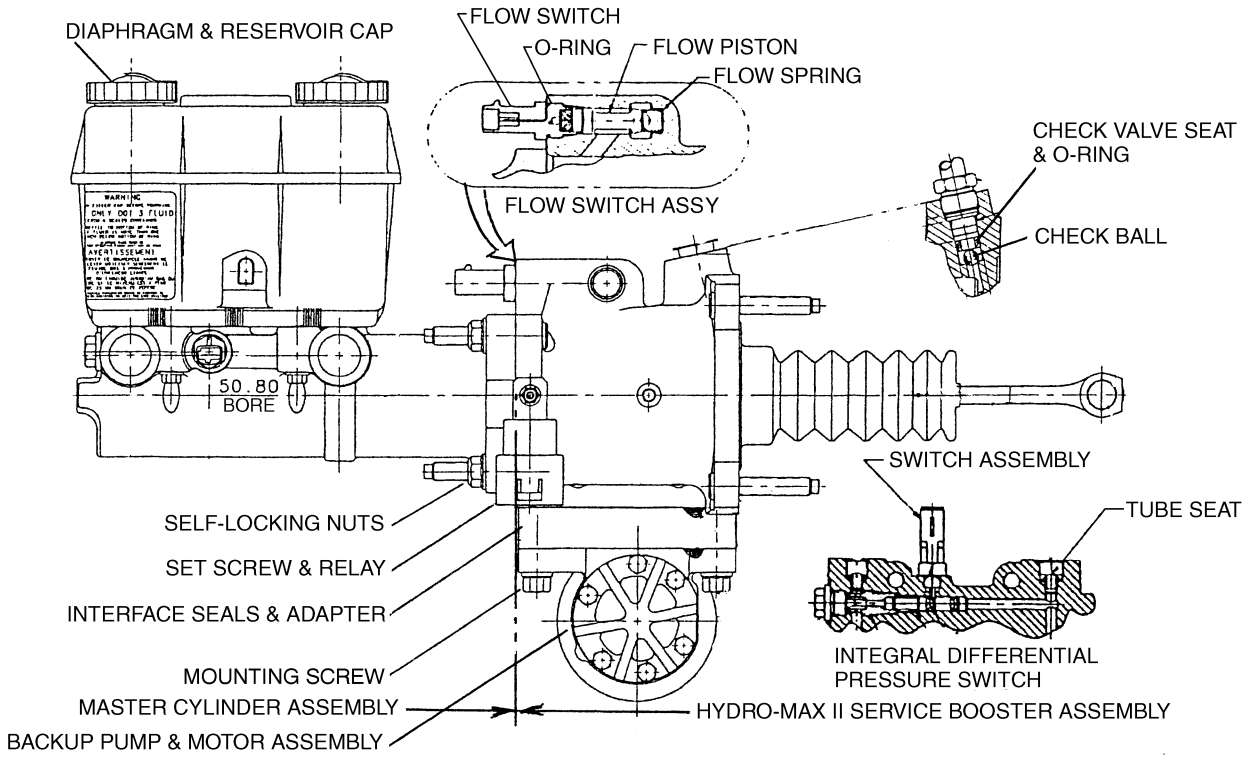
DATA AND SPECIFICATIONS

EN1680102I200001

Manufacturer	**BOSCH**
Type	**HYDRO-MAX II and master cylinder**
Master cylinder diameter	**50.80 mm {2.00 in}**

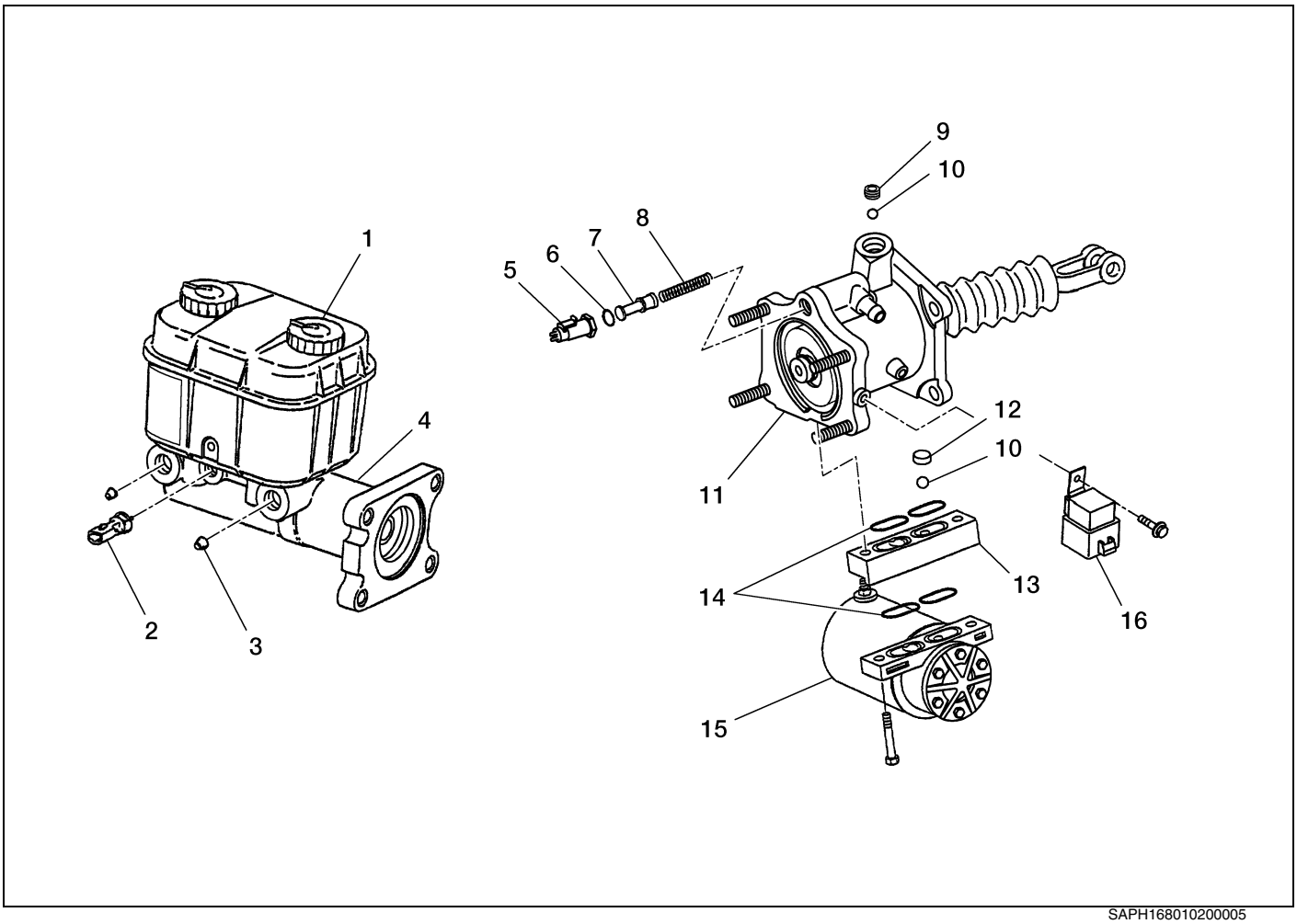
DESCRIPTION

EN1680102D100001



SAPH168010200004

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SAPH168010200005

1	Reservoir cap with diaphragm	9	Check valve seat
2	Differential pressure switch	10	Check ball
3	Tube seat	11	Hydro-Max booster assembly
4	Master cylinder assembly	12	Check ball retainer
5	Flow switch	13	Adapter
6	O-ring	14	Face seal
7	Flow piston	15	Backup pump
8	Flow piston spring	16	Backup pump relay

NOTICE

The above parts can be replaced if necessary. Any malfunctions to master cylinder or Hydro-max booster assembly requires complete assembly replacement.

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PRINCIPLE OF OPERATION

EN1680102C100001

1. HYDRO-MAX BOOSTER

During normal system operation, fluid flow from a hydraulic power source (the power steering pump) enters the inlet port of the Hydro-Max booster, flows through the power piston, around the throttle valve and through the flow switch, exiting through the outlet port.

Force applied to the brake pedal by the vehicle operator is multiplied by the lever ratio of the pedal mechanism to move the pedal rod of the booster. This movement closes the throttle valve which restricts flow. This restriction of flow, which results in a pressure increase acting on the power piston, applies an amplified force to the master cylinder primary piston. A reaction piston, inside the power piston subassembly, provides the driver "pedal feel" during an application of the brake pedal.

Fluid flow through the flow switch opens the backup pump electrical circuit during normal operation. A separate check valve in the backup pump prevents back-flow through the pump during normal power applications. In the event normal flow from the power source is interrupted, the backup pump provides the power at a reduced rate for stopping. Upon flow interruption, the Integral flow switch closes, energizing a relay, providing electrical power to the backup pump.

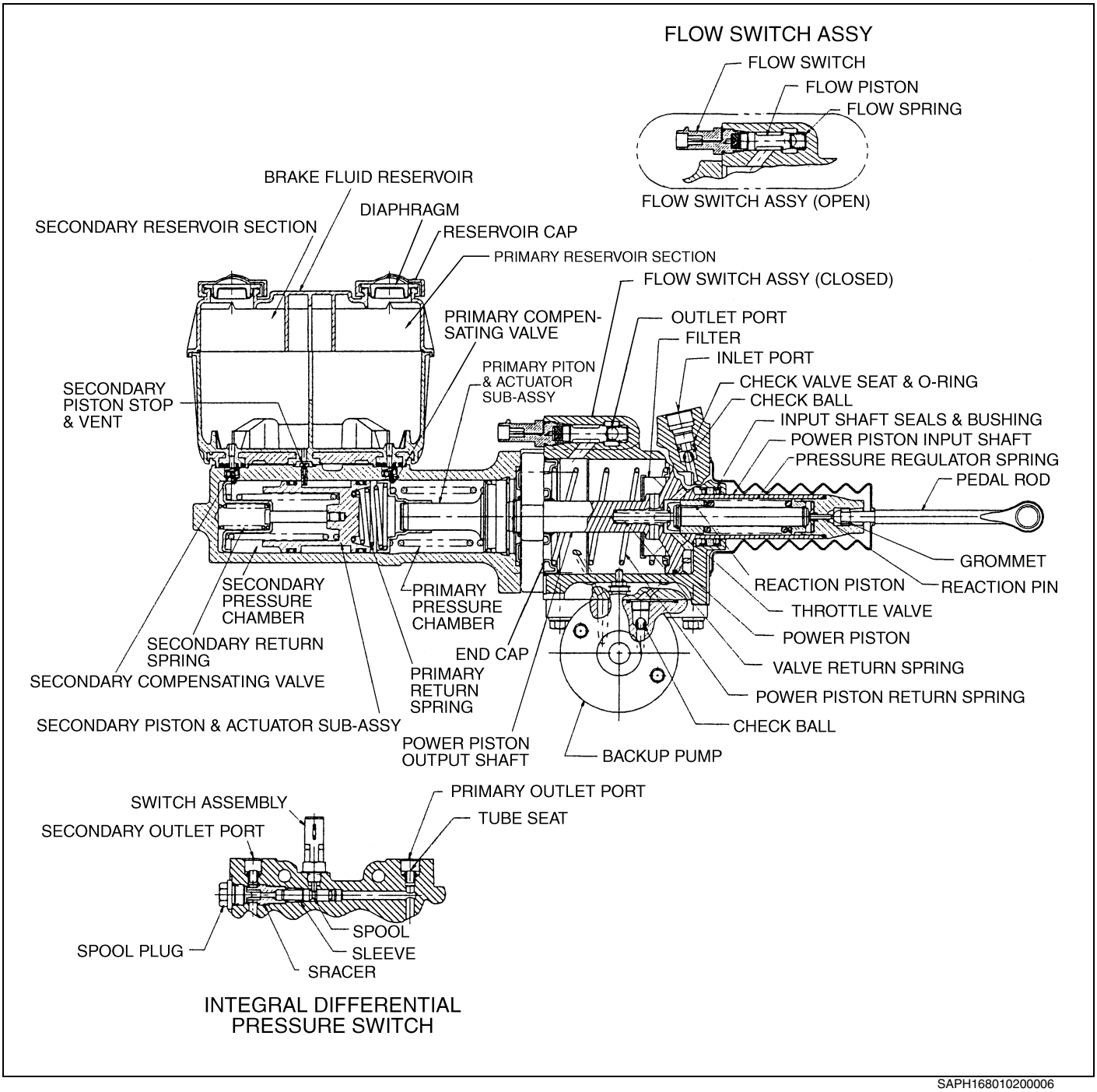
During backup operation, the pump re-circulates fluid within the booster assembly with pressure built on demand via the throttle valve. Fluid is retained within the booster by the inlet port check valve.

2. MASTER CYLINDER

The primary circuit is separated from the secondary hydraulic circuit. Hydraulic leakage in one circuit does not affect the function of the other circuit.

A differential pressure switch is available. It illuminates a light on the dash panel to warn when there is a pressure differential between the primary and secondary brake circuits caused by a leak in one circuit. This may occur when one circuit leaks or is improperly bled.

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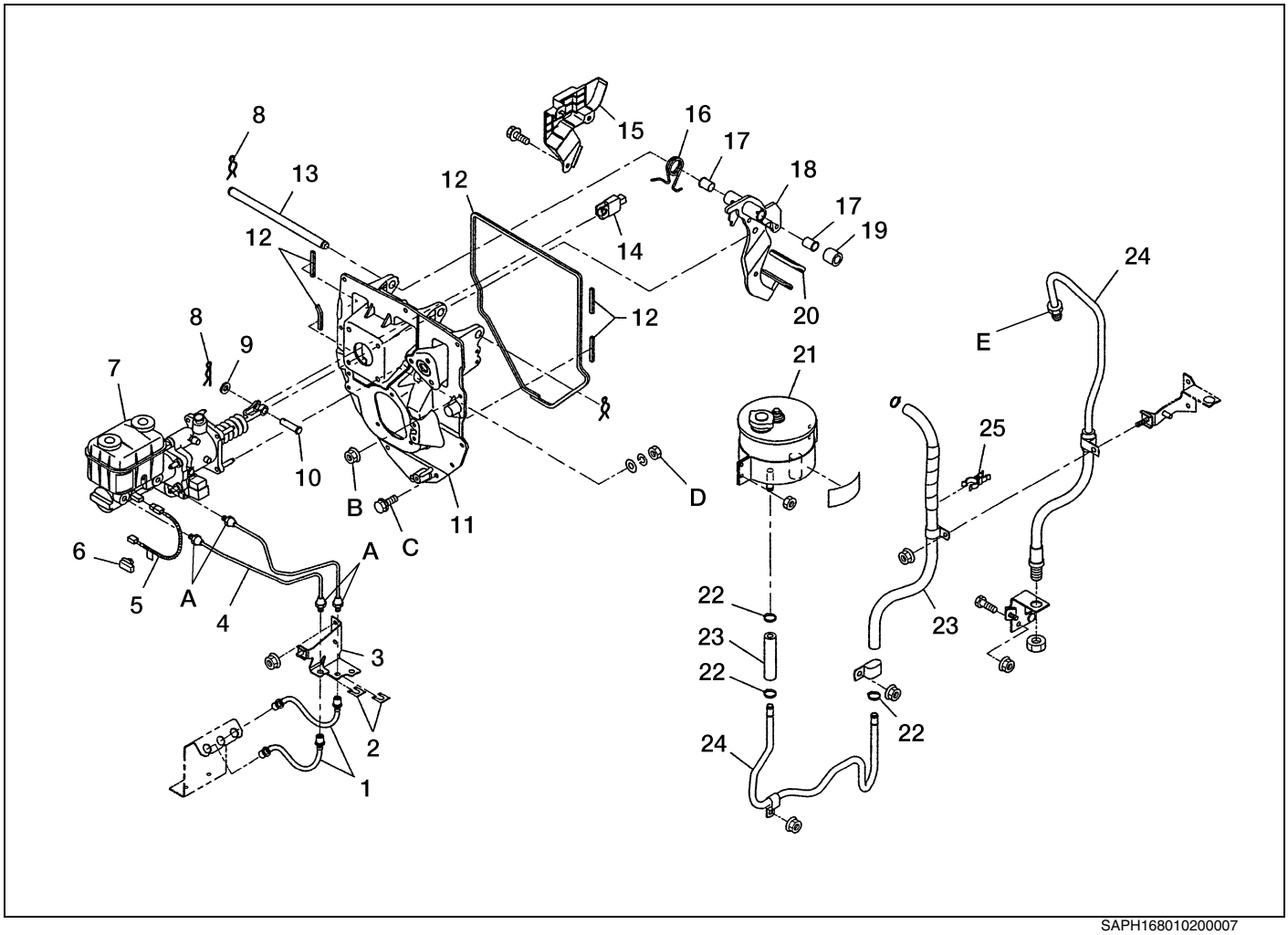
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NOTICE
This illustration is a representative model for operation reference.

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COMPONENT LOCATOR

EN1680102D100002



SAPH168010200007

1	Brake hose	14	Stop light switch
2	Brake hose clip	15	Stop light switch cover
3	Brake pipe bracket	16	Return spring
4	Brake pipe	17	Bushing
5	Sub harness	18	Brake pedal
6	Harness clamp	19	Collar
7	Hydro-Max booster and master cylinder	20	Pedal pad
8	Retainer	21	Power steering fluid reservoir
9	Plane washer	22	Hose clamp
10	Clevis pin	23	Power steering fluid hose
11	Pedal bracket	24	Power steering fluid pipe
12	Seal	25	Pipe clamp
13	Shaft		

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	20-30 {204-305, 15-22}	D	33.9-40.7 {346-415, 25-30}
B	18-26 {184-265, 14-19}	E	22-34 {224-346, 16-25}
C	18-26 {184-265, 14-19}		

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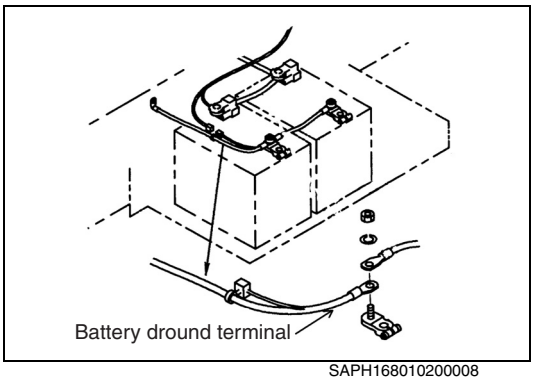
HYDRO-MAX BOOSTER

OVERHAUL

EN1680102H200001

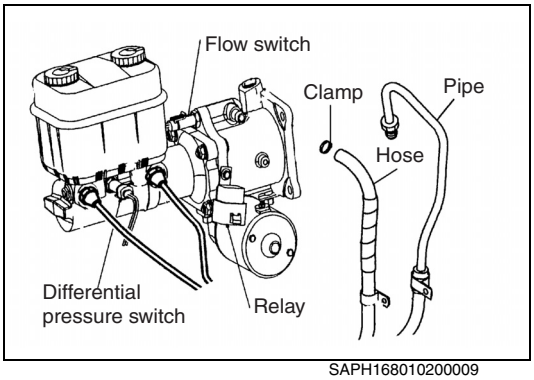
IMPORTANT POINT-DISMOUNTING

⚠ **CAUTION**
The Hydro-Max booster and the master cylinder use two distinctly different incompatible hydraulic fluids. They must not be mixed. Using the incorrect fluid will permanently damage the seals and can cause malfunctioning brakes.



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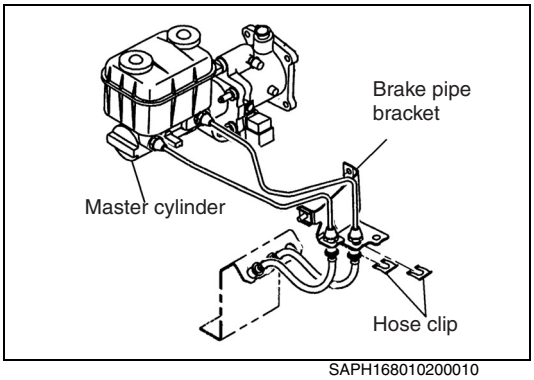
1. BEFORE DISMOUNTING THE HYDRO-MAX BOOSTER
(1) Be sure to block the wheels.
(2) Disconnect the battery cable from the battery ground terminal.



SAPH168010200009

2. DISCONNECT THE HARNESS CONNECTORS AND HARNESS
(1) Disconnect the connectors of differential pressure switch, flow switch, backup pump sub harness and relay.
(2) Remove the sub harness from the backup pump terminal.

3. DISCONNECT THE HYRDAULIC HOSE AND PIPE FROM THE HYDRO-MAX BOOSTER
Drain the power steering fluid.

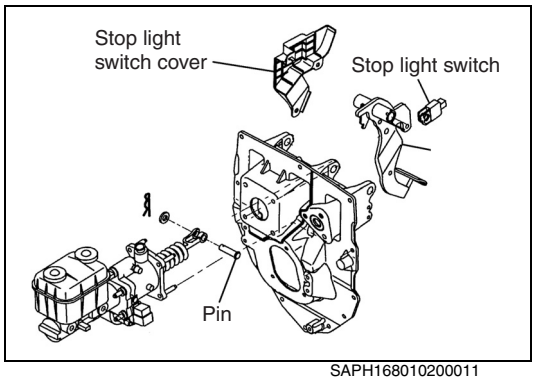


SAPH168010200010

4. DISCONNECT THE MASTER CYLINDER
HINT
- **By removing the brake pipe bracket or brake hose clips, it is possible to remove the Hydro-Max booster without removing the master cylinder from the vehicle.**
- **It is not necessary to disconnect the brake pipes from the master cylinder.**

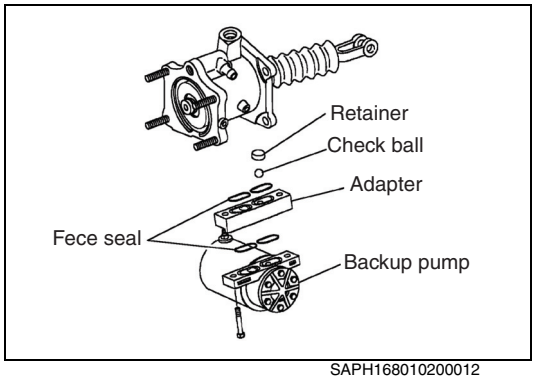
(1) Remove the brake pipe bracket or brake hose clips.
(2) Remove the nuts to disconnect the master cylinder.

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5. REMOVE THE HYDRO-MAX BOOSTER
(1) Remove the stop light switch cover.
(2) Remove the clevis pin to disconnect the brake pedal, stop light switch and push rod.
(3) Remove the Hydro-Max booster tightening nuts.
(4) Move the master cylinder forward to allow for the Hydro-Max booster removal and support it in that position.
(5) Remove the Hydro-Max booster.



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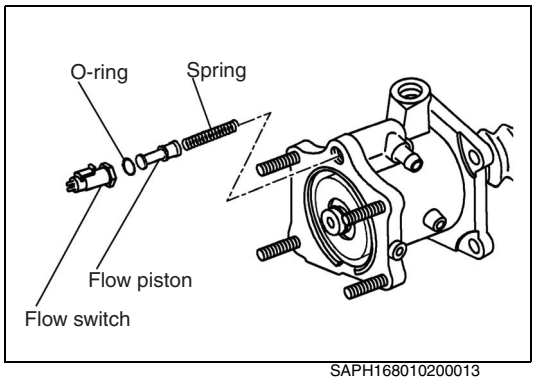
IMPORTANT POINTS-DISASSEMBLY

1. REMOVE THE BACKUP PUMP
(1) Remove the two tightening bolts.
(2) Remove the backup pump and adapter.

⚠ CAUTION
Do not damage the contact surface.

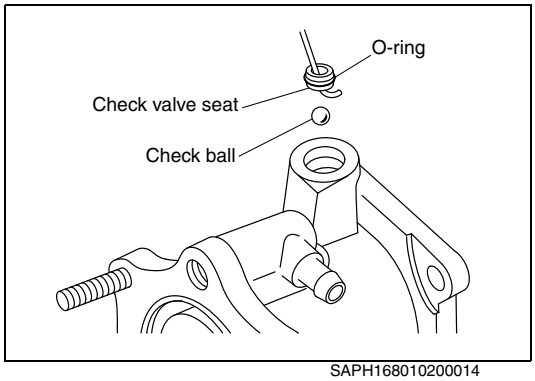
NOTICE
The power steering fluid will drain out from Hydro-Max booster.

(3) Remove and discard the four face seals.
(4) Remove the check ball. (If necessary)



SAPH168010200013

2. REMOVE THE FLOW SWITCH ASSEMBLY
(1) Remove the flow switch.
(2) Remove and discard the O-ring from the flow switch.
(3) Using a small magnet, remove the flow piston and spring.



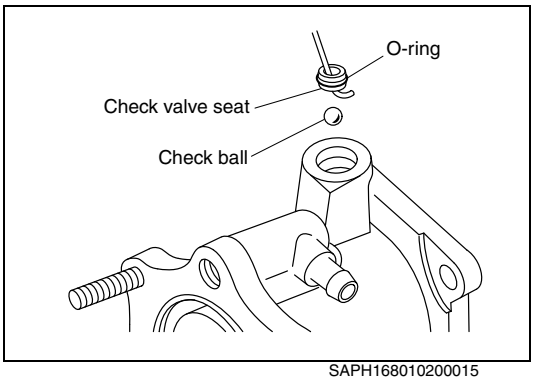
SAPH168010200014

3. REMOVE THE INLET CHECK VALVE
(1) Using a hook wire remove and discard the inlet check valve seat with O-ring from inlet port.
(2) Remove the check ball.

4. USE CLEAN POWER STEERING FLUID FOR CLEANING THE REUSED PARTS AND NEW SEALS

⚠ CAUTION
Do not use brake fluid.

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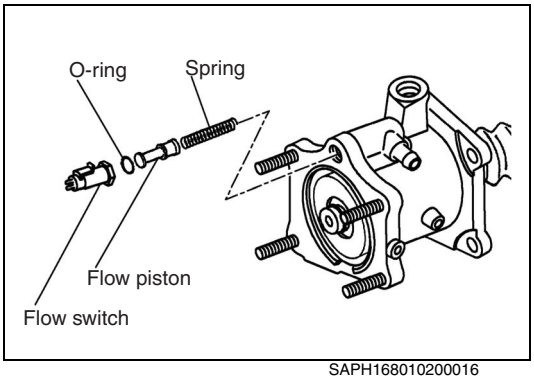


SAPH168010200015

IMPORTANT POINTS-ASSEMBLY

1. INSTALL THE INLET CHECK VALVE

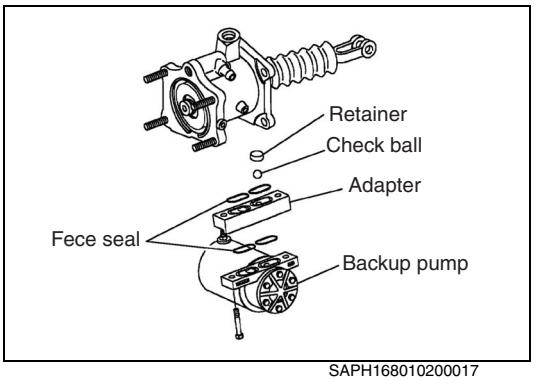
(1) Install the check ball to inlet port.
(2) Lubricate and install the O-ring in the inlet check seat.
(3) Install the inlet check valve seat.



SAPH168010200016

2. INSTALL THE FLOW SWITCH ASSEMBLY

(1) Install the flow spring and piston.
(2) Lubricate and install the O-ring in the flow switch.
(3) Install the flow switch.
Tightening Torque:
2.3-4.5 N·m{23-45 kgf·cm, 20.4-39.8 lbf·in}



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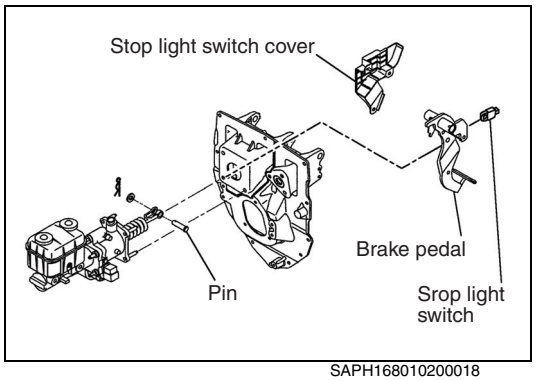
3. INSTALL THE BACKUP PUMP

(1) Install the check ball in the delivery port (If removed). If not replaced, make sure the check ball is in the delivery port.
(2) Lubricate and install the four face seals in the adapter and backup pump.
(3) Install the adapter and backup pump.

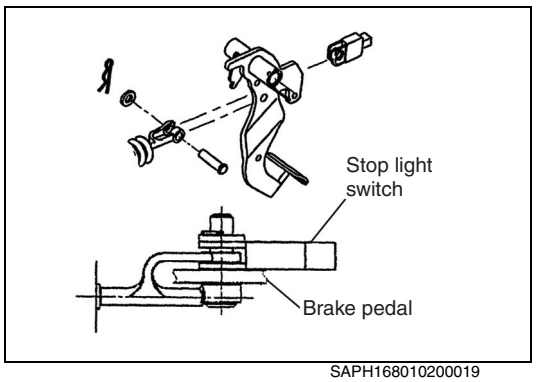
NOTICE
Ensure that the delivery ports for hydraulic pump, adaptor and Hydro-Max booster correspond during installation.
Do not confuse mating surfaces.
Install the backup pump in its proper position.

(4) Tighten the two bolts.
Tightening Torque:
24.5-33.9 N·m {250-345 kgf·cm, 18-25 lbf·ft}

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SAPH168010200019

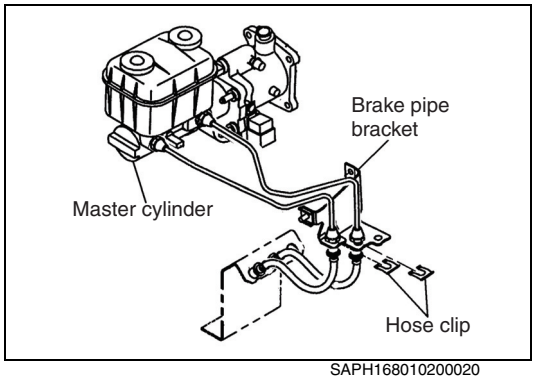
IMPORTANT POINTS-MOUNTING

1. INSTALL THE HYDRO-MAX BOOSTER

(1) Install the Hydro-Max booster and tighten the nuts.
Tightening Torque:
33.9-40.7 N·m {346-415 kg·cm, 25-30 lbf·ft}

(2) Install the clevis pin to connect the brake pedal, stop light switch and push rod.

(3) Install the stop light switch cover.

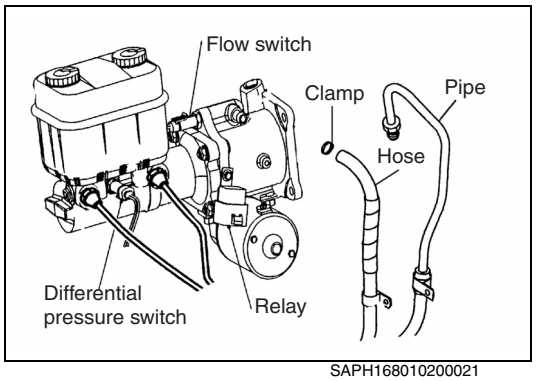


SAPH168010200020

2. CONNECT THE MASTER CYLINDER

(1) Connect the master cylinder to Hydro-Max booster and tighten the nuts.
Tightening Torque:
33.9-40.7 N·m {346-415 kgf·cm, 25-30 lbf·ft}

(2) Install the brake pipe bracket or brake hose clips.

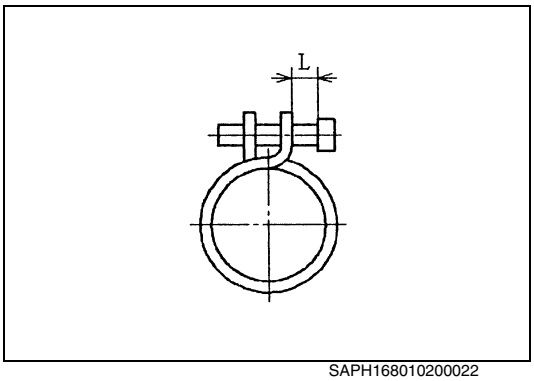


SAPH168010200021

3. CONNECT THE HYRDAULIC HOSE AND PIPE FROM THE HYDRO-MAX BOOSTER

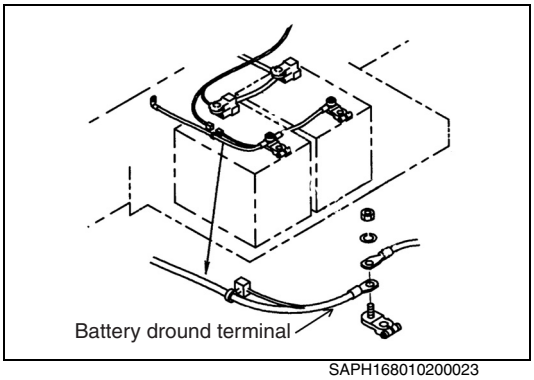
(1) Connect hydraulic pipe and tighten the flare nut.
Tightening Torque:
22-34 N·m {224-346 kgf·cm, 16-25 lbf·ft}

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SAPH168010200022

(2) Connect hydraulic hose and tighten the clamp.
Tighten the clamp until dimension L = 4-5 mm (0.16-0.19 in.).



SAPH168010200023

4. CONNECT THE HARNESS CONNECTORS AND HARNESS

(1) Install the sub harness to the backup pump terminal.
(2) Connect the connectors of differential pressure switch, flow switch, backup pump sub harness and relay.

5. CONNECT THE BATTERY CABLE TO THE BATTERY GROUND TERMINAL

6. BLEEDING OF HYDRO-MAX SYSTEM

Refer to POWER STEERING SYSTEM AIR BLEEDING of chapter "BRAKE EQUIPMENT (MODELS WITH HYDRAULIC BRAKE)" BR01-11.

⚠ WARNING

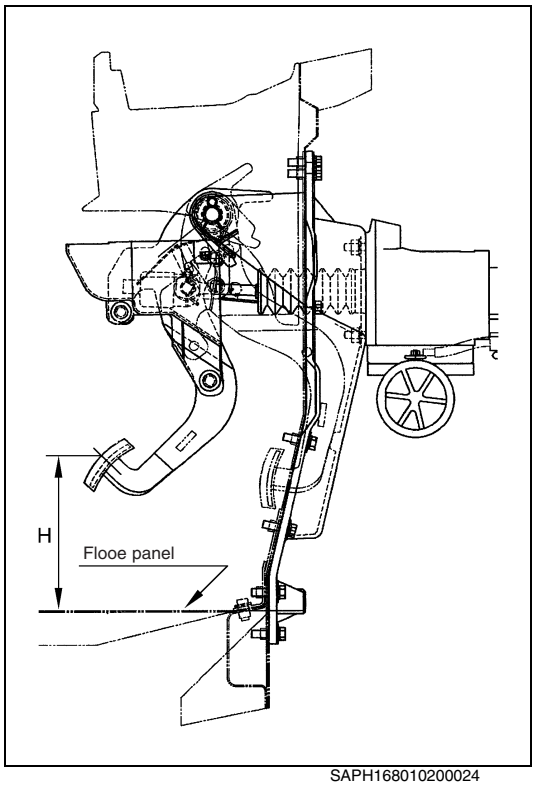
Any Hydro-Max booster or brake hydraulic line removed or disconnected should be properly bled before attempting to move the vehicle, as the braking force will not be sufficient.

7. BLEEDING OF BRAKE HYDRAULIC SYSTEM

If the master cylinder was removed, bleed the brake hydraulic system.

Refer to BRAKE SYSTEM AIR BLEEDING of chapter "BRAKE EQUIPMENT (MODELS WITH HYDRAULIC BRAKE)" BR01-9.

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8. BRAKE PEDAL HEIGHT

Check that the pedal height H from the floor is within the standard dimension.

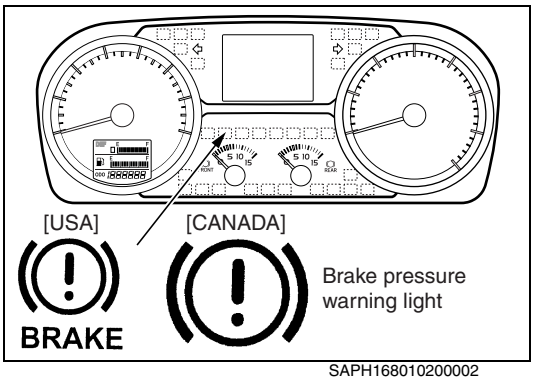
Standard: 162.5-172.5 mm {6.4-6.7 in}

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MASTER CYLINDER

OVERHAUL

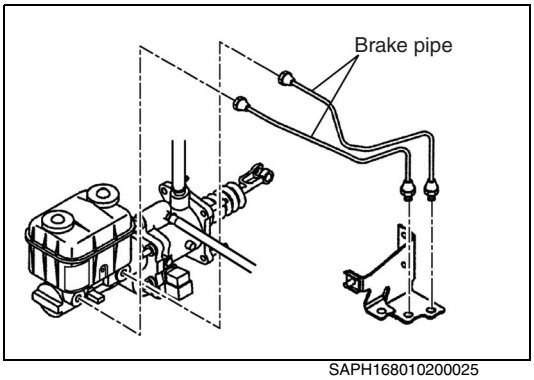
EN1680102H200002



SAPH168010200002

IMPORTANT POINTS-DISMOUNTING

⚠ WARNING
If the brake pressure warning light continues to light up after the engine has started, the vehicle should not be operated for safety reasons. During normal driving a longer stopping distance is required so extreme caution should be taken as there is a risk of personal injury or property damage.



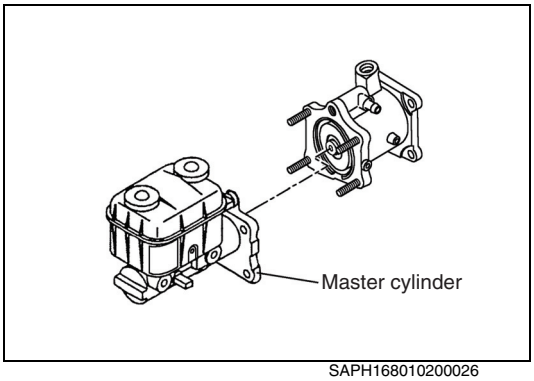
SAPH168010200025

1. BLOCK THE WHEELS

2. DISCONNECT THE BRAKE PIPES
(1) Drain the fluid from the master cylinder into a container.
(2) Disconnect the brake pipe from the master cylinder.

NOTICE
Observe the position of the brake pipe to master cylinder before removal to prevent mix-up during assembly.

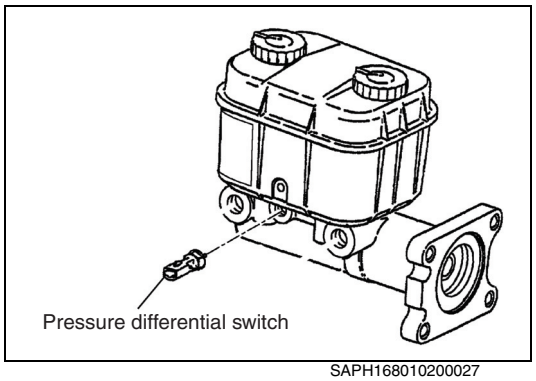
(3) Cover the pipe end to prevent entry of foreign matter.



SAPH168010200026

3. DISCONNECT THE MASTER CYLINDER
(1) Remove the tightened nuts.
(2) Disconnect the master cylinder.

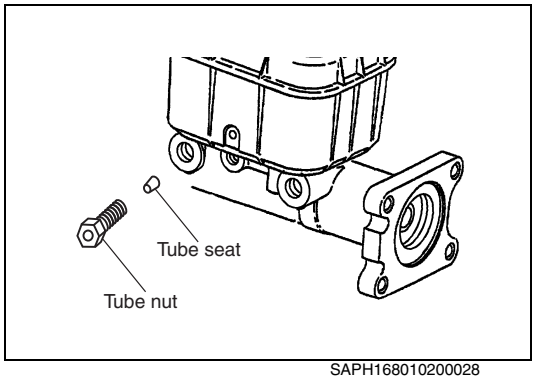
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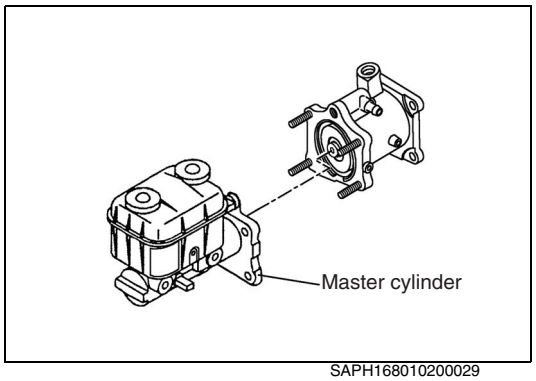
IMPORTANT POINTS-ASSEMBLY

1. INSTALL THE PRESSURE DIFFERENTIAL SWITCH
Tightening Torque:
1.1-1.7 N·m {11-17 kgf·cm, 9.7-15 lbf·in.}



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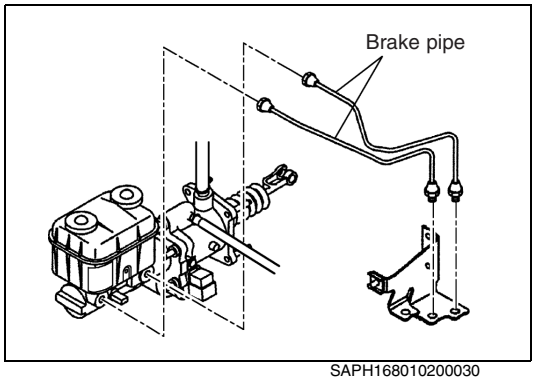
2. INSTALL THE TUBE SEAT
(1) If the tube seat was removed, install the new parts.
Press the tube seat by using a tube nut.
Make sure the seat is completely inserted in the bottom.
(2) Check installation condition of the sealing surface.
If necessary, clean and rinse the master cylinder ports to remove any metal fragments.



SAPH168010200029

IMPORTANT POINTS-MOUNTING

1. CONNECT THE MASTER CYLINDER
(1) Connect the master cylinder to Hydro-Max booster.
(2) Tighten the nut.
Tightening Torque:
33.9-40.7 N·m {346-415 kgf·cm, 25-30 lbf·ft}



SAPH168010200030

2. CONNECT THE BRAKE PIPES
(1) Remove cover from the pipe end.
(2) Connect the brake pipe to the master cylinder.
Tightening Torque:
20-30 N·m {204-305 kgf·cm, 15-22 lbf·ft}

3. BRAKE SYSTEM AIR BLEEDING
Refer to BRAKE SYSTEM AIR BLEEDING of chapter "BRAKE EQUIPMENT (MODELS WITH HYDRAULIC BRAKE)" BR01-9.

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PRESSURE TESTS

EN1680102H600002

1. CHECK THE BRAKE LINE PRESSURE

(1) To measure the brake line pressure, install a 0 to 13,800 kPa {140 kgf/cm^2, 2,000 lbf/in^2} gauge to the brake caliper.

(2) Depress the brake pedal while the engine is not running.
The backup pump should start and produce pressure approximately 5,515 kPa {56 kgf/cm^2, 800 lbf/in^2}.

(3) Warm-up the engine until the power steering fluid reaches normal operating temperature.

(4) Depress the brake pedal while the engine is at idling speed.
The pressure should be approximately 12,400 kPa {126 kgf/cm^2, 1,800 lbf/in^2}.

2. AIR BLEEDING

(1) Remove the pressure gauge.

(2) Bleed air from the pressure gauge installed line.

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ABS MODULATOR

DATA AND SPECIFICATIONS

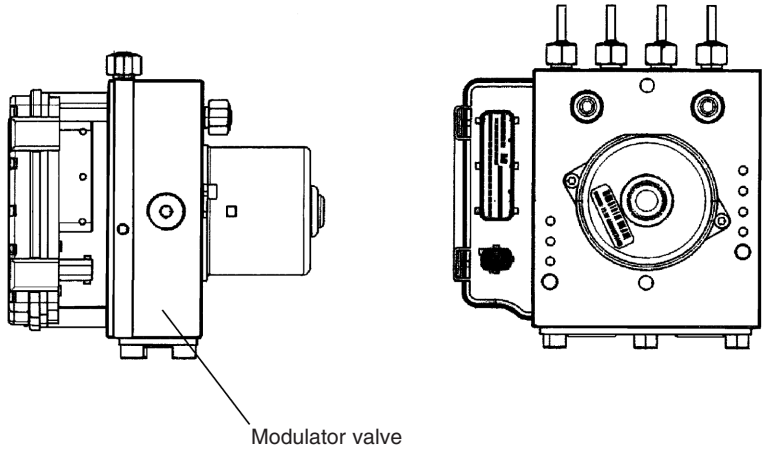
EN1680102I200002

Manufacturer	**MERITOR WABCO**
Type	**Hydraulic ABS modulator**

DESCRIPTION

EN1680102D100003

E version



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NOTICE
For removal and installation of ABS MODULATOR. refer to chapter "BRAKE CONTROL (ABS: HYDRAULIC) (E version)" DN03-20.

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WHEEL BRAKE (TYPE: 4 PISTON)

DATA AND SPECIFICATIONS

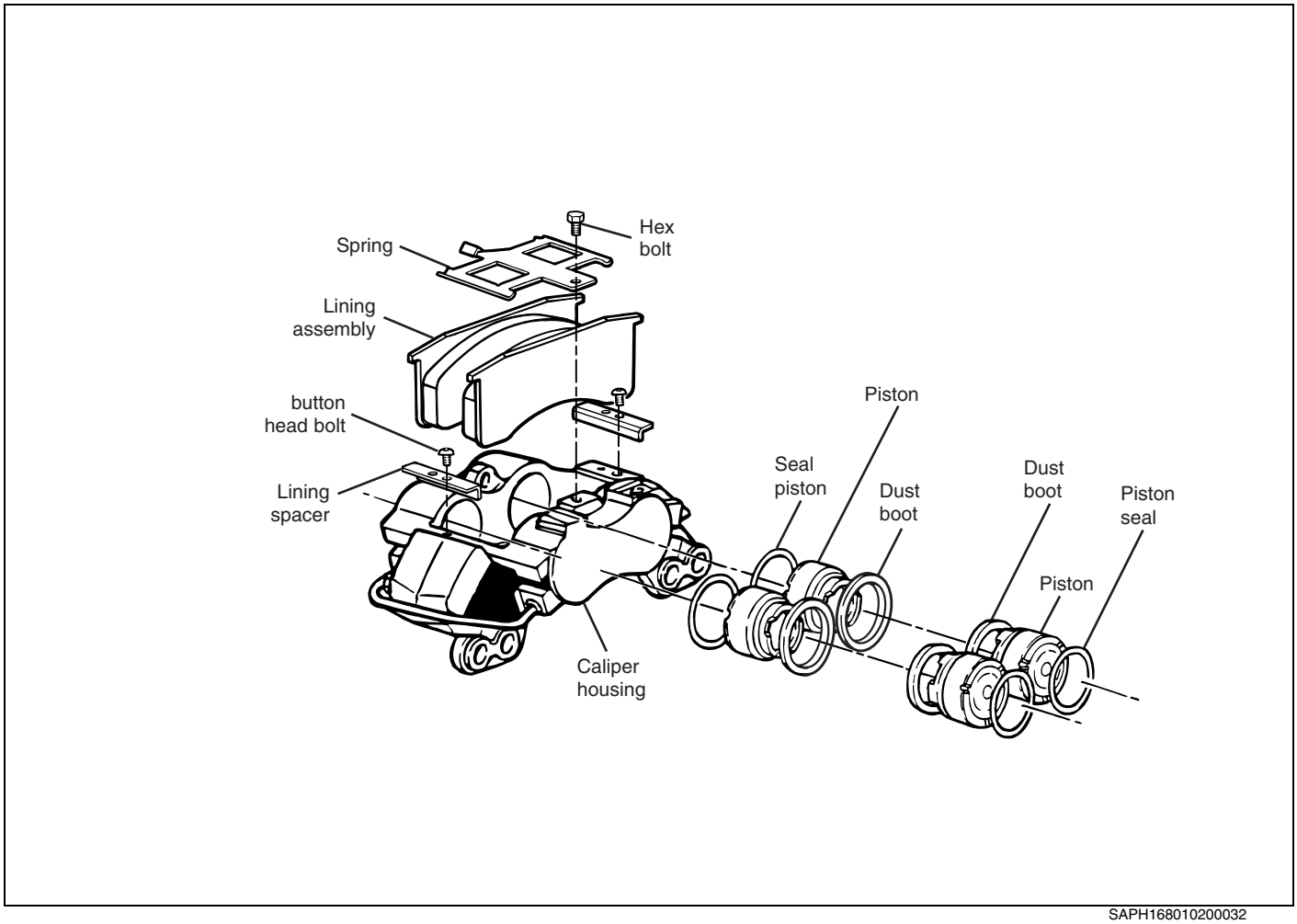
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Manufacturer		MERITOR
Type		4 PISTON FIXED MOUNT CALIPER
Brake pad	Thickness Above Metal (New)	0.73" (18.5 mm)
	Minimum Thickness Above Metal (Discard)	0.125" (3.2 mm)
Brake Fluid	High-Performance Brake Fluid	DOT 3 or DOT 4
Rotor	Rotor Diameter	15.38" (390.7 mm)
	Thickness (New)	1.54" (39.1 mm)
	Thickness (Discard)	1.42" (36.1 mm)
Vehicle Model		HINO 238, 258, 268, 338 (NE8J, NF8J): Front, Rear

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DESCRIPTION

EN1680102D100004



SAPH168010200032

TORQUE SPECIFICATIONS

Description	Specification
ABS Sensor Bolts — 5/16-18	9-12 lb-ft (12.2-16.3 N·m)
Brake Hose Hold Down Clamp Bolt — 5/16-18	9-12 lb-ft (12.2-16.3 N·m)
Banjo Bolt	30-40 lb-ft (40.8-54.4 N·m)
Pad Retainer Spring Bolt — M10x1.5x16	28-32 lb-ft (38.1-43.5 N·m)
Caliper-to-Support Bolts — M20	320-360 lb-ft (435.2-489.6 N·m)
Cross Over Tube Nuts — 7/16-24	9-12 lb-ft (12.2-16.3 N·m)
Bleed Screw — 7/16-24	9-12 lb-ft (12.2-16.3 N·m)
Lining Rail Covers — M8x1.25x14	12-18 lb-ft (16.3-24.5 N·m)
Rotor to Hub Bolt (9/16-12 bolt)	100-125 lb-ft (136.0-170.0 N·m)
Rotor to Hub Bolt (9/16-18) with Lock Nuts	70-95 lb-ft (95.2-129.2 N·m)
Rotor to Hub Bolt (9/16-18) with Plain Nuts	130-165 lb-ft (176.8-224.4 N·m)
Support to Axle (5/8-18 bolt) (9/16-18 bolt)	 190-250 lb-ft (258.4-340.0 N·m) 130-165 lb-ft (176.8-224.4 N·m)

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TROUBLESHOOTING

EN1680102F300001

Symptom	Possible cause	Remedy/Prevention
Excessive Pedal Effort	Pads worn below minimum thickness	Install new pads.
	Faded, overheated condition, glazed pads, blued or heat-checked rotors	Replace the rotor and/or reface pads if sufficient lining remains.
	Grease, oil and/or brake fluid on linings	Install new pads in the axle sets.
	Seized or frozen pistons	Disassemble the calipers and free pistons, or replace the caliper.
Pedal Pulsation (Brake Roughness or Chatter)	Excessive lateral runout of brake rotor	Check with a dial indicator. Install a new rotor if the runout exceeds the maximum specified.
	Excessive out-of-parallelism of brake rotor	Check the parallelism or rotor thickness variation with a micrometer. Resurface the rotor or install a new rotor if the parallelism exceeds the maximum allowed.
	Loose or worn steering or suspension parts	Replace the parts and realign.
	Excessive front bearing clearance	Readjust the bearing to specifications.
Vehicle Pulls to One Side	Brake fluid, oil and/or grease on linings	Install new pads in the axle sets.
	Unmatched linings, uneven lining wear, distorted pads	Install new pads in the axle sets.
	Rough rotor surfaces on one rotor	Resurface or replace the rotor in the axle sets.
	Seized or frozen pistons	Disassemble the caliper and repair or replace.
	Loose caliper mounting bolts	Tighten to specifications.
	Uneven tire pressure, tread wear or size, right to left	Equalize to the recommended pressures. Install the correct size tires with good tread.
	Excessive rotor parallelism or runout	Resurface or replace the rotor.
	Restricted hose or line	Examine the hoses and lines, and replace as necessary.
	Front end out of alignment	Reset the alignment.
Leaky Caliper	Cylinder bore surface scored or corroded	Disassemble the calipers, clean the bore and replace the seals and boots.
	Caliper piston seal damaged or worn	Disassemble the calipers and install new seals and boots.
	Caliper piston damaged	Replace the piston.

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Symptom	Possible cause	Remedy/Prevention
No Braking Effect or Excessive Pedal Travel	Reservoir fluid level low	Check for causes of fluid leak, repair as required and refill the reservoir. Bleed the system as needed.
	Air in the hydraulic system	Bleed the system.
	Bleed screw loose or open	Bleed the system and tighten the bleed screw.
	Caliper piston seal damaged	Disassemble the caliper and replace the piston seals. Replace the piston if it is damaged.
	Excessive rotor runout or bent rotor	Check the rotor with a dial indicator. Install a new rotor if the runout exceeds the maximum specified.
	Worn or excessively loose wheel bearings	Adjust or replace the bearings as needed.
	Low quality brake fluid	Drain and clean the system. Replace with the recommended brake fluid.
	Weak brake hose that expands under pressure	Replace the hoses.
Brake Noise (Chatter)	Excessive lateral runout of rotor	Check the runout with a dial indicator. Install a new rotor if the runout exceeds the maximum specified.
	Lack of rotor parallelism	Check the parallelism with a micrometer. Resurface or install a new rotor as required.
	Loose wheel bearing	Readjust the bearing to the specified torque.
Brake Noise (Scraping)	Rust or mud build-up on edges of rotor and on caliper housing	Clean or replace as necessary.
	Worn pad or pad installed backward	Replace the pads in the axle sets only with the friction surface against the rotor.
	Incorrect caliper alignment permitting rotor to scrape on housing	Correct the alignment.
Brake Noise (Groan)	Pressure on the brake pedal too light	Slightly increase the pedal effort to eliminate the noise.
Brake Noise (Rattle)	Excessive clearance between the shoe and caliper	Install new pads.
	Pad retainer spring missing or not correctly positioned	Install a new pad retainer spring or position it correctly.
Brake Noise (Squeal)	Glazed pads	Resurface or replace the pads in the axle sets only.
	Weak pad retainer spring	Install a new pad retainer spring.
	Pad wear indicator contacting rotor	Install new pads in the axle sets only.
	Foreign material embedded in linings	Replace the pads in the axle sets only.

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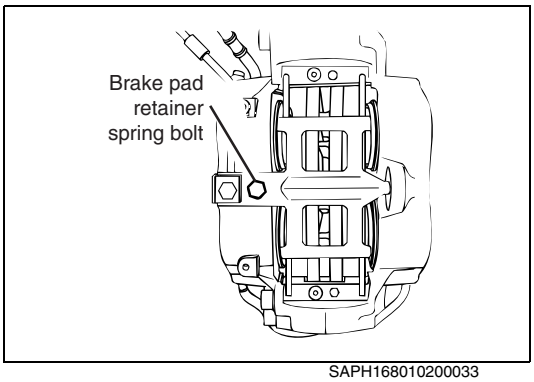
REMOVAL

⚠ WARNING
To prevent serious personal injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. BRAKE PADS
(1) Visually inspect all brake pads. Replace pads when the remaining lining reaches 1/8-inch (3.175 mm) thickness.

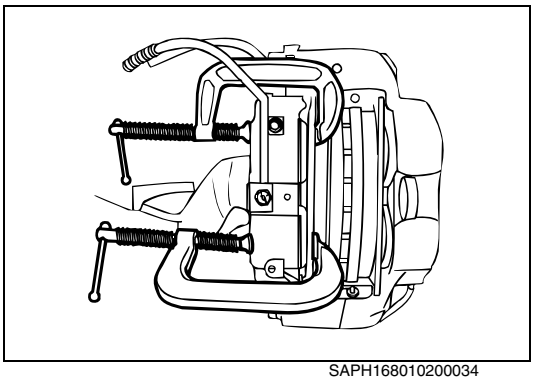
- **If you replace pads:** Replace all disc brake pads at the same time to maintain original brake balance.
- **If a complete vehicle pad replacement is not necessary or desirable:** Replace the pads on both wheel ends on the same axle.

2. REPLACE BRAKE PADS
(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly according to manufacturer's recommendation.
(3) Remove the master cylinder reservoir filler cap. Check the brake fluid level in the reservoir. If necessary, remove fluid to keep the reservoir from overflowing when compressing pistons into the caliper.
(4) Remove the pad retainer spring bolt.

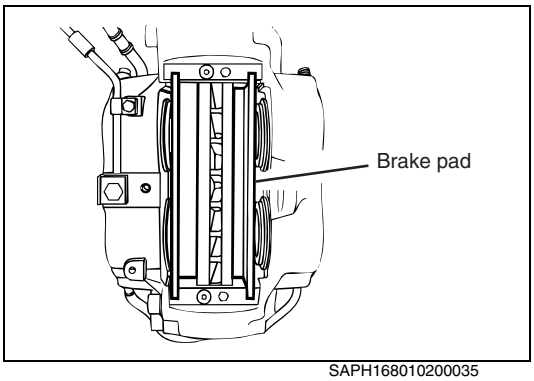


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(5) Compress the caliper pistons.


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(6) Remove the brake pads.



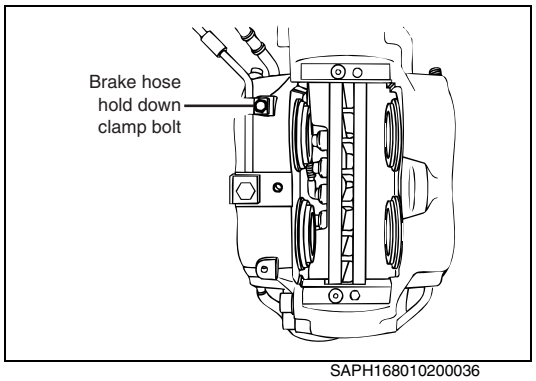
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3. BRAKE CALIPER

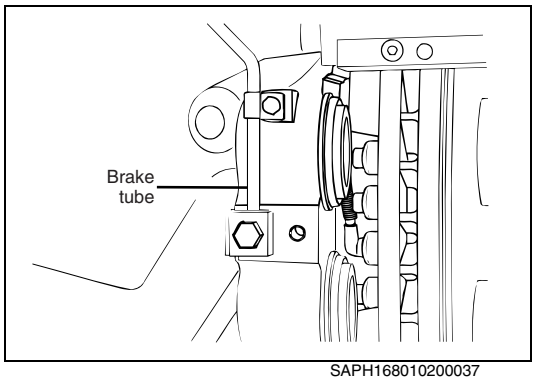
⚠ WARNING
Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

(1) Raise and support the vehicle.
(2) Remove the tire and wheel assembly according to manufacturer's instructions.
(3) Remove the brake hose hold down clamp bolt, if equipped.



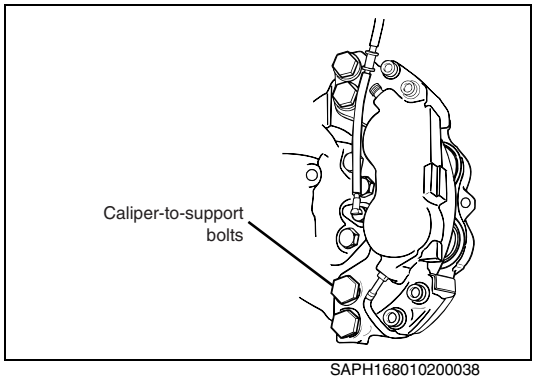
SAPH168010200036

(4) Remove the brake hose/tube from the caliper.



SAPH168010200037

(5) Remove four caliper-to-support assembly bolts. **Do not disassemble the four bolts joining the two halves of the caliper.**

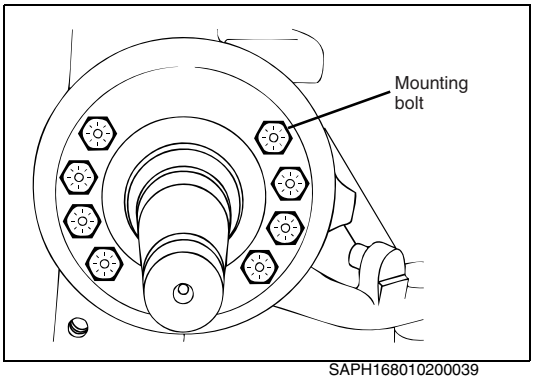


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4. SUPPORT

(1) Remove the caliper from vehicle as described in Brake Caliper in this section.
(2) Remove the splash shield if installed from the support.
(3) Remove the hub and rotor assembly according to vehicle manufacturer's recommended service procedure.
(4) Remove the ABS sensor.
(5) Remove the support-to-axle mounting bolts.



SAPH168010200039

5. ROTOR

NOTICE

The thickness of the resurfaced rotor must exceed the minimum thickness dimension stamped or cast into the rotor. Replace if necessary.

(1) Check the rotor while assembled to the hub or spoke wheel and mounted on the axle spindle. The lateral runout of the rotor friction surfaces should not exceed 0.015-inches (0.381 mm) total indicator reading (TIR). The thickness variation of the rotor should not exceed 0.0012-inches (0.0300 mm).

- **If the lateral runout and/or the thickness variation exceed the above values:** Resurface or replace the rotor.

(2) Remove the caliper. Refer to Brake Caliper in this section.
(3) Remove the hub/spoke wheel and rotor assembly from the axle according to vehicle manufacturer's recommendation.
(4) Remove the hub-to-rotor attachment fasteners (hat-shaped rotor). For the U-shaped rotor, remove the studs holding the hub and rotor.

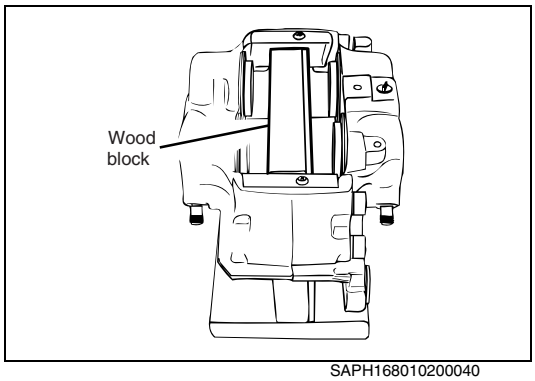
6. DISASSEMBLE AND OVERHAUL THE BRAKE CALIPER

(1) Remove the brake caliper. Refer to Brake Caliper in this section.
(2) Drain all fluid from the caliper.
(3) Push all four pistons to the bottom of their bores.
(4) Remove the piston boots by prying the metal ring portion of the boot out of the bore with a screwdriver. Use care to avoid damage to the piston or bore. Discard the boots.

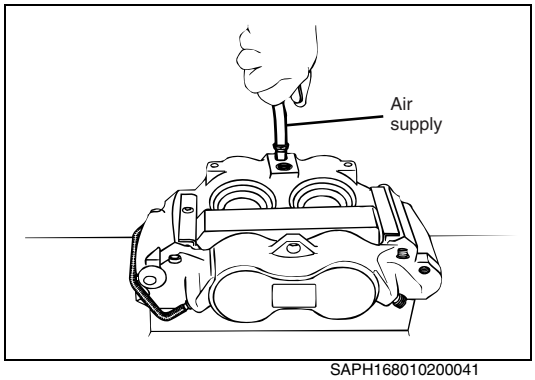
NOTICE

The C-clamp must be between the pistons on the opposite side so they may move to the wood block without striking the C-clamp. Cover pistons with shop rag to prevent brake fluid spray.

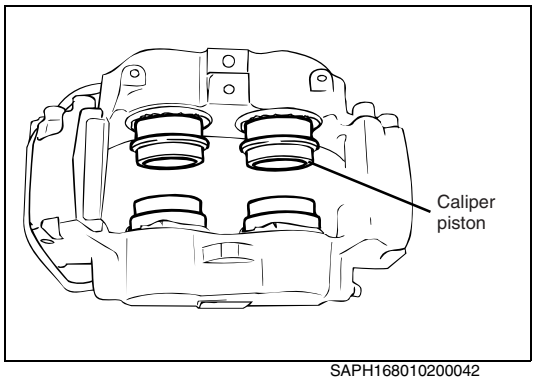
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(5) Place a block of wood (7-5/8 x 3-1/2 x 2-9/16-inches thick) between the caliper pistons. Use a C-clamp to hold the block of wood against the pistons on one side of the caliper.

⚠ WARNING
When you use compressed air to remove the pistons form the caliper bore, do not place your hands or fingers near the bore to catch or protect the pistons. Serious personal injury can result.

⚠ CAUTION
When you remove the pistons from the caliper bore, only direct enough compressed air into the caliper brake fluid inlet to ease the pistons out of the bore. Do not exceed 25 psi (172 kPa). Damage to components will result.

(6) Apply low air pressure (no more than 25 psi [172 kPa]) to the fluid port in the caliper to move the caliper pistons out to the wood block.

(7) With the pistons in contact with the wood block, there will be a small amount of seal engagement remaining. Remove the C-clamp and the wood block. The pistons may now be removed by hand.

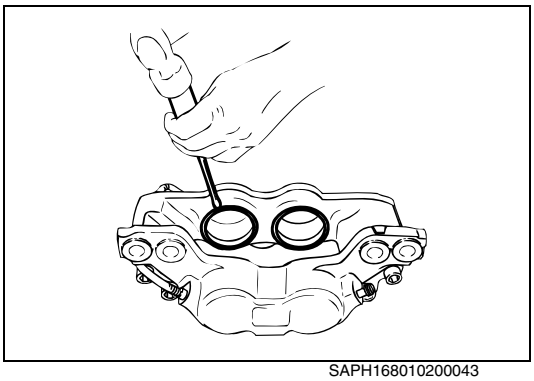
(8) To remove the pistons from the other side of the caliper, place the block of wood now over the empty bores (from where the pistons have been removed) with a thick sheet of rubber (3/8-inch) between the wood and the caliper bores.

NOTICE
Use the C-clamp to hold the block of wood in position against the empty bores. The C-clamp must be between the pistons on the opposite side so they may move out to the wood block without striking the C-clamp. Cover pistons with a shop rag to prevent brake fluid spray.

(9) Apply low air pressure (no more than 25 psi [172 kPa]) to the fluid port in the caliper to move the caliper pistons out to the wood block.

(10) With the pistons in contact with the wood block, there will be a small amount of seal engagement remaining. Remove the C-clamp and the wood block. The pistons may now be removed by hand.

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(11) Remove the piston seals with a non-metallic device and discard them. Do not knock, scratch or otherwise scar piston bores or seal grooves.

NOTICE
Do not hone the caliper bores. Pistons are not available for honed caliper bores. If the caliper bores are excessively scored or corroded, install a new caliper.

⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners and petroleum-based cleaners. To avoid serious personal injury when you use solvent cleaners, you must carefully follow the manufacturer's instructions and these procedures:

- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline or solvents that contain gasoline. Gasoline can explode.**
- **You must use hot solution tanks or alkaline solutions correctly. Carefully follow the manufacturer's instructions.**

CLEAN, DRY AND INSPECT PARTS

1. CLEAN PARTS FOR GROUND OR POLISHED METAL PARTS

⚠ CAUTION
Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts will result.

Use a cleaning solvent or kerosene or diesel fuel to clean ground or polished metal parts or surfaces.

2. FOR ROUGH METAL PARTS

Use a cleaning solvent or a weak alkaline solution in a hot solution tank to clean rough metal parts.
If you use a hot solution tank, follow the instructions below.

(1) Leave the rough parts in the tank until they are completely cleaned and heated.
(2) Remove the rough parts from the tank.
(3) Wash the parts with water until you remove the alkaline solution.

3. DRY AND INSPECT PARTS

(1) Use soft, clean paper or cloth rags or compressed air to completely dry parts immediately after you clean them.
(2) Carefully inspect all parts for wear or damage before you assemble them.
(3) Repair or replace worn or damaged parts.

4. APPLY CORROSION PROTECTION

(1) Apply a thin layer of brake grease to cleaned, dried parts. Be careful that you do not apply the grease to the linings or rotor.
(2) If you will store the parts, apply a special material, which prevents corrosion and rust, to all surfaces. Store parts inside special paper or other material that prevents rust and corrosion.

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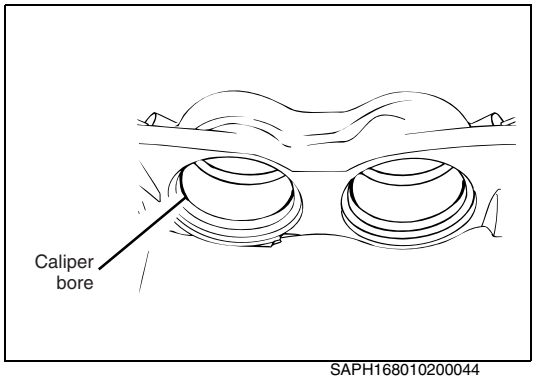
ASSEMBLY

⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. BRAKE CALIPER

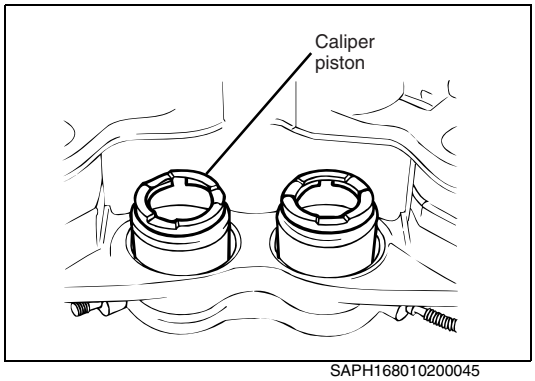
NOTICE
When using compressed air, use air lines that are completely free of oil and moisture.
All brake parts must be clean and completely dried of cleaning fluid. Use ONLY ArvinMeritor replacement parts to ensure proper caliper performance.

(1) Clean caliper, caliper piston bores and fluid ports with solvent. Use compressed air to clean out and dry grooves and passages.
(2) Dip new piston seals in new, clean DOT 3 hydraulic brake fluid and install in piston seal groove in caliper piston bores. Make sure that they are properly seated. Apply a thin film of silicon grease or brake fluid to the caliper bore seal land between the piston boot and seal groove. Apply the grease or brake fluid around the entire circumference of the caliper bore.



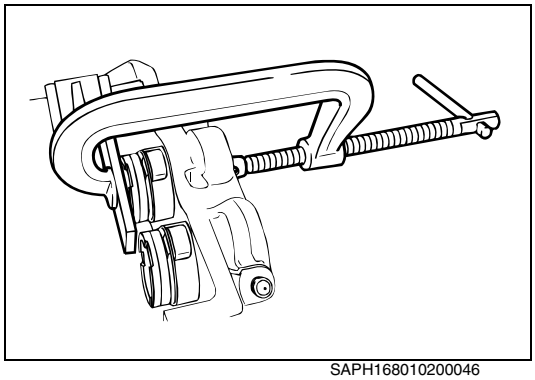
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(3) Apply DOT 3 hydraulic brake fluid to the outside of the caliper pistons and install them in caliper bores, making sure that they are square to the bore.

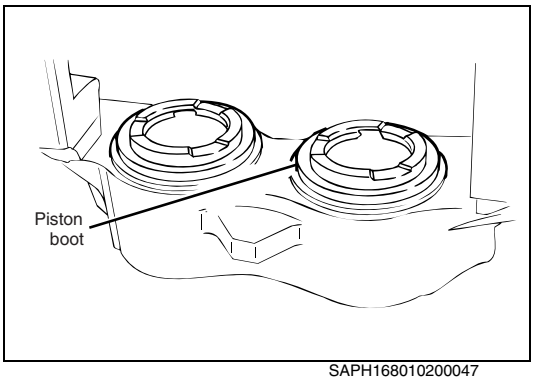


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(4) Be careful not to cock the caliper pistons and press them into the bores.


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(5) Install the piston boots over the projecting ends of the pistons and press the ring side of the boots into the boot bore. An old bearing cup equal to the boot ring size helps install the boots. Make sure the piston boot bead is seated back against the shoulder of the projecting end of the piston. Boots for the 64 mm and 70 mm pistons are color-coded.

(6) If required, replace the two stainless steel wear rails by removing the button head bolts.

NOTICE

Inspect the caliper prior to reinstalling it onto the support. Pistons must be fully retracted into the caliper. Piston boots must be fully seated in the caliper boot grooves.

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INSTALLATION

1. ROTOR

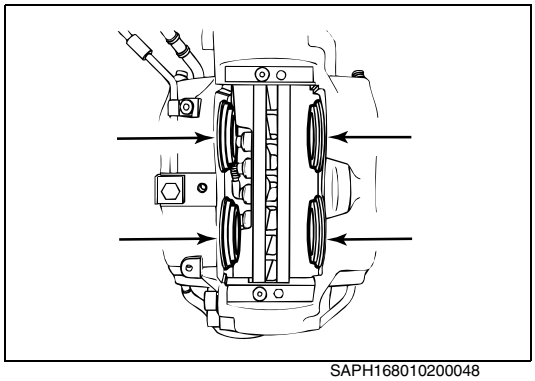
NOTICE

Do not resurface a new replacement rotor.

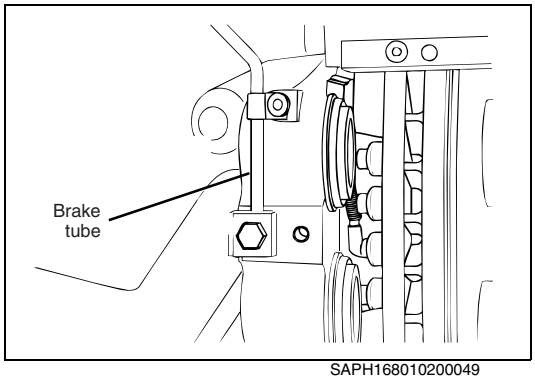
(1) To install, reverse the removal processes, making sure that the mating surfaces of the hub or spoke wheel and rotor are clean and free of rust build-up.
(2) Check the rotor for lateral runout. If the lateral runout exceeds 0.015-inches (0.381 mm), the rotor may be rotated to a different mounting hole position on the hub or spoke wheel to reduce the value.

2. CALIPER

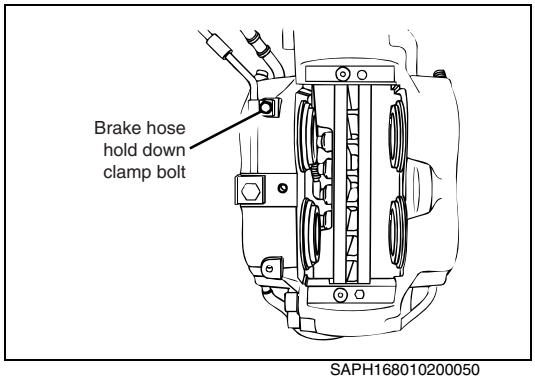
(1) Inspect the caliper for leakage, damage or defects to piston seals or pistons. If leakage, damage or defect is found, caliper disassembly may be required.


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(2) To install, reverse the removal process.
(3) Bleed the brake system and road test the vehicle.



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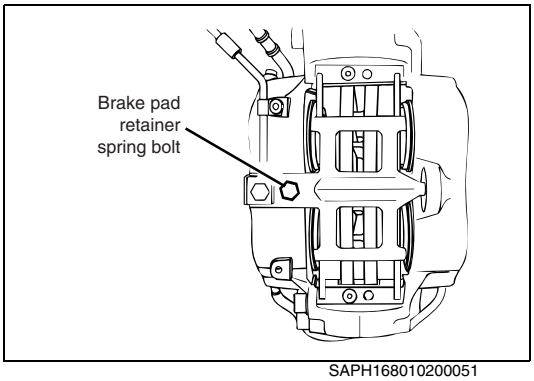
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3. BRAKE PADS

(1) Inspect the rotor for scoring, warping, cracks, bluing, heat spots or other damage or defects and minimum thickness. Repair or replace if necessary.
(2) Inspect the disc brake calipers for leakage, damage or defects to piston boots, seals or pistons. Replace or repair the parts as required.
(3) Clean and inspect the lining rail covers. If they are worn, they must be replaced.

NOTICE

The inboard and outboard brake pads are identical, except when they are equipped with a mechanical wear sensor.



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(4) Install the brake pads. Ensure that the friction surface is against the rotor. Install the pad retainer spring and tighten the bolt to 30 lb-ft (40 N·m) of torque.

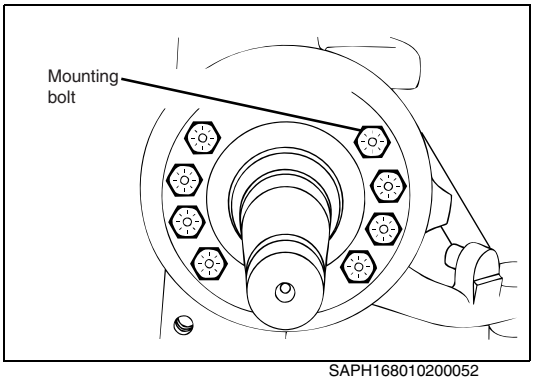
NOTICE

Brake pad clearance adjustment is automatic.

(5) Fill the master cylinder reservoir with new, clean, high-performance DOT 3 brake fluid or equivalent. Make several brake applications to move the brake pistons and linings out into contact with the brake rotors.
(6) Recheck master cylinder reservoir and top off as necessary to manufacturer's recommended level.
(7) Bleed the brake system.
(8) Install the tire and wheel assembly according to the manufacturer's instructions.
(9) Lower the vehicle and road test for correct operation.

4. ASSEMBLE THE SUPPORT

(1) Install the support mounting bolts. Tighten the bolts to the specified torque. Refer to Section 8.



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(2) Install the ABS sensor. Tighten the bolt to 8 lb-ft (11 N·m).
(3) Install the hub and rotor assembly according to vehicle manufacturer's recommended service procedure.
(4) Install the splash shield, if equipped.
(5) Install the caliper as described in Caliper in this section.

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INSPECT PARTS

⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. CALIPER
(1) Clean the area around the brake hose. Use brake parts cleaner.
(2) Inspect the heat shields (previous style only) for wear and damage. Replace worn or damaged shields.
(3) Inspect the caliper lining spacers for wear and damage. Replace worn or damaged spacers.
(4) Inspect the housing for cracks or damage.
Replace a cracked or damaged housing.

⚠ CAUTION
The OUTSIDE diameter of the piston is the caliper's primary sealing surface and is manufactured to very close tolerances. Replace a piston if the OUTSIDE diameter is damaged.
Do not refinish or use abrasives, including an emery cloth, on the piston. Damage to components can result.

(5) Inspect the OUTSIDE diameter of the pistons for scoring, nicks, corrosion, wear and damage.

- **If any of these conditions are evident:**
Replace the pistons. Do not refinish or use abrasives.

(6) Inspect the caliper bore for scoring, nicks, corrosion, wear and damage.

- **If any of these conditions are evident:**
Replace the caliper.

⚠ CAUTION
Use a crocus cloth to remove minor stains and corrosion from the caliper bore. Do not use abrasives, including an emery cloth. If you cannot remove minor stains and corrosion, replace the caliper bore to avoid damage to components.

(7) Inspect the caliper bore for minor stains and corrosion.

- **If these conditions are evident:** Use a crocus cloth to remove stains or corrosion. Clean the caliper bore after using a crocus cloth. Do not use abrasives, including an emery cloth.
- **If you cannot remove stains and corrosion from the caliper bore:** Replace the caliper.

2. CALIPER MOUNTING PLATE
(1) Inspect caliper mounting plate area for rust, corrosion. Replace a damaged or worn mounting plate.
(2) Use a wire brush to clean the caliper mounting area.
(3) Inspect the mounting plate for cracks or elongated bolt holes.

- **If these conditions are evident:** Replace the mounting plate.

3. BRAKE SYSTEM BLEEDING PROCEDURE
Refer to manufacturer's service information for ABS bleeding instructions.
(1) Check the master cylinder reservoir and fill, if necessary, with DOT 3 or DOT 4 brake fluid.
(2) Bleed brakes in the following order: right rear, left rear, right front and left front.
(3) Each four-piston caliper is equipped with two bleeder screws. Loosen the inner bleeder screw (which is always on the top) and purge the air. Tighten it loosely.

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(4) Open the outer bleeder screw and purge the air and tighten the bleeder screw to 9-12 lb-ft (12.2-16.3 N·m).
(5) Now again open the inner bleeder screw and purge the air and tighten the bleeder screw to 9-12 lb-ft (12.2-16.3 N·m).
(6) Repeat this procedure for all other brakes in the sequence specified in step 2.
(7) Test brakes prior to returning vehicle to service. A firm pedal should be felt during brake application.

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SERVICE BRAKE (FULL AIR BRAKE)

BR02-002

AIR DRYER AND RESERVOIR SYSTEM (MODEL: BENDIX AD-IS)..... BR02-2
- DESCRIPTION BR02-2
- AD-IS® AIR DRYER RESERVOIR SYSTEM TROUBLESHOOTING CHART..... BR02-13

CHECK VALVE..... BR02-17
- DATA AND SPECIFICATIONS BR02-17
- DESCRIPTION BR02-17
- INSPECTION AND REPAIR BR02-18

BRAKE PEDAL..... BR02-20
- OVERHAUL BR02-20

BRAKE VALVE..... BR02-23
- DATA AND SPECIFICATIONS BR02-23
- DESCRIPTION BR02-23
- COMPONENT LOCATOR..... BR02-24
- INSPECTION AND REPAIR BR02-25

RELAY VALVE..... BR02-29
- DATA AND SPECIFICATIONS BR02-29
- DESCRIPTION BR02-29
- INSPECTION AND REPAIR BR02-29

SPRING BRAKE MODULATING VALVE BR02-33
- DESCRIPTION BR02-33
- COMPONENT LOCATOR..... BR02-34
- INSPECTION AND REPAIR BR02-35

SPRING BRAKE CONTROL VALVE BR02-37
- DESCRIPTION BR02-37
- COMPONENT LOCATOR..... BR02-38
- INSPECTION AND REPAIR BR02-39

BRAKE CHAMBER (FRONT)..... BR02-42
- DATA AND SPECIFICATIONS BR02-42
- DESCRIPTION BR02-42
- COMPONENT LOCATOR..... BR02-43
- OVERHAUL BR02-44
- INSPECTION AND REPAIR BR02-45

BRAKE CHAMBER (REAR) BR02-46
- DATA AND SPECIFICATIONS..... BR02-46
- DESCRIPTION..... BR02-47
- COMPONENT LOCATOR BR02-48
- INSPECTION AND REPAIR..... BR02-49

PROTECTION VALVE BR02-60
- DATA AND SPECIFICATIONS..... BR02-60
- DESCRIPTION..... BR02-60
- INSPECTION..... BR02-61

WHEEL BRAKE BR02-63
- DATA AND SPECIFICATIONS..... BR02-63
- DESCRIPTION..... BR02-64
- COMPONENT LOCATOR BR02-65
- OVERHAUL BR02-67
- INSPECTION AND REPAIR..... BR02-84

AUTOMATIC SLACK ADJUSTER..... BR02-86
- DESCRIPTION..... BR02-86
- DIAGNOSTICS..... BR02-87
- COMPONENT LOCATOR BR02-88
- OVERHAUL BR02-90
- INSTALLING THE SLACK ADJUSTER ONTO THE CAMSHAFT BR02-98
- CHECK & ADJUSTMENT BR02-100

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AIR DRYER AND RESERVOIR SYSTEM (MODEL: BENDIX AD-IS)

DESCRIPTION

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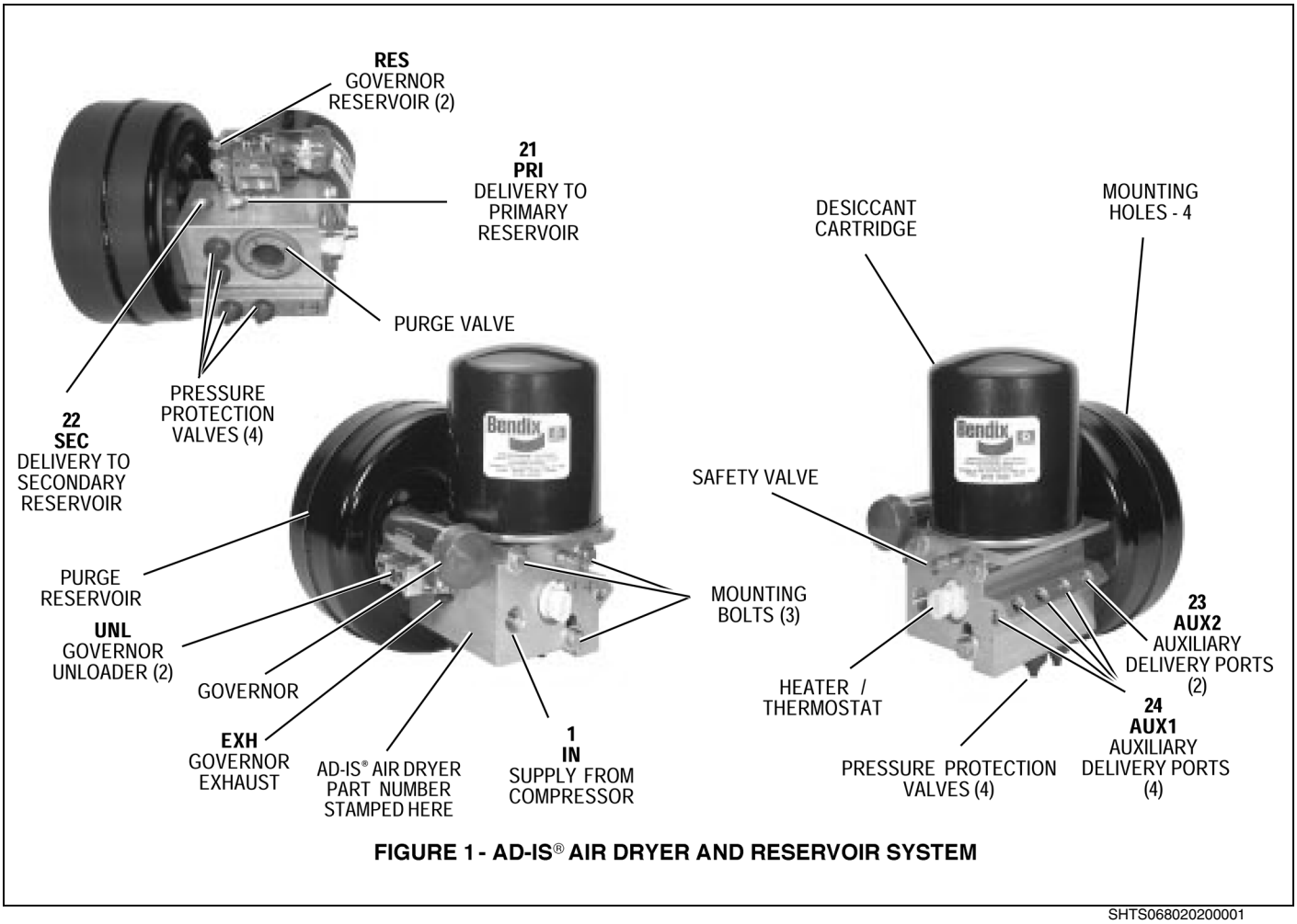


FIGURE 1 - AD-IS® AIR DRYER AND RESERVOIR SYSTEM

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TABLE 1 - PORT DESIGNATIONS

Air Connection Port ID	Function/Connection	QTY
1 IN	Inlet Port (air in).	1
21 PRI	Delivery Port out (to Primary reservoir)	1
22 SEC	Delivery Port out (to Secondary reservoir)	1
24 AUX 1	Auxiliary Delivery Port (air out).	4
23 AUX 2	Auxiliary Delivery Port (air out).	1
UNL	Unloader Control Air (D-2A™ Governor)	2
RES	Common Reservoir Pressure (D-2A™ Governor)	2
EXH	Governor Exhaust.	1

The function of the Integrated Solution Air Dryer (AD-IS®) and Reservoir System is to provide heavy vehicles with an integrated vehicle air dryer, purge reservoir, governor and a number of the charging valve components in a module. These have been designed as an integrated air supply system.

The AD-IS® air dryer and reservoir system collects and removes air system contaminants in solid, liquid and vapor form before they enter the brake system. It provides clean, dry air to the components of the brake system which increases the life of the system and reduces maintenance costs. The necessity for daily manual draining of the reservoirs is eliminated.

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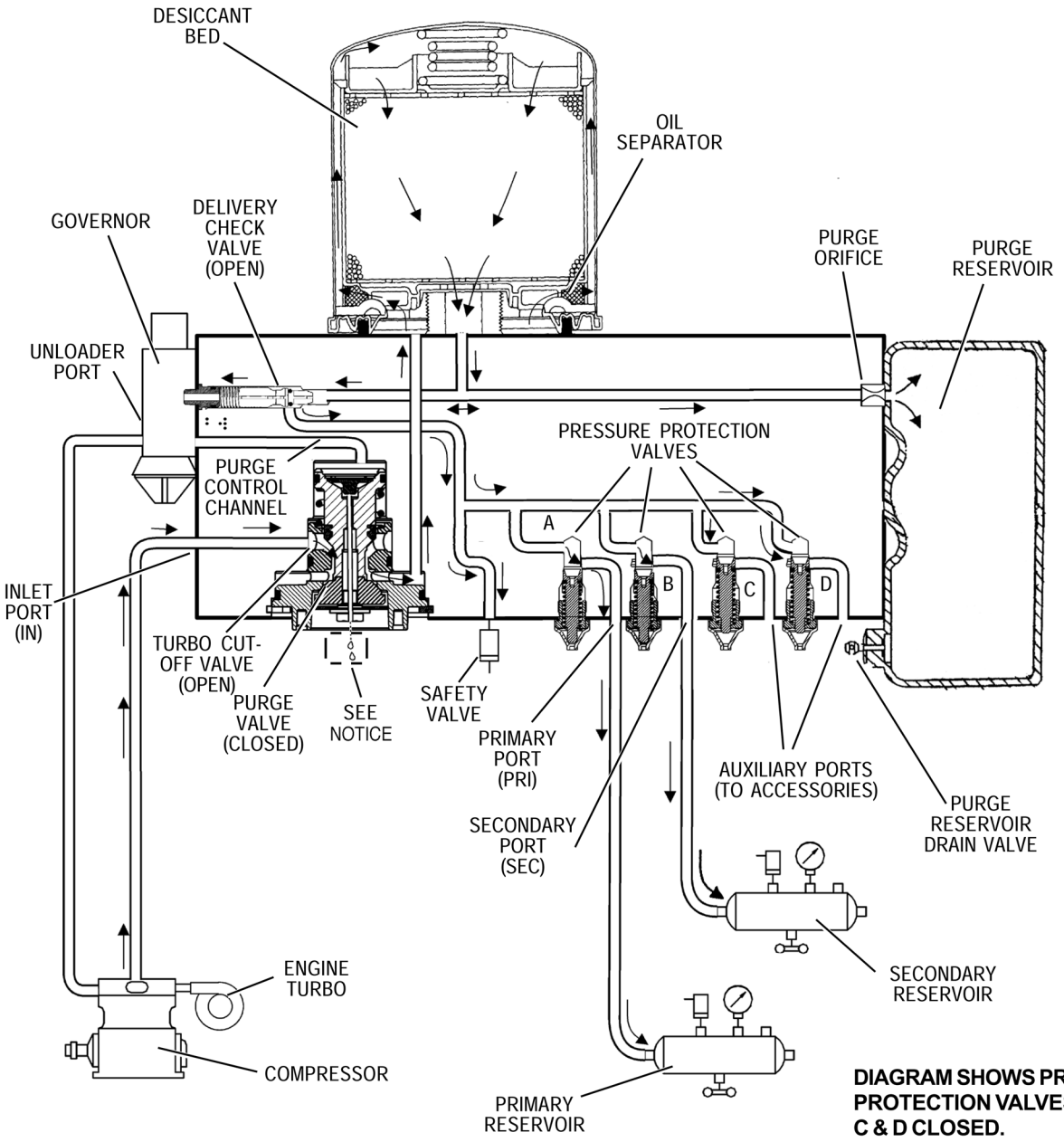


FIGURE 2 - AD-IS® AIR DRYER AND RESERVOIR SYSTEM CHARGE CYCLE

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The function of the pressure protection valves is to protect each reservoir from a pressure loss in the other reservoir or a pressure loss in an air accessory. Each of the pressure protection valves in the AD-IS® air dryer and reservoir system may have different pressure settings, but these are factory set and must not be changed or adjusted.

The air dryer and reservoir system consists of a "spin on" desiccant cartridge secured to a base assembly. The base assembly contains a delivery check valve assembly, safety valve, heater and thermostat assembly, pressure protection valves, threaded air connections and the purge valve assembly.

The removable purge valve assembly incorporates the purge valve mechanism and a turbocharger cut-off feature that is designed to prevent loss of engine "turbo" boost pressure during the purge cycle of the AD-IS® air dryer and reservoir system. For ease of maintenance, all replaceable assemblies can be serviced without removal of the air dryer and reservoir system from its mounting on the vehicle. Refer to Preventive Maintenance section.

NOTICE

The AD-IS® air dryer and reservoir system purge piston has a purge control channel drain. This allows any condensation in this area to flow past a diaphragm in the top of the purge piston and out through a channel in the middle of the central bolt of the purge assembly to be drained. During the purge cycle this drain is closed.

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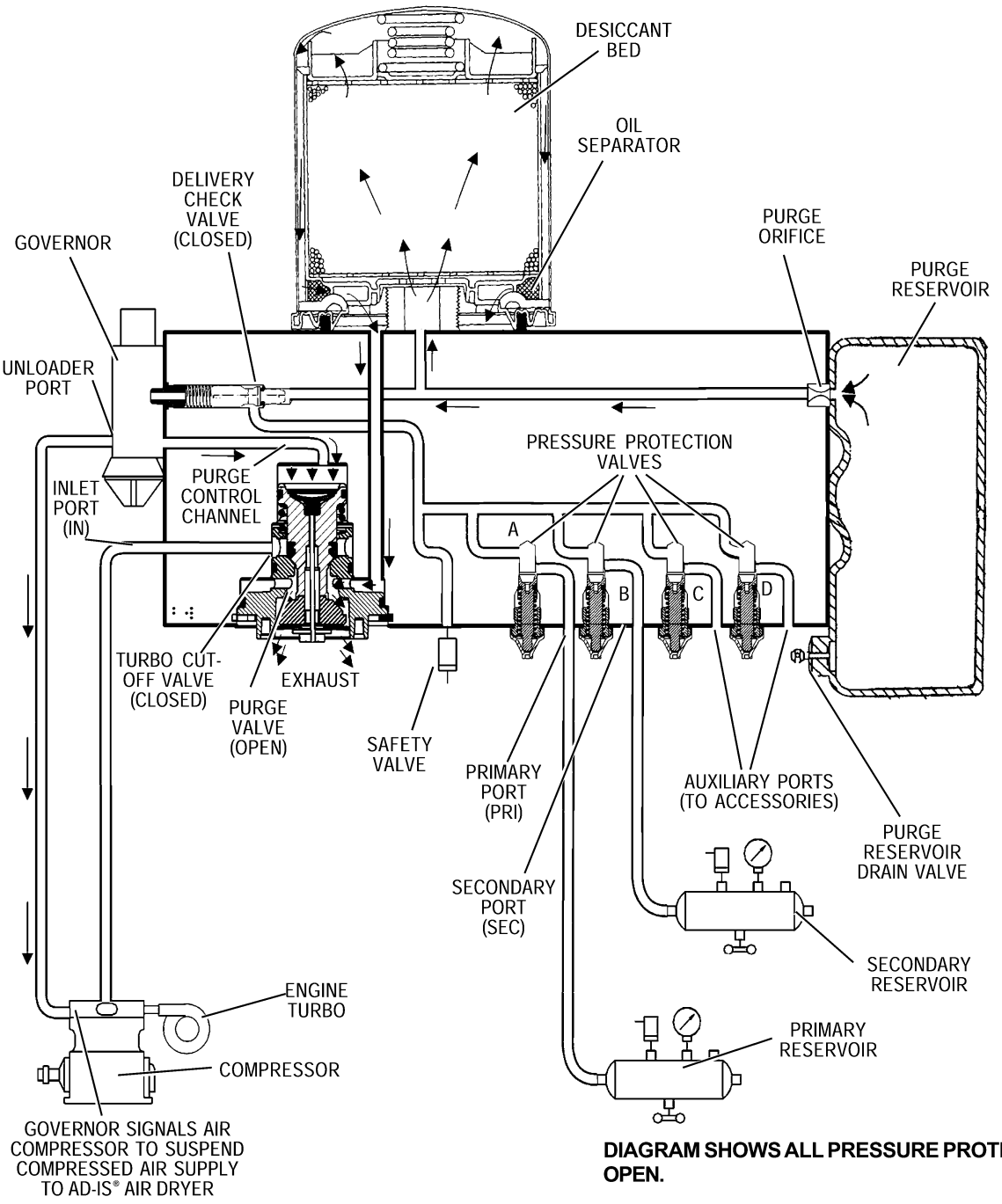


FIGURE 3 - AD-IS® AIR DRYER AND RESERVOIR SYSTEM PURGE CYCLE

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AD-IS® AIR DRYER AND RESERVOIR SYSTEM OPERATION: GENERAL (Refer to Figure 2)

The AD-IS® air dryer and reservoir system is designed to receive compressed air from the vehicle air compressor, clean and dry the air, deliver air to the vehicle's primary reservoir, secondary reservoir and accessories, and control the compressor/dryer charge cycle.

AIR DRYER AND RESERVOIR SYSTEM OPERATION: GENERAL

The AD-IS® air dryer and reservoir system alternates between two operational modes or "cycles" during operation: the Charge Cycle and the Purge Cycle. The following descriptions are separated into these "cycles" of operation.

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CHARGE CYCLE (Refer to Figure 2)

When the compressor is loaded (compressing air) compressed air flows through the compressor discharge line to the inlet (1/IN) port of the air dryer body. The compressed air often includes contaminates such as oil, oil vapor, water and water vapor.

Traveling through the discharge line and into the air dryer, the temperature of the compressed air falls, causing some of the contaminants to condense and drop to the bottom of the air dryer and reservoir system purge valve assembly, ready to be expelled at the next purge cycle. The air then flows into the desiccant cartridge, where it flows through an oil separator which removes liquid oil and solid contaminants.

Air then flows into the desiccant drying bed and becomes progressively drier as water vapor adheres to the desiccant material in a process known as "ADSORPTION."

Dry air exits the desiccant cartridge through the center of the base assembly. The air then flows to the delivery check valve and also through an orifice into the purge reservoir. The delivery check valve opens, supplying air to the pressure protection valves (A) through (D) simultaneously, the safety valve, and also to the reservoir port of the attached governor. The purge reservoir fills, storing air that will be used to reactivate the desiccant during the purge cycle. This air is available to supply downstream components during the charge mode.

When the air pressure reaches approximately 106 psi, the four pressure protection valves will open and air will be supplied to the primary reservoir, secondary reservoir and accessories. If the pressure protection valves are preset to different values the valves will open in order of lowest setting to highest setting when charging a flat system.

The air dryer and reservoir system will remain in the charge cycle until the air brake system pressure builds to the governor cut-out setting of approximately 130 p.s.i.

PURGE CYCLE (Refer to Figure 3.)

When air brake system pressure reaches the cut-out setting of the governor, the governor unloads the compressor and the purge cycle of the air dryer and reservoir system begins.

The governor unloads the compressor by allowing air pressure to fill the line leading to the compressor unloader mechanism - causing the delivery of compressed air to the AD-IS® air dryer and reservoir system to be suspended.

Similarly, the governor also supplies air pressure to the AD-IS® air dryer and reservoir system purge control channel. The AD-IS® air dryer and reservoir system purge piston moves down in response to this air pressure, causing the purge valve to open to the atmosphere and the turbo cut-off valve to close off the supply of air from the compressor (this will be further discussed in the Turbo Cut-off Feature section). Water and contaminants which have collected in the purge valve base are expelled immediately when the purge valve opens. Also, air which was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Oil and solid contaminants collected by the oil separator are removed by air flowing from the purge reservoir through the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-IS® air dryer and reservoir system exhaust.

The actual reactivation of the desiccant drying bed begins as dry air from the purge reservoir flows through the purge orifice into the desiccant bed. Pressurized air from the purge reservoir expands after passing through the purge orifice; its pressure is lowered and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it. Approximately 30 seconds are required for the entire contents of the purge reservoir of a standard AD-IS® air dryer and reservoir system to flow through the desiccant drying bed.

The delivery check valve assembly prevents air pressure in the brake system from returning to the air dryer and reservoir system during the purge cycle. After the purge cycle is complete, the air dryer and reservoir system is ready for the next charge cycle to begin.

TURBO CUT-OFF FEATURE (Refer to Figure 3.)

The primary function of the turbo cut-off valve is to prevent loss of engine turbocharger air pressure through the AD-IS® air dryer and reservoir system when the dryer is in the unloaded mode.

At the onset of the purge cycle, the downward travel of the purge piston is stopped when the turbo cut-off valve (tapered portion of purge piston) contacts its mating metal seat in the purge valve housing. With the turbo cut-off valve seated (closed position), air in the compressor discharge line and AD-IS® air dryer and reservoir system inlet port cannot enter the air dryer and reservoir system. In this manner the turbo cut-off effectively maintains turbo charger boost pressure to the engine.

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PREVENTIVE MAINTENANCE

Important: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period. Purge valve maintenance is permissible during the warranty period only when using a genuine Bendix purge valve kit.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 900 operating hours, or 25,000 miles or three (3) months:

1. Check for moisture in the air brake system by opening reservoir drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:

a. An outside air source has been used to charge the system. This air did not pass through the drying bed.

b. Air usage is exceptionally high and not normal for a highway vehicle.
This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycle) in a normal fashion. Check for high air system leakage. If the vehicle vocation has changed it may be necessary to upgrade the compressor size. Refer to Bendix Specification BW-100-A, Appendix D to determine if any changes are necessary.

c. Location of the air dryer and reservoir system is too close to the air compressor. Refer to Bendix Specification BW-100-A, Appendix B for discharge line lengths.

d. In areas where more than a 30 degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal.

NOTICE

A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge. Some oil at the dryer exhaust is normal.

2. Visually check for physical damage such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check the AD-IS® air dryer and purge reservoir bolts for tightness. See Figure 1. Re-torque the three air dryer bolts to 360-420 inch pounds and the four purge reservoir bolts to 300-360 inch pounds.
4. Perform the Operation & Leakage Tests listed in this publication.

⚠ WARNING

This air dryer and reservoir system is intended to remove moisture and other contaminants normally found in the air brake system. Do not inject alcohol, anti-freeze, or other de-icing substances into or upstream of the air dryer and reservoir system. Alcohol is removed by the dryer, but reduces the effectiveness of the device to dry air. Use of these or other substances can damage the air dryer and reservoir system and may void the warranty.

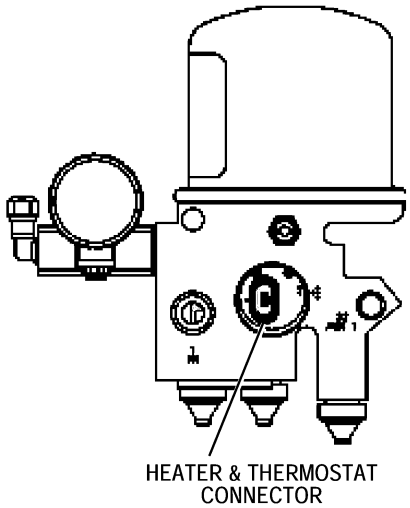


FIGURE 4 - AD-IS® AIR DRYER AND RESERVOIR SYSTEM HEATER AND THERMOSTAT CONNECTOR

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OPERATION & LEAKAGE TESTS (ALSO SEE VIDEO BW2327)

1. Check all lines and fittings leading to and from the air dryer and reservoir system for leakage and integrity. Repair any leaks found.
2. Build up system pressure to governor cut-out and note that the AD-IS® air dryer and reservoir system purges with an audible escape of air. Watch the system pressure and note the pressure fall-off for a ten minute period. If pressure drop exceeds, for a single vehicle - 1 psi/minute from either service reservoir; or for tractor trailer - 3 psi/minute from either service reservoir, inspect the vehicle air systems for sources of leakage and repair them. Refer to section entitled Troubleshooting, Symptoms 1 and 4.
3. **Caution: Be sure to wear safety glasses in case of a purge blast.** Check for excessive leakage around the purge valve with the compressor in the loaded mode (compressing air). Apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1" bubble in 1 second. If the leakage exceeds the maximum specified, refer to section entitled Troubleshooting, Symptom 4.
4. Build up system pressure to governor cut-out and note that the AD-IS® air dryer and reservoir system purges with an audible burst of air, followed immediately by approximately 30 seconds of air flowing out of the purge valve. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by an AD-IS® air dryer and reservoir system purge. If system does not follow this pattern, refer to section entitled Troubleshooting, Symptoms 5 and 6.
5. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

a. Electric Power to the Dryer
With the ignition or engine kill switch in the RUN position, check for voltage to the heater and thermostat assembly using a voltmeter or testlight. Unplug the electrical connector at the air dryer and reservoir system and place the test leads on each of the connections of the female connector on the vehicle power lead. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

b. Thermostat and Heater Operation

NOTICE
These tests are not possible except in cold weather operation.

Turn off the ignition switch and cool the thermostat and heater assembly to below 40 degrees Fahrenheit. Using an ohmmeter, check the resistance between the electrical pins in the air dryer and reservoir system connector half. The resistance should be 1.5 to 3.0 ohms for the 12 volt heater assembly and 6.0 to 9.0 ohms for the 24 volt heater assembly. Warm the thermostat and heater assembly to approximately 90 degrees Fahrenheit and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.

6. Pressure Protection Valves. Observe the pressure gauges of the vehicle as system pressure builds from zero. The primary or secondary gauge should rise until it reaches approximately 106 p.s.i. (6 p.s.i.), then level off (or a momentary slight fall) as the next pressure protection valve opens supplying its reservoir. When that pressure gauge passes through approximately 106 p.s.i. (6 p.s.i.) there should be an associated leveling off (or momentary slight fall) of pressure as the third and fourth pressure protection valves open. Then the primary and secondary gauges should increase together until they reach their full pressure of approximately 130 psi (5 psi).
If the AD-IS® air dryer and reservoir system does not perform within the pressure ranges as described above, recheck using gauges known to be accurate. If the readings remain outside of the ranges outlined above, replace the AD-IS® air dryer and reservoir system. **NOTE:** There are no kits available for the servicing of the pressure protection valves. **WARNING: Do not attempt to adjust or service the pressure protection valves - incorrect pressure protection valve settings can result in automatic application of the vehicle spring brakes without prior warning in the event one of the supply circuits experiences rapid pressure loss.**

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REBUILDING THE AD-IS® AIR DRYER AND RESERVOIR SYSTEM

GENERAL SAFETY GUIDELINES

⚠ WARNING
PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.
2. Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.

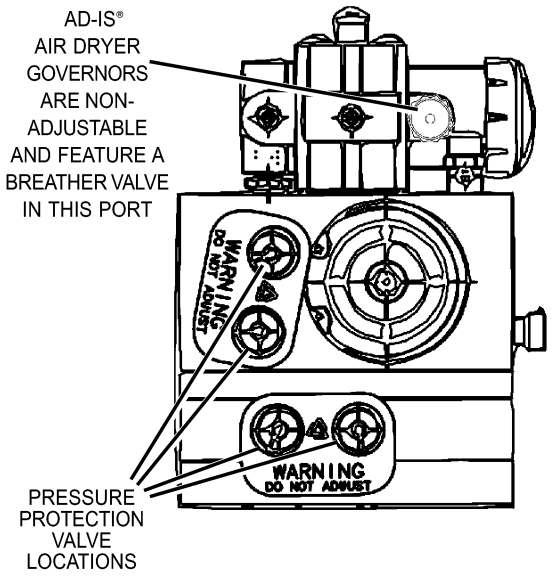


FIGURE 5 - PRESSURE PROTECTION VALVE LOCATIONS

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⚠ WARNING
DO NOT ATTEMPT TO ADJUST OR SERVICE THE PRESSURE PROTECTION VALVES. INCORRECT PRESSURE PROTECTION VALVE SETTINGS CAN RESULT IN AUTOMATIC APPLICATION OF VEHICLE SPRING BRAKES WITHOUT PRIOR WARNING.

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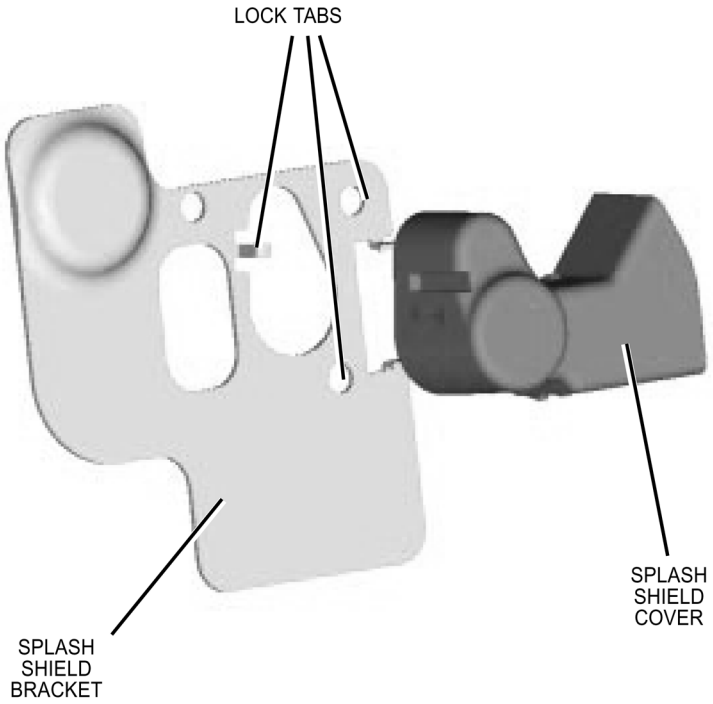


FIGURE 6 - SPLASH SHIELD BRACKET AND COVER - (EXPLODED VIEW)

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3. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
4. If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS® air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.
5. Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
6. Never exceed manufacturer's recommended pressures.
7. Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
8. Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.
9. Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
10. Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
11. For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator light should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.

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GENERAL

When rebuilding or replacing components of the air dryer and reservoir system use only genuine Bendix parts. For ease in servicing, the AD-IS® air dryer and reservoir system has been designed so that any of the following maintenance kits can be installed without removing the air dryer and reservoir system from the vehicle.

CAUTION: Always depressurize the air dryer and reservoir system purge reservoir, and all other reservoirs on the vehicle to 0 p.s.i. before servicing the air dryer and reservoir system. If, after completing the routine operation and leakage tests, it has been determined that one or more components of the air dryer and reservoir system requires replacement or maintenance, refer to the following list to find the appropriate kit(s).

MAINTENANCE KITS AVAILABLE:

- Service New Desiccant Cartridge Kit - Part Number 5008414: This kit contains the parts necessary to change the desiccant cartridge only.
- Delivery Check Valve Maintenance Kit - Part Number 5004052: This kit contains the parts necessary to replace the delivery check valve.
- Purge Valve Maintenance Kit - Part Number 5018313: This kit contains the parts necessary to replace and relubricate the purge valve sealing rings.
- Governor/Delivery Check Valve Kit - Part Number 5004049: This kit contains the parts necessary to replace both the governor and delivery check valve.
- 12 volt or 24 volt Heater and Thermostat Kit - Part Numbers 109495 & 109496: Contains a replacement heater and thermostat assembly and related components required for replacement.
- Purge Valve Housing Rebuild Kit - Part Number 5003547: This kit contains the parts necessary to rebuild the purge valve sub-assembly.
- Service New Purge Valve Housing Assembly - Part Number 800404: Contains a service new assembly and related components to change the purge valve subassembly.
- Pressure Protection Valve Boot Replacement- Part Number 5005163.
- AD-IS® Air Dryer Replacement: Replaces the complete air dryer assembly. Includes air dryer assembly and governor.
- AD-IS® Air Dryer Splash Shield Replacement Kit - Part Number 5006698.
- Purge Reservoir Drain Valve: Replaces the drain valve on the purge reservoir.

SEE THE AD-IS® AIR DRYER CATALOG PAGE (STARTING ON PAGE 08-A-24) FOR A FULL LIST OF MAINTENANCE KITS AVAILABLE.

NOTICE

Kits are not available for the servicing of the pressure protection valves (See Figure 5). Do not attempt to adjust or service the pressure protection valves - these are not service items.

TESTING THE AD-IS® AIR DRYER AND RESERVOIR SYSTEM

Before placing the vehicle in service, perform the following tests:

1. Close all reservoir drain valves.
2. Build up system pressure to governor cut-out and note that the AD-IS® air dryer and reservoir system purges with an audible burst of air, followed immediately by approximately 30 seconds of air flowing out of the purge valve.
3. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IS® air dryer and reservoir system exhaust.
4. It is recommended that the total air system be tested for leakage to assure that the AD-IS® air dryer and reservoir system will not cycle excessively.
   See Bendix publication BW5057 "Air Brake Handbook."

BRAKING SYSTEM PROTECTION

The AD-IS® air dryer and reservoir system allows the system to maintain one brake circuit up to about 100 psi even after a pressure loss in the other brake circuit. This allows a vehicle to be moved (in an emergency), but with reduced braking capacity. Compare this to a conventional system where a loss of pressure in one service tank leaves the vehicle with a limited number of reduced braking capacity applications before the parking brakes automatically apply and stay on.

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ROADSIDE INSPECTION

In the event of a roadside inspection the system behavior will be as follows: When the system is charged to governor cut-out, and then one reservoir drain valve is opened, initially both reservoir gauges will fall, however, the AD-IS® air dryer and reservoir system primary and secondary pressure protection valves will close at pressures above 70 psi, protecting the remaining brake circuit from further loss of pressure.

TEMPORARY AIR DRYER AND RESERVOIR SYSTEM BYPASS

To temporarily bypass the air dryer, the following procedure needs to be followed:
Follow the Maintenance Precautions outlined elsewhere in this document.
Make sure that all residual pressure has been released and the air dryer purge reservoir has been drained to 0 p.s.i., then remove the air supply line from the compressor to the inlet port (1/IN). Remove the safety valve from the AD-IS® air dryer and reservoir system body (see Figure 1 for location). Note that a short puff of trapped air may vent from the safety valve port when the valve is being removed. Install a T-fitting into the port. Using any adapters necessary, reinstall the safety valve in one of the branches of the T-fitting. Using any adapters necessary, install the air supply line into the remaining T-fitting port. After testing the T-fitting for any air leakage, by using a soap solution after charging to system cut-out pressure (a 1" bubble in 10 seconds is acceptable), the vehicle may be returned to temporary service.

NOTICE

This is a temporary bypass of the air dryer, and full repair of the unit must be carried out at the earliest opportunity.

With the air dryer and reservoir system removed from the system, contaminants will be entering the air system: reservoirs will need to be manually drained daily until the repairs are completed. At end of each working day, park vehicle and slowly drain pressure through the drain valves - leave open to the atmosphere, for several hours if possible. When repairs are carried out, be sure to check that all reservoirs (including the air dryer purge reservoir) are emptied of all contaminants.
If after bypassing the air dryer and reservoir system the system pressure still does not build, use the following procedure to remove, clean and reinstall the delivery check valve.

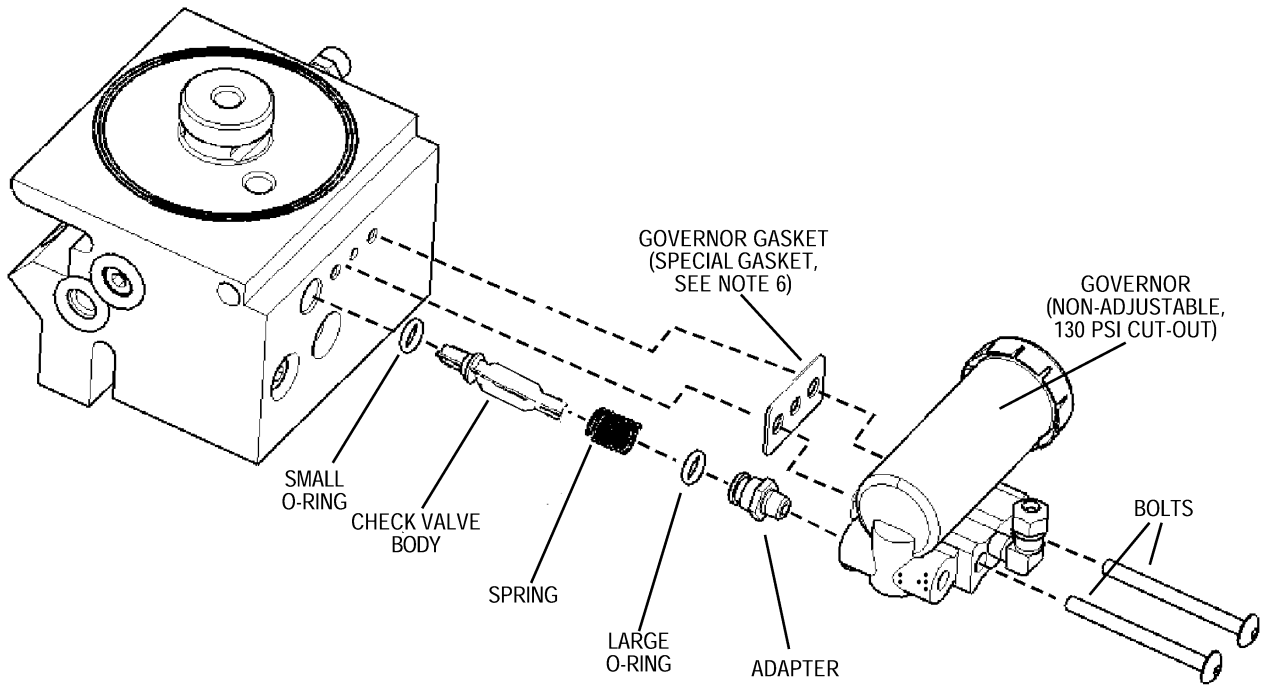


FIGURE 7 - AD-IS® AIR DRYER AND RESERVOIR SYSTEM DELIVERY CHECK VALVE

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DELIVERY CHECK VALVE CLEANING PROCEDURE

(Note: This is only required if system pressure does not build after temporary bypass is completed.)
See Figure 7 throughout this procedure. Depressurize the air brake system following the general safety precautions outlined elsewhere in this document. Also, always depressurize the air dryer purge reservoir before servicing the air dryer.
This procedure does not require removal of the AD-IS® air dryer and reservoir system from the vehicle.

1. Remove the line from the governor and mark for easy reinstallation.
2. Remove the bolts attaching the governor to the AD-IS® air dryer and reservoir system and retain for reassembly.
3. Remove the governor from the air dryer. Be aware that a short puff of trapped air may vent when the governor is removed. Retain the governor gasket for reassembly if a new governor gasket is not available. Remove and retain the o-ring from the adapter.
4. The spring/delivery check valve can now be removed.
5. Remove and retain the o-ring from check valve body.

CLEANING & INSPECTION

1. Use a suitable solvent to clean all metal parts, and use a cotton swab to clean the bore (Note: Do not use abrasives or tools to clean the bore: any scratches caused may necessitate replacing the AD-IS® air dryer and reservoir system.) Superficial external corrosion and/or pitting is acceptable.
2. Clean the o-rings with a clean dry cloth. Do not use solvents.
3. Inspect for physical damage to the bore and the check valve seat. If the bore is damaged (by scratches etc. that would prevent delivery check valve from seating), replace the AD-IS® air dryer.
4. Inspect the delivery check valve, o-rings, etc. for wear or damage. Replace if necessary using the check valve replacement kit available at authorized Bendix parts outlets.
5. Inspect all air line fittings for corrosion and replace as necessary.

ASSEMBLY

1. Lubricate the smaller o-ring and check valve body with Bendix supplied barium or silicon grease.
2. Install this o-ring on the check valve body by sliding the o-ring over the set of 4 tapered guide lands. The o-ring groove holds the o-ring in its correct location.
3. At the other end of the check valve body, the spring is installed over the set of 4 straight guide lands. When the spring has been pushed to the correct location, the check valve body is designed to hold the end of the spring in position - be sure that the spring is not loose before continuing with this installation.
4. Install the assembled check valve body/o-ring/spring in the delivery port so that the o-ring rests on its seat and the free end of the spring is visible.
5. Grease the adapter and the remaining larger o-ring and install it onto the fitting.
6. Position the Bendix supplied gasket, then insert the governor mounting bolts through the governor and tighten (to 125 in-lbs). **(Note: Do not replace with a standard compressor/governor gasket.)**
7. Reattach line to the governor.
8. Before placing vehicle back into service, check to see that the system pressure now builds to full operational pressure.

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AD-IS® AIR DRYER RESERVOIR SYSTEM TROUBLESHOOTING CHART

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SYMPTOMS	CAUSE	REMEDY
1. Dryer is constantly "cycling" or purging	A. Excessive system leakage	A. Test for excessive system leakage. Allowable leakage observed at dash gauge: Single vehicle - 1 psi/minute. Tractor trailer - 3 psi/minute. Using soap solution, test vehicle for leakage at fittings, drain valves and system valves. Repair or replace as necessary.
	B. Defective delivery check valve.	B. Build system pressure to governor cut-out. Wait 1 minute for completion of purge cycle. Using soap solution at exhaust of purge valve, leakage should not exceed a 1" bubble in less than 5 seconds. If a rapid loss of pressure is found, the following procedure will determine if the delivery check valve is malfunctioning: Build system pressure to governor cut-out and allow a full minute for the normal dryer purge cycle to empty the purge reservoir. Switch off the engine and "fan" the brakes so that the system pressure reaches governor cut-in. The purge valve will return to its closed position. The purge reservoir has a drain valve which is opened by moving the center lever away from its closed position. Open the drain valve and wait 10 seconds to allow any residual purge pressure to be released. Release the lever, closing the drain valve. Carefully remove the air dryer cartridge using a strap wrench and then test for air leaking through the center of the threaded boss by applying a soap solution to the boss. Replace the delivery check valve if there is excessive leakage (exceeding a 1" bubble in 5 seconds). Regrease the seal on the air dryer cartridge before reinstalling. Be sure the drain valve on the purge reservoir is not leaking before restoring vehicle to service.
	C. Defective governor.	C. Check governor at both "cut-in" and "cut-out" position for (i) proper pressures and (ii) excessive leakage at fittings and exhaust.
	D. Compressor unloader mechanism leaking excessively.	D. Remove air strainer or fitting from compressor inlet cavity. With compressor unloaded, check for unloader piston leakage. Slight leakage is permissible.

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SYMPTOMS	CAUSE	REMEDY
2. Water in vehicle reservoirs.	A. Maximum air dryer inlet temperature is exceeded due to improper discharge line length.	A. Check for excessive carbon build up in compressor discharge line. Replace if required. Make certain that discharge line length is at least 6 ft. Increase discharge line length and/or diameter to reduce air dryer inlet temperature.
	B. Air system charged from outside air source (outside air not passing through air dryer).	B. If system must have outside air fill provision, outside air should pass through air dryer.
	C. Excessive air usage - Air dryer not compatible with vehicle air system requirement (Improper air dryer/ vehicle application).	C. Refer to Bendix Advanced Troubleshooting Guide for Air Brake Compressors (BW1971) for proper application of the AD-IS® air dryer and reservoir system. An extended purge model (AD-ISEP) is available for many higher air usage vehicles, such as city buses and construction vehicles. If the vehicle is equipped with high air usage accessories such as trailer pump-off systems or central tire inflation, the air for these accessories must by-pass the dryer reservoir system.
	D. Desiccant requires replacement.	D. Replace desiccant cartridge assembly.
	E. Air by-passes desiccant cartridge assembly.	E. If vehicle uses Holset compressor, inspect feedback check valve for proper installation and operation.
	F. Air dryer not purging.	F. Refer to Symptom 6.
	G. Purge (air exhaust) time insufficient due to excessive system leakage.	G. Refer to Symptom 1.
3. Safety valve on air dryer "popping off" or exhausting air.	A. Defective AD-IS® air dryer and reservoir system delivery check valve.	A. Test to determine if air is passing through check valve. Repair or replace. Refer to Symptom 1, Remedy B.
	B. Safety valve setting too low (<150 p.s.i.)	B. Replace safety valve.
	C. System pressure too high (>135 p.s.i.)	C. Test with accurate gauge. Replace governor if necessary.
	D. Excessive pressure pulsations from compressor. (Typical single cylinder type).	D. Increase volume in discharge line. This can be accomplished by adding a 90 cubic inch (or larger) reservoir between the compressor and the AD-IS® air dryer and reservoir system.

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SYMPTOMS	CAUSE	REMEDY
4. Constant exhaust of air at air dryer purge valve exhaust or unable to build system pressure. (Charge mode.)	A. Air dryer purge valve leaking excessively.	A. With compressor loaded, apply soap solution on purge valve exhaust, to test for excessive leakage. Repair or replace purge valve as necessary. Refer to Technical Bulletin TCH-008-040.
	B. Purge valve frozen open - faulty heater and thermostat, wiring, blown fuse.	B. Refer to paragraph 5 of Operation and Leakage Tests for heater and thermostat test.
	C. Defective AD-IS® air dryer delivery check valve.	C. Refer to Symptom 1, Remedy B.
	D. Leaking Turbo Cut-Off valve.	D. Repair or replace purge valve assembly.
	E. Defective governor.	E. Check governor at both "cut-in" and "cut-out" position for (i) proper pressures and (ii) excessive leakage at fittings and exhaust.
	F. Leaking purge valve control piston quad-ring.	F. Repair or replace purge valve assembly.
5. Cannot build system air pressure.	A. Kinked or blocked (plugged) discharge line.	A. Check to determine if air passes through discharge line. Check for kinks, bends, excessive carbon deposits, or ice blockage.
	B. Excessive bends in discharge line (water collects and freezes).	B. Discharge line should be constantly sloping from compressor to air dryer with as few bends as possible.
	C. Pressure protection valve(s) in air dryer will not open.	C. Replace air dryer (pressure protection valves are not serviceable).
	D. Refer to Symptom 4.	D. Refer to Symptom 4, Remedy A.
	E. Refer to Symptom 7.	E. Refer to Symptom 7, Remedies A and B.
6. Air dryer does not purge or exhaust air.	A. Faulty air dryer purge valve.	A. After determining air reaches purge valve control port by installing a T-fitting with a pressure gauge into the governor unloader port, repair purge valve if necessary.
	B. See Causes B, E, and F for Symptom #4.	B. Refer to Symptom 4, Remedies B, E, and F. Also refer to Symptom 1, Remedy B.
7. Desiccant material being expelled from air dryer purge valve exhaust (may look like whitish liquid or paste or small beads.)	A. Faulty dryer cartridge.	A. Replace AD-IS® air dryer cartridge and/or AD-IS® air dryer.
	B. Excessive dryer vibration.	B. Check the AD-IS® air dryer mounting for looseness or damage. Repair mounting and replace cartridge.
8. Unsatisfactory desiccant life.	A. Excessive system leakage.	A. Refer to Symptom 1, Remedy A.
	B. Wrong vehicle application for AD-IS® air dryer.	B. Refer to Symptom 2, Remedy C.
	C. Compressor passing excessive oil.	C. Check for proper compressor installation; if symptoms persist, replace compressor. Refer to Bendix Advanced Troubleshooting Guide for Air Brake Compressor (BW1971).

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SYMPTOMS	CAUSE	REMEDY
9. "Pinging" noise excessive during compressor loaded cycle.	A. Single cylinder compressor with high pulse cycles.	A. A slight "pinging" sound may be heard during system build up when a single cylinder compressor is used. If this sound is deemed objectionable, it can be reduced substantially by increasing the discharge line volume. This can be accomplished by adding a 90 cubic inch (or larger) reservoir between the compressor and the AD-IS® air dryer and reservoir system.
10. The air dryer purge piston cycles rapidly in the compressor unloaded (noncompressing) mode.	A. Compressor fails to "unload".	A. Check air hose from governor to compressor for a missing, kinked or restricted line. Install or repair air hose. Repair or replace compressor unloader.

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CHECK VALVE

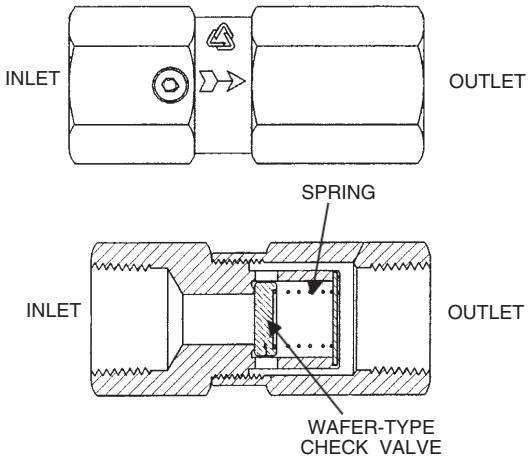
DATA AND SPECIFICATIONS

EN0680202I200001

Type	**Spring type, wafer type valve**

DESCRIPTION

EN0680202C100002



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INSPECTION AND REPAIR

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1. PREVENTATIVE MAINTENANCE

Every 6 months, 1,800 operating hours or every 50,000 miles inspect all parts.

Replace any check valves leaking or showing signs of wear or deterioration. Check for proper operation.

2. OPERATION & LEAKAGE CHECKS

NOTICE

Depending upon installation, it may be easier or necessary to completely remove check valves so that the following checks may be made.

With air pressure present at outlet side of check valve and the inlet side open to atmosphere, coat the open end of the check valve with soap suds; a 1" bubble in 5 seconds is permissible.

If the check valve does not function as described, or leakage is excessive, it is recommended that it be replaced with a new genuine Bendix part available at any Bendix parts outlet.

3. REMOVAL

Block and hold vehicle by means other than air brakes.

Completely drain all reservoirs.

Disconnect air lines at single check valve and remove.

4. DISASSEMBLY/ASSEMBLY

NOTICE

There are no Disassembly/Assembly procedures for SC-3 valves. They are non-serviceable items. If a valve does not meet the Operational and Leakage tests, it should be replaced at any authorized Bendix parts outlet.

5. TESTING AND TROUBLESHOOTING

Perform "2.OPERATION & LEAKAGE CHECK".

6. IMPORTANT! PLEASE READ

When working on or around a vehicle, the following general precautions should be observed:

(1) Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.
(2) Stop the engine when working around the vehicle.
(3) If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning **ANY** work on the vehicle.
(4) Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.
(5) When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
(6) Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
(7) Never exceed recommended pressures and always wear safety glasses.

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(8) Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
(9) Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.
(10) Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.
(11) Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

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BRAKE PEDAL

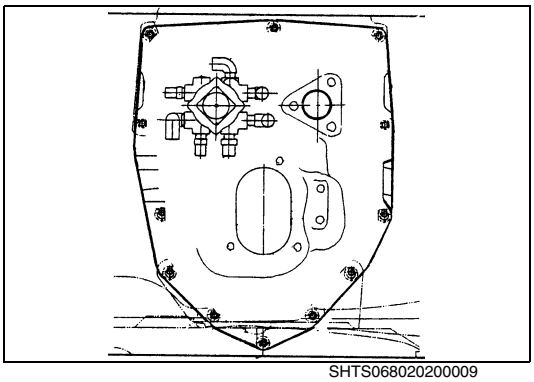
OVERHAUL

EN0680202H200001

IMPORTANT POINTS-DISMOUNTING

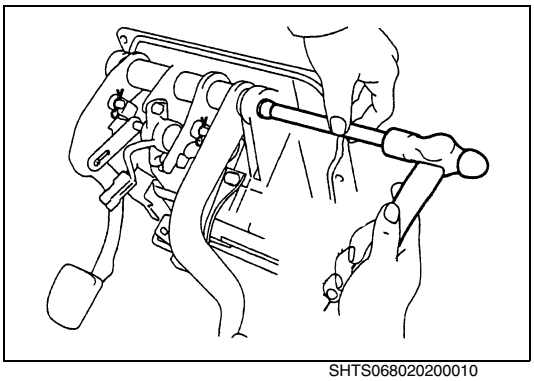
1. DISCONNECT THE NYLON TUBE FROM THE BRAKE VALVE AND CLUTCH PIPE FROM THE MASTER CYLINDER

2. REMOVE THE CLUTCH MASTER CYLINDER AND DISCONNECT THE STEERING SHAFT


SHTS068020200009

3. REMOVE THE PEDAL BRACKET ASSEMBLY

(1) Loosen the bolts and remove the pedal bracket assembly.


SHTS068020200010

4. REMOVE THE BRAKE PEDAL.

(1) Tap the shaft lightly using a brass rod and a hammer, remove the brake pedal from the pedal bracket assembly.

NOTICE

Do not pull out the shaft because the brake pedal and the clutch pedal are installed by one shaft.

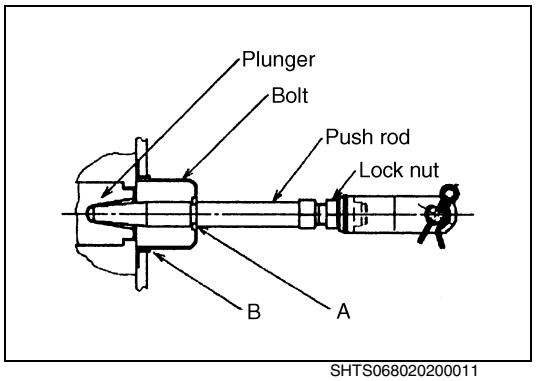
5. DISCONNECT THE PUSH ROD JOINT FROM THE BRAKE PEDAL LEVER

6. REMOVE THE BRAKE VALVE ASSEMBLY

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IMPORTANT POINTS-MOUNTING

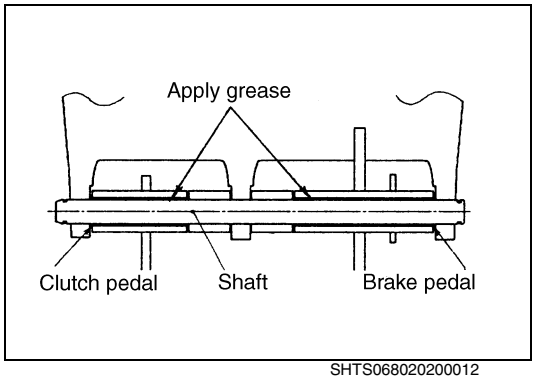
1. INSTALL THE BRAKE VALVE ASSEMBLY
Install the brake valve assembly with the 4 nuts.
Tightening Torque:
18-26 N·m{184-265 kgf·cm, 13-19 lbf·ft}



SHTS068020200011

2. CONNECT THE PUSH ROD JOINT TO THE BRAKE PEDAL LEVER

NOTICE
A: The boot has to be securely fit into the groove of the push rod.
B: After assembling boot into the pedal bracket.
Make sure that the projection of all around the boot all around is seen above the surface of the pedal bracket.



SHTS068020200012

3. INSTALL THE BRAKE PEDAL
(1) Apply thinly lithium grease, Fuji sunlight 2000 or its equivalent to the pedal bushing.
(2) Install the shaft into the pedal bracket and the pedal.
(3) Insert 2 snap rings to the pedal shaft.

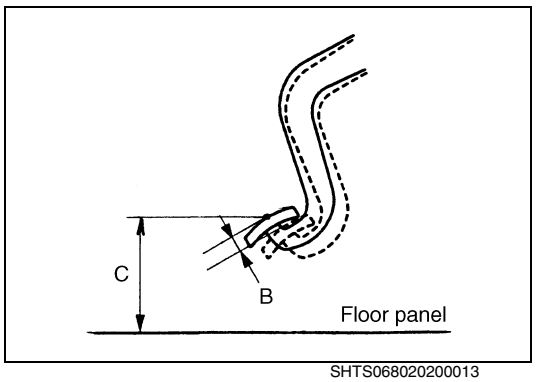
4. INSTALL THE PEDAL BRACKET ASSEMBLY
Install the pedal bracket assembly with bolts.
Tightening Torque:
18-26 N·m{184-265 kgf·cm, 13-19 lbf·ft}

5. INSTALL THE CLUTCH MASTER CYLINDER AND THE STEERING SHAFT

6. CONNECT THE NYLON TUBE TO THE BRAKE VALVE CONNECTOR
Tightening Torque:
ϕ3/8: 35-45 N·m{375-459 kgf·cm, 26-33 lbf·ft}
ϕ1/2: 50-60 N·m{510-612 kgf·cm, 37-44 lbf·ft}

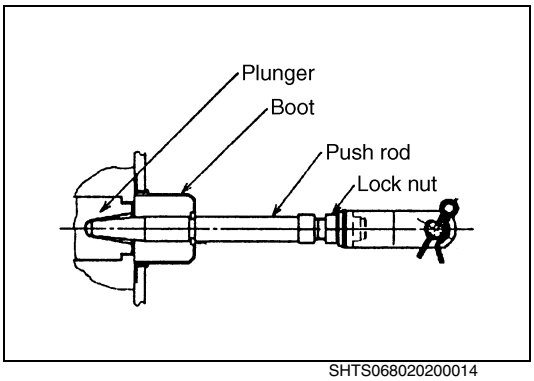
NOTICE
- **When assembling the nylon tubes be careful not to press them down by foot, and pinch them between other parts and so on.**
- **When fitting the joint to the nylon tube, be careful not to fold the tube. If it is folded or damaged, replace it with a new one.**

7. INSPECT THE BRAKE PEDAL PLAY
(1) Make sure that the installing height of the brake pedal "C" and the pedal play "B".
B: 2-5 mm {0.0788-0.1968 in.}
C: 164.6-174.6 mm {6.48-6.87 in.}



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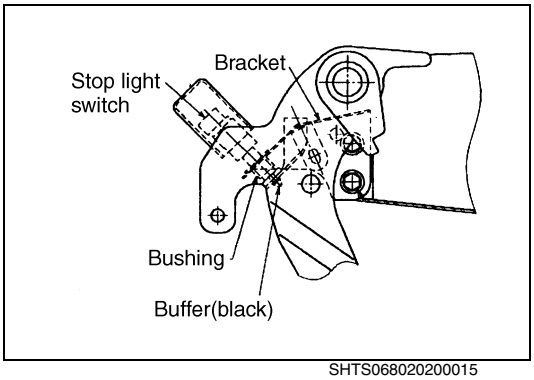
SHTS068020200014

(2) If the pedal play is out of the standard value, loosen the lock nut and turn the push rod to adjust the pedal play to the standard value.

NOTICE

If you have loosened the push rod lock nut for the adjustment, retighten it securely.

Tightening Torque:
17.5-32.5 N·m{179-332 kgf·cm, 12.9-24 lbf·ft}

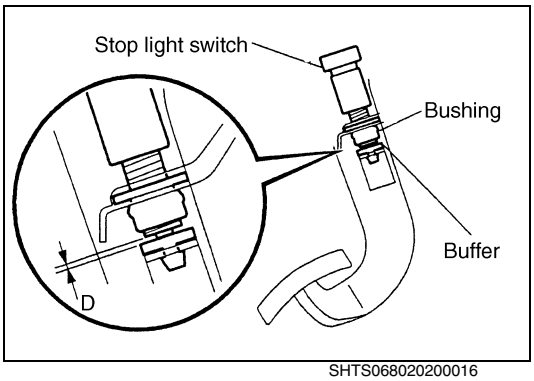


SHTS068020200015

8. ADJUST AND INSPECT THE STOP LIGHT SWITCH

(1) After installing bushing to the switch bracket, insert the stop light switch then twist it clockwise while making contact with the tip of the switch and the buffer, and fix it.

(2) After installing the switch, when releasing the brake pedal, make sure there is no contact between the switch and buffer.
Confirm the operation of the switch surely.



SHTS068020200016

(3) Check the clearance between stop light switch and buffer.
"D": 0.5-1.5 mm {0.0197-0.0590 in.}

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BRAKE VALVE

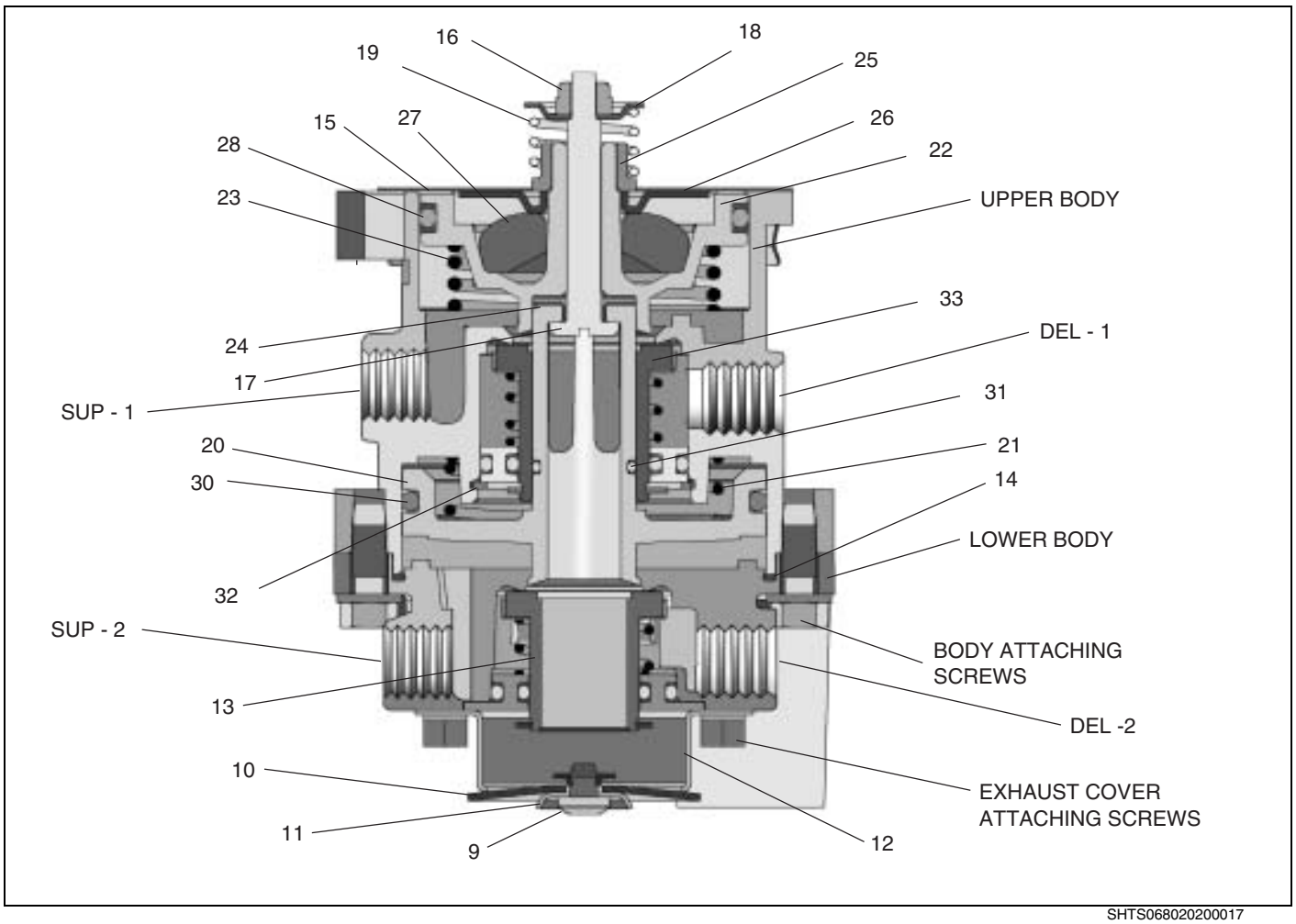
DATA AND SPECIFICATIONS

EN0680202I200002

Type	**Dual pistons and valves with a plunger type pedal**

DESCRIPTION

EN0680202C100003



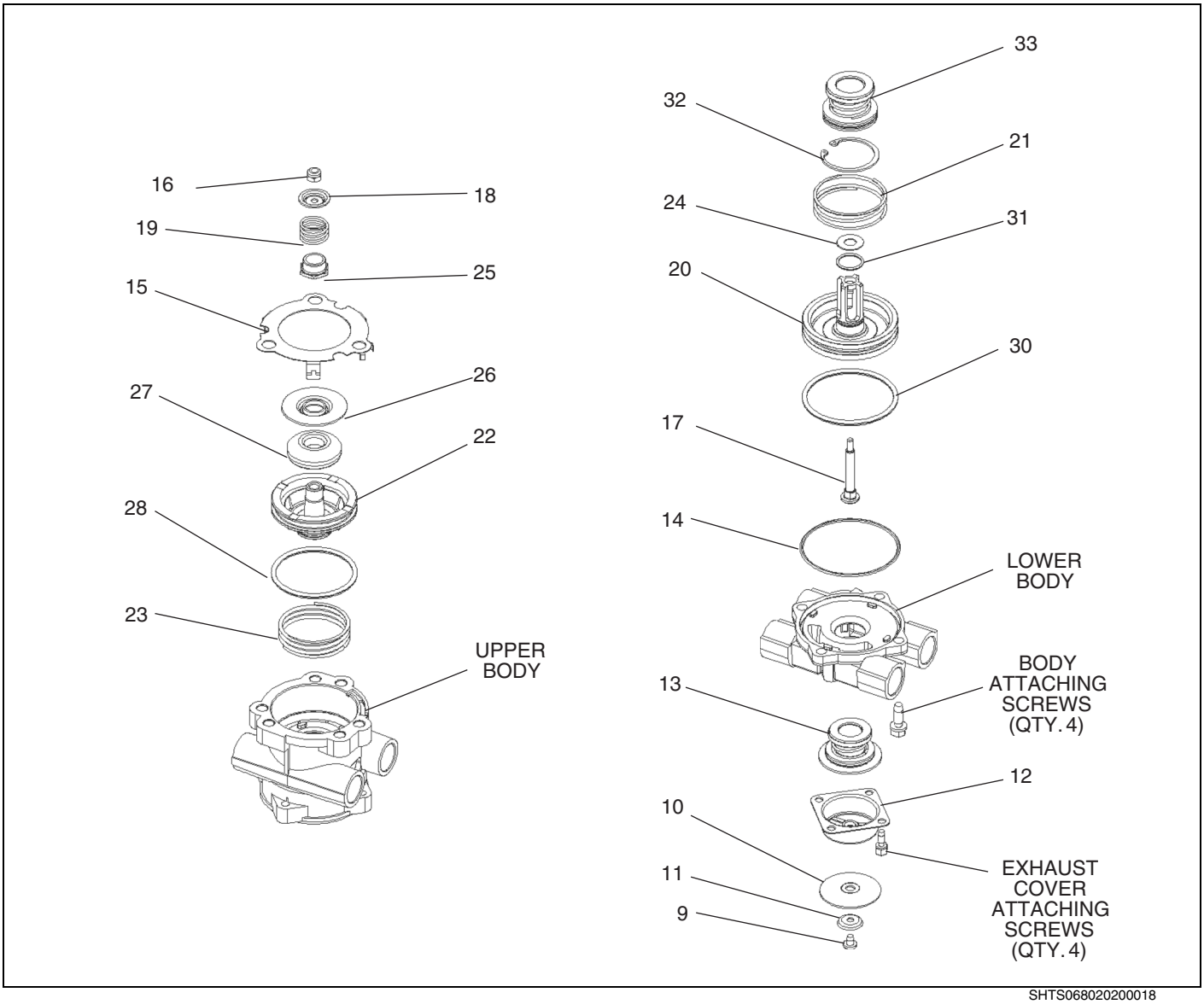
SHTS068020200017

9	**Screw**	**21**	**Relay piston spring**
10	**Exhaust diaphragm**	**22**	**Primary piston**
11	**Washer**	**23**	**Graduating spring**
12	**Exhaust cover**	**24**	**Washer**
13	**Inlet valve**	**25**	**Primary piston spring seat nut**
14	**Seal ring**	**26**	**Spring seat**
15	**Primary piston retainer**	**27**	**Rubber spring**
16	**Lock nut**	**28**	**Piston O-ring**
17	**Stem**	**30**	**O-ring**
18	**Spring seat**	**31**	**O-ring**
19	**Stem spring**	**32**	**Retaining ring**
20	**Relay**	**33**	**Primary inlet and exhaust valve**

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COMPONENT LOCATOR

EN0680202D100001



SHTS068020200018

9	Screw	21	Relay piston spring
10	Exhaust diaphragm	22	Primary piston
11	Washer	23	Graduating spring
12	Exhaust cover	24	Washer
13	Inlet valve	25	Primary piston spring seat nut
14	Seal ring	26	Spring seat
15	Primary piston retainer	27	Rubber spring
16	Lock nut	28	Piston O-ring
17	Stem	30	O-ring
18	Spring seat	31	O-ring
19	Stem spring	32	Retaining ring
20	Relay piston	33	Primary inlet and exhaust valve

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INSPECTION AND REPAIR

EN0680202H200002

1. PREVENTIVE MAINTENANCE

Important Note: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Visually check for physical damage to the AD-IP such as chaffed or broken air and electrical lines and broken or missing parts.

Every 3 months, or 25,000 miles or 900 operating hours:

Clean any accumulated dirt, gravel, or foreign material away from the heel of the treadle, plunger boot, and mounting plate.

Using light oil, lubricate roller, roller pin, and hinge pin.

Check the rubber plunger boot for cracks, holes or deterioration and replace if necessary. Also, check mounting plate and treadle for integrity.

Apply 2 to 4 drops of oil between plunger and mounting plate **- do not over oil!**

Every year, or 100,000 miles, or 3,600 operating hours:

Disassemble: clean parts with mineral spirits, replace all rubber parts, or any part worn or damaged. Check for proper operation before placing vehicle in service.

2. SERVICE CHECKS

(1) Operating check

Check the delivery pressure of both primary and secondary circuits using accurate test gauges. Depress the treadle to several positions between the fully released and fully applied positions, and check the delivered pressure on the test gauges to see that it varies equally and proportionately with the movement of the brake pedal.

After a full application is released, the reading on the test gauges should fall off to zero promptly. It should be noted that the primary circuit delivery pressure will be about 2 PSI greater than the secondary circuit delivery pressure with both supply reservoirs at the same pressure. This is normal for this valve.

IMPORTANT

A change in vehicle braking characteristics or a low pressure warning may indicate a malfunction in one or the other brake circuit, and although the vehicle air brake system may continue to function, the vehicle should not be operated until the necessary repairs have been made and both braking circuits, including the pneumatic and mechanical devices, are operating normally. Always check the vehicle brake system for proper operation after performing brake work and before returning the vehicle to service.

(2) Leakage check

a. Make and hold a high pressure (80 psi) application.
b. Coat the exhaust port and body of the brake valve with a soap solution.
c. Leakage permitted is a one inch bubble in 3 seconds. If the brake valve does not function as described above or leakage is excessive, it is recommended that it be re-placed with a new or remanufactured unit, or repaired with genuine Bendix parts available at authorized Bendix parts outlets.

Refer to figures on page BR02-23 and 24 for item numbers referenced in parenthesis.

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3. REMOVAL

(1) Chock the vehicle wheels or park the vehicle by mechanical means. (Block and hold vehicle by means other than air brakes.) Drain all air system reservoirs.
(2) Identify and disconnect all supply and delivery lines at the brake valve.
(3) Remove the brake valve and treadle assembly from the vehicle by removing the three cap screws on the outer bolt circle of the mounting plate. The basic brake valve alone can be removed by removing the three cap screws on the inner bolt circle.

4. DISASSEMBLY

(1) If the entire brake valve and treadle assembly was removed from the vehicle, remove the three cap screws securing the treadle assembly to the basic brake valve.
(2) Remove the screw (9) securing the exhaust diaphragm (10) and washer (11) to the exhaust cover (12).
(3) Remove the four screws that secure the exhaust cover (12) to the lower body.
(4) Remove the secondary inlet and exhaust valve assembly (13) from the lower body.
(5) Remove the four hex head cap screws securing the lower body to the upper body and separate the body halves.
(6) Remove the rubber seal ring (14) from the lower body.
(7) **For E-8P:** While applying thumb pressure to the primary piston (22), lift out and up on the three lock tabs of the primary piston retainer (15).

⚠ CAUTION

Before proceeding with the disassembly, refer to figures on pages BR02-23 and 24, and note that the lock nut (16) and stem (17) are used to contain the primary piston return spring (for E-8P: 23), stem spring (19), and the relay piston spring (21). The combined force of these springs is approximately 50 pounds and care must be taken when removing the lock nut as the spring forces will be released. It is recommended that the primary piston and relay piston be manually or mechanically contained while the nut and stem are being removed.

(8) Using a 3/8" wrench, hold the lock nut (16) on the threaded end of the stem (17). Insert a screwdriver to restrain the stem, remove the lock nut (16), spring seat, (18) and stem spring (19).
(9) Remove the relay piston (20), relay piston spring (21), primary piston (**E-8P:** 22) and primary piston return spring (**E-8P:** 23) from the upper body. Use care so as not to nick seats.
(10) A small washer (24) will be found in the cavity of the lower side of the primary piston (**for E-8P**: 22).
(11) **For E-8P:** Disassemble the primary piston by rotating the spring seat nut (25) counterclockwise. Separate the spring seat nut, spring seat (26), and rubber spring (27) and remove the piston o-ring (28).
(12) Remove the large and small o-rings (30 & 31) from the relay piston (20).
(13) Remove the retaining ring (32) securing the primary inlet and exhaust valve assembly (33) in the upper body and remove the valve assembly.

5. CLEANING AND INSPECTION

(1) Wash all metal parts in mineral spirits and dry.
(2) Inspect all parts for excessive wear or deterioration.
(3) Inspect the valve seats for nicks or burrs.
(4) Check the springs for cracks or corrosion.
(5) Replace all rubber parts and any part not found to be serviceable during inspection, use only genuine Bendix replacement parts.

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6. ASSEMBLY

Prior to reassembling, lubricate all o-rings, o-ring grooves, piston bores, and metal to metal moving surfaces with Dow Corning 55 o-ring lubricant (Bendix piece number 291126).

IMPORTANT

All torques specified in this manual are assembly torques and can be expected to fall off, after assembly is accomplished. Do not retorque after initial assembly torques fall.

(1) Install the primary inlet and exhaust assembly (33) in the upper body and replace the retaining ring (32) to secure it. Be sure the retaining ring is seated completely in its groove.
(2) Install the large and small o-rings (30 & 31) on the relay piston (20).
(3) **For E-8P:** Install o-ring (28) in the primary piston (22) o-ring groove.
(4) **For E-8P:** Install the rubber spring (do not lubricate) (27), concave side down in the primary piston (22) and place the spring seat (26), flat side up, over the rubber spring.
(5) **For E-8P:** Install the primary piston spring seat nut (25), with its hex closest to the spring seat, and rotate clockwise until the top surface of the spring seat is even with the top surface of the piston. Set aside.
(6) Place relay piston spring (21) in concave portion of relay piston (20) and install relay piston through primary inlet/exhaust assembly (33) into under side of upper body.
(7) Place screwdriver, blade up, in vise. Insert stem (17) through the relay piston upper body sub assembly, slide this assembly over the blade of the secured screwdriver, engage the screwdriver blade in the slot in the head of the stem.
(8) Place the washer (24) over the stem (17) and on top of the relay piston (20).
(9) Install primary return spring (**E-8P:** 23) in upper body piston bore.
(10) **For E-8P:** Install the primary piston rubber spring sub assembly (1. (4) and (5)) over the stem, into the up-per body piston bore.
(11) Compress piston(s) (**For E-8P:** the relay piston (20)) and retaining ring into the upper body from either side and hold compressed, either manually or mechanically. **See the cautionary note under 3. (7) in the Disassembly section of this manual.**
(12) Place the stem spring (19) (**E-8P:** place over the spring seat nut (25)), the spring seat (18) (concave side up) and lock nut (16) on the stem (17). Torque to 20-30 inch pounds.
(13) **For E-8P:** Install the primary piston retainer (15) over the piston, making certain all three lock tabs have engaged the outer lip of the body.
(14) Replace the rubber seal ring (14) on the lower body.
(15) Install the 4 hex head cap screws securing the lower body to the upper body. Torque to 30-60 inch pounds.
(16) Install the secondary inlet and exhaust valve assembly (13) on the lower body.
(17) Install the screws that secure the exhaust cover (12) to the lower body. Torque to 20-40 inch pounds.
(18) Secure the screw (9) holding the exhaust diaphragm (10) and the diaphragm washer (11) to the exhaust cover (12). Torque to 5-10 inch pounds.
(19) Install all air line fittings and plugs making certain thread sealant material does not enter valve.

7. VALVE INSTALLATION

(1) Install the assembled brake valve on the vehicle.
(2) Reconnect all air lines to the valve using the identification made during VALVE REMOVAL step 2.
(3) After installing the brake valve assembly, perform the "OPERATION AND LEAKAGE CHECKS" before placing the vehicle in service.

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8. IMPORTANT: MAINTENANCE PRECAUTIONS

When working on or around a vehicle, the following general precautions should be observed:

(1) Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.
(2) Stop the engine when working around the vehicle.
(3) Drain the air pressure from all reservoirs before beginning ANY work on the vehicle.
(4) Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.
(5) When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
(6) Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
(7) Never exceed recommended pressures and always wear safety glasses.
(8) Do not attempt to install, remove, disassemble, or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
(9) Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.
(10) Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.
(11) Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

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RELAY VALVE

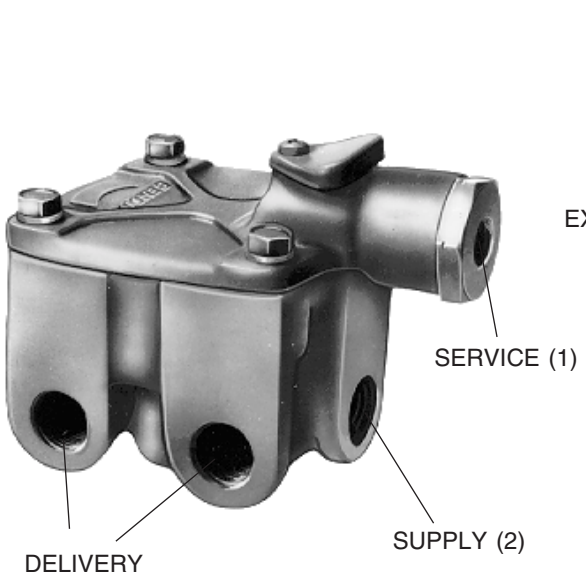
DATA AND SPECIFICATIONS

EN0680202I200003

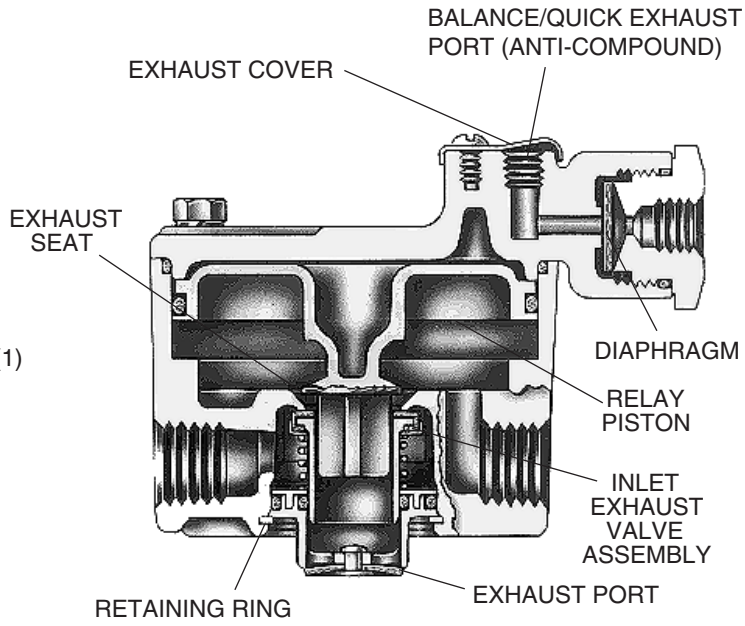
Type	**Diaphragm type with double check valve combined**
Pressure difference between signal and outlet pressure	**29.4 kPa {0.3 kgf/cm^2, 4.26 lbf/in^2.}**

DESCRIPTION

EN0680202C100004



EXTERIOR R-14H



R-14H

SHTS068020200019

INSPECTION AND REPAIR

EN0680202H200003

1. PREVENTIVE MAINTENANCE

Important Note: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

(1) Every 3 months or 25,000 miles or 900 operating hours check for proper operation.

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(2) Every 12 months or 100,000 miles or 3,600 operating hours: disassemble valve, clean parts with mineral spirits. Replace all rubber parts and any part worn or damaged. Check for proper operation before placing vehicle in service.

2. OPERATIONAL AND LEAKAGE TEST

(1) Chock the wheels, fully charge air brake system and adjust the brakes.
(2) Make several brake applications and check for prompt application and release at each wheel.
(3) Check for inlet valve and o-ring leakage.
   a. Make this check with the service brakes released when the R-12 or R-14 is used to control the service brakes.
   b. Make the check with the spring brakes applied (PARK) when the R-14 is used to control the spring brakes. Coat the exhaust port and the area around the retaining ring with a soap solution; a 1 inch bubble in 3 seconds leakage is permitted.
(4) Check for exhaust valve leakage.
   a. Make this check with the service brakes fully applied if the R-12 or R-14 control the service brakes.
   b. Make this check with the spring brakes fully released if the R-14 is used to control the spring brakes. Coat the exhaust port with a soap solution; a 1 inch bubble in 3 seconds leakage is permitted. Coat the outside of the valve where the cover joins the body to check for seal ring leakage; no leakage is permitted.
(5) If the R-14 is used to control the spring brakes, place the park control in the released position and coat the balance port with a soap solution to check the diaphragm and its seat. Leakage equivalent to a 1 inch bubble in 3 seconds is permitted.

NOTICE
If the anti-compound feature is in use, the line attached to the balance port must be disconnected to perform this test.

If the valves do not function as described above, or if leakage is excessive, it is recommended that the valves be replaced with new or remanufactured units or repaired with genuine Bendix parts, available at any authorized Bendix parts outlet.

3. REMOVAL

(1) Block and hold vehicle by means other than air brakes.
(2) Drain air brake system reservoirs.
(3) If entire valve is to be removed, identify air lines to facilitate installation.
(4) Disconnect air lines from valve*.
(5) Remove valve from reservoir or if remotely mounted, remove mounting bolts and then valve.

*It is generally not necessary to remove entire valve to service the inlet/exhaust valve. The inlet/exhaust valve insert can be removed by removing the snap ring, exhaust cover assembly and then inlet/exhaust valve.

⚠ CAUTION
Drain all reservoirs before attempting to remove the inlet exhaust valve.

4. DISASSEMBLY

NOTICE
Prior to disassembly, mark the location of the mounting bracket to the cover and the cover to the body.

(1) Remove the four (4) cap screws and lockwashers securing the cover to the body.
(2) Remove the cover, sealing ring, and mounting bracket.

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(3) Remove the piston and o-ring from the body.
(4) While depressing the exhaust cover, remove the retaining ring and slowly relax the spring beneath the exhaust cover.
(5) Remove the exhaust cover assembly and o-rings.
(6) Remove the inlet/exhaust valve return spring from the body.
(7) Remove the inlet/exhaust valve from the body.
(8) Remove the valve retainer from the inlet/exhaust valve.
(9) Remove the Phillips head screw and exhaust cover from the R-14 cover.
(10) Remove the service port cap nut and o-ring from the R-14.
(11) Remove the diaphragm from the R-14 cover.

5. CLEANING AND INSPECTION

(1) Wash all metal parts in mineral spirits and dry them thoroughly.

NOTICE

When rebuilding, all springs and all rubber parts should be replaced.

(2) Inspect all metal parts for deterioration and wear, as evidenced by scratches, scoring and corrosion.
(3) Inspect the exhaust valve seat on the relay piston for nicks and scratches which could cause excessive leakage.
(4) Inspect the inlet valve seat in the body for scratches and nicks, which could cause excessive leakage.
(5) Inspect the exhaust seat of the quick release diaphragm in the R-14 cover and make sure all internal air passages in this area are open and clean and free of nicks and scratches.
(6) Replace all parts not considered serviceable during these inspections and all springs and rubber parts. Use only genuine Bendix replacement parts, available from any authorized Bendix parts outlet.

6. ASSEMBLY

NOTICE

All torque specified in this manual are assembly torque and can be expected to fall off slightly after assembly. Do not re-torque after initial assembly torque fall. For assembly, hand wrenches are recommended.

Prior to assembly, lubricate all o-rings, o-ring bores and any sliding surface with a silicone lubricant equivalent to Dow Corning #10.
(1) Install large piston o-ring on piston.
(2) Install inner and outer o-rings in the exhaust cover assembly.
(3) Install the sealing ring on the cover.
(4) Install piston in body, taking care not to damage the piston o-ring.
(5) Noting the reference marks made during disassembly, install the cover on the valve body and the mounting bracket on the cover.
(6) Secure the mounting bracket and cover to the body using the four (4) cap screws and lock washers. Torque to 80-120 inch pounds.
(7) Install the valve retainer on the inlet/exhaust valve and install in the body.
(8) Install the inlet/exhaust valve return spring in the body.
(9) Install the exhaust cover assembly in the body, taking care not to damage the o-ring.
(10) While depressing the exhaust cover, install the retaining ring. Make certain the retainer is completely seated in its groove in the body.
(11) Install the R-14 service port cap nut o-ring on the cap nut. Install the diaphragm in the R-14 cover making certain it is positioned between the guide ribs in the cover.
(12) Install the service port cap nut and torque to 150 inch pounds.
(13) If the quick release exhaust port was protected with an exhaust cover, install the cover using the #10-24 Phillips head screw. Torque to approx. 15-25 inch pounds.

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(14) Test the valves as outlined in the Operational and Leakage Test on page BR02-30 before returning the valve to service.

7. INSTALLATION

(1) Clean air lines.
(2) Inspect all lines and/or hoses for damage and replace as necessary.
(3) Install valve and tighten mounting bolts.
(4) Connect air lines to valve (plug any unused ports).
(5) Test valve as outlined in Operational and Leakage Tests.

8. IMPORTANT! PLEASE READ

When working on or around a vehicle, the following general precautions should be observed:

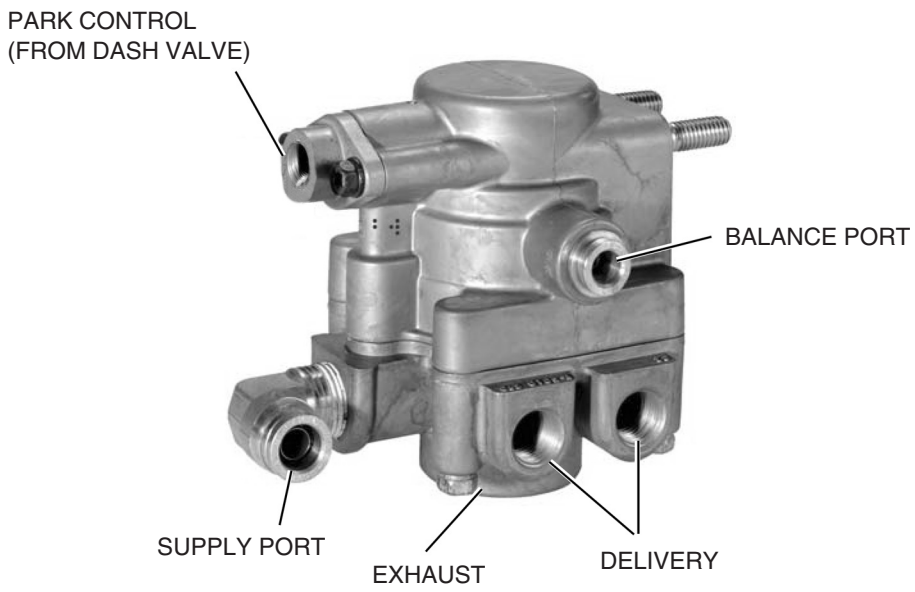
(1) Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.
(2) Stop the engine when working around the vehicle.
(3) If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle.
(4) Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.
(5) When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
(6) Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
(7) Never exceed recommended pressures and always wear safety glasses.
(8) Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
(9) Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.
(10) Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.
(11) Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

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SPRING BRAKE MODULATING VALVE

DESCRIPTION

EN0680202C100005

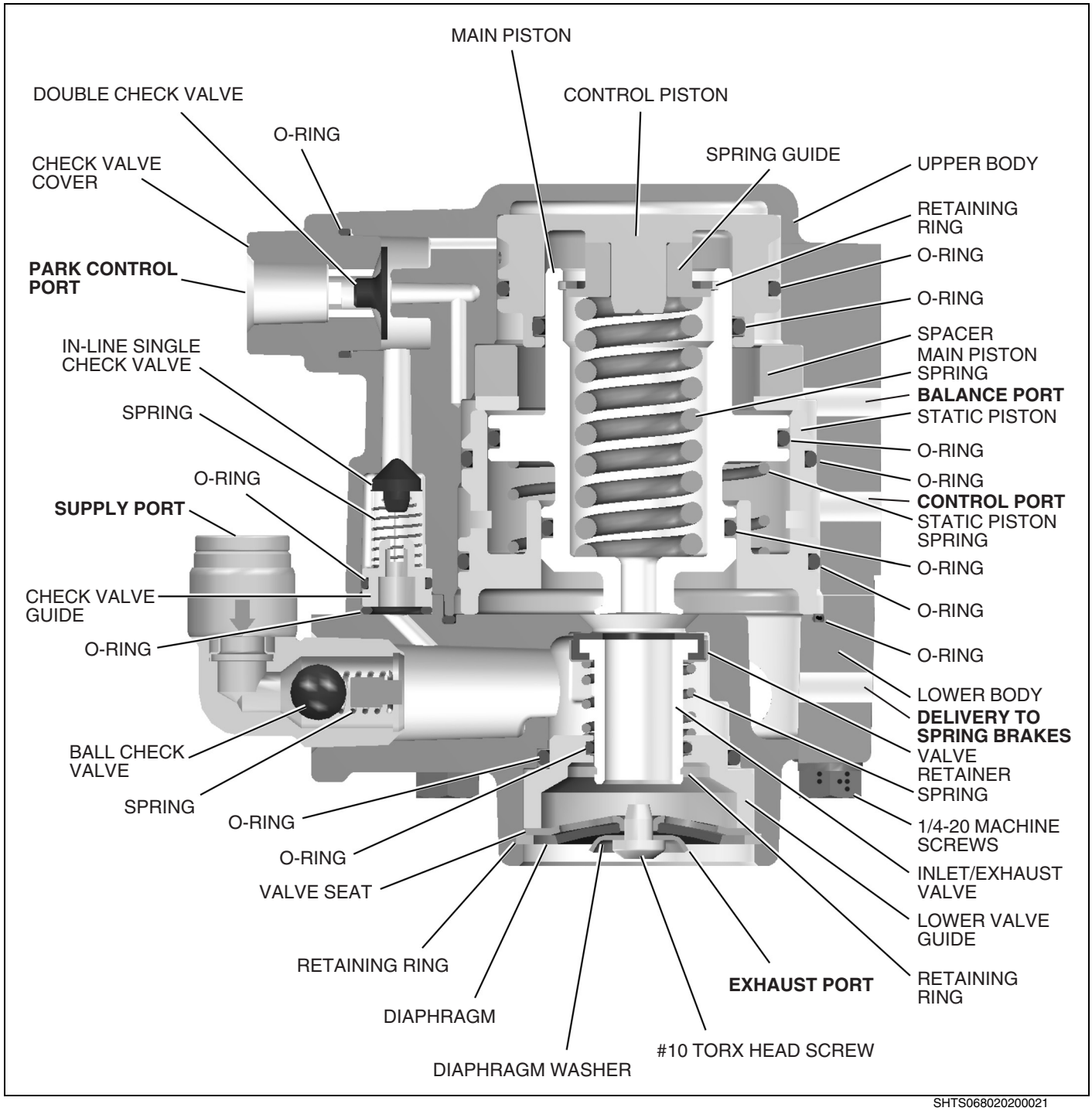


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COMPONENT LOCATOR

EN0680202D100002



SHTS068020200021

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INSPECTION AND REPAIR

EN0680202H200004

1. PREVENTIVE MAINTENANCE

The SR-7™ valve should be inspected every 6 months or 1500 operating hours, whichever comes first, for proper operation. Should the SR-7™ valve not meet the elements of the operational tests noted in this document, further investigation and service of the valve may be required.

2. SERVICE CHECKS

(1) Operating tests

Block vehicle and hold by means other than vehicle brakes.

Charge air brake system to governor cut-out pressure.

a. Place parking control valve in "park" position. Observe that spring brake actuators apply promptly. Remove one line from delivery port of the SR-7™ valve and install test gauge known to be accurate. Place parking control valve in "release" position. Observe that spring brake actuators release fully.
b. With parking control valve in "release" position, note gauge pressure reading. (Correct spring brake actuator hold-off pressure is 107 psi nominally.)
c. Place parking control valve in "park" position - gauge reading should drop to zero promptly. A lag (more than 3 seconds) in drop of pressure would indicate faulty operation.
d. With the parking control valve in the "park" position, gradually apply foot brake valve and note a pressure reading increase on the gauge installed in the SR-7™ valve delivery port.
e. Place parking control valve in "release" position.
f. Drain the reservoir, which supplies the rear service brake circuit, apply the foot brake valve several times and note that pressure reading on gauge decreases each time foot brake valve is applied (spring brake modulation). After the foot brake valve has been applied several times, pressure on gauge will drop to the point where release of the spring brake actuators will no longer occur.

3. LEAKAGE TEST

Place the park control valve in the "release" position; using a soap solution, coat all ports including the exhaust port. A 1" bubble in 3 seconds is permitted.

If the valve does not function as described, or if leakage is excessive, it is recommended that it be replaced with a new or remanufactured unit available from a Bendix parts outlet.

⚠ WARNING

DO NOT ATTEMPT TO DISASSEMBLE THE SR-7™ VALVE. THE VALVE CONTAINS HIGH SPRING FORCES THAT COULD RESULT IN PERSONAL INJURY IF DISASSEMBLY IS ATTEMPTED!

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4. WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

(1) Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.

(2) Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.

(3) Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.

(4) If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS™ air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.

(5) Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.

(6) Never exceed manufacturer's recommended pressures.

(7) Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.

(8) Use only genuine Bendix replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.

(9) Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.

(10) Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

5. REMOVAL

(1) Prior to removing the SR-7™ valve, apply the parking brakes and drain all the vehicle reservoirs.

(2) Identify all air lines before disconnecting.

(3) Remove the two mounting nuts that secure the valve to the frame rail and remove the valve.

6. INSTALLATION

(1) Align the mounting studs with the mounting holes on the vehicle frame rail. Tighten the mounting nuts to 180-220 in. lbs.

(2) Install the valve onto the vehicle ensuring all ports are connected as marked during disassembly.

7. TESTING THE REPLACEMENT SR-7™ SPRING BRAKE MODULATING VALVE

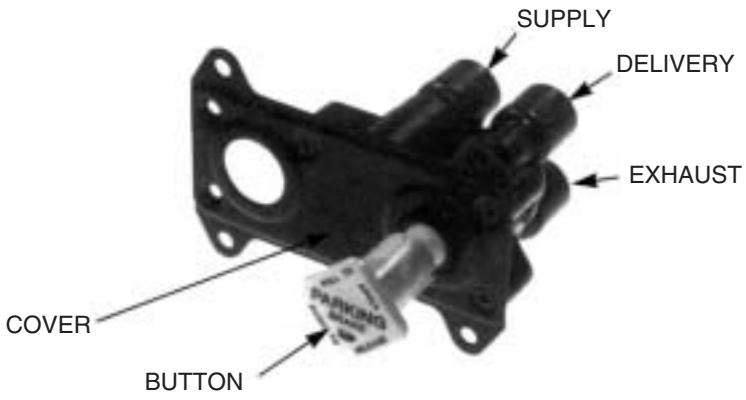
Perform operating and leakage tests as outlined in "Operating Tests" section.

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SPRING BRAKE CONTROL VALVE

DESCRIPTION

EN0680202C100006



Ports:

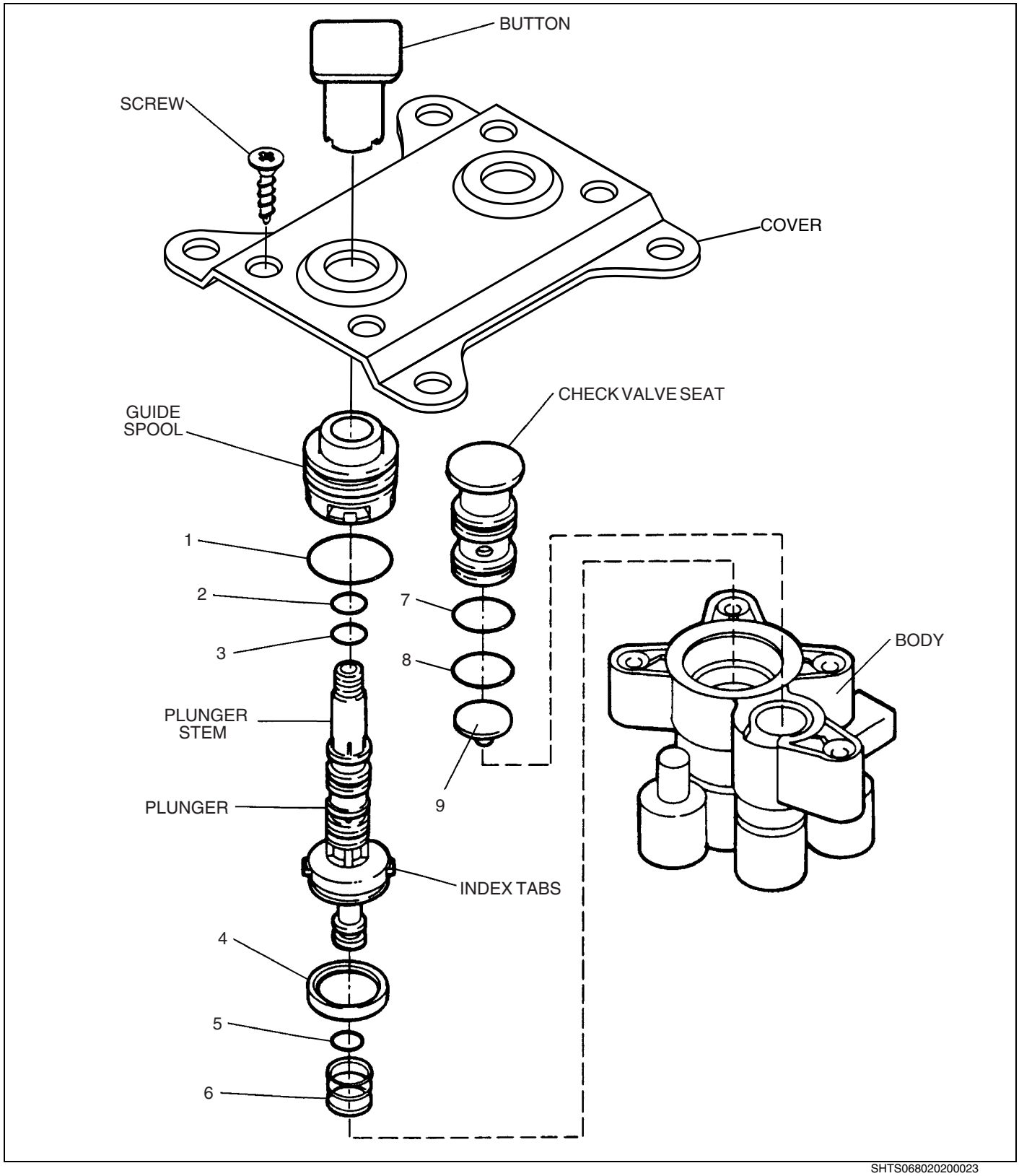
Port	Embossed I.D.
Primary Reservoir Supply	Supply 11
Secondary Reservoir Supply	Supply 12
Delivery	Delivery 21
Exhaust	Exhaust 3

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COMPONENT LOCATOR

EN0680202D100003



SHTS068020200023

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INSPECTION AND REPAIR

EN0680202H200005

1. PREVENTIVE MAINTENANCE

(1) Every 3 months; 25,000 miles; or 900 operating hours; or during the vehicle chassis lubrication interval, make the visual inspections noted in "SERVICE CHECKS."

(2) Every 12 months; 100,000 miles; or 3,600 operating hours, perform "OPERATIONAL AND LEAKAGE TESTS."

2. SERVICE CHECKS

(1) Remove any accumulated contaminants. Visually inspect the valve's exterior for excessive wear or physical damage. Repair/replace as necessary.

(2) Inspect all air lines connected to the valve for signs of wear or physical damage. Repair/replace as necessary.

(3) Test air line fittings for excessive leakage. Repair/replace as necessary.

3. LEAKAGE AND OPERATIONAL TESTS

To perform the following tests, connect two separate 120 psi air sources to the PP-DC supply ports. Tee an accurate test gauge into the supply lines, and provide for a means to control supply line pressure. Connect a small volume with a gauge to the delivery port.

(1) Leakage test

a. Supply the valve with 120 psi from the primary reservoir supply port. With the button out, coat the exhaust port and the plunger stem with a soap solution. Leakage should not exceed a 1" bubble in 5 seconds. There should be no leakage from the secondary reservoir supply port.

b. With the button out, supply the valve with 120 psi from the secondary reservoir supply port. There should be no leakage from the primary reservoir supply port.

c. With the button in, coat the exhaust port and the plunger stem with a soap solution. Leakage at both areas should not exceed a 1" bubble in 3 seconds.

(2) Operational test

a. With the button out, supply either supply port with 120 psi of air. Then push the button in. Air pressure should rise in the delivery volume equivalent to supply pressure.

b. Pull the button out. Delivery pressure should exhaust to 0 psi.

c. Build each supply source to 120 psi. Decrease supply pressure at the secondary service reservoir supply port at a rate of 10 psi per second. Primary supply pressure and delivery pressure should not drop below 100 psi.

Repeat the test for decreasing primary service reservoir pressure.

d. Build each supply source to 120 psi. Then decrease both supply pressures to below 20 to 30 psi. The button should automatically "pop" out when pressure drops within that range.

4. REMOVAL

(1) Identify and mark or label all air lines and their connections on the valve.

(2) Remove the PP-DC from the vehicle and save the mounting hardware.

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5. INSTALLATION

(1) Install the PP-DC in its location on the dashboard. Using the mounting hardware saved in "REMOVAL," secure the valve to the vehicle.
(2) Reconnect all air lines to the valve using the identification made in "REMOVAL."
(3) Perform "OPERATIONAL AND LEAKAGE TESTS" before placing the vehicle back in service.

6. DISASSEMBLY

The following disassembly and assembly procedures are for reference only. Always have the appropriate maintenance kit on hand and use its instructions in lieu of those presented here. Refer to figure on page BR02-38 throughout the procedure.

(1) Turn the button counterclockwise to remove it from the plunger stem.
(2) Remove the four screws that secure the cover to the body, and remove the cover.
(3) Pull the plunger stem to remove the plunger and the guide spool from the body.
(4) Remove plunger spring(6) and discard.
(5) If necessary, use a screwdriver to carefully remove the check valve seat from the body. Be sure not to damage the check valve seat or the body.
(6) Remove and discard check valve seat o-rings(7) and (8).
(7) Turn the body upside down and gently tap it on a flat surface to remove check valve(9). Discard the check valve.
(8) Remove the guide spool from the plunger. Remove and discard o-ring(1) from the guide spool.
(9) Remove and discard o-rings(2), (3) and (5) from the plunger. Also remove and discard exhaust seal(4).

7. CLEANING & INSPECTION

(1) Wash all metal parts in mineral spirits and thoroughly dry.
(2) Inspect all re-usable parts for excessive wear or damage. Inspect the body for gouges or deep scuffing. Replace key numbers 1-9 (and any parts not determined usable) with genuine Bendix replacements.

8. ASSEMBLY

Before assembly, lubricate all o-rings, o-ring grooves, rubbing surfaces and bores with Bendix silicone lubricant (Pc. No. 291126) or equivalent.

(1) Place check valve(9) into its seat in the body with its flat surface facing upward. If necessary, reach into the body to make sure the valve is seated evenly in the bore.
(2) Install o-rings(7) and (8) on the check valve seat and install the check valve seat into the body. Make sure the seat is fully seated-its surface should be even with the body's surface.
(3) Install plunger spring(6) into the body. Make sure it stands upright and is seated properly in the body bore. (It should surround the protrusion or "lip" at the bottom of the body bore.)
(4) Install o-rings(2), (3), (5) and exhaust seal(4) onto the plunger. Then install the plunger into the body. Line up the plunger's index tabs with the spaces in the body bore for ease of installation.
(5) Install o-ring(1) onto the guide spool. Then install the guide spool over the plunger and into the body. Press the guide spool into place firmly.
(6) Place the cover onto the body and secure with its four screws. Torque to 35 in. lbs.
(7) Thread the button clockwise onto the plunger stem. It should take approximately 3 full button revolutions to install it on the plunger. The protrusions on the side of the plunger should line up with the button grooves. Push on the button a number of times to make sure the plunger moves freely throughout its range of motion.

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NOTICE
Before placing the vehicle back into service, perform the "leakage and operational tests" in this manual.

If the PP-DC fails to function as described, or if leakage is excessive, repair the valve or replace it at the nearest authorized Bendix Commercial Vehicle Systems parts outlet.

9. IMPORTANT! PLEASE READ

When working on or around a vehicle, observe the following general precautions.

(1) Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.
(2) Stop the engine when working around the vehicle.
(3) Drain the air pressure from all reservoirs before beginning ANY work on the vehicle.
(4) When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
(5) Never connect or disconnect a hose or line containing pressure; it may whip.
(6) Never remove a component or plug unless you are certain all system pressure has been depleted.
(7) Never exceed recommended pressures and always wear safety glasses.
(8) Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to the use of those tools.
(9) Use only genuine Bendix replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type and strength as original equipment and should be designed specifically for such applications and systems.
(10) Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.

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BRAKE CHAMBER (FRONT)

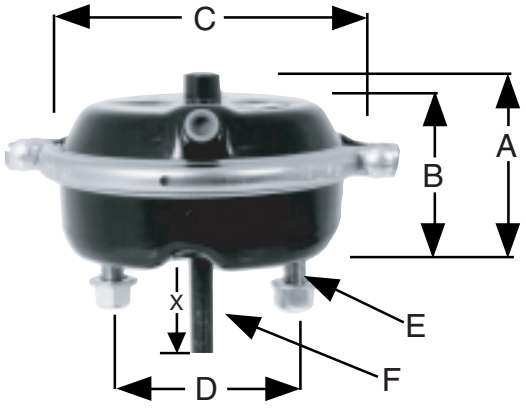
DATA AND SPECIFICATIONS

EN0680202I200004

P/N Series	**1420**
Model	**C20**
Size	**20**
Stroke	**2.25"**
Part Number	**1420001**
Wt. (Lbs.)	**7.55**
A	**4.16**
B	**3.41**
C	**6.92**
D	**4.75**
E	**5/8"-11UNC**
F	**5/8"-18UNF**
Inlets	**3/8"-NPTF**
X-Min. (in the caged position)	**8.00"**

DESCRIPTION

EN0680202C100007

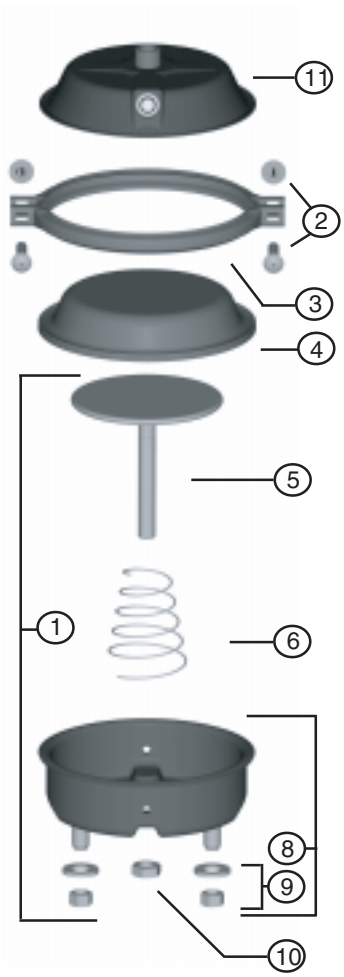


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COMPONENT LOCATOR

EN0680202D100004



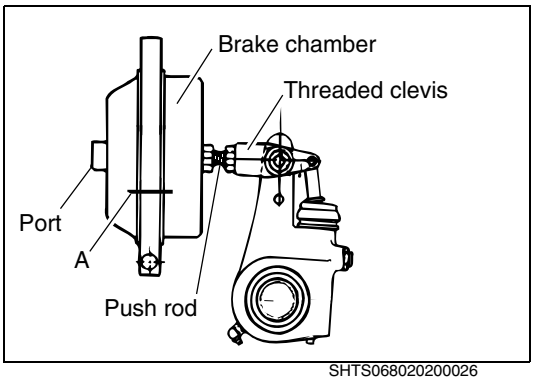
SHTS068020200025

1	Kit - NP Chamber (b)	7	Kit - Center Hole Shield
2	Kit - Nuts & Bolts	8	NP Chamber Assembly
3	Clamp Band Assembly	9	Kit - Nuts & Washers
4	Diaphragm	10	Hex Nut - Yoke
5	Kit - Push-Rod Assembly (b)	11	Pressure Cap (2-inlets/steel) (a)
6	Return Spring		

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OVERHAUL

EN0680202H200006

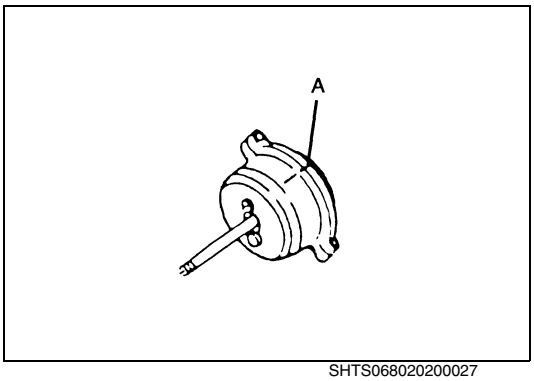


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IMPORTANT POINT-DISMOUNTING

1. DISMOUNTING OF THE BRAKE CHAMBER

(1) Before dismounting, apply aligning mark to the chamber, clamp and chamber cover.
(2) Apply a position mark "R" or "L" to identify the side where the chamber was installed.

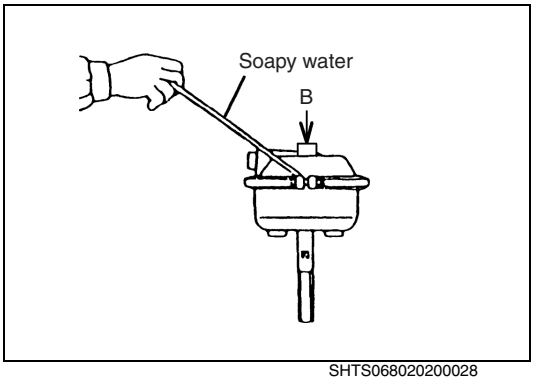


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IMPORTANT POINTS-ASSEMBLY

1. ASSEMBLING THE BRAKE CHAMBER

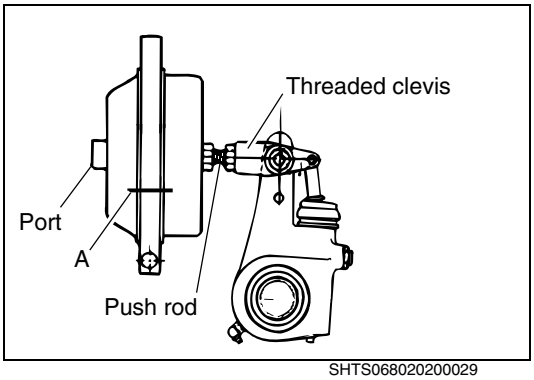
(1) Replace the diaphragm with new one.
(2) Align the aligning mark "A" of the chamber, clamp and chamber cover.
(3) Insert the bolt from opposite side of drain hole and tighten the bolts evenly with nut within the specified torque.



SHTS068020200028

2. CHECKING FOR AIR LEAKAGE

(1) Apply soapy water to the chamber as shown and charge with compressed air of 830 kPa {8.5 kgf/cm^2, 121 lbf/in^2.} from the inlet port "B" then check for leakage.



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3. INSTALLING CLEVIS

(1) Install the clevis to the push rod.

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IMPORTANT POINT-MOUNTING

1. INSTALLING THE BRAKE CHAMBER

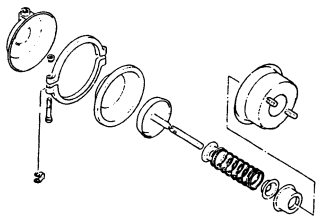
(1) The chamber must be mounted on the side a s marked when dismounting.

NOTICE

- **See the position mark ("R" or "L") which was applied when dismounting.**
- **When connecting the clevis with the slack adjuster, lubricate the clevis pin hole and clevis pin with sufficient chassis grease.**

INSPECTION AND REPAIR

EN0680202H300002

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Cover, clamp, push rod, return spring, retainer, dust seal, holder and chamber: Wear and damage	**—**	**—**	**Replace, If necessary.**	**Visual check** 

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BRAKE CHAMBER (REAR)

DATA AND SPECIFICATIONS

EN0680202I200005

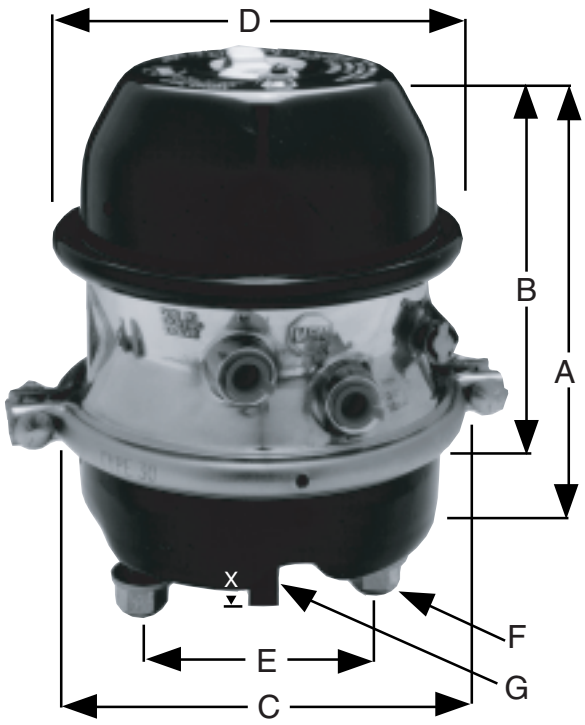
Type	Diaphragm type

P/N Series	3430
Model	TR3030
Size	3030
Stroke	2.50"
P/N Combination	3430051
P/N Single/Piggyback	3430001
P/N Piggyback Plus Kit	3430008
Wt.Combination (Lbs.)	20.0
Wt. Single (Lbs.)	11.6
A	9.04
B	6.66
C	8.31
D	8.21
E	4.75"
F	5/8" - 11UNC
G	5/8" - 18UNF
Inlets	3/8" - NPTF
X - Min. (in the caged position)	8.00" (b)

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DESCRIPTION

EN0680202C100008

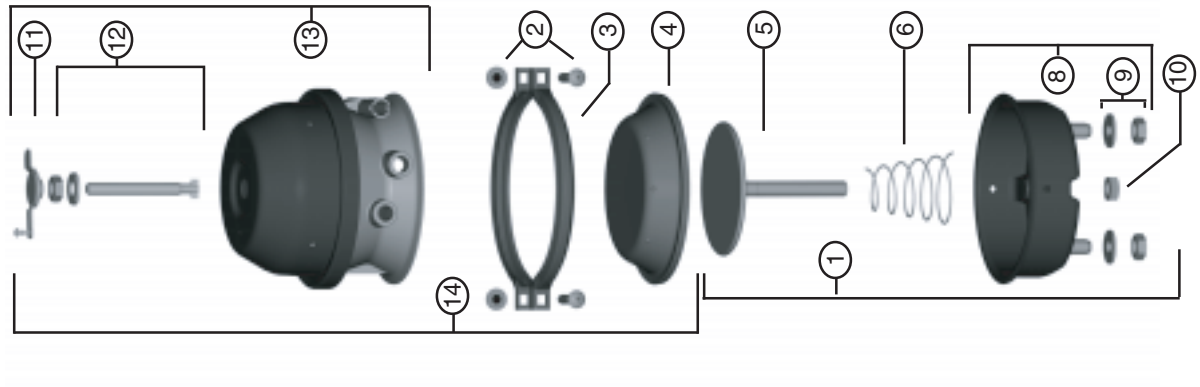


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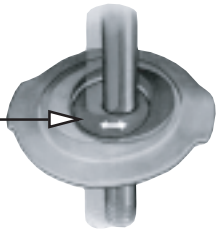
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COMPONENT LOCATOR

EN0680202D100005



7 **Center Hole Shield**
Permits visual inspection of stroke alert but prevents entry of contaminants



SHTS068020200032

1	Kit-NP Chamber (b)	8	NP Chamber Assembly
2	Kit-Nuts & Bolts	9	Kit-Nuts & Washers
3	Clamp Band Assembly	10	Hex Nut - Yoke
4	Diaphragm	11	Kit-Weatherseal™ Plug
5	Kit-Push-Rod Assembly (b)	12	Kit-Release Bolt
6	Return Spring	13	Piggyback
7	Kit-Center Hole Shield	14	Kit-Piggyback Plus

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Model “TR” Series

SHTS068020200033

INSPECTION AND REPAIR

EN0680202H300003

⚠ CAUTION
The MGM Brakes Tamper Resistant spring brake chambers are an important part of your braking system. While they do not require scheduled servicing, it is good preventative maintenance to make the following routine inspections while they are in the shop for regular servicing of other components or at a minimum of every 50,000 miles.

⚠ WARNING
Your MGM brakes tamper resistant spring brake has been factory sealed for your protection. There are no user-serviceable parts inside the spring brake chamber. If you experience any damage or failure of your spring brake chamber, remove either the entire actuator as in section (3) of this manual, or the single (piggyback) as in section (5) of this manual. See section (8) of this manual for disposal instructions. Never attempt to disassemble the spring brake chamber as serious personal injury could result from accidental sudden release of the high energy spring.

1. RECOMMENDED INSPECTION POINTS

(1) The plastic END CAP on all "TR" and "TR-T" models requires no positioning or maintenance, but must be snapped tightly into place. Inspect the cap for damage and replace as necessary. "TR-T" units equipped with a breather tube and the white WEATHER SEAL END CAP must be equipped with a rubber O-ring to ensure proper sealing of the spring chamber. **Operating units equipped with the BREATHER TUBE without the END CAP or DUST CAP securely in place will void the MGM Brakes warranty without remedy**.

(2) Visually inspect the exterior surfaces of the unit for signs of damage from outside sources, corrosion and/or rust. If any of these are seen or suspected, cautiously remove the complete combination chamber by following the directions in Section 3 on page BR02-51 of this manual. Per CVSA out of service criteria any non-manufactured hole or crack will place the vehicle out of service. (Not Shown)

(3) Inspect SERVICE BRAKE CLAMP RING to be sure it is securely in place and damage free. If any damage is seen or suspected, cautiously remove the complete piggyback/spring brake chamber by following directions in Section 5 on page BR02-54 of this manual. **MGM Brakes recommends 30-35 Lbs.-Ft. torque on CLAMP BOLTS.**

(4) Check to ensure the MOUNTING STUD NUTS are tightened to **133-155 Lbs.-Ft. torque (clockwise)** and washers are in place between the nut and bracket.

(5) Inspect air lines, hoses and fittings attached to chamber. Replace any damaged or leaking parts. **MGM Brakes recommends the fittings be tightened to 25-30 Lbs.-Ft. torque into the chamber air inlet ports**.

IMPORTANT
Inspect the air ports to determine the model of brake. Round ports denote (2.50 inch) standard stroke model, square ports denote (3.00 inch) long stroke model. This information is important when replacing the service diaphragm and determining the chamber's rated stroke.

(6) Inspect the PUSH-ROD to be sure it is working free, not bent, not binding and is square to the chamber bottom within ±3° in any direction at any point in the stroke of the chamber. If the PUSH-ROD is not square, make corrections by repositioning the chamber on the mounting bracket and/or by shimming the slack adjuster to the right or left on the camshaft as required.

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(7) Inspect the YOKE ASSEMBLY being sure YOKE PIN is installed and locked into place with a COTTER PIN. Replace any damaged, worn or missing parts. **MGM Brakes recommends the YOKE LOCKNUT be tightened to 25-50 Lbs.-Ft. torque**. (Not Shown)
(8) On units equipped with a DUST BOOT, check the BOOT for damage and replace as necessary. (Not Shown).
(9) On units equipped with an external BREATHERTUBE be sure both ends of the connector tube are engaged a minimum of 1/2-inch into each of the flexible elbows. The tube must be glued to both of the elbows with a high quality rubber adhesive or secured with a clamp that may be purchased with the MGM Brakes BREATHER TUBE KIT. These units must be mounted with the BREATHER TUBE in the upper half of the non-pressure chamber facing away from the road surface.

IMPORTANT: Failure to operate any MGM Brakes Model Series "TR-T" or "TR-TS" chamber without the EXTERNAL BREATHER TUBE and END CAP with O-ring being present and in good condition will void the MGM Brakes Warranty without remedy.

2. MANUAL RELEASE-PARKING BRAKES

(1) Before releasing the parking brakes, chock wheels of the vehicle to prevent a vehicle movement.
(2) Remove the plastic end cap from the spring brake chamber.


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(3) Using a 3/4 inch wrench, unscrew the release-nut and remove the nut, flat washer, and release-bolt from their storage pocket on side of chamber for all "TR" series brakes.

IMPORTANT
If these parts are not stored on the chamber, they must be obtained from vehicle tool box or service department, as the piggyback/spring brake cannot be manually released without them.


SHTS068020200035

(4) Insert the release-bolt into the center hole of the head and, being sure that the formed end of the bolt has entered the hole in the piston inside the chamber, continue to insert the bolt until it reaches the bottom.

IMPORTANT
If you are not absolutely sure of correct bolt-to-piston engagement, repeat 1. (4) until you are sure.


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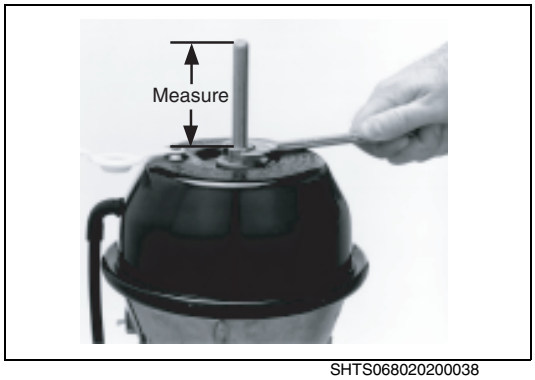
(5) Turn the release-bolt 1/4 turn clockwise and pull the bolt out to lock the formed end into the piston.

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IMPORTANT
If the bolt does not lock into the piston in less than 1/2 inch outward movement, repeat 1. (4) and (5) until you are sure it does lock.


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(6) Holding the bolt locked into the piston, install the flat washer and the release nut on the end of the release-bolt, and turn down the nut against the flat washer until finger tight.



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(7) Using a 3/4 inch handwrench (**DO NOT USE AN IMPACT WRENCH**) turn the release-nut clockwise until the following length of bolt extends above the nut.
3.25 inch-Type 3030 Chamber

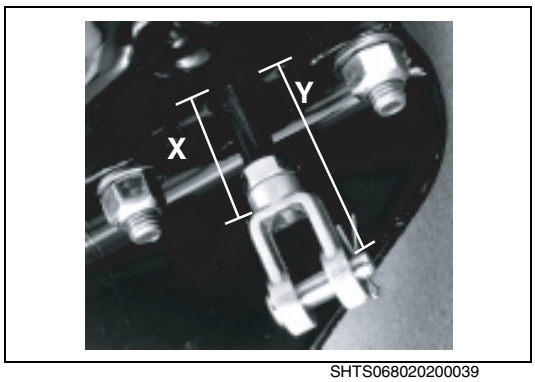
⚠ WARNING
Do not exceed these lengths and do not exceed 50 lbs.-ft. torque on release nut at any time or damage may occur which could prevent any future correct manual-releasing of the piggyback spring brake chamber.

NOTICE

- **For easier manual-releasing, apply 90-125 psi air pressure to inlet port marked "SPRING BRAKE" before 1. (4) above, but be sure to exhaust all air pressure after 1. (7) is completed.**
- **To reactivate the piggyback/spring brake from its manually-released position, reverse the order of 1. (1)-(7) above.**
- **When re-installing the release-bolt, flat washer and release-nut into the storage pocket, MGM Brakes recommends 10 Lbs.-Ft. torque on nut against the flat washer.**

3. REMOVAL AND INSTALLATION INSTRUCTIONS FOR "COMBINATION CHAMBERS"

NOTICE
Before removing air brake chamber to be replaced to ensure that the brake chamber being replaced was properly installed with the correct rod length.



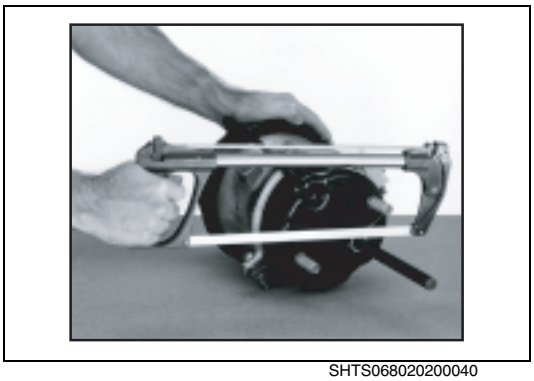
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(1) Determine the manufacturer of the single (piggyback) spring brake or combination chamber to be removed from the vehicle and, following that manufacturer's instructions exactly, manually release the spring brake completely. (Instructions for all MGM Brakes Model Series "TR", "TR-T" and single (piggyback) spring brakes having removable bolts are given in Section 2 on page BR02-50 of this manual. (Service Manuals for all other design series of MGM Brakes piggyback spring brakes are also available upon request to MGM Brakes.)

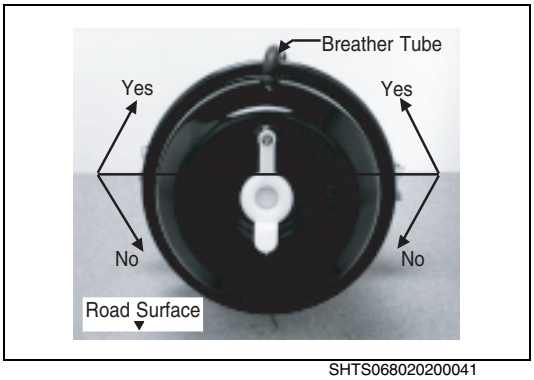
(2) Remove the cotter pin from the yoke pin, knock out the yoke pin, and remove both air lines from the assembly.

IMPORTANT
Be sure to mark the air line from the inlet port marked "SPRING BRAKE" for later re-installation reference.

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(3) Using a 15/16 inch wrench, unscrew hex nuts on mounting bolts and cautiously remove the old chamber from the mounting bracket.

(4) **Cut the service push-rod to proper length.**

(5) Remove the hex nut and the flat washers on the mounting bolts of the new chamber, clean the face of the mounting bracket and install the chamber on the bracket with close attention given to positioning the chamber air inlet ports for correct alignment to the vehicle lines. Then install one flat washer and hex nut on each mounting bolt and using a 15/16 inch hand wrench **(DO NOT USE AN IMPACT WRENCH)**, tighten nuts to **MGM Brakes recommended 133-155 Lbs-Ft. torque**.

IMPORTANT

- **If it is required to reposition the air inlet ports to assure proper mating and alignment with vehicle air lines, refer to Section 5 on page BR02-55 and 56 of this manual and follow Steps (3) through (6) very carefully.**
- **When installing any MGM Brakes model with the breather tube it is mandatory to position the non-pressure chamber end of the breather tube in upper half of chamber facing away from the road surface. Failure to comply will void the MGM Brakes Warranty on these models.**

(6) Reconnect yoke to the slack adjuster, being sure that the correct diameter and length of yoke pin is installed into the correct hole in the slack adjuster. Secure the yoke pin with a new cotter pin.
IMPORTANT: When making a reconnection to an automatic slack adjuster follow the vehicle manufacturer's recommendations for installation and set-up.

(7) Inspect the push-rod to be sure that it is working free, not bent, not binding an is square to the chamber bottom within ±3° in any direction at any point in the stroke of the chamber. If the push-rod is not square, make corrections by repositioning the chamber on the mounting bracket and/or by shimming the slack adjuster to the right or left on the camshaft as required.

(8) Apply a non-hardening sealing compound to the hose fittings and re-install both of the air lines to the chamber being sure each is mated to the correct air inlet port according to the markings made earlier. **MGM Brakes recommends the fittings be tightened to 25-30 Lbs.-Ft. torque into the chamber air-inlet ports**.

(9) Using the vehicle system air, charge the spring brake with full line pressure (minimum 100 psi). Spray only soapy water or leak detection solution (NEVER ANY TYPE OF OIL!) to the air line fittings and inspect for air leaks. If bubbles appear, tighten fittings slightly, but not over 30 Lbs.-Ft. torque.
IMPORTANT: If the service brake clamp ring was loosened to reposition air inlet ports in Step(5) above, apply air to the spring brake and then apply and hold foot brake treadle valve down to charge the service brake chamber. Test for air leaks around the circumference of the service clamp ring using soapy water or leak detection solution. If bubbles appear, firmly tap the circumference of the clamp ring with a hammer and retighten the clamp nuts until leaks cease. **MGM Brakes recommends 30-35 Lbs-Ft. torque on clamp hex nuts.** Completely exhaust air from both of the chambers when complete.

(10) With air pressure now exhausted from the service chamber, but still applied on the spring brake, remove release-nut, washer and release-bolt for all "TR" models. Replace these parts in their storage pocket on chamber (or in vehicle tool box if storage pocket is not present on chamber) and tighten nut against flat washer to 10 Lbs.-Ft. torque.

(11) Replace the END CAP properly. **Operating units equipped with the EXTERNAL BREATHER TUBE without the END CAP and O-RING**

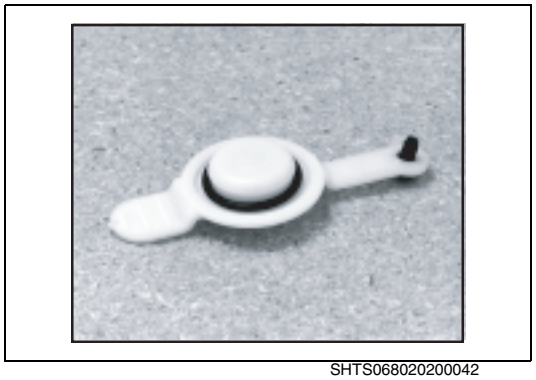
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securely in place will void the MGM Brakes Warranty without remedy.

IMPORTANT: If chamber is fitted with an external breather tube be sure both ends of the connector tube are engaged a minimum of 1/2 inch into each of the flexible elbows. The tube must be glued to both of the elbows with a high quality rubber adhesive or secured with a clamp that may be purchased with the MGM Brakes Breather Tube Kit. These units must be mounted with the BREATHER TUBE in the upper half of the non-pressure chamber facing away from the road surface.

⚠ WARNING

After replacement of any brake chamber, the chamber pushrod stroke and actuating alignment must be checked to assure correct installation and foundation brake adjustment. It is very important to recognize that no foundation adjustments can be made at either the spring brake chamber, or at the service brake chamber, and that all "stroke adjustments" must be made at the slack adjuster according to the specific recommendations of the foundation brake manufacturer or the vehicle manufacturer.



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4. PROCEDURE TO CUT THE SERVICE PUSH-ROD TO PROPER LENGTH

⚠ WARNING

Do not attempt to service or disassemble the spring chamber or any spring brake actuator. A large spring in the spring chamber having extreme force could cause serious bodily injury if it were suddenly released due to inadvertent removal of this clamp or tamper resistant head.

IMPORTANT: Place blocks under wheels to prevent vehicle runaway before removing air brake actuators.

(1) REMOVE WORN OR NON-FUNCTIONAL UNIT FROM VEHICLE: Determine manufacturer and model of unit to be replaced. Refer to that manufacturer's service manual for caging and removal instructions.

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(2) Make sure the spring chamber of the removed actuator is fully released (power spring caged) and the service brake push-rod is fully retracted to zero stroke position (i.e., brake fully released).

(3) Measure and record the "X" and "Y" dimensions.
"X" Dimension - The dimension from bottom of actuator to end of push-rod. "Y" Dimension - The dimension from bottom of actuator to center line of yoke pin.

NOTICE

If for some reason the spring chamber power spring cannot be caged and fully released, then the "X" and "Y" dimensions will need to be measured from another actuator of the exact type from the same vehicle provided it is retracted to its zero stroke position (brake fully released) and was operating correctly.

(4) Before marking push-rod to be cut on a new unit, be sure the spring chamber and push-rod are fully retracted to the zero position. (This may be done with the manual caging bolt or by applying 90-100 psi air pressure to the spring chamber air inlet port.)
(5) Take measured "X" dimension from the removed unit and mark push-rod of new unit from the bottom of the actuator.
(6) Thread yoke jam nut past mark on push-rod. Align bottom edge of nut with mark.
(7) Use a sharp hack-saw and cut push-rod on the mark.
(8) After cutting rod, thread jam nut off to clean up the thread.
(9) Thread jam nut back onto the push-rod a sufficient length to allow assembly of the yoke.
(10) Thread yoke onto the push-rod. Yoke from removed unit may be reused provided yoke pin hole is not worn. Adjust yoke to the same "Y" dimension as measured from the removed unit.
(11) Hold yoke to prevent it from turning and tighten locknut against yoke 25-35 Lbs.-Ft. torque.

TO INSTALL NEW UNIT ON VEHICLE: Refer to MGM Brakes Service Manual for the model that is being installed.



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5. REMOVAL AND INSTALLATION INSTRUCTIONS FOR SINGLE (PIGGYBACK) SPRING BRAKES

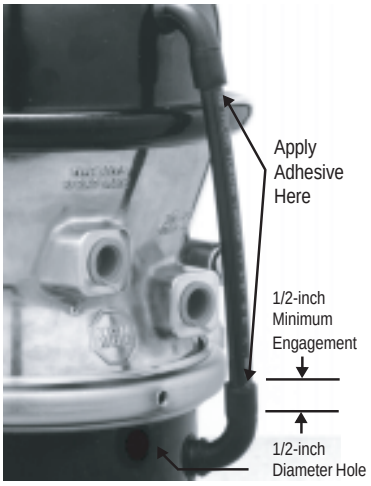
The removal and installation of a single spring brake chamber (without removal of the service brake chamber) can be made easier by "locking off" the service chamber piston. To do this apply the service brake by applying the driver's foot brake treadle valve and, while applied, clamp vise-grip pliers on push-rod so that vice-grips abut mounting bracket to prevent rod from retracting when air pressure is released.

(1) Determine manufacturer of the single spring brake to be removed from the vehicle and, following that manufacturer's instructions exactly, manually release the spring brake completely. (Instructions for all MGM Brakes Model Series "TR", "TR-T" and single spring brakes having removable release bolts are given in Section 2 on page BR02-50 of this manual.) (Service Manuals for all other design series of MGM Brakes single spring brakes are also available upon request to MGM Brakes.)
(2) Remove both air lines from the chamber.

IMPORTANT

Be sure to mark the air line from the inlet port marked "SPRING BRAKE" for later re-installation reference.

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(3) On all MGM Brakes models fitted with external breather tubes, disconnect the tube and elbow from the service chamber housing.



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(4) Using a 9/16 inch wrench or socket, remove the clamp nuts on the service clamp ring. Then, while holding the single spring brake securely in place, remove the clamp ring to allow removal of the single brake from the service chamber.

IMPORTANT
At this time take the opportunity to inspect all parts in the service chamber (especially the diaphragm) and replace the return spring, and any other parts which may be damaged or worn. Use only genuine MGM Brakes Engineered replacement parts!

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(5) Make sure the new single (piggyback) spring brake is fully released as outlined in Section 2 on page BR02-50 of this manual. Position the diaphragm in the bottom recess of the chamber and, with very close attention taken to assure all mating parts are aligned straight and the air lines are positioned to mate with the vehicle air supply lines, replace the service clamp ring.

(6) Re-install the clamp bolts and nuts. **Alternately tighten each nut in 5-10 Lbs.Ft. torque increments** while constantly rechecking mating parts alignment. (If re-alignment is required, loosen clamp nuts and repeat Step (5) above). Firmly tap around circumference of the clamp ring with a hammer to assure the full seating of the clamp and **tighten the nuts to 30-35 Lbs-Ft. torque**.

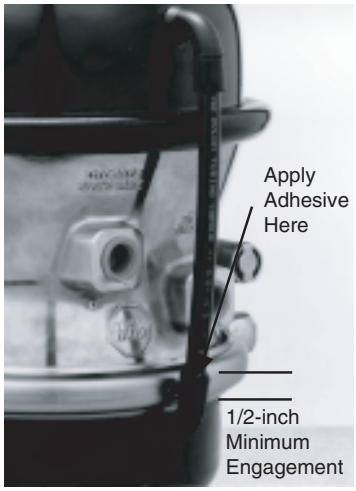
(7) Apply a non-hardening sealing compound to the hose fittings and re-install both of the air lines to the chamber, being sure each is mated to the correct air inlet port according to the markings made earlier. **MGM Brakes recommends the fittings be tightened to 25-30 Lbs.-Ft. torque into the chamber air inlet ports.**

(8) Using the vehicle system air, charge the spring brake with full line pressure (minimum 100 psi). Spray only soapy water or leak detection solution (NEVER ANY TYPE OF OIL!) to the air line fittings and inspect for air leaks. **If bubbles appear, tighten fittings slightly, but not over 30 Lbs.-Ft. torque.**

(9) With the spring brake still fully charged with full line pressure, apply and hold foot brake treadle valve down to charge the service brake chamber.

IMPORTANT

At this time, remove the vise-grip pliers from the service push-rod so that the piston can return to a normal position in the chamber. Now test for air leaks around the circumference of the service clamp ring by spraying with soapy water or leak detection solution. If bubbles appear, firmly tap the circumference of the clamp ring with a hammer and retighten the clamp nuts until leaks cease. MGM Brakes recommends 30-35 Lbs.-Ft. torque on the clamp hex nuts.



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(10) On all MGM Brakes models fitted with an EXTERNAL BREATHER TUBE, wipe the open end of the connector tube clean to be sure that no oil is present, apply a high quality rubber cement to the tube and re-insert tube into flexible elbow a minimum 1/2 inch engagement.

If the old single unit was not equipped with an EXTERNAL BREATHER TUBE, drill a 1/2 inch diameter hole 1 inch from the top of the non-pressure chamber, at a point closest to the center line between the air ports, but in the upper half of the chamber facing away from the road surface. Remove any burrs around the hole, install a new rubber elbow in the non-pressure chamber, wipe the open end of connector tube clean to be sure no oil is present. Apply a high quality rubber cement to the tube and insert the tube into the flexible elbow with a minimum 1/2 inch engagement.

IMPORTANT

These units must be mounted with the BREATHER TUBE in the upper half of the non-pressure chamber facing away from the road surface and the tube glued or clamped securely into the rubber elbows. Failure to comply with these installation instructions will void the MGM Brakes Warranty without remedy.

(11) With air pressure exhausted from the service chamber, but with line pressure still on the spring brake, remove the release nut, washer and bolt for all "TR" models. Replace these parts in their storage pocket on the chamber (or in the vehicle tool box if a storage pocket is not on the chamber) and **tighten the nut against the flat washer to 10 Lbs.-Ft. torque**.

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(12) Replace the end cap properly. Operating these units without the END CAP securely in place will void the MGM Brakes Warranty without remedy.



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6. REMOVAL AND INSTALLATION INSTRUCTIONS FOR "SERVICE BRAKE DIAPHRAGM"

(1) Follow all instructions given in Section 5 of this manual and install the new diaphragm in Step 5-(5). Use only genuine MGM Brakes Engineered replacement diaphragms!

⚠ WARNING
When servicing a 3-inch "long stroke" model brake, be sure to replace with the correct diaphragm. Installation of a standard (2.50 inch) stroke diaphragm in a 3-inch "long stroke" chamber could result in catastrophic failure of the unit.

IMPORTANT: It may not be necessary to disconnect the air lines from the spring brake during this procedure as long as correct and straight parts alignment can be obtained during the re-assembly operations.

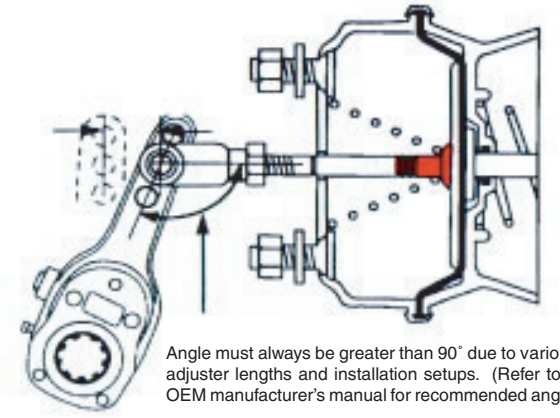
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7. CAM BRAKE ADJUSTMENT - ALL MODELS SPRING BRAKE AND SERVICE BRAKE ACTUATORS.

NOTICE

The last half of an air chamber stroke is less efficient than the first half. Therefore, the following adjustments are recommended for maximum efficiency when using manually adjusted slack adjusters.

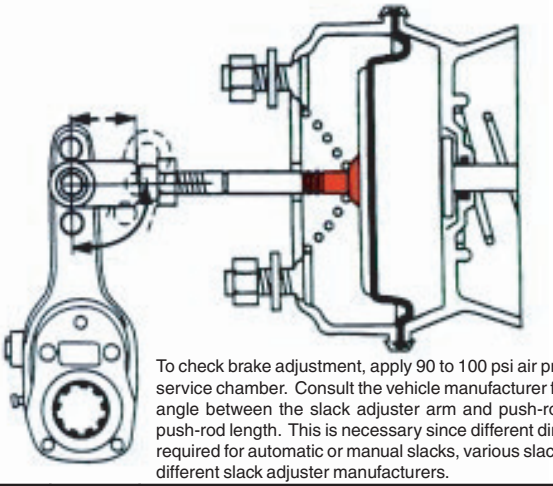
BRAKES "OFF" - NOT APPLIED



Angle must always be greater than 90˚ due to various slack adjuster lengths and installation setups. (Refer to axle or OEM manufacturer's manual for recommended angle).

Stroke should be as short as possible with no lining to drum contact.

PROPERLY - ADJUSTED BRAKES "ON" - APPLIED

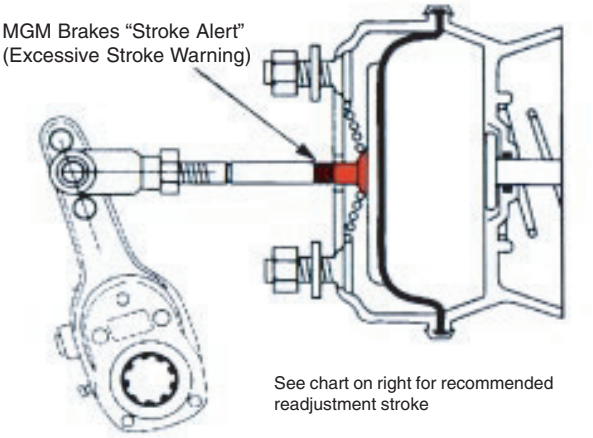


To check brake adjustment, apply 90 to 100 psi air pressure to the service chamber. Consult the vehicle manufacturer for the correct angle between the slack adjuster arm and push-rod and/or the push-rod length. This is necessary since different dimensions are required for automatic or manual slacks, various slack lengths and different slack adjuster manufacturers.

IMPROPERLY ADJUSTED BRAKES "ON" - APPLIED

(Maximum recommended readjustment stroke has been exceeded)

MGM Brakes "Stroke Alert" (Excessive Stroke Warning)



See chart on right for recommended readjustment stroke

Type	Effective Area (SQ. IN.)	Approx. Diaphragm O.D.		Rated Stroke of Chamber		Maximum Stroke with Brakes Adjusted	"B" MV/MA Recommended Readjustment Stroke	
		Inches	MM	Inches	MM		Inches	MM
9	9	5.00	125	1.75	45	SHOULD BE AS SHORT AS POSSIBLE WITHOUT LINING TO DRUM CONTACT	1.35	35
12	12	5.50	140	1.75	45		1.35	35
16	16	6.00	150	2.25	57		1.75	45
16L	16	6.00	150	2.50	64		2.00	51
20	20	6.50	165	2.25	57		1.75	45
20L	20	6.50	165	2.50	64		2.00	51
24	24	7.00	175	2.25	57		1.75	45
24L	24	7.00	175	2.50	64		2.00	51
24LP3	24	7.00	175	3.00	76		2.50	64
30	30	8.00	200	2.50	64		2.00	51
30LP3	30	8.00	200	3.00	76		2.50	64
36	36	9.00	230	3.00	76		2.25	57

SOURCE: MVMA (Motor Vehicle Manufacturers Association)

Note: The push-rod must remain perpendicular to the bottom surface of the non-pressure chamber (NPC) within ±3˚ zero to full stroke.

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8. RECOMMENDED SPRING BRAKE ACTUATOR DISARMING PROCEDURE

⚠ WARNING

- **This procedure must be strictly adhered to. never attempt to remove the spring chamber clamp ring from a double diaphragm actuator or the spring chamber retaining ring from a piston actuator. both actuators employ a high energy power spring that could cause serious bodily injury if the spring were suddenly released due to improper disassembly.**

  All retired spring brake actuators must be safely disarmed before they are disposed of to prevent serious personal injury from accidental sudden release of the high energy spring (as much as 2,700 Lbs. of force) in the parking chamber. To disarm the unit, remove it from the vehicle following the instructions in Section 3 on page BR02-51 for combination chambers, or Section 5 on page BR02-54 for single/piggyback chambers. Be sure to release the brake per Section 2 on page BR02-50 of this manual. Never attempt to remove the head which contains the power spring. Observe all safety precautions. Place the unit in a steel *container and use an acetylene torch to cut a hole through the head housing the power spring. Cut completely through at least two spring coils. The steel container must have openings to expose the head where it is to be cut with the acetylene torch and it must be strong enough to prevent parts from hurtling out should the unit suddenly separate before it is safely disarmed. It is the users responsibility to ensure the steel container is safe.

  ***Information concerning a suitable container is available through your MGM Brakes Representative.**

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PROTECTION VALVE

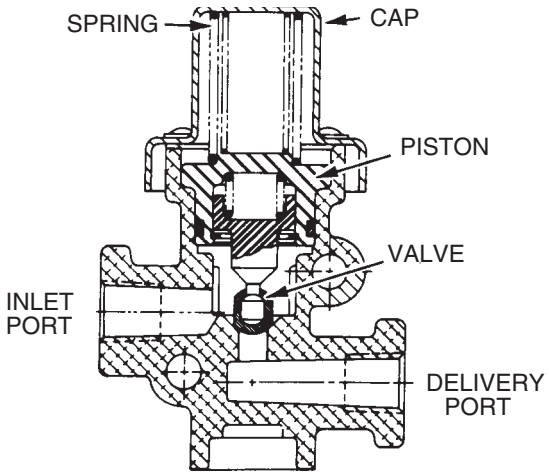
DATA AND SPECIFICATIONS

EN0680202I200006

Type		**Spring type**
Operating pressure	**Close**	**70 PSI**

DESCRIPTION

EN0680202C100009



PR-4

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INSPECTION

EN0680202H200007

1. PREVENTIVE MAINTENANCE

Every 3 months, 900 operating hours or 25,000 miles, whichever if first, it is recommended that the operation and leakage checks described in this manual be performed.

2. OPERATING CHECKS

(1) Provide a pressure gauge and drain valve at the supply side and delivery side of the pressure protection valve being checked.
(2) Build up the air system to full pressure and shut off the engine.
(3) While watching the gauges on the supply and delivery sides of the valve, slowly begin to exhaust pressure from the delivery side. Note that both gauges will show pressure loss until the closing pressure of the pressure protection valve is reached.
The pressure protection valve should close at approximately (±5 psi) the pressure indicated on the valve's label or in the vehicle handbook. The gauge on the delivery side of the valve should continue to show loss of pressure while the gauge on the supply side should stop at the same pressure as the setting of the valve.
(4) (PR-3 only) Build pressure up again and shut off engine. Slowly exhaust air from the supply side of the PR-3. The gauge on the delivery side of the valve should remain at the highest pressure previously attained.

3. LEAKAGE CHECKS

(1) Build up the air system to full pressure and shut off the engine.
(2) Apply a soap solution around the cap of the pressure protection valve. A one-inch bubble in three seconds or longer is acceptable. PR-3 - No leakage permissible at bottom of valve.
(3) Drain the air pressure from the delivery side of the pressure protection valve and disconnect the air line to it.
(4) Apply a soap solution to the delivery port. A one inch bubble in five seconds or more is acceptable.

4. REMOVING

(1) Block or hold the vehicle by means other than air brakes.
(2) Drain all system reservoirs individually, to 0 psi.
(3) Disconnect and identify (supply and delivery) the air lines leading to and from the pressure protection valve.
(4) Remove the mounting bolts, if any, that secure the valve.

5. INSTALLING

(1) Re-install the mounting bolts and secure the replacement valve to the vehicle.
(2) Reconnect the supply delivery air lines to the proper ports of the replacement valve.

6. GENERAL

After installing a replacement valve, it is recommended that the operating and leakage checks be performed as outlined in this manual. If the proper setting cannot be attained by moderate adjustment of the cap, the valve may have the wrong spring and will have to be exchanged for the correct valve. The PR-4 is not adjustable.

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7. WHEN WORKING ON OR AROUND A VEHICLE, THE FOLLOWING GENERAL PRECAUTIONS SHOULD BE OBSERVED AT ALL TIMES:

⚠ WARNING
Please read and follow these instructions to avoid personal injury or death.

(1) Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.
(2) Stop the engine when working around the vehicle.
(3) If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle.
(4) Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.
(5) When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
(6) Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
(7) Never exceed recommended pressures and always wear safety glasses.
(8) Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
(9) Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.
(10) Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.
(11) Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

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WHEEL BRAKE

DATA AND SPECIFICATIONS

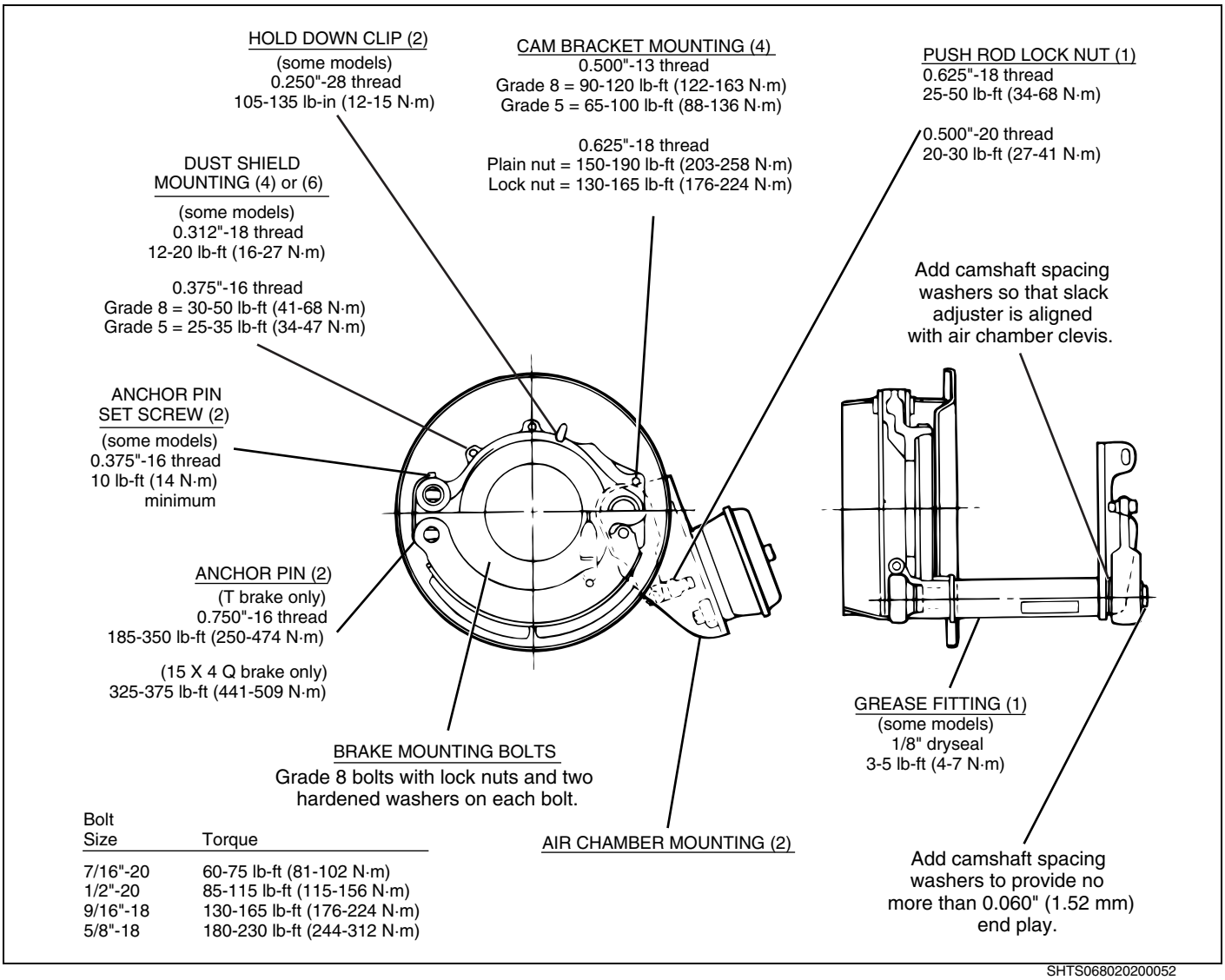
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Type		**Drum brake with internally expanding, leading-trailing shoes operated by camshaft and automatic slack adjuster in all wheels.**
Brake drum inside diameter x lining width	**Front**	**15 x 4 in. (381 x 102 mm), 16.5 x 5 in. (419 x 127 mm)**
	Rear	**16.5 x 7 in. (419 x 178 mm)**
Brake drum inside diameter x lining width (Low floor type vehicle with full air brake)	**Front**	**15 x 4 in. (381 x 102 mm)**
	Rear	**15 x 8.625 in. (381 x 219 mm)**

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DESCRIPTION

EN0680202C100010



Bolt Size	Torque
7/16"-20	60-75 lb-ft (81-102 N·m)
1/2"-20	85-115 lb-ft (115-156 N·m)
9/16"-18	130-165 lb-ft (176-224 N·m)
5/8"-18	180-230 lb-ft (244-312 N·m)

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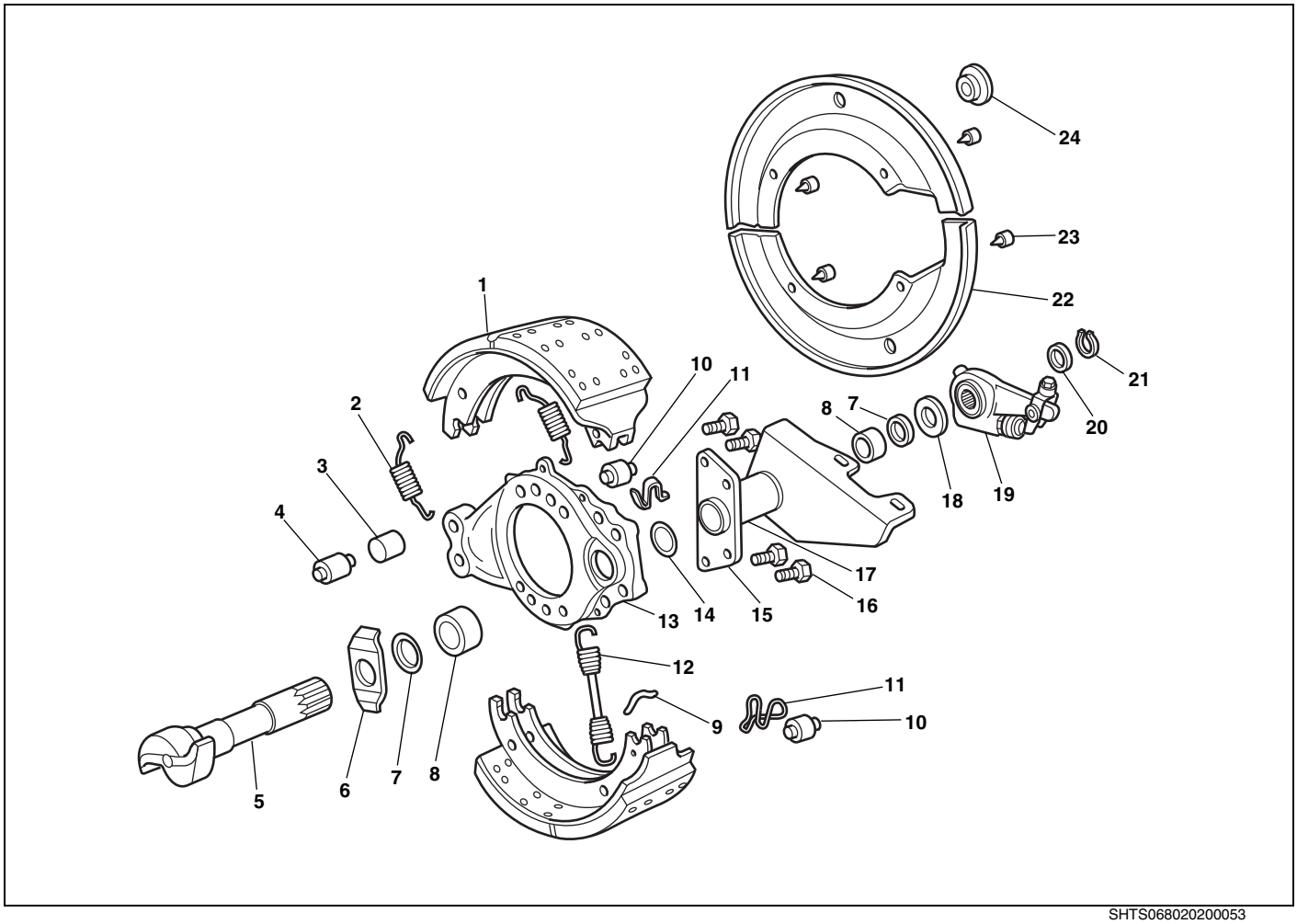
Grade 8 Nuts and Hard Flat Washers								
Chamber Size	**9**	**12**	**16**	**20**	**24**	**30**	**36**	**Spring Chamber**
Bendix	**20-30 lb-ft (27-41 N·m)**		**30-45 lb-ft (41-61 N·m)**			**45-65 lb-ft (61-88 N·m)**		**65-85 lb-ft (88-115 N·m)**
Haldex	**35-50 lb-ft (48-68 N·m)**			**70-100 lb-ft (95-136 N·m)**				
MGM	**35-40 lb-ft (48-54 N·m)**			**133-155 lb-ft (180-210 N·m)**				
Anchorlok/Haldex				**130-150 lb-ft (177-203 N·m)**				

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COMPONENT LOCATOR

EN0680202D100006

FRONT



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1	Shoe and Lining Assembly	13	Cast spider — brake
2	Spring — shoe retaining	14	Seal — chamber bracket
3	Bushing — anchor pin	15	Bracket — camshaft and chamber
4	Anchor Pin — brake shoe	16	Capscrew — chamber bracket
5	Camshaft — "S" head	17	Fitting — grease
6	Washer — camhead	18	Washer — camshaft (thick)
7	Seal — camshaft (grease)	19	Slack Adjuster — automatic
8	Bushing — camshaft	20	Washer — spacing
9	Pin — return spring	21	Snap Ring — camshaft
10	Roller — brake shoe	22	Dust Shield
11	Retainer — shoe roller	23	Capscrew — dust shield
12	Spring — brake shoe return	24	Plug

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ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

Hazard Summary

Because some brake linings contain asbestos, workers who service brakes must understand the potential hazards of asbestos and precautions for reducing risks. Exposure to airborne asbestos dust can cause serious and possibly fatal diseases, including asbestosis (a chronic lung disease) and cancer, principally lung cancer and mesothelioma (a cancer of the lining of the chest or abdominal cavities). Some studies show that the risk of lung cancer among persons who smoke and who are exposed to asbestos is much greater than the risk for non-smokers. Symptoms of these diseases may not become apparent for 15, 20 or more years after the first exposure to asbestos.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons. OSHA has set a maximum allowable level of exposure for asbestos of 0.1 f/cc as an 8-hour time-weighted average and 1.0 f/cc averaged over a 30-minute period. Scientists disagree, however, to what extent adherence to the maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling asbestos dust. OSHA requires that the following sign be posted at the entrance to areas where exposures exceed either of the maximum allowable levels:

DANGER: ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA.

2. Respiratory Protection. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA for use with asbestos at all times when servicing brakes, beginning with the removal of the wheels.

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

NON-ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to non-asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled. Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to non-asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.

2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m^3 as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

Therefore, wear respiratory protection at all times during brake servicing, beginning with the removal of the wheels. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA, if the exposure levels may exceed OSHA or manufacturer's recommended maximum levels. Even when exposures are expected to be within the maximum allowable levels, wearing such a respirator at all times during brake servicing will help minimize exposure.

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize exposure. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

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OVERHAUL

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⚠ WARNING

- **ArvinMeritor Automatic Slack Adjusters (ASA's) should not need to be manually adjusted in service. ASA's should not have to be adjusted to correct excessive pushrod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.**
- **ArvinMeritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.**
- **In the event that a manual adjustment must be made (although should not be a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.**

IMPORTANT POINTS-DISASSEMBLY

1. BEFORE YOU BEGIN

This manual describes the correct service and repair procedures for Meritor cam brakes. Before you begin procedures:

(1) Read and understand all instructions and procedures before you begin to service components.

(2) Read and observe all Caution and Warning safety alerts that precede instructions or procedures you will perform. These alerts help to avoid damage to components, serious personal injury, or both.

(3) Follow your company's maintenance and service, installation, and diagnostics guidelines.

(4) Use special tools when required to help avoid serious personal injury and damage to components.

Safety Alerts, Torque Symbol and Notes

⚠ WARNING	**A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury.**
⚠ CAUTION	**A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.**
NOTICE	**A Note provides information or suggestions that help you correctly service a component.**

2. HOW TO ORDER TOOLS, SUPPLIES AND BRAKE CONVERSION KITS

Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to order tools and supplies specified in this manual. You also can order the following brake conversion kits.

- A kit to convert Q Series cam brake shoes (except models with cast shoes) to Q Series brakes with "quick change" shoes
- A kit to convert standard 16.5-inch Q Series cam brakes to Q Plus™ cam brakes

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⚠ WARNING

- **Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials. Refer to page BR02-66 in this manual for hazard summaries and recommended work practices.**
- **To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance and service.**
- **Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip or fall over. Serious personal injury and damage to components can result.**

3. REMOVAL

(1) Wheel Components
   a. Park the vehicle on a level surface.
   b. Block the wheels to prevent the vehicle from moving.
   c. Raise the vehicle, so that the area you will service is off of the ground. Support the vehicle with safety stands.

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

   d. If the brake has spring chambers, carefully cage and lock the spring, so that the spring cannot actuate during assembly.

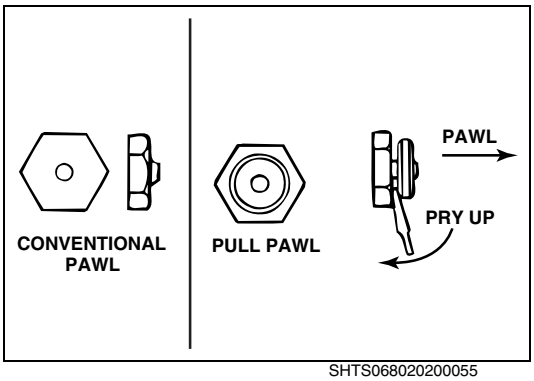
(2) Automatic Slack Adjuster
   For complete maintenance and service information on Meritor's automatic slack adjuster, refer to Automatic Slack Adjuster.

⚠ CAUTION

You must disengage a pull pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

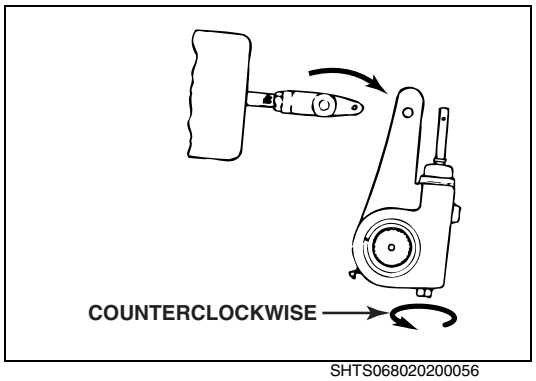
   a. Disengage the pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8mm) to disengage the teeth.

- **If the slack adjuster has a conventional pawl:** Remove the pawl.



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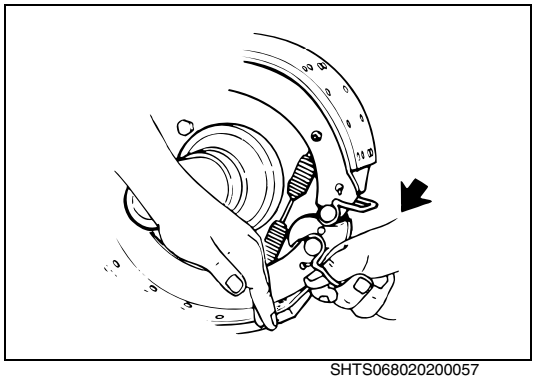
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b. Use a wrench to turn the manual adjusting nut COUNTERCLOCKWISE until the brake shoes are fully retracted, and the lining clears the drum.

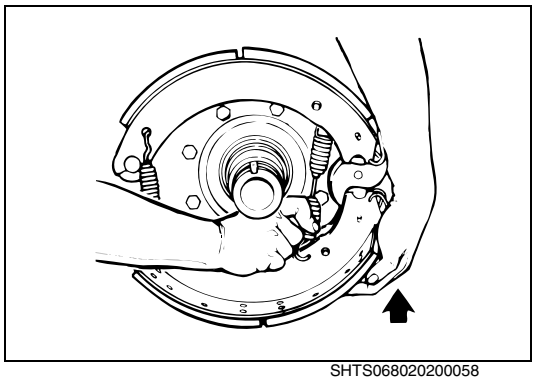
⚠ WARNING
When you remove a clevis pin that has a spring, hold the spring with pliers. The spring can disengage from the clevis with enough force to cause serious personal injury.

c. Remove both clevis pins, and retainer clips or cotter pins. Move the slack adjuster away from the clevis.
d. Follow the manufacturer's instructions to remove the wheel and drum from the axle.

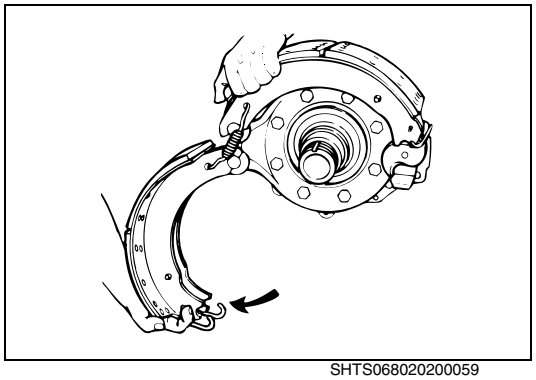
(3) Brake Shoes
All Q Plus and Q Series 15-Inch and 16.5-Inch Brakes


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1. Push down on the bottom brake shoe. Pull on the cam roller retainer clip to remove the bottom cam roller.
2. Lift the top brake shoe and pull on the cam roller retainer clip to remove the top cam roller.

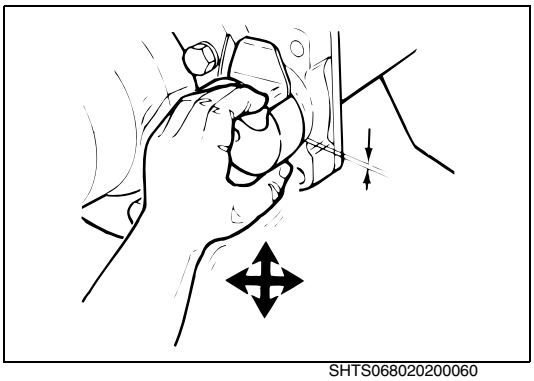

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3. Lift the bottom shoe to release the tension on the brake shoe return spring.


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4. Rotate the bottom shoe to release the tension on the brake shoe retainer springs.
5. Remove the shoe retainer springs and the brake shoes.

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(4) Check Cam-to-Bushing Radial Free Play and Axial End Play
Before you remove the automatic slack adjuster and camshaft, move the camshaft as shown in figure. Use a feeler gauge to verify that the cam-to-bushing radial free play and axial end play are within specification.

- **If radial free play movement is less than 0.030-inch (0.76 mm):** Do not replace the bushings and seals.
- **If radial free play movement exceeds 0.030-inch (0.76 mm):** Replace the bushings and seals.
- **If axial end play movement exceeds 0.060-inch (1.52 mm):** Remove the snap ring. Add an appropriate number of spacing washers between the slack adjuster and snap ring to achieve the correct specification of 0.005-0.060-inch (0.127-1.52 mm).

(5) Remove the Automatic Slack Adjuster and Camshaft
a. Remove the snap ring, washers and spacers from the camshaft.
b. Remove the automatic slack adjuster from the camshaft.

- **If the slack adjuster has a "quick connect" clevis, and the gap between the clevis and clevis collar exceeds 0.060-inch (1.52 mm):** Remove the clevis from the push rod.

c. Remove the camshaft from the spider. Use the correct size driver to remove the camshaft bushings from the spider and spider bracket.

⚠ WARNING
Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, and emulsion-type and petroleum-base cleaners. Read the manufacturer's instructions before using a solvent cleaner, then carefully follow the instructions. Also follow the procedures below.

- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.**
- **You must use hot solution tanks or alkaline solutions correctly. Read the manufacturer's instructions before using hot solution tanks and alkaline solutions. Then carefully follow the instructions.**

⚠ CAUTION
Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts can result.

(6) Clean and Dry Parts
Use soap and water to clean non-metal parts. Dry parts immediately after cleaning with soft, clean paper or cloth, or compressed air.

(7) Corrosion Protection
a. **If you assemble parts immediately after you clean them:** Lubricate parts with grease to prevent corrosion. Parts must be clean and dry before you lubricate them.
b. **If you store parts after you clean them:** Apply a corrosion-preventive material. Store parts in a special paper or other material that prevents corrosion.

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4. IMPORTANT POINTS-ASSEMBLY

(1) Automatic Slack Adjuster

a. If the slack adjuster has a "quick connect" clevis, check the gap between the clevis and the collar.

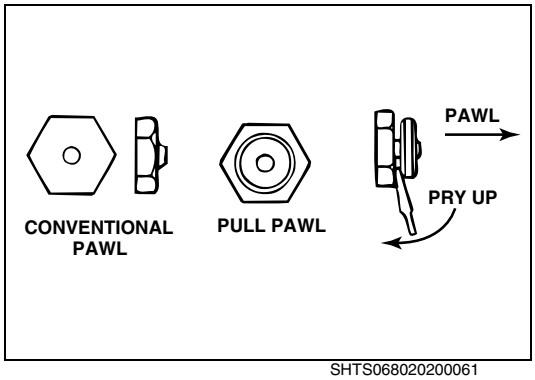
- **If the gap exceeds 0.060-inch (1.52 mm):** Replace the clevis with a one-piece threaded clevis.

b. Check the clevis pins, clips and bushing in the slack adjuster arm for wear and damage.
Replace worn or damaged parts. Check the bushing's diameter to ensure it does not exceed 0.531-inch (13.5 mm).

- **If the bushing diameter exceeds 0.531-inch (13.5 mm):** Replace the bushing.

⚠ CAUTION
You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

NOTICE
When you service an automatic slack adjuster with a conventional pawl, replace the conventional pawl with a pull pawl.

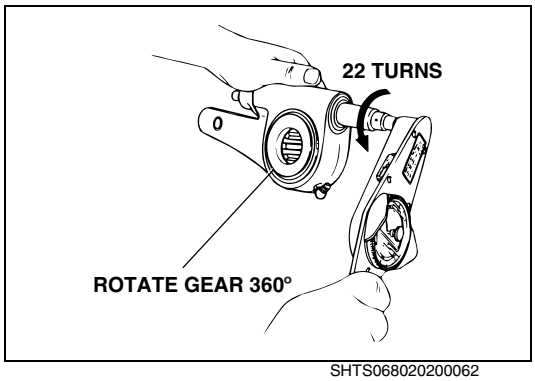


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c. Disengage the pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8mm) to disengage the teeth.

- **If the slack adjuster has a conventional pawl:** Remove the pawl.

⚠ CAUTION
Only turn the adjusting nut counterclockwise when you check gear torque on an automatic slack adjuster. If you turn the adjusting nut incorrectly, you will damage the pawl teeth. A damaged pawl will prevent the slack adjuster from automatically adjusting clearance between the linings and drum. Damage to components can result.



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d. Use a lb-in torque wrench and turn the adjusting nut COUNTER-CLOCKWISE to rotate the gear 360 degrees (22 turns of the wrench) as you read the torque scale on the wrench. The value should remain at less than 25 lb-in (2.83 N·m) as you rotate the gear.

- **If the torque value remains less than 25 lb-in (2.8 N·m) as you rotate the gear:** The slack adjuster is operating correctly.
- **If the torque value exceeds 25 lb-in (2.8 N·m) as you rotate the gear:** The slack adjuster is not operating correctly.
Disassemble the slack adjuster. Check that it's assembled correctly. Check that parts are aligned correctly.

e. Re-engage the pull pawl. Remove the screwdriver or equivalent tool. The pull pawl will re-engage automatically.

- **If the slack adjuster has a conventional pawl:** Install the pawl assembly into the housing. Tighten the capscrew to 12-17 lb-ft (16-23 N·m).

NOTICE
If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.

f. Use a grease gun to apply Meritor lubricant specification O-616-A, O-692 or O-645 to the slack adjuster grease fitting, until grease flows from around the camshaft splines and pawl assembly.

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Automatic Slack Adjuster Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Automatic Slack Adjuster	O-616-A	1	Clay Base	Down to -40°F (-40°C)
	O-692	1 and 2	Lithium Base	Down to -40°F (-40°C)
	O-645	2	Synthetic Oil, Clay Base	Down to -65°F (-54°C)
Clevis Pins	Any of Above	See Above	See Above	See Above
	O-637	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

*Do not mix Meritor grease specification O-637 (part number 2297-U-4571), a calcium-base, rust-preventive grease, with other greases.

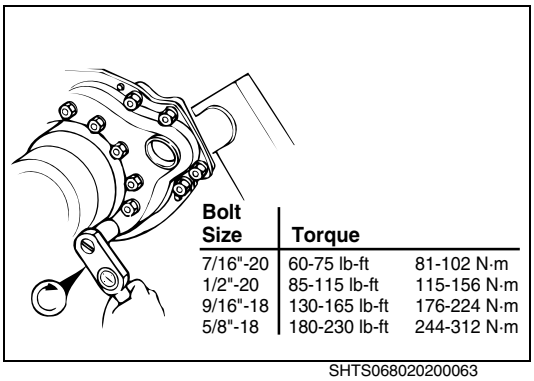
(2) Camshafts

NOTICE

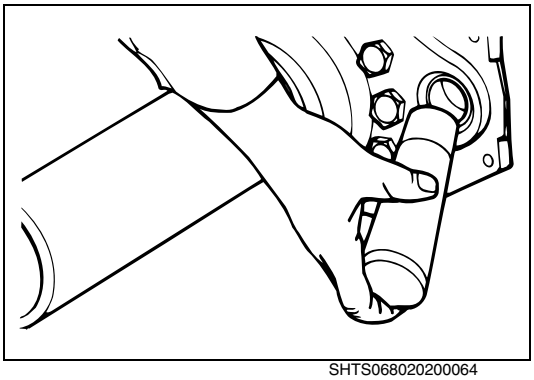
Install new camshaft bushings and seals whenever you install a new camshaft.

a. Tighten all spider bolts to the correct torque.

b. Use a seal driver to install new camshaft seals and new bushings into the cast spider and camshaft bracket.

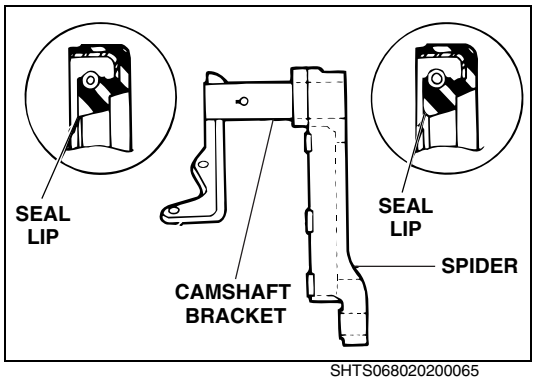


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- **If the brake has a stamped spider:** Install both bushings into the bracket. Install the seals with the seal lips toward the slack adjuster.

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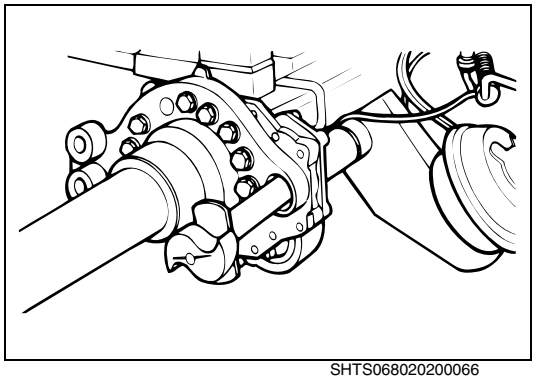
⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

⚠ WARNING
Do not use the straight-center bar shoe return spring with the Q Plus camshaft. The shoe spring can interfere with the camshaft and affect braking performance. Serious personal injury and damage to components can result.

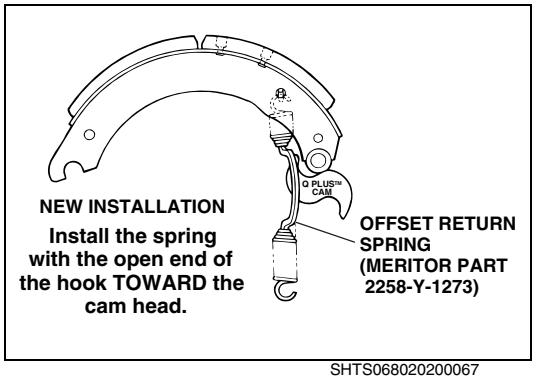
⚠ CAUTION
Only install a Q Plus camshaft in a Q Plus brake. A Q Series hammer-claw camshaft will not provide enough clearance between the brake shoe and the brake drum. Brake drag and damage to components can result.
To install a new brake drum so that it fits correctly over a Q Plus brake shoe, you must install a Q Plus camshaft to prevent damage to components.

5. INSTALLATION

(1) Camshaft
   a. Install the cam head thrust washer onto the camshaft. Apply Meritor specification O-617-A or O-617-B grease to the camshaft bushings and journals.
   b. Install the camshaft through the spider and bracket so that the camshaft turns freely by hand.


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(2) Shoe Return Spring
Install the new offset shoe return spring with the open end of the spring hooks toward the camshaft.



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(3) Automatic Slack Adjuster onto the Camshaft

a. Check the camshaft and bushings and seals for wear and corrosion. Turn the camshaft by hand to check for smooth operation. Repair or replace parts as required.

b. Apply the service brake and spring brake several times. Check that the chamber return spring retracts the push rod quickly and completely. If necessary, replace the return spring or the air chamber.

c. Verify that the new automatic slack adjuster is the same length as the one you are replacing. Refer to Table below.

Chamber and Automatic Slack Adjuster Sizes

Length of Slack Adjuster (Inches)	Size of Chamber (Square Inches)
5	9*, 12*, 16, 20, 24, 30
5-1/2	9*, 12*, 16, 20, 24, 30, 36
6	24, 30, 36
6-1/2	30, 36
* Use an auxiliary spring on slack adjusters used with these size chambers. A size 9 or 12 chamber return spring cannot supply enough spring tension to completely retract the slack adjuster.	

⚠ WARNING
Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

d. If the vehicle has spring brakes, follow the chamber manufacturer's instructions to compress and lock springs to completely release the brakes. Verify that no air pressure remains in the service chambers.

⚠ CAUTION
Most Meritor automatic slack adjusters manufactured after January 1990 have lubrication holes in the gear splines. Do not operate the actuator rod before you install the slack adjuster. Lubricant can pump through the holes and onto the splines. Damage to components can result.

e. If the automatic slack adjuster gear has a 10-tooth spline, apply Meritor specification O-637 (part number 2297-U-4571) anti-seize compound, or equivalent. This specification is a corrosion-control grease. Do not mix this grease with other greases.

NOTICE
Install the slack adjuster so that you can remove a conventional pawl or disengage a pull pawl when you adjust the brake.

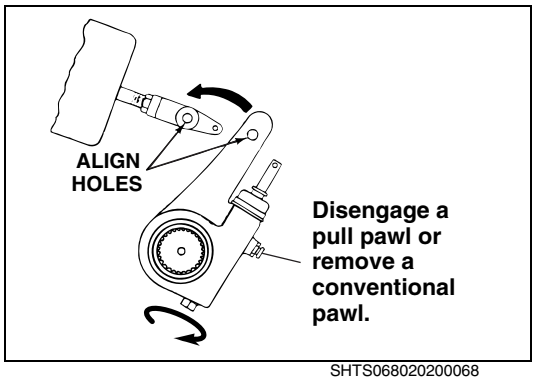
f. Install the slack adjuster onto the camshaft. Position the slack adjuster so that you can access the pawl when you adjust the brake.

g. Verify that camshaft axial end play is 0.005-0.060-inch (0.127-1.52 mm).

- **If axial end play exceeds 0.060-inch (1.52 mm):** Remove the snap ring. Add an appropriate number of spacing washers to achieve the correct specification.

h. Install the clevis onto the push rod.

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⚠ CAUTION
You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

i. Disengage the pull pawl or remove a conventional pawl. Turn the manual adjusting nut to align the holes in the slack adjuster arm and clevis.

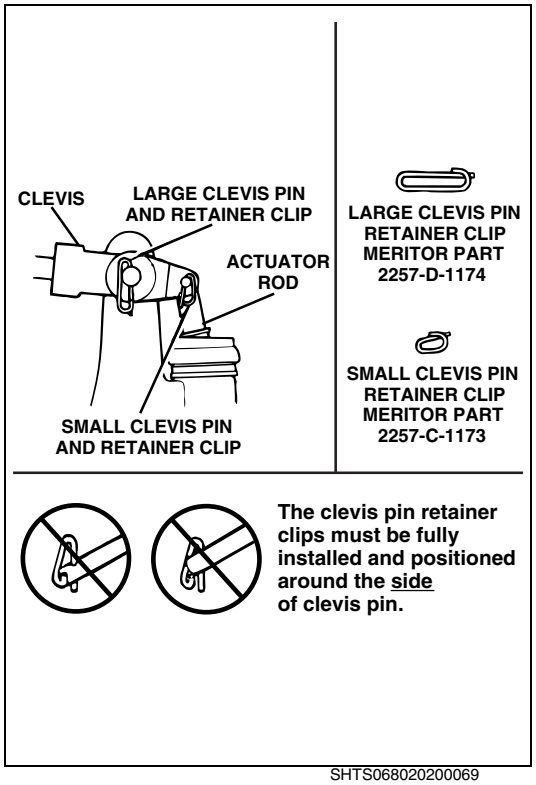
(4) Welded Clevis

a. Check the clevis position. Apply Meritor specification O-637 (part number 2297-U-4571) anti-seize compound or equivalent to the large and small clevis pins. This specification is a corrosion-control grease. Do not mix this grease with other greases.

⚠ CAUTION
Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or chamber. Do not reuse retainer clips. Discard used clips. When you remove a retainer clip, it can bend or "gap apart" and lose retention. Damage to components can result.

NOTICE
Meritor recommends that you replace cotter pins with clevis retainer clips at assembly.

b. Install new clevis pin retainer clips or cotter pins to secure the clevis pins. Retainer clips must be fully installed and positioned around the side of the clevis pin.



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(5) Threaded Clevis

Adjust the Clevis Position on the Chamber Push Rod

Automatic Slack Adjuster Template Method for Standard Stroke Chambers Only

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⚠ WARNING

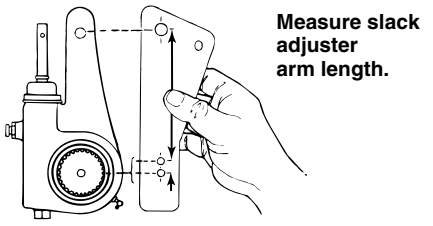
- **Meritor provides a slack adjuster template for truck and tractor, trailer, and coach drum brakes. These templates are not interchangeable. You must use the correct template when you install the clevis.**
- **If you use the wrong template, the automatic slack adjuster will not adjust the brakes correctly. Under-adjustment can increase stopping distances. Over-adjustment can cause the linings to drag. Serious personal injury and damage to components can result.**

a. Install the large clevis pin through the large clevis pin hole in the correct slack adjuster template for the drum brake you're servicing.

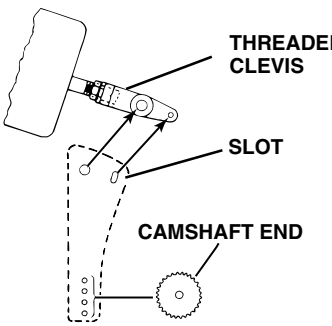
b. Select the hole at the small end of the template that matches the slack adjuster arm length. Position and hold the hole on the center of the camshaft.



Color of Template	Part Number	Applications
Dark brown	TP-4786	Truck or tractor drum brake
Tan	TP-4787	Trailer drum brake
White	TP-4781	Coach drum brake



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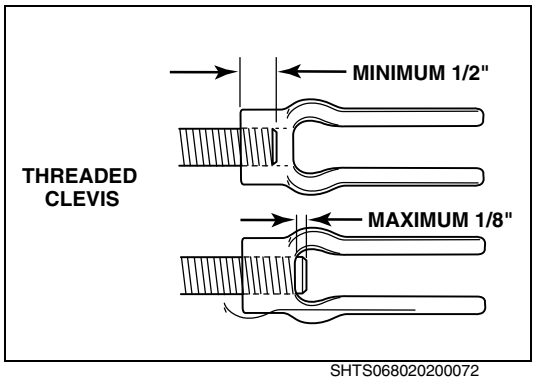


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c. Look through the small clevis pin slot on the template to see if the small clevis hole completely aligns within the slot.

- **If the small clevis hole doesn't align within the slot:** Adjust the clevis until you can see the small clevis pin hole within the slot.

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d. Verify that thread engagement between the clevis and push rod is 1/2-5/8-inch (12.7-15.9 mm).

e. Verify that the push rod does not extend through the clevis more than 1/8-inch (12.7 mm).

- **If the push rod extends through the clevis more than 1/8-inch (12.7 mm):** Cut the push rod, or install a new air chamber and push rod.

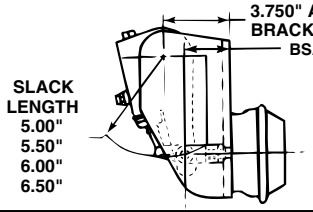
f. Tighten the jam nut against the clevis to the torque specification.

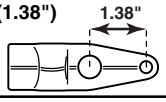
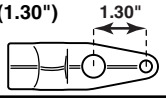
Jam Nut Torque Specifications

Threads	Torque
1/2-20	20-30 lb-ft (27-41 N·m)
5/8-18	35-50 lb-ft (48-68 N·m)

(6) **Brake Slack Adjuster Position (BSAP) Method for Standard Stroke and Long Stroke Chambers**

When you install the slack adjuster, verify that the BSAP chamber dimension matches the table in figure.

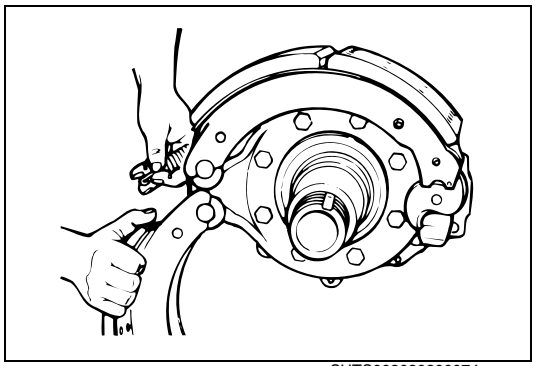


Slack Adjuster Size	Standard Stroke Chamber Clevis (1.38") 	Long Stroke Chamber Clevis (1.30") 
5.00"	2.75"	2.25"
5.50"	2.75"	2.25"
6.00"	2.75"	2.25"
6.50"	2.62"	2.25"

±0.125" Tolerance. You must use the correct clevis with the correct chamber type.

Correct positions of the automatic slack adjuster are 3.750-inch and 3.812-inch offsets only. For other bracket offsets, refer to the vehicle manufacturer's specifications.

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(7) Brake Shoes

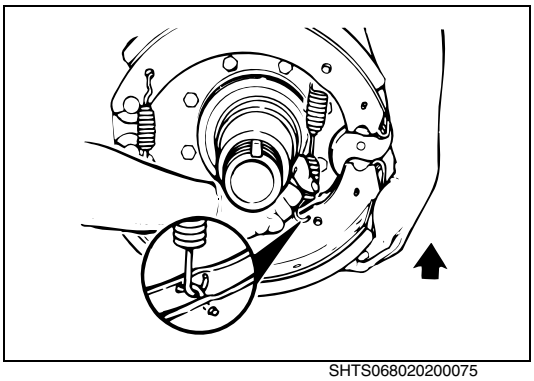
NOTICE

Meritor recommends that you replace springs, rollers, anchor pins and cam bushings at each reline.

Q Plus and Q Series 16.5-Inch Brakes

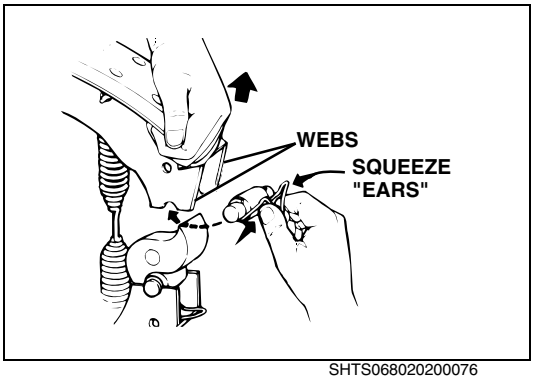
a. Place the upper brake shoe into position on the top anchor pin. Hold the lower brake shoe on the bottom anchor pin. Install two new brake shoe retaining springs.

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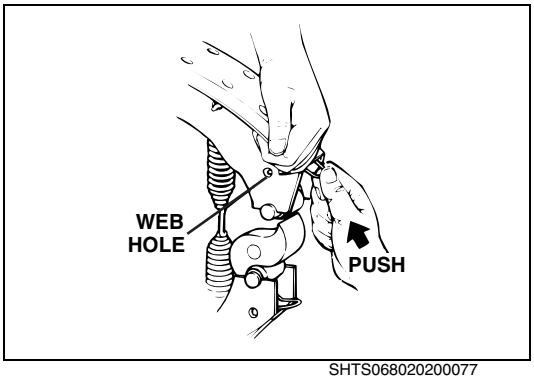
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b. Rotate the lower brake shoe forward. Install a new brake shoe return spring with the open end of the spring hooks toward the camshaft.



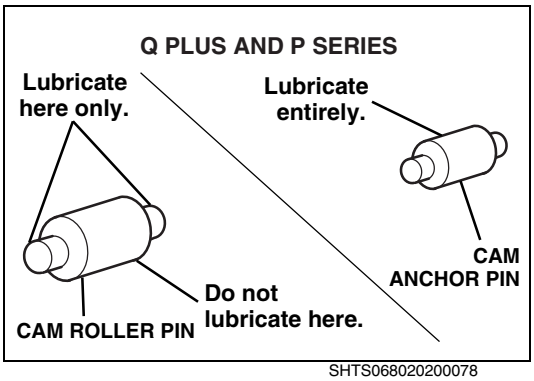
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c. Pull each brake shoe away from the camshaft to enable you to install the camshaft roller and roller retainer. Press the retainer "ears" to fit into the retainer between the brake shoe webs.



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d. Push the camshaft roller retainer into the brake shoe until the "ears" lock into the shoe web holes.



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e. Use Meritor specification grease O-617-A or O-617-B to lubricate the camshaft roller pin and anchor pin.

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Cam Brake Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
• Retainer Clips • Anchor Pins • Rollers (Journals Only) • Camshaft Bushings	O-616-A	1	Clay Base	Down to -40°F (-40°C)
	O-617-A or O-617-B	1 2	Lithium 12-Hydroxy Stearate or Lithium Complex	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-645	2	Synthetic Oil, Clay Base	Down to -65°F (-54°C)
	O-692	1 and 2	Lithium Base	Down to -40°F (-40°C)
Camshaft Splines	Any of Above	See Above	See Above	See Above
	O-637*	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

*Do not mix Meritor grease specification O-637 (part number 2297-U-4571), a calcium-base, rust-preventive grease, with other greases.

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6. ADJUST THE BRAKES

When you perform preventive maintenance procedures on an in-service brake, check both the free stroke and adjusted chamber stroke. Refer to Commercial Vehicle Safety Alliance (CVSA) Guidelines to Measure Push Rod Travel (Adjusted Chamber Stroke) in this section.

Free stroke sets the clearance between the linings and drum. The in-service free stroke may be slightly longer than 1/2-5.8-inch (12.7-15.9 mm) specified in this procedure. This is not a concern if the adjusted chamber stroke is within the limits shown in Table on page BR02-82.

(1) Measure Free Stroke

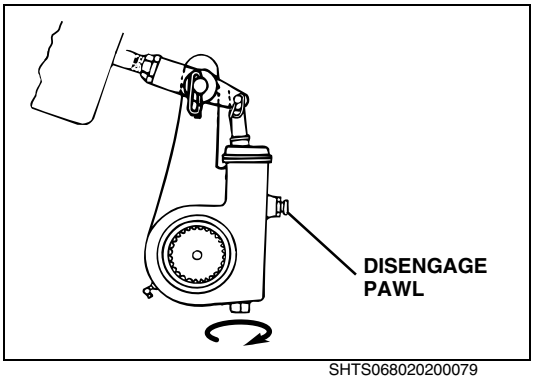
⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

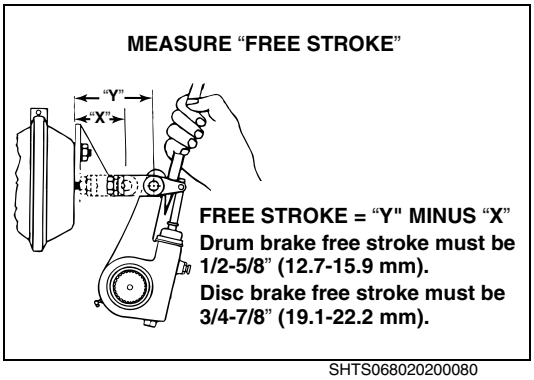
a. Disengage a pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch to disengage the teeth.

- **If the slack adjuster has a conventional pawl:** Remove the pawl.

b. Use a wrench to turn the manual adjusting nut COUNTERCLOCKWISE until the brake shoes are fully retracted, and the lining clears the drum. Then back-off the adjusting nut one-half turn in the opposite direction.



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c. Measure the distance from the center of the large clevis pin to the bottom of the air chamber while the brake is released. The measurement you obtain is "X" in figure.

d. Use a pry bar to move the slack adjuster and position the linings against the drum (brakes applied). Measure the same distance again while the brakes are applied. The measurement you obtain is "Y" in figure.

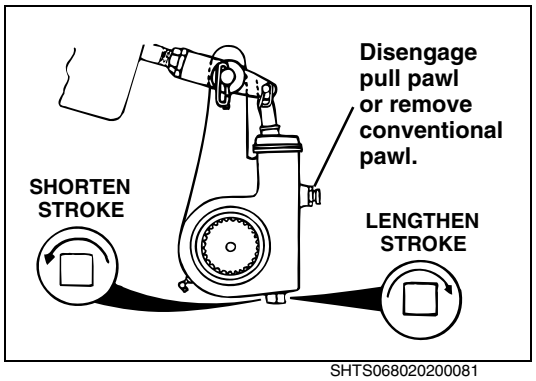
⚠ CAUTION

Do not set free stroke shorter than 1/2-5/8-inch (12.7-15.9 mm) for drum brakes. If the measurement is too short, linings can drag. Damage to components can result.

e. Subtract "X" from "Y" to obtain the in-service free stroke. The measurement must be 1/2-5/8-inch (12.7-15.9 mm) for drum brakes.

- **If the free stroke measurement is not within specification:** Turn the adjusting nut COUNTERCLOCKWISE 1/8 turn to adjust free stroke. Follow the steps above to check free stroke again, until the measurement is within specification.

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f. Re-engage the pull pawl by removing the screwdriver or equivalent tool. The pull pawl will re-engage automatically.

- **If the slack adjuster has a conventional pawl:** Install the pawl assembly into the housing. Tighten the capscrew to 12-17 lb-ft (16-23 N·m).

g. If the brakes have spring chambers, carefully release the springs. Test the vehicle before you return it to service.

7. COMMERCIAL VEHICLE SAFETY ALLIANCE (CVSA) GUIDELINES

(1) Measure Push Rod Travel (Adjusted Chamber Stroke)

Use the following procedure to check in-service push rod travel (adjusted chamber stroke) on truck and tractor brakes.

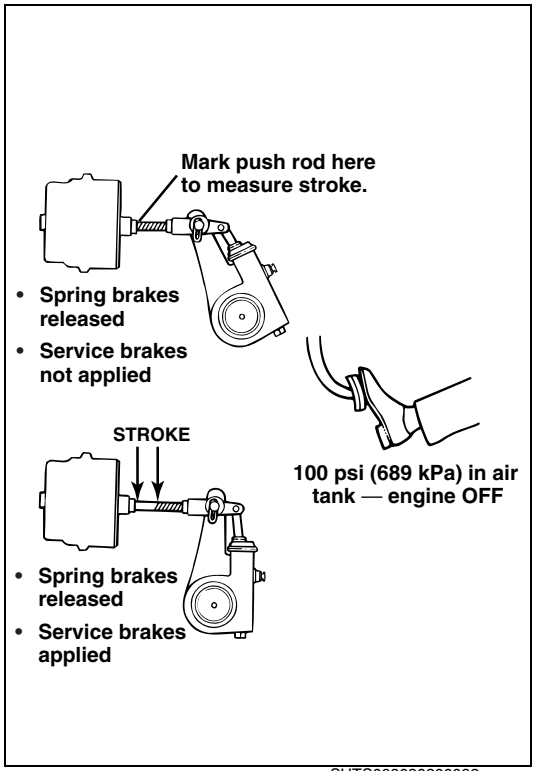
NOTICE

Hold the ruler parallel to the push rod and measure as carefully as possible. A measurement error can affect CVSA re-adjustment limits. CVSA states that "any brake 1/4-inch or more past the re-adjustment limit, or any two brakes less than 1/4-inch beyond the re-adjustment limit, will be cause for rejection."

a. The engine must be OFF. If the brake has a spring chamber, follow the manufacturer's instructions to release the spring. Verify that no air pressure remains in the service section of the chamber.

b. Verify that pressure is 100 psi (689 kPa) in the air tanks. Determine the size and type of brake chambers on the vehicle.

c. With the brakes released, mark the push rod where it exits the chamber. Measure and record the distance. Have another person apply and hold the brakes on full application.



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d. Measure push rod travel (adjusted chamber stroke) from where the push rod exits the brake chamber to your mark on the push rod. Measure and record the distance.

e. Subtract the measurement you recorded in Step c. from the measurement you recorded in Step d. The difference is push rod travel (adjusted chamber stroke).

f. Refer to Table on page BR02-82 to verify that the stroke length is correct for the size and type of air chambers on the vehicle.

- **If push rod travel (adjusted chamber stroke) is greater than the maximum stroke shown in on page BR02-82:** Inspect the slack adjuster and replace it, if necessary.

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"Standard Stroke" Clamp-Type Brake Chamber Data

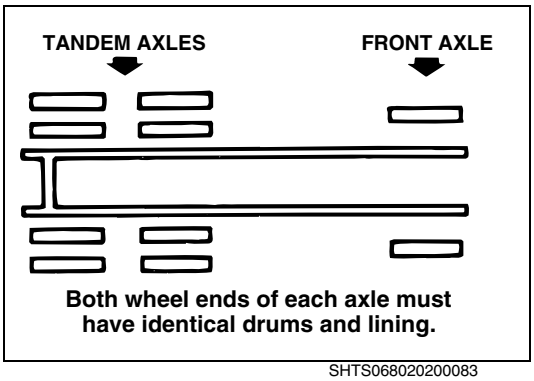
Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)	
6	4-1/2	1-1/4	As short as possible without lining to drum contact
9	5-1/4	1-3/8	
12	5-4/16	1-3/8	
16	6-3/8	1-3/4	
20	6-25/32	1-3/4	
24	7-7/32	1-3/4	
30	8-3/32	2	
36	9	2-1/4	

"Long Stroke" Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)	
16	6-3/8	2.0	As short as possible without lining to drum contact
20	6-25/32	2.0	
24	7-7/32	2.0	
24*	7-7/32	2.5	
30	8-3/32	2.5	
* For 3" maximum stroke type 24 chambers.			

(2) Alternate Method to Measure Push Rod Travel (Adjusted Chamber Stroke)
Use the CVSA procedure, except in Steps c and d, measure the distance from the bottom of the air chamber to the center of the large clevis pin on each of the brakes.

(3) CVSA North American Out-of-Service Criteria Reference Tables
Information contained in the following tables is for reference only. Consult the CVSA's Out-of-Service Criteria Handbook for North American Standards, Appendix A. Visit their website at http://64.35.82.7/ to order the handbook.



Both wheel ends of each axle must have identical drums and lining.

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8. IMPORTANT INFORMATION ON LININGS AND PRIMARY SHOE LOCATIONS

(1) Use the Correct Lining Material
Use the lining material specified by the vehicle manufacturer. This will help to ensure that the brakes perform correctly and meet Department of Transportation (DOT) performance regulations.

Also note that the drums and linings on a front axle can be different than drums and linings on a rear axle.

(2) Single Axles
Always reline both wheels of a single axle at the same time.

Always install the same linings and drums on both wheels of a single axle.

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(3) Combination Friction Linings

⚠ CAUTION
When you install combination friction linings, you must install the primary lining on the primary brake shoe. If you install combination friction linings incorrectly, damage to components will result. Carefully follow instructions included with the replacement linings.

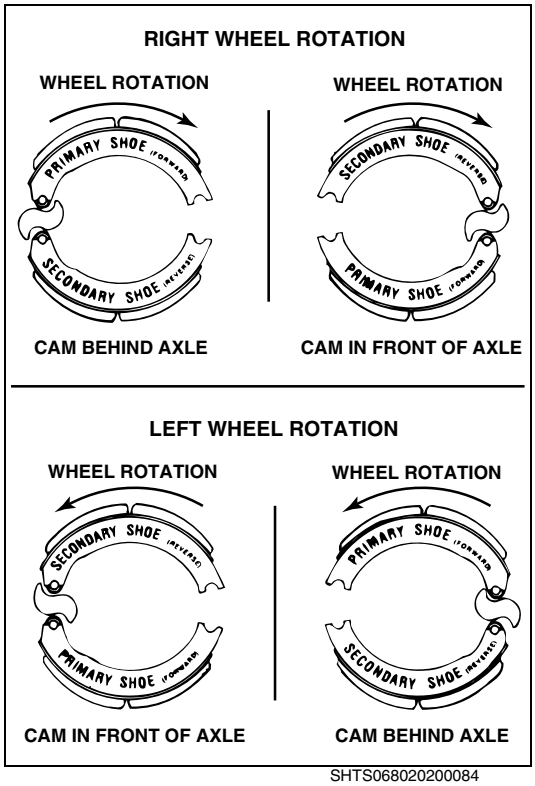
You can combine brake linings, which means that the linings you install on the primary shoe will have a different friction rating than the linings you install on the secondary shoe.

However, you must install the primary lining on the primary shoe. Carefully follow the instructions included with the replacement combination linings.

(4) Primary Shoe Locations
The first shoe past the camshaft in the direction of wheel rotation is the primary shoe. The primary shoe can be either at the top or bottom position, depending on the location of the camshaft.

If the camshaft is behind the axle, the top shoe is the primary shoe.

If the cam is in front of the axle, the top shoe is the primary shoe.

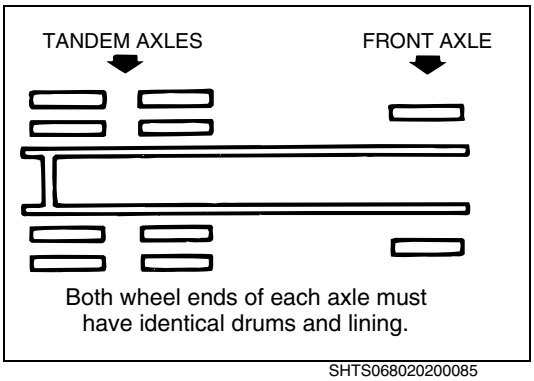


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9. BEFORE YOU RETURN THE VEHICLE TO SERVICE

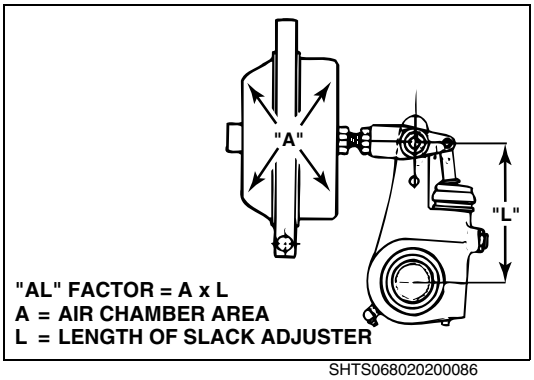
(1) Check the complete air system for worn hoses and connectors. With air pressure at 100 psi (689 kPa), brakes released and engine off, loss of tractor air pressure must not exceed two psi a minute. Total tractor and trailer loss must not exceed three psi per minute.
(2) Check to see that the air compressor drive belt is tight. Air system pressure must rise to approximately 100 psi (689 kPa) in two minutes.
(3) The governor must be checked and set to the specifications supplied by the vehicle manufacturer.
(4) Both the tractor and trailer air systems must match the specifications supplied by the vehicle manufacturer.

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Both wheel ends of each axle must have identical drums and lining.

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(5) Both wheel ends of each axle must have the same linings and drums. All four wheel ends of tandem axles also must have the same linings and drums. It is not necessary for the front axle brakes to be the same as the rear driving axle brakes.

(6) Always follow the specifications supplied by the vehicle manufacturer for the correct lining to be used. Vehicle brake systems must have the correct friction material and these requirements can change from vehicle to vehicle.

(7) The return springs must retract the shoes completely when the brakes are released. Replace the return springs each time the brakes are relined. The spring brakes must retract completely when they are released.

(8) The air chamber area multiplied by the length of the automatic slack adjuster is called the "AL" factor. This number must be equal for both ends of a single axle and all four ends of a tandem axle.

INSPECTION AND REPAIR

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1. INSPECT PARTS

(1) Check the spider for expanded anchor pin holes and for cracks. Replace damaged spiders and anchor pin bushings.

(2) Check the camshaft bracket for broken welds, cracks and correct alignment. Replace damaged brackets.

(3) Check anchor pins for corrosion and wear. Replace worn or damaged anchor pins.

(4) Check brake shoes for rust, expanded rivet holes, broken welds and correct alignment. Replace a shoe with any of the above conditions.

2. 16.5-INCH BRAKE SHOES ONLY

Anchor pin holes must not exceed 1.009-inches (25.63 mm) in diameter. The distance from the center of the anchor pin hole to the center of the roller hole must not exceed 12.779-inches (32.46 cm). Replace brake shoes with measurements that do not meet specifications.

(1) Check the camshaft for cracks, wear and corrosion. Check the cam head, bearing journals and splines. Replace worn or damaged camshafts.

(2) Inspect the large and small clevis pins for wear or damage. Replace worn or damaged parts.

⚠ CAUTION

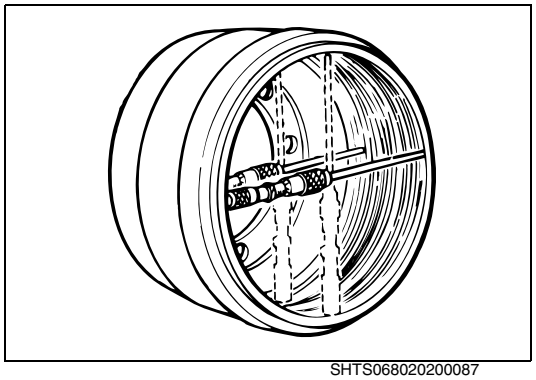
Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or chamber. Do not reuse retainer clips. Discard used clips. When you remove a retainer clip, it can bend or "gap apart" and lose retention. damage to components can result.

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NOTICE
If you remove cotter pins from a slack adjuster during maintenance and service procedures, Meritor recommends that you install clevis pin retainer clips at assembly.

(3) Inspect clevis pin retainer clips or cotter pins for wear or damage. Replace worn or damaged retainer clips or cotter pins. Do not reuse clevis pin retainer clips. Always replace used retainer clips with new ones. Discard used clips.

⚠ WARNING
Do not operate the vehicle with the brake drum worn or machined beyond the discard dimension indicated on the drum. The brake system may not operate correctly and damage to components and serious personal injury can result.


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(4) Use the following procedure to inspect the brake drums.
   a. Check the brake drums for cracks, severe heat checking, heat spotting, scoring, pitting and distortion. Replace drums as required. Do not turn or rebore brake drums, which decreases the strength and heat capacity of the drum.
   b. Measure the inside diameter of the drum in several locations with a drum caliper or internal micrometer. Replace the drum if the diameter exceeds the specifications supplied by the drum manufacturer.

(5) Check dust shields for wear and damage. Repair or replace worn or damaged parts as necessary.

3. RELINE THE BRAKES

⚠ CAUTION
Reline the brakes when the lining thickness is 0.25-inch (6.3 mm) at the thinnest point. The rivets or bolts must not touch the drum. Damage to components will result.

Meritor recommends that you replace springs, rollers, camshaft bushings and anchor pins at each reline.

Reline the brake when the lining thickness is 0.25-inch (6.3 mm) at the thinnest point.

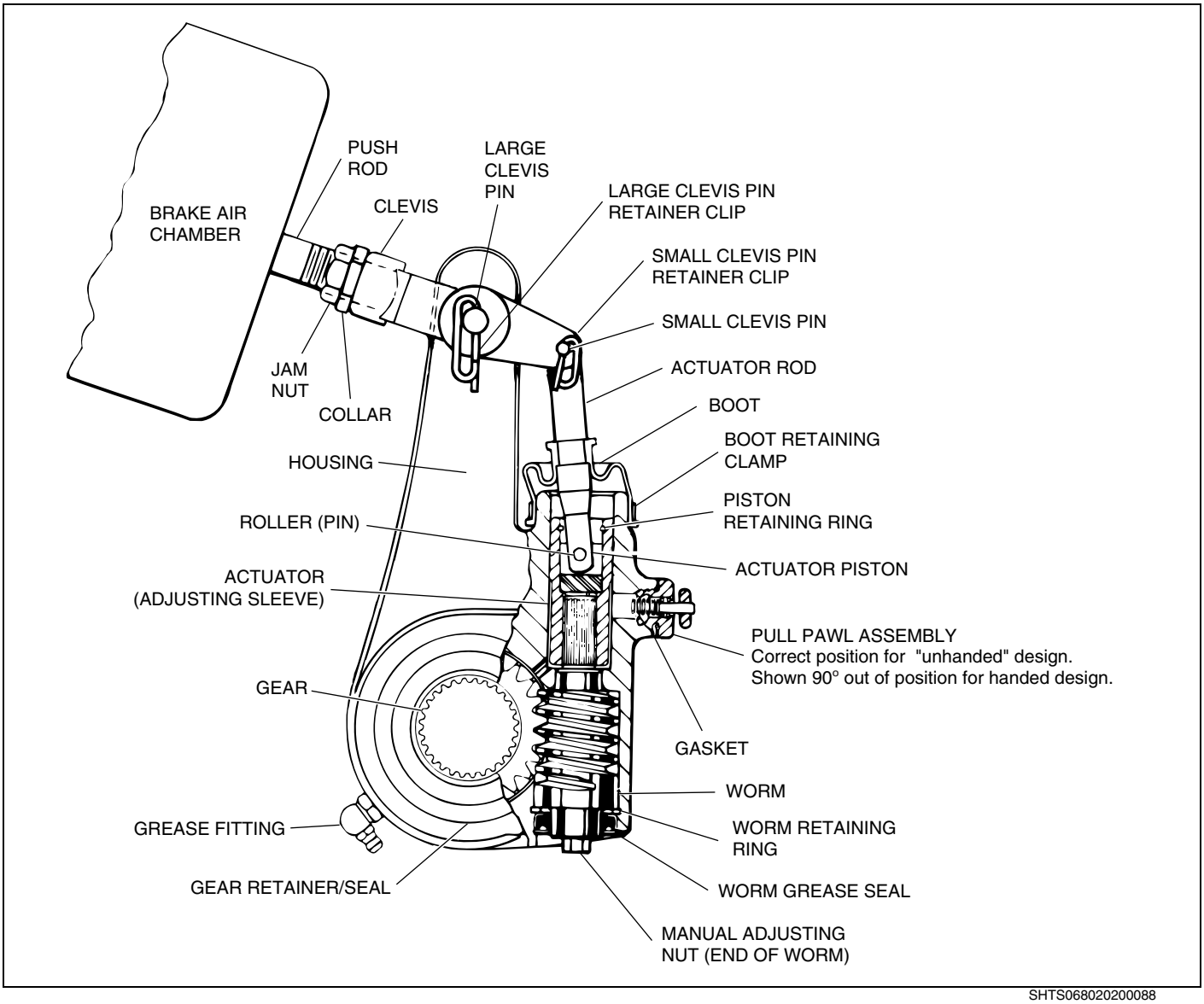
Replace shoe retainer springs, check the drum, and perform a major inspection when you reline the brakes.

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AUTOMATIC SLACK ADJUSTER

DESCRIPTION

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DIAGNOSTICS

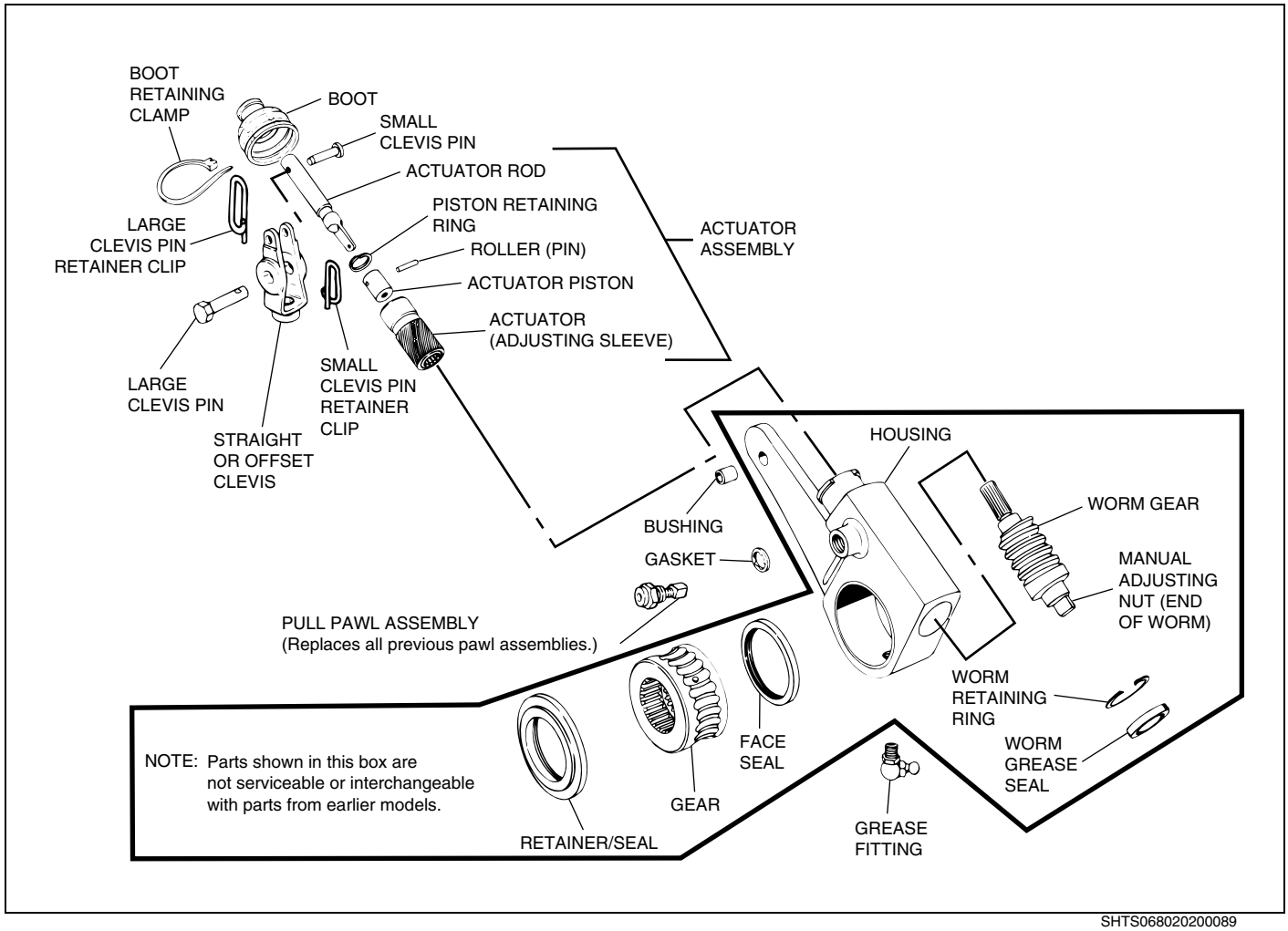
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Symptom	Possible Causes	Corrective Actions
Adjusted stroke is too long. No adjustment.	The slack adjuster part number is incorrect.	Check with WD or OEM.
	The clevis angle is incorrect.	Use correct template or BSAP setting to install clevis correctly.
	Excessive wear exists between the clevis and collar (more than 0.060" [1.52 mm]).	Replace with threaded clevis.
	The jam nut at the clevis is loose.	Tighten to specification.
	There is a worn clevis pin bushing in slack arm (ID larger than 0.53" [13.46 mm]).	Replace bushing.
	There is a weak or damaged air chamber spring. Spring force must be at least 32 lb (142.4 N) at first push rod movement.	Replace return spring or air chamber.
	The spring brake does not retract fully.	Repair or replace spring brake.
	There are worn or damaged teeth on the pawl or actuator.	Replace pawl or actuator.
	High torque is required to rotate worm when slack is removed from vehicle. In service slack maximum worm torque: 45 lb-in (5.09 N·m) New or rebuilt slack maximum worm torque: 25 lb-in (2.83 N·m)	Rebuild or replace slack adjuster.
	Excessive looseness exists between the splines of the camshaft and the slack adjuster gear.	Replace powershaft, gear or automatic slack adjuster as needed.
	A cam brake has worn components (cam bushing, for example).	Replace components.
Adjusted stroke is too short. Linings drag.	OEM replacement linings are not installed. Linings exhibit excessive swell or growth.	Use Meritor-approved linings.
	The slack adjuster part number is incorrect.	Check with WD or OEM.
	The clevis angle is incorrect.	Use correct template to install clevis correctly.
	The jam nut at the clevis is loose.	Tighten to specification.
	The spring brake does not retract fully.	Repair or replace spring brake.
	The manual adjustment is incorrect.	Adjust brake.
	Poor contact exists between the linings and the drum. The drum is out-of-round.	Repair or replace drums or linings.
	Brake temperature is not even.	Correct brake balance.

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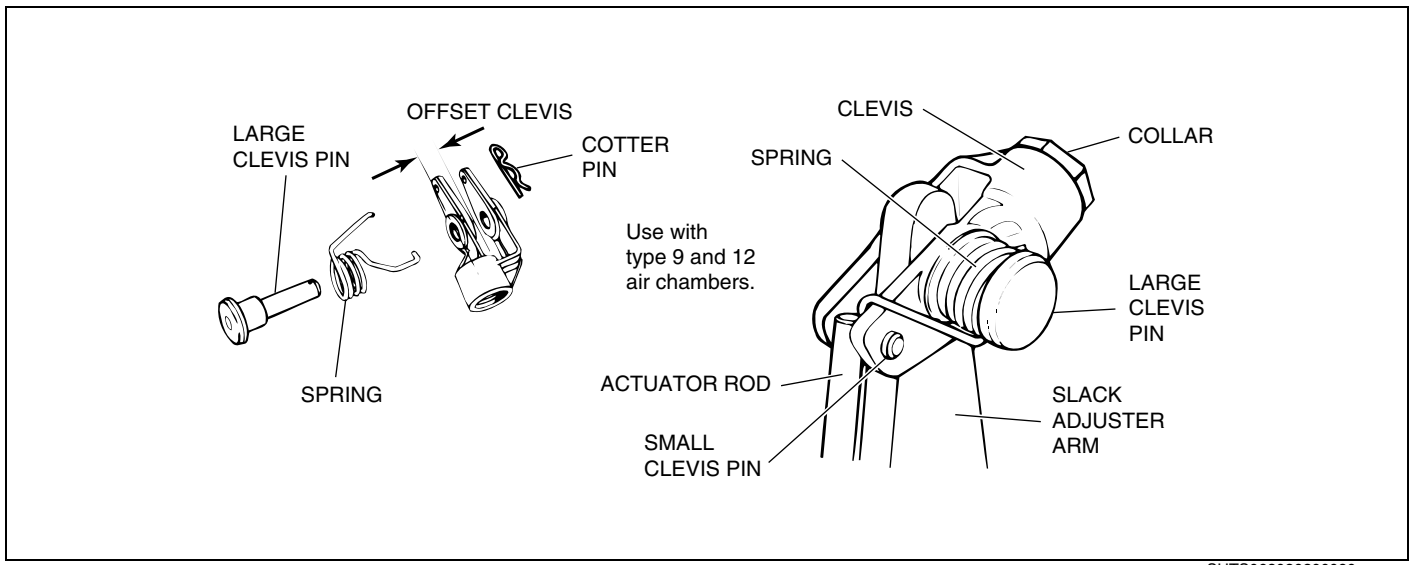
COMPONENT LOCATOR

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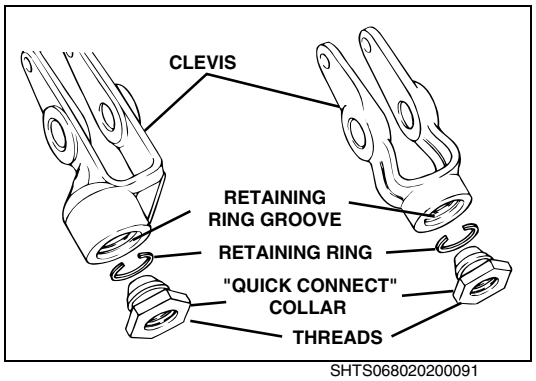
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OFFSET CLEVIS FOR FRONT AXLE SLACK ADJUSTER



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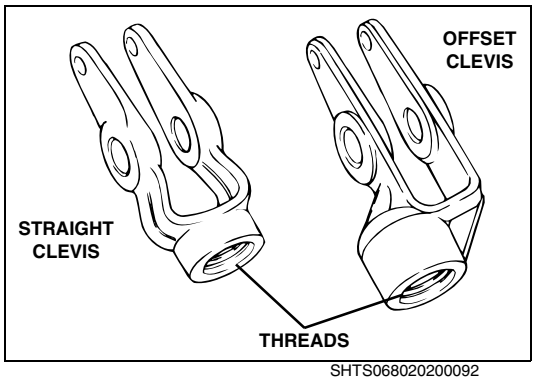


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1. "QUICK CONNECT" CLEVIS

Some models of Meritor's automatic slack adjuster have a "Quick Connect" clevis.

- A "Quick Connect" clevis is a three-piece assembly that cannot be separated after it is assembled.
- The collar has a threaded hole for the push rod.
- A "Quick Connect" clevis can be straight or offset. Use an offset clevis when more clearance is necessary between the air chamber and the tire on the front axle.



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2. ONE-PIECE THREADED CLEVIS

Most of Meritor's automatic slack adjusters, including the factory-installed slack adjusters on the new Q Plus™ LX500 and MX500 cam brakes, have a one-piece threaded clevis.

- The clevis has a threaded hole for the push rod.
- The one-piece threaded clevis can be straight or offset.
- All service replacement automatic slack adjusters have one-piece threaded clevises.

This publication provides maintenance and service procedures for Meritor's automatic slack adjuster. The information contained in this publication was current at the time of printing and is subject to revision without notice or liability.

(1) You must understand all procedures and instructions before you begin maintenance and service procedures.
(2) You must follow your company's maintenance and service guidelines.
(3) You must use special tools, when required, to avoid serious personal injury and damage to components.

Meritor uses the following notations to alert the user of possible safety issues and to provide information that will help to prevent damage to equipment and components.

⚠ **WARNING**	**A WARNING indicates a procedure that you must follow exactly to avoid serious personal injury.**
⚠ **CAUTION**	A **CAUTION** indicates a procedure that you must follow exactly to avoid damaging equipment or components. Serious personal injury can also occur.
NOTICE	A **NOTICE** indicates an operation, procedure or instruction that is important for proper service. A **NOTICE** can also supply information that will help to make service quicker and easier.

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OVERHAUL

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⚠ WARNING

- **ArvinMeritor Automatic Slack Adjusters (ASA's) should not need to be manually adjusted in service. ASA's should not have to be adjusted to correct excessive pushrod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.**
- **ArvinMeritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.**
- **In the event that a manual adjustment must be made (although should not be a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.**

IMPORTANT POINTS-DISASSEMBLY

1. REMOVAL

⚠ WARNING

- **To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.**
- **When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.**
- **Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.**

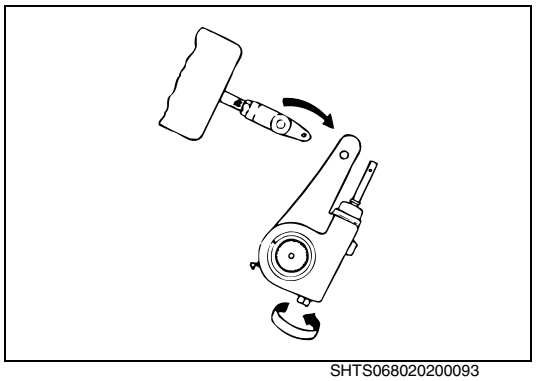
(1) If the brake has a spring brake, compress and lock the spring, so that the brake is released completely. Check that no air pressure remains in the service half of the air chamber.
(2) If it is necessary to raise the vehicle, use a jack and support the vehicle with safety stands.

⚠ WARNING
When you remove a clevis pin that has a spring, hold the spring with pliers. The spring can disengage from the clevis with enough force to cause serious personal injury.

(3) Remove both clevis pins.
(4) **Remove a conventional pawl or disengage a pull pawl:** Use a screwdriver or equivalent tool to lift the button of a pull pawl assembly at least 1/32-inch from the actuator.

⚠ CAUTION
You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

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(5) Use a wrench to turn the manual adjusting nut in the direction shown in figure. Move the slack adjuster away from the clevis.

(6) Remove the snap ring and washers from the camshaft. Remove the slack adjuster from the camshaft.

(7) Remove the clevis from the push rod if the gap between the clevis and the collar of a "Quick Connect" clevis exceeds 0.060-inch (1.52 mm). You do not have to remove the clevis if it is in good condition.

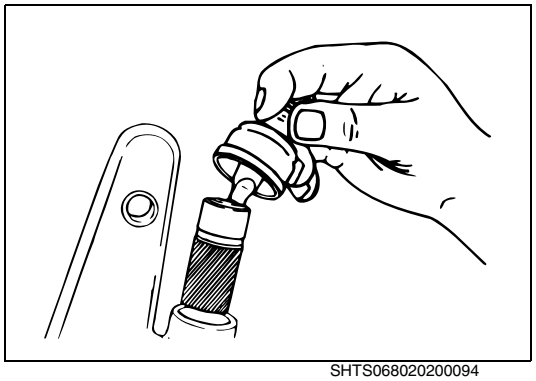
2. DISASSEMBLY

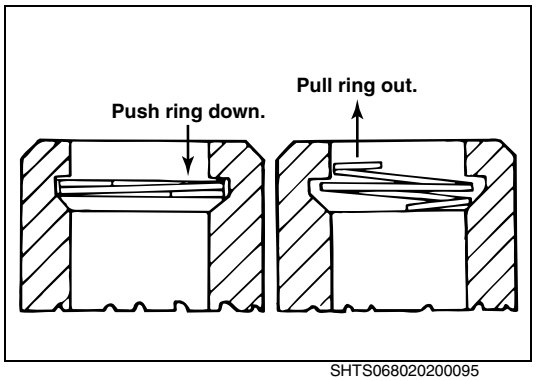
⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

(1) Cut the clamp and remove it from the boot.
Use a new clamp and boot when you assemble the slack adjuster.

(2) Remove the boot from the housing. Pull the actuator assembly from the housing.


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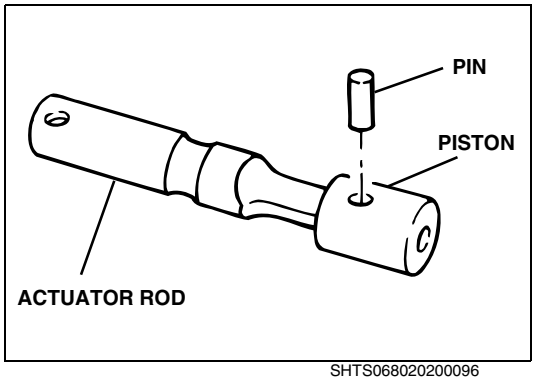
(3) Use a small screwdriver to push down on one side of the piston retaining ring to force the ring out of the groove.

(4) Extend the coils of the ring.

(5) Use pliers to unwind the ring and pull it out of the groove.

(6) Use a new ring when you assemble the slack adjuster.

(7) Pull the actuator rod, piston and pin from the actuator.



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(8) Remove the pin from the rod and piston, if necessary.

NOTICE

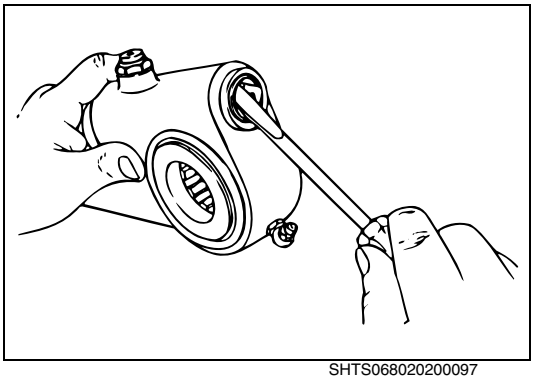
You do not have to remove the slack adjuster arm bushing unless it is worn or "egg-shaped."

(9) Inspect the condition and fit of the slack adjuster arm bushing.

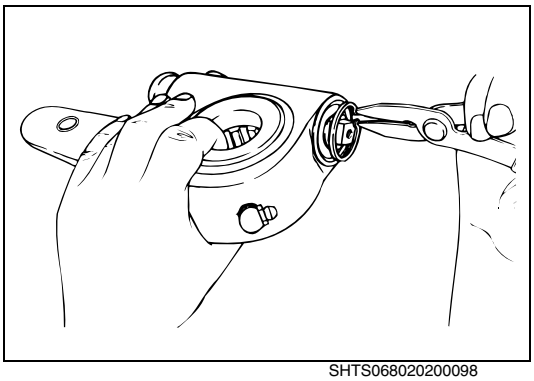
(10) If necessary, install a new bushing onto the clevis pin. Use the clevis pin and mallet to drive out the old bushing while you drive in the new bushing.

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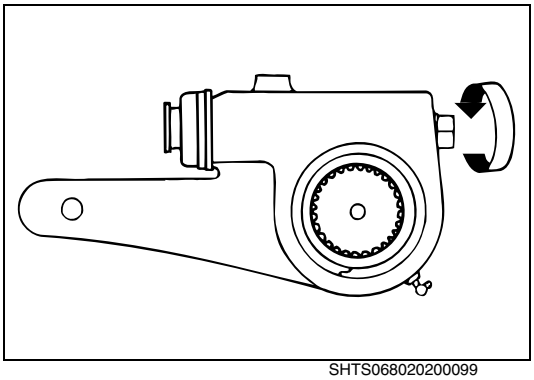
NOTICE
Steps (11) through (21) apply only to automatic slack adjusters manufactured BEFORE January 1993. The gear set and seals are not serviceable on automatic slack adjusters manufactured AFTER January 1993. Refer to the exploded views on pages (2) and (3) of this manual for more information.


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(11) Use a small screwdriver to remove the grease seal from around the worm bore.
Discard the seal. Use a new seal when you assemble the slack adjuster.

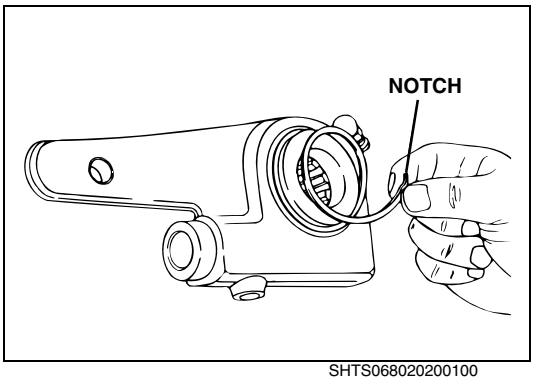

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(12) Use snap ring pliers to remove the retaining ring from the worm bore.


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(13) Use a wrench to turn the manual adjusting nut and wind the worm out of the bore.

(14) Remove the retaining rings and thrust washers from both sides of the gear.
(15) Fit a small screwdriver into the notch at the end of the retaining ring.
(16) Remove the end of the retaining ring from the groove.



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(17) Unwind the ring by hand and pull it out of the groove.

(18) Remove the thrust washer.

⚠ CAUTION
Push one seal out of one side of the slack adjuster housing and the other seal out of the other side of the housing to avoid damaging the seals.

(19) Push the gear out of the housing only far enough to enable you to remove one gear seal.
(20) Push the gear out of the opposite side of the housing and remove the other seal.
(21) Inspect the seals. Discard damaged seals.

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IMPORTANT POINTS-INSPECTION

1. PREPARE PARTS FOR ASSEMBLY

⚠ WARNING

- **To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.**
- **Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners and petroleum-based cleaners. To avoid serious personal injury when you use solvent cleaners, you must carefully follow the manufacturer's product instructions and these procedures:**

a. Wear safe eye protection.

b. Wear clothing that protects your skin.

c. Work in a well-ventilated area.

d. Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.

e. You must use hot solution tanks or alkaline solutions correctly. Follow the manufacturer's instructions carefully.

⚠ CAUTION

- **Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts will result.**
- **Only use solvent cleaners on metal parts. Damage to parts will result.**

2. CLEAN PARTS

(1) Use solvent cleaners to clean all automatic slack adjuster parts that have ground or polished surfaces; for example, the gear, the worm and the inner bores of the housing.
(2) Use soap and water to clean non-metal parts.
(3) Use soft paper or cloth that is free from dirt, oil or abrasives to dry the parts completely.

3. DRY PARTS AFTER CLEANING

Dry the parts immediately after cleaning. Dry parts with clean paper or rags, or compressed air.

4. INSPECT PARTS

(1) You must carefully inspect all slack adjuster parts, including pawl teeth, for wear and damage before you assemble the slack adjuster.
(2) Replace any part that is worn or damaged.

5. CORROSION PROTECTION

NOTICE

Parts must be clean and dry before you lubricate them.

(1) **If you assemble parts immediately after you clean them:** Lubricate parts with grease to prevent corrosion. Parts must be clean and dry before you lubricate them.
(2) **If you store parts after you clean them:** Apply a corrosion-preventive material. Store parts in a special paper or other material that prevents corrosion.

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6. AUTOMATIC SLACK ADJUSTERS

⚠ CAUTION
Always replace used clevis pin retainer clips with new ones when servicing the automatic slack adjuster or chamber. Do not reuse clevis pin retainer clips after removing them. Discard used clips. When removed for maintenance or service, clevis pin retainer clips can be bent or "gapped apart" and can lose retention. Damage to components can result.

Check the clevis pins and the bushing in the arm of the slack adjuster. Replace the pins if they are worn. Replace the bushing if its diameter exceeds 0.531-inch (13.5 mm).

IMPORTANT POINTS-ASSEMBLY

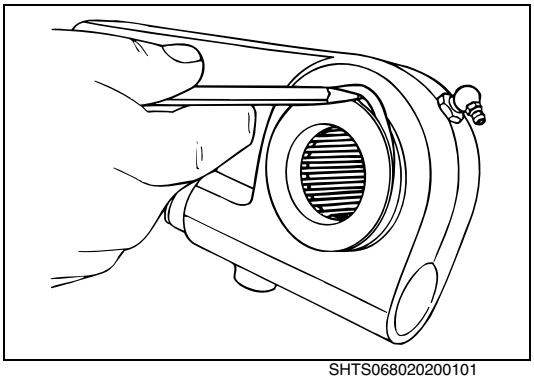
⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

NOTICE
Steps 3 through 11 apply only to automatic slack adjusters manufactured BEFORE January 1993. The gear set and seals are not serviceable on automatic slack adjusters manufactured AFTER January 1993. If you are working on a current model, skip to Step (10).

1. ASSEMBLY
(1) Remove any corrosion-preventive material that may have been applied to the parts you will assemble.
(2) Use grease to lubricate the gear bore in the housing.

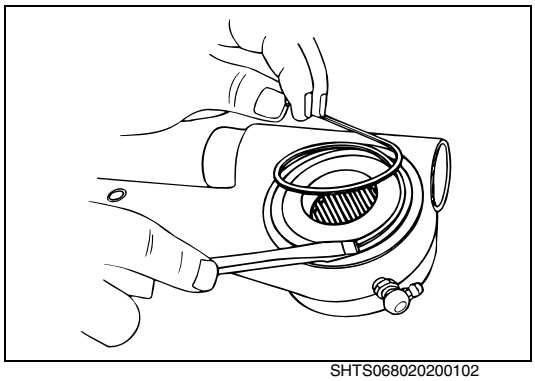
⚠ CAUTION
Follow Steps (3), (4) and (5) exactly when you install the seals so that the sharp edges of the worm bore will not damage the seals.

(3) Install the gear straight into the bore in the housing without the seals, keeping one seal groove outside of the housing.
(4) Install a seal into the groove.

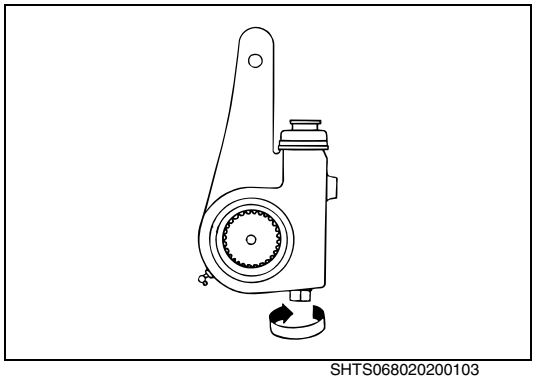

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(5) Lubricate the seal with grease that meets Meritor's specifications. Compress the seal in its groove. Push the gear into the housing.
(6) Push the gear out of the opposite side of the housing only until the other seal groove is visible. Repeat Steps (4) and (5) to install the second seal.
(7) Lubricate a thrust washer with grease that meets Meritor's specifications. Refer to page BR02-106. Install the washer around the gear.

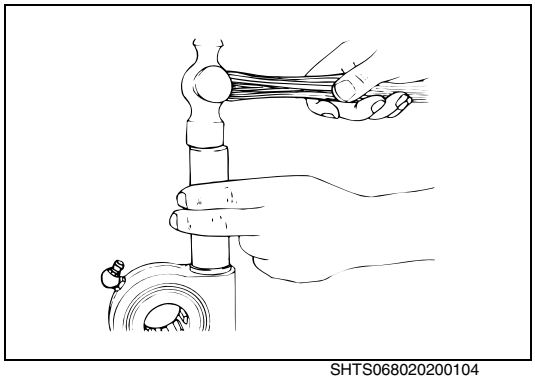
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(8) Expand the retaining ring coil. Install one end of the coil into the groove in the outer diameter of the gear. Work around the gear and press the coil into the groove.


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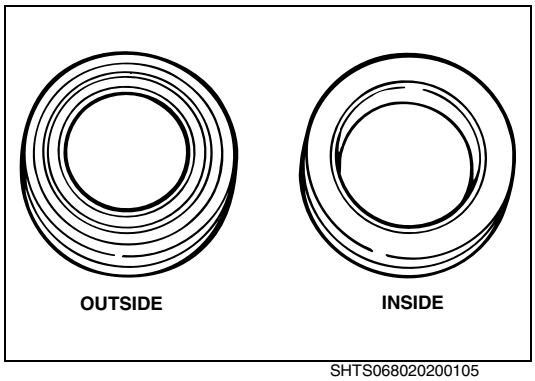
(9) Repeat Steps 7 and 8 for the opposite side of the gear.
(10) Install the worm into the bore. Turn the adjusting nut to wind the worm completely into the bore.


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(11) Use snap ring pliers to install the retaining ring into the worm bore.

⚠ CAUTION

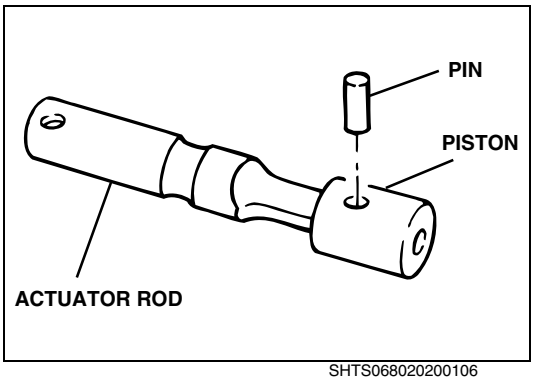
- **Install the seal with the lips OUTSIDE of the bore and the metal retainer INSIDE of the bore to prevent contamination from entering the slack adjuster housing. Damage to components can result.**
- **Do not hit the seal after it reaches the bottom of the bore. Damage to seal will result.**



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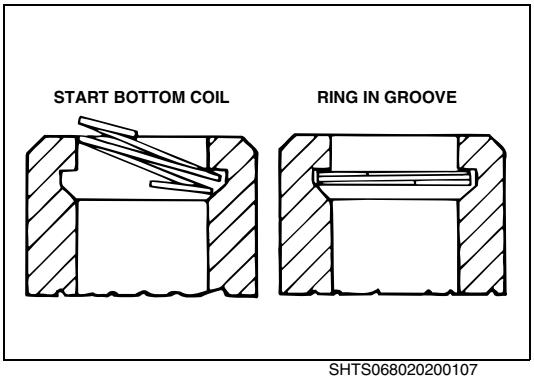
(12) Place the seal directly over the worm bore. Use a hammer and 1-3/16-inch (30.2 mm) diameter seal driver to install the seal straight into the bore.

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(13) If you removed the pin, install it into the rod and piston.
(14) Install the actuator rod and piston assembly into the actuator (adjusting sleeve).
(15) Slide the piston retaining ring over the rod.
(16) Extend the coils of the ring.



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(17) Use a small screwdriver to press one end of the ring into the groove.
(18) Keep the coil extended. Press on the ring and work around the groove until the ring is in the groove completely.
(19) Check to ensure that the ring is installed correctly in the groove. You cannot pull the piston out of the actuator if the retaining ring is installed correctly.
(20) Install the actuator assembly into the housing so that the actuator slides along the worm splines.
(21) Slip the boot over the actuator rod.

NOTICE
Do not seal the boot to the tapered part of the actuator rod.

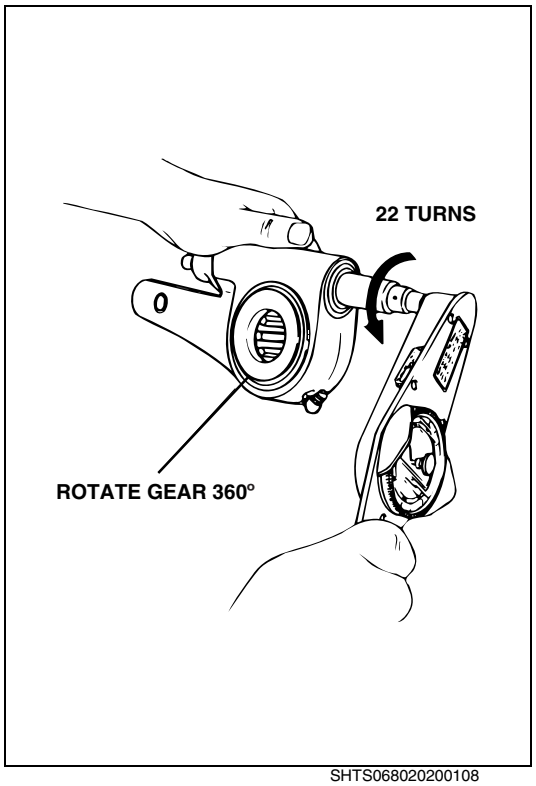
- **If the rod has a groove:** The top of the boot must fit into the groove.
- **If the rod does not have a groove:** Use silicone sealant to seal the top of the boot to the round part of the rod.

(22) Fasten the bottom of the boot to the housing with a retaining clamp.
(23) **Conventional Pawl:** Install the pawl assembly into the housing. Tighten the capscrew to a torque of 15-20 lb-ft (20-27 N·m).
(24) **Pull Pawl:** Remove the screwdriver or equivalent tool. The pull pawl will re-engage automatically.
(25) Use a grease gun to lubricate the slack adjuster through the grease fitting. If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.
(26) Apply lubrication that meets Meritor's specifications until new grease purges from around the camshaft splines and from the pawl assembly. Refer to page BR02-106.

⚠ CAUTION
In Step (28) turn the adjusting nut only in the direction shown in figure. If you turn the adjusting nut in the opposite direction while the pawl is installed, you will damage pawl teeth.
Damaged teeth prevent automatic adjustment.
Replace damaged pawls before putting the vehicle in service.

(27) Use a torque wrench that measures lb-in.

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(28) As you turn the adjusting nut in the direction shown in figure, read the torque scale and rotate the gear 360 degrees (22 turns of the wrench).

(29) The torque value must remain less than 25 lb-in (2.83 N·m) during the complete 360-degree rotation of the gear.

(30) **If the torque value remains less than 25 lb-in (2.8 N·m):** The slack adjuster is working correctly.

(31) **If the torque value exceeds 25 lb-in (2.8 N·m):** The slack adjuster is not working correctly.
Disassemble the slack adjuster.

- Check that the slack adjuster is assembled correctly.
- Check that parts are aligned correctly.

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INSTALLING THE SLACK ADJUSTER ONTO THE CAMSHAFT

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1. INSTALLATION

⚠ WARNING

- **To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.**
- **Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.**

(1) Check the camshaft and bushings and seals for wear and corrosion.
(2) Turn the camshaft by hand to check for smooth operation.
(3) Repair or replace parts as required.
(4) Apply the service brake and spring brake several times. Check that the chamber return spring retracts the push rod quickly and completely. If necessary, replace the return spring or the air chamber.
(5) The new automatic slack adjuster must be the same length as the one you are replacing.
Table below shows the length of slack adjuster that is used with each brake chamber size.

Chamber and Automatic Slack Adjuster Sizes

Length of Slack Adjuster (Inches)	Size of Chamber (Square Inches)
5	9*, 12*, 16, 20, 24, 30
5-1/2	9*, 12*, 16, 20, 24, 30, 36
6	24, 30, 36
6-1/2	30, 36
*Use an auxiliary spring on slack adjusters used with these size chambers. A size 9 or 12 chamber return spring cannot supply enough spring tension to completely retract the slack adjuster.	

(6) Place blocks in front of and behind the vehicle's wheels to prevent it from moving.

⚠ WARNING
When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

(7) If the brake has a spring brake, compress and lock the spring to completely release the brake. No air pressure must remain in the service half of the air chamber.

⚠ CAUTION
Most Meritor automatic slack adjusters manufactured after January 1990 have lubrication holes in the gear splines. Do not operate the actuator before you install the slack adjuster.
Lubricant can pump through the holes and onto the splines. Damage to components can result.

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(8) If the automatic slack adjuster gear has a 10-tooth spline, apply anti-seize compound to the slack adjuster and cam splines. Use Meritor specified O-637, Southwest SA 8249496 or equivalent lubricants.

NOTICE

Install the slack adjuster so that you can remove a conventional pawl or disengage a pull pawl when you adjust the brake.

(9) Install the slack adjuster onto the camshaft. Position the slack adjuster so that you can remove the pawl when you adjust the brake.
(10) If necessary, install spacing washers and the snap ring at a maximum clearance of 0.062-inch (1.57 mm).
(11) Install the clevis onto the push rod. Do not tighten the jam nut against the clevis.

⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

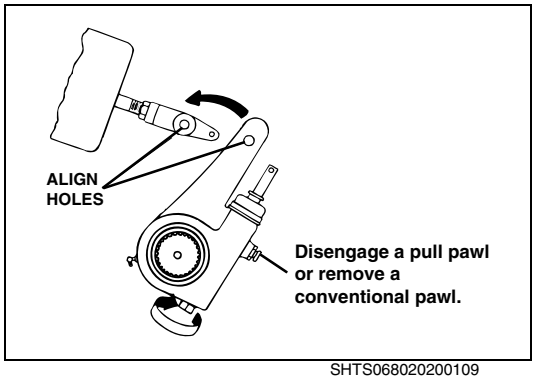
(12) Disengage the pawl. Turn the manual adjusting nut to align the holes in the slack adjuster arm and the clevis.

(13) **If the slack adjuster has a welded clevis:** Apply anti-seize compound to the two clevis pins.
Install the clevis pins through the clevis and the slack adjuster.
(14) **If the slack adjuster has a threaded clevis:** Refer to page BR02-100.

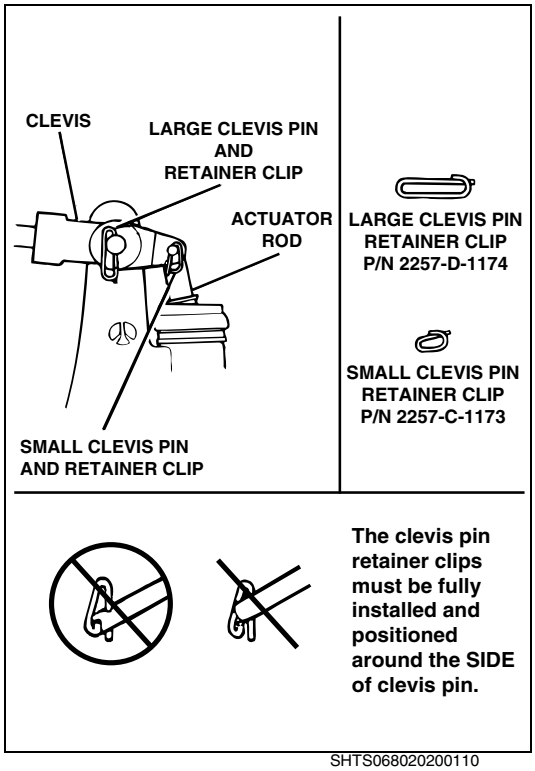
⚠ CAUTION

Always replace used clevis pin retainer clips with new ones when servicing the automatic slack adjuster or chamber. Do not reuse clevis pin retainer clips after removing them. Discard used clips. When removed for maintenance or service, clevis pin retainer clips can be bent or "gapped apart" and can lose retention. Damage to components can result.

(15) Install new clevis pin retainer clips to hold the clevis in place.



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CHECK & ADJUSTMENT

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CHECK BRAKE CHAMBER PUSH ROD STROKE AND ADJUST THE CLEVIS POSITION

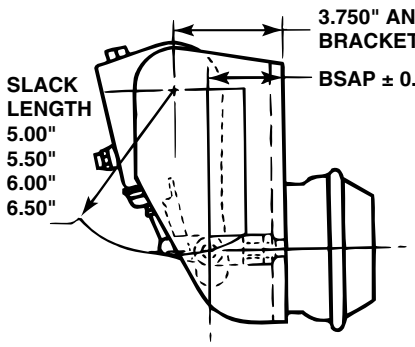
⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

NOTICE
You cannot adjust the clevis position on a chamber push rod that is equipped with a welded clevis.

There are two methods you can use to adjust the clevis position on a chamber push rod that is equipped with a threaded clevis:

- The Brake Slack Adjuster Position (BSAP) method for standard and long stroke chambers.
- Meritor's automatic slack adjuster template method for **standard stroke chambers only**.

1. BRAKE SLACK ADJUSTER POSITION (BSAP) METHOD
When installing the automatic slack adjuster, verify that the BSAP dimension of the chamber matches the table in figure.



SLACK ADJ. SIZE	± 0.125" BSAP	LONG STROKE
5.00"	2.75"	-
5.50"	2.75"	2.25"
6.00"	2.75"	-
6.50"	2.62"	-

Correct position of automatic slack adjuster: 3.750" and 3.812" offsets only. For other bracket offsets, refer to the vehicle manufacturer's specifications.

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2. AUTOMATIC SLACK ADJUSTER TEMPLATES
Order the correct automatic slack adjuster template from Meritor's Customer Service Center at 800-535-5560.

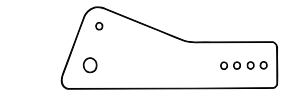
⚠ CAUTION
There are five different installation templates for Meritor automatic slack adjusters. The templates are NOT interchangeable. You MUST use the correct template and you MUST adjust the clevis position as described below. If you use the wrong template and install the clevis in the wrong position, the slack adjuster will not adjust the brake correctly. If the slack adjuster under-adjusts, then stopping distances are increased. If the slack adjuster over-adjusts, then the linings may drag and damage the brake.

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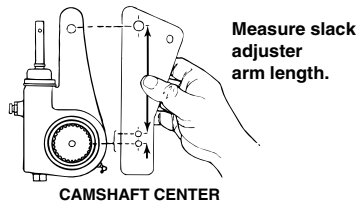
3. MEASURE THE SLACK ADJUSTER

NOTICE
For long stroke chambers, use the BSAP method to measure the automatic slack adjuster.

(1) Use the correct Meritor automatic slack adjuster template to measure the length of the slack adjuster. The marks by the holes in the small end of the template indicate the length of the slack adjuster.



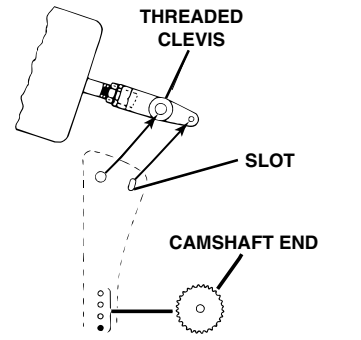
Color of Template	Part Number	Use to Install Slack Adjusters On
Dark brown	TP-4786	Truck or tractor drum brake
Tan	TP-4787	Trailer drum brake
White	TP-4781	Coach drum brake
Green	TP-4788	Disc brake with offset clevis
Yellow	TP-4789	Disc brake with straight clevis



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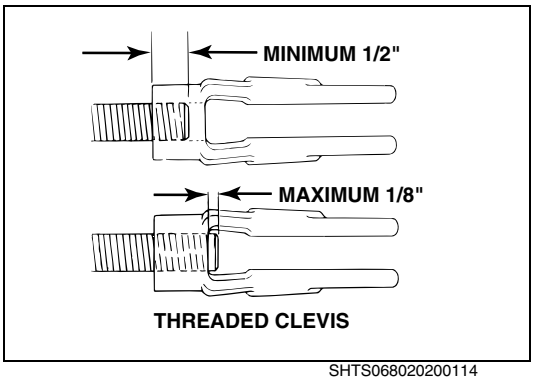
4. INSTALL A THREADED CLEVIS

(1) Install the large clevis pin through the large holes in the template and the clevis.
(2) Select the hole in the template that matches the length of the slack adjuster. Hold that hole on the center of the camshaft.
(3) Look through the slot in the template. If necessary, adjust the position of the clevis until the small hole in the clevis is completely visible through the template slot.



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(4) Check for these specifications:

- Thread engagement between the clevis and the push rod must be at least 1/2-inch (12.7 mm).
- The push rod must not extend through the clevis more than 1/8-inch (3.18 mm). If necessary, cut the push rod, or install a new push rod with a new air chamber.

(5) Tighten the jam nut against the clevis to torque specifications.

Jam Nut Torque Specifications

Threads	Torque
1/2-20	20-30 lb-ft (27-41 N·m)
5/8-18	35-50 lb-ft (48-68 N·m)

5. FREE STROKE MEASUREMENT

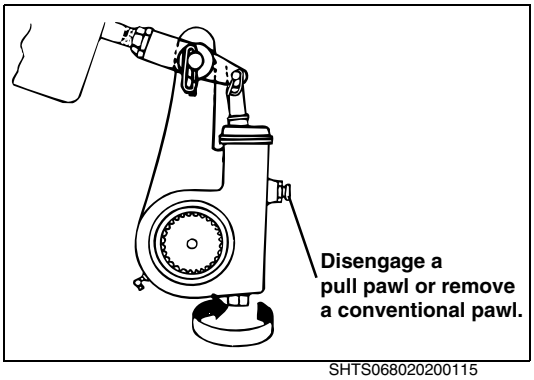
⚠ CAUTION
You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

NOTICE
During preventive maintenance on an in-service brake, check both the free stroke as described below and the adjusted chamber stroke as described on page BR02-104.

On some applications, you may find the in-service free stroke to be slightly longer than specified in Step (5). However, this is not necessarily a concern, as long as the adjusted chamber stroke is within the limits shown in the Commercial Vehicle Safety Alliance (CVSA) charts on page BR02-105.

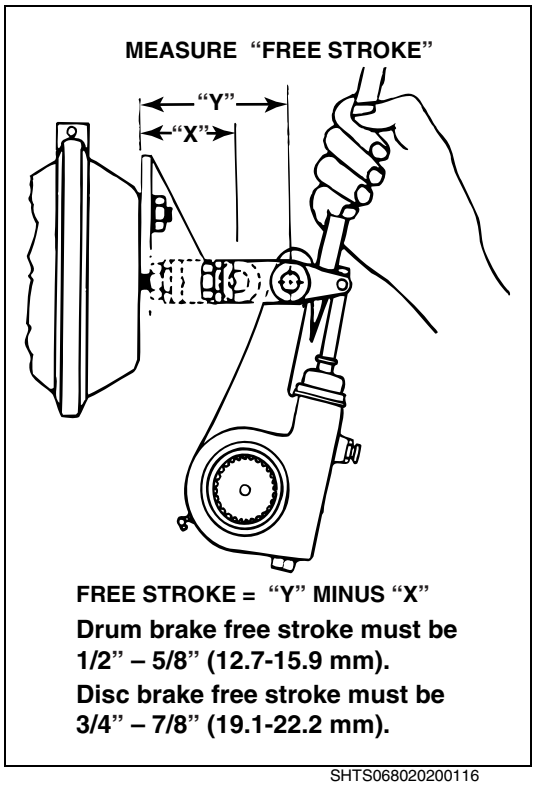
(1) Disengage a pull pawl or remove a conventional pawl.
(2) Turn the adjusting nut in the direction shown in figure until the linings touch the drum, and then turn the adjusting nut in the opposite direction:

- 1/2 turn for drum brakes
- 3/4 turn for disc brakes



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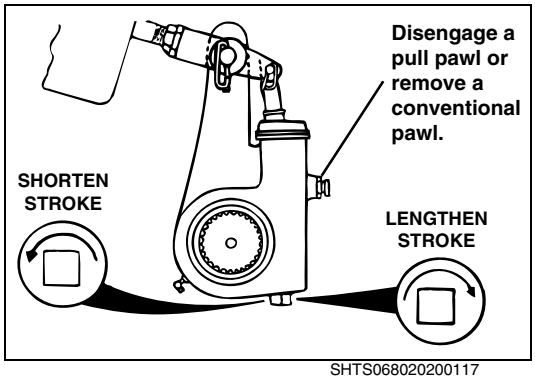
(3) Measure the distance from the center of the large clevis pin to the bottom of the air chamber while the brake is released. **Refer to "X" in figure**.

(4) Use a pry bar to move the slack adjuster so that the linings are against the drum (applying the brakes). Measure the same distance again while the brakes are applied. **Refer to "Y" in figure**.

⚠ CAUTION
Do not set free stroke shorter than specifications. If free stroke is too short, linings can drag and damage the brake.

(5) The difference between measurement "X" and measurement "Y" is the free stroke, which sets the clearance between the linings and drum.
Free stroke must be within the following specifications.

- **Drum Brakes:**
  1/2-inch-5/8-inch (12.7-15.9 mm)
- **Disc Brakes:**
  3/4-inch-7/8-inch (19.1-22.2 mm)



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(6) If it is necessary to adjust the stroke, turn the adjusting nut 1/8 turn in the direction shown in figure and check the stroke again. Continue to measure and adjust the stroke until it is adjusted correctly.

(7) Release a pull pawl or install a conventional pawl.

⚠ WARNING
When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

(8) If the brake has spring chambers, carefully release the spring.
(9) Test the vehicle to ensure that the brake system is operating correctly before you return the vehicle to service.

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COMMERCIAL VEHICLE SAFETY ALLIANCE (CVSA) GUIDELINES TO MEASURE PUSH ROD TRAVEL (ADJUSTED CHAMBER STROKE)

Use the following procedures to check in-service push rod travel (adjusted chamber stroke) on truck or tractor air brakes with automatic slack adjusters.

Hold the ruler parallel to the push rod and measure as carefully as possible. An error in measurement can affect CVSA re-adjustment limits, which state that "any brake 1/4-inch or more past the re-adjustment limit, or any two brakes less than 1/4-inch beyond the re-adjustment limit will be cause for rejection."

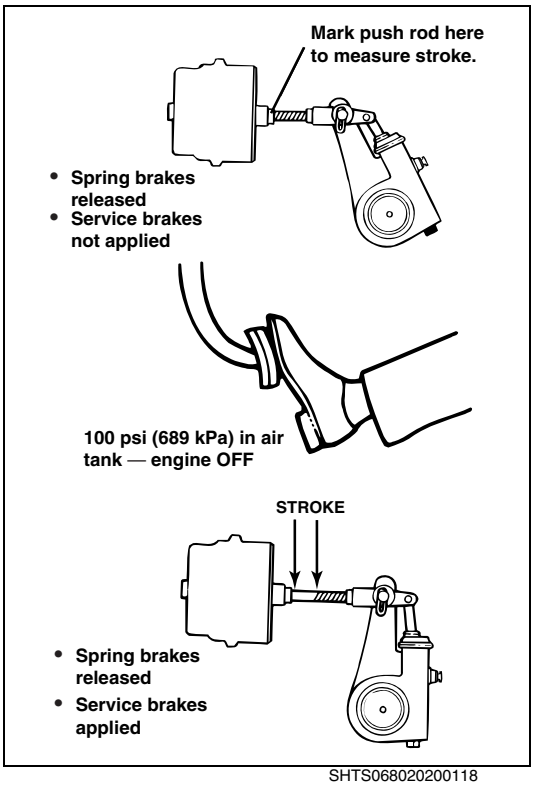
⚠ WARNING

- **To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.**
- **When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.**

1. MEASURE PUSH ROD TRAVEL (ADJUSTED CHAMBER STROKE)

(1) The engine must be **OFF**. If the brake has spring chambers, carefully release the spring.
(2) Check the gauges in the cab to ensure that air pressure in the tanks is 100 psi (689 kPa).
(3) Determine the size and type of brake chamber you are inspecting.
(4) With the brakes released, mark the push rod where it exits the chamber.
Measure and record the distance.
(5) Have another person apply and hold the brakes one full application.
(6) Measure push rod travel distance (adjusted chamber stroke) from where the push rod exits the brake chamber to your mark on the push rod. Measure and record the distance.
(7) **To determine push rod travel (adjusted chamber stroke):** Subtract the measurement you obtained in Step (4) from the measurement you obtained in Step (6). The difference is the push rod travel (adjusted chamber stroke).

- Push rod travel (adjusted chamber stroke) must not be greater than the stroke length shown in the CVSA reference charts for the size and type of air chamber you are inspecting.
- If push rod travel (adjusted chamber stroke) is greater than the maximum stroke shown in the CVSA reference charts, inspect the slack adjuster and replace it if necessary.



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COMMERCIAL VEHICLE SAFETY ALLIANCE (CVSA) NORTH AMERICAN OUT-OF-SERVICE CRITERIA REFERENCE CHARTS

NOTICE

A brake found at the adjustment limit is not a violation.

"Standard Stroke" Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)	
6	4-1/2	1-1/4	Should be as short as possible without lining to drum contact
9	5-1/4	1-3/8	
12	5-4/16	1-3/8	
16	6-3/8	1-3/4	
20	6-25/32	1-3/4	
24	7-7/32	1-3/4	
30	8-3/32	2	
36	9	2-1/4	
* For 3" maximum stroke type 24 chambers			

"Long Stroke" Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)	
16	6-3/8	2.0	Should be as short as possible without lining to drum contact
20	6-25/32	2.0	
24	7-7/32	2.0	
24*	7-7/32	2.5	
30	8-3/32	2.5	

1. ANTI-SEIZE COMPOUND

Meritor lubricant specification O-637 (part number 2297-U-4571) is a corrosion control grease. Do not mix this grease with other greases. This compound is also available from the Southwest Petro-Chemical Division of Witco Chemical Corporation, 1400 South Harrison, Olathe, KS 66061, as "Corrosion Control," part number SA 8249496.

- Use anti-seize compound on the clevis pins of all slack adjusters.
- Also use anti-seize compound on the automatic slack adjuster and cam splines if the slack adjuster gear has no grease groove and holes around its inner diameter.

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LUBRICANTS

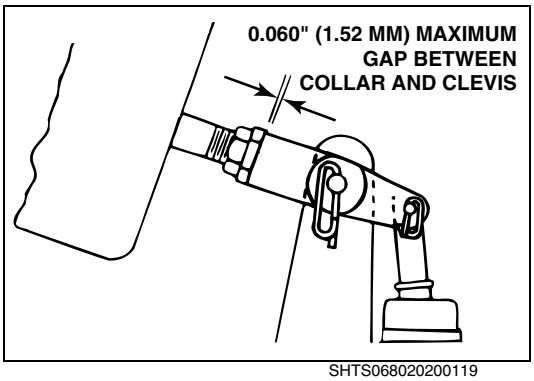
Conventional Automatic Slack Adjuster Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Automatic Slack Adjuster	O-616-A	1	Clay Base	Down to -40°F (-40°C)
	O-692	1 and 2	Lithium Base	Down to -40°F (-40°C)
	O-645	2	Synthetic Oil, Clay Base	Down to -65°F (-54°C)
Clevis Pins	Any of Above	See Above	See Above	See Above
	O-637	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

MAINTENACE

1. AT BRAKE RELINE

(1) Before you perform brake maintenance, check the free stroke and the adjusted chamber stroke as described on BR02-104.
(2) If the free stroke is not correct, refer to the Diagnostics table on page BR02-87 to correct the stroke before you adjust the chamber stroke.
(3) Inspect the boot for cuts or other damage. If the boot is cut or damaged, remove the pawl and inspect the grease.
(4) If the grease is in good condition, replace the damaged boot with a new boot.
(5) Use a grease gun to lubricate the slack adjuster through the grease fitting. If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.
(6) Lubricate until new grease purges from around the inboard camshaft splines and from the pawl assembly.
(7) Measure the gap between the clevis and the collar on a "Quick Connect" clevis. Replace the clevis if the gap exceeds 0.060-inch (1.52 mm).



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ABS (ABS : HYDRAULIC (E VERSION)) BR03-001

ABS BR03-2
OVERVIEW BR03-2
COMPOSITION AND OPERATION BR03-3
FUNCTION BR03-6
PRECAUTIONS WHEN DRIVING VEHICLES EQUIPPED WITH ABS BR03-7
OVERVIEW AND FUNCTION BR03-8

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ABS

OVERVIEW

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ABS is a system that makes effective use of the friction between the tires and the road surface to maintain vehicle stability while the brakes are being applied and for stopping the vehicle.

Applying the brakes forcefully on a slippery road surface can cause the wheels to be locked, due to excessive braking force. This causes the vehicle to lose stability because the locked wheels lose resistance in the lateral direction. More specifically, if the front wheels are locked, it becomes impossible to steer the vehicle, and if the rear wheels are locked, the rear of the vehicle may fishtail from side to side.

Also, when wheel-locking occurs, it is not possible to make effective use of friction between the tires and the road surface. This may cause the braking distance to be increased.

ABS uses wheel sensors mounted on the axles to constantly monitor the rotation of the wheels. If any of the wheels is starting to lock up, the ABS ECU sends signals to the ABS modulator and immediately adjusts the brake pressure to prevent wheel-locking.

In this way, ABS maintains the stability of the vehicle while stopping by making effective use of the friction between the tires and the road surface.

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COMPOSITION AND OPERATION

EN0680103C100002

The ABS system is comprised of sensor rings mounted on the wheels, the ABS ECU, which receives signals from the wheel sensors that monitor the rotational speed of the wheels and outputs control signals to maintain the appropriate braking force; ABS modulator, which increase or decrease the braking force, based on the control signals; the warning light, which gives an alarm if the system malfunctions; the piping, wire harnesses, etc., that link together the various units that compose the system.

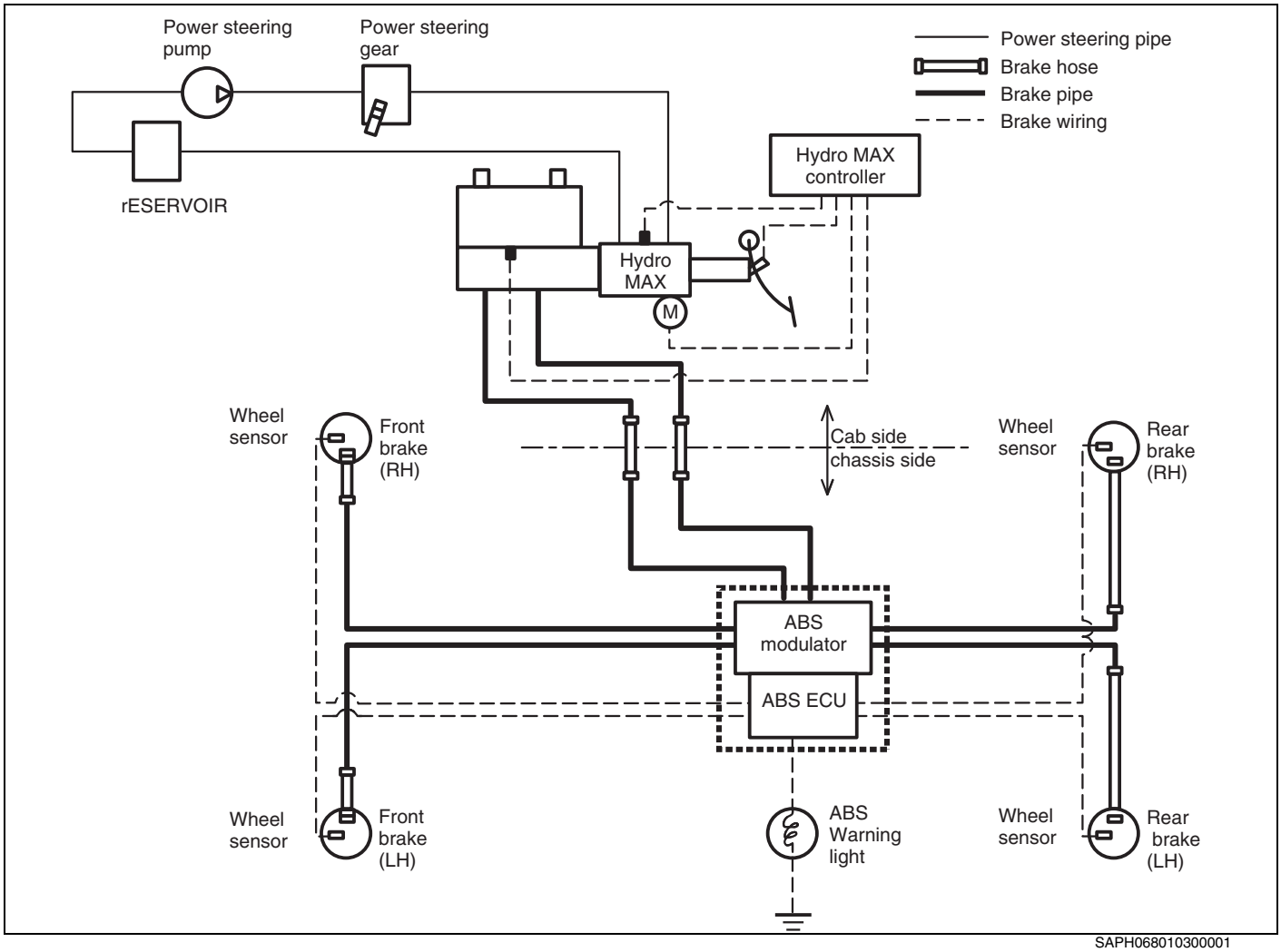
Pulse signals transmitted by the sensor rings mounted on the wheel hubs, rotated together with the wheels, and the wheel sensors mounted near sensor ring on the axles are sent to the ABS ECU. The ABS ECU then calculates the wheels' rotational speed, acceleration, deceleration, and amount of slippage, based on these signals.

If the limit values for the wheel's deceleration, or slippage ratio are exceeded, the ABS ECU immediately transmits signals to the ABS modulator to adjust any excess braking force.

- ABS system operates as following table.

	FRONT AXLE	REAR AXLE
CONTROL SYSTEM	Independently control right and left wheels	Independently control right and left wheels

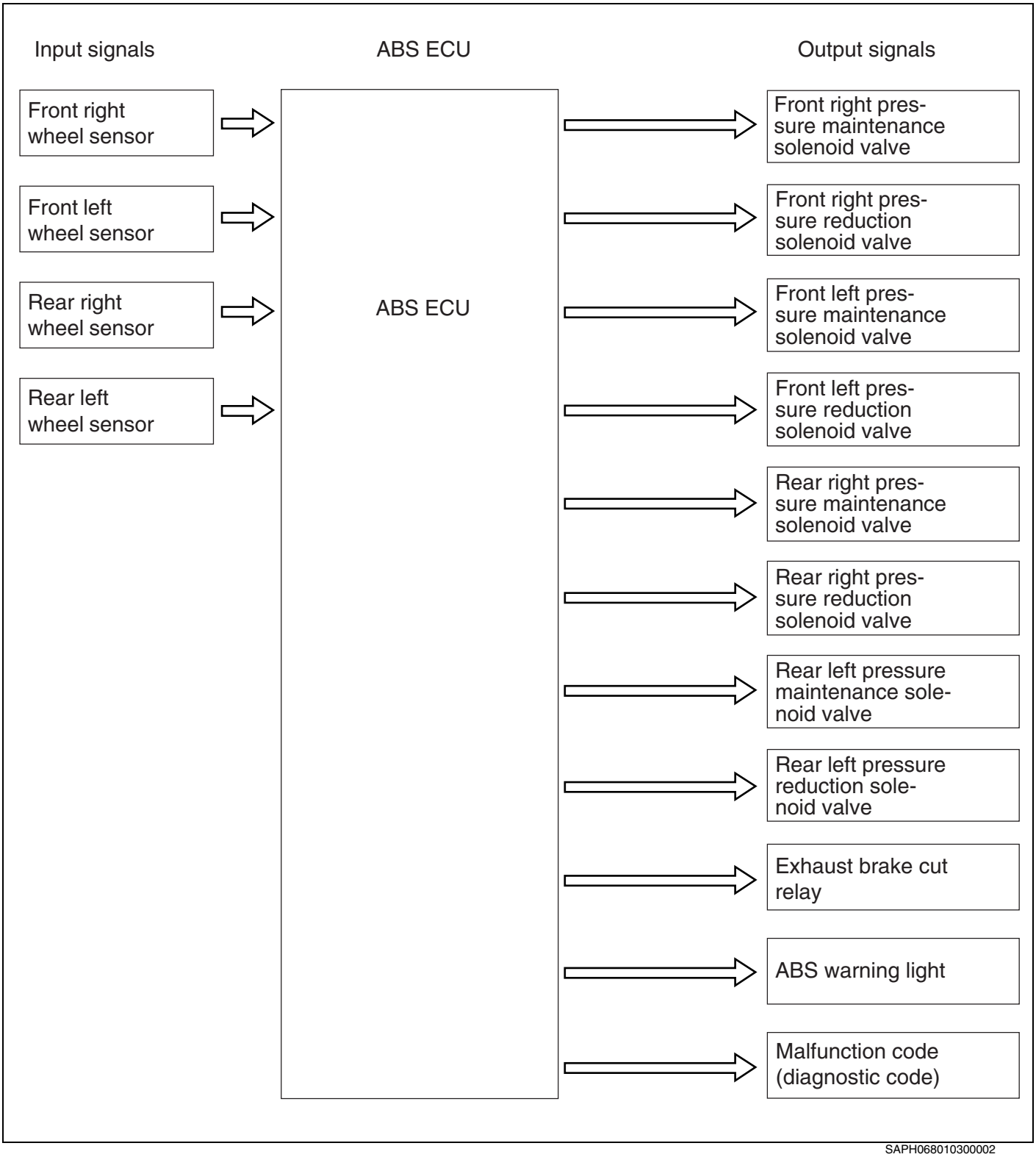
1. SYSTEM COMPOSITION DIAGRAM



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2. ABS CONTROL FLOWCHART



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BASIC PRINCIPLE

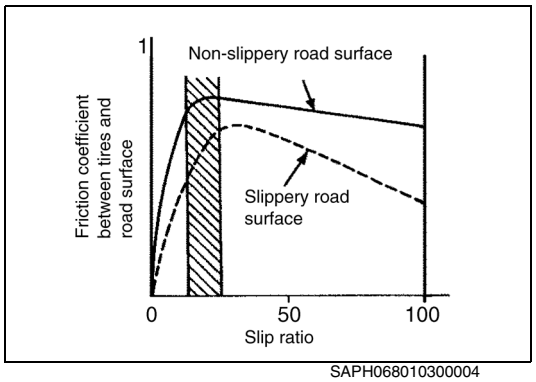
Based on its relationship with the slip ratio, which is determined from the wheels' rotational speed and the vehicle's speed, ABS controls the brake force so that it will be most effective.

When the driver applies the brakes, the rotation of the wheels is controlled and the vehicle speed drops. However, the momentum of the vehicle attempts to push it forward further even though the rotation of the wheels is being braked. At this point, slipping will occur if there is a gap between the wheels' rotational speed and the vehicle's speed. The slip ratio is a value that indicates the rate of slippage.

$$\text{Slip ratio} = \frac{\text{Vehicle's speed} - \text{Wheel's rotational speed}}{\text{Vehicle's speed}} \times 100\ \%$$

Slip ratio 0 % : No slipping between the wheels and the road surface

100 % : Wheels locked



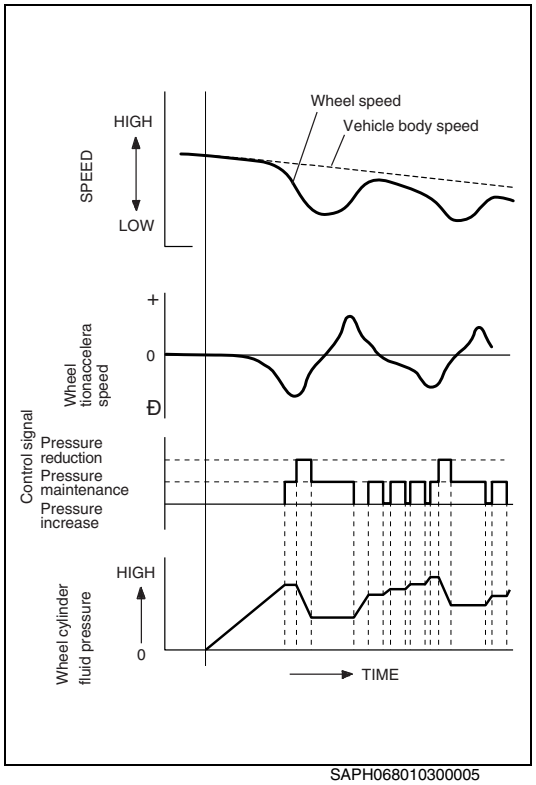
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The graph shown at left shows the relationship between the friction coefficient of the tires and of the road surface and the slip ratio.

In an ABS-equipped vehicle, the brake force is controlled to ensure that it is within the range where the friction coefficient is high (shaded portion of the graph) without locking the wheels. This ensures efficient braking performance.

OPERATION

The ABS ECU calculates the wheel speed and wheel acceleration speed for each of the 4 wheels, from 4 wheel sensor signals, and determines the wheel slip conditions. And depending on these conditions, control signals are output to the ABS actuator solenoid valves in 3 modes (pressure increase, pressure maintenance, and pressure reduction). Control signals are output independently to the front and rear wheels and to the left and right wheels.



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FUNCTION

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FAIL-SAFE FUNCTION

This ABS system is equipped with a fail-safe function that causes the ABS warning light on the instrument panel to light and to restore the normal (non-ABS) brake system, should an ABS malfunction occur.
Note that the ABS system consists of two independent circuits. Should a malfunction occur for whatever reason in the electrical circuits, that system's ABS is switched off and the normal brake system is restored while ABS control continued for the other system. This configuration is designed to minimize the effects of any malfunction on ABS function.

EXHAUST BRAKE CONTROL FUNCTION

The ABS of this vehicle is equipped with a function that controls the exhaust brake while ABS is operating. If the exhaust brake is applied independently or in conjunction with the service brake on a road surface with an abnormally low friction coefficient, the drive wheels may lock. This ABS prevents the drive wheels from locking in such situations by automatically releasing the exhaust brake, if necessary, during ABS operation.

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PRECAUTIONS WHEN DRIVING VEHICLES EQUIPPED WITH ABS

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Electronically, ABS uses the coefficient of friction (the amount of traction) between the tires and the road surface to monitor the speed of each wheel. If one or more wheels indicates the possibility of locking, resulting in fishtailing or other loss of stability, ABS enables the vehicle to be brought to a stop. Even with ABS, however, a driver must operate the vehicle in a safe manner and recognize the following points with respect to the operation of ABS.

CHECK POINTS	REMEDIAL ACTIONS
• Even with ABS, the braking distance on a wet or slippery road will be longer than on a dry road, and if the road surface is covered with ice, snow or gravel, the braking distance will be even greater.	• Even with ABS, always drive safely, taking into consideration the road and traffic conditions and the condition of your tires, including tire type and tire wear. Always keep a safe distance from any vehicle being driven in front of you.
• ABS does not operate when the vehicle is starting, accelerating or turning, and will not assist in maintaining directional stability or steerability or in shortening the braking distance. • Even if the ABS is operational, where the coefficient of friction is very low, such as on an icy roadway, skidding, inability to steer, and instability may occur because of insufficient traction by the tires.	• If engine braking causes instability or fishtailing, the clutch should be engaged or the transmission shifted to neutral, to prevent the application of the engine braking to the drive wheels.
• Where engine braking, as a result of downshifting, occurs on a surface with a low coefficient of friction, such as ice, the drive wheels may lock, causing fishtailing or vehicle instability. ABS does not operate unless the brake pedal is applied.	• Vibrations and noise during the operation of ABS are not malfunctions. Remain calm and continue to steer the vehicle in an appropriate manner.
• When ABS is activated, the driver may experience a small amount of vibration (especially if the road surface between the left and right tires is different) and difficulty in steering. Also, the operation of the ABS may generate some noise.	• If the warning light lights up again when you reach a speed of about 6 km/h (4 mile/h), the ABS system may not be functioning properly. Have it inspected and repaired if necessary. *The warning light can be reset by turning off the engine while the vehicle is at rest. If the warning light fails to go out after the engine is restarted and the speed indicated above is reached, or if it lights frequency while the vehicle is being driven, the ABS must be inspected.
• The ABS warning light will come on when you turn the starter switch to the "on" position. It stays on briefly and then turns off automatically. If the light does not come on, have your vehicle inspected and serviced immediately at your nearest Hino service dealer.	

• <u>OTHER CHECKPOINTS REGARDING HANDLING</u>

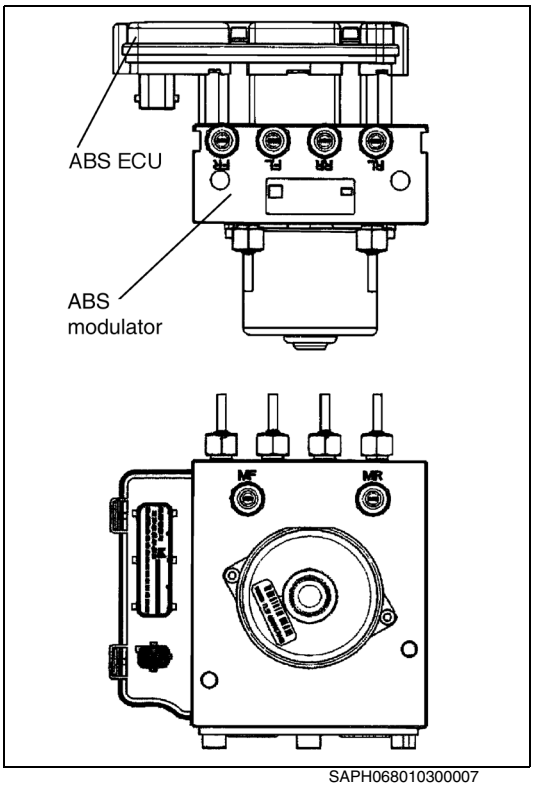
1. When washing the vehicle, take care not to direct high-pressure streams of water at the ABS modulator, harnesses, or connectors. Also, under no circumstances should the ABS ECU or electrical relays be exposed to water.
2. Be very careful not to damage the ABS wire harness when removing snow, ice, mud or other material from the outside or underside of the vehicle.
3. All electronic and radio equipment installed on the vehicle must be mounted as far away from the ABS ECU and wire harness as possible. Installation of certain electronic and radio equipment can also cause the ABS ECU to malfunction. All such equipment must also conform to all applicable laws. If you wish to install a radio or other electronic equipment, please contact your Hino service representative.

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OVERVIEW AND FUNCTION

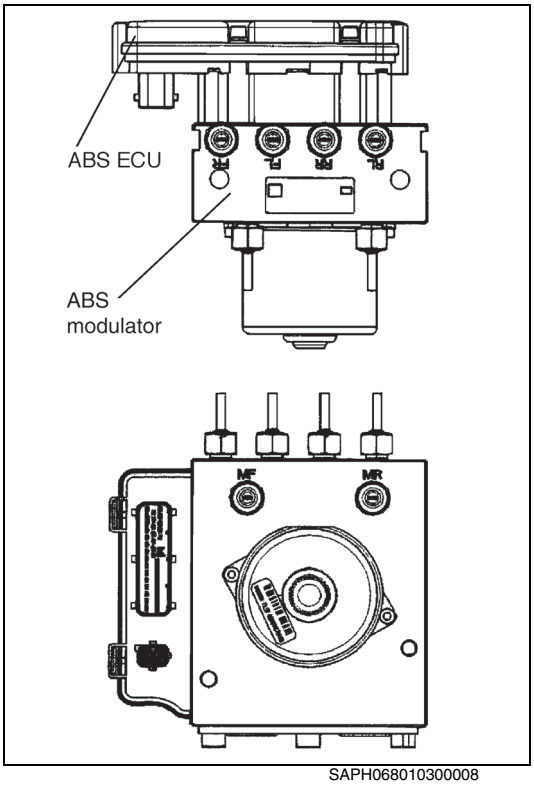
EN0680103C100004



SAPH068010300007

ABS ECU (INTEGRATED WITH ABS MODULATOR)

Based on pulse signals from the wheel sensors, the ABS ECU mounted in the vehicle calculates and evaluates the slip ratio and the acceleration/deceleration speed of the wheels. Based on the results, it sends signals to the modulator assembly as necessary, causing them to operate and apply the brakes to maintain the slippage of the wheels within the optimal range.
During braking, the fluid pressure applied to the brake cylinder is regulated to prevent the wheels from locking. The brakes are applied so as to maintain the slippage of the wheels within the optimal range.
Regardless of whether the vehicle is stopped or being driven, and whether or not the brakes are being applied, the circuit consisting of the wheel sensors, modulator assembly, ABS ECU, and wire harnesses are constantly being checked by the ABS ECU's fail-safe circuit. If some sort of malfunction occurs, the fail-safe circuit warns the driver by lighting the ABS warning light. At the same time, the ABS system that is experiencing the malfunction is shut off and braking is restored to normal (non-ABS) operation.



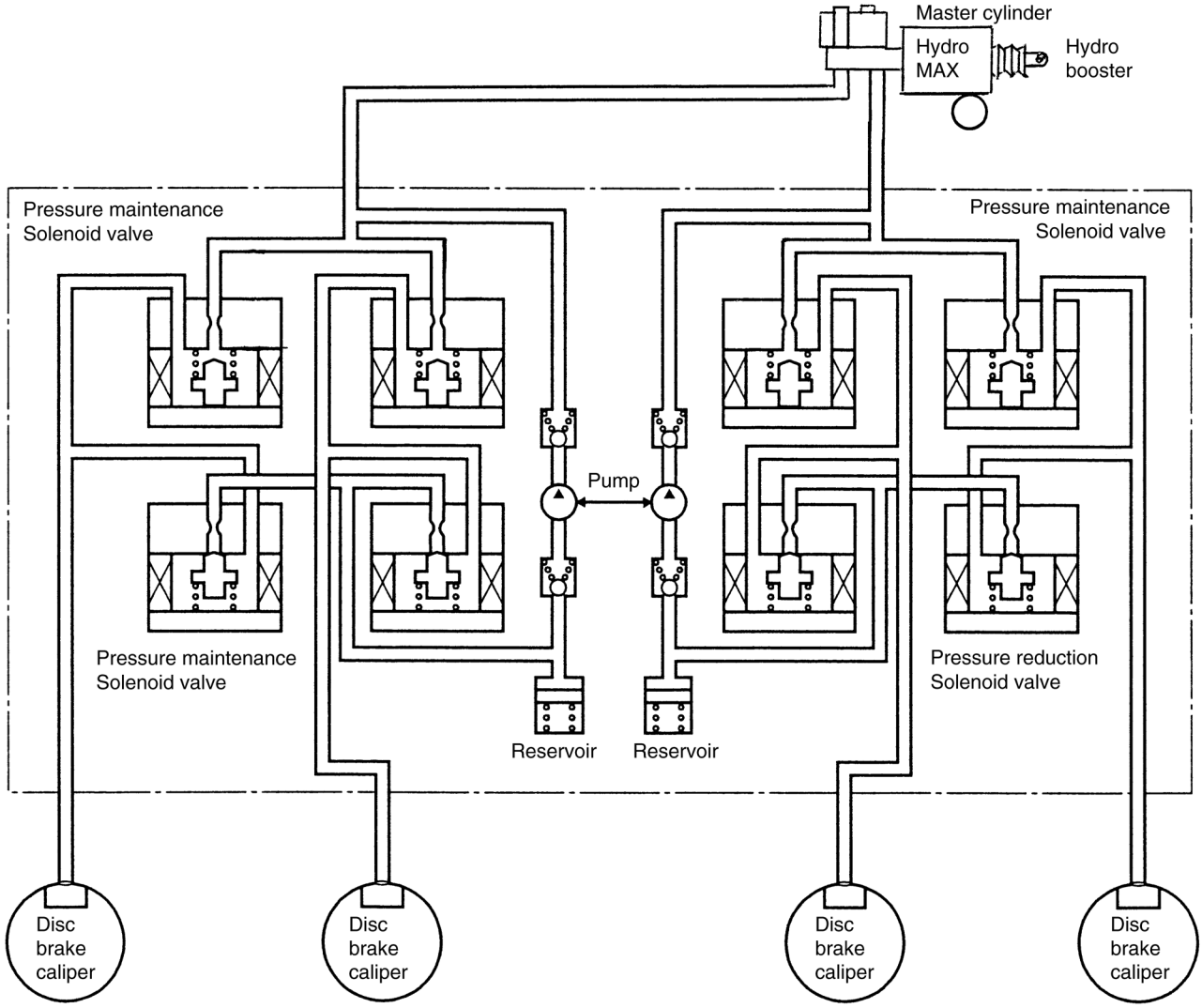
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ABS MODULATOR ASSEMBLY

1. Overview

- The ABS modulator is mounted between the Hydro booster and disc brake caliper. It controls the fluid pressure to the disc brake caliper, regulating the pressure according to signals from the ABS ECU in three modes: pressure maintenance, pressure reduction, and pressure increase.

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ABS modulator

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2. Operation

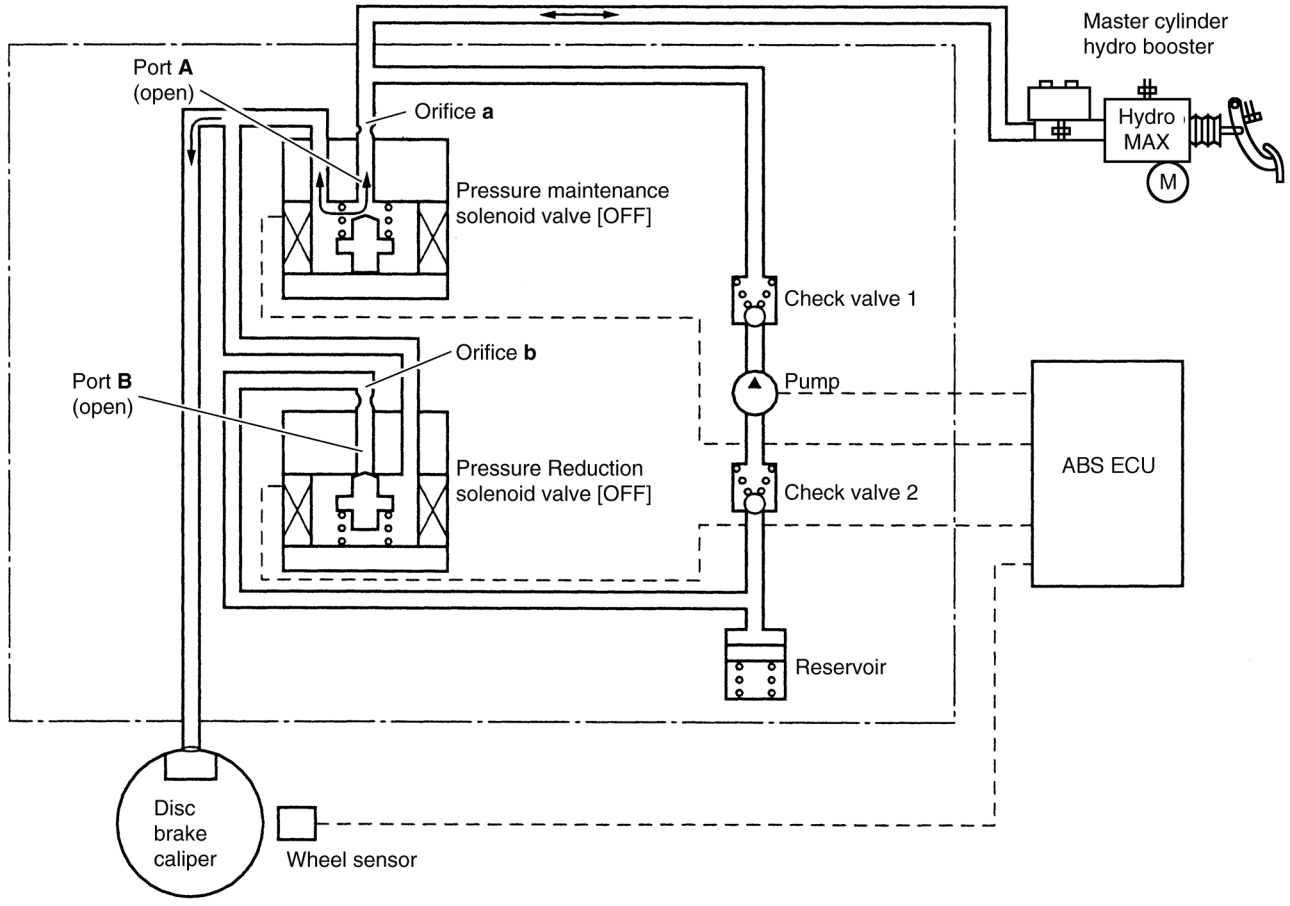
(1) During Normal Braking (ABS is not operating)

- Since there is no control signal input from the ABS ECU, the pressure maintenance solenoid valve port **A** is open, and the pressure reduction solenoid valve port **B** is closed. Accordingly, when the fluid pressure generated by the Hydro booster rises according to the fluid pressure from the master cylinder produced when the brake pedal is depressed, brake fluid is fed through port **A** to the wheel cylinder. Brake fluid is not sent to the pump side at this time because of the check valve **1** installed on that side. Then, when the brake pedal is released, the wheel cylinder brake fluid is returned to the master cylinder through the pressure maintenance solenoid valve port **A** to the Hydro booster.

Each Port Status

	ABS ECU signal	Port status
Pressure maintenance solenoid valve	OFF	Port **A**: Open
Pressure reduction solenoid valve	OFF	Port **B**: Closed

ABS modulator



Brake fluif flow (during normal braking)

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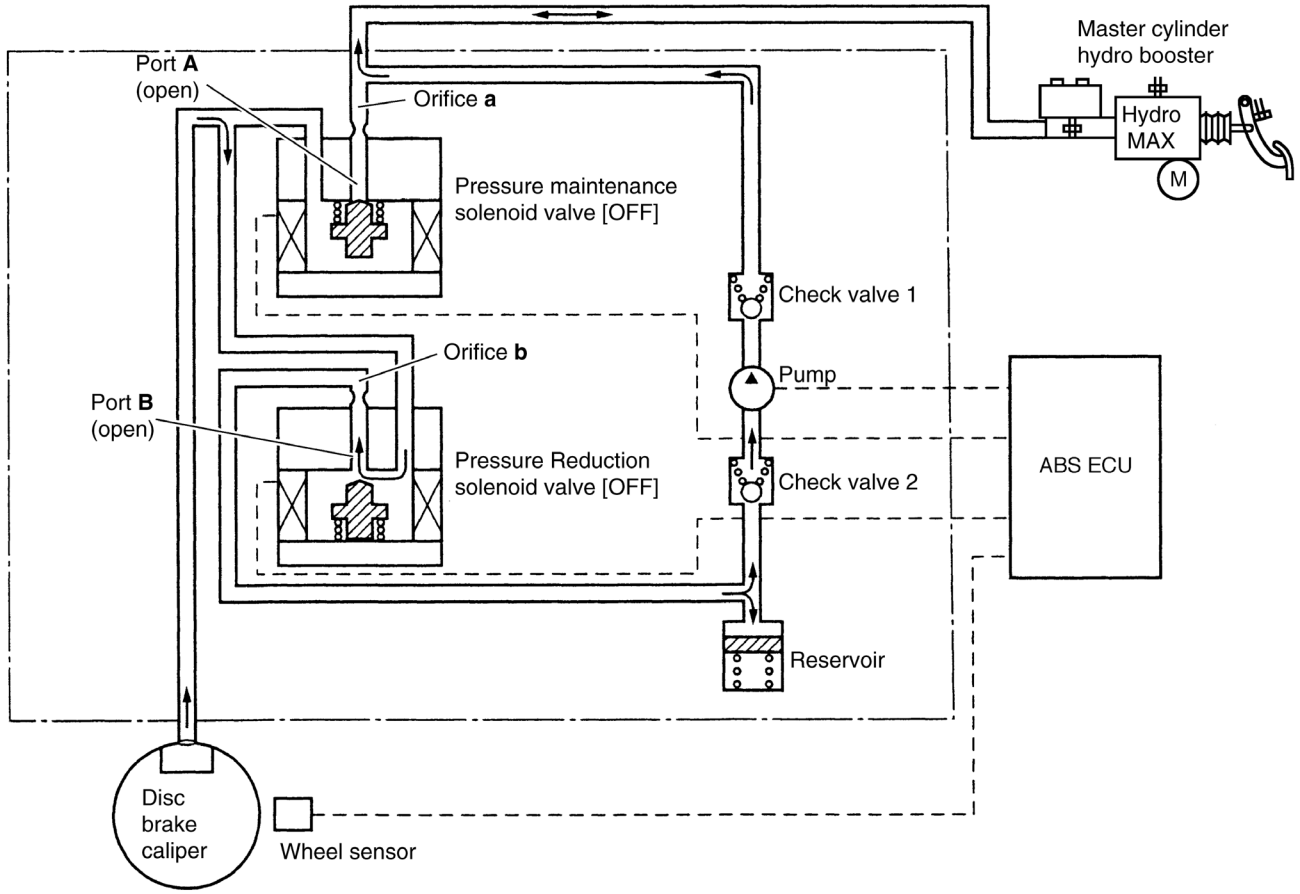
(2) During ABS Braking
a. Pressure Reduction Mode

- When the wheels are about to lock, the pressure maintenance solenoid valve port **A** closes and the pressure reduction solenoid valve port **B** opens according to control signals from the ABS ECU. Accordingly, the wheel cylinder brake fluid is fed through the pressure reduction solenoid valve port **B** to the reservoir, reducing the wheel cylinder fluid pressure. While the ABS is in operation, the ABS ECU outputs a normal operating signal to the pump, which pumps out the brake fluid that accumulates in the reservoir and returns it to the Hydro booster.

Each Port Status

	ABS ECU signal	Port status
Pressure maintenance solenoid valve	ON	Port **A**: Closed
Pressure reduction solenoid valve	ON	Port **B**: Open

ABS modulator



Brake fluif flow (during normal braking)

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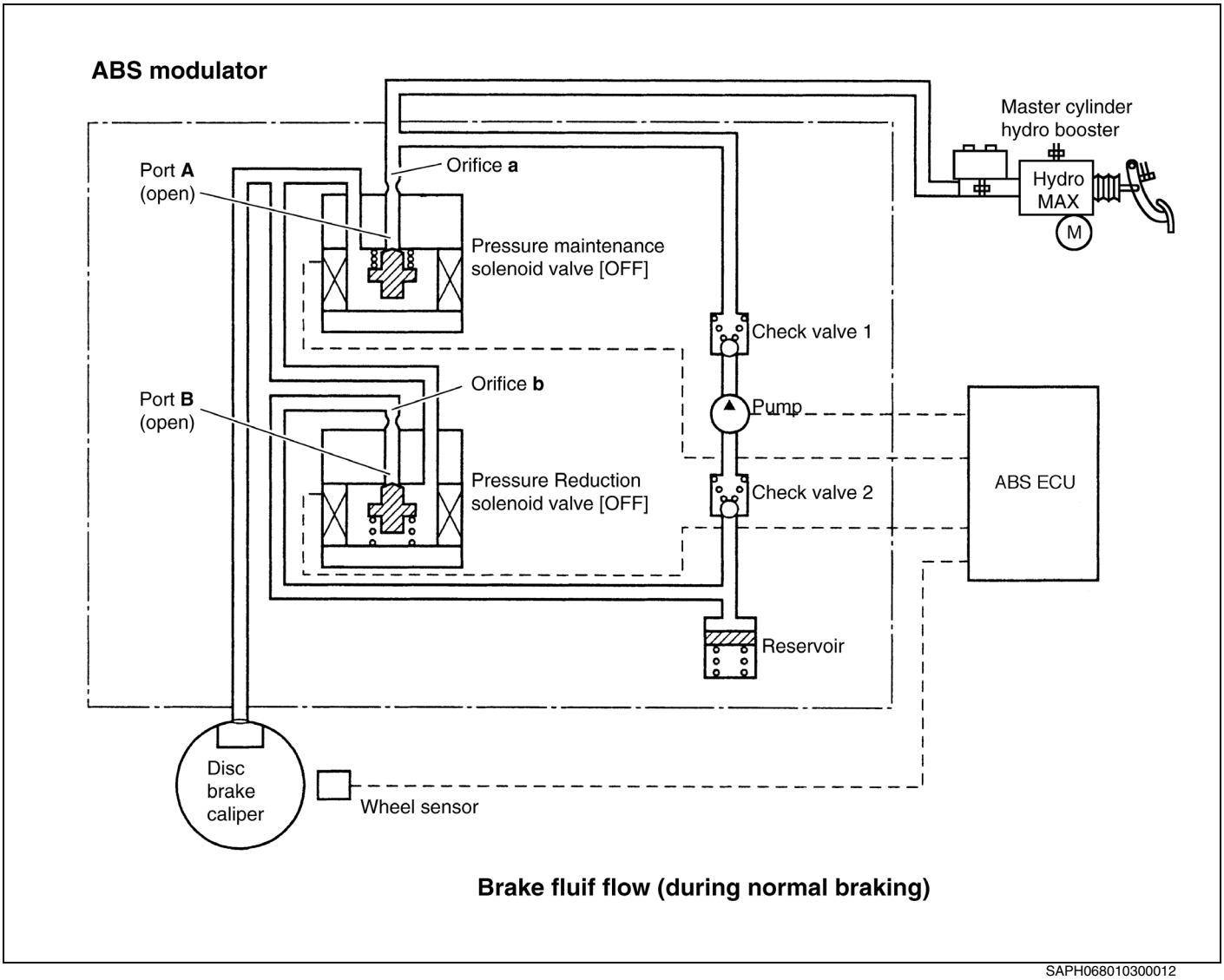
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b. During Pressure Maintenance

- When the wheel cylinder fluid pressure is reduced or increased to the required fluid pressure, the pressure maintenance solenoid valve port **A** and the pressure reduction solenoid valve port **B** simultaneously close according to control signals from the ABS ECU. This closes both the Hydro booster side and reservoir side oil routes, maintaining the wheel cylinder fluid pressure.

Each Port Status

	ABS ECU signal	Port status
Pressure maintenance solenoid valve	ON	Port **A**: Closed
Pressure reduction solenoid valve	OFF	Port **B**: Closed



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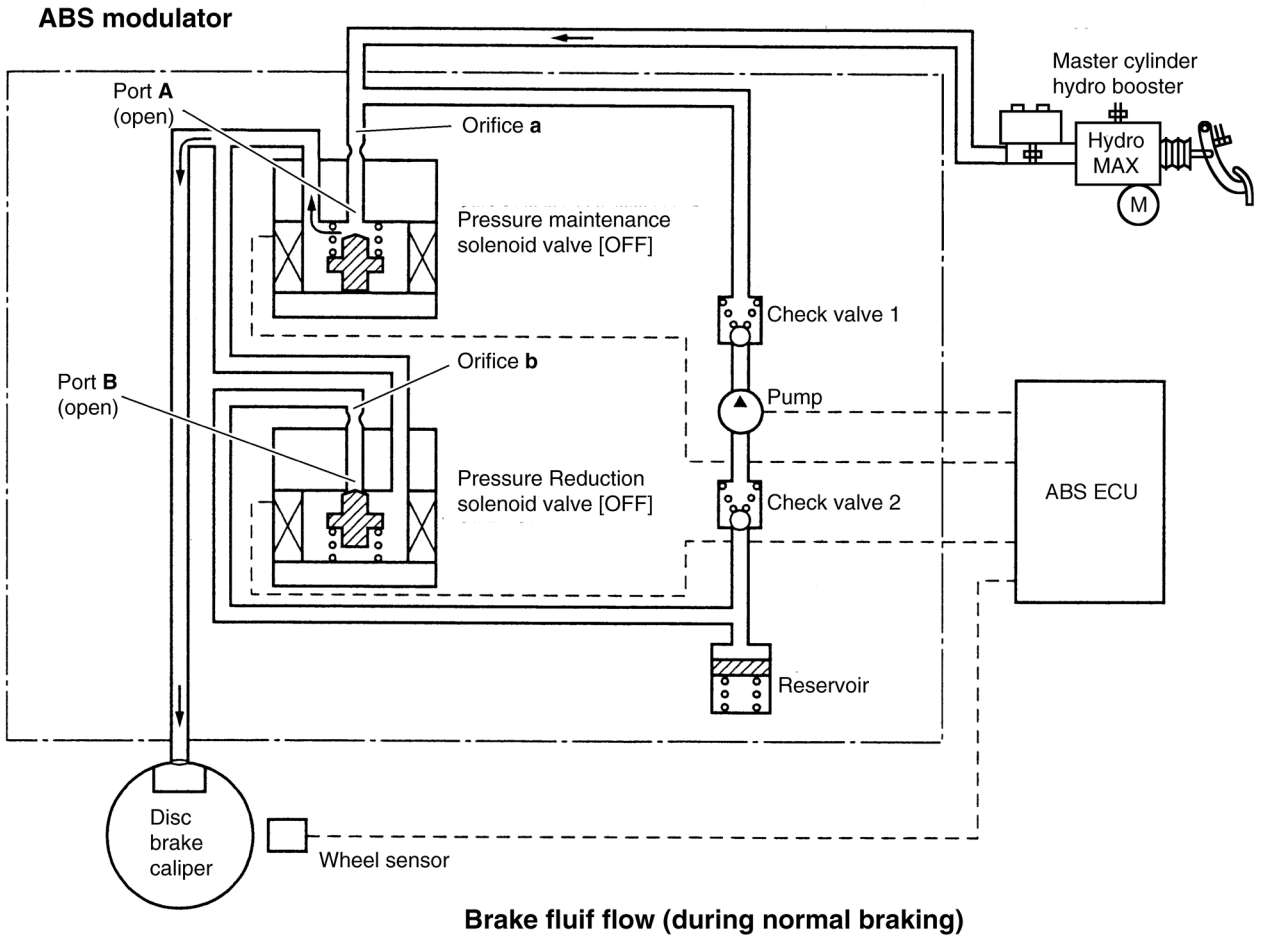
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c. During Pressure Increase

- When the wheel cylinder fluid pressure needs to increase rapidly, the pressure maintenance solenoid valve port **A** opens and the pressure reduction solenoid valve port **B** closes according to control signals from the ABS ECU. This condition is the same as the normal condition, and Hydro booster brake fluid is fed to the wheel cylinder, causing the wheel cylinder fluid pressure to rise. If there is any brake fluid remaining in the reservoir at this time, it is pumped out by the pump and sent to the wheel cylinder. The speed of the pressure increase is controlled by combination of the pressure increase and the pressure maintenance.

Each Port Status

	ABS ECU signal	Port status
Pressure maintenance solenoid valve	OFF	Port **A**: Open
Pressure reduction solenoid valve	OFF	Port **B**: Closed

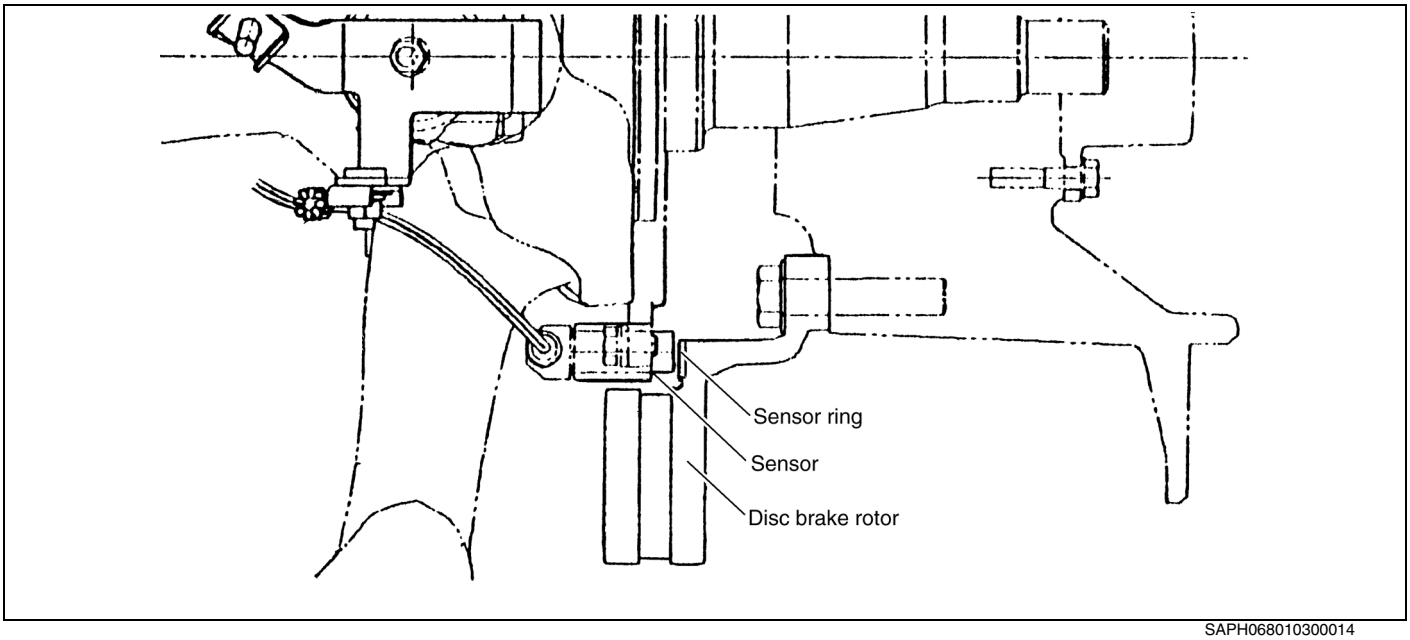


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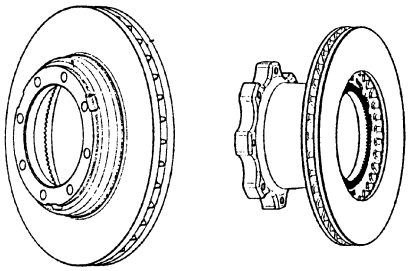
WHEEL SENSOR

These sensors are mounted facing the sensor rings on each wheel on the front and rear axles.
The wheel sensors are electromagnetic sensors consisting of a permanent magnet core with a coil of wire wrapped around it. The frequency of the pulse signals generated by magnetic inductance between the sensors and the sensor rings they face is proportional to the rotational speed of the wheels. These pulse signals are sent to the ABS ECU and are used to determine the wheels' rotational status.



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Rotor integrated type



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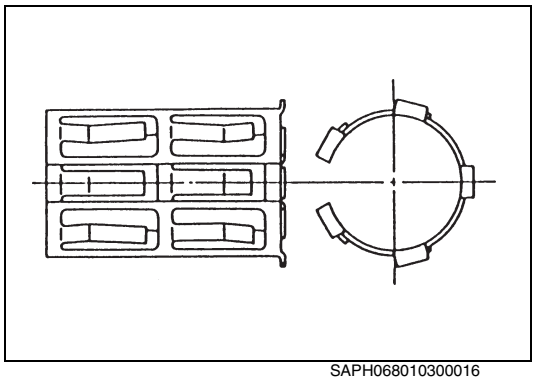
SENSOR RING

The sensor rings are press-fitted into the insides of the wheel hubs of each wheel or integrated in the brake rotor on the front and rear axles, and they face the wheel sensors described in the preceding section. The sensor rings are made of a magnetic material, and teeth are cut into the surface which faces the wheel sensor at regular intervals.Also, when the sensor ring performs one complete rotation, the sensor generates pulse signals corresponding to the number of teeth.

Sensor ring position and number of teeth

Model		238 NE	258LP NE	268 NE, NF	338 NF
Front	Position	Rotor integrated			
	Teeth No.	100			
Rear	Position	Rotor integrated			
	Teeth No.	100			

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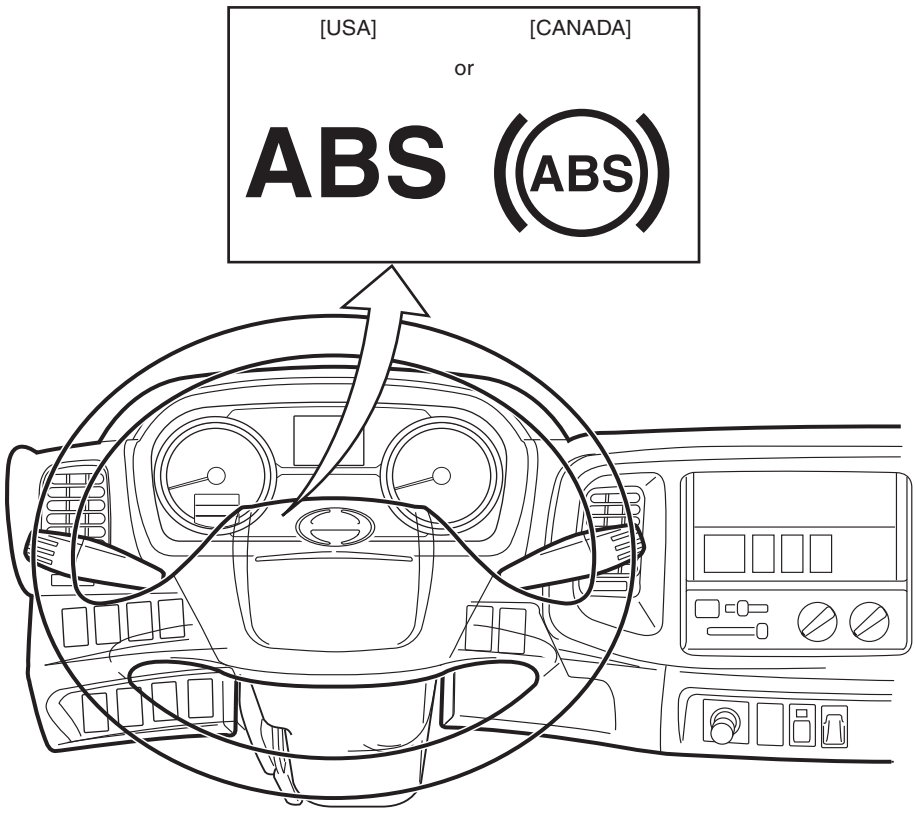
CLAMPING BUSHING

The wheel sensors are held in place through friction by clamping bushings that are inserted into the mounting brackets. If they are assembled properly (the clamping bushings should be pushed in to place so that the stoppers on the clamping bushings come in contact with the holder), the clamping bushings serve to eliminate the need to adjust the clearance between the wheel sensors and sensor rings.

WARNING LIGHT

The ABS is equipped with the following warning light.

ABS warning light



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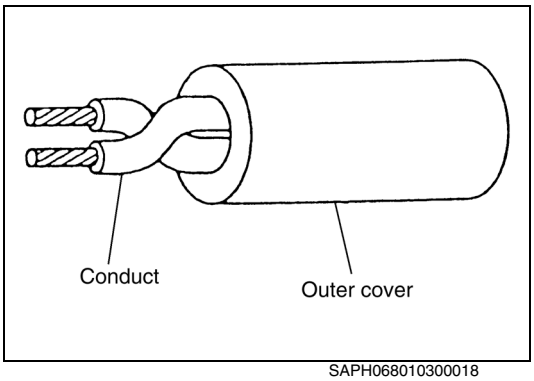
1. ABS WARNING LIGHT

- This light indicates the status of the ABS. It lights once when the starter switch is turned on and automatically goes off if the ABS is functioning normally. If a malfunction occurs in the ABS while the vehicle is being driven, the light comes on to alert the driver.
  Also used as the diagnostic display light.

NOTICE

Trouble shooting and Testing of the ABS refer to MERITOR WABCO Maintenance Manual.Cab-Mounted ECU and D Version Hydraulic ABS.

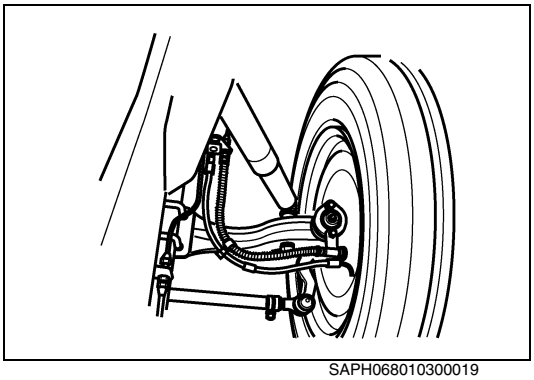
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WHEEL SENSOR WIRE HARNESSES

Each wheel sensor wire harness employs a two-conductor twisted wire cable. Its function is to protect the wheel sensor signals, which are vital to the proper operation of the ABS, from electromagnetic interference. Under no circumstances should any part of the wheel sensor wire harness be cut or connected to any other wire. In the event that the wire harness should become cut, have it replaced by an authorized Hino dealer.

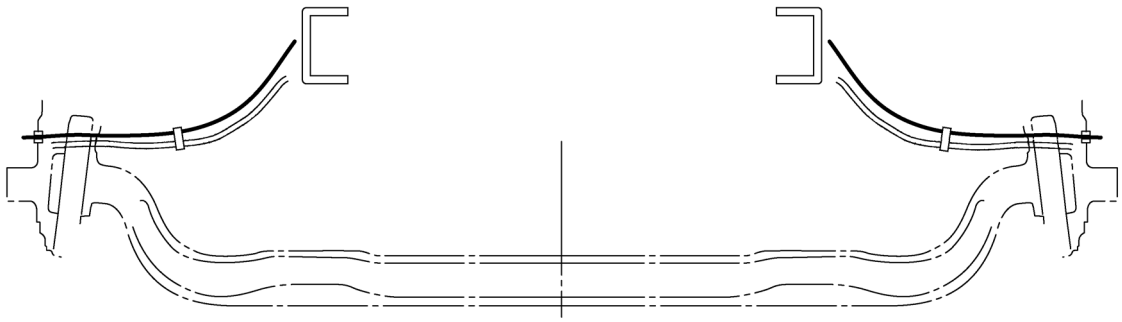

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ABS WIRE HARNESSES

1. Front axle ABS wire harness

- The wire harness that runs from the side frame to the front axle wheel sensor must absorb the steering angle of the front wheel and the movement of the chassis springs. It is therefore necessary to always maintain an optimal spacing between the clips.

- The optimal spacing between the clips is achieved when the wheel sensor connectors are attached in the regular locations shown in the diagram such that the sensor cabling within the frame is not loose. When disassembling and reassembling, confirm that the connector and sensor cable layout is appropriate.



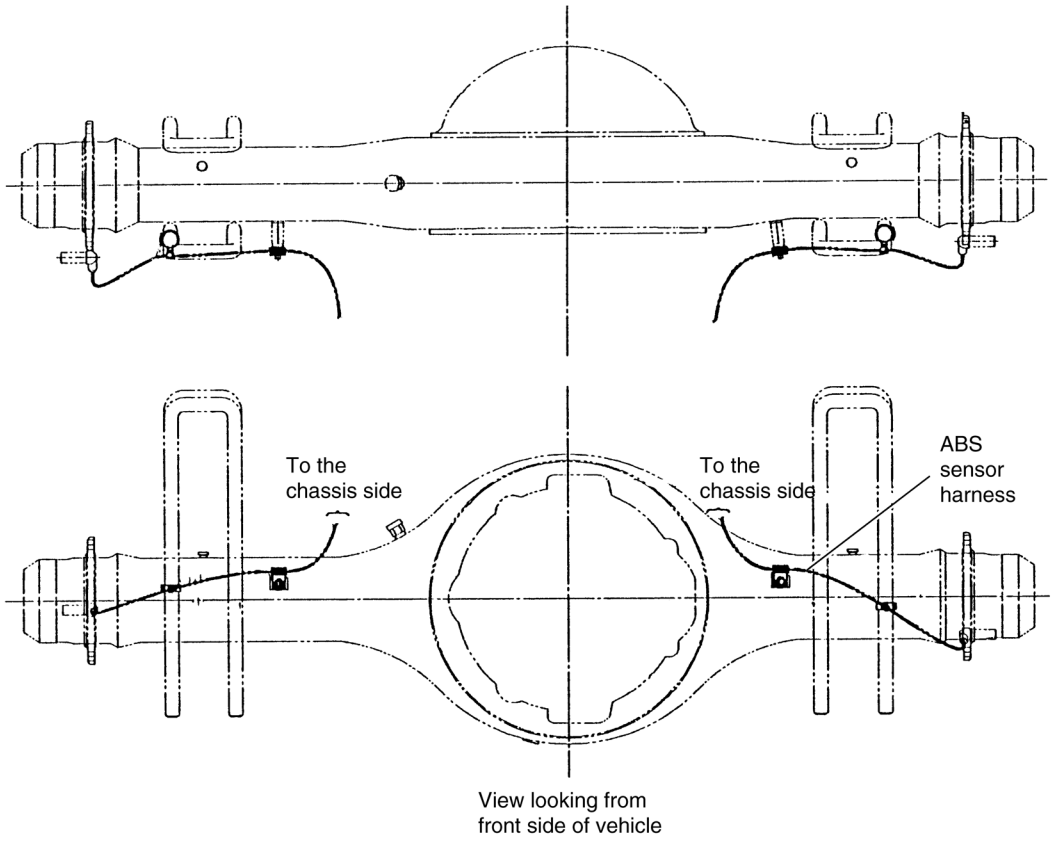
Front axle wheel sensor wire harness arrangement

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2. Rear axle ABS wire harness

- The wheel sensor wire harness is arranged so that the left and right wheel sensor wire harnesses are near each other. Therefore, special care should be taken not to make incorrect connections if the harnesses have been removed for inspection or repairs. If incorrect connections are made, it will interfere with the functioning of the ABS. For this reason, caution plates indicating "LEFT" and "RIGHT" are affixed to the wire harnesses. Be sure to check when connecting the harnesses. The wheel sensor wire harnesses, just like the front axle harnesses, must absorb the movement of the chassis springs. It is therefore necessary to always maintain an optimal spacing between the clips.
  When disassembling and re-assembling, confirm that the connector is secured in its proper place as shown in the diagram and that the sensor cables in the frame and over the axle are not hanging loosely.



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HANDLING WIRE HARNESSES

- The various sensors, valves, relays and wire harness connections to the ABS ECU employ multipolar harness connectors suitable for use with the weak currents used by electronic circuitry. Be very careful when handling them.

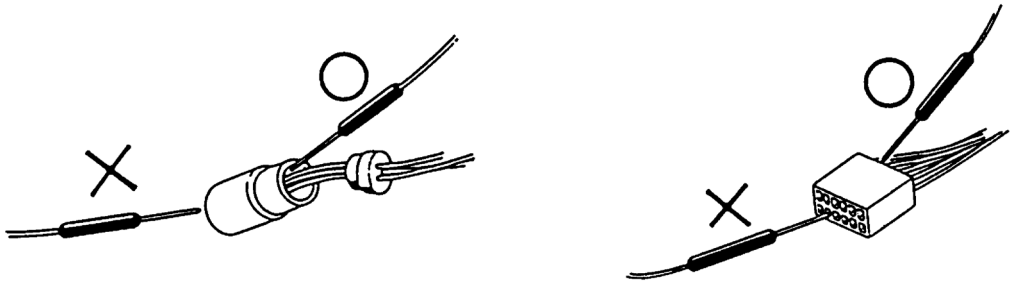
1. **Place the starter switch on "LOCK" before unplugging the harness connectors.**

2. **When unplugging the harness connectors, release the lock, hold the housing and unplug it straight as much as possible.**

3. **Do not pull holding the wire harness or pull with excessive force. Doing so can cause the pins of the harness connectors to be deformed.**

4. **Remove unnecessary connectors and do not plug them.**

5. **When inspecting using a circuit tester, insert the test probe from the wire harness side.**
   Never insert the test probe from the pins of harness connectors as this can cause bad contacts.



How to insert test probe

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6. **When unplugging the harness connectors, do not allow water, oil, dust, or any other liquid or substance to get on the terminals as they can cause bad contacts.**

7. **Be careful not to allow water, oil, dust, or any other liquid or substance to get on any component.**

8. **When plugging the harness connector, insert it completely and confirm that the harness connector lock is engaged.**

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ADDITIONAL PRECAUTIONS

1. **Make sure the model's starter switch is in the OFF position before unplugging the harness connector from the ABS ECU.**

2. **Make sure to unplug all the harness connectors from the ABS ECU before performing welding on the chassis or body of the vehicle. Also be careful that welding sputter does not get onto the harnesses.**

3. **When cleaning the interior of the model, make sure water does not get onto the ABS ECU, various relays, connectors, or any other component.**

4. **Use of a circuit tester**

- If a circuit tester is being used, always use one with an internal resistance greater than 100 kΩ inside the voltage measurement range.

5. **Installation of a radio or other electronic equipment**

- All electronic and radio equipment installed on the vehicle must be mounted as far away from the ABS ECU and wire harness as possible. Installation of certain electronic and radio equipment can also cause the ABS ECU to malfunction. All such equipment must also conform to all applicable laws. If you wish to install a radio or other electronic equipment, please contact your Hino service representative.

6. **Quick battery charge**

- When charging batteries using a quick charger, do it with both battery terminals removed.

7. **Installation of electrical equipment inside of the cab**

- When installing an air conditioner or other electrical equipment inside of the cab, be careful not to damage the engine, chassis, and wire harnesses inside the cab. Moreover, do not forget to plug the harness connectors unplugged during the installation.

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ABS (ABS : FULL AIR)

BR03-002

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COMPOSITION AND OPERATION BR03-3
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OVERVIEW AND FUNCTION BR03-8
INSPECTION (FRONT WHEEL BRAKE) BR03-13
INSPECTION (REAR WHEEL BRAKE) BR03-15

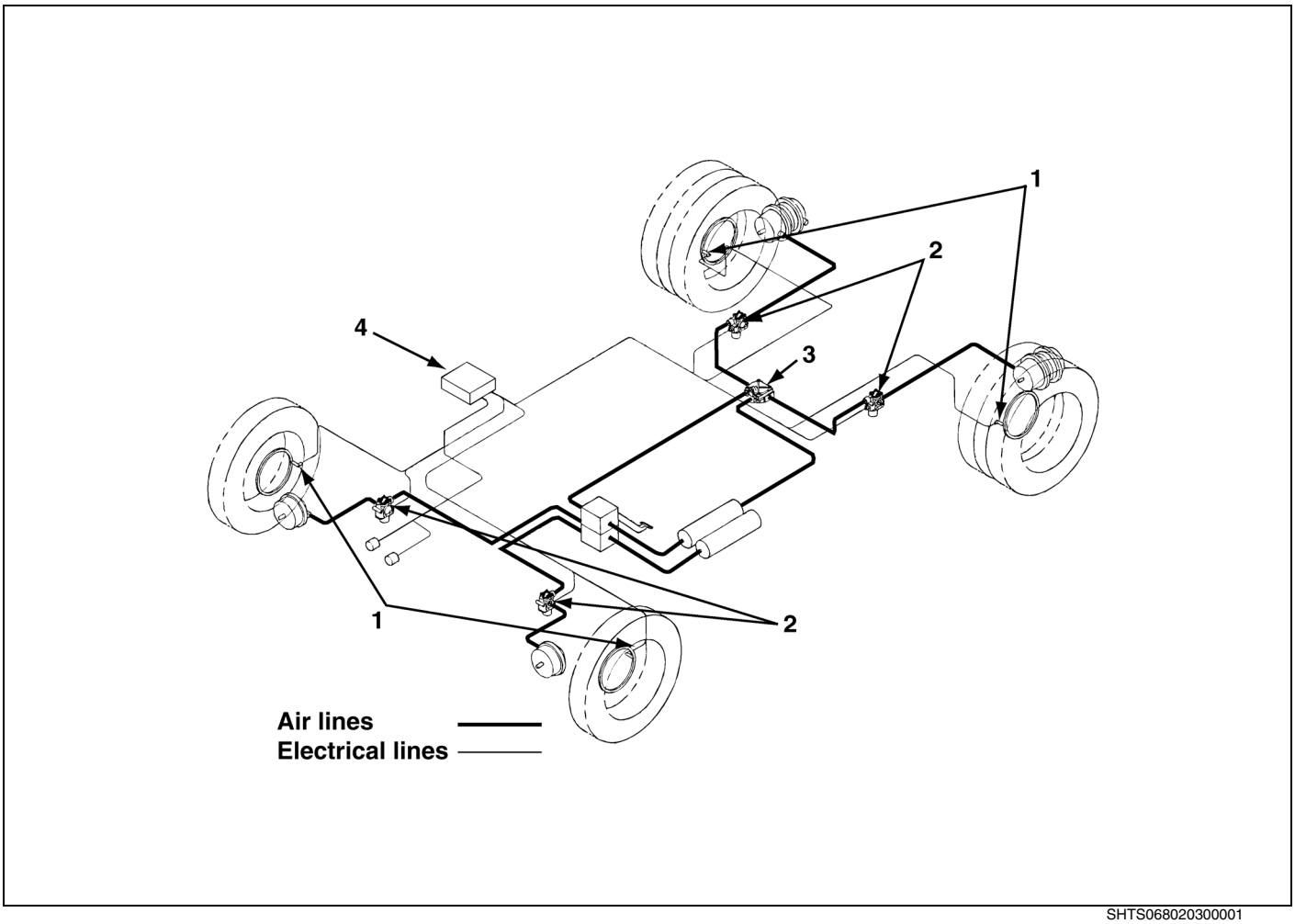
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ABS

OVERVIEW

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ABS is a system that makes effective use of the friction between the tires and the road surface to maintain vehicle stability while the brakes are being applied and for stopping the vehicle.
Applying the brakes forcefully on a slippery road surface can cause the wheels to be locked, due to excessive braking force. This causes the vehicle to lose stability because the locked wheels lose resistance in the lateral direction. More specifically, if the front wheels are locked, it becomes impossible to steer the vehicle, and if the rear wheels are locked, the rear of the vehicle may fishtail from side to side.
Also, when wheel-locking occurs, it is not possible to make effective use of friction between the tires and the road surface. This may cause the braking distance to be increased.
ABS uses wheel sensors mounted on the axles to constantly monitor the rotation of the wheels. If any of the wheels is starting to lock up, the ABS ECU sends signals to the ABS control valve and immediately adjusts the brake pressure to prevent wheel-locking.
In this way, ABS maintains the stability of the vehicle while stopping by making effective use of the friction between the tires and the road surface.



SHTS068020300001

1	Wheel sensors	3	Relay valve
2	ABS control valves	4	ABS ECU

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COMPOSITION AND OPERATION

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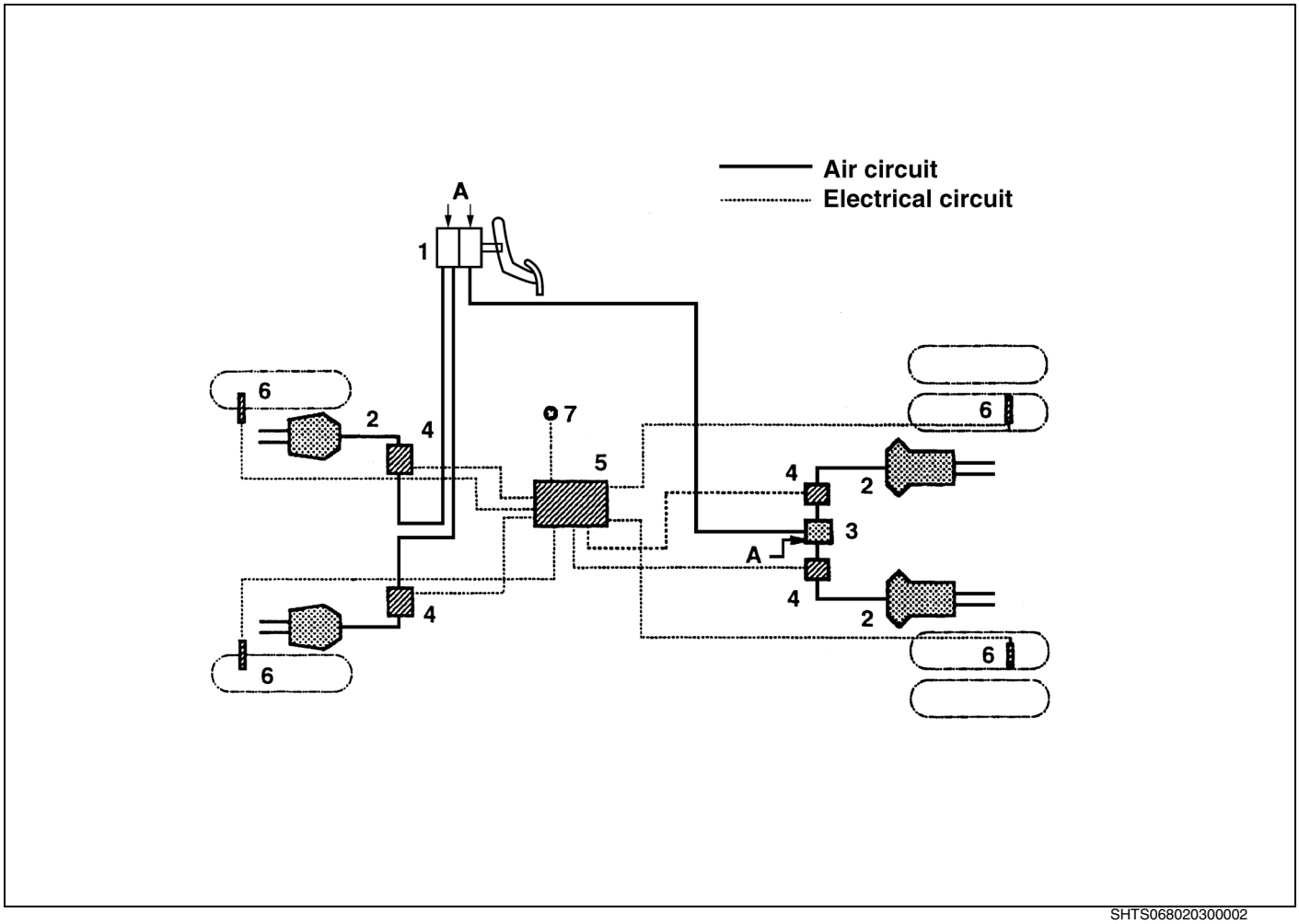
The ABS system is comprised of sensor rings mounted on the wheels. The ABS ECU, which receives signals from the wheel sensors that monitor the rotational speed of the wheels and outputs control signals to maintain the appropriate braking force; ABS control valves, which increase or decrease the braking force, based on the control signals; the warning light, which gives an alarm if the system malfunctions; the piping, wire harnesses, etc., that link together the various units that compose the system.

Pulse signals transmitted by the sensor rings mounted on the wheel hubs, rotated together with the wheels, and the wheel sensors mounted near sensor ring on the axles are sent to the ABS ECU. The ABS ECU then calculates the wheels' rotational speed, acceleration, deceleration, and amount of slippage, based on these signals.

If the limit values for the wheel's deceleration, or slippage ratio are exceeded, the ABS ECU immediately transmits signals to the ABS control valves to adjust any excess braking force.

This ABS system controls the four wheels, front, rear, right, and left, independently.

1. SYSTEM COMPOSITION DIAGRAM

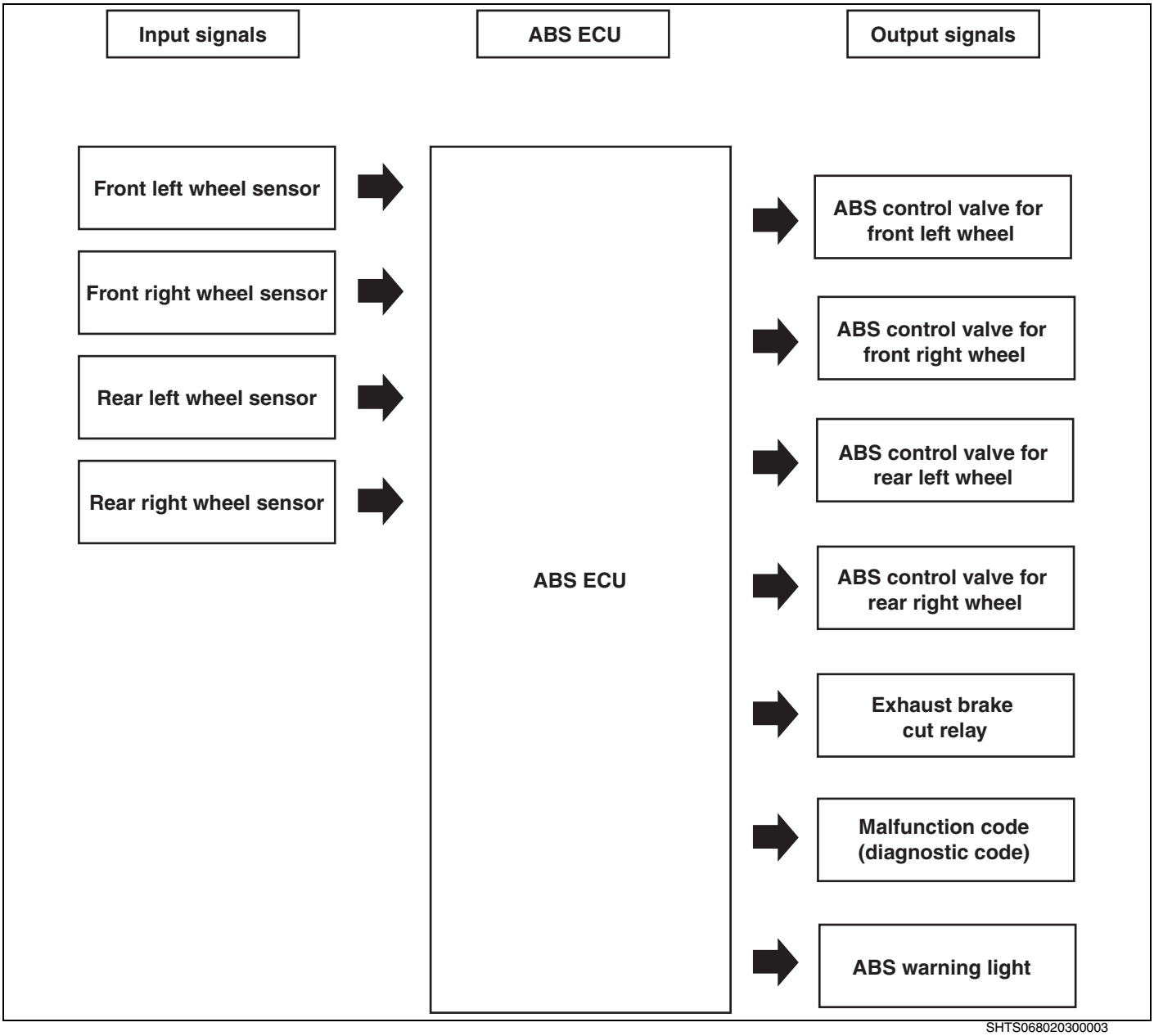


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1	Brake valve	5	ABS ECU
2	Brake chamber	6	Wheel sensor
3	Relay valve	7	ABS warning light
4	ABS control valve	A	From air tank

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2. ABS CONTROL FLOWCHART



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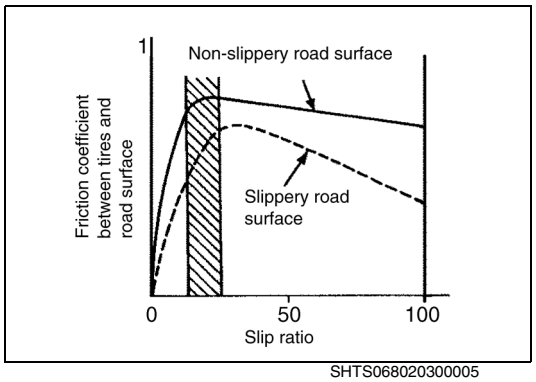
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BASIC PRINCIPLE

Based on its relationship with the slip ratio, which is determined from the wheels' rotational speed and the vehicle's speed, ABS controls the brake force so that it will be most effective.
When the driver applies the brakes, the rotation of the wheels is controlled and the vehicle speed drops. However, the momentum of the vehicle attempts to push it forward further even though the rotation of the wheels is being halted. At this point, slipping will occur if there is a gap between the wheels' rotational speed and the vehicle's speed. The slip ratio is a value that indicates the rate of slippage.

$$\text{Slip ratio} = \frac{\text{Vehicle's speed - Wheel's rotational speed}}{\text{Vehicle's speed}} \times 100\ \%$$

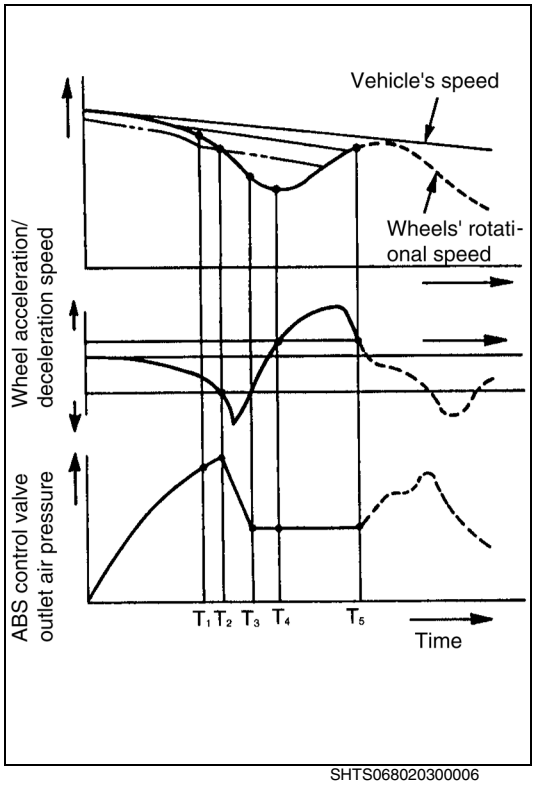
Slip ratio 0 % : No slipping between the wheels and the road surface
100 % : Wheels locked



SHTS068020300005

The graph shown at left shows the relationship between the friction coefficient of the tires and of the road surface and the slip ratio.
In an ABS-equipped vehicle, the brake force is controlled to ensure that it is within the range where the friction coefficient is high (shaded portion of the graph) without locking the wheels. This ensures efficient braking performance.

OPERATION



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The ABS control characteristics line graph at left illustrates how the vehicle's speed, the wheels' rotational speed, the wheel acceleration/deceleration, and the air pressure at the ABS control valve outlet change over time after the brakes are applied.
When the brakes are applied, the vehicle's speed and the wheels' rotational speed drop and at the same time, the wheel acceleration/deceleration speed also drops. At point T1, a gap begins to open between the wheels' rotational speed and the vehicle's speed. Passing on point T2, the ABS ECU detects that the wheels are beginning to lock and is lowering the outlet air pressure of the ABS control valve to prevent wheel locking from occurring.
At point T3, the wheel acceleration/deceleration speed is starting to return to normal one, and the ABS ECU stops lowering the air pressure at the ABS control valve outlet and maintains it at a constant level.
At point T5, the wheels' rotational speed and the vehicle's speed are about the same. The ABS ECU detects that the wheels are no longer likely to be locked and increases the air pressure at the ABS control valve outlet.
The above processes is repeated over and over until the vehicle comes to a complete stop.

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FUNCTION

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FAIL-SAFE FUNCTION

This ABS system is equipped with a fail-safe function that causes the ABS warning light on the instrument panel to light and to restore the normal (non-ABS) brake system, should an ABS malfunction occur.
Note that the ABS system consists of two independent circuits. Should a malfunction occur for whatever reason in the electrical circuits, that system's ABS is switched off and the normal brake system is restored while ABS control continued for the other system. This configuration is designed to minimize the effects of any malfunction on ABS function.

EXHAUST BRAKE CONTROL FUNCTION

The ABS of this vehicle is equipped with a function that controls the exhaust brake while ABS is operating. If the exhaust brake is applied independently or in conjunction with the service brake on a road surface with an abnormally low friction coefficient, the drive wheels may lock. This ABS prevents the drive wheels from locking in such situations by automatically releasing the exhaust brake, if necessary, during ABS operation.

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PRECAUTIONS WHEN DRIVING VEHICLES EQUIPPED WITH ABS

EN0680203F100001

Electronically, ABS uses the coefficient of friction (the amount of traction) between the tires and the road surface to monitor the speed of each wheel. If one or more wheels indicates the possibility of locking, resulting in fishtailing or other loss of stability, ABS enables the vehicle to be brought to a stop. Even with ABS, however, a driver must operate the vehicle in a safe manner and recognize the following points with respect to the operation of ABS.

CHECK POINTS	REMEDIAL ACTIONS
• Even with ABS, the braking distance on a wet or slippery road will be longer than on a dry road, and if the road surface is covered with ice, snow or gravel, the braking distance will be even greater.	• Even with ABS, always drive safely, taking into consideration the road and traffic conditions and the condition of your tires, including tire type and tire wear. Always keep a safe distance from any vehicle being driven in front of you.
• ABS does not operate when the vehicle is starting, accelerating or turning, and will not assist in maintaining directional stability or steerability or in shortening the braking distance. • Even if the ABS is operational, where the coefficient of friction is very low, such as on an icy roadway, skidding, inability to steer, and instability may occur because of insufficient traction by the tires.	• If engine braking causes instability or fishtailing, the clutch should be engaged or the transmission shifted to neutral, to prevent the application of the engine braking to the drive wheels.
• Where engine braking, as a result of downshifting, occurs on a surface with a low coefficient of friction, such as ice, the drive wheels may lock, causing fishtailing or vehicle instability. ABS does not operate unless the brake pedal is applied.	• If the air pressure becomes low and the air pressure warning light comes on and a buzzer sounds, immediately stop the vehicle in a safe place. Begin driving again only after the return to normal air pressure.
• If the ABS engages, the vehicle's air consumption rate will be higher than usual.	• Vibrations and noise during the operation of ABS are not malfunctions. Remain calm and continue to steer the vehicle in an appropriate manner.
• When ABS is activated, the driver may experience a small amount of vibration (especially if the road surface between the left and right tires is different) and difficulty in steering. Also, the operation of the ABS may generate some noise.	
• The ABS warning light will come on when you turn the starter switch to the "on" position. It stays on briefly and then turns off automatically. If the light does not come on, have your vehicle inspected and serviced immediately at your nearest HIno service dealer.	• If the warning llight lights up again when you reach a speed about 6 km/h (4 mph) the ABS system may not be functioning properly. Have it inspected and repaired if necessary * The warning light can be reset by turning off the engine while the vehicle is at rest. If the warning light fails to go out after the engine is restarted and the speed indicated above is reached, or if it lights frequency while the vehicle is being driven, the ABS must be

• <u>OTHER CHECKPOINTS REGARDING HANDLING</u>

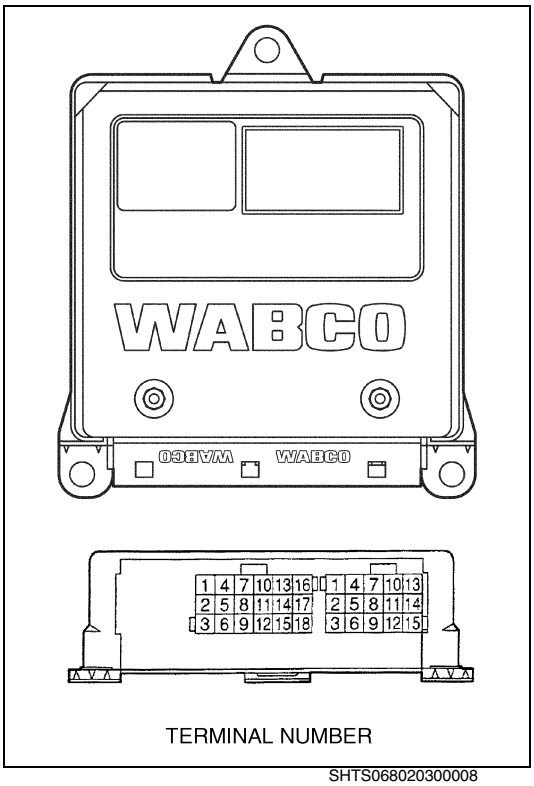
1. When washing the vehicle, take care not to direct high-pressure streams of water at the ABS control valves, harnesses, or connectors. Also, under no circumstances should the ABS ECU or electrical relays be exposed to water.
2. Be very careful not to damage the ABS wire harness when removing snow, ice, mud or other material from the outside or underside of the vehicle.
3. All electronic and radio equipment installed on the vehicle must be mounted as far away from the ABS ECU and wire harness as possible. Installation of certain electronic and radio equipment can also cause the ABS ECU to malfunction. All such equipment must also conform to all applicable laws. If you wish to install a radio or other electronic equipment, please contact your Hino service representative.

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OVERVIEW AND FUNCTION

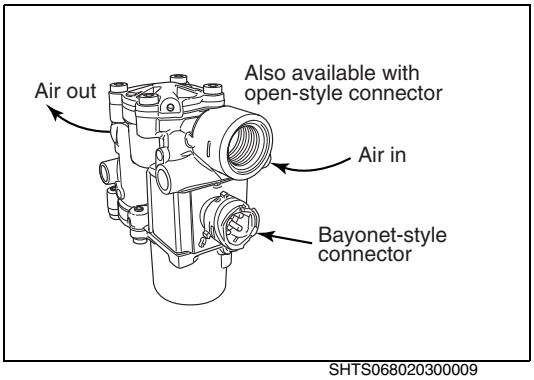
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1. ABS ECU

Based on pulse signals from the wheel sensors, the ABS ECU mounted in the vehicle calculates and evaluates the slip ratio and the acceleration/deceleration speed of the wheels. Based on the results, it sends signals to the ABS control valves as necessary, causing them to operate and apply the brakes to maintain the slippage of the wheels within the optimal range.
During braking, the air pressure applied to the brake chambers is regulated to prevent the wheels from locking. The brakes are applied so as to maintain the slippage of the wheels within the optimal range.
Regardless of whether the vehicle is stopped or being driven, and whether or not the brakes are being applied, the circuit consisting of the wheel sensors, control valves, ABS ECU, and wire harnesses are constantly being checked by the ABS ECU's fail-safe circuit. If some sort of malfunction occurs, the fail-safe circuit warns the driver by lighting the ABS warning light. At the same time, the ABS system that is experiencing the malfunction is shut off and braking is restored to normal (non-ABS) operation.



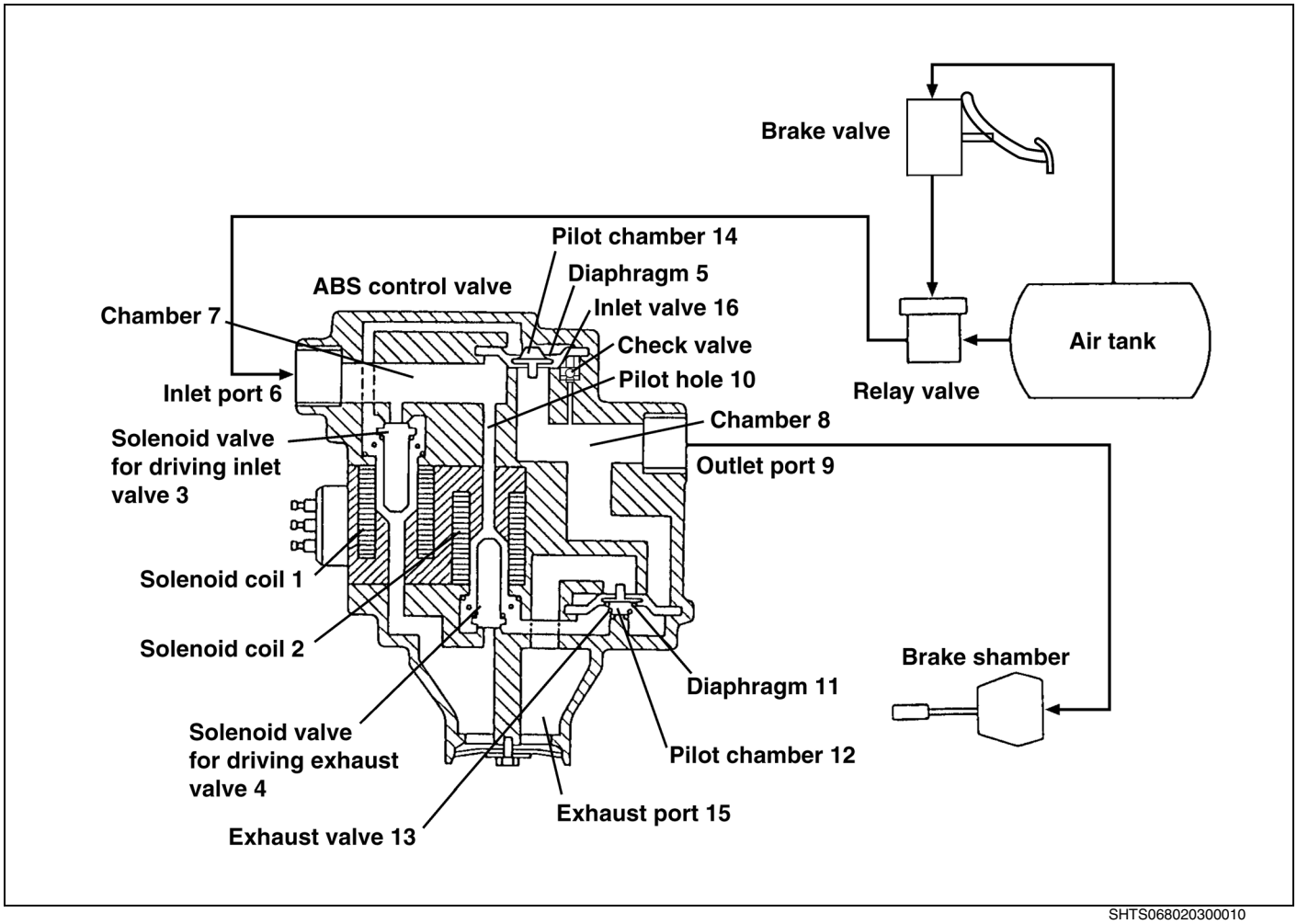
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2. ABS CONTROL VALVES

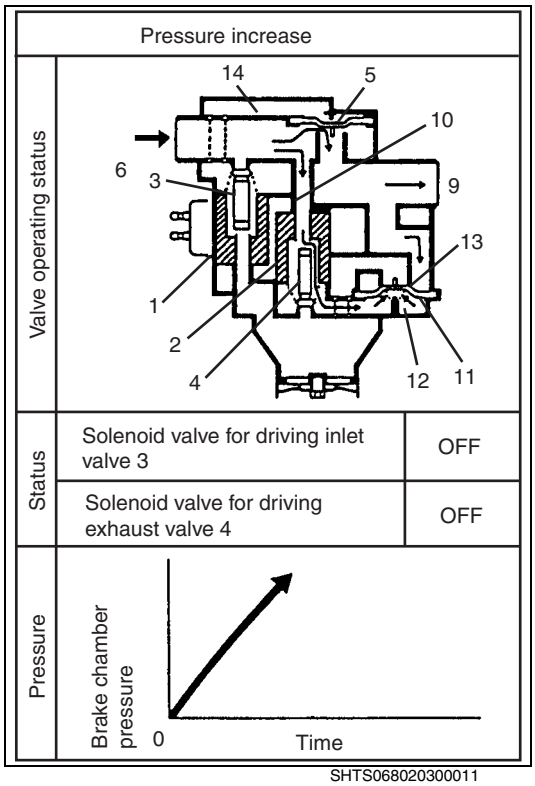
(1) Overview

- The ABS control valves are positioned in the brake air circuit on the way to brake chambers. Based on signals from the ABS ECU, they adjust the air pressure sent to the brake chambers in one of three modes: pressure increase, pressure reduction, or pressure maintenance.

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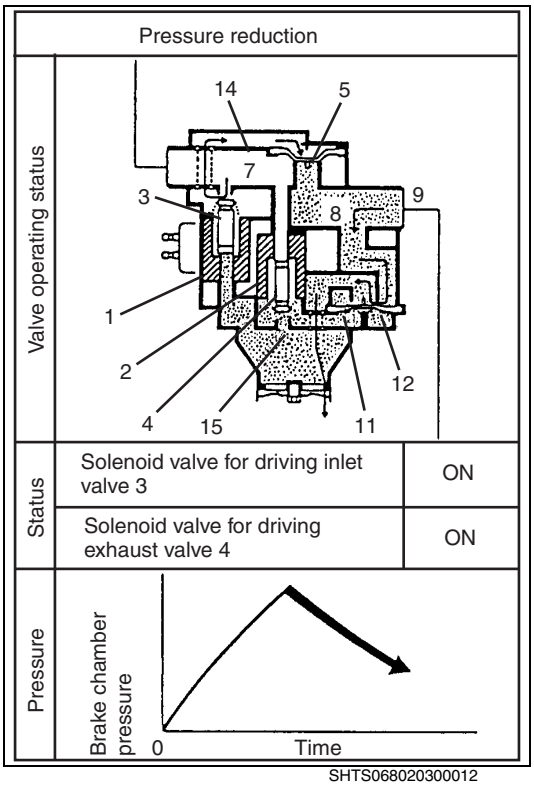
SHTS068020300011

(2) Operation

a. PRESSURE INCREASE MODE

- When the driver steps on the brake pedal, air from the relay valve enters through inlet port (6), pushes open diaphragm (5), passes through outlet port (9), and flows into the brake chamber. At this point, solenoid coil (1) is not energized, so solenoid valve (3) is closed and pilot chamber (14) is open to the atmosphere. Also, solenoid coil (2) is also not energized, so solenoid valve (4) is closed. As a result, air passes through pilot hole (10) and enters pilot chamber (12). It then pushes up diaphragm (11) and closes exhaust valve (13).

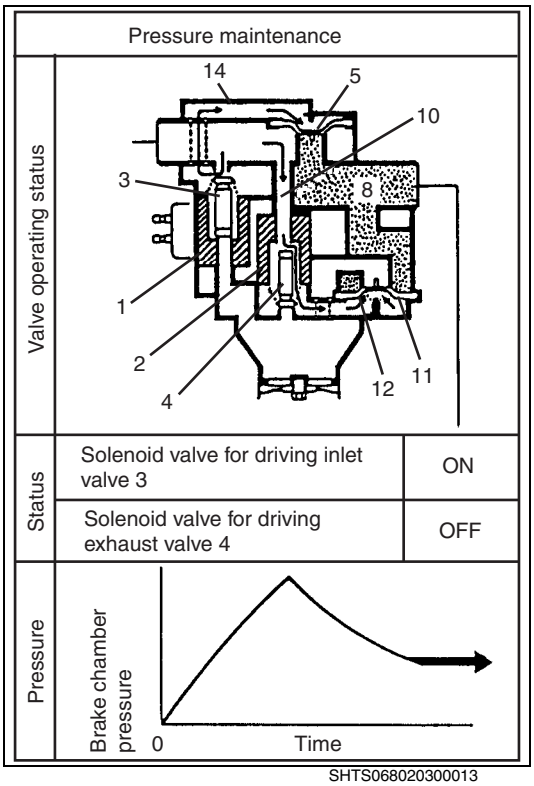
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b. PRESSURE REDUCTION MODE

- When solenoid coil (1) is energized, solenoid valve (3) opens and air also flows into pilot chamber (14). It pushes down on diaphragm (5), shutting off chambers (7) and (8). At the same time, solenoid coil (2) is also energized. This causes solenoid valve (4) to open and the operating air from pilot chamber (12) passes through exhaust port (15) and is released into the atmosphere. Consequently, the air from the outlet port (9) side (brake chamber) pushes down on diaphragm (11) and air is released into the atmosphere. This causes the air pressure of the brake chamber to decrease.

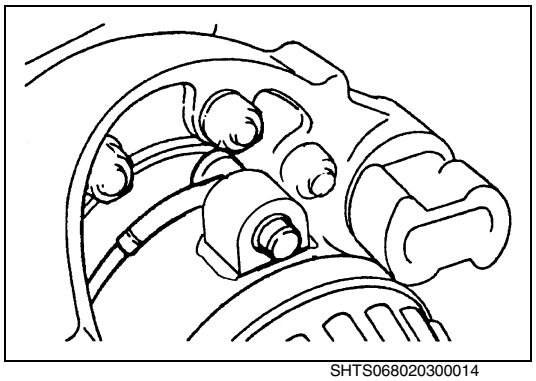


SHTS068020300013

c. PRESSURE MAINTENANCE MODE

- When solenoid coil (1) is energized, solenoid valve (3) opens and air flows through chamber (7) and acts on pilot chamber (14). On the other hand, since solenoid coil (2) is not energized, solenoid valve (4) is closed and air flows through pilot hole (10) and acts on pilot chamber (12). This causes diaphragms (5) and (11) to shut off their air passages, and the chamber (8) pressure, that is to say the air acting on the brake chamber, is maintained at the pressure that was current when the switch from the pressure reduction mode to the pressure maintenance mode took place.

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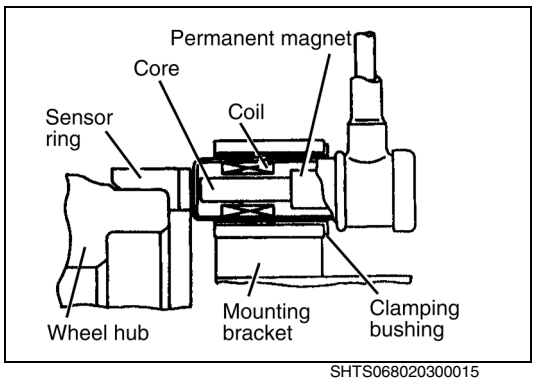

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3. WHEEL SENSORS

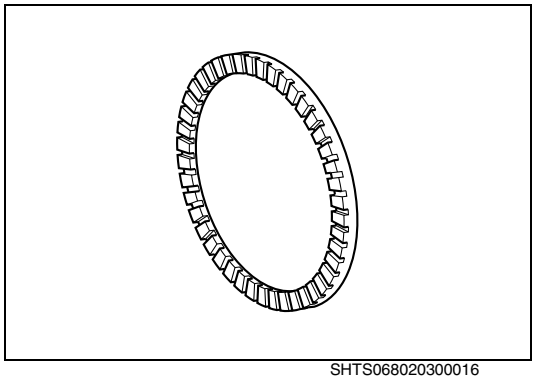
These sensors are mounted, facing the sensor rings on each wheel on the front and rear axles.

The wheel sensors are electromagnet sensors consisting of a permanent magnet core with a coil of wire wrapped around it.

The frequency of the pulse signals generated by magnetic inductance between the sensors and the sensor rings they face is proportional to the rotational speed of the wheels. These pulse signals are sent to the ABS ECU and are used to determine the wheels, rotational status.

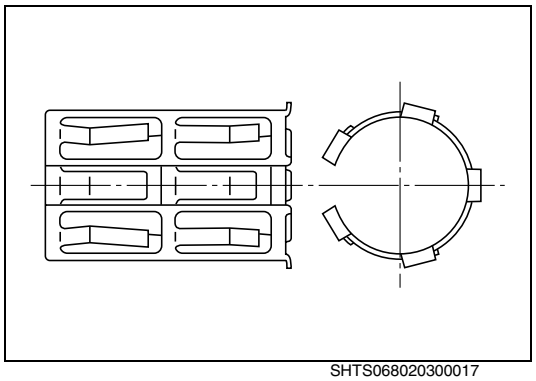


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SHTS068020300016

4. SENSOR RINGS

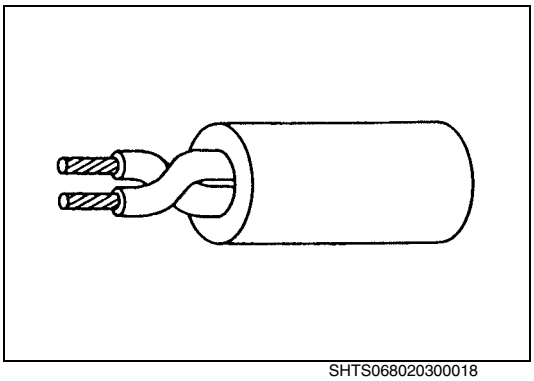
The sensor rings are press-fitted into the insides of the wheel hubs of each wheel on the front and rear axles, and they face the wheel sensors described in the preceding section. The sensor rings are made of a magnetic material, and teeth are cut into the surface which faces the wheel sensor at regular intervals. Also, when the sensor ring performs one complete rotation, the sensor generates pulse signals corresponding to the number of teeth.


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5. CLAMPING BUSHINGS

The wheel sensors are held in place through friction by clamping bushings that are inserted into the mounting brackets. If they are assembled properly, the clamping bushings serve to eliminate the need to adjust the clearance between the wheel sensors and sensor rings.

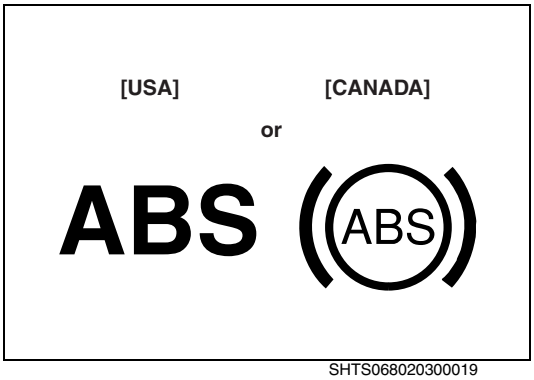
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6. WHEEL SENSOR HARNESSES

Each wheel sensor wire harness employs a two-conductor twisted wire cable. Its function is to protect the wheel sensor signals, which are vital to the proper operation of the ABS system, from electromagnetic interference. Under no circumstances should any part of the wheel sensor wire harnesses be cut or connected to any other wire.



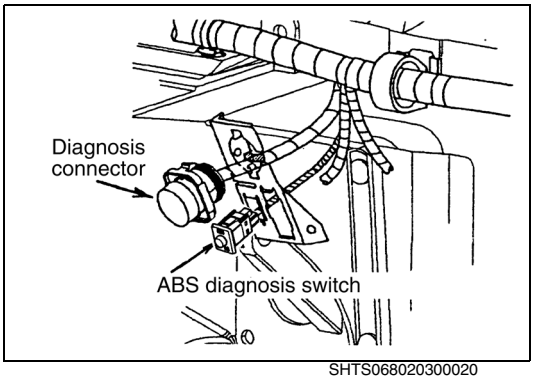
SHTS068020300019

7. ABS WARNING LIGHT

The status of the ABS system is indicated.
It lights when the starter switch is turned "ON" and automatically goes off when the system functions correctly.
If malfunction occurs in the ABS system while the vehicle is being driven, the light comes on to alert the driver.
However, when a defects code is eliminated after repairing it and the starter switch is turned "ON", the light will remain lit until the vehicle speed reaches about 6 km/h {4 mile/h}.
Then, note that even when the warning light is lit, the ABS system, unaffected by the malfunction, continues to operate. Also, the brake whose ABS system experiences the malfunction is reverted to normal braking operation without ABS.
When a Diagnosis switch is turned "ON", this light will goes on and off, which indicates defect code.

8. EXHAUST BRAKE CUT RELAY

When this relay is energized during ABS operation, the relay contact opens, the current to the solenoid valve for the exhaust brake is shut down, and the exhaust brake is released.



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9. DIAGNOSIS SWITCH OF ABS SYSTEM

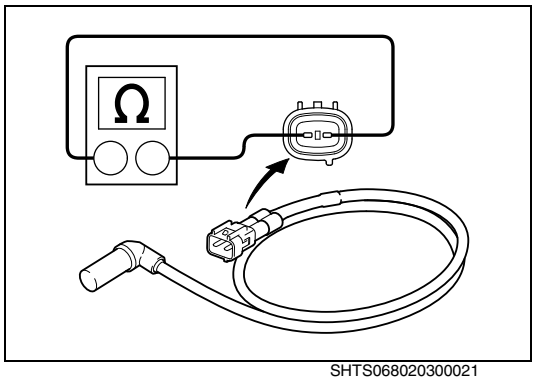
It is positioned at the side of diagnosis connector in the instrument panel of driver seat front side.
By switching the starter key "ON" and pushing to "ON" this ABS diagnosis switch, which is led to the diagnosis mode, the ABS warning light flashes on and off to inform the trouble codes.

NOTICE
ABS diagnosis switch reverts automatically to "OFF" position.

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INSPECTION (FRONT WHEEL BRAKE)

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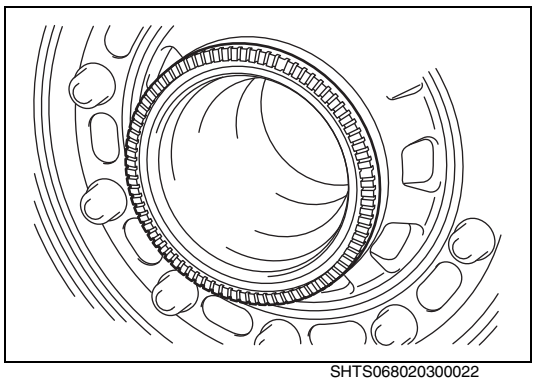


SHTS068020300021

1. INSPECTION OF ONLY WHEEL SENSOR

(1) With a tester, measure the resistance of wheel sensor.
Standard: 900-2,000 Ω

(2) When the measured value is out of the basic standard, change the wheel sensor as it might be considered presumably to be abnormal.

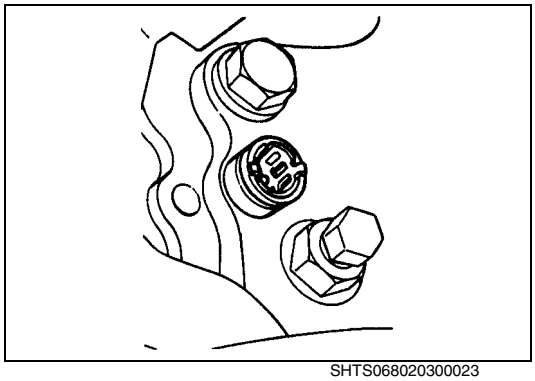

SHTS068020300022

2. INSPECTION OF THE SENSOR RING.

(1) Make a visual inspection to check for damage or deformation of the sensor ring, and also to make sure it is not coming loose from the wheel hub.

(2) If any damage or malformation is discovered, replace the sensor ring.

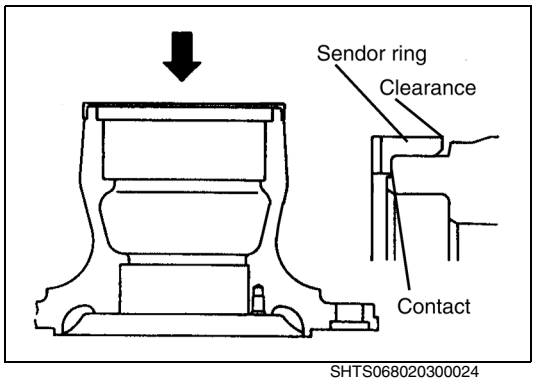
(3) If the sensor ring is coming loose from the wheel hub, use a dolly block and press it in with a press again.


SHTS068020300023

3. INSPECTION OF THE CLAMPING BUSHING.

(1) Make sure that wheel sensor is securely fixed.

(2) Change the clamping bushing when it can be pulled off or pushed in with a weak force.



SHTS068020300024

4. MOUNTING THE SENSOR RING

(1) Place the sensor ring on the wheel hub and use the dolly block and a press to evenly pressure mount it.

NOTICE

Warming up the sensor ring with hot water will make it easier to pressure mount it. Do not use a gas burner or the like to warm the sensor ring. Doing so could cause malformation of the sensor ring.

(2) After pressure mounting it, check for flutter of the sensor ring in the axle direction.
Assembly standard: Less than 0.2 mm {0.0078 in.}

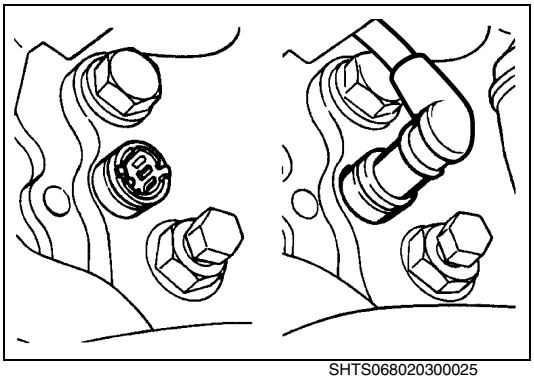
https://truckmanualshub.com/

5. MOUNTING THE WHEEL HUB AND BRAKE DRUM

(1) Refer to CHAPTER, FRONT AXLE.

NOTICE

If the wheel sensors are mounted, hammering on the wheel hubs and the like on that axle could cause internal damage to the wheel sensors. Either mount the tire and then tap on the tire or tap on the wheel hub after removing the right and left wheel sensors.



SHTS068020300025

6. MOUNTING THE WHEEL SENSOR

(1) Push in the clamping bushing until the stopper makes contact with the knuckle's wheel sensor holder.

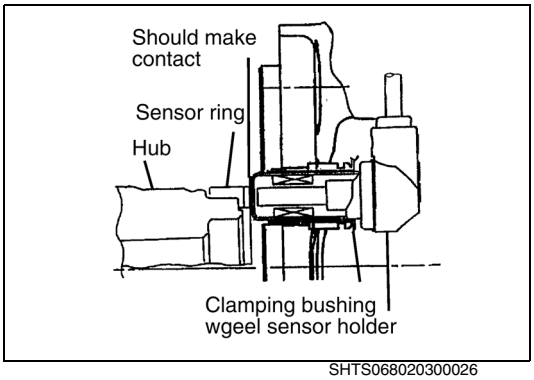
(2) Apply a light coating of chassis grease to the hub of the wheel sensor. Then push it forcefully into the clamping bushing until you feel that the wheel sensor has made contact with the sensor ring.

NOTICE

When inserting the wheel sensor, do not tap on it with a hammer or attempt to pry it into place with a screwdriver, or the like. Doing so could damage the wheel sensor.

(3) Slowly turn the wheel hub and brake drum and confirm that they move smoothly.

(4) Mount the drum dust cover.



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7. INSPECT THE WHEEL SENSOR

(1) Arrange the wire harness.

(2) With a circuit tester, confirm the output voltage of the wheel sensor (By rotating the tire by one time for 2 seconds)

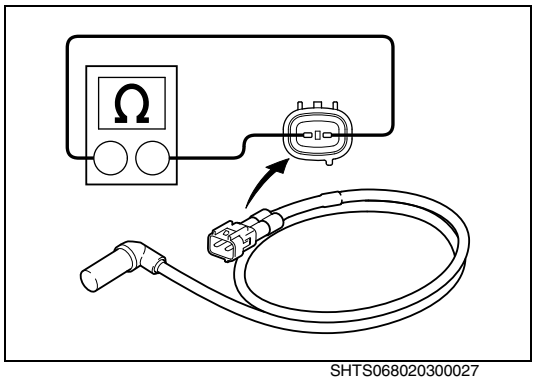
Standard: more than 200 mV

(Range of Alternating Current Voltage)

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INSPECTION (REAR WHEEL BRAKE)

EN0680203H300002

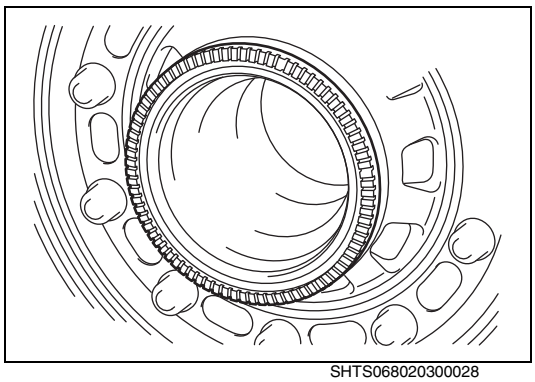


SHTS068020300027

1. INSPECTION OF ONLY WHEEL SENSOR

(1) With a tester, measure the resistance of wheel sensor.
Standard: 900-2,000 Ω

(2) When the measured value is out of the basic standard, change the wheel sensor as it might be considered presumably to be abnormal.

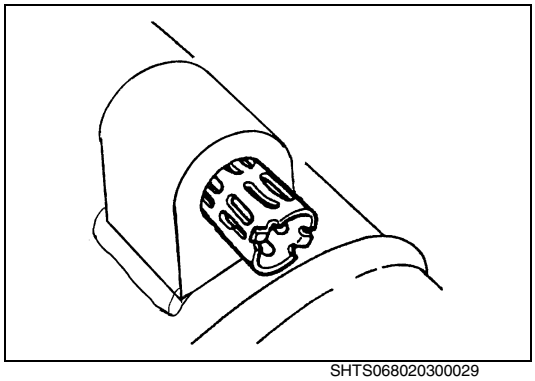

SHTS068020300028

2. INSPECTION OF THE SENSOR RING.

(1) Make visual inspection to check for damage or deformation of the sensor ring, and also to make sure it is not coming loose from the wheel hub.

(2) If any damage or malformation is discovered, replace the sensor ring.

(3) If the sensor ring becomes loose from the wheel hub, use a dolly block and a press to pressure mount it again.


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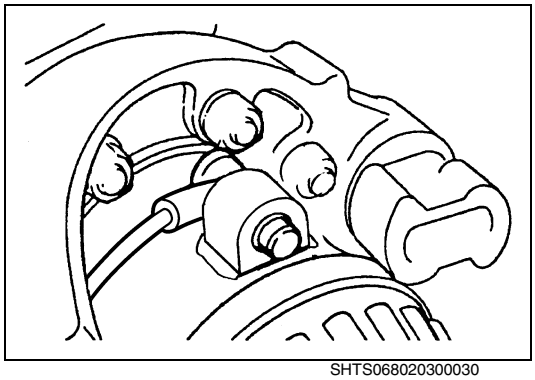
3. INSPECTION OF THE CLAMPING BUSHING.

(1) Make sure that the wheel sensor is securely fixed.

(2) Change the clamping bushing when it can be pulled off or pushed in with a weak force.

4. MOUNTING THE WHEEL SENSOR

(1) Push in the clamping bushing until the stopper makes contact with the wheel sensor holder.


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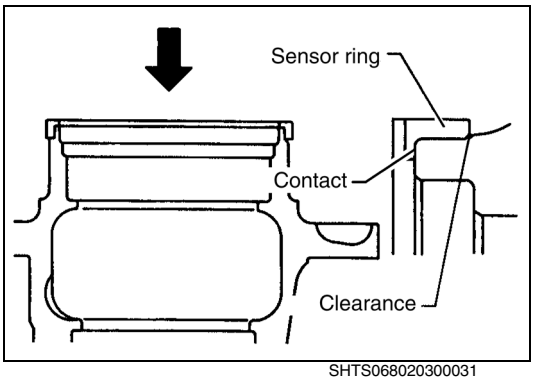
(2) Push the wheel sensor fully in the wheel sensor holder with hands until the wheel sensor makes contact with the clamping bushing.

NOTICE

When inserting the wheel sensor, do not tap on it with a hammer or attempt to pry it into place using a screwdriver, or the like. Doing so could damage the wheel sensor.

(3) Arrange the wire harness.

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5. MOUNTING THE SENSOR RING

(1) Place the sensor ring on the wheel hub and use the dolly block and a press to evenly pressure mount it.

NOTICE

Warming up the sensor ring with hot water will make it easier to pressure mount it. Do not use a gas burner or the like to warm the sensor ring. Doing so could cause malformation of the sensor ring.

(2) After pressure mounting it, check for flutter of the sensor ring in the axle direction.
Assembly standard: Less than 0.2 mm {0.0078 in.}

6. MOUNTING THE WHEEL HUB AND BRAKE DRUM

(1) Refer to CHAPTER REAR AXLE.

NOTICE

- **Be careful not to push back the wheel sensor too far when mounting the wheel hub and brake drum. Also, make sure they are straight so that you do not bump the tip of the wheel sensor.**
- **When inserting the outer hub bearing, avoid tapping on it with a hammer as this will expose the wheel sensor to bumps. Insert the outer hub bearing carefully with a lock nut.**

7. INSPECT THE WHEEL SENSOR

(1) Arrange the wire harness.

(2) With a circuit tester, confirm the output voltage of the wheel sensor (By rotating the tire by one time for 2 seconds)
Standard: more than 200 mV
(Range of Alternating Current Voltage)

(3) In case of out of the standard range at 2), remove the dust cover located on the back plate unit. Then push the wheel sensor by using a round end bar until the sensor contacts with the sensor ring.

NOTICE

Do not tap with a hammer or turn when pushing the wheel sensor. This may damage the wheel sensor.

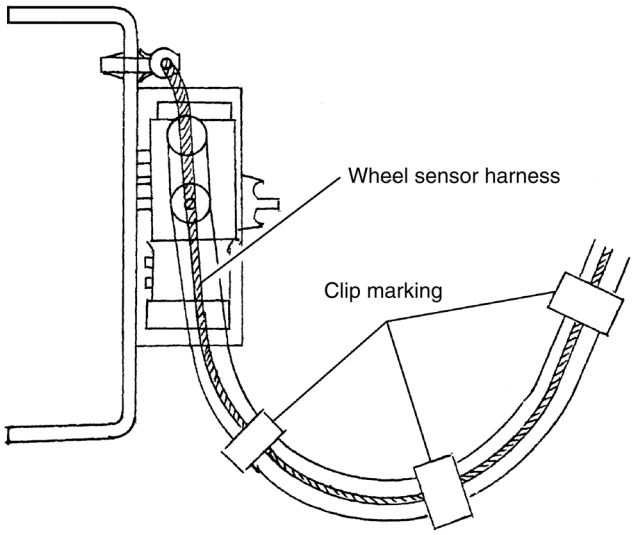
(4) Mount the axle shaft to the wheel hub and tighten the bolt on the axle shaft.
Refer to CHAPTER, REAR AXLE.

8. ABS WIRE HARNESSES

(1) Front axle ABS wire harnesses

- The front axle chassis harnesses, particularly the ones that pass over the front axle and extend as far as the wheel sensors, must absorb the movement when the wheels are turned and when the springs move. It is therefore necessary to always maintain an optimal spacing between the clips.
In addition, if there is a large amount of variation in the spacing between the clips, the wheel sensor harnesses can come into contact with tire chains and sustain damage.
The wire harness for the front axle wheel sensor extends directly from the clip on top of the king pin cover to the frame. In particular, make sure that the distance between the clip on top of the king pin cover and the clip on the frame side is as indicated in the diagram below. There are markings on the wheel sensors in cases where the wheel sensor harness clips are in locations where the relative movement is particularly great. These places should be inspected regularly to ensure that the clip positions are still meeting with the same marking.

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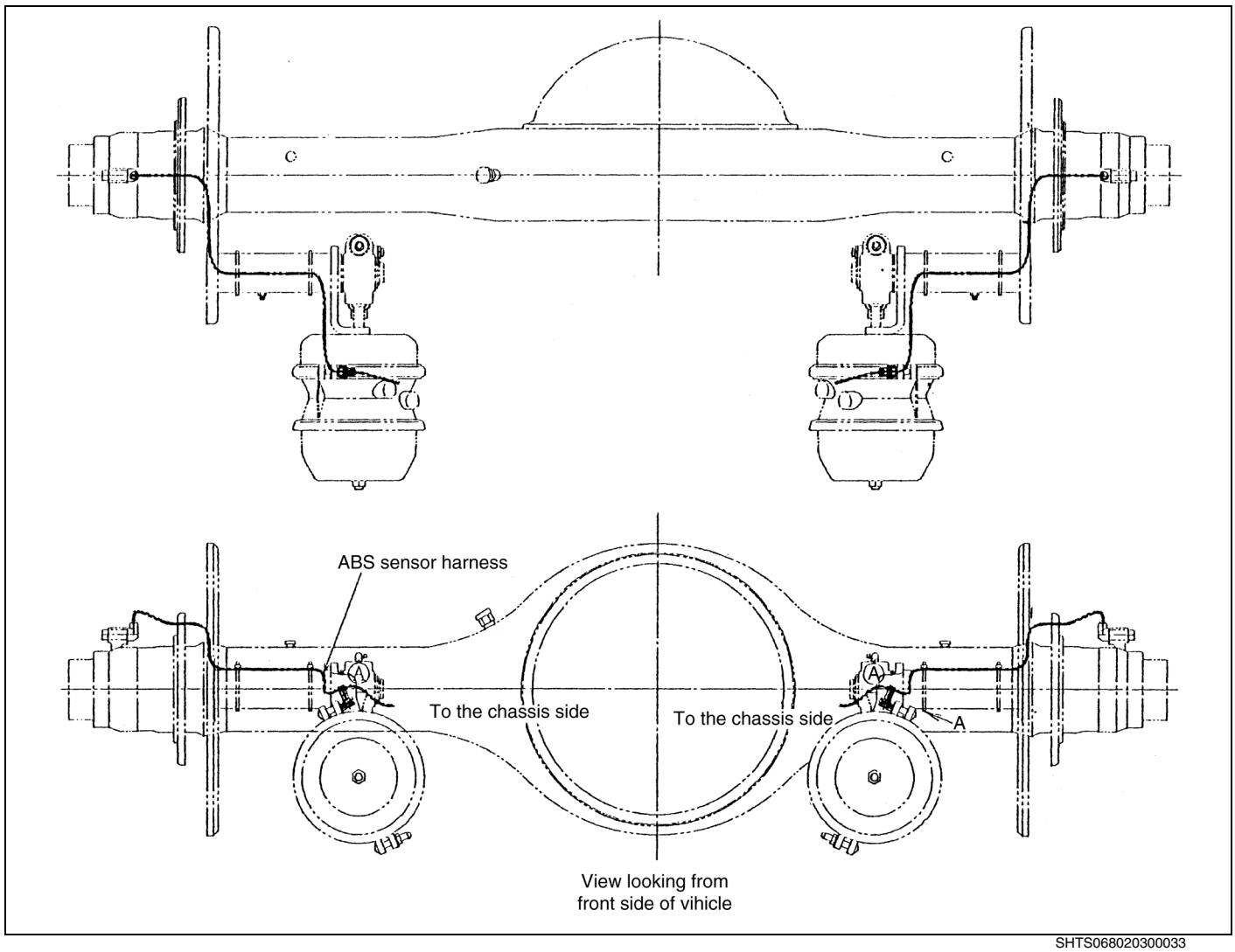
You shold lead the ABS wheel sensor harness back with the air hose.

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(2) Rear axle chassis harness

- The rear axle chassis harnesses is arranged so that the left and right wheel sensor harnesses are near each other. Therefore, special care should be taken not to make incorrect connections if the harnesses have been removed for inspection or repairs.
  If incorrect connections are made, it will interfere with the functioning of the ABS system. For this reason, caution plates indicating "LEFT" and "RIGHT" are affixed to the harnesses. Be sure to check when connecting the harnesses. (The left harness is on the left side of the vehicle when viewed from the behind and facing toward the front, and the right harness is on the right side of the vehicle.)
  The wheel sensor harnesses are arranged along the top of the rear axle housing. Therefore, make sure to allow sufficient harness length between the chassis and the rear axle so that the harnesses can absorb the up-and-down motion of the rear axle.



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HANDLING WIRE HARNESSES

- The various sensors, valves, relays and wire harness connections to the ABS ECU employ multipolar harness connectors suitable for use with the weak currents used by electronic circuitry. Be very careful when handling them.

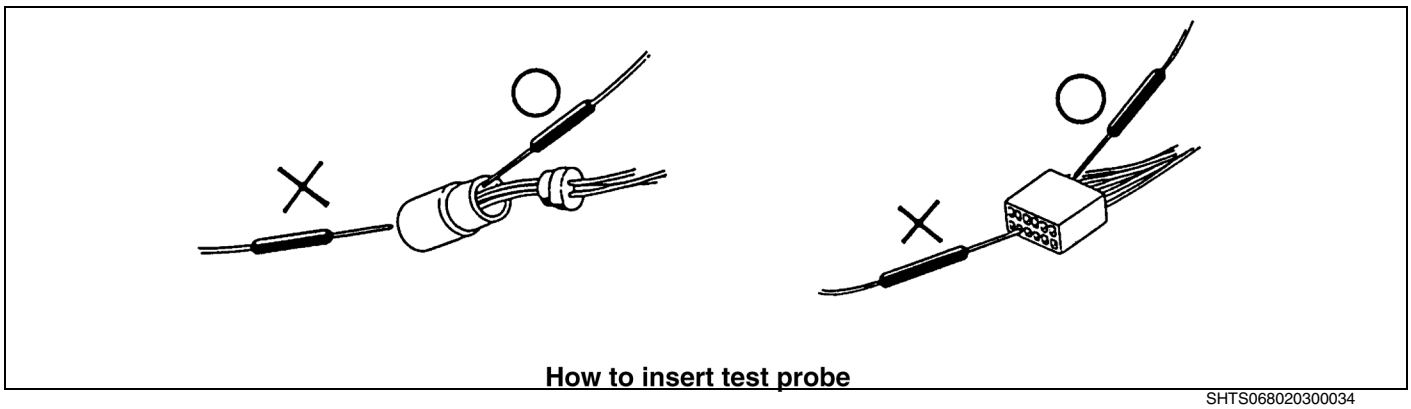
1. **Place the starter switch on "LOCK" before unplugging the harness connectors.**

2. **When unplugging the harness connectors, release the lock, hold the housing and unplug it straight as much as possible.**

3. **Do not pull holding the wire harness or pull with excessive force. Doing so can cause the pins of the harness connectors to be deformed.**

4. **Remove unnecessary connectors and do not plug them.**

5. **When inspecting using a circuit tester, insert the test probe from the wire harness side.**
   Never insert the test probe from the pins of harness connectors as this can cause bad contacts.



How to insert test probe

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6. **When unplugging the harness connectors, do not allow water, oil, dust, or any other liquid or substance to get on the terminals as they can cause bad contacts.**

7. **Be careful not to allow water, oil, dust, or any other liquid or substance to get on any component.**

8. **When plugging the harness connector, insert it completely and confirm that the harness connector lock is engaged.**

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ADDITIONAL PRECAUTIONS

1. Make sure the model's starter switch is in the OFF position before unplugging the harness connector from the ABS ECU.

2. Make sure to unplug all the harness connectors from the ABS ECU before performing welding on the chassis or body of the vehicle. Also be careful that welding sputter does not get onto the harnesses.

3. When cleaning the interior of the model, make sure water does not get onto the ABS ECU, various relays, connectors, or any other component.

4. Use of a circuit tester

- If a circuit tester is being used, always use one with an internal resistance greater than 100 kΩ inside the voltage measurement range.

5. Installation of a radio or other electronic equipment

- All electronic and radio equipment installed on the vehicle must be mounted as far away from the ABS ECU and wire harness as possible. Installation of certain electronic and radio equipment can also cause the ABS ECU to malfunction. All such equipment must also conform to all applicable laws. If you wish to install a radio or other electronic equipment, please contact your Hino service representative.

6. Quick battery charge

- When charging batteries using a quick charger, do it with both battery terminals removed.

7. Installation of electrical equipment inside of the cab

- When installing an air conditioner or other electrical equipment inside of the cab, be careful not to damage the engine, chassis, and wire harnesses inside the cab. Moreover, do not forget to plug the harness connectors unplugged during the installation.

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EXHAUST BRAKE

BR05-001

EXHAUST BRAKE SYSTEM BR05-2
SYSTEM DIAGRAM BR05-2
TROUBLESHOOTING BR05-3
ADJUSTMENT BR05-3

BRAKE CYLINDER.....BR05-5
DATA AND SPECIFICATIONS BR05-5
DESCRIPTION BR05-5

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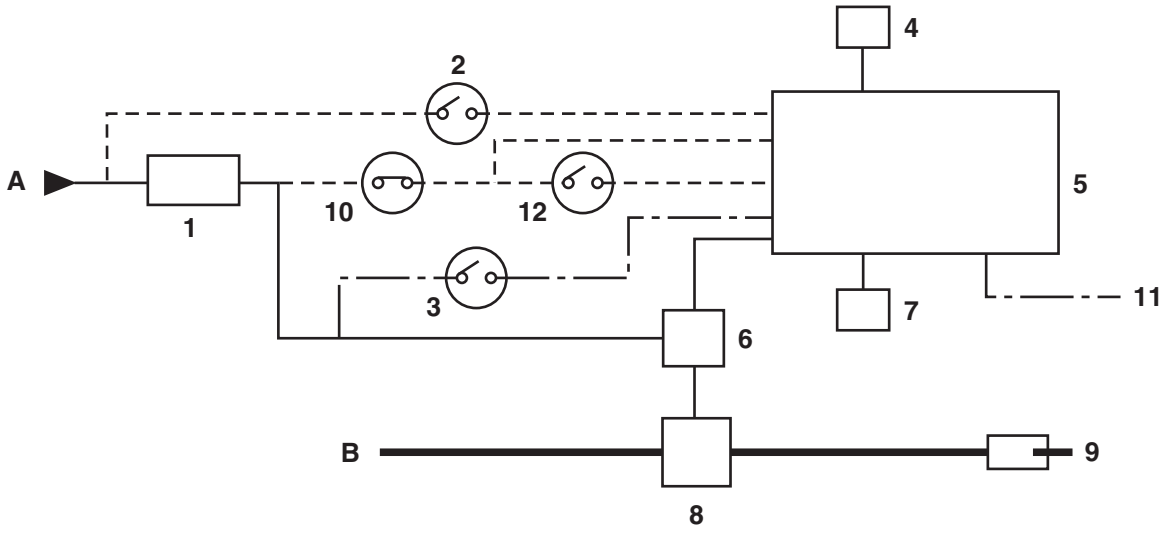
EXHAUST BRAKE SYSTEM

SYSTEM DIAGRAM

EN06Z0805J100001

Manual transmission

Fine line : Electric line
Thick line : Air line
Dotted line : In case of manual transmission



Automatic transmission and ultrashift transmission

No. 2, 10 and 12 circuit are less. Three is No. 3 instead of this with automatic transmission and UltraShift transmission. (One point chain line)

SHTS06Z080500001

1	ABS exhaust cut relay	8	Exhaust brake magnetic valve
2	Neutral switch (Manual T/M)	9	Exhaust control cylinder
3	Wiper and retarder switch (Automatic T/M and UltraShift T/M)	10	Exhaust clutch switch (Manual T/M)
4	Exhaust brake light	11	Signal of neutral
5	Engine U2 ECU	12	Wiper and retarder switch (Manual T/M)
6	U2 exhaust relay	A	From power source
7	Signal of engine stop	B	From air tank

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TROUBLESHOOTING

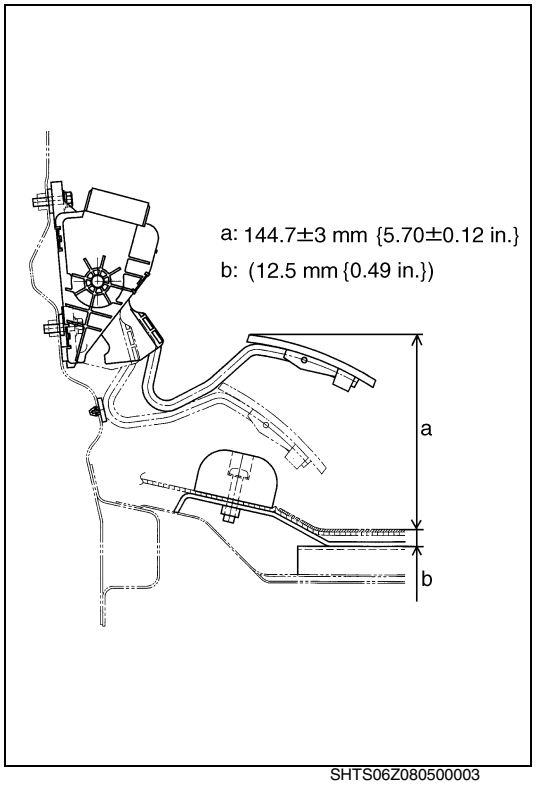
EN06Z0805F300001

Symptom	Possible cause	Remedy/Prevention
Switch does not work	Defective contacts	Check and correct.
	Open circuit in harness	Check and correct.
Valve does not close	Valve clogged with carbon	Remove carbon.
	Burnt shaft	Check and correct.

ADJUSTMENT

EN06Z0805H300001

ACCELERATOR SWITCH ADJUSTMENT



SHTS06Z080500003

1. ADJUST THE ACCELERATOR PEDAL HEIGHT.

(1) Adjust the accelerator pedal height at the accelerator pedal assembly mounting section.

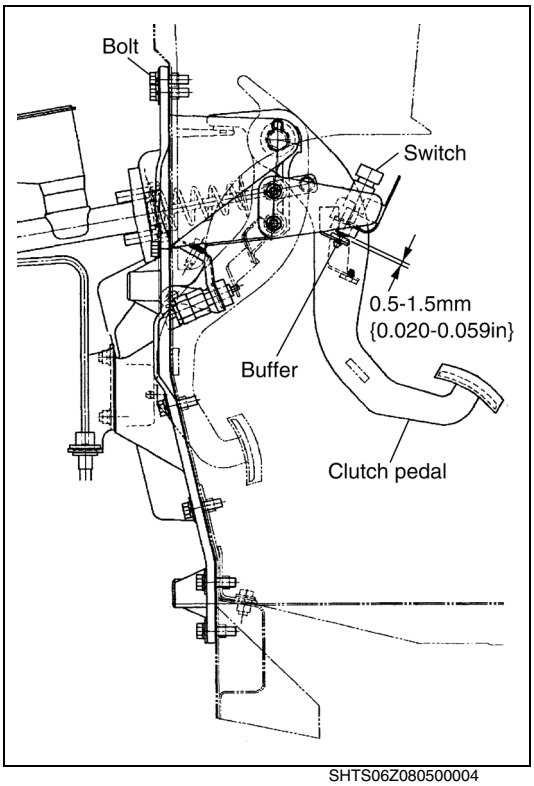
(2) ADJUST THE OUTPUT VOLTAGE OF THE ACCELERATOR PEDAL STROKE SENSOR.

a. Use HINO DX II to check the output voltage of the accelerator pedal stroke sensor. In case the output voltage does not conform to the standard, shift the mounting position of the sensor in the direction of rotation (at the long hole of the sensor) for adjustment or replace the sensor with new one.

Specific value **Units: V**

Idle (Pedal stroke: 0 mm {0 in.})	**Sensor No.1**	**0.7-1.0**
	Sensor No.2	**1.5-1.8**
Full (Pedal stroke: MAX)	**Sensor No.1**	**3.1-4.0**
	Sensor No.2	**3.9-4.8**
Exhaust brake switch "ON"		**0.7-1.0**

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SHTS06Z080500004

CLUTCH SWITCH ADJUSTMENT (MANUAL TRANSMISSION)

The clutch switch should not be knocked against.
With the clutch pedal release, the clearance between the plastic bush and the clutch switch's tip should be 0.5-1.5 mm {0.020-0.059 in.}.
Assembly standard: 0.5-1.5 mm {0.020-0.059 in.}

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BRAKE CYLINDER

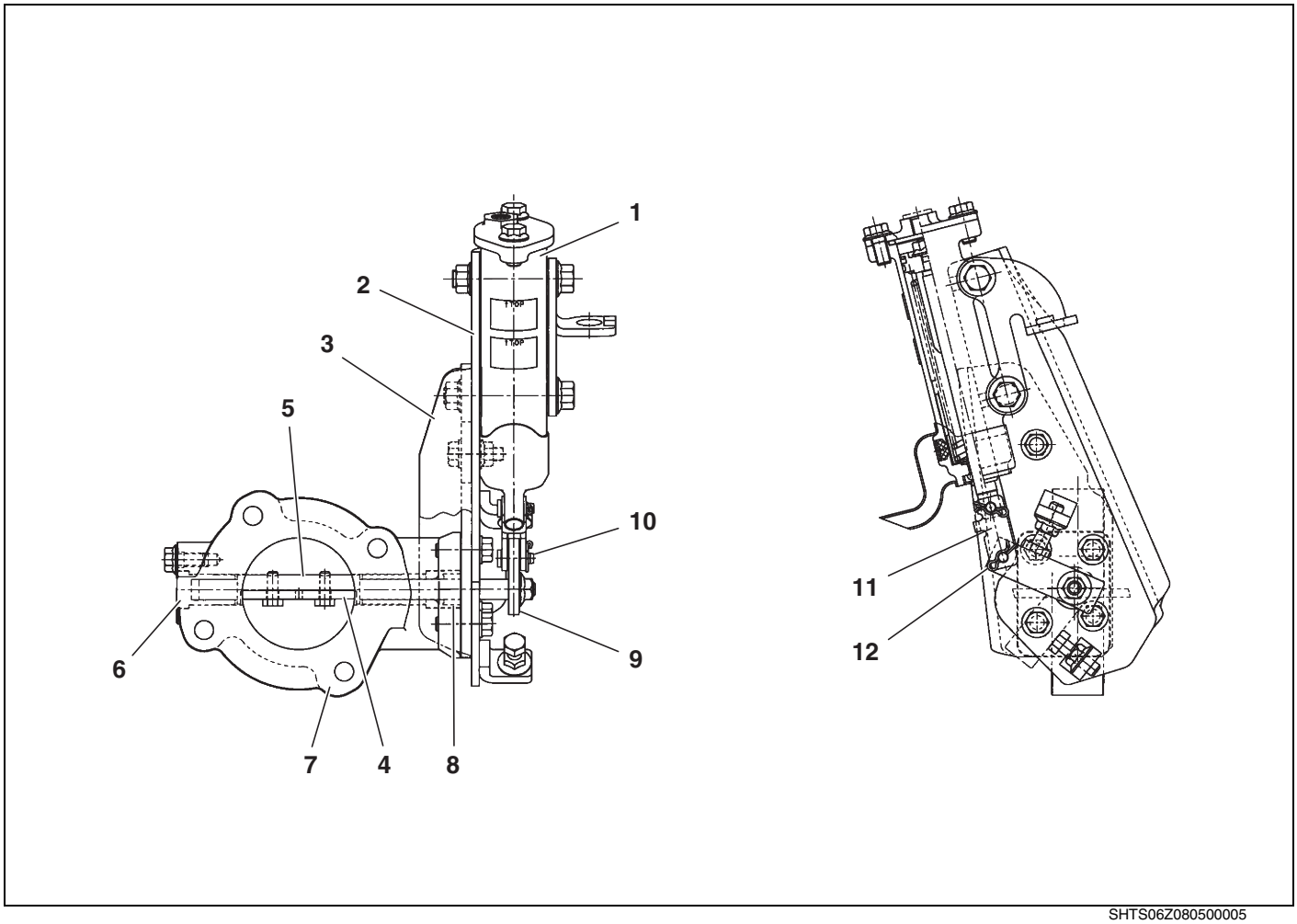
DATA AND SPECIFICATIONS

EN06Z0805I200001

Type	Butterfly valve

DESCRIPTION

EN06Z0805C100001



SHTS06Z080500005

1	Control cylinder	7	Body
2	Plate	8	Seal ring
3	Plate	9	Lever
4	Valve	10	Pin
5	Shaft	11	Clevis
6	Bush	12	Pin

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PARKING BRAKE (BOSCH 12")

BR07-001

PARKING BRAKE ASSEMBLY BR07-2

DATA AND SPECIFICATIONS BR07-2
DESCRIPTION BR07-2
TROUBLESHOOTING BR07-3
COMPONENT LOCATOR BR07-4
OVERHAUL BR07-6
INSPECTION AND REPAIR BR07-20
ADJUSTMENT BR07-21

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PARKING BRAKE ASSEMBLY

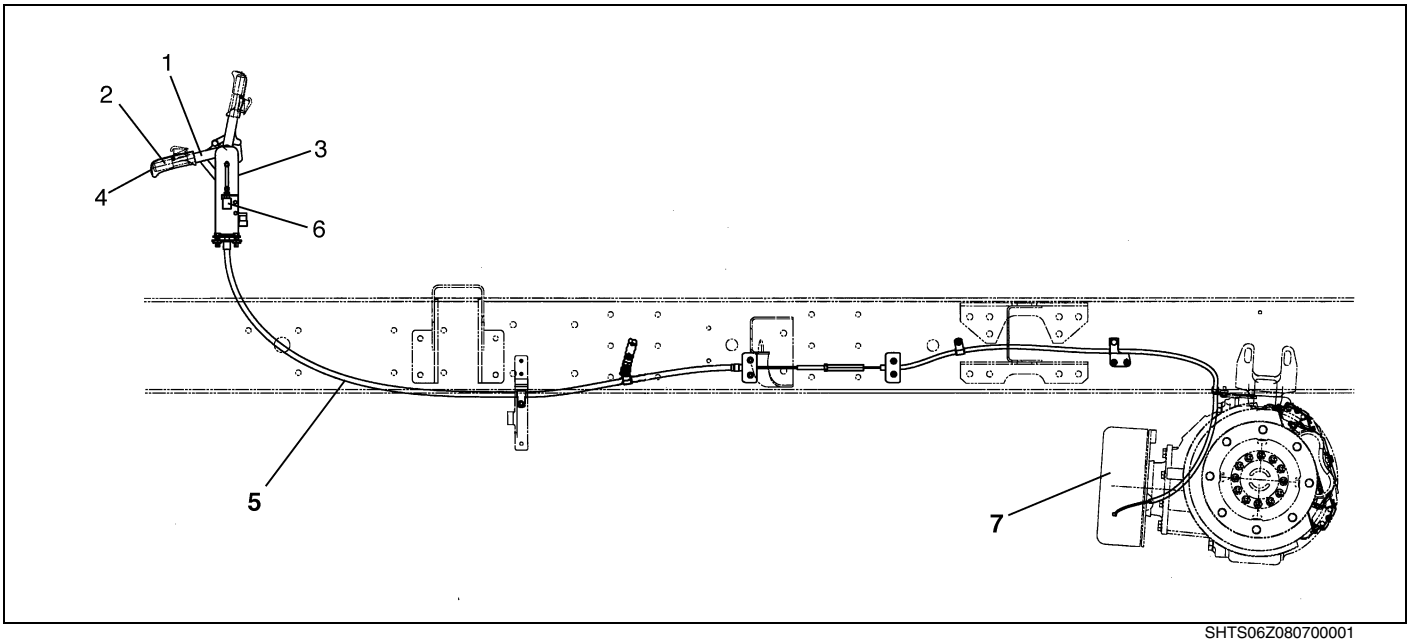
DATA AND SPECIFICATIONS

EN06Z0807I200001

Parking brake type	**Duplex Cam mechanical brake, internal expanding acting type**
Parking brake control type	**Lever type control with control cable**
Drum inside diameter	**304.8 mm {12.0 in.}**
Brake lining	**Width 76.2 mm {3.0 in}**

DESCRIPTION

EN06Z0807C100001



SHTS06Z080700001

1	**Parking brake lever**	**5**	**Parking brake cable**
2	**Knob**	**6**	**Parking brake switch**
3	**Brake lever bracket**	**7**	**Parking brake assembly**
4	**Knob cover**		

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TROUBLESHOOTING

EN06Z0807F300001

Symptom	Possible cause	Remedy/Prevention
Light force or lack of resistance when applying brake lever (on manual apply systems)	Shoe cage under-adjusted(*1)	Adjust shoes per cage adjustment procedure.
	Worn or deformed actuation components (lever, cam lugs shoe ends)	Inspect and replace per Anchor Screw, Lever and Cam. Replacement procedure or Shoe Replacement procedure
	Maladjusted control linkage	Readjust.
Heavy force or excessive resistance when applying when applying brake lever (on manual apply system)	Over adjusted brake	Adjust brake cage clearance diameter.
	Apply system over adjusted.	Adjust or repair per manufacture's recommended procedures.
Brake does not release.	Internal damage to brake.	Inspect and replace damaged components.
	Apply cable bound up.	Check cable for corrosion, binding, kinks, or damage.
	The parking brake lever in the cab is binding	Check the parking brake lever assembly for damage or corrosion. Repair or replace as needed.
Brake does not hold vehicle on hill.	Grease, oil or other foreign material on or embedded in shoe linings.	Replace shoes and clean drum(*2).
	Damaged or incorrect shoes.	Replace with correct shoes.
	Worn out lining (metal shoe run contacting drum)	Replace shoes and resurface or replace drum as necessary.
	Excessive drum runout.	Resurface or replace drum per manufacturer's recommended procedure.
	Shoe cage under-adjusted.	Adjust shoes per primary (or alternate) Shoe Cage Adjustment procedure.
	Worn or deformed actuation components (lever, cam lugs, shoe).	Inspect and replace per Anchor, Screw, Lever and Cam. Replacement procedure

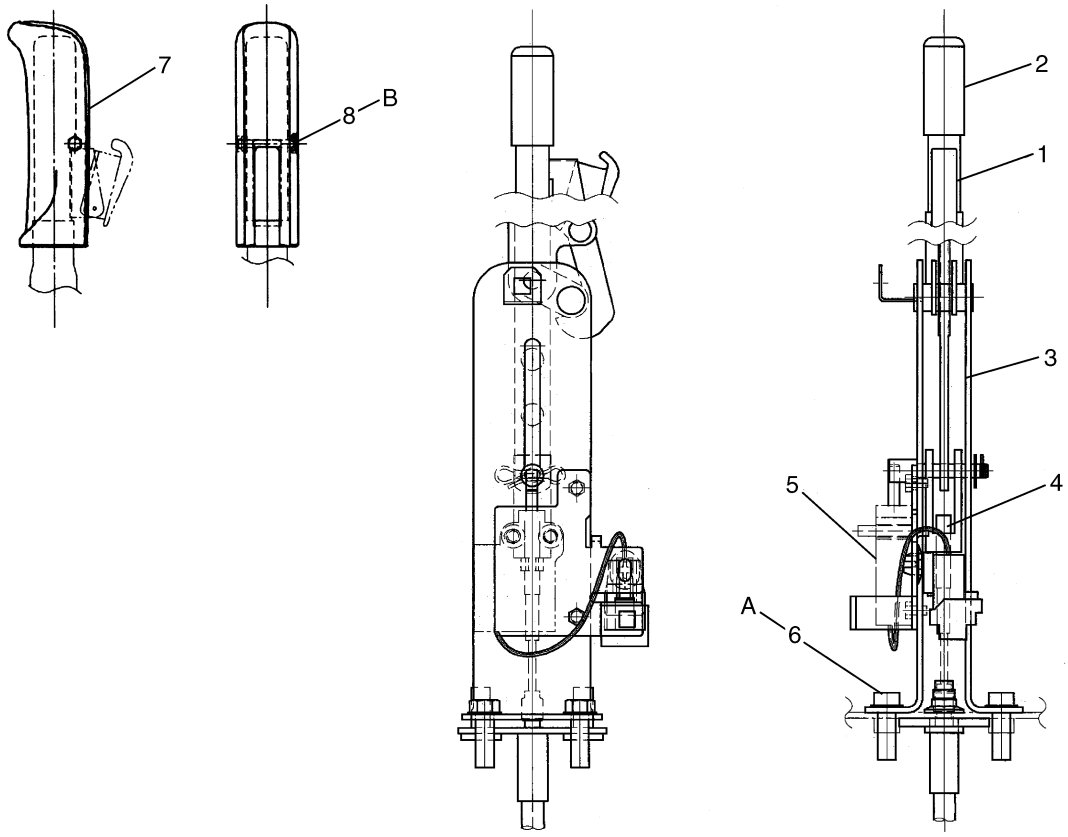
*1: Inspect adjuster components to see if any are damaged or jammed.
*2: Inspect the rear pinion seal for leakage that can contaminate the park brake system part. Repair as necessary.

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COMPONENT LOCATOR

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PARKING BRAKE LEVER



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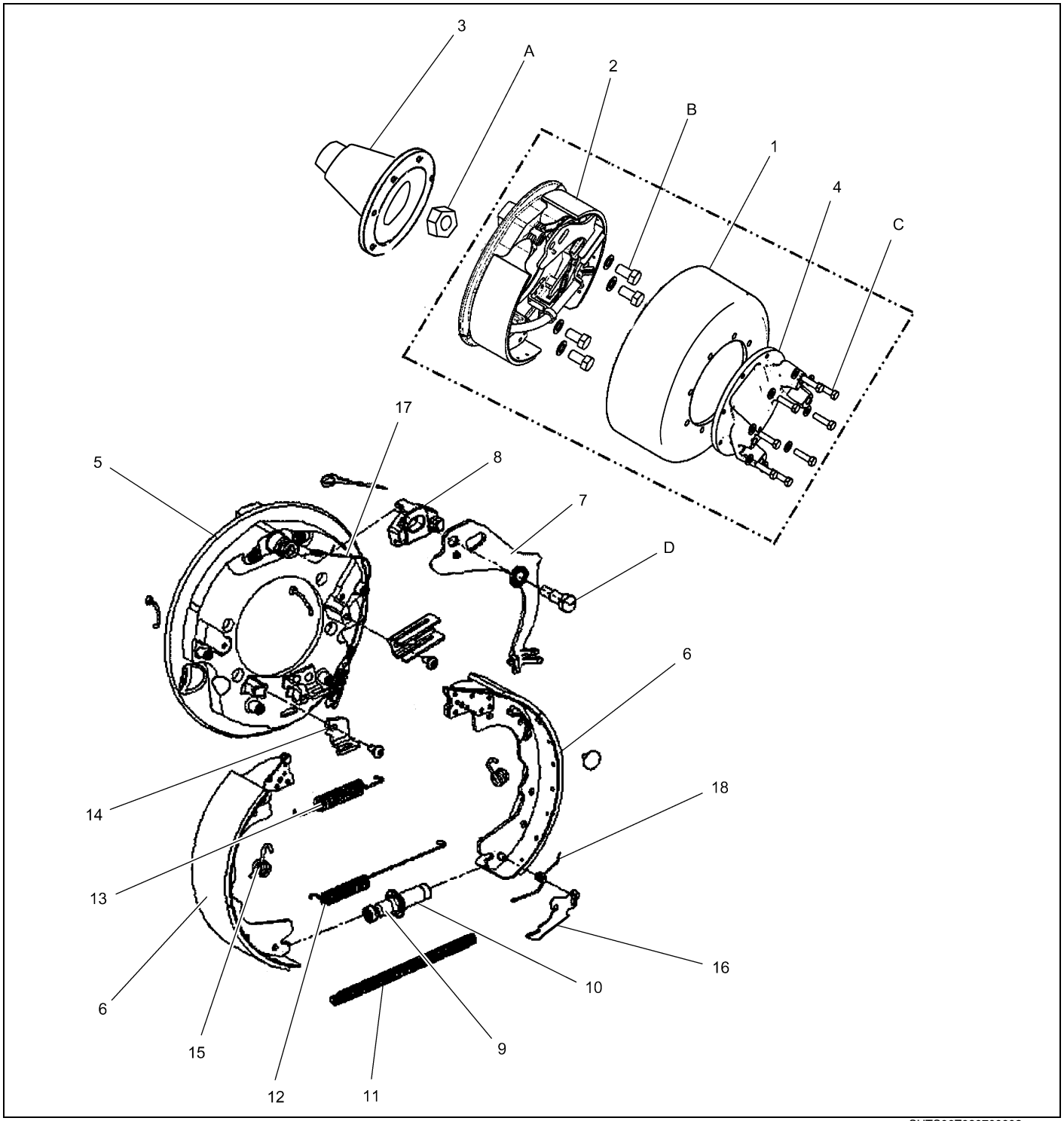
1	Parking brake lever	5	Parking brake switch
2	Knob	6	Bolt
3	Brake lever bracket	7	Knob cover
4	Clevis	8	Bolt

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	42-62 {430-630, 31-46}	B	1.1-1.9 {12-19, 0.9-1.4}

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PARKING BRAKE



SHTS06Z080700003

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1	Brake drum	10	Adjuster nut
2	Parking brake assembly	11	Lever return spring
3	Companion flange	12	Lower return spring
4	End yoke	13	Upper return spring
5	Backing plate	14	Hold-down bracket
6	Brake shoe	15	Hold-down spring
7	Lever	16	Auto adjuster lever
8	Cam plate	17	Adjuster cable
9	Adjuster screw	18	Auto adjuster spring

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	1,251-1,535 {12,757-15,653, 923-1,132 }	C	55-75 {561-765, 41-55}
B	270-350 {2,753-3,569, 200-258}	D	90-110 {918-1,120, 67-81}

OVERHAUL

EN06Z0807H200001

SHOE REPLACEMENT

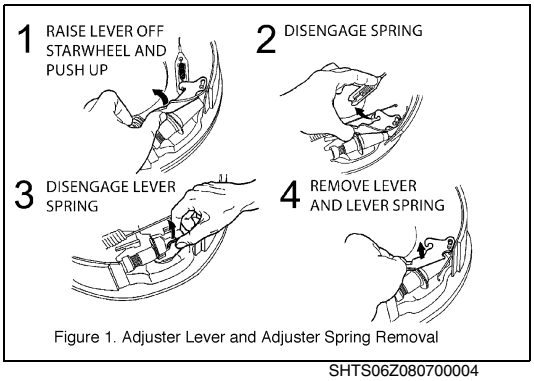


Figure 1. Adjuster Lever and Adjuster Spring Removal

SHTS06Z080700004

1. REMOVING THE SHOES

(1) Block the front wheels to keep the vehicle from moving.

(2) With the engine off and battery disconnected, place the transmission in gear and release the parking brake.

(3) If recommended in vehicle manufacturer's service manual, raise the rear of the vehicle so the wheels clear the floor and install safety stands to support.

(4) Remove the drum. See vehicle manufacturer's service manual for details, if necessary.

⚠ CAUTION

Do not use a drum puller or a torch to remove a brake drum. Drum distortion may result.

NOTICE

If the drum proves difficult to remove, insert a thin flat bladed screwdriver through the brake adjusting hole in the backing plate and disengage the adjuster lever from the adjuster nut teeth. With the adjuster lever disengaged as shown in Figures 8 and 9, insert a brake adjusting tool (or flat bladed screw driver) through the adjusting hole to engage the adjusting nut teeth. Move the teeth upward enough times to retract the brake shoes to clear the drum. If the drum is rusted to the axle input flange yoke pilot, tap the center of the brake drum with a nonmetallic mallet to loosen.

(5) Inspect the brake per the INSPECTION PROCEDURE in this service manual.

(6) Detach adjuster cable from adjuster lever, slide cable off of adjuster cable guide, and remove the cable retaining tab if so equipped. See Figure 1.

(7) Remove the adjuster lever and the adjuster spring. (These parts will need to be placed on the new replacement shoe, along with the adjuster lever mounting pin, in the opposite order removed.) See Figure 1.

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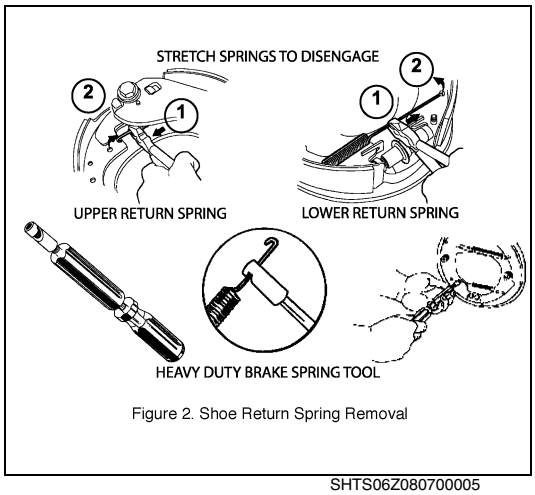


Figure 2. Shoe Return Spring Removal

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(8) Remove both shoe-return springs. Use pliers, vice-grips, or a heavy duty brake spring tool as shown in Figure 2.

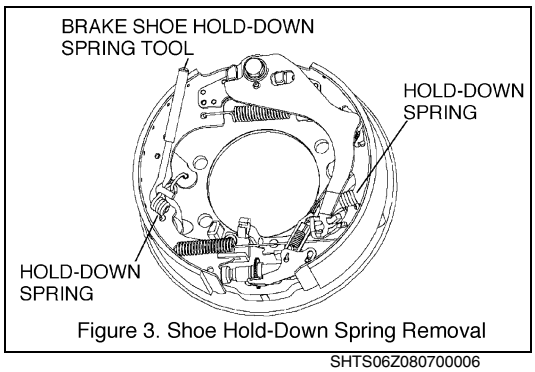


Figure 3. Shoe Hold-Down Spring Removal

SHTS06Z080700006

(9) Remove both shoe hold-down springs. Use a brake shoe spring tool as shown in Figure 3.

HINT

Detach the parking brake apply cable and lever return spring from the end of the lever to allow easier access to the spring on the lever side.

NOTICE

If the brake is a Release 2 level design with a lever guide present, it will need to be removed to provide access to the spring underneath with the tool shown in Figure 9. Upon removal of the hold down springs, the shoes, and the adjuster nut screw assembly will fall if not secured by hand.

(10) Remove brake shoes from backing plate.

(11) Disassemble the adjuster nut and screw assembly for cleaning and inspection of the threads.

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2. INSTALLING THE SHOES

⚠ WARNING

- **Failure to correctly assemble the Adjuster Cable may result in reduced brake performance that could cause personal injury or property damage.**
- **Torque all fasteners to the manufacturer's recommended torque using a torque wrench. Failure to do so could possibly result in personal injury or property damage.**

(1) Clean backing plate and adjuster screw assembly. Remove old grease from shoe contact points and adjuster threads as well as debris and corrosion that could contaminate linings or interfere with proper brake operation.

(2) Apply a light film of Wolfrakote paste ledge grease to the six (6) backing plate shoe ledges and one (1) anchor post as shown in Figure 4.

(3) Apply Chevron RPM heavy duty, lithium complex, molybdenum disulfide, extreme pressure grease, or equivalent, to the cam plate lugs where they contact the shoe ends, the end of the shoes that contact the cam lugs, and the brake lever.

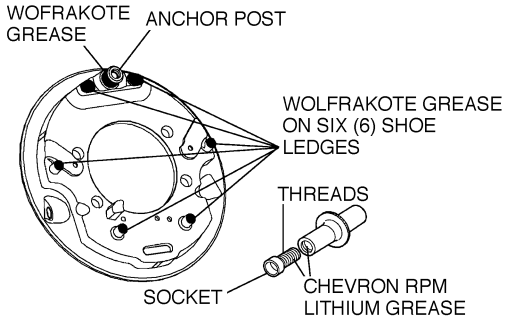


Figure 4. Application of Wolfrakote Paste Grease to Wear Points and Chevron RPM Lithium Shoe Grease to Adjuster Screw

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(4) Apply Chevron RPM heavy duty, lithium complex, molybdenum disulfide, extreme pressure grease to the threads of the adjuster screw, adjuster nut, and the socket ends of the adjuster nut and install the screw fully into the adjuster nut. Insure the screw moves in and out freely. If any damage to the threads prohibits free movement, or if the starwheel is damaged, replace adjuster assembly. See Figure 4.

NOTICE

- **Only use the approved lubricants as specified. Do not substitute.**
- **When installing new shoes, make sure the shoe with the adjuster cable guide and adjuster lever pin is installed on the correct side of the shoe. See Figure 5.**

(5) Place one shoe into the installed position. Reattach shoe hold-down spring and pin. See Figures 3 and 5.

⚠ CAUTION

For Steps (5) through (10), proper orientation of the various springs, including their hook-ends must be maintained, as shown in Figure 5, for proper brake function.

(6) Position the second shoe and the adjuster nut and screw assembly as shown in Figure 5. The adjuster nut (internally threaded) should be seated against the shoe with the adjuster cable guide and pin. Reattach shoe hold-down spring to shoe hold-down pin using the brake spring tool as shown in Figure 3.

(7) Install both shoe-return springs as shown in Figure 5.

(8) Install the adjuster spring and the adjuster lever. Ensure that the adjuster lever is properly seated against the starwheel as shown in Figure 5.

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(9) If the lever has been removed, reinstall lever and associated components per the ANCHOR SCREW, LEVER, AND CAM REPLACEMENT section in the manual.

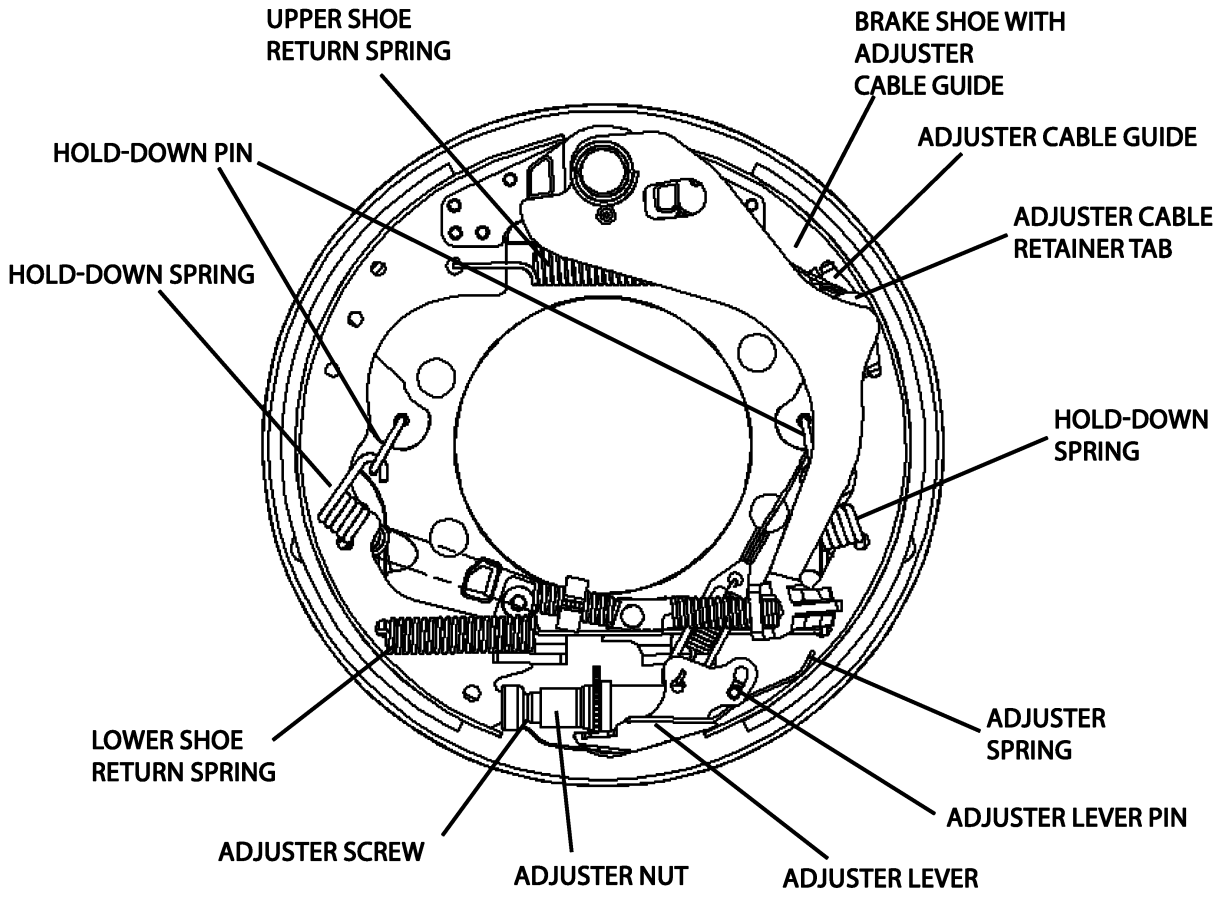


Figure 5. Brake Shoe Installation

SHTS06Z080700008

(10) Route the adjuster cable around the adjuster cable guide, under the shoe hold down spring, and attach to the adjuster lever as shown in Figure 6. Install adjuster cable retaining tab if so equipped.

NOTICE

Correctly assembled, the adjuster cable end-fitting is behind the adjuster lever, with the spring hook facing out as shown in Figure 6.

(11) The shoe cage should be adjusted now per the SHOE CAGE ADJUSTMENT PRIMARY procedure or after the drum has been reinstalled per the SHOE CAGE ADJUSTMENT ALTERNATE procedure in this service manual.

(12) Make a final inspection of the shoe linings and the inside of the drum to ensure that no grease or other contamination was accidentally applied.

⚠ WARNING

Keep grease and other foreign materials away from the shoe lining and drum surfaces. Contamination of shoe linings or drum surface may result in degradation of brake holding capability, possibly resulting in personal injury or property damage.

(13) Inspect, service and reinstall drum per the vehicle manufacturer's service manual.

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(14) Lower the vehicle and test the brake for proper function before returning the vehicle for service use. If necessary, make adjustments per the vehicle manufacturer's service manual.

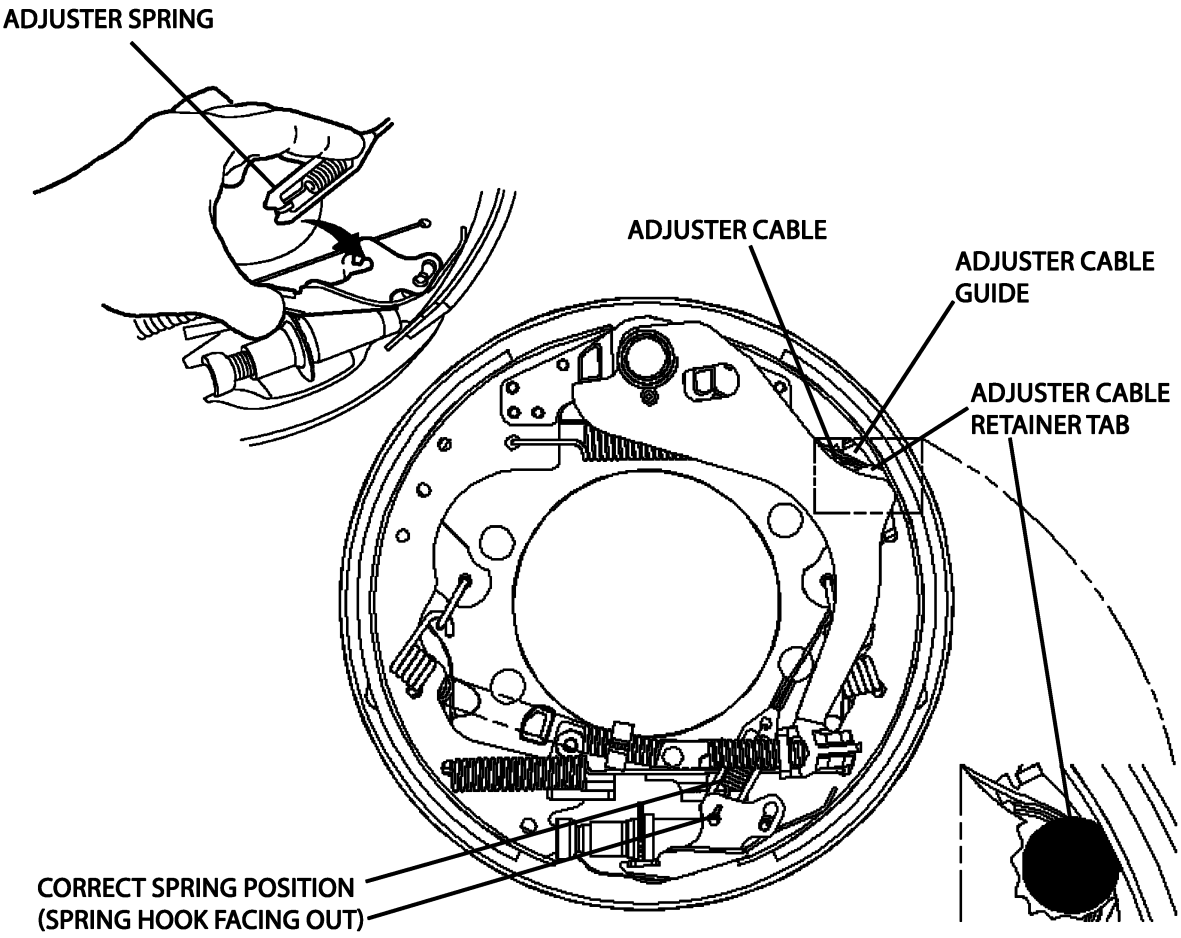


Figure 6. Adjuster Cable Installation

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SHOE CAGE ADJUSTMENT PROCEDURES

1. ADJUSTMENT WITH DRUM OFF - PRIMARY PROCEDURE

(1) Use a 12 inch caliper, or inside micrometer, to measure the inside diameter of the drum. Subtract 0.025 inches from the drum inside diameter measurement. Set the measurement caliper to this value, and lock the set screw.

(2) Rotate the axle input flange yoke as necessary to provide clearance for the measurement caliper.

(3) Place the pre-adjusted caliper over the shoes at the center of the shoes.

(4) To adjust brake, rotate the starwheel until the shoes touch the measurement caliper jaws. It is necessary to disengage the adjuster lever away from the starwheel. See Figure 7.

NOTICE

During adjustment the calipers should be moved up and down around the shoe center points to ensure adjustment at the highest points across the width of the shoes.

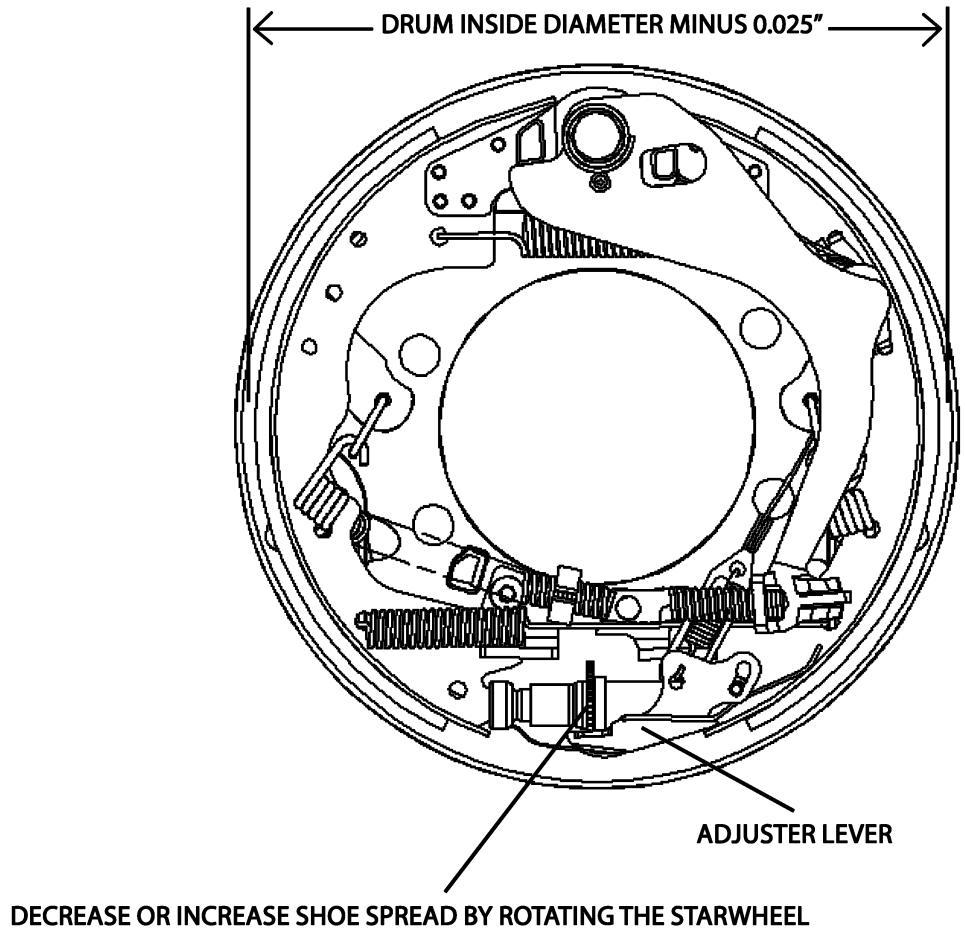


Figure 7. Initial Brake Shoe Adjustment

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2. ADJUSTMENT WITH DRUM INSTALLED - ALTERNATE PROCEDURE

(1) With the engine off, the battery disconnected, and the tires blocked to prevent vehicle movement, place transmission in neutral and fully release the parking brake. Check to see if the drum can be rotated back and forth by hand. If the drum cannot rotate, it will be necessary to raise the rear wheels off the ground, in order to allow rotation of the drum. Support the vehicle with suitable floor stands.

NOTICE

Some vehicles may not have enough clearance behind the park brake to have direct access through the access slot to the adjuster lever. In these cases, an adjuster lever tool can be made from 3/32"diameter welding filler rod. See Figure 10.

(2) Insert the adjuster lever tool or a thin flat bladed screw driver through the adjusting slot in the backplate and push on the adjuster lever to disengage it from the adjuster starwheel. Insert a brake adjusting tool (or flathead screwdriver) through the adjusting slot and move the starwheel teeth downward to expand the brake shoes outward. See Figures 8and 9. Continue expanding the shoes until the drum can not be rotated by hand.

(3) Now adjust the starwheel teeth upward to retract the shoes until the drum just begins to rotate freely by hand (without drag from the shoes). See Figures 8 and 9.

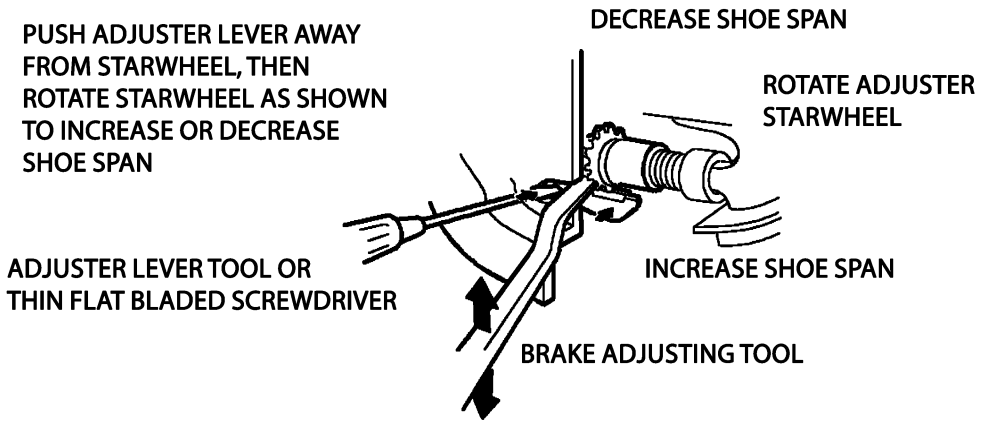


Figure 8. Brake Adjustment With Drum In Place (cut away view)

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3. DISENGAGING ADJUSTER LEVER FROM ADJUSTER STARWHEEL TO ALLOW RETRACTING THE BRAKE SHOES (LOOSEN BRAKE)

NOTICE

Some vehicles may not have enough clearance behind the park brake to have direct access through the access slot to the adjuster lever. In these cases, an adjuster lever tool can be made from 3/32 inch diameter welding filler rod. See Figure 10.

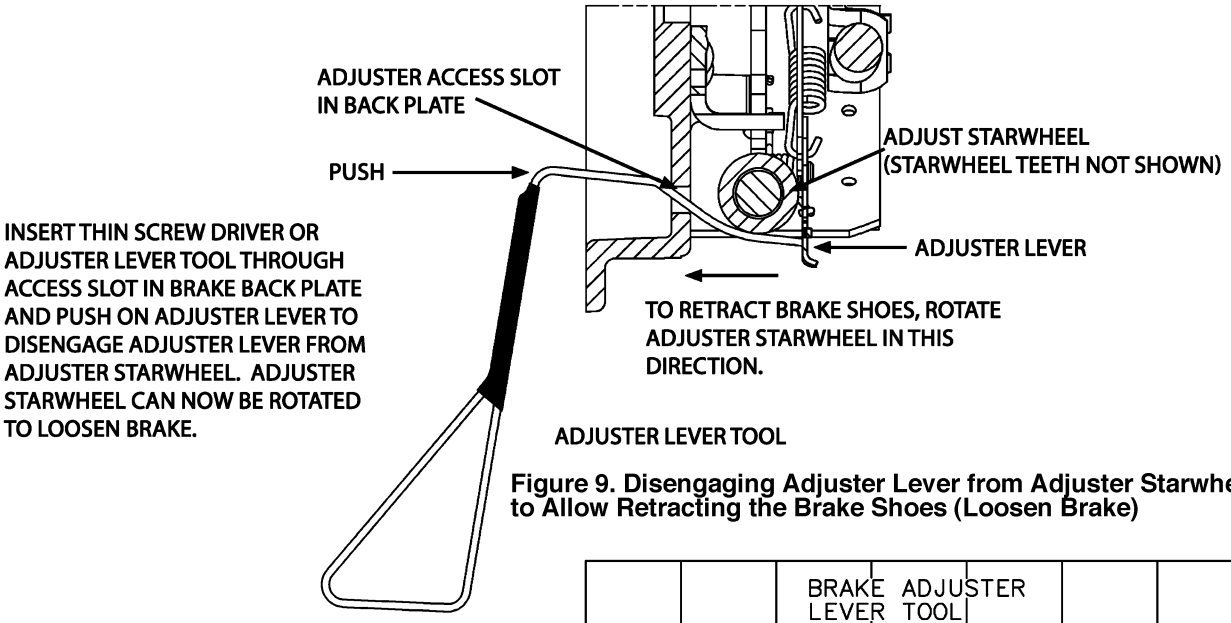


Figure 9. Disengaging Adjuster Lever from Adjuster Starwheel to Allow Retracting the Brake Shoes (Loosen Brake)

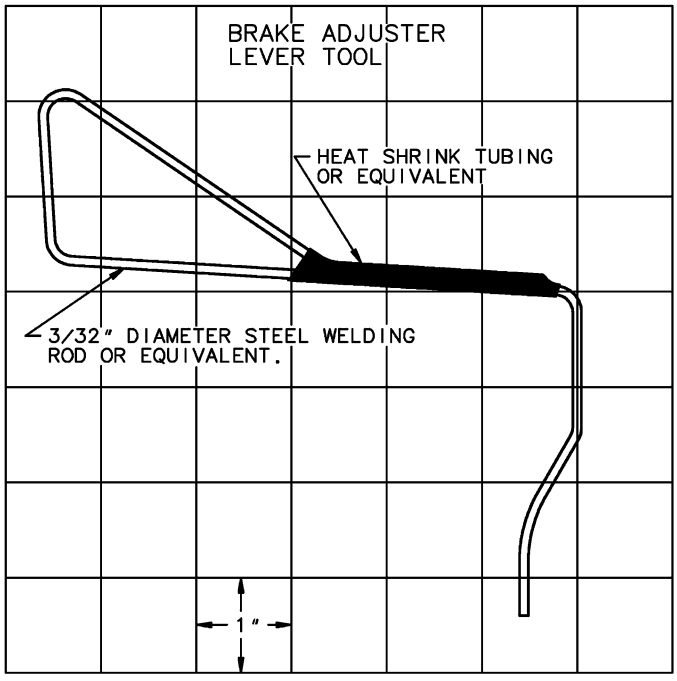


Figure 10. Brake Adjuster Lever Tool

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ANCHOR SCREW, LEVER AND CAM REPLACEMENT

1. REMOVING COMPONENTS

NOTICE

The anchor screw, lever, and cam should all be replaced at the same time. Do not replace just one or two of the three parts at any time. Inspection of these parts is recommended at 250,000 miles or 5 years for typical use, or more often under severe operating conditions.

(1) Block the front wheels to keep the vehicle from moving.
(2) With the engine off and battery disconnected, place the transmission in gear and fully release the parking brake.
(3) If recommended in vehicle manufacturer's service manual, raise the rear of the vehicle so the wheels clear the floor and install safety stands to support.
(4) Remove the drum. See vehicle manufacturer's service manual for details, if necessary.

⚠ CAUTION

Do not use a drum puller or a torch to remove a brake drum. Drum distortion may result.

NOTICE

If the drum proves difficult to remove, insert a narrow screwdriver through the brake adjusting hole in the backing plate and disengage the adjuster lever from the adjuster nut starwheel teeth. With adjuster lever disengaged as shown in Figures 8 and 9, insert a brake adjusting tool (or screw driver) through the adjusting hole to engage the adjusting nut teeth. Move the teeth upward enough times to retract the brake shoes to clear the drum. If the drum is rusted to the axle input flange yoke pilot, tap the center of the brake drum with a non-metallic mallet to loosen.

(5) Inspect the brake per the INSPECTION procedure in this service manual.
(6) Detach the parking brake apply cable and lever return spring from end of brake lever. Remove the apply lever guide (on Release brakes).
(7) Detach adjuster cable from the adjuster lever and slide adjuster cable off the adjuster cable guide, remove retaining tab if so equipped. See Figure 1.
(8) Remove the anchor screw. See Figure 11.

NOTICE

On Release 1 brakes with a hex socket anchor screw, the use of a thread-locking compound may prevent removal of the anchor screw with a hex key and torque in excess of 55 N·m (40 ft.-lbs.) May break or deform a 6 mm hex key. If necessary, use a pipe wrench, vice grips, or similar tool on the knurling of the head to loosen the anchor screw. Replace screw if removed, regardless of condition.

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(9) Remove the flat washers (if installed on your application for Release 1 level brake), anti-rattle spring, lever, cam, and adjuster cable. See Figure 11.

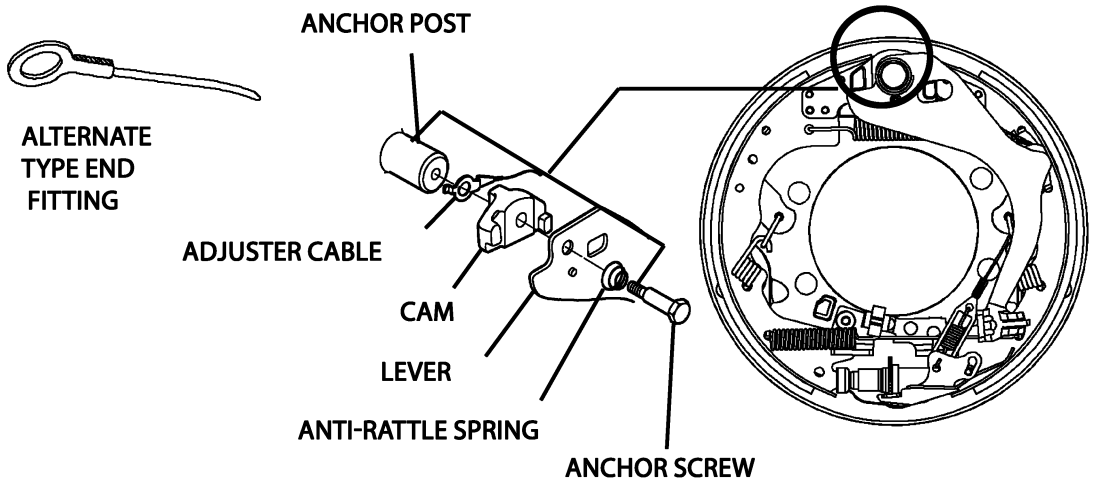


Figure 11. Spring, Lever, Cam, and Adjuster Cable Removal (Release 3 Brake Shown)

SHTS06Z080700013

2. INSTALLING COMPONENTS

NOTICE

If for any reason the cam, lever, and anchor screw is removed, a complete new set is recommended for service.

(1) Remove the cured thread-locking compound from the anchor post hole threads. Run the appropriate size tap completely into the anchor post and back out to clean the threads. Remove loose debris from anchor post hole.

NOTICE

For brakes with a hex socket head anchor screw, use an M10 x 1.5 tap (brakes manufactured prior to April 2002). For brakes with an external hex head anchor screw, use and M12 x 1.75 tap (brakes manufactured after April 2002).

(2) Apply Chevron heavy duty lithium complex extreme pressure grease, or equivalent, to the cam plate lugs where they contact the shoes and the apply lever, to the cam plate slotted hole and top and bottom faces. Apply grease to the brake lever pivot hole and the contact surfaces with the cam plate lugs. Apply grease to the non-threaded portion of the anchor screw. Do not get grease on anchor screw threads or in anchor post threaded hole.

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(3) Reinstall the adjuster cable, new cam plate, new lever, anti-rattle spring (small coil end toward screw head for Release 2), flat washers (if previously installed on your application), and new anchor screw as shown in Figure 12. Make sure the adjuster cable end fitting is installed to allow the cam plate to sit flat on the fitting and anchor post.

- Stepped type end fitting - the step faces towards the backplate. See Figure 12.
- Alternate "eyelet" type fitting - cable crimp portion faces towards the backplate. See Figure 12.

⚠ CAUTION

- **Only thread anchor screw into the anchor post 1 to 2 turns to temporarily hold assembly together. Do not thread in completely until ready to tighten to specification (step (4)).**
- **A faulty installation will result if the thread-locking compound is activated and begins to cure prior to tightening the screw.**
- **When installing the hex socket head anchor screw, careful attention should be taken during reassembly to ensure that the adjuster cable-end fitting is not clamped underneath the shoulder of the anchor screw during reassembly.**
- **Clamping the adjuster cable may prevent proper functioning of the brake selfadjust feature.**

(4) Tighten the anchor screw per the appropriate specification:
For the internal hex socket anchor screw tighten to 50±3 Nm (37±2 ft-lbs.)
For the external hex head anchor screw tighten to 100±10 Nm (74±7 ft-lbs.)

⚠ CAUTION
To tighten the anchor screw, only use a recently calibrated, known good, "clicker" type torque wrench set to the correct torque specification. Do not use add on devices such as universal joints, swivels, crows feet or other devices as these can cause inaccurate tightening results. Do not attempt this repair if a recently calibrated, known good "clicker" type torque wrench is not available.
Failure to do so could result in personal injury or property damage.

NOTICE
Remove excess grease that could contaminate brake drum or linings while the brake is in service.

(5) Reinstall the lever return spring and parking brake cable to the end of the brake lever.
(6) Route the adjuster cable around the adjuster cable guide, under the shoe hold-down spring, and attach to the adjuster lever as shown in Figure 6. Install adjuster cable retainer tab if equipped.

NOTICE
When correctly assembled, the adjuster cable end-fitting is behind the adjuster lever with the spring hook facing out as shown in Figures 6 and 12. Failure to do so may result in reduced brake operation.

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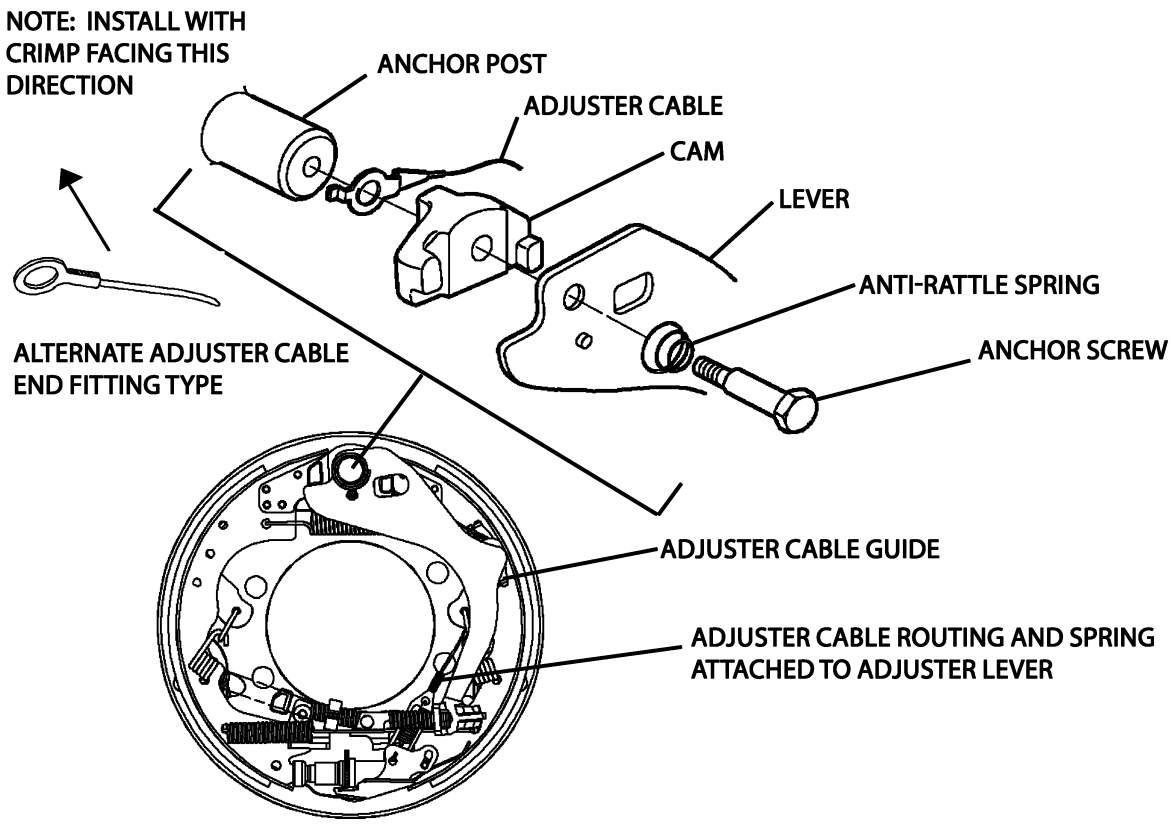


Figure 12. Install Adjuster Cable, Cam Lever, Anti-rattle Spring and Anchor Screw

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(7) The shoe cage should now be adjusted per the SHOE CAGE ADJUSTMENT PRIMARY procedure or after the drum has been reinstalled, per the SHOE CAGE ADJUSTMENT ALTERNATE procedure in this service manual.
(8) Make a final inspection of the shoe linings and the inside of the drum to ensure that no grease or other contamination is present.

⚠ CAUTION
Keep grease and other foreign materials away from the shoe lining and drum surfaces. Contamination of shoe linings or drum surface may result in degradation of brake holding capability, possibly resulting in personal injury or property damage.

(9) Inspect, service, then reinstall drum per the vehicle manufacturer's service manual.
(10) Lower vehicle and remove the blocks or wheel chocks from the front wheels.
(11) Test the brake for proper function before returning the vehicle for service use. If necessary, make adjustments per the vehicle manufacturer's service manual.

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INSPECTION

1. INSPECT PARTS.

NOTICE

It is not necessary to raise vehicle for "inspection" in most cases. However, if required, follow steps (1) through (3) in SHOE REPLACEMENT section.

Anytime service is required, it is recommended that a complete visual inspection be performed on all components in the park brake assembly. This includes:

(1) Follow manufacturer's recommended procedures to ready the vehicle for servicing. Pay attention to all WARNING and CAUTION notes throughout this booklet.
(2) Remove the drum. See section on SHOE REPLACEMENT.
(3) Clean the individual brake components, removing dust and grease.
(4) Visually inspect the brake shoes (Figure 13). Shoes should be replaced if there is uneven lining wear or when the remaining lining reaches 0.76 mm (0.030 in. or approximately 1/32 in.) thickness or less above the shoe. If grease, automotive fluids, or other foreign material that would compromise operation is found on, soaked into or embedded in the linings, the shoes should be replaced. Also, if cracks, excessive deformation, or wear on either end is found, the shoes should be replaced. See section on SHOE REPLACEMENT for service details.
(5) Visually inspect the brake lever and cam (COMPONENT LOCATOR). If cracks, excessive wear, or abnormal deformation is found in either part, they should be replaced. Light wear, which typically shows up as polishing is acceptable. If unsure, replace brake lever, cam plate and anchor screw. See section on ANCHOR SCREW, LEVER, AND CAM REPLACEMENT for service details.
(6) Inspect various springs and hold down pins (Figure 13) for excessive wear, heat discoloration, heavy corrosion or other damage and replace as necessary. See section on SHOE REPLACEMENT for service.

⚠ WARNING

Whenever possible, work on brakes in a separate area away from other operations. Always wear a respirator approved by NIOSH or MSHA during all brake service procedures. NEVER use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that you use cylinders that enclose the brake. These cylinders have vacuums with high efficiency HEPA filters and worker's arm access sleeves. But, if such equipment is not available, carefully clean parts and assemblies in the open air.

Clean brake parts and assemblies in the open air. During disassembly, carefullyhandle all parts to avoid getting dust in the air. Use an industrial vacuum cleanerwith a HEPA filter system to clean dust from the brake drums, backing plates and other brake parts. After using the vacuum, remove any remaining dust with a rag soaked in water and wrung until nearly dry.

(7) Inspect adjuster cable assembly for damage or wear (Figure 13). Replace as necessary. See section on SHOE REPLACEMENT for service details.
(8) Inspect adjuster nut and screw (Figure 13) for any damage or corrosion to the threads or burrs, chips, corrosion or other damage to the teeth on the adjuster nut starwheel. Damaged teeth or threads may prevent proper function of the brake self-adjusting function. Replace as necessary. See section SHOE REPLACEMENT for service details.

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(9) Clean-out all dust or grease present on the inside of drum. Use a 12 inch caliper or an inside diameter micrometer to measure the manufacturer's recommended inside diameter of the drum. Replace drum if it exceeds maximum inside diameter (which typically is stamped on the inside of the drum near the mounting holes), is worn unevenly, has deep grooves, heavy corrosion or excessive runout.

(10) Inspect the parking brake lever-apply cable for excessive wear or damage, and replace as necessary.

(11) Inspect the axle pinion oil seal for leakage that can contaminate the park brake system parts and repair as necessary. See the section "REAR AXLE" for details.

(12) After a thorough inspection, if the brake and its components are found to be in good working condition, check parking brake for proper shoe cage adjustment. See the section "SHOE CAGE ADJUSTMENT PROCEDURES" for details.

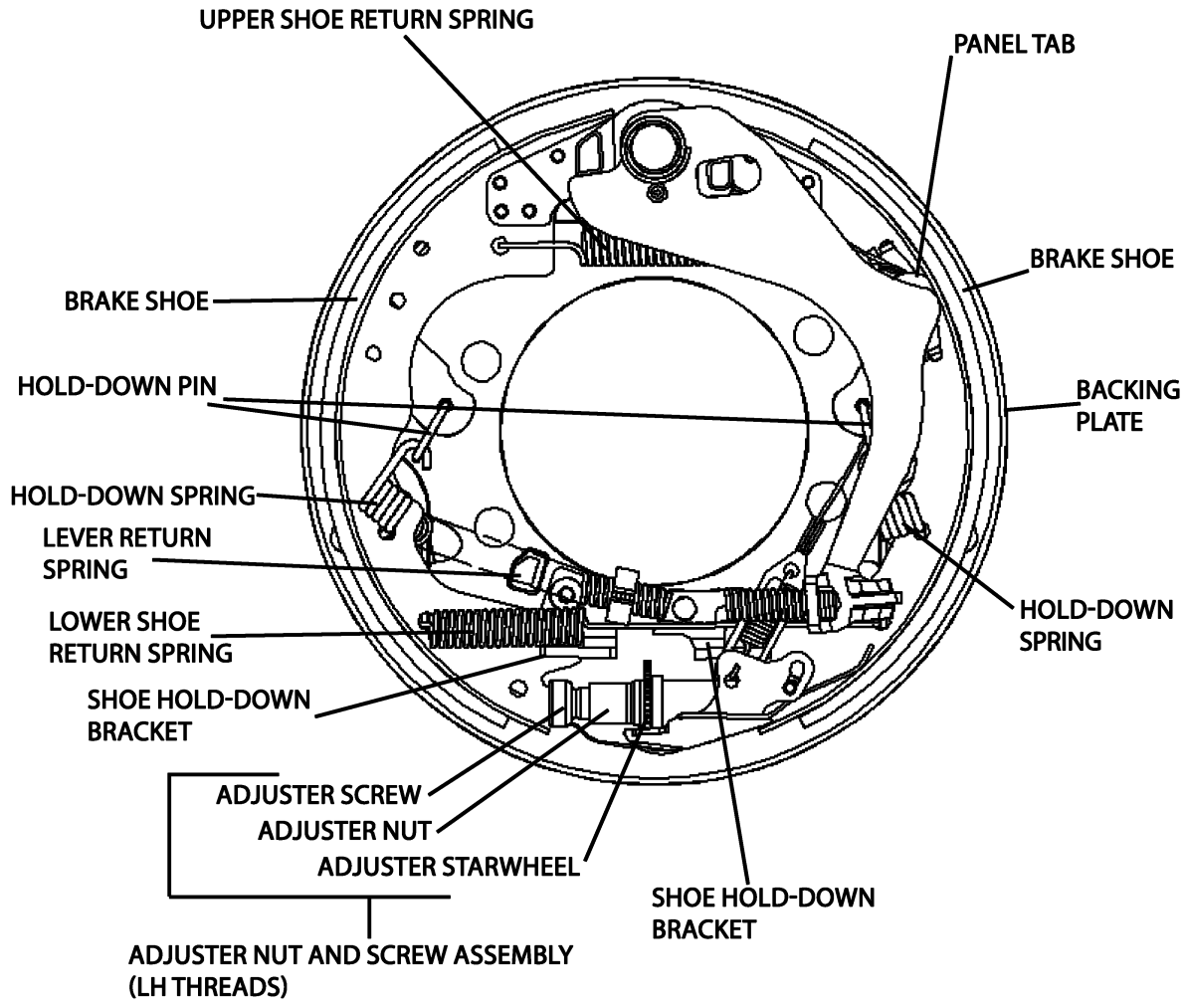


Figure 13. Brake Shoe Installation

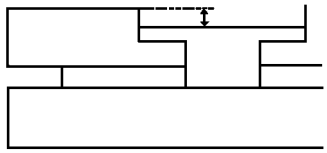
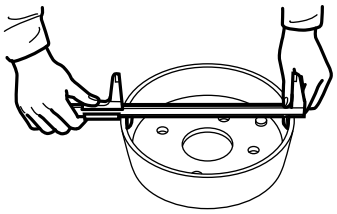
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INSPECTION AND REPAIR

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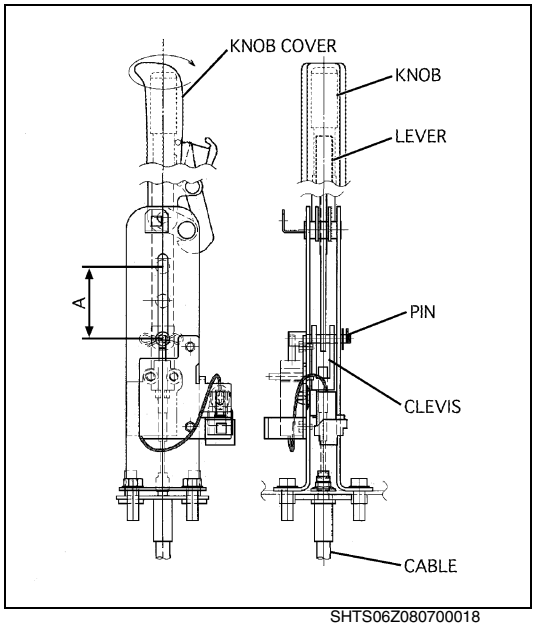
Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Brake lining: Lining thickness	**7.00 {0.277}**	**0.76 {0.03}**	**Replace.**	**Measure** 
Brake drum: Inside diameter	**304.8 {12}**	**305.7 {12.035}**	**Replace.**	**Measure** 

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ADJUSTMENT

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1. INSTALL THE CABLE

(1) Connect the cable inner wire to the brake assy and set the cable to cab side.

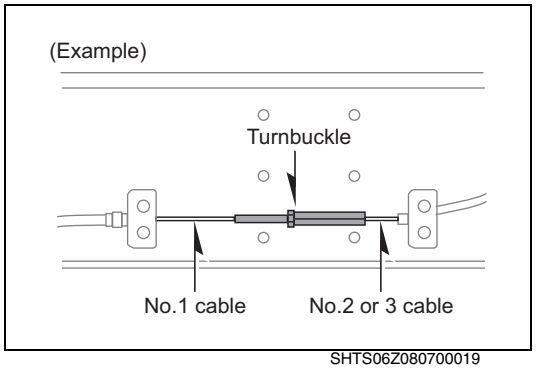
(2) Pull and release the parking brake cable 2 to 3 times with specified force.
Pull up force: 220-270 N (22-28 kgf, 49-62 lbf) at 207 mm (8.1 in.) from pivot of the lever.

(3) Adjust the cable connecting pin at specified distance A (See figure on page BR07-4) by turning the knob.
Distance A: 65 mm (2.56 in.)

(4) Connect the clevis to the parking brake lever.

2. ADJUST THE PARKING BRAKE LEVER

(1) Pull up the parking brake lever 2 to 3 times.



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(2) Adjust pull up force of parking brake lever to specified force by tightening up a turnbuckle.
Pull up force: 220-270 N (22-28 kgf, 49-62 lbf) at 207 mm (8.1 in.) from pivot of the lever.
Turnbuckle Tighten torque:
22-32 N·m (224-326 kgf·cm, 16-24 lbf·ft)

NOTICE
When connecting the cable or adjusting the turnbuckle, confirm that the lever is off and there is no tension on the cable.

(3) Confirm that the male thread end of a turnbuckle is fitted into the female thread more than 12.7 mm (0.5 in.).

(4) Check that there is no drag feeling of the brake with parking lever released.

(5) Check proper working, holding and cancellation of parking brake by actually operating the parking brake lever.

3. BRAKE BURNISHING

(1) Burnishing of lining
When replacing lining or drum of parking brake with new parts, be sure to perform lapping by the following procedure.
Braking force may be extremely lowered without lapping, so be sure to perform the lapping.

NOTICE
Apply parking brake burnishing only after replacing the lining and in an emergency when the vehicle is moving.

a. Release parking brake and turn adjusting knob until a control force becomes approximately 18 kgf (40lbf).
b. Mark ten (10) stops from 16 km/h (10 mph) on a dry, hard surface road using only parking brake to stop vehicle.
c. After each stop, release parking brake and drive vehicle at 32 km/h (20 mph) for 4 km (2.5 miles) to cool the brake.
d. After operation, adjust hand lever adjusting knob.

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(2) Confirmation of parking brake application.
After completing all-brake adjustment, stop the vehicle on a safe slope or using a brake tester, confirm whether the parking brake is securely applied.

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