CEBM001301

SHOP MANUAL

KOMATSU

WA250-3L

WHEEL LOADER

MACHINE MODEL	SERIAL NUMBERS
WA250-3L	A70001 and up

It is our policy to improve our products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to install such changes on products sold previously.

Due to this continuous program of research and development, periodic revisions may be made to this publication. It is recommended that customers contact their distributor for information on the latest revision.

CONTENTS

The affected pages are indicated by using the following marks. It is requested that necessary actions be taken to these pages according to the table below.

Mark	Indicatioin	Action
"	New page to be added	Add
!	Page to be replaced	Replace
( )	Page to be deleted	Discard

Pages without marks were previous additions or revised pages.

LIST OF ORIGINAL, NEW AND REVISED PAGES

MARK	PAGE	REV	MARK	PAGE	REV	MARK	PAGE	REV	MARK	PAGE	REV
!	00-1	Î		10-1			10-45			10-89	
	00-2			10-2			10-46			10-90	
"	00-2-1	Î		10-3			10-47			10-91	
"	00-2-2	Î		10-4			10-48			10-92	
"	00-2-3	Î		10-5			10-49			10-93	
"	00-2-4	Î		10-6			10-50			10-94	
!	00-3	Î		10-7			10-51			10-95	
	00-4			10-8			10-52			10-96	
	00-5			10-9			10-53			10-97	
	00-6			10-10			10-54			10-98	
	00-7			10-11			10-55			10-99	
	00-8			10-12			10-56			10-100	
	00-9			10-13			10-57			10-101	
	00-10			10-14			10-58			10-102	
	00-11			10-15			10-59			10-103	
	00-12			10-16			10-60			10-104	
	00-13			10-17			10-61			10-105	
	00-14			10-18			10-62			10-106	
	00-15			10-19			10-63			10-107	
	00-16			10-20			10-64			10-108	
	00-17			10-21			10-65			10-109	
	00-18			10-22			10-66			10-110	
	00-19			10-23			10-67			10-111	
	00-20			10-24			10-68			10-112	
				10-25			10-69			10-113	
				10-26			10-70			10-114	
	01-1			10-27			10-71			10-115	
	01-2			10-28			10-72			10-116	
	01-3			10-29			10-73			10-117	
	01-4			10-30			10-74			10-118	
	01-5			10-31			10-75			10-119	
	01-6			10-32			10-76			10-120	
	01-7			10-33			10-77			10-121	
	01-8			10-34			10-78			10-122	
	01-9			10-35			10-79			10-123	
	01-10			10-36			10-80			10-124	
	01-11			10-37			10-81			10-125	
	01-12			10-38			10-82			10-126	
	01-13			10-39			10-83			10-127	
	01-14			10-40			10-84			10-128	
				10-41			10-85			10-129	
				10-42			10-86			10-130	
				10-43			10-87			10-131	
				10-44			10-88			10-132	

MARK	PAGE	REV
	10-133	
	10-134	
	10-135	
	10-136	
	10-137	
	10-138	
	10-139	
	10-140	
	10-141	
	10-142	
	10-143	
	10-144	
	10-145	
	10-146	
!	20-1	Î
	20-2	
	20-3	
	20-4	
	20-5	
	20-6	
	20-7	
	20-8	
	20-9	
	20-10	
	20-11	
	20-12	
	20-13	
	20-14	
	20-15	
	20-16	
	20-17	
	20-18	
	20-19	
	20-20	
	20-21	
	20-22	
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	20-24	
	20-25	
	20-26	
	20-27	
	20-28	
	20-29	
	20-30	
	20-31	
	20-32	
	20-33	
	20-34	
	20-35	
	20-36	
	20-37	
	20-38	
	20-39	
	20-40	

MARK	PAGE	REV
	20-41	
	20-42	
	20-43	
	20-44	
	20-45	
	20-46	
	20-47	
	20-48	
	20-49	
	20-50	
	20-51	
	20-52	
	20-53	
	20-54	

MARK	PAGE	REV
"	20-101	Î
"	20-102	Î
"	20-103	Î
"	20-104	Î
"	20-105	Î
"	20-106	Î
"	20-107	Î
"	20-108	Î
"	20-109	Î
"	20-110	Î
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"	20-112	Î
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"	20-144	Î
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"	20-146	Î
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"	20-148	Î
"	20-149	Î
"	20-150	Î
"	20-151	Î
"	20-152	Î
"	20-153	Î
"	20-154	Î
"	20-155	Î

MARK	PAGE	REV
"	20-156	Î
"	20-157	Î
"	20-158	Î
"	20-159	Î
"	20-160	Î
"	20-161	Î
"	20-162	Î
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"	20-164	Î
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"	20-203	Î
"	20-204	Î
"	20-205	Î
"	20-206	Î
"	20-207	Î
"	20-208	Î
"	20-209	Î
"	20-210	Î

MARK	PAGE	REV	MARK	PAGE	REV	MARK	PAGE	REV	MARK	PAGE	REV
"	20-211	Î	"	20-266	Î	"	30-47	Î	"	30-102	Î
"	20-212	Î	"	20-267	Î	"	30-48	Î	"	30-103	Î
"	20-213	Î	"	20-268	Î	"	30-49	Î	"	30-104	Î
"	20-214	Î	"	20-269	Î	"	30-50	Î	"	30-105	Î
"	20-215	Î	"	20-270	Î	"	30-51	Î	"	30-106	Î
"	20-216	Î	"	20-271	Î	"	30-52	Î	"	30-107	Î
"	20-217	Î	"	20-272	Î	"	30-53	Î	"	30-108	Î
"	20-218	Î				"	30-54	Î	"	30-109	Î
"	20-219	Î				"	30-55	Î	"	30-110	Î
"	20-220	Î	"	30-1	Î	"	30-56	Î	"	30-111	Î
"	20-221	Î	"	30-2	Î	"	30-57	Î	"	30-112	Î
"	20-222	Î	"	30-3	Î	"	30-58	Î	"	30-113	Î
"	20-223	Î	"	30-4	Î	"	30-59	Î	"	30-114	Î
"	20-224	Î	"	30-5	Î	"	30-60	Î	"	30-115	Î
"	20-225	Î	"	30-6	Î	"	30-61	Î	"	30-116	Î
"	20-226	Î	"	30-7	Î	"	30-62	Î	"	30-117	Î
"	20-227	Î	"	30-8	Î	"	30-63	Î	"	30-118	Î
"	20-228	Î	"	30-9	Î	"	30-64	Î	"	30-119	Î
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"	20-236	Î	"	30-17	Î	"	30-72	Î	"	30-127	Î
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"	20-256	Î	"	30-37	Î	"	30-92	Î	"	30-147	Î
"	20-257	Î	"	30-38	Î	"	30-93	Î	"	30-148	Î
"	20-258	Î	"	30-39	Î	"	30-94	Î	"	30-149	Î
"	20-259	Î	"	30-40	Î	"	30-95	Î	"	30-150	Î
"	20-260	Î	"	30-41	Î	"	30-96	Î	"	30-151	Î
"	20-261	Î	"	30-42	Î	"	30-97	Î	"	30-152	Î
"	20-262	Î	"	30-43	Î	"	30-98	Î	"	30-153	Î
"	20-263	Î	"	30-44	Î	"	30-99	Î	"	30-154	Î
"	20-264	Î	"	30-45	Î	"	30-100	Î	"	30-155	Î
"	20-265	Î	"	30-46	Î	"	30-101	Î	"	30-156	Î

MARK	PAGE	REV	MARK	PAGE	REV	MARK	PAGE	REV	MARK	PAGE	REV
"	30-157	Î		40-1							
"	30-158	Î		40-2							
"	30-159	Î		40-3							
"	30-160	Î		40-4							
"	30-161	Î		40-5							
"	30-162	Î		40-6							
"	30-163	Î		40-7							
"	30-164	Î		40-8							
"	30-165	Î		40-9							
"	30-166	Î		40-10							
"	30-167	Î		40-11							
"	30-168	Î		40-12							
"	30-169	Î		40-13							
"	30-170	Î		40-14							
"	30-171	Î		40-15							
"	30-172	Î		40-16							
"	30-173	Î		40-17							
"	30-174	Î		40-18							
"	30-175	Î		40-19							
"	30-176	Î		40-20							
"	30-177	Î		40-21							
"	30-178	Î		40-22							
"	30-179	Î		40-23							
"	30-180	Î		40-24							
"	30-181	Î		40-25							
"	30-182	Î		40-26							
"	30-183	Î		40-27							
"	30-184	Î		40-28							
"	30-185	Î		40-29							
"	30-186	Î		40-30							
"	30-187	Î		40-31							
"	30-188	Î		40-32							
"	30-189	Î		40-33							
"	30-190	Î		40-34							
"	30-191	Î		40-35							
"	30-192	Î		40-36							
"	30-193	Î		40-37							
"	30-194	Î		40-38							
"	30-195	Î		40-39							
"	30-196	Î		40-40							
"	30-197	Î		40-41							
"	30-198	Î		40-42							
"	30-199	Î		40-43							
"	30-200	Î		40-44							
"	30-201	Î		40-45							
"	30-202	Î		40-46							
"	30-203	Î		40-47							
"	30-204	Î		40-48							

PRODUCT PUBLICATIONS INFORMATION

VARIOUS PRODUCT PARTS & SERVICE PUBLICATIONS ARE AVAILABLE TO ALL **KOMATSU** CONSTRUCTION EQUIPMENT OWNERS, INCLUDING OPERATION & MAINTENANCE MANUALS, PARTS BOOKS AND SHOP MANUALS.

SPECIAL PUBLICATIONS SUCH AS SERVICE TOOL, AIR CONDITIONING, AND TURBOCHARGER SHOP MANUALS ARE ALSO AVAILABLE AS WELL AS SELECTED OPERATION & MAINTENANCE AND SHOP MANUALS IN FOREIGN LANGUAGES.

THE PUBLICATIONS LISTED BELOW ARE AVAILABLE FOR THIS PARTICULAR MACHINE(S).

DESCRIPTION	FORM NUMBER
PARTS BOOK - PAPER:	
Engine and Chassis	BEPB002300
PARTS BOOK - MICROFICHE:	
Engine and Chassis	BEPM002300
OPERATION & MAINTENANCE MANUAL:	
Engine and Chassis	CEAM001500
SHOP MANUAL:	
Chassis	CEBM001301
Engine:	SEBM010002
SAFETY MANUAL	WLT70-1

PARTS AND SERVICE PUBLICATIONS CAN *ONLY* BE ACQUIRED BY AUTHORIZED KOMATSU DISTRIBUTORS, USING THE KOMATSU AMERICA INTERNATIONAL COMPANY PARTS INFORMATION PROCESSING SYSTEM (PIPS).

IF THE PIPS SYSTEM IS NOT AVAILABLE AT THE DISTRIBUTOR LOCATION, THEN THE FOLLOWING REQUISITION FOR TECHNICAL SERVICE PUBLICATIONS AND SERVICE FORMS CAN BE USED. FORM KDC91D IS SHOWN ON THE REVERSE SIDE OF THIS PAGE.

REQUISITION FOR TECHNICAL SERVICE PUBLICATIONS AND SERVICE FORMS

COMPLETE FORM AND RETURN TO →

Komatsu America International Company
440 North Fairway Drive
Vernon Hills, IL 60061-8112 U.S.A.
Attn: Technical Publications
Fax No. (847) 970-4186
Tel No. (847) 970-5887

SHIP TO →

TYPE or PRINT ONLY →

COMPANY NAME
ATTN.
STREET ADDRESS
CITY, STATE, ZIP CODE
COUNTRY

PURCHASE ORDER NO.
ORDER DATE

PHONE NO.	FAX NO.	SHIPPING METHOD	DISTR/BRANCH CODE

IMPORTANT - TO ASSURE SHIPMENT OF THE CORRECT PUBLICATION(S), THE MODEL NUMBER AND MACHINE SERIAL NUMBER MUST BE SHOWN.

QTY.	PUBLICATION FORM NO.	PARTS BOOK P-Paper M-Microfiche	PUBLICATION DESCRIPTION	MODEL NUMBER	SERIAL NUMBER

KDC91D 081696

CURRENT PRICES WILL BE CHARGED

SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended and described in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed for the purpose.

To prevent injury to workers, the symbols ⚠ and are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the OPERATION & MAINTENANCE MANUAL carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out. Before disconnecting or removing components of the oil,

water or air circuits, first remove the pressure completely from the circuit.

12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned. Wait for the oil and water to cool before carrying out any work on the oil or water circuits.

13. Before starting work, remove the leads from the battery. ALWAYS remove the lead from the negative (**-**) terminal first.

14. When raising heavy components, use a hoist or crane. Check that the wire rope, chains and hooks are free from damage. Always use lifting equipment which has ample capacity. Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.

15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.

16. When removing components, be careful not to break or damage the wiring, Damaged wiring may cause electrical fires.

17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.

18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.

19. Be sure to assemble all parts again in their original places. Replace any damaged part with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.

20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also check that connecting parts are correctly installed.

21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.

22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.

23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.

24. Take care when removing or installing the tracks of track-type machines. When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWARD

GENERAL

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop. For ease of understanding, the manual is divided into the following sections. These sections are further divided into each main group of components.

GENERAL

This section lists the general machine dimensions, performance specifications, component weights, and fuel, coolant and lubricant specification charts.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs. Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your distributor for the latest information.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:
Chassis volume: Issued for every machine model
Engine volume: Issued for each engine series
Electrical volume: Each issued as one to cover all models
Attachment volume: Each issued as one to cover all models

These various volumes are designed to avoid duplication of information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine electrical and attachment be available.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to your distributors. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number:
   Example 1 (Chassis volume):

   10 - 3
   - 10: Item number (10. Structure and Function)
   - 3: Consecutive page number for each item

   Example 2 (Engine volume):
   Refer to the pertinent engine manual.

3. Additional pages: Additional pages are indicated by a hyphen (-) and numbered after the page number. File as in the example.
   Example:
   10-4
   10-4-1 } Added pages
   10-4-2 }
   10-5

REVISED EDITION MARK

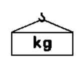
When a manual is revised, an edition mark (①②③ ....) is recorded on the bottom outside corner of the pages.

REVISIONS

Revised pages are shown at the LIST OF REVISED PAGES between the title page and SAFETY page.

SYMBOLS

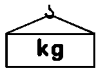
So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS

HOISTING

Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **DISASSEMBLY AND ASSEMBLY** section, every part weighing 25 kg or more is indicated clearly with the symbol



- If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
  1) Check for removal of all bolts fastening the part to the relative parts.
  2) Check for existence of another part causing interface with the part to be removed.

WIRE ROPES

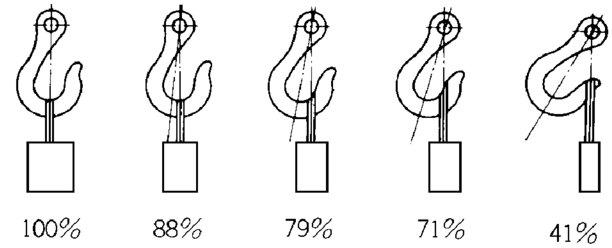
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes
(Standard "Z" or "S" twist ropes without galvanizing

Rope diameter (mm)	Allowable load (tons)
10.0	1.0
11.2	1.4
12.5	1.6
14.0	2.2
16.0	2.8
18.0	3.6
20.0	4.4
22.4	5.6
30.0	10.0
40.0	18.0
50.0	28.0
60.0	40.0

★ The allowable load value is estimated to be 1/6 or 1/7 of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook. Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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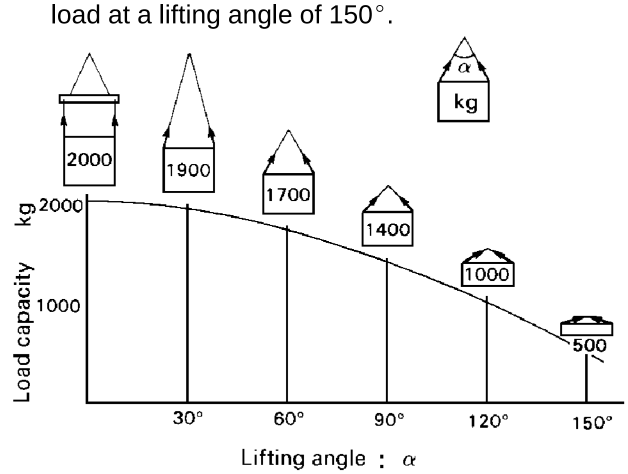
3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles. When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subject to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



FS0065

COATING MATERIALS

The recommended coating materials prescribed in the shop manuals are listed below.

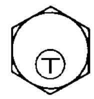
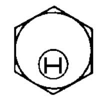
Category	Code	Part No.	Qty	Container	Main applications,features
Adhesive	LT-1A	790-129-9030	150 g	Tube	● Used to prevent rubber gaskets, rubber cushions and cork plugs from coming out
	LT-1B	790-129-9050	20 g (x2)	Plastic container	● Used in places requiring an immediately effective, strong adhesive. Used for plastics (except polyethylene, polypropylene, tetrafluoroethylene, and vinyl chloride), rubber, metal and non-metal.
	LT-2	09940-00030	50 g	Plastic container	● Features: Resistance to heat, chemicals ● Used for anti-loosening and sealant purposes for bolts and plugs.
	LT-3	790-129-9060 Set of adhesive and hardening agent	Adh 1 kg Hard agt 500 kg	Can	● Used as adhesive or sealant for metal, glass or plastic.
	LT-4	790-129-9040	250 g	Plastic container	● Used as sealant for machined holes.
	Loctite 648-50	79A-129-9110	50 cc	---	● Features: Resistance to heat, chemicals ● Used at joint portions subject to high temperature.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	● Used as adhesive or sealant for gaskets and packing of power train case, etc.
	LG-3	790-129-9070	1 kg	Can	● Features: Resistance to heat ● Used as sealant for flange surfaces and bolts at high temperature locations; used to prevent seizure. ● Used as sealant for heat resistant gasket for at high temperature locations such as engine pre-combustion chamber, exhaust pipe.
	LG-4	790-129-9020	200 g	Tube	● Features: Resistance towater, oil ● Used as sealant for flange surface, thread. ● Also possible to use as sealant for flanges with large clearance. ● Used as sealant for mating surfaces of final drive case, transmission case.
	LG-5	790-129-9080	1 kg	Plastic container	● Used as sealant for various threads, pipe joints, flanges. ● Used as sealant for tapered plugs, elbows, nipples of hydraulic piping.
	LG-6	09940-00011	250 g	Tube	● Features: Silicon based, resistant to heat, cold. ● Used as sealant for flange surface, thread. ● Used as sealant for oil pan, final drive case, etc.
	LG-7	09920-00150	150 g	Tube	● Features: Silicon based, quick hardening type. ● Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
Rust preven-tion lubricant	---	09940-00051	60 g	Can	● Used as lubricant for sliding parts (to prevent squeaking).
Molybdenum disulfide lubricant	---	09940-00040	200 g	Tube	● Used to prevent seizure or scuffing of the thread when press fitting or shrink fitting. ● Used as lubricant for linkage, bearings, etc.
Lithium grease	G2-L1	SYG-350LI SYG-400LI SYG-400LI-A SYG-160LI SYGA-160CNLI	Various	Various	● General purpose type
Calcium grease	G2-CA	SSG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-16CNCA	Various	Various	● Used for normal temperature, light load bearing at places in contact with water or steam.
Molybdenum disulfide grease	---	SYG2-400M	400 g (10/case)	Bellows type	● Used for places with heavy load.

STANDARD TORQUE REQUIREMENTS

STANDARD TORQUE REQUIREMENTS OF BOLTS AND NUTS

The following charts give the standard torques values of bolts and nuts. Exceptions are given in sections of **DISASSEMBLY AND ASSEMBLY**.

1 kgm = 9.806 Nm

Thread diameter of bolt	Width across flat		
mm	mm	kgm	Nm
6	10	1.35 ±0.15	13.2 ±1.4
8	13	3.20 ±0.3	31.4 ±2.9
10	17	6.70 ±0.7	65.7 ±6.8
12	19	11.5 ±1.0	112 ±9.8
14	22	18 ±2.0	177 ±19
16	24	28.5 ±3	279 ±29
18	27	39 ±4	383 ±39
20	30	56 ±6	549 ±58
22	32	76 ±8	745 ±78
24	36	94.5 ±10	927 ±98
27	41	135 ±15	1320 ±140
30	46	175 ±20	1720 ±190
33	50	225 ±25	2210 ±240
36	55	280 ±30	2750 ±290
39	60	335 ±35	3280 ±340

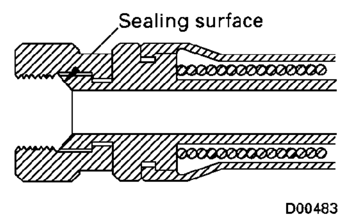
★ This torque table does not apply to the bolts with which nylon packing or other non-ferrous metal washers are to be used, or which require torquing to otherwise specified values.

TORQUE REQUIREMENTS OF SPLIT FLANGE BOLTS

Use these torques values for split flange bolts.

Thread diameter of bolt	Width across flat	torque requirement values	
mm	mm	kgm	Nm
10	14	6.70 ±0.7	65.7 ±6.8
12	17	11.5 ±1.0	112 ±9.8
16	22	28.5 ±3	279 ±29

TORQUE REQUIREMENTS FOR FLAIRED NUTS



Use these torque values for flaired part of nut.

Thread diameter of bolt	Width across flat	torque requirement values	
mm	mm	kgm	Nm
14	19	2.5 ±0.5	24.5 ±4.9
18	24	5 ±2	49 ±19.6
22	27	8 ±2	78.5 ±19.6
24	32	14 ±3	137.3 ±29.4
30	36	18 ±3	176.5 ±29.4
33	41	20 ±5	196.1 ±49
36	46	25 ±5	245.2 ±49
42	55	30 ±5	294.2 ±49

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires. This wire code table will help you understand WIRING DIAGRAMS.
Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number of strands	Dia. Of strand (mm)	Cross section (mm^2)			
0.85	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
2	26	0.32	2.09	3.1	20	Lighting, signal etc.
5	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

Priority	Classification	Circuits	Charging	Ground	Starting	Lighting	Instruments	Signal	Other
1	Primary	Code	W	B	B	R	Y	G	L
		Color	White	Black	Black	Red	Yellow	Green	Blue
2	Auxiliary	Code	WR	---	BW	RW	YR	GW	LW
		Color	White/Red	---	Black/White	Red/White	Yellow/Red	Green/White	Blue/White
3		Code	WB	---	BY	RB	YB	GR	LR
		Color	White/Black	---	Black/Yellow	Red/Black	Yellow/Black	Green/Red	Blue/Red
4		Code	WL	---	BR	RY	YG	GY	LY
		Color	White/Blue	---	Black/Red	Red/Yellow	Yellow/Green	Green/Yellow	Blue/Yellow
5		Code	WG	---	---	RG	YL	GB	LB
		Color	White/Green	---	---	Red/Green	Yellow/Blue	Green/Black	Blue/Black
6		Code	---	---	---	RL	YW	GL	---
		Color	---	---	---	Red/Blue	Yellow/White	Green/Blue	---

CONVERSION TABLES

METHOD OF USING THE CONVERSION TABLE

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

EXAMPLE

- Method of using the Conversion Table to convert from millimeters to inches.

1. Convert 55 mm into inches.
   (1) Locate the number 50 in the vertical column at the left side, take this as Ⓐ, then draw a horizontal line from Ⓐ.
   (2) Locate the number 5 in the row across the top, take this as Ⓑ, then draw a perpendicular line down from Ⓑ.
   (3) Take the point where the two lines cross as Ⓒ. This point Ⓒ gives the value when converting from millimeters to inches. Therefore, 55 millimeters = 2.165 inches.

2. Convert 550 mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10 (move the decimal one place to the left) to convert it to 55 mm.
   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to Inches

1 mm = 0.03937 in

mm	0	1	2	3	4	5 Ⓑ	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
Ⓐ 50	1.969	2.008	2.047	2.087	2.126	Ⓒ 2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to Inches

1 mm = 0.03937 in

mm	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

kg	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liter to U.S. Gallon

1ℓ = 0.2642 U.S. Gal

ℓ	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

Liter to U.K. Gallon

1ℓ = 0.21997 U.K. Gal

ℓ	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft. lb

1 kgm = 7.233 ft. lb

kgm	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kg/cm² to lb/in²

1kg/cm² = 14.2233 lb/in²

kg/cm²	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

Temperature

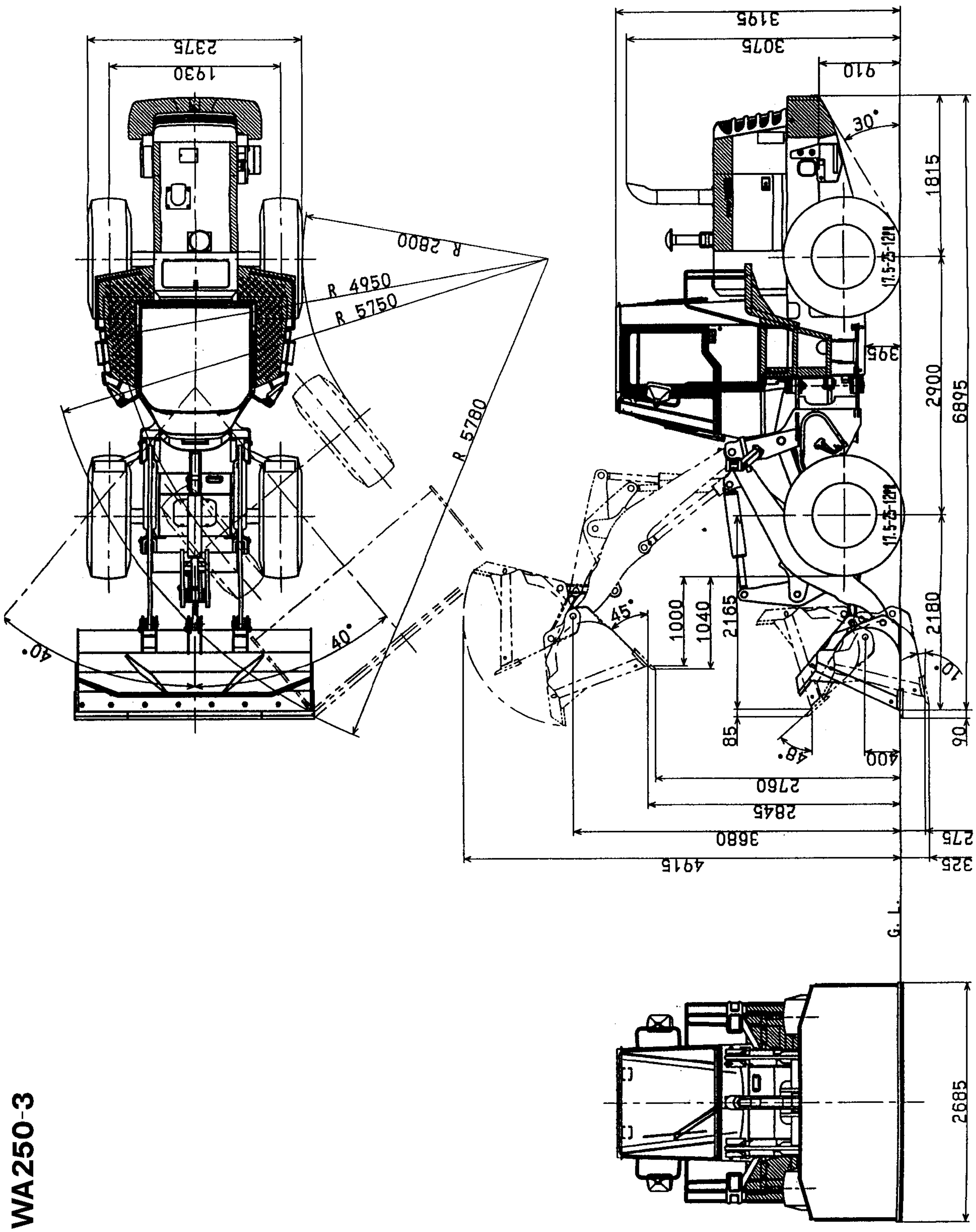
Fahrenheit Centigrade Conversion; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vise versa is to enter the accompanying table in the center or boldface column of figures. These figures refer to the temperature in either Fahrenheit or Centigrade degrees. If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left. If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

1°C = 33.8°F

°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-7.2	19	66.2	12.2	54	129.2	31.7	89	192.2
26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

0 1 GENERAL

SPECIFICATION DRAWINGS



WA250-3

W30716

WA250-3

SPECIFICATIONS

Model: WA250-3 **Serial Number: A70001 and up**			**Size Tire** 17.5-25 -12PR, L2
WEIGHT (Includes full fuel tank,and optional counterweigh)			
Operating weight Distribution front axle Distribution rear axle			10760 kg 4300 kg 6460 kg
PERFORMANCE			
Bucket capacity (piled) Rated load			$2.1\ m^3$ 3360 kg
Travel speed	FORWARD	1st	7.8 km/h
		2nd	12.0 km/h
		3rd	21.2 km/h
		4th	34.5 km/h
	REVERSE	1st	8.1 km/h
		2nd	12.3 km/h
		3rd	21.8 km/h
		4th	35.0 km/h
Grade ability			25 deg
Minimum turning radius	Outside of chassis		5780 mm
	Center of outside wheel		4950 mm
DIMENSIONS			
Overall length			6985 mm
Overall width (chassis)			2375 mm
Bucket width (with bolt on cutting edge))			2685 mm
Overall height (top of cab)			3195 mm
Overall height (bucket raised)			4915 mm
Wheelbase			2900 mm
Tread			1930 mm
Minimum ground clearance			395 mm
Height of bucket hinge pin			3680 mm
Dumping clearance (tip of cutting edge)			2760 (2845) mm

	Dumping reach (tip of cutting edge)	1040 (1000) mm
	Bucket dump angle	45 deg
	Bucket tilt (SAE carrying position)	48 deg
	Digging depth (10° dump angle)	325 mm
ENGINE		
	Model	S6D102E-1 diesel engine
	Type	Direct injection (Aspiration, Turbo charged)
	Number of cylinders - bore x stroke	6 - 102 mm x 120 mm
	Piston displacement	5.88 ℓ (359 in^3)
	Gross power @ 2400 rpm Maximum torque @ 1600 RPM High idle Low idle	101 kW (135 HP) 468 N•m (345 lbf ft) 2650 ± 50 rpm 850 ± 25 rpm
	Starting motor	24V, 4.5 kW
	Alternator	24V, 50A
	Battery	12V, 110Ah x 2
POWER TRAIN		
	Torque converter	3-element, 1-stage, single-phase (Komatsu TCA32-7A)
	Transmission	Spur gear, constant-mesh multiple-disc, hydraulic actuated, modulation type
	Reduction gear	Spiral bevel gear
	Differential	Straight bevel gear, torque proportioning
	Final drive	Planetary gear, single reduction
AXLE, WHEEL, AND TIRE		
	Drive type	Front/rear wheel drive
	Front axle	Fixed frame, semi-floating
	Rear axle	Center pin support type, semi-floating type
	Standard tire	17.5-25 x 12 pr (L2)
	Wheel rim	25 x 13.00
	Front tire inflation pressure	294 kPa (3.0 kg/cm^2)
	Rear tire inflation pressure	294 kPa (3.0 kg/cm^2)

BRAKES	
Main brakes	Front/rear wheel independent wet-type sealed disc brakes with hydraulic booster
Parking brake	Wet multiple disc brake on transmission output shaft
STEERING SYSTEM	
Type	Articulated type
Structure	Fully hydraulic power steering
HYDRAULIC SYSTEM	
Hydraulic + Steering pump type Delivery	Gear pump 175 ℓ/min.
Control valves: Set pressure for work equipment Set pressure for steering	 Spool type 20.6 MPA (210 kg/cm²) Spool type 18.6 MPa (190 kg/cm²)
Cylinders: Boom - qty. - bore x stroke Bucket - qty. - bore x stroke Steering - qty. - bore x stroke	Reciprocating piston 2 - 120 x 714 1 - 130 x 498 2 - 70 x 460
WORK EQUIPMENT	
Linkage type	Single link (Z-bar linkage)
Bucket edge type	Flat edge with bolt on cutting edge

WEIGHT TABLE

Machine model	WA250-3
Serial No.	A70001 and up
	kg
Engine (with air cleaner & muffler)	575
Radiator	70
Torque converter	40
Transmission with torque converter	557
Center drive shaft	19
Front drive shaft	15
Rear drive shaft	6
Front axle	507
Rear axle	495
Axle pivot	85
Wheel (each)	77
Tire (each)	106
Orbit-roll valve	7
Priority valve	6
Steering cylinder (each)	20
Hydraulic tank	71
Equipment / Steering pump	13
Brake booster	11

Machine model	WA250-3
Serial No.	A70001 and up
	kg
Main control valve	21
Boom lift cylinder (each)	87
Bucket cylinder	80
Engine hood with side panel	119
Front frame	900
Rear frame	660
Bucket link	25
Bellcrank	145
Boom lift arm including bushings	660
Bucket with bolt on cutting edge	970
Counterweight	1390
Fuel tank	104
Battery (each)	33
Floor, cab assembly	1080
Cab (ROPS)	520
Air conditioner unit	38
Operator’s seat	40

FUEL, COOLANT AND LUBRICANTS

PROPER SELECTION OF FUEL, COOLANT AND LUBRICANTS

Reservoir	Kind of fluid	Ambient Temperature (-22 -30, -4 -20, 14 -10, 32 0, 50 10, 68 20, 86 30, 104 40, 122°F 50°C)	Capacity Specified	Capacity Refill
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40	22 ℓ 5.8 US gal 4.8 UK gal	19.5 ℓ 5.1 US gal 4.3 UK gal
Brake	Engine oil	SAE 5W	1 ℓ 0.26 US gal 0.22 UK gal	1 ℓ 0.26 US gal 0.22 UK gal
Transmission case	Engine oil	SAE 10W	35 ℓ 9.2 US gal 7.7 UK gal	30 ℓ 7.9 US gal 6.6 UK gal
Hydraulic system	Engine oil	SAE 10W	90 ℓ 23.8 US gal 19.8 UK gal	64 ℓ 16.9 US gal 14.1UK gal
Axle (front & rear) (each)	Axle oil	See Note 1	17 ℓ 4.5 US gal 3.7 UK gal	17 ℓ 4.5 US gal 3.7 UK gal
Pins	Grease	NLGI No. 2	-	-
Fuel tank	Diesel fuel	ASTM D975 No. 2 ❈	184 ℓ 48.6 US gal 40.5 UK gal	-
Cooling system	Coolant	See 20.3 Coolant specification on page 3-13	40ℓ 10.6 US gal 8.8 UK gal	36.5 ℓ 9.6 US gal 8 UK gal

❈ ASTM D975 No. 1

Other equipment will be necessary, when operating the machine at temperatures below -20°C (-4°F),therefore consult your distributor for your needs.

Note 1: For axle oil, use only the recommended oil as follows.

SHELL: DONAX TT or TD
CALTEX: RPM TRACTOR HYDRAULIC FLUID
CHEVRON: TRACTOR HYDRAULIC FLUID
TEXACO: TDH OIL
MOBIL: MOBIL 424

It is possible to substitute engine oil SAE 30 API classification CD for axle oil. Although increased brake noise may result, durability is not be affected.

ENGINE OIL SPECIFICATIONS

Normal operation

Oil performance recommendations are as follows:

The use of a quality engine lubricating oil combined with appropriate oil and filter change intervals are critical factors in maintaining engine performance and durability.

SAE 15W-40 multi-viscosity oil meeting the American Petroleum Institute (API) performance classification of CF-4 or CF-4/SG is recommended.

★ CE or CE/SF oils may be used in areas where CF-4 or CF-4/SG oil is not yet available.

A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and oil consumption control. the sulfated ash **must not** exceed 1.85 mass percent. The sulfated ash limit of 1.85 mass percent has been placed on all engine lubricating oils recommended for use in the engine. Higher ash oils can cause valve and/or piston damage and lead to excessive oil consumption.

The API service symbol displays the following information. The upper half of the symbol displays the appropriate oil categories; the lower half may contain words to describe oil energy conserving features. The center section identifies the SAE oil viscosity grade.

Oil viscosity recommendations are as follows:

The use of a multi-graded lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures.

While SAE 15W-40 multi-viscosity oil is recommended for most operating climates, refer to the previous chart for oil viscosity recommendations for extreme climates.

Single graded oils may be used if multi-graded oil is not available. But be sure to use oil that matches the temperature shown in the table.

Special break-in lubricating oils are **not** recommended for a new or rebuilt engine. Use the same type of oil during the break-in as specified for normal operation.

Additional information regarding lubricating oil availability throughout the world is available in the "E.M.A. Lubricating Oils Data Book for Automotive and Industrial Engines". The data book may be ordered from the Engine Manufacturers Association, 401 North Michigan Ave., Chicago, Il U.S.A. 60611. The telephone number is (312) 644-6610.

Arctic Operation

If an engine is operated in ambient temperatures consistently below -23°C (-10°F) and there are no provisions to keep the engine warm when it is **not** in operation, use a synthetic API performance classification CE or CF-4 engine oil with adequate low temperature properties such as SAE 5W-20 or 5W-30.

The oil supplier **must** be responsible for meeting the performance service specifications.

★ The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as; corrosion, deposits and wear.

DIESEL FUEL SPECIFICATIONS

> Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.

★ Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and nozzles.

For normal service above -12°C (+10°F), the use of ASTM Grade No. 2-D diesel fuel with a minimum Cetane number of 40 is recommended. The use of No. 2-D diesel fuel will result in optimum engine performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke.

At operating temperatures below -12°C (+10°F), use ASTM Grade No. 1-D diesel fuel. The use of lighter fuels can reduce fuel economy.

Where a winterized blend of Grade No. 2-D and No. 1-D fuels is available, it may be substituted for Grade No. 1-D fuel. However, it is the supplier's responsibility to provide the fuel for the anticipated ambient temperature.

Use a low sulfur content fuel having a cloud point that is at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which crystals begin to form in the fuel. The viscosity of the fuel **must** be kept above 1.3 cSt to provide adequate fuel system lubrication.

COOLANT SPECIFICATIONS

GENERAL

Selection and maintenance of the engine coolant is important to long engine life. The following information provides recommendations for selecting the engine coolant and maintaining the coolant inhibitors.

Heavy duty diesel engines require a balanced coolant mixture of water, antifreeze, and supplemental coolant additives. Supplemental coolant additive recommendations are included in the section entitled Inhibitors Conditioners. The coolant mixture **must** be drained and replaced at the specified service interval shown in the OPERATION & MAINTENANCE MANUAL, or every two years of operation, whichever comes first.

WATER

Use water which has a low mineral content. Water used in conjunction with antifreeze, coolant filters and inhibited water must meet the following standards:

Total Hardness - Not to exceed 170 parts per million (10 grains/gallon maximum) to prevent scale deposits. Water containing dissolved magnesium and calcium (the usual reason for water hardness) above the specified amount will cause scale deposits to develop in the engine.

Chlorides - Not to exceed 40 parts per million (2.5 grains/gallon maximum) to prevent corrosion.

Sulfites - Not to exceed 100 parts per million (5.8 grains/gallon maximum) to prevent corrosion.

Dissolved Solids - Not to exceed 340 parts per million (20 grains/gallon maximum) to minimize sludge deposits, scale deposits, corrosion or a combination of these.

If any of the above requirements cannot be met, use distilled, de-ionized, or de-mineralized water. To determine if local water supplies meet these standards, water samples can be tested by water treatment laboratories. Softened water that is prepared using common salt (sodium chloride) contains excessive amounts of chlorides and should not be used.

★ Never use water alone in the cooling system because corrosion will occur.

ANTIFREEZE

In climates where the temperature is above -37°C (-34°F), use a coolant mixture that contains 50 percent antifreeze. **Antifreeze is essential in any climate**. It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point. Do **not** use more than 50 percent antifreeze in the mixture unless additional freeze protection is required. **Never** use more than 68 percent antifreeze under any condition.

An antifreeze concentration greater than 68% will adversely affect freeze protection and heat transfer rates. Antifreeze concentrations between 68 and 100% actually have a higher freezing point than a 68% antifreeze concentration and should not be used due to reduced heat transfer rates.

Low silicate ethylene glycol antifreeze is recommended. The antifreeze should contain no more than 0.1% anhydrous alkali metasilicate. Low silicate antifreeze is recommended to avoid the formation of silica-gel (hydro-gel). This gel formation can occur when the cooling system contains an over concentration of high silicate antifreeze and/or supplemental coolant additive. DO NOT use methanol or alcohol as an antifreeze because of its low boiling point.

Antifreeze may retain its freeze protection for more than one season but coolant conditioners must be added to maintain corrosion protection.

Antifreeze formulated with methoxy propanol, or propylene glycol, is not recommended for this system.

★ Do not mix types of antifreeze solutions. Mixed solutions make it impossible to determine the protection against freezing. Antifreeze containing sealer or anti-leak additives should NOT be used in this system. Sealer or anti-leak additives will cause plugging problems in the cooling system.

Check the solution periodically and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing.

The following table shows the approximate percentage of antifreeze solution required for various temperatures.

Approximate Freezing Point	Percentage of Antifreeze Concentration by Volume	Specific Gravity at 16°C (60°F)
0°C (+32°F)	0	1.000
-7°C (+20°F)	15	1.025
-12°C (+10°F)	25	1.040
-18°C (0°F)	33	1.053
-23°C (-10°F)	40	1.062
-29°C (-20°F)	45	1.070
-34°C (-30°F)	48	1.074
-40°C (-40°F)	53	1.080
-46°C (-50°F)	56	1.083
-51°C (-60°F)	59	1.088
-57°C (-70°F)	62	1.092
-62°C (-80°F)	65	1.095
-68°C (-90°F)	67	1.097
-69°C (-92°F)	68	1.098

In tropical climates where antifreeze availability may be limited, use a corrosion inhibitor DCA4, to protect the engine cooling system.

INHIBITORS/CONDITIONERS

1. All cooling system inhibitors, including those in antifreeze solutions, become depleted through normal operation. If the inhibitors in antifreeze are allowed to become depleted, the antifreeze becomes corrosive and attacks and coats the metallic surfaces of the cooling system which reduces heat transfer. Cooling system conditioners which contain these inhibitors must be added to maintain corrosion protection.

2. Soluble oil is not recommended for use in this engine as its use will reduce heat transfer.

3. There are no miracle additives that will increase heat transfer or prevent overheating. Conditioned water is still the best coolant.

4. DCA4 is recommended to inhibit corrosion in the cooling system for the following reasons:

   - Improved compatibility with high silicate antifreezes to minimize hydro-gel formation if over concentration occurs.

   - Provides engine protection in the following areas:
     - Solder corrosion/bloom
     - Copper corrosion/erosion/stress cracking
     - Oil fouling
     - Cylinder liner cavitation corrosion
     - Aluminum cavitation corrosion
     - Seal and gasket degradation

Maintenance of Cooling System Inhibitors

Keeping the engine coolant properly inhibited will keep the engine and radiator free of rust, scale deposits and corrosion.

New machines are delivered with antifreeze protection. Service at regular scheduled intervals specified in the OPERATION & MAINTENANCE MANUAL with a service DCA4 filter.

Each time the coolant is drained and replaced, the coolant must be recharged with DCA4. New coolant can be correctly charged with supplemental coolant additives by using DCA4 filters or DCA4 concentrate listed in the table entitled, DCA4 Unit Guide.

If coolant is added between drain intervals, additional DCA4 will be required.

Coolant Testing for Conditioner Concentration

When the cooling system is maintained as recommended, the conditioner concentration should be satisfactory. The DCA4 concentration must not fall below 1.0 unit per 3.8 ℓ (1 US gal) or exceed 2 units per 3.8 ℓ (1 US gal) of coolant. The only accurate method for testing chemical concentrations in coolant with mixed chemical compounds is a laboratory analysis. For this reason, the coolant inhibitor should be maintained as shown in the OPERATION & MAINTENANCE MANUAL.

★ Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over concentration can cause formation of gel that can cause restriction, plugging of passages and overheating.

Replenishing Coolant Conditioner

Install a precharge DCA4 filter when the coolant is changed or a significant (more than 50%) coolant loss occurs. Install a service DCA4 filter as specified in the OPERATION & MAINTENANCE MANUAL When antifreeze is added, add coolant conditioner equal to 1.0 unit per 3.8 ℓ (1 US gal) of antifreeze.

Mixing of DCA4 and other supplemental coolant additives is not recommended because there is currently no test kit available to measure concentration levels with mixed chemical solutions.

DCA4 Unit Maintenance Guide

Use supplemental coolant additives (corrosion inhibitors) to protect the engine cooling system from corrosion. Antifreeze alone does **not** provide enough corrosion protection for a heavy duty diesel engine. Supplemental corrosion protection **must** be supplied through periodic additions of supplemental coolant additives to the coolant.

To protect against corrosion, a new coolant charge **must** be brought up to 0.26 DCA4 unit per liter (one unit per U.S. gal) of coolant (initial charge). Maintain the correct DCA4 concentration by changing the service coolant filter at each engine oil and filter change interval.

Each time the coolant is drained and replaced, the coolant **must** be recharged with supplemental coolant additives. Use the appropriate DCA4 spin-on filter listed in following table. The coolant mixture **must** be drained and replaced as defined under General.

The amount of replacement inhibitor is determined by the length of the service interval and the cooling system capacity. Refer to the DCA4 Unit Guide for the selection of the correct filter to replenish the DCA4.

If coolant is added between drain intervals, additional DCA4 will be required. Check the coolant DCA4 concentration level anytime make-up coolant is added to the system. The DCA4 concentration **must not** fall below 0.13 units per liter or exceed 0.5 units per liter (0.5 units per U.S. gallon or exceed 2 units per U.S. gallon).

DCA4 Unit Guide

Fleetguard Part No.	DCA4 Units
DCA4 Coolant Filter	
WF-2070	2
WF-2071	4
WF-2072	6
WF-2073	8
WF-2074	12
WF-2075	15
WF-2076	23
WF-2077	0
DCA4 Liquid	
DCA60L	4 (1 Pint)
DCA80L	1760 (55 USgal)
DCA4 Powder	
DCA95	20

DCA4 Precharge and Service Filters

System Capacity		Precharge Filter (See NOTE 1)	Service Filter (See NOTE 3)
Liters	US Gallons		
19 to 26	5 to 7	WF-2072	WF-2070
26 to 38	**7 to 10**	**WF-2073**	**WF-2071**
38 to 57	10 to 15	WF-2074	WF-2071
57 to 76	15 to 20	WF-2075	WF-2071
76 to 114	20 to 30	WF-2076	WF-2072
114 to 190	30 to 50	(See NOTE 2)	WF-2073

NOTE 1 - After draining and replacing coolant, always precharge the cooling system to maintain the DCA4 concentration between 1.0 and 2.0 units per 3.8 ℓ (1 US gal).

★ When performing service which requires draining the cooling system, discard the coolant. Reusing coolant can introduce contaminates or over concentrated chemicals, resulting in premature failure of cooling system components.

- Install appropriate service filter listed in the above table based on cooling system capacity.

  Example: 95 gal (360 ℓ) cooling system capacity
  -15 Units (1) WF-2075 Filter
  80 Units

- The answer represents the additional units required to precharge the cooling system. Four bottles of powder, part number DCA95, will provide a sufficient amount of DCA4 units (80) to precharge the example cooling system.

- Install the appropriate service filter at the next and subsequent maintenance intervals.

NOTE 3 - Change the coolant filter at every engine oil and filter change interval to protect the cooling system.

Maintain a nominal concentration of 1.0 DCA4 unit per 3.8 ℓ (1 US gal) of coolant in the system. Less than 0.5 unit per 3.8 ℓ (1 US gal) indicates an under-concentrated coolant solution. More than 2.0 units per 3.8 ℓ (1 USgal) indicates an over-concentrated coolant solution.

To check the DCA4 concentration level, use the Fleetguard coolant test kit, CC2626. Instructions are included with the test kit.

DCA4 Unit Concentration Guide

Number of Solution A Drops to Cause Color Change	Coolant Condition	Action Required
0 to 10 Drops	Extremely under-concentrated - less than 0.4 DCA4 units per 3.8 ℓ (1 US gal)	Initially charge the system to a minimum of 1.0 DCA4 unit per 3.8 ℓ (1 US gal)
11 to 16 Drops	Marginally under-concentrated - 0.45 to 0.8 DCA4 units per 3.8 ℓ (1 US gal)	Add DCA4 liquid units to maintain 1.0 DCA4 unit per 3.8 ℓ (1 US gal) minimum or change the DCA4 coolant filter
17 to 25 Drops	Acceptable - 0.85 to 1.3 DCA4 units per 3.8 ℓ (1 US gal)	NONE
26 to 35 Drops	Highly acceptable - 1.35 to 2.0 DCA4 units per 3.8 ℓ (1 US gal)	NONE
36 to 55 Drops	Marginally over-concentrated - 2.1 to 3.3 DCA4 units per 3.8 ℓ (1 US gal)	Review maintenance practice
Over 55 Drops	Extremely over-concentrated	Drain 50% of the coolant and replace with water antifreeze mixture. Retest the system for correct DCA4 unit concentration.

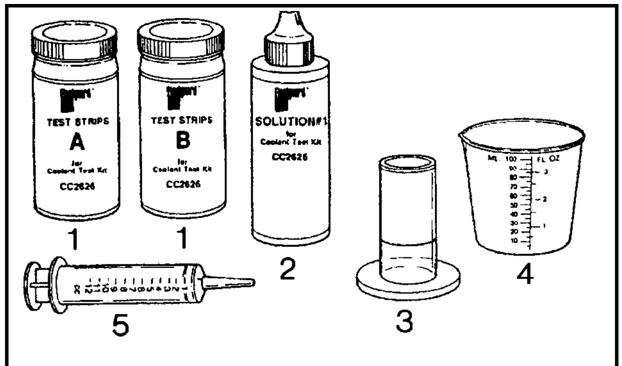
The following may be purchased from your Komatsu International Company distributor.

Cooling system test kit

The Fleetguard® Coolant Test Kit is used to check the coolant concentration of coolant additives in the cooling system.

Part Number: CC-2626

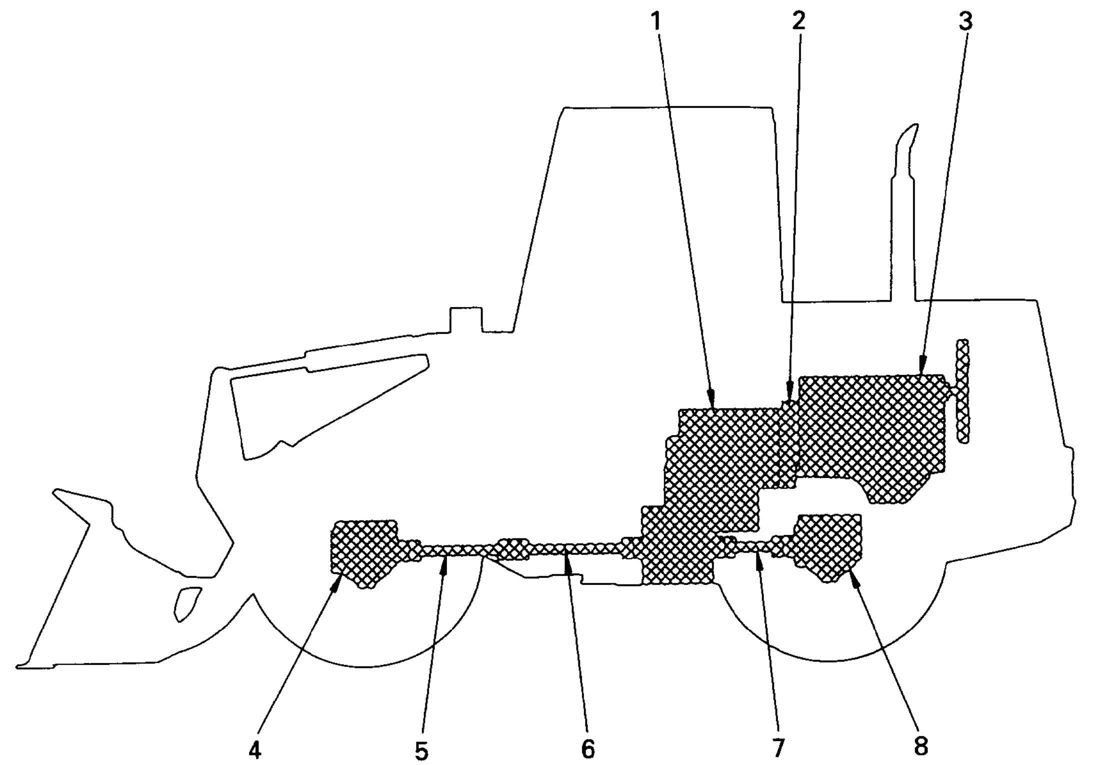
1. Test strip bottles
2. Solution #1 bottle
3. Small plastic container
4. Large plastic cup
5. Syringe



PN CC-2626 L12AM025

1 0 STRUCTURE AND FUNCTION

POWER TRAIN

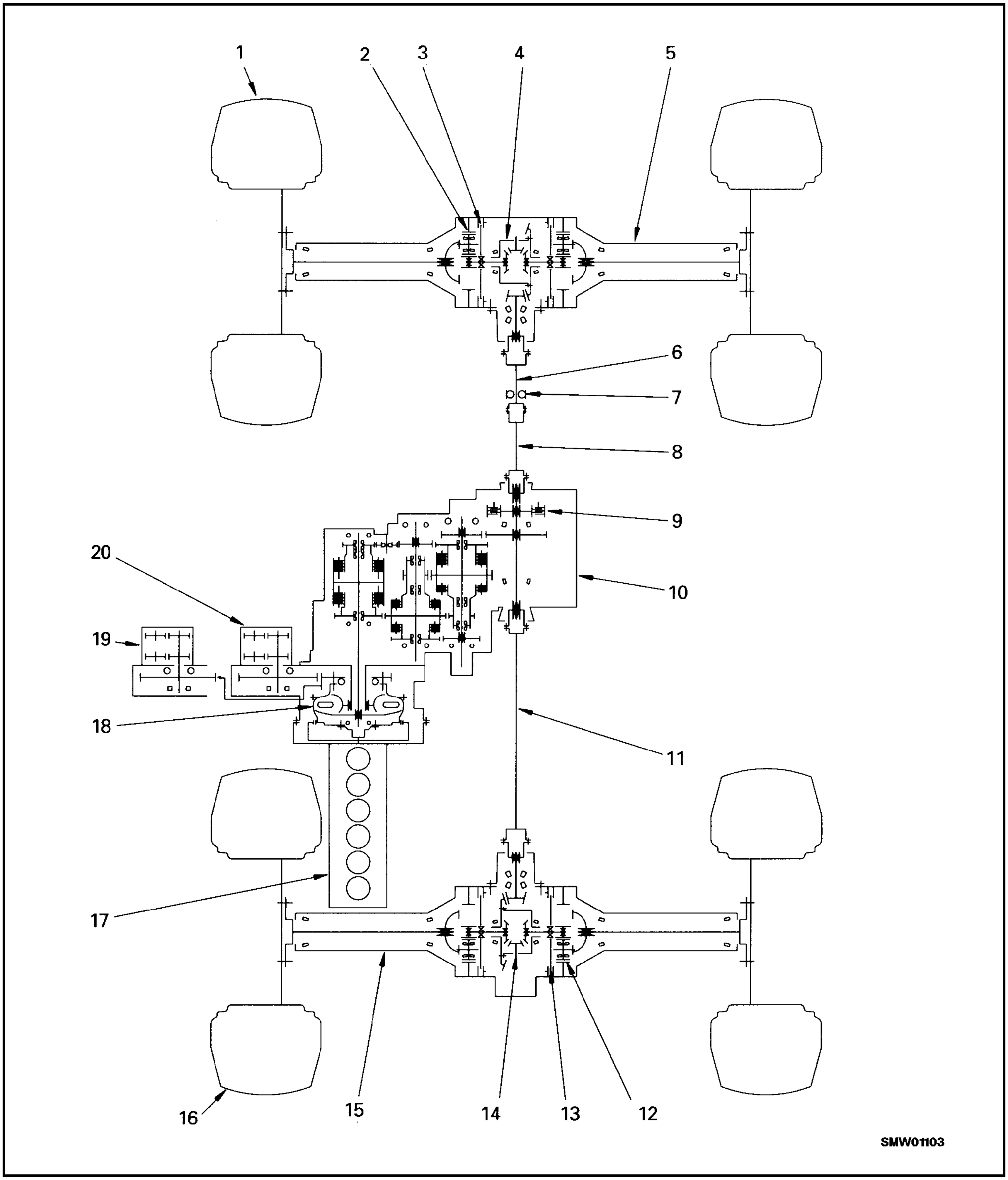


1. Transmission
2. Torque converter
3. Engine
4. Front axle
5. Front drive shaft
6. Center drive shaft
7. Rear drive shaft
8. Rear axle

Outline

- The motive force from engine (3) passes through the engine flywheel and is transmitted to torque converter (2), which is connected to the input shaft of transmission (1). The transmission has six hydraulically actuated clutches, and these provide four speed ranges for both FORWARD and REVERSE. The transmission speed ranges are selected manually.
- The motive force from the output shaft of the transmission passes through center drive shaft (6), front drive shaft (5) and rear drive shaft (7), and is then transmitted to front axle (4) and rear axle (8) to drive the wheels.

PATH OF POWER TRANSMISSION

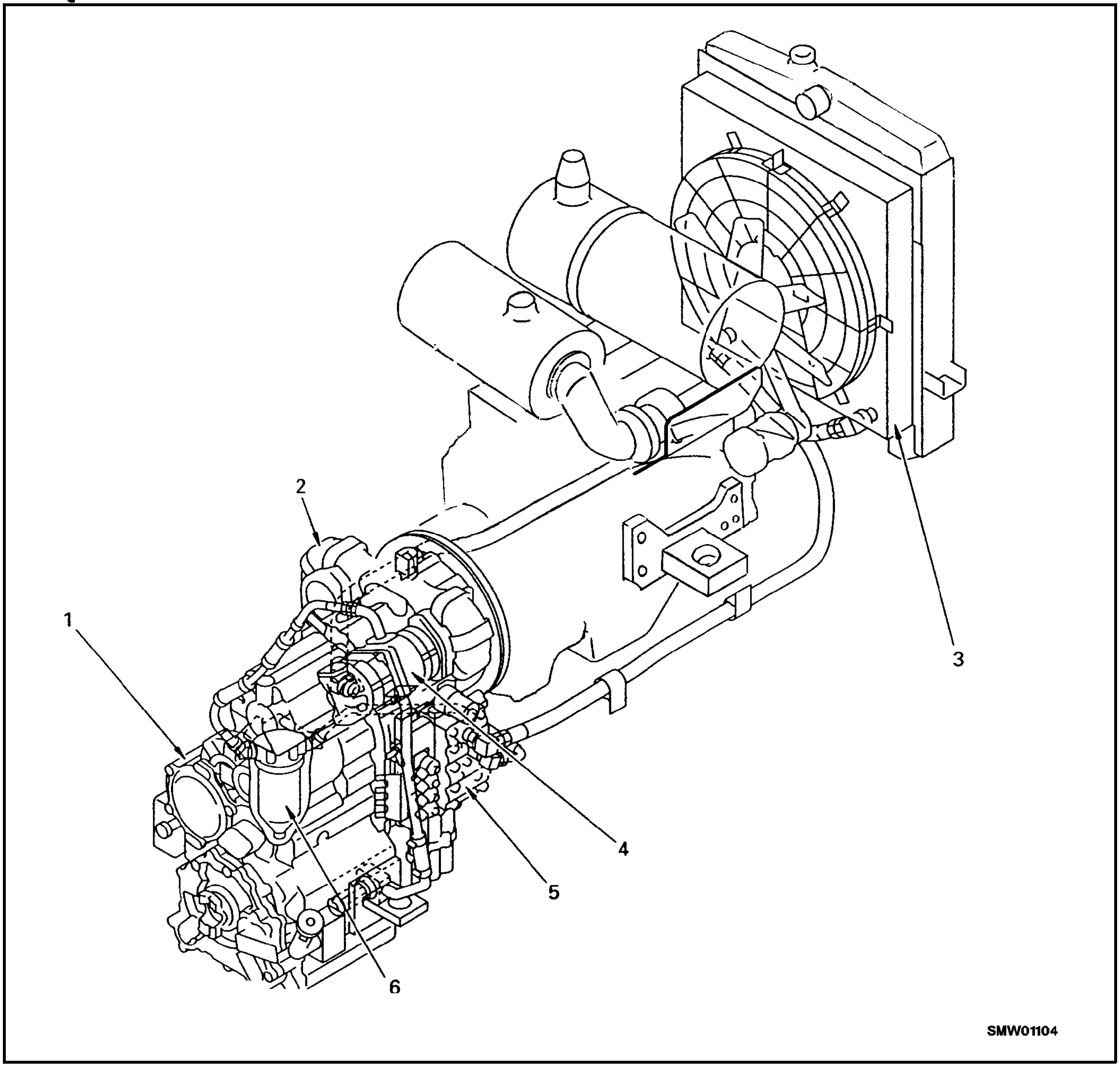


1. Front tire
2. Final drive
3. Wet type disc brake
4. Differential
5. Front axle
6. Front drive shaft
7. Flange bearing
8. Center drive shaft
9. Parking brake
10. Transmission
11. Rear drive shaft
12. Final drive
13. Wet type disc brake
14. Differential
15. Rear axle
16. Rear tire
17. Engine
18. Torque converter
19. Hydraulic, steering Pump
20. Torque converter charging pump

Outline

- The motive force from engine (17) passes through the flywheel and is transmitted to torque converter (18).
  The torque converter uses oil as a medium. It converts the transmitted torque in accordance with the change in the load, and transmits the motive force to the input shaft of the transmission.
  In addition, the motive force of the engine passes through the pump drive gear of the torque converter, and is transmitted to hydraulic, steering switch, PPC Pump (19) and torque converter charging pump (20) to drive each pump.
- Transmission (10) operates the directional spool and speed spool of the transmission valve through the solenoid valves, and actuates the six hydraulically actuated clutches to select one of the four FORWARD or REVERSE speeds.
  The transmission speed range is selected manually.
- The output shaft of transmission (10) transmits the power to the front and rear axles. At the front, the power is transmitted to front axle (5) through center drive shaft (8), flange bearing (7), and front drive shaft (6).
  At the rear, the power is transmitted to rear axle (15) through rear drive shaft (11).
- The motive force transmitted to front axle (5) and rear axle (15) has its speed reduced by the bevel gear and pinion gear of differentials (4) and (14), and is then transmitted to the sun gear shaft through the differential mechanism.
- The motive force of the sun gear is reduced further by the planetary mechanism and is transmitted to the wheels through the axle shaft.

TORQUE CONVERTER TRANSMISSION PIPING

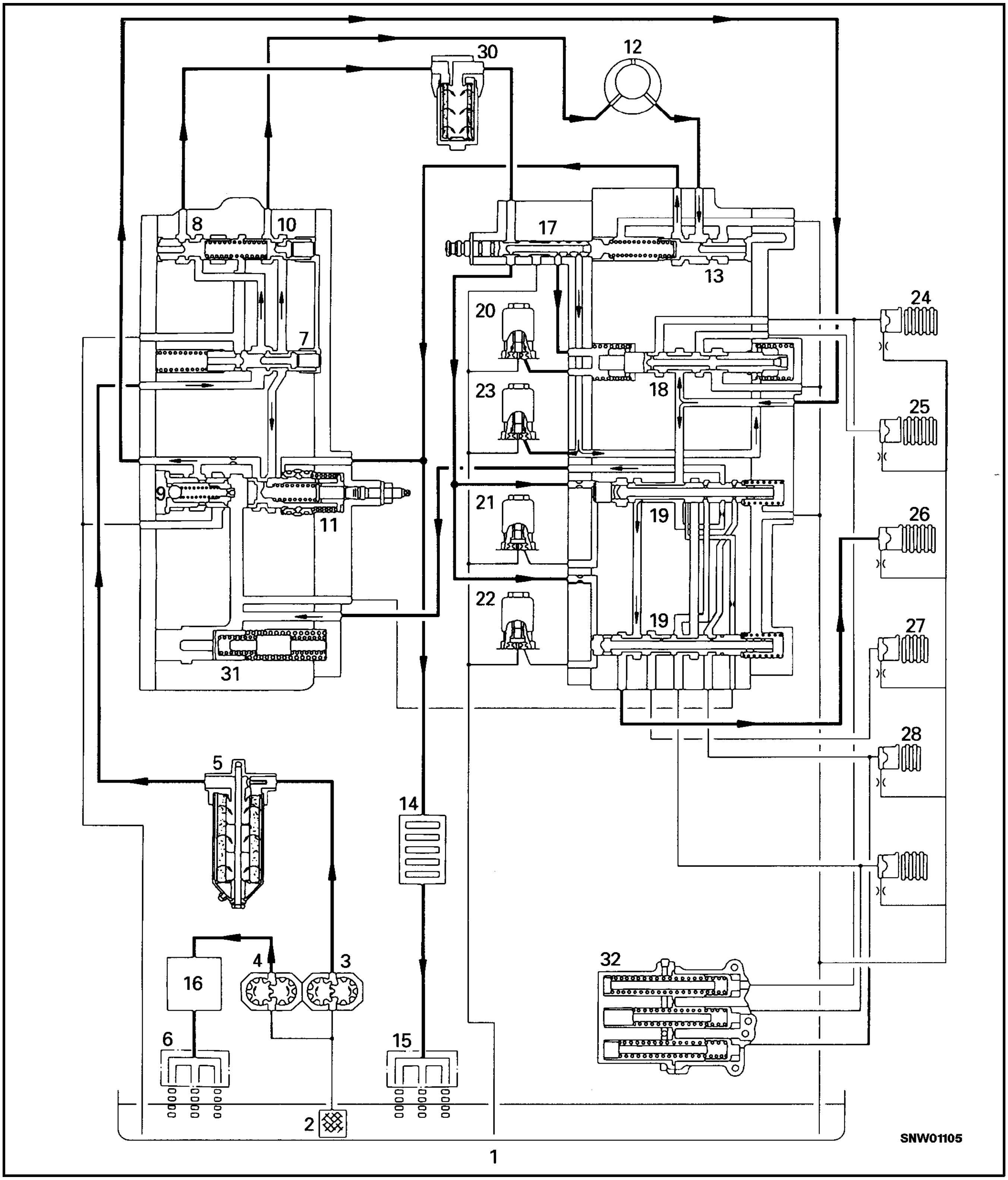


1. Transmission
2. Torque converter
3. Torque converter oil cooler
4. Torque converter charging pump
5. Transmission valve
6. Torque converter oil filter

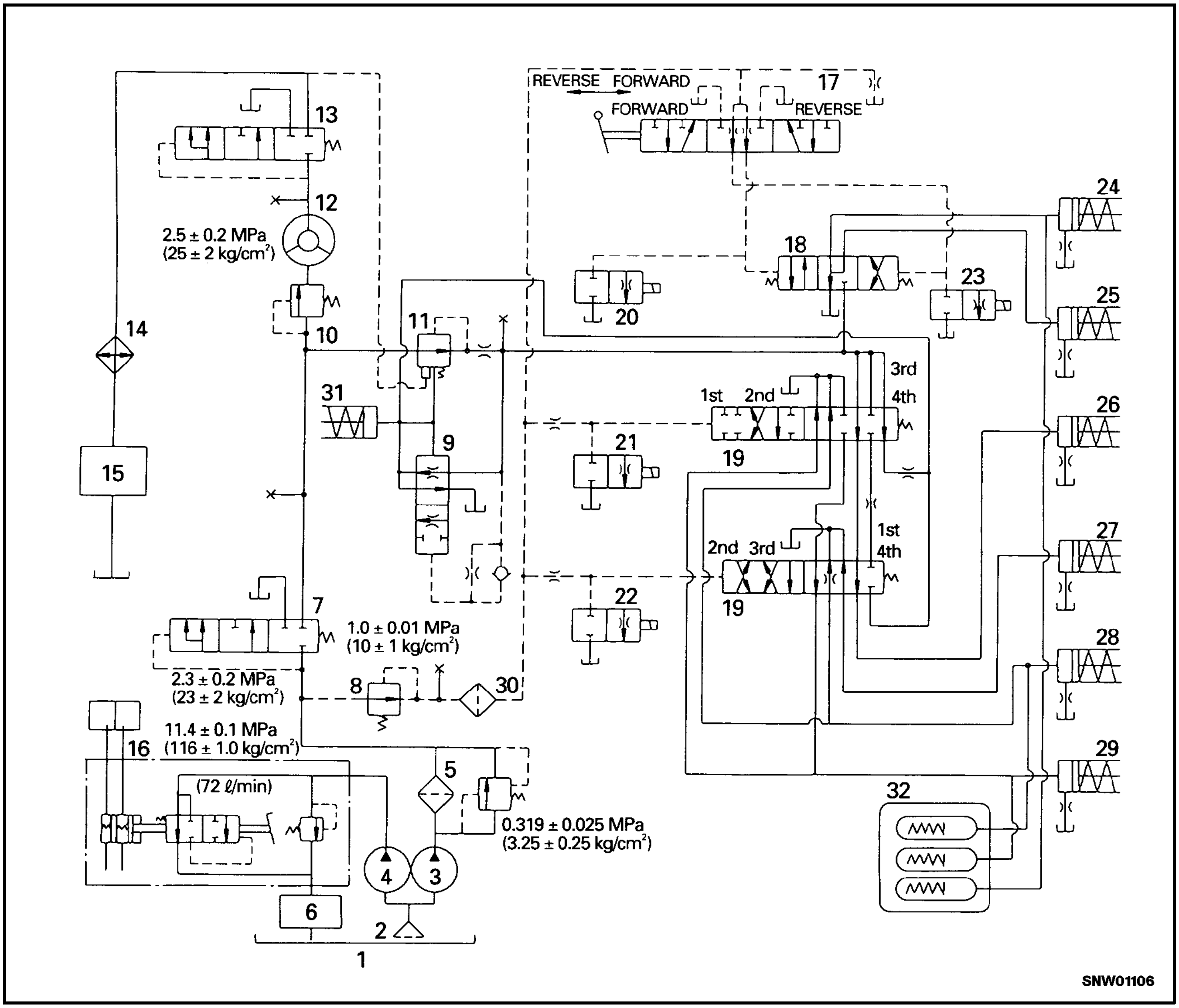
MEMORANDA

TORQUE CONVERTER, TRANSMISSION HYDRAULIC SYSTEM DIAGRAM

(Engine at low idle, directional lever at neutral, speed lever at 4th)

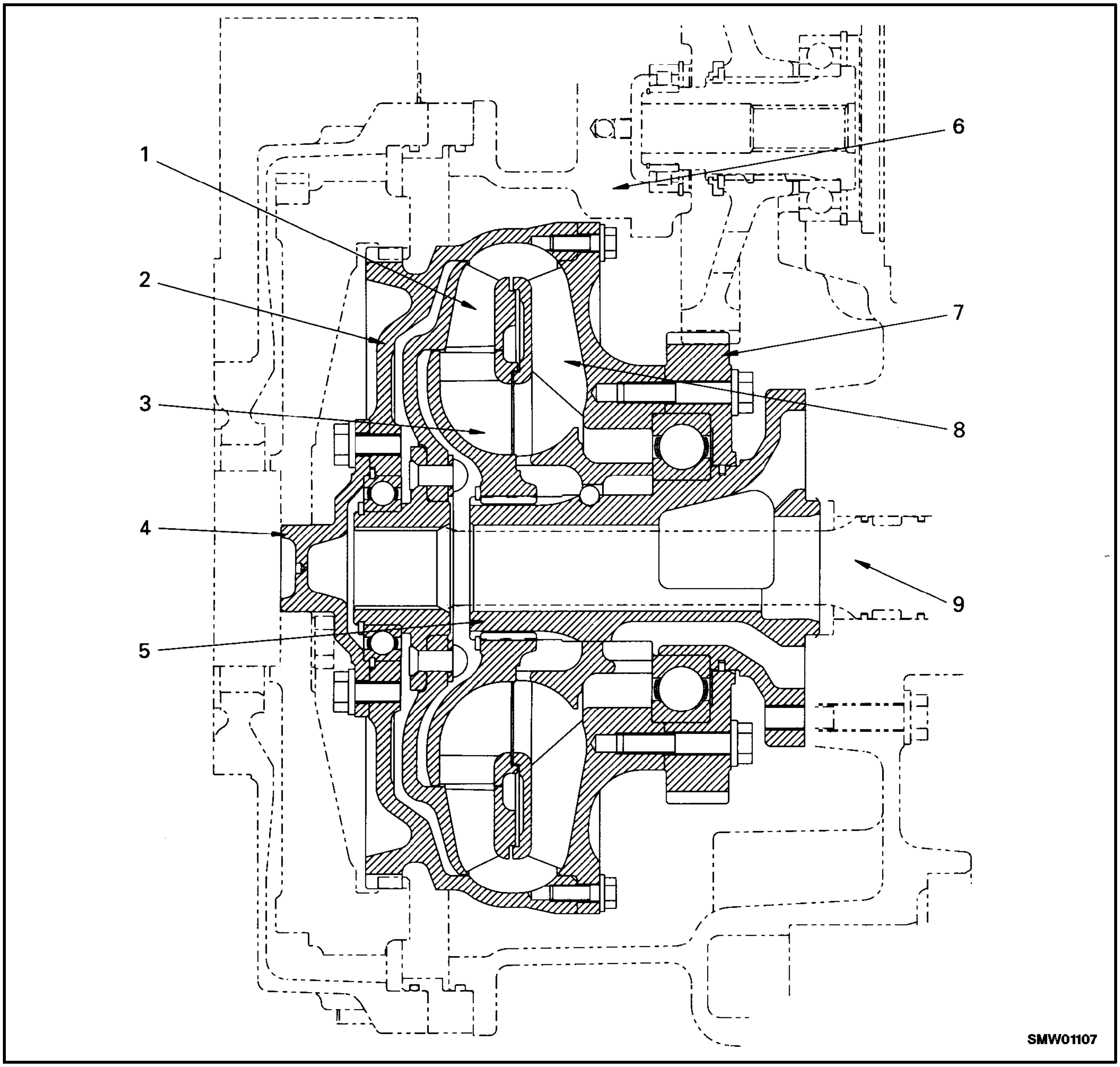


TORQUE CONVERTER, TRANSMISSION HYDRAULIC CIRCUIT DIAGRAM



1. Transmission case
2. Strainer
3. Torque converter charging pump
4. Lubrication pump
5. Oil filter
6. Directional clutch lubrication
7. Priority valve
8. Pilot reducing valve
9. Quick return valve
10. Main regulator valve
11. modulation fill valve
12. Torque converter
13. Torque converter outlet port valve
14. Oil cooler
15. Transmission clutch lubrication
16. Brake booster circuit
17. Emergency manual spool
18. Directional spool
19. Speed spool\
20. FORWARD (2nd) solenoid valve
21. 3rd, 4th solenoid valve
22. 1st, 4th solenoid valve
23. REVERSE (2nd) solenoid valve
24. FORWARD clutch
25. REVERSE clutch
26. 4th clutch
27. 3rd clutch
28. 2nd clutch
29. 1st clutch
30. Pilot oil filter
31. Accumulator
32. Accumulator valve

TORQUE CONVERTER

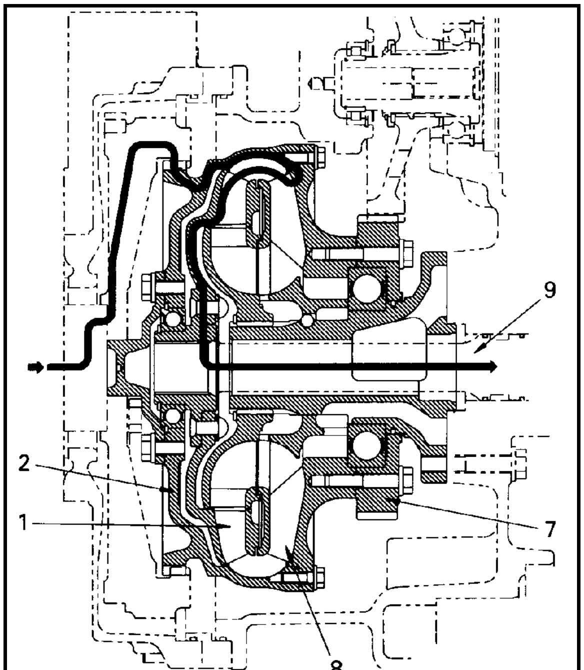


1. Turbine
2. Drive case
3. Sator
4. Pilot
5. Stator shaft
6. Housing
7. PTO gear (drive)
8. Pump
9. Output shaft (Transmission input shaft)

Specifications
Model: TCA32-7A
Type: 3-element, 1-stage, 1-phase
Stall torque ratio: 2.84

Path of motive force

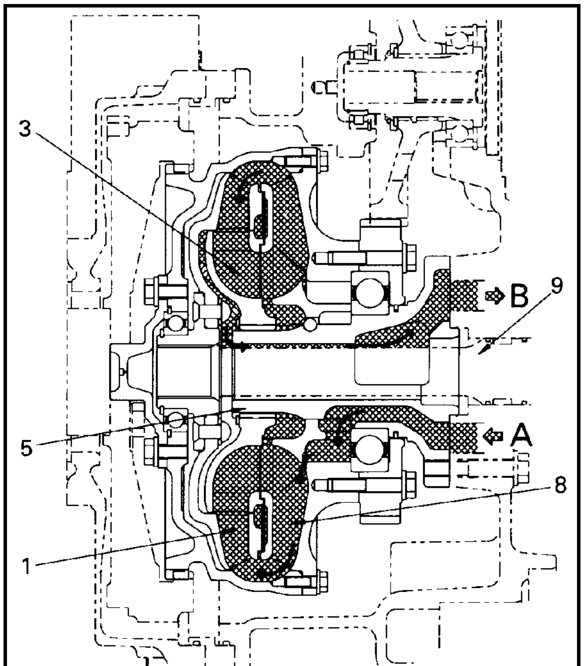
- The torque converter is installed between the engine and the transmission.
  The motive force from the engine enters drive case (2) from flywheel.
  Drive case (2), pump (8), and PTO gear (drive) (7) are each secured by bolts and are rotated directly by the rotation of the engine. The motive force of pump (8) uses oil as a medium to rotate turbine (1) and transmit the motive force to transmission input shaft (9).
- The motive force of drive case (2) is used as the motive force to drive the gear pump through PTO gear (drive) (7).



SMW01108

Flow of oil

- The oil supplied from the torque converter charging pump enters inlet port **A,** passes through the oil passage of stator shaft (5), and flows to pump (8).
  The oil is given centrifugal force by pump (8), enters turbine (1), and transmits the energy of the oil to the turbine. Turbine (1) is fixed to transmission input shaft (11), so the motive force is transmitted to the transmission input shaft.
  The oil from turbine (1) is sent to stator (3) and enters the pump again. However, pari of the oil is sent from the stator through outlet port **B** to the cooler.



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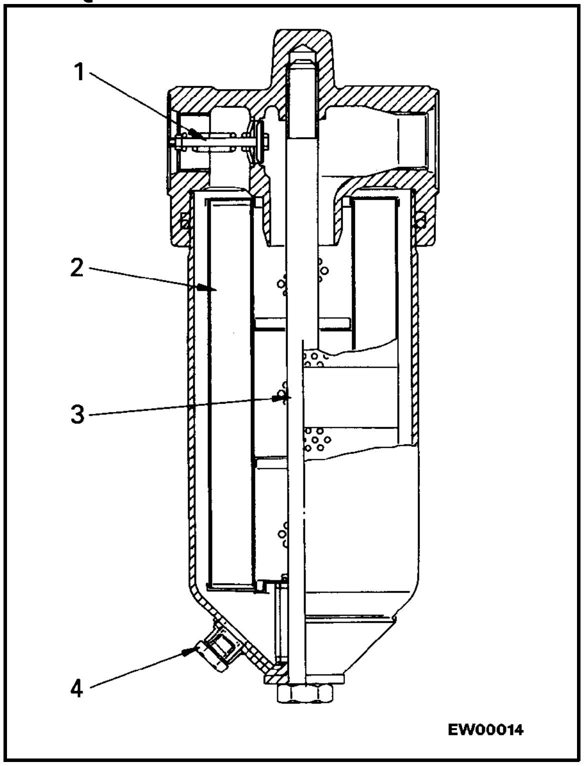
TORQUE CONVERTER OIL FILTER



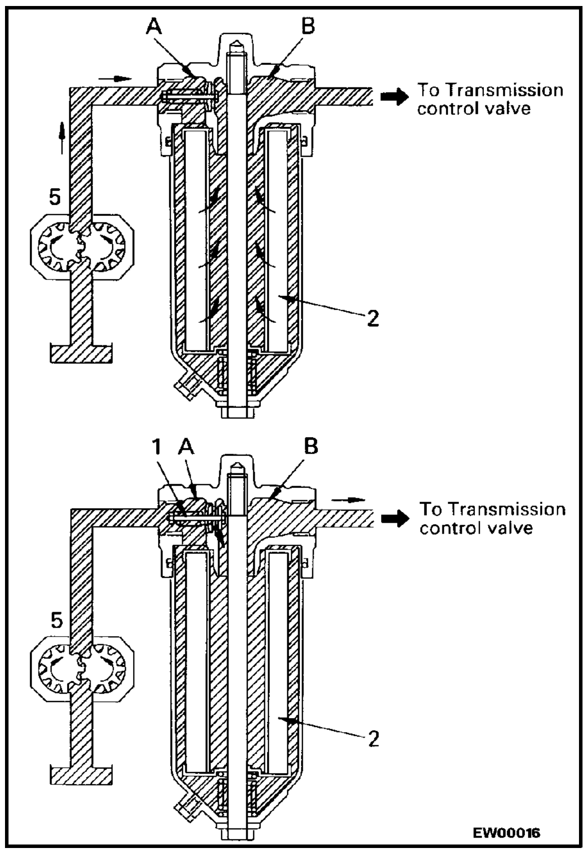
1. Relief valve
2. Element
3. Center bolt
4. Drain plug

Specifications

Filter mesh size: 10 microns
Filtering area : 8900 cm²
Relief pressure: 0.34 MPa (3.5 kg/cm²)

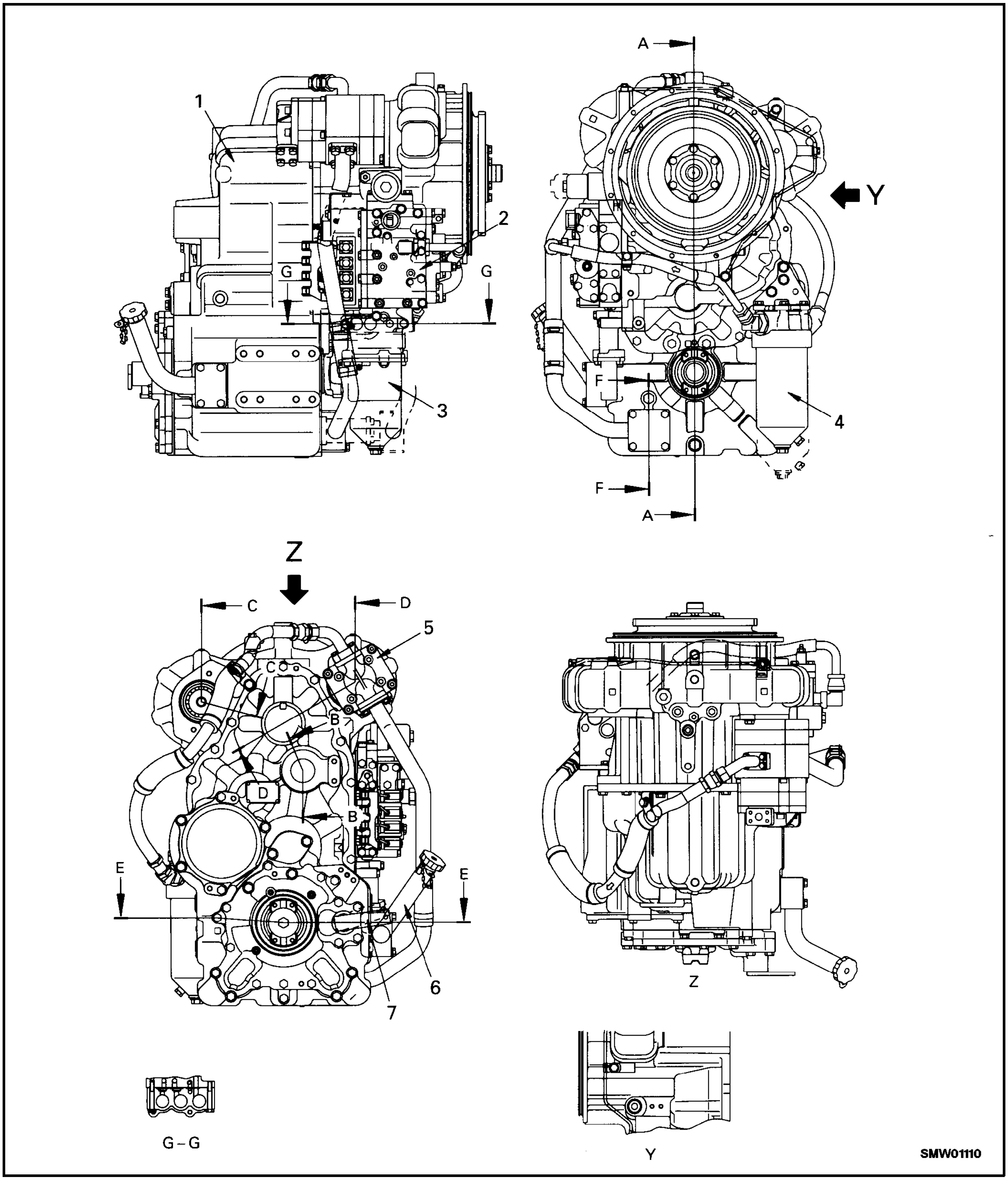
Operation

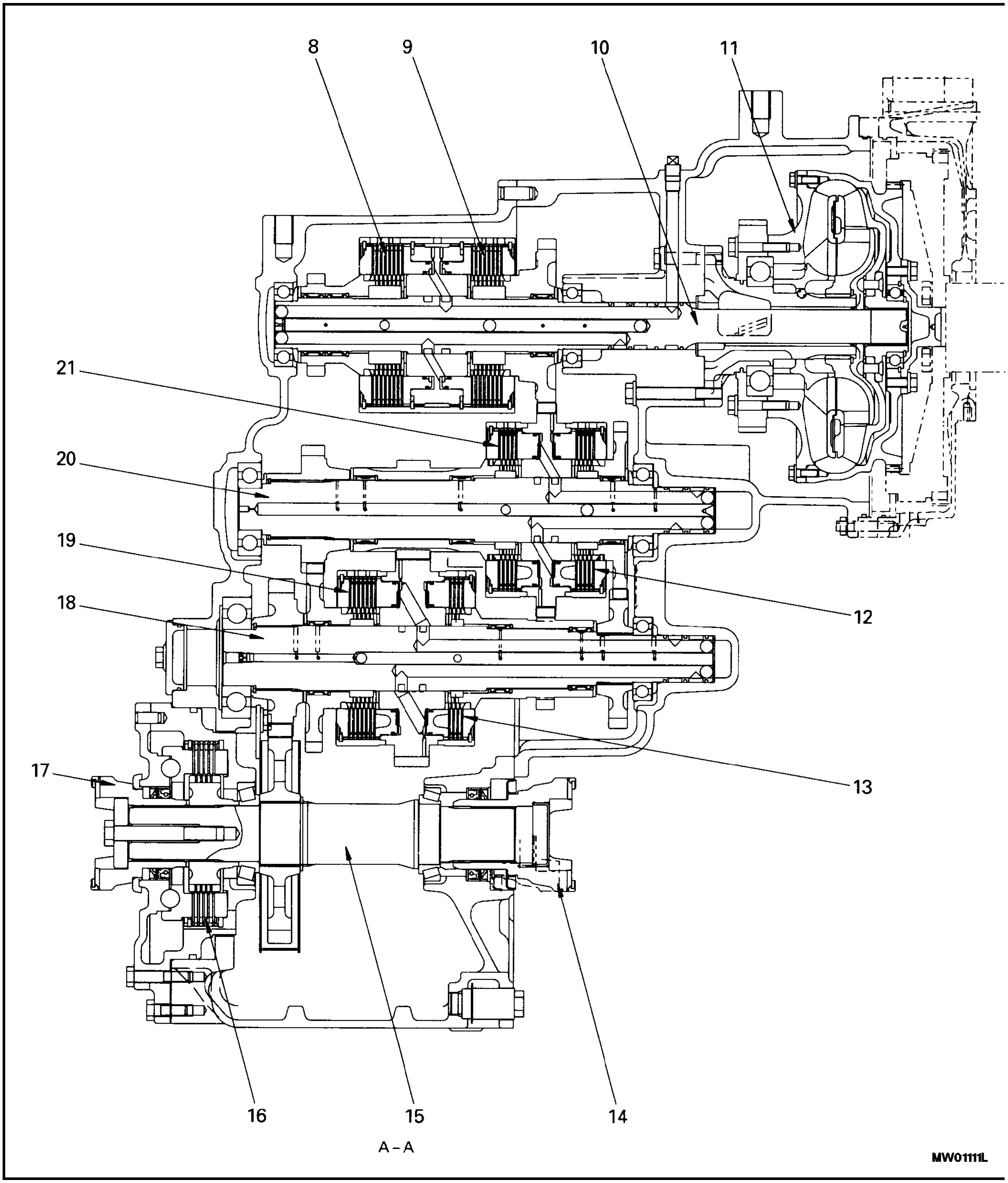
- The oil from the torque converter charging pump enters filter inlet port **A.** It is filtered from the outside of element (2) to the inside, and flows to outlet port **B.**



- If element (2) becomes clogged with dirt, or the oil temperature is low and the pressure rises at inlet port **A,** the oil from inlet port **A** opens relief valve (1) and flows directly to outlet port **B** in order to prevent damage to the pump or element (2).

TRANSMISSION

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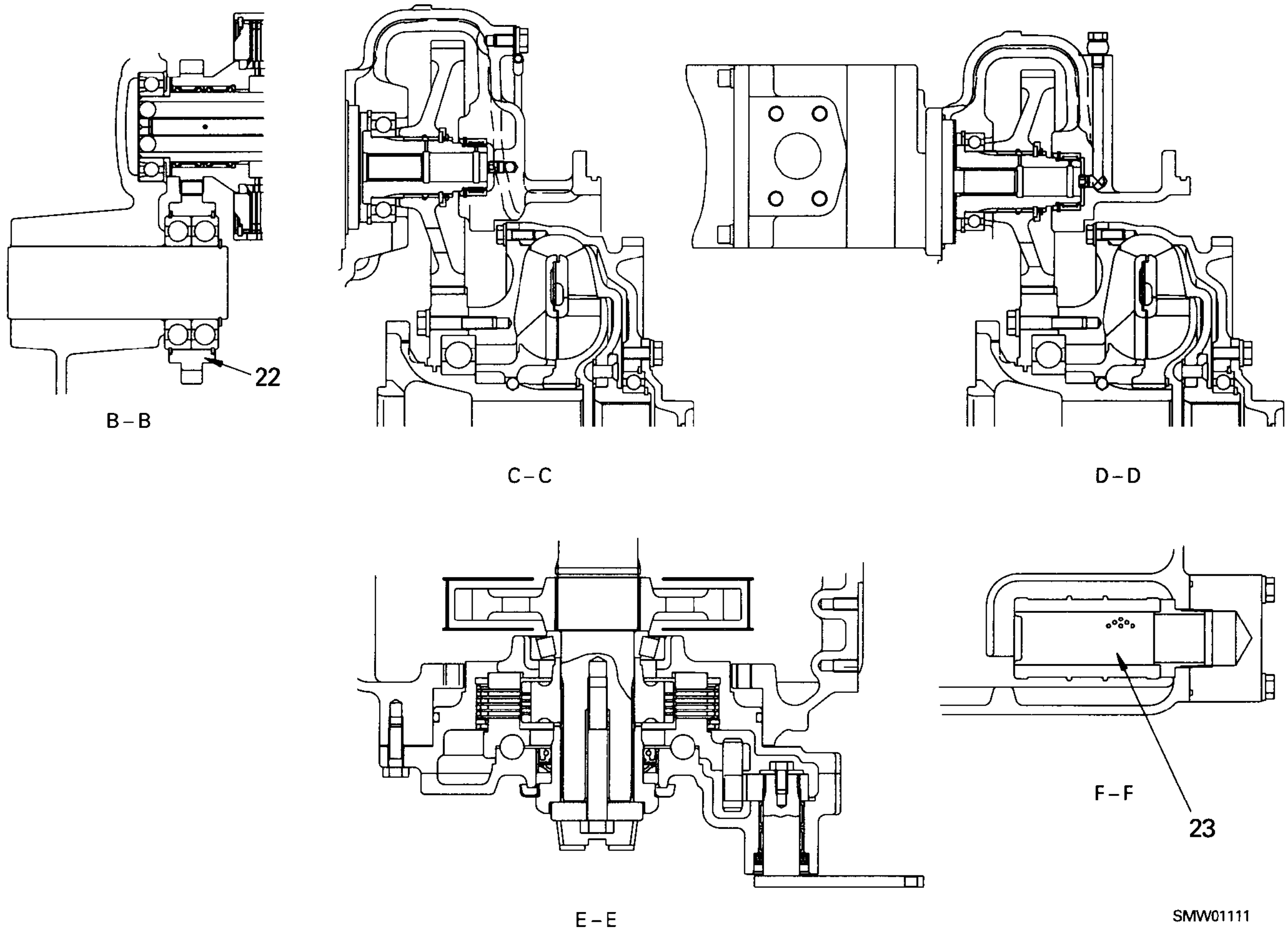
A – A
MW01111L



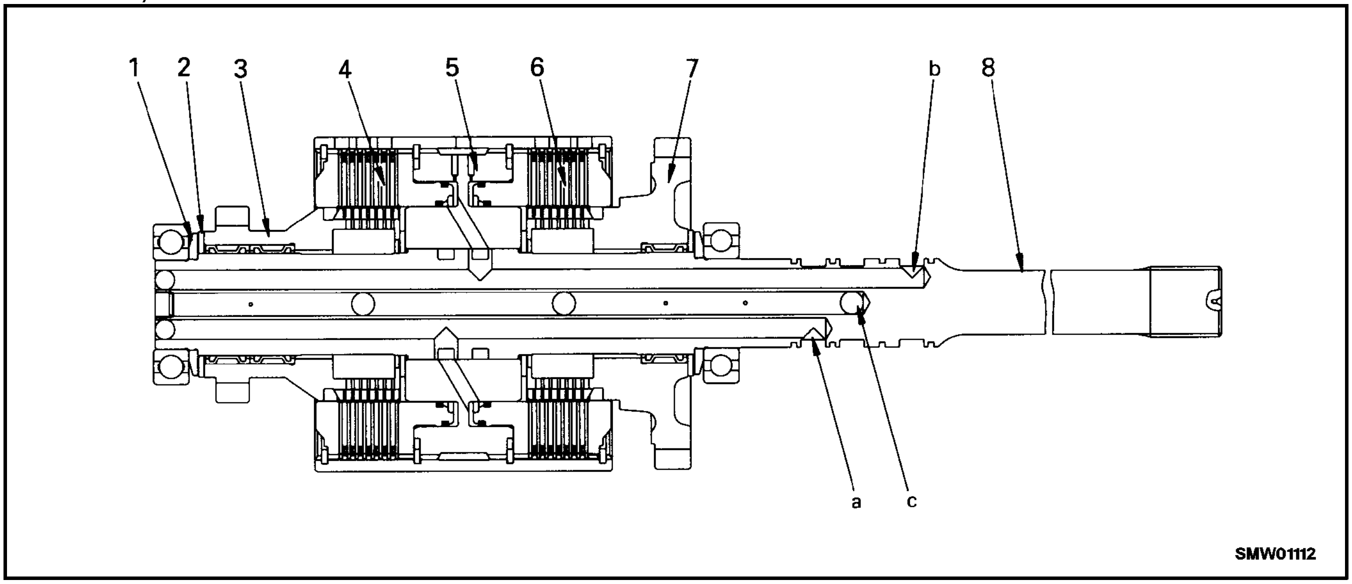
1. Transmission
2. Transmission control valve
3. Accumulator valve
4. Torque converter oil filter
5. Torque converter charging pump (SAL032)
6. Oil filler port
7. Parking brake lever
8. REVERSE clutch
9. FORWARD clutch
10. Input shaft
11. Torque converter
12. 3rd clutch
13. 4th clutch
14. Rear coupling
15. Output shaft
16. Parking brake
17. Front coupling
18. 2nd, 4th shaft
19. 2nd clutch
20. 1st, 3rd shaft
21. 1st clutch
22. REVERSE idler gear
23. Strainer

MW01111R

Outline

- The transmission is installed behind the torque converter. The motive force from the torque converter passes through the transmission input shaft and enters the transmission.
- The transmission uses the combination of forward or reverse clutches and the four speed clutches to shift to F1 - 4 or R1 4, transmits the motive force from the input shaft to the output shaft.

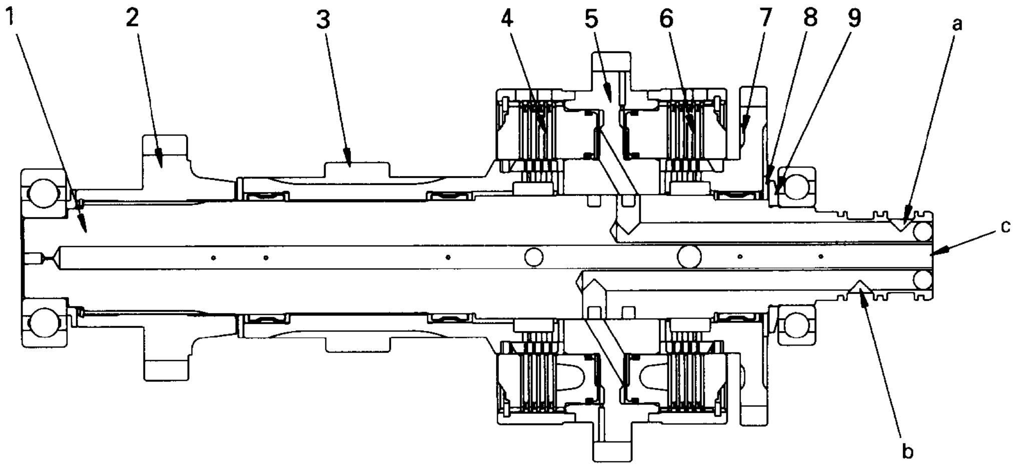
CLUTCH
FORWARD, REVERSE CLUTCH



1. Spacer
2. Thrust washer
3. REVERSE gear
4. REVERSE clutch
5. FORWARD, REVERSE cylinder
6. FORWARD clutch
7. FORWARD clutch
8. FORWARD gear

a. FORWARD clutch oil port
b. REVERSE clutch oil port
c. Lubrication oil port

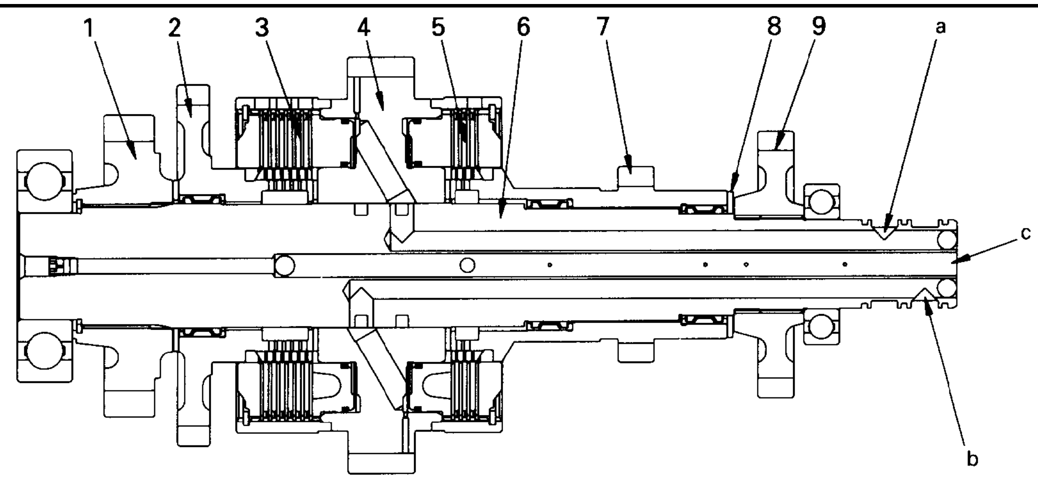
1ST, 3RD CLUTCH



1. 1st, 3rd shaft
2. Idler gear
3. 1st gear
4. 1st clutch
5. 1st, 3rd cylinder
6. 3rd clutch
7. 3rd gear
8. Thrust washer
9. Spacer

a. 1st clutch oil port
b. 3rd clutch oil port
c. Lubrication oil port

2ND, 4TH CLUTCH



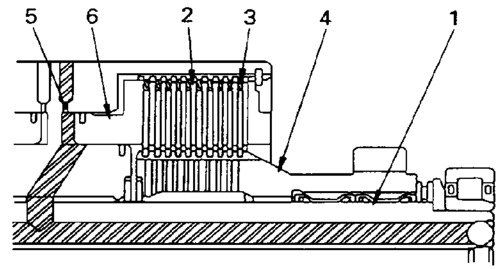
1. Idler gear
2. 2nd gear
3. 2nd clutch
4. 2nd, 4th cylinder
5. 4th clutch
6. 2nd, 4th shaft
7. 4th gear
8. Thrust washer
9. Idler gear

a. 2nd clutch oil port
b. 4th clutch oil port
c. Lubrication oil port

Operation of clutch

When operated

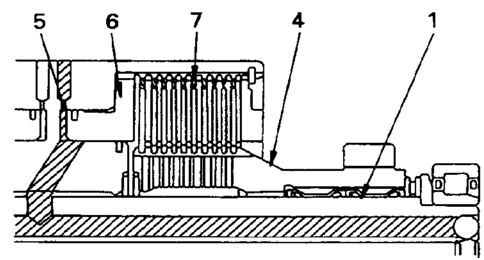
- The oil sent from the transmission valve passes through the oil passage inside shaft (1), and goes to the rear face of piston (6) to actuate the piston.
- When piston (6) is actuated, separator plate (2) is pressed against clutch disc (3) and forms shaft (1) and clutch gear (4) into one unit to transmit the motive force.
- Oil is drained from oil drain hole (5) at this time, but this does not affect clutch operation since less oil is drained than supplied.



SBW00437

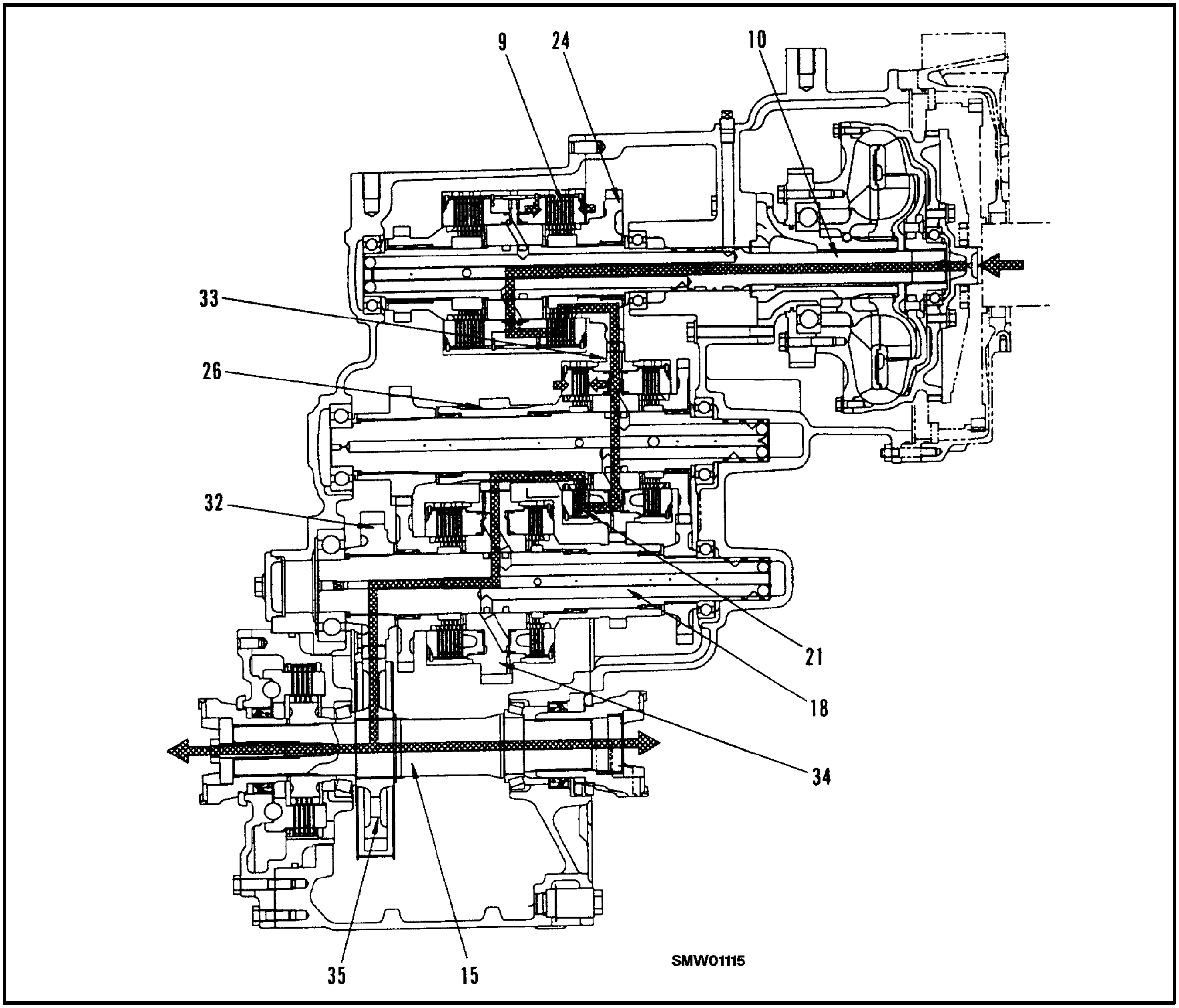
When not actuated

- If the oil from the transmission valve is shut off, the pressure of the oil acting on the rear face of piston (6) drops.
- The piston is returned to its original position by wave spring (7), so shaft (1) and clutch gear (4) are separated.
- When the clutch is disengaged, the oil at the rear face of the piston is drained by centrifugal force through oil drain hole (5), preventing the clutch from remaining partially engaged.



SBW00438

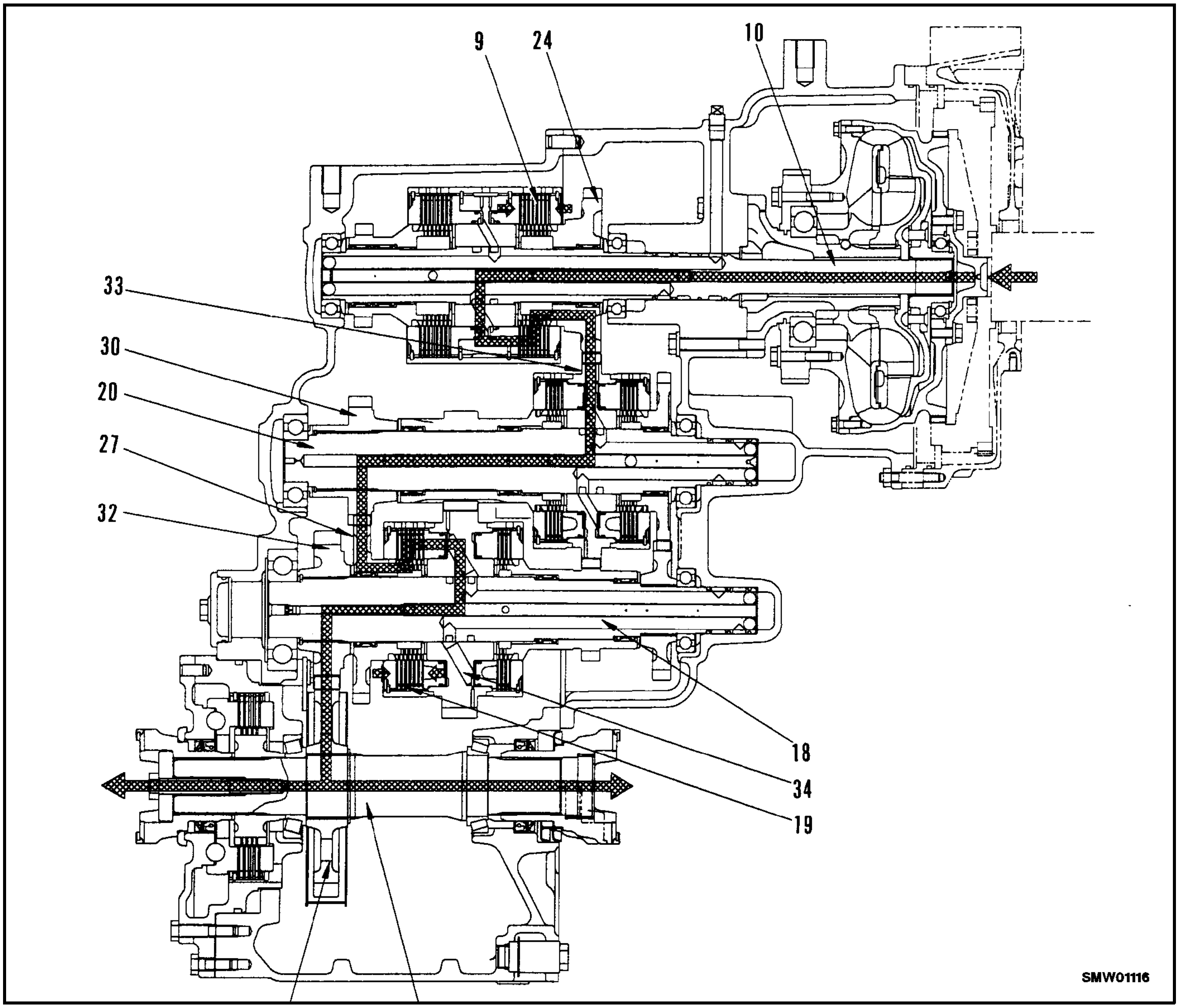
FORWARD 1ST



Operation

- In forward 1st, forward clutch (9) and 1st clutch (21) are engaged. The motive force from the torque converter transmitted to input shaft (10) is transmitted to output shaft (15).
- The clutch discs of forward clutch (9) and 1st clutch (21) are held by the hydraulic pressure applied to the piston.
- The motive force from the torque converter is transmitted from input shaft (10) via forward clutch (9) to forward gear (24), then transmitted to 1st and 3rd cylinder gear (33).
- Since the 1st clutch is engaged, the motive force transmitted to 1st and 3rd cylinder gear (33) is transmitted from 1st gear (26) via the 1st clutch to 2nd and 4th cylinder gear (34), then transmitted to output shaft (15) via 2nd and 4th shaft (18), idler gear (32) and output gear (35).

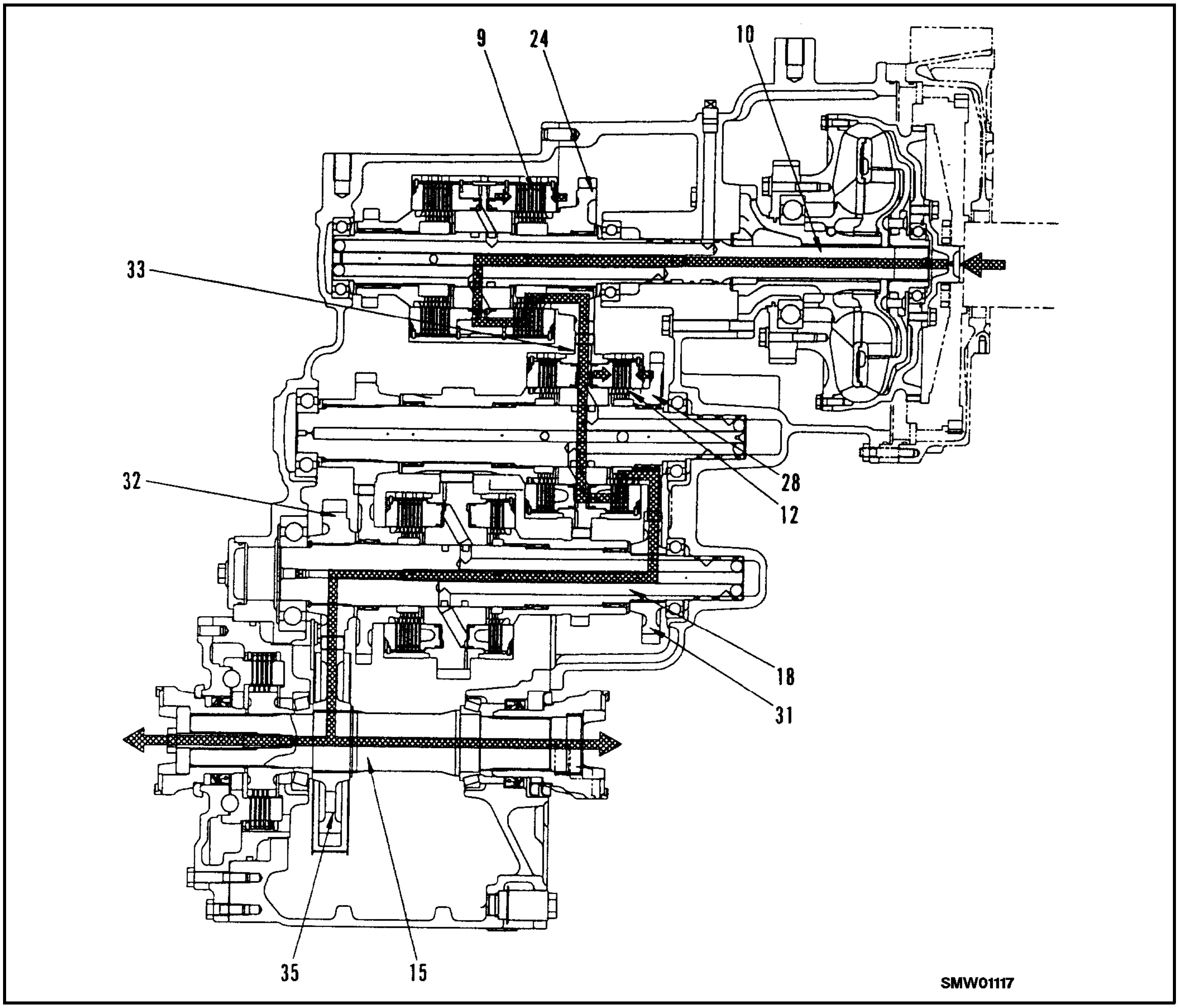
FORWARD 2ND



Operation

- In forward 2nd, forward clutch (9) and 2nd clutch (19) are engaged. The motive force from the torque converter transmitted to input shaft (10) is transmitted to output shaft (15).
- The clutch discs of forward clutch (9) and 2nd clutch (19) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from the torque converter is transmitted from input shaft (10) via forward clutch (9) to forward gear (24), then transmitted via 1st and 3rd cylinder gear (33), 1st and 3rd shaft (20), and idler gear (30) to 2nd gear (27).
- Since the 2nd clutch (19) is engaged, the motive force transmitted to the 2nd gear is transmitted from 2nd and 4th cylinder gear (34) via the 2nd clutch to output shaft (15) via 4th shaft (18), idler gear (32) and output gear (35).

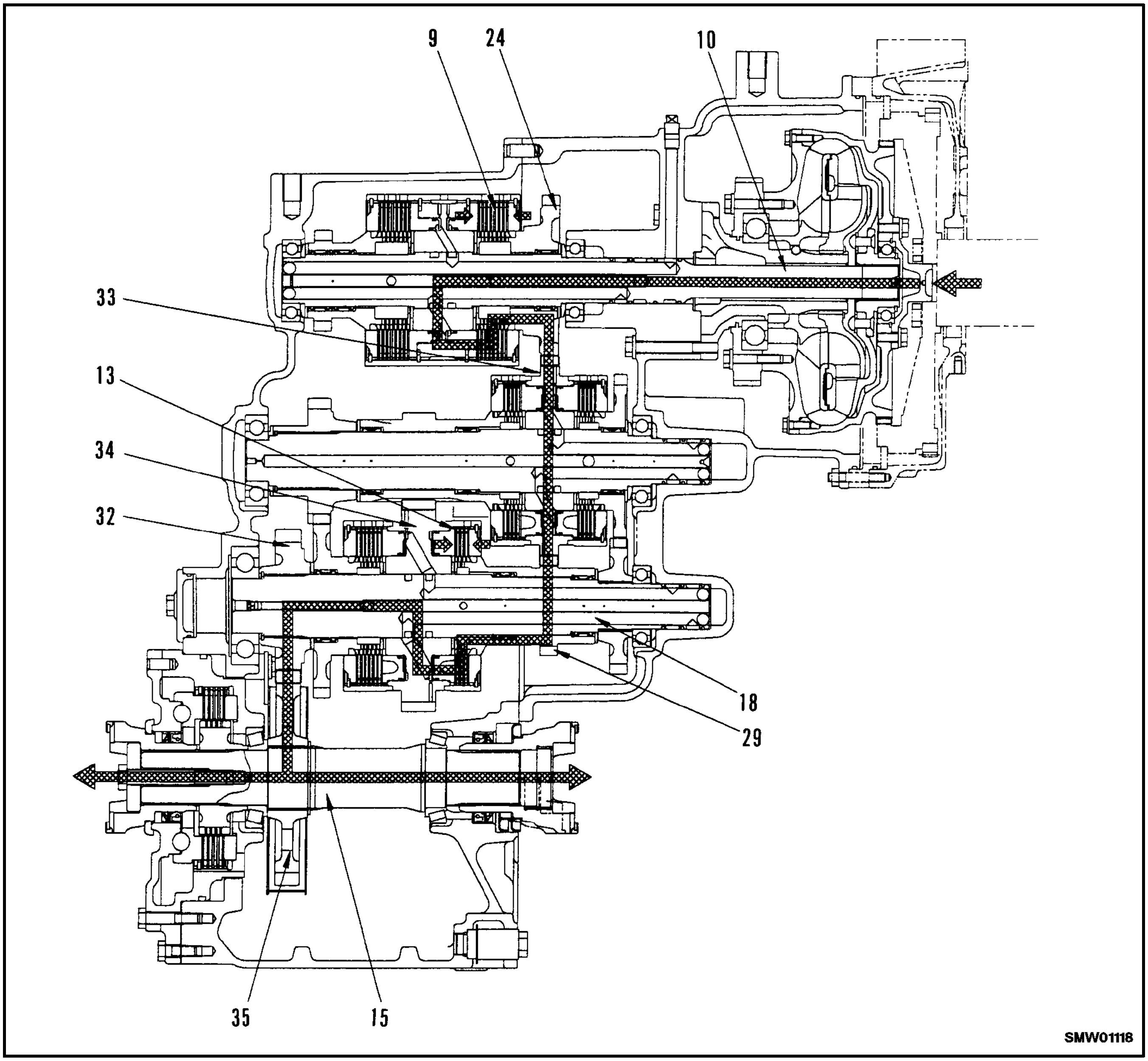
FORWARD 3RD



Operation

- In forward 3rd, forward clutch (9) and 3rd clutch (12) are engaged. The motive force from the torque converter transmitted to input shaft (10) is transmitted to output shaft (15).
- The clutch discs of forward clutch (9) and 3rd clutch (12) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from the torque converter is transmitted from input shaft (10) via forward clutch (9) to forward gear (24), then to 1st and 3rd cylinder gear (33).
- Since 3rd clutch (12) is engaged, the motive force transmitted to 1st and 3rd cylinder gear (33) is transmitted from 3rd gear (28) via the 3rd clutch, then to output shaft (15) via 2nd and 4th shaft (18), idler gear (32) and output gear (35).

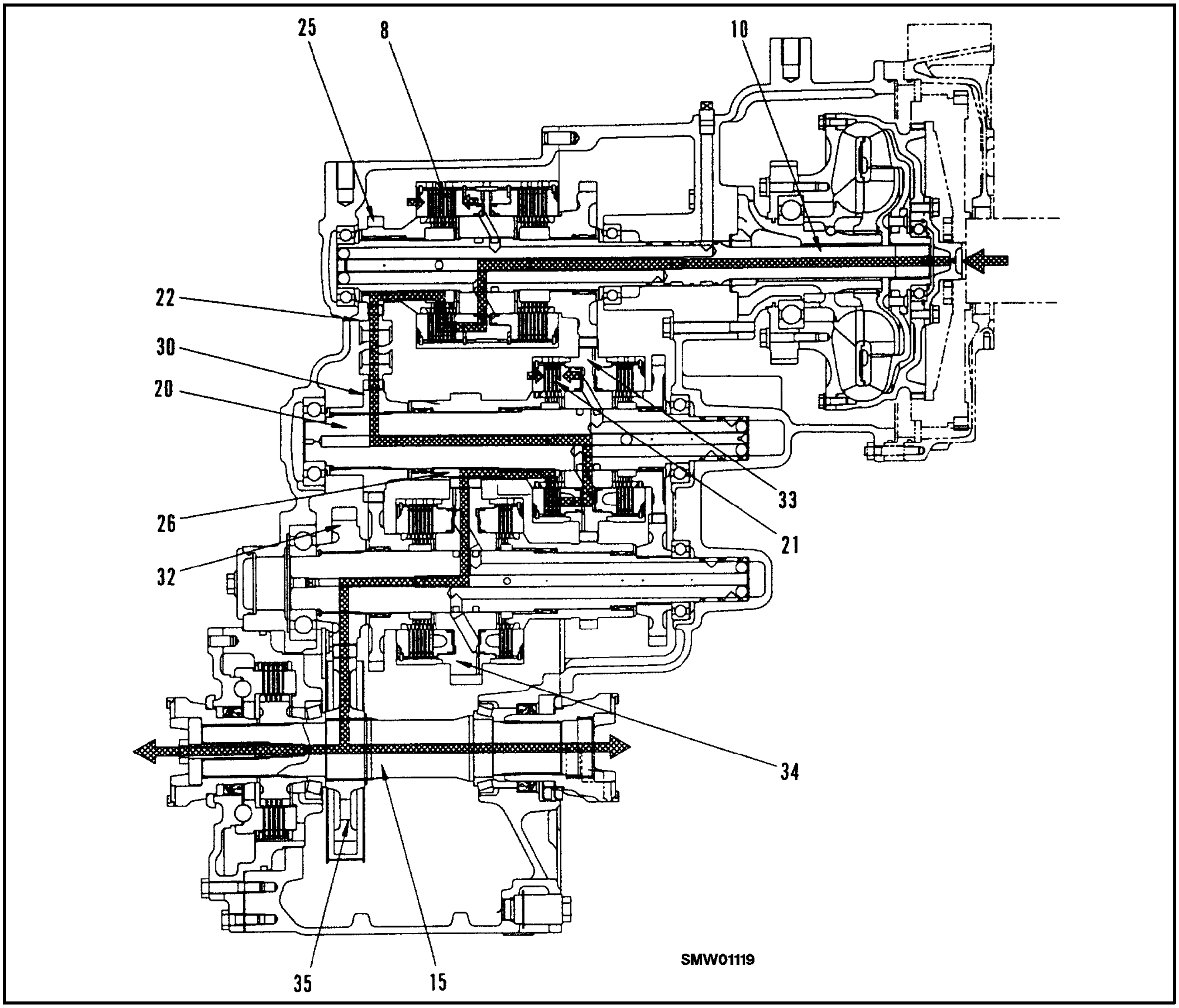
FORWARD 4TH



Operation

- In forward 4th, forward clutch (9) and 4th clutch (13) are engaged. The motive force from the torque converter transmitted to input shaft (10) is transmitted to output shaft (15).
- The clutch discs of forward clutch (9) and 4th clutch (13) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from the torque converter is transmitted from input shaft (10) via forward clutch (9) to forward gear (24), then transmitted via 1st and 3rd cylinder gear (33) to 4th gear (29).
- Since the 4th clutch is engaged, the motive force transmitted to the 4th gear is transmitted from 2nd and 4th cylinder gear (34) via the 4th clutch, then to output shaft (15) via 2nd and 4th shaft (18), idler gear (32) and output gear (35).

REVERSE 1ST

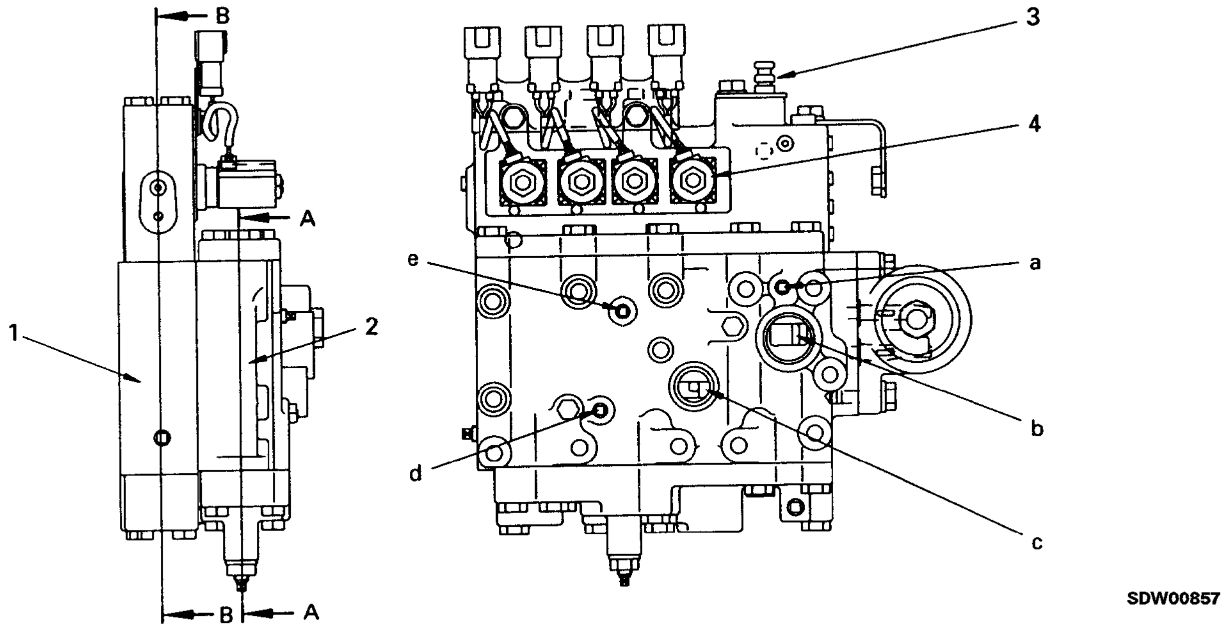


Operation

- In reverse 1st, reverse clutch (8) and 1st clutch (21) are engaged. The motive force from the torque converter transmitted to input shaft (10) is transmitted to output shaft(15).
- The clutch discs of reverse clutch (8) and 1st clutch (21) are held by the hydraulic pressure applied to the piston.
- The motive force from the torque converter is transmitted from input shaft (10) via reverse clutch (8) to reverse gear (25). The direction of rotation is reversed by idler gear (22), and the motive force is then transmitted to 1st and 3rd cylinder gear (33) via idler gear (30) and 1st and 3rd shaft (20). Since the 1st clutch is engaged, the motive force transmitted to 1st and 3rd cylinder gear (33) is transmitted from 1st gear (26) via the 1st clutch to 2nd and 4th cylinder gear (34), then transmitted to output shaft (15) via the 2nd and 4th shaft, idler gear (32) and output gear (35).

MEMORANDA

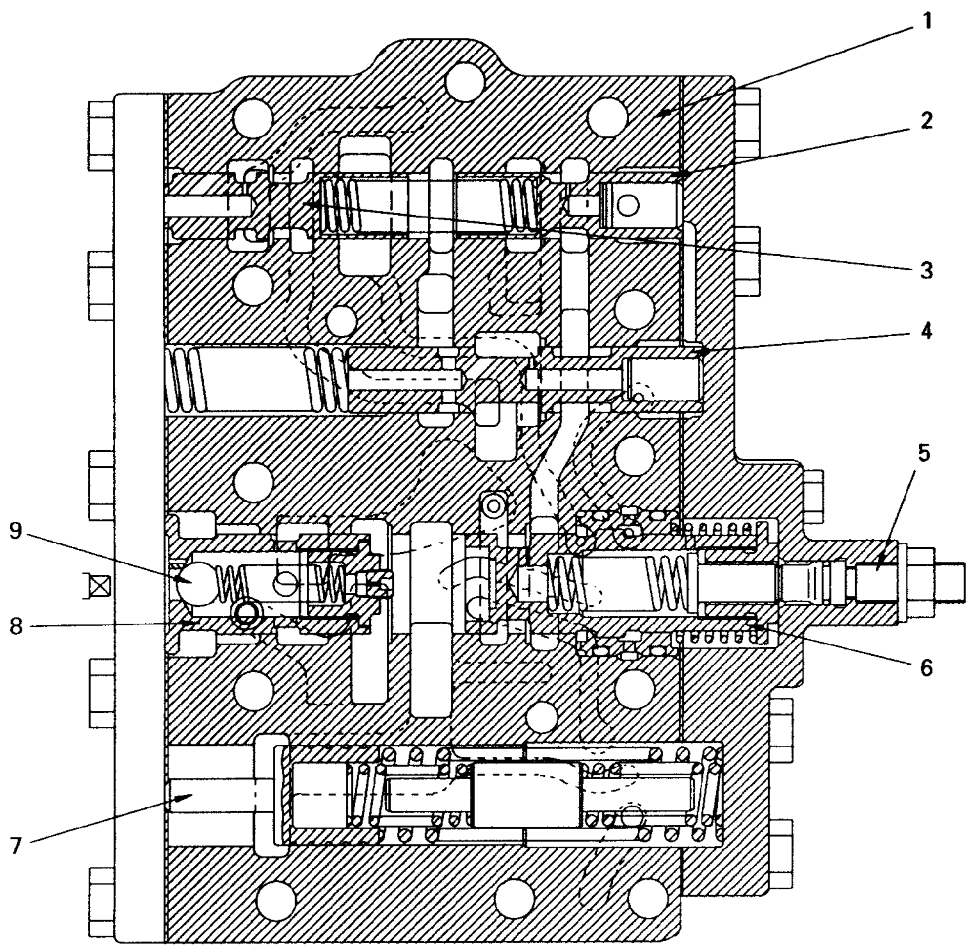
TRANSMISSION CONTROL VALVE



1. Lower valve
2. Upper valve
3. Emergency manual spool
4. Solenoid valve port

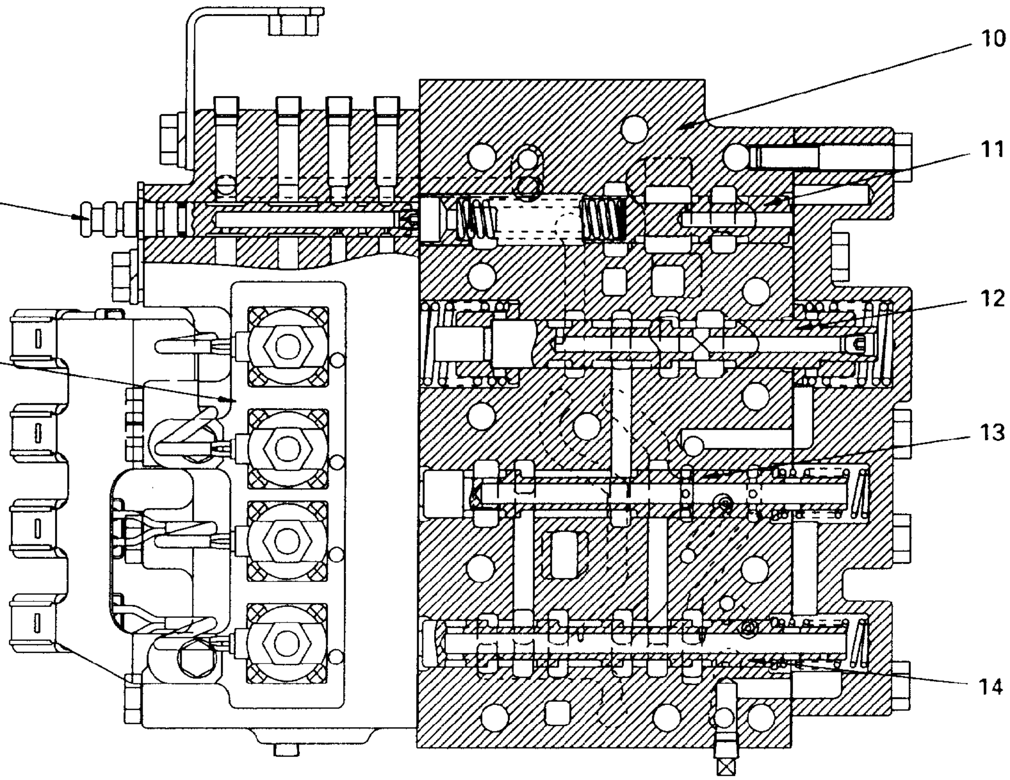
a. Pilot oil pressure measurement port
b. To oil cooler
c. From pump
d. Pump oil pressure measurement
e. Clutch oil pressure measurement port

UPPER VALVE



1. Upper valve body
2. Main regulator valve
3. Pilot reducing valve
4. Priority valve
5. Modulation fill valve pressure adjusting screw
6. Modulation fill valve
7. Accumulator
8. Quick return valve
9. Check valve
10. Lower valve body
11. Torque converter outlet valve
12. FORWARD and REVERSE spool
13. HIGH and LOW spool
14. Speed range spool
15. Solenoid valve
16. Emergency manual spool

LOWER VALVE

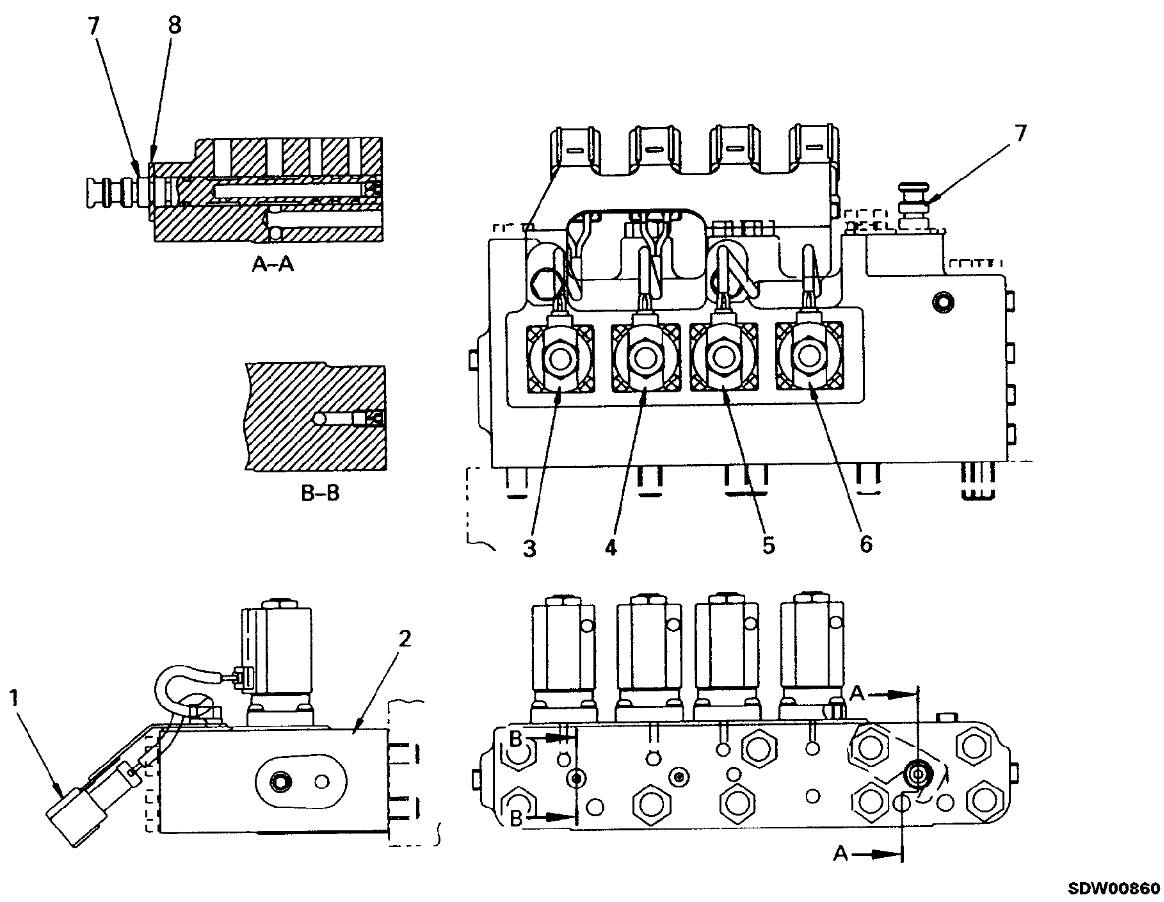


B-B

Outline

- The oil from the pump passes through the torque converter oil filter, enters the transmission valve, and is divided into the pilot circuit and the clutch actuation circuit.
- The priority valve gives priority to the oil sent to the pilot circuit, so the pilot pressure is always kept the same.
- The pressure of the oil flowing to the clutch actuation circuit is adjusted by the modulation fill valve and actuates the clutch. The oil which is relieved is sent to the torque converter.
- The quick return and modulation fill valve are interconnected during gear shifting. They act to raise the clutch oil pressure smoothly, thereby reducing the shock when shifting gear. During traveling, the clutch pressure is kept the same.
- The pressure of the oil which flows to the circuit is adjusted by the pilot reducing valve. During gear shifting, the oil flows in accordance with ON-OFF position of the solenoid valves and actuates the FORWARD, REVERSE and speed spools.
- By switching the FORWARD, REVERSE, and speed spools, the oil regulated by the modulation fill valve is sent to the selected clutch to obtain the necessary gear combination.

TRANSMISSION SOLENOID VALVE



1. Connector
2. Valve body
3. 1st, 4th solenoid valve
4. 3rd solenoid valve
5. REVERSE solenoid valve
6. FORWARD solenoid Valve
7. Emergency manual spool
8. Lock plate

STRUCTURE

- The transmission solenoid valve is installed to the transmission together with the transmission valve. When the directional lever or speed control lever are operated, the solenoid valve is actuated and moves the spool inside the transmission valve.

Solenoid Operating table

	①	②	③	④
F-1	○			○
F-2	○			
F-3	○		○	
F-4	○		○	○
N				
R-1		○		○
R-2		○		
R-3		○	○	
R-4		○	○	○

○ : Solenoid ON

TB28

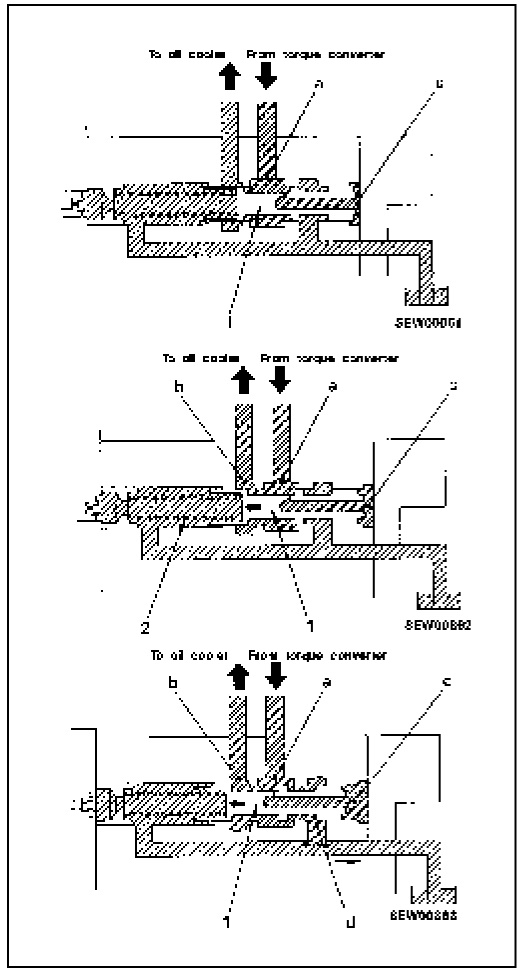
TORQUE CONVERTER OUTLET PORT VALVE

Function

! The torque converter outlet port valve is installed in the outlet line of the torque converter and adjusts the maximum pressure of the torque converter.

Operation

! The oil at port **a** passes through the orifice in spool (1) and flows to port **c**.



! When the pressure at port **a** rises, the pressure at port **c** also rises. This overcomes the tension of spring (2) and moves spool (1) to the left in the direction of the arrow to allow oil to flow from port **a** to port **b.**

! If the pressure at port **a** becomes even higher, spool (1) is moved further to the left in the direction of the arrow, and the oil flows from port **a** to port **b** and drain port **d.** (Cold relief)

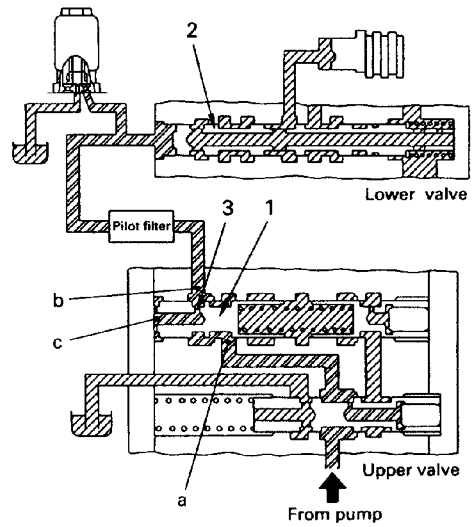
PILOT REDUCING VALVE

Function

- The pilot reducing valve controls the pressure used to actuate the directional selector spool, H-L selector spool, range selector spool.

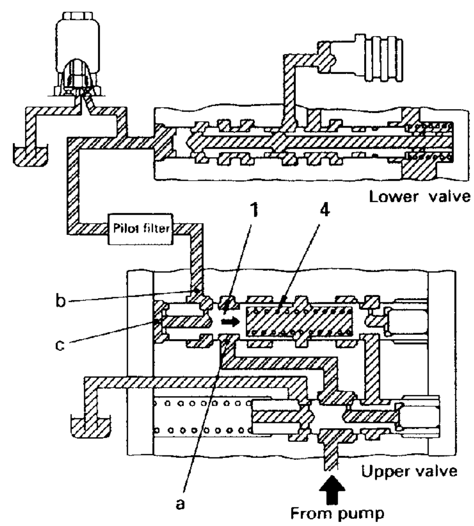
Operation

- The oil from the pump enters port **a,** passes through port **b** of pilot reducing spool (1), enters spool (2) in the lower valve, and fills the pilot circuit. The oil at port **b** passes through the orifice (3)and flows to port **c.**



SEW00864

- When the pressure in the pilot circuit rises, the pressure at port **c** also rises. This overcomes the tension of spring (4) and moves pilot reducing spool (1) to the right in the direction of the arrow. For this reason, port **a** at port **b** are shut off, so the pressure at port **c** is maintained.

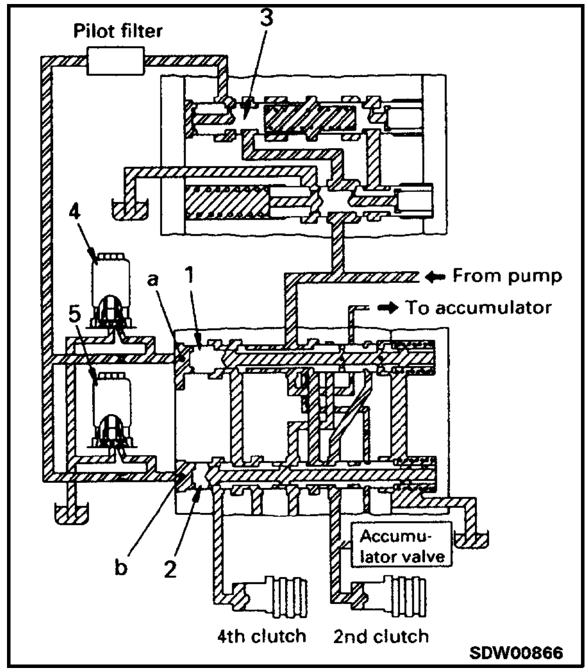


SEW00865

TRANSMISSION SOLENOID VALVE

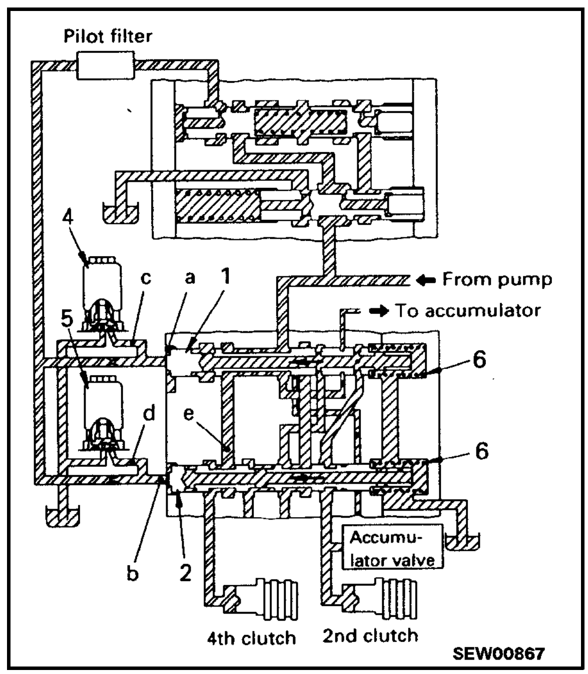
Function

- There are four solenoid valves installed to the transmission control valve. When the gear shift lever in the operator's compartment is operated, the solenoid valves are switched ON/OFF, and the oil is drained to actuate the gear shift spool.



Operation

1 . **Solenoid valve OFF**
The oil from pilot reducing valve (3) flows to ports **a** and **b** of gear shift spools (1) and (2). The oil at ports **a** and **b** is stopped by solenoids (4) and (5), and gear shift spools (1) and (2) move to the right in the direction of the arrow. As a result, the oil from the pump flows to the 2nd clutch.

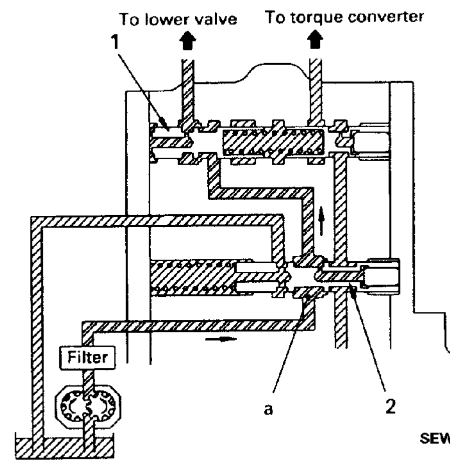


2. **Solenoid valve ON**
When the gear shift lever is operated, the drain port of solenoid valves (4) and (5) opens.
The oil at ports **a** and **b** of gear shift spools (1) and (2) flows from ports **c** and **d** to the drain circuit. Therefore, ports **a** and **b** become the low pressure circuit, and the gear shift spool is moved to the left in the direction of the arrow by the tension of spring (6).
As a result, the oil at port **e** flows to the 4th clutch and the clutch is switched.

PRIORITY VALVE

Function

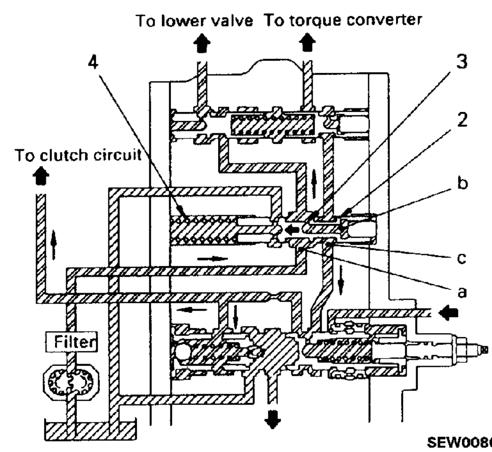
- The priority valve gives priority to sending oil to the pilot circuit of the lower valve. When the pressure in the circuit goes above the set pressure, it acts as a main relief valve to protect the circuit.



SEW00868

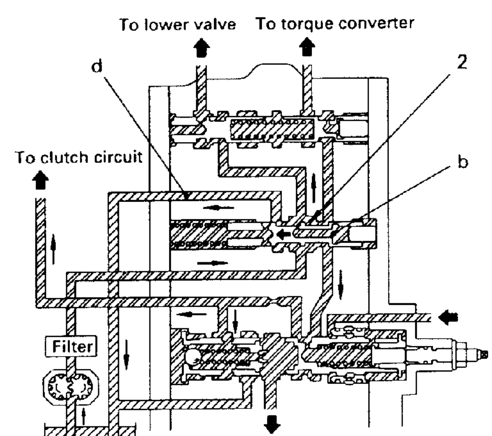
Operation

- The oil from the pump is divided into two lines. One oil flow enters port **a,** passes around priority valve (2), goes through pilot reducing valve (1), and flows to the pilot circuit of the lower valve. The other oil flow goes to priority valve (2).



SEW00869

- The oil flowing to priority valve (2) passes through orifice (3) and flows to port **b.**
  As a result, it pushes priority valve(2) to the left in the direction of the arrow against the force of spring (4), and flows to port **c.**



SEW00870

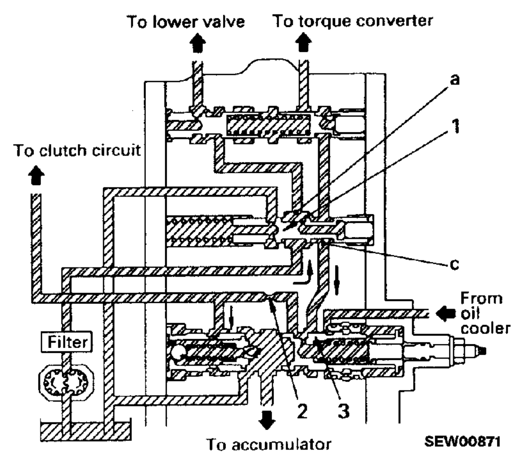
- When the pressure at port **b** goes above the set pressure, priority valve (2) is pushed further to the left in the pa direction of the arrow, and the oil is drained from port **d** to protect the circuit. (The main relief function)

MAIN REGULATOR VALVE

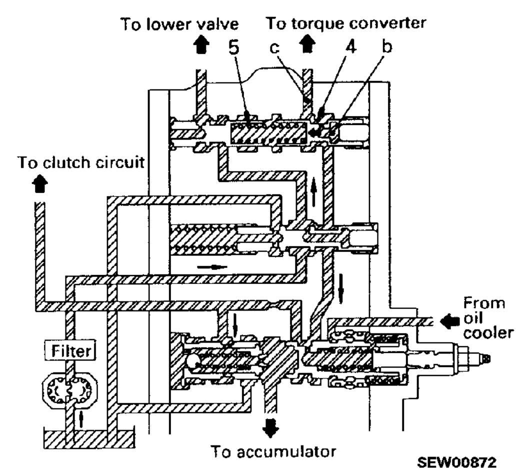
Function

- The main regulator valve controls the flow of oil to the clutch circuit, and sends any excess oil to the torque converter circuit.

- **Operation**
  The oil from the pump enters port **a** of priority valve (1), and then passes from port **c** through modulation fill valve (3) and main orifice (2), and flows to the clutch circuit.



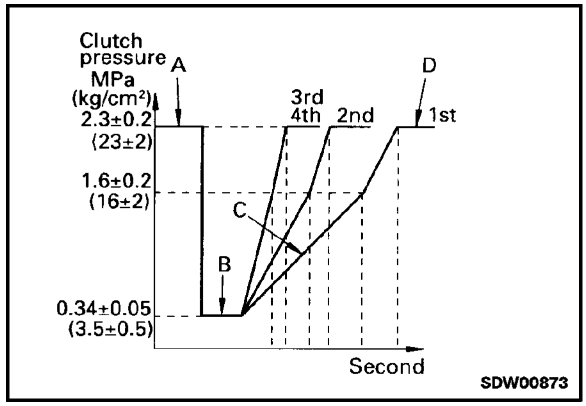
- The oil passing through orifice (4) and entering port **b** moves the spool to the left in the direction of the arrow against the force of spring (5), so the oil passes through port **c** and flows to the torque converter circuit.



QUICK RETURN VALVE

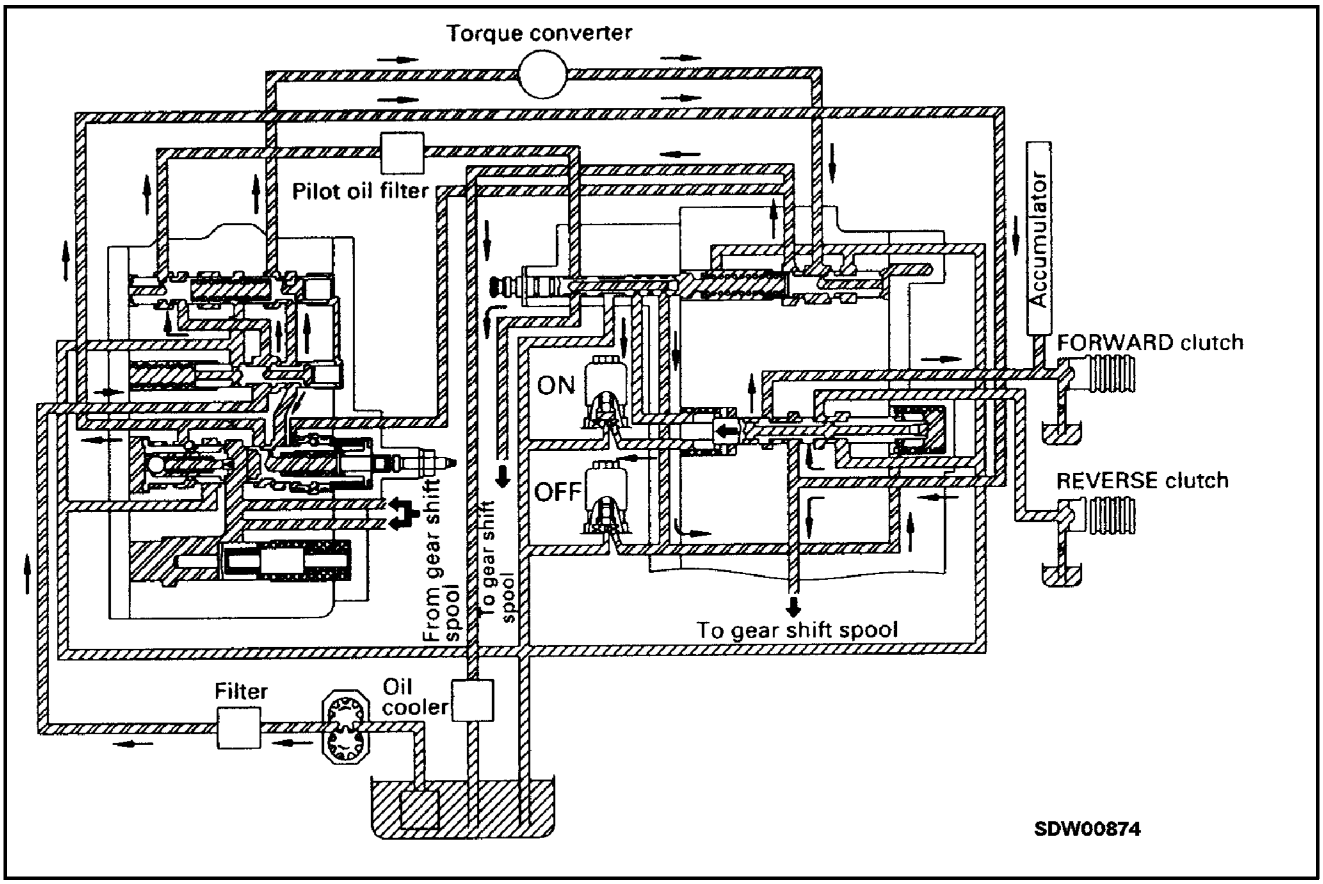
Function

- The pressure of the transmission clutch is raised smoothly by the modulating action. This reduces any shock when shifting gear and prevents the generation of peak torque and the power train. Therefore, it reduces operator fatigue and ensures a comfortable ride for the operator. At the same time, it also increases the durability of the power train.

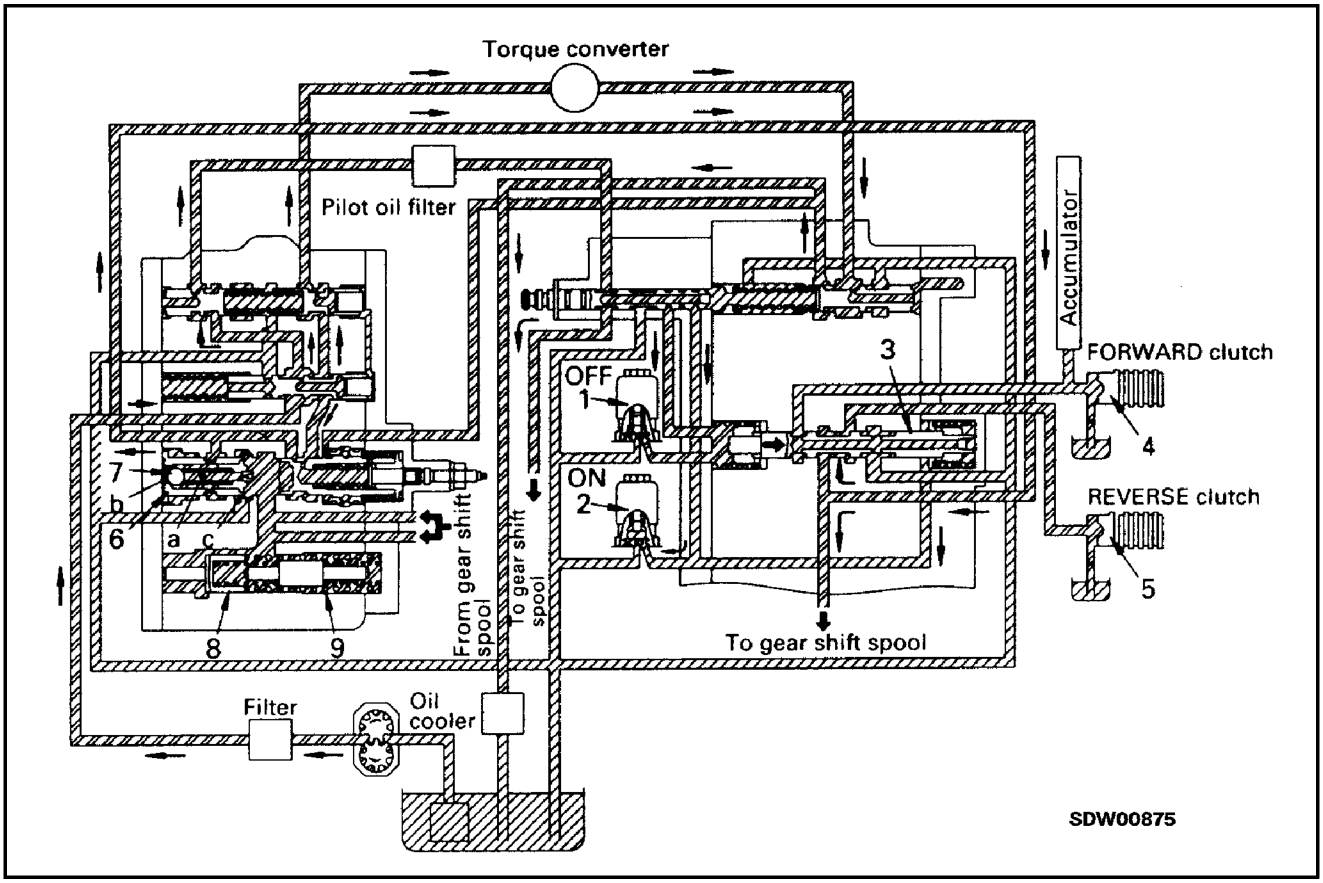


Operation

1. After starting engine, clutch fully engaged (clutch pressure at point A) (FORWARD 1st)



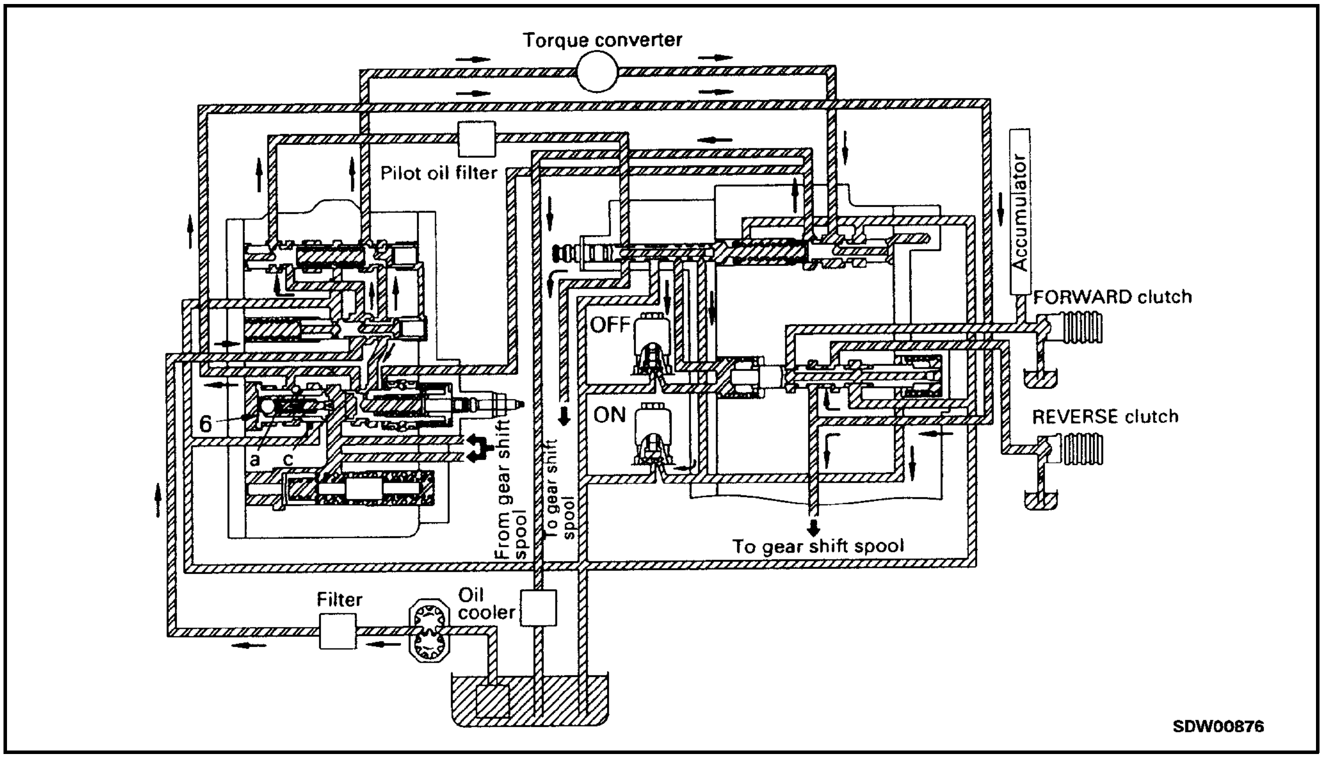
2. When shifting from FORWARD to REVERSE
(clutch pressure at point B)



- When the directional lever is moved from FORWARD to REVERSE, FORWARD solenoid (1) closes, REVERSE solenoid (2) opens, and directional spool (3) moves to the right in the direction of the arrow. FORWARD clutch (4) is connected to the drain circuit and the oil is drained.
- At the same time, the oil from the pump flows to REVERSE clutch (5), but while the oil is filling the clutch, the clutch pressure is low. As a result, the oil pressure at port **a** of quick return valve (6) also drops, so check valve (7) opens and the oil at port **b** flows to port **a.** At the same time, quick return valve (6) is moved to the left in the direction of the arrow by the pressure of the accumulator, and the oil from accumulator (8) is suddenly drained from port **c**.
- Accumulator (8) is returned fully to the left by the force of spring (9).

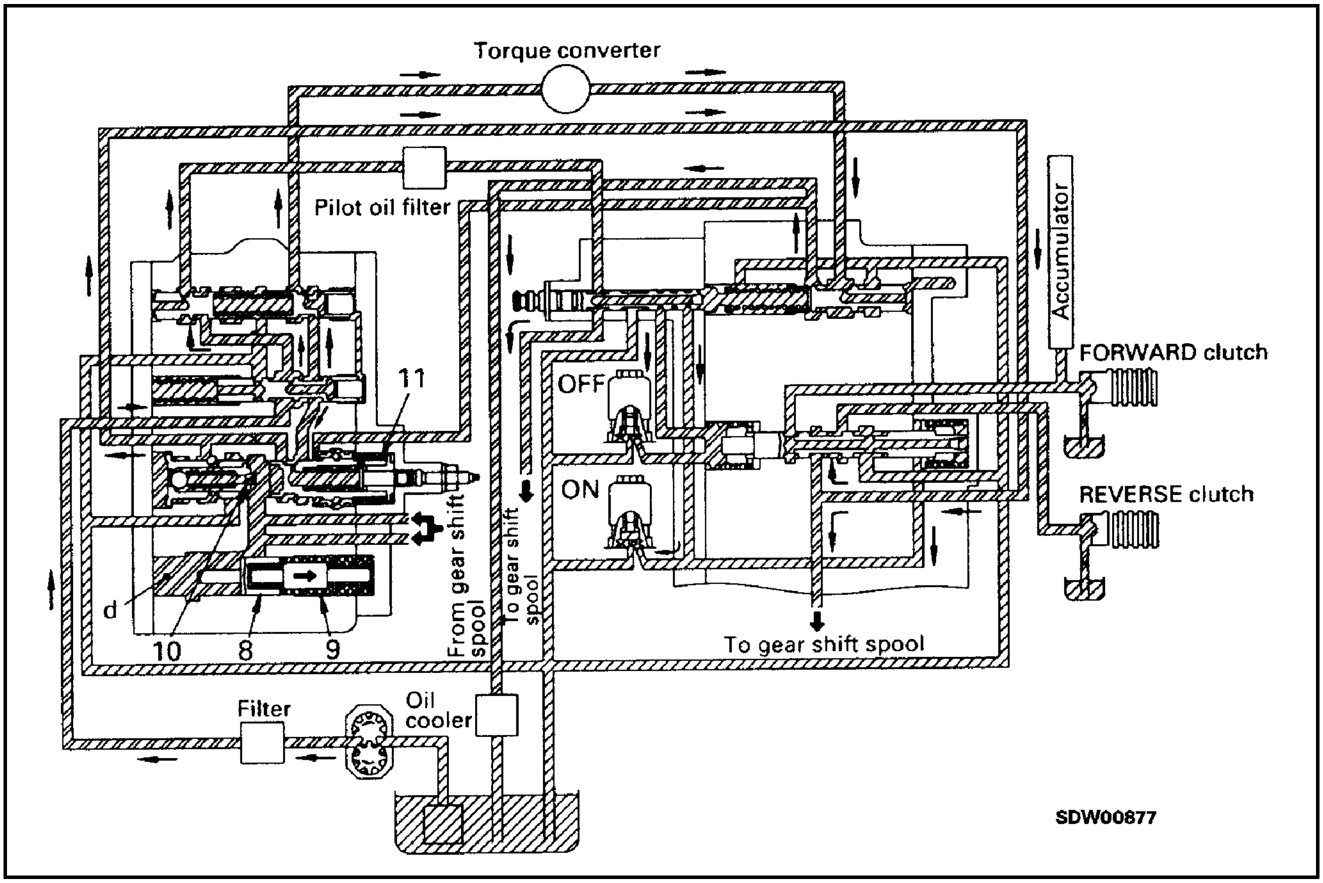
★ To reduce the shock when shifting gear, the pressure in the clutch circuit must be completely lowered and accumulator (8) must move fully to the left.

3. Clutch pressure starting to rise (clutch pressure at point C)



- The oil from the pump fills the REVERSE clutch and the pressure in the clutch circuit starts to rise. As a result, the pressure at port **a** rises, so quick return valve (6) is moved to the right in the direction of the arrow, and closes drain port **c.**

4. Start of accumulator action, clutch completely engaged (clutch pressure at point D)

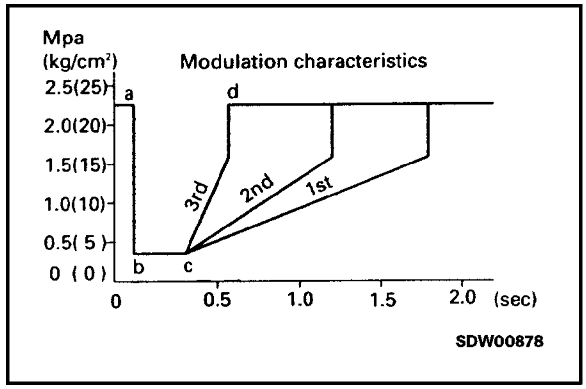


- Because of the differential pressure created by modulation fill valve (1 1), a constant flow of oil passes through 1st orifice (10) and enters accumulator (8). As this oil flows in, the accumulator piston gradually moves to the right in the direction of the arrow, and spring (9) is compressed, so the accumulator pressure rises. As this accumulator pressure rises, it raises the clutch pressure. Except in 1st, oil flows into the accumulator from 1st orifice + 2nd (3rd) orifice, so the modulating time is shorter than for 1st.
- when accumulator piston (8) moves to the end of its stroke, the rise in the pressure at port **d** finishes, so the specified pressure is maintained and the REVERSE clutch is completely engaged.
  When the gear shift spool is operated, the action is the same as above.

MODULATION FILL VALVE

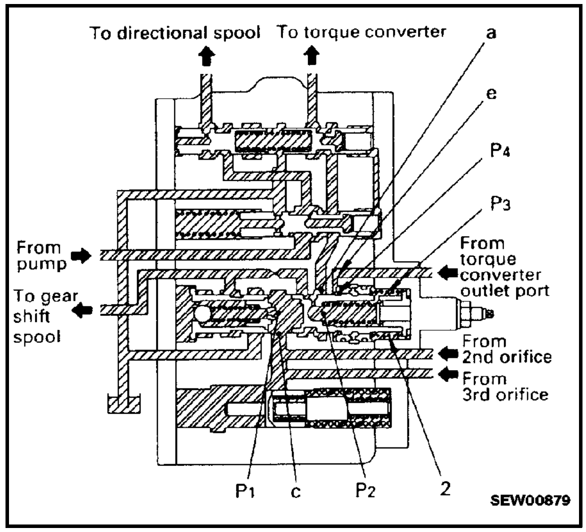
Function

The modulation fill valve adjusts the pressure and controls the amount of oil flowing to the accumulator while allowing the clutch pressure to rise.



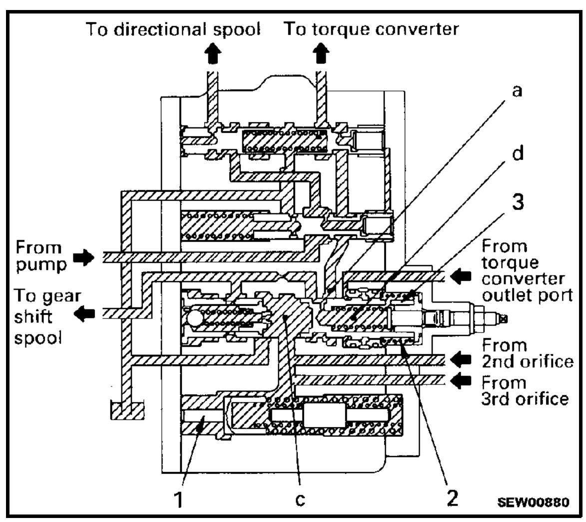
Operation

1. Clutch completely engaged (point a)



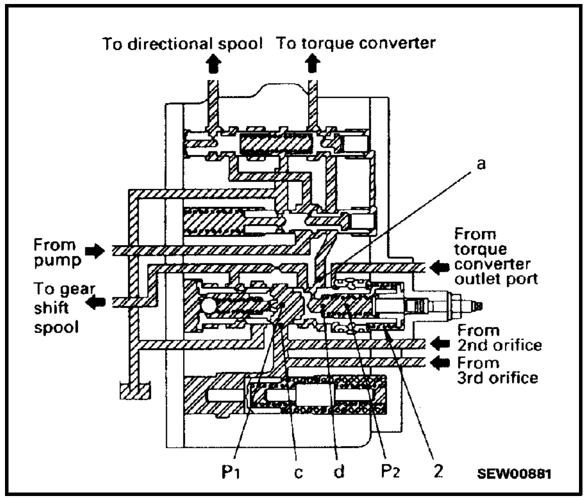
2. Shifting from FORWARD to REVERSE

The oil inside the accumulator is drained by the quick return valve, and accumulator piston (1) moves to the left. When this happens, the pressure in chamber **c** and Chamber **d** drops, and spring (2) moves modulation fill valve (3) to the right to open port **a**.

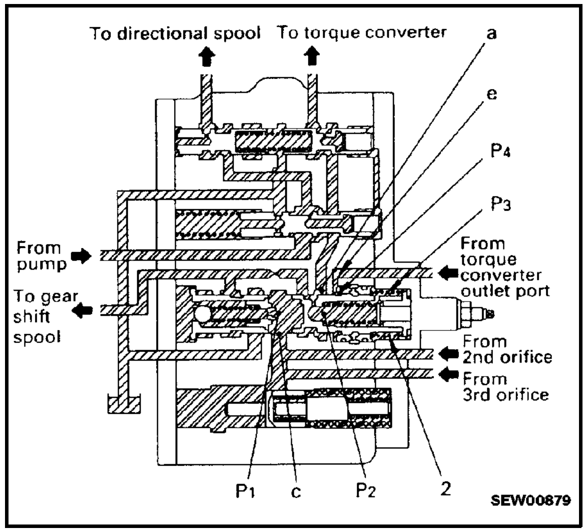


3. Clutch pressure starting to rise (point c point d)

- When the oil from the pump fills the clutch piston, the pressure in the clutch circuit starts to rise. When this happens, the drain circuit of the quick return valve is closed.
  When the drain circuit of the quick return valve closes, the oil passing through port **a** enters chamber **d** and pressure **P2** in chamber **d** starts to rise. When the relationship between **P1** and **P2** becomes **P2 > P1 + P3** (tension of spring (2)), the fill valve moves to the left, shuts off port **a,** and prevents the clutch pressure from rising suddenly.



- At the same time as the oil from port **a** flows to the directional spool, the relationship is **P2 > P1,** so oil also passes through the orifice in the quick return valve and flows into chamber **c. P1** rises and **P2** also rises at the same time. This process is repeated while maintaining the relationship **P2 = P1 + P3** (tension of spring (2)), and the clutch pressure rises.
- The oil from the torque converter outlet port circuit forms the pilot pressure to the modulation fill valve and flows to port **e.** The pressure at port **e** changes according to the engine speed. The relationship is **P2 = P1 + P3 + P4** (changes according to engine speed), so if pressure **P4** changes, pressure **P2** also changes by the same amount. Therefore, pressure **P2** rises at the same time by the same amount that pressure **P4** changes, so it is possible to create oil pressure characteristics that matches the engine speed.

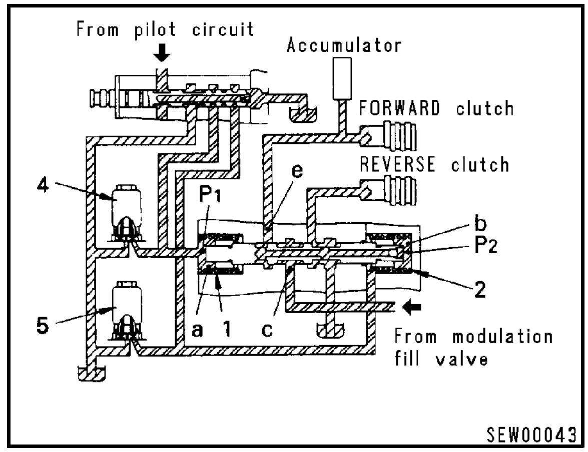


DIRECTIONAL SELECTOR SPOOL

Operation

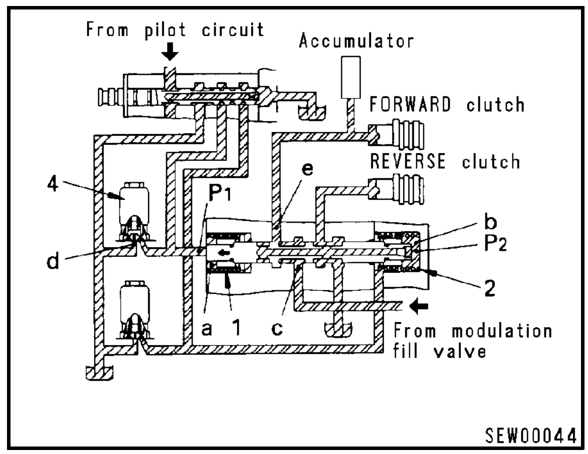
1. When at neutral

- Solenoid valves (4) and (5) are OFF and the drain port is closed. The oil from the pilot circuit passes through the oil hole in the emergency manual spool and fills ports **a** and **b** of the directional spool.
  In this condition, **P1 +** spring force (1) = **P2 +** spring force (2), so the balance is maintained. Therefore, the oil at port **c** does not go to the FORWARD or REVERSE clutch.



2. When at FORWARD

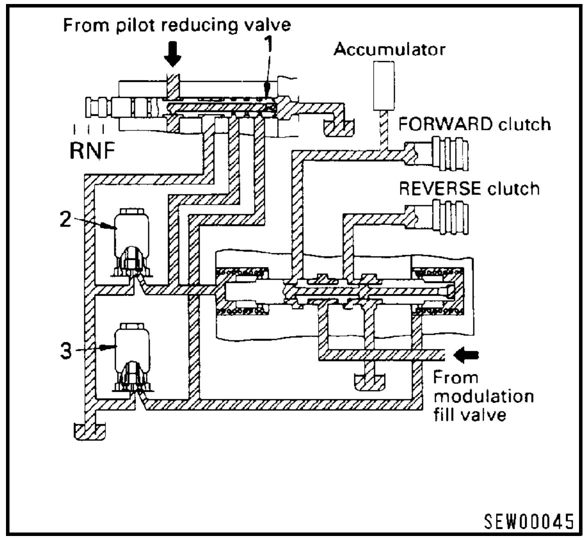
- When the directional lever is placed at the FORWARD position, solenoid valve (4) is switched ON and drain port **d** opens. The oil which is filling port **a** is drained, so **P1 +** spring force (1) < **P2 +** spring force (2). When this happens, the directional spool moves to the left, and the oil at port **c** flows to port **e** and is supplied to the FORWARD clutch.



EMERGENCY MANUAL SPOOL

Function

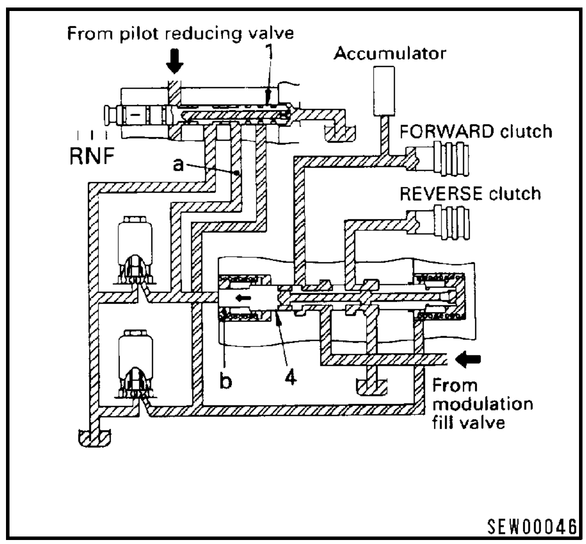
- If there should be any failure in the electrical circuit and the directional solenoid valve does not work, this spool can be operated manually to engage the FORWARD or REVERSE clutch.



Operation

1. Emergency manual spool at neutral

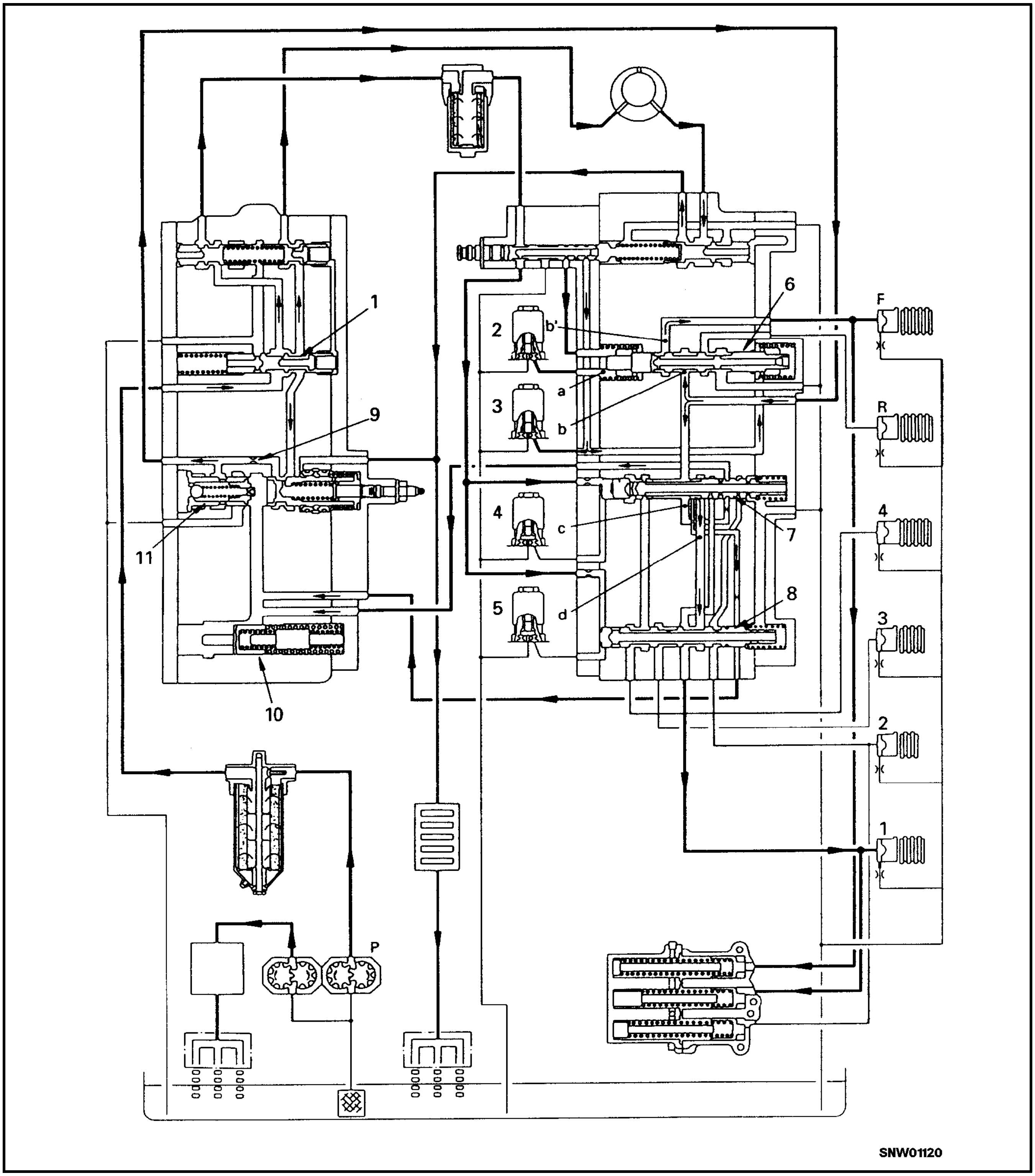
- The oil from the upper valve (pilot reducing valve) passes around emergency manual spool (1), and is blocked by solenoid valves
- When the operating condition is normal, the emergency manual spool is at the neutral position.



2. Emergency manual spool actuated (FORWARD)

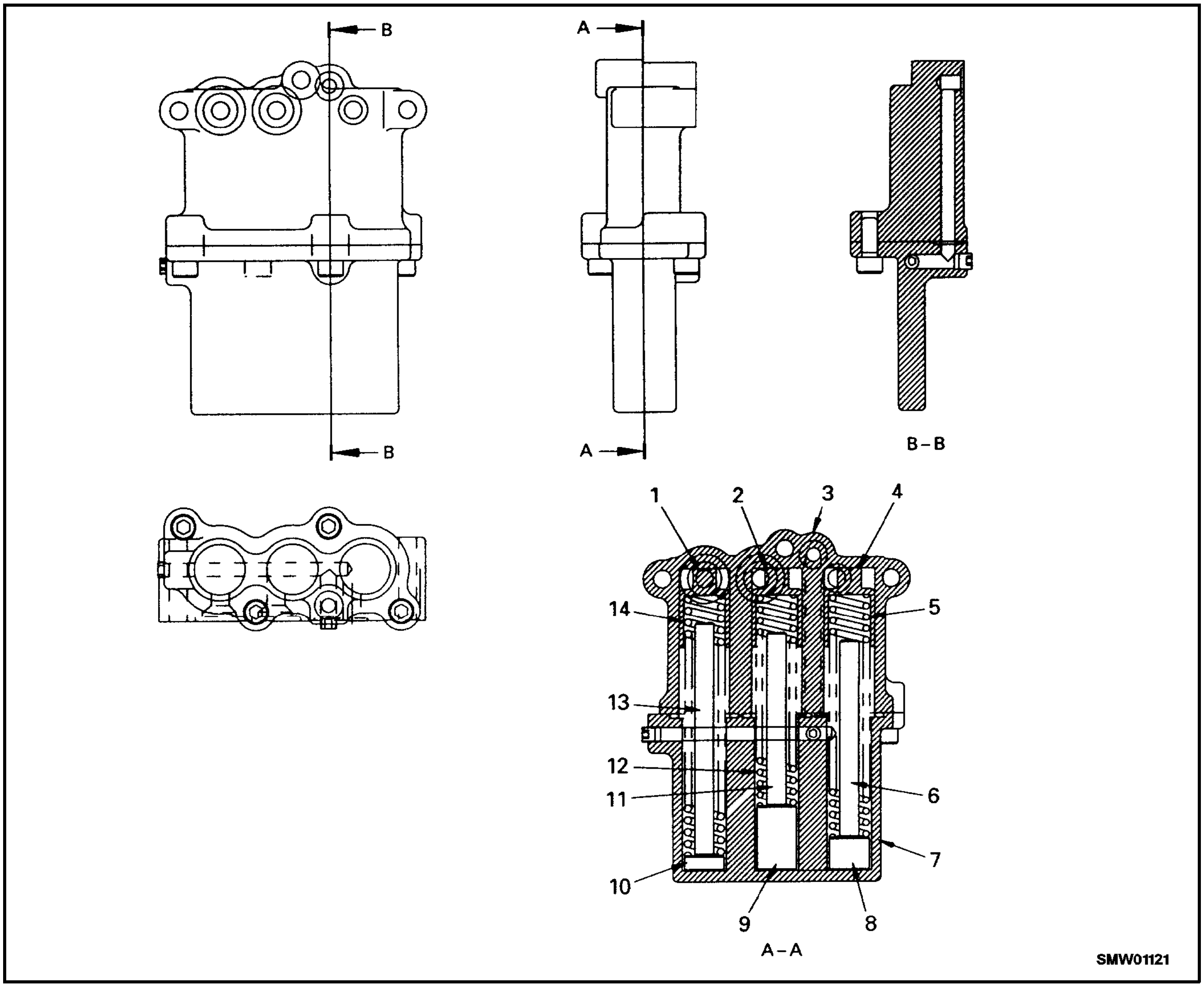
When emergency manual spool (1) is pushed in, port **a** and the drain port are connected, so the oil in chamber **b** is drained. As a result, directional spool (4) moves to the left in the direction of the arrow, and the oil flows to the FORWARD clutch to engage the clutch.

Operation of FORWARD 1st



- The oil from pump (P) passes through priority valve (1) and is divided to the pilot circuit and clutch actuation circuit.
- When the gear shift lever is operated to FORWARD 1st, FORWARD solenoid valve (2) is actuated and the oil filling port **a** is drained. Directional spool (6) moves to the left, and clutch oil pressure port **b** and FORWARD clutch oil pressure port **b'** are connected. In addition, H.L spool solenoid valve (4) is closed, so H.L spool (7) is kept pushed to the right and clutch hydraulic port **c** and 1st clutch port **d** are connected.
- At the same time, the oil to the clutch actuation circuit passes through main orifice (9), and flows through spools (6), (7), and (8) to the FORWARD clutch and 1st clutch.
- When the oil completely fills the clutch cylinder, accumulator (10) and quick return valve (11) are actuated to gradually raise the pressure. When the oil reaches the set

ACCUMULATOR VALVE



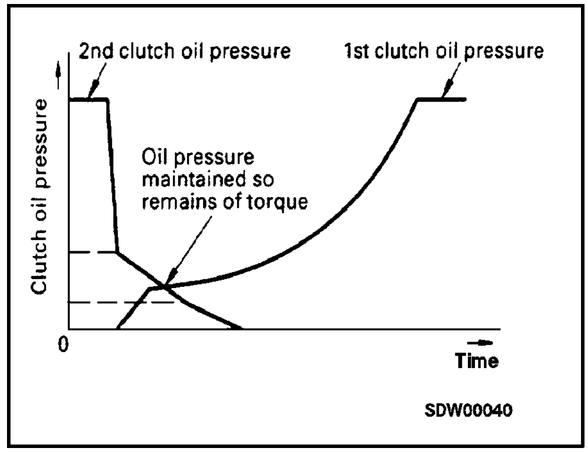
1. Piston (for 2nd clutch)
2. Piston (for 1st clutch)
3. Body
4. Piston (for FORWARD clutch)
5. Spring (for FORWARD clutch)
6. Stopper (for FORWARD clutch)
7. Cover
8. Spacer (for FORWARD clutch)
9. Spacer (for 1st clutch)
10. Spacer (for 2nd clutch)
11. Stopper (for 1st clutch)
12. Spring (for 1st clutch)
13. topper (for 2nd clutch)
14. Spring (for 2nd clutch)

Outline

- The accumulator valve is installed in the FORWARD, 1st, 2nd clutch circuit. When the transmission shifts gear, the accumulator valve slowly reduces the oil pressure to the clutch that was first engaged in order to prevent loss of torque and to reduce the transmission shock when shifting gear. It temporarily stores the clutch oil pressure in order to allow gear shifting to be carried out smoothly without any time lag. (To make it possible to reduce the oil pressure to the clutch slowly, there are throttles installed in the directional spool, H-L spool and range spool of the transmission control valve.)

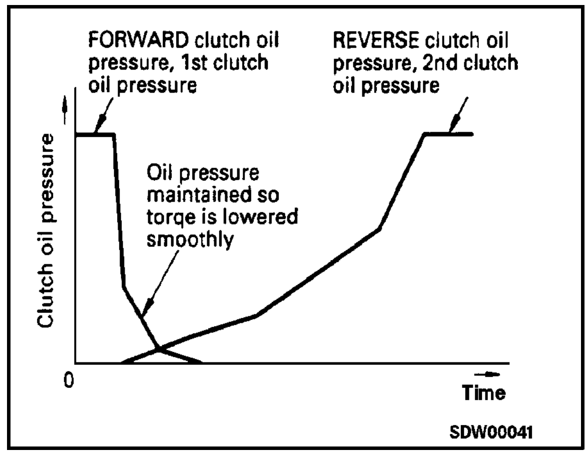
Operation

1. **Shifting down when digging (kick-down F2 Fl)**
   When the transmission is in F2, oil pressure is stored in the 2nd clutch accumulator.
   When the kick-down is operated, the Fl clutch is engaged, but the oil pressure in the accumulator is maintained for the 2nd clutch until the torque is transmitted to the 1st clutch. In this way, it is possible to shift gear smoothly without losing the torque.

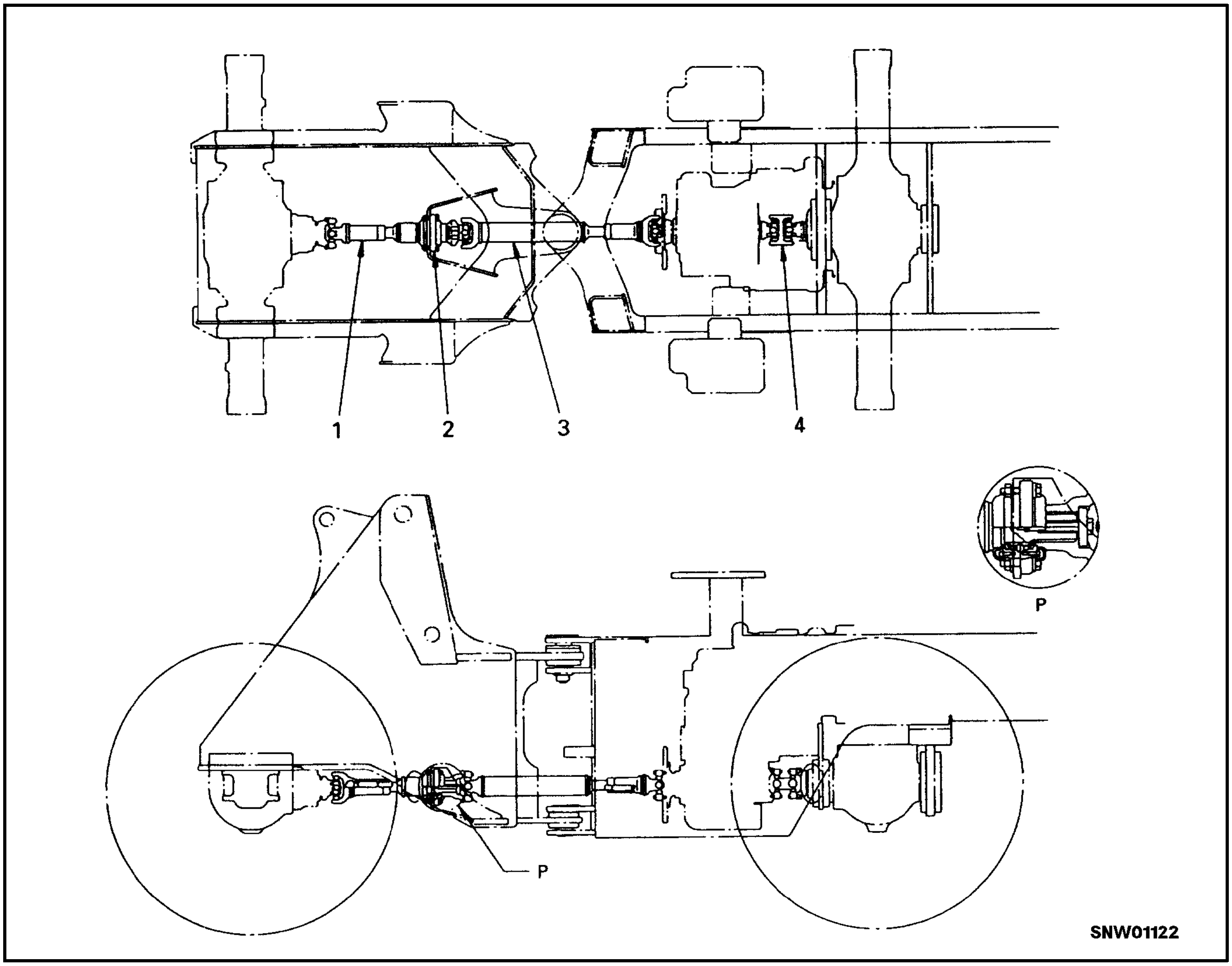


Moving out after digging (Fl R2)

When the transmission is in Fl, oil pressure is stored in the accumulator for the FORWARD clutch and 1st clutch.
When shifting to R2 after completing digging operations, the R2 clutch is engaged,
but the oil pressure for the FORWARD **Clutch** and 1st clutch is maintained in the accumulator. This makes it possible to reduce the loss of torque due to the reaction force to the product being handled, and to move back smoothly without shock.



DRIVE SHAFT



1. Front drive shaft
2. Flange bearing
3. Center drive shaft
4. Rear drive shaft

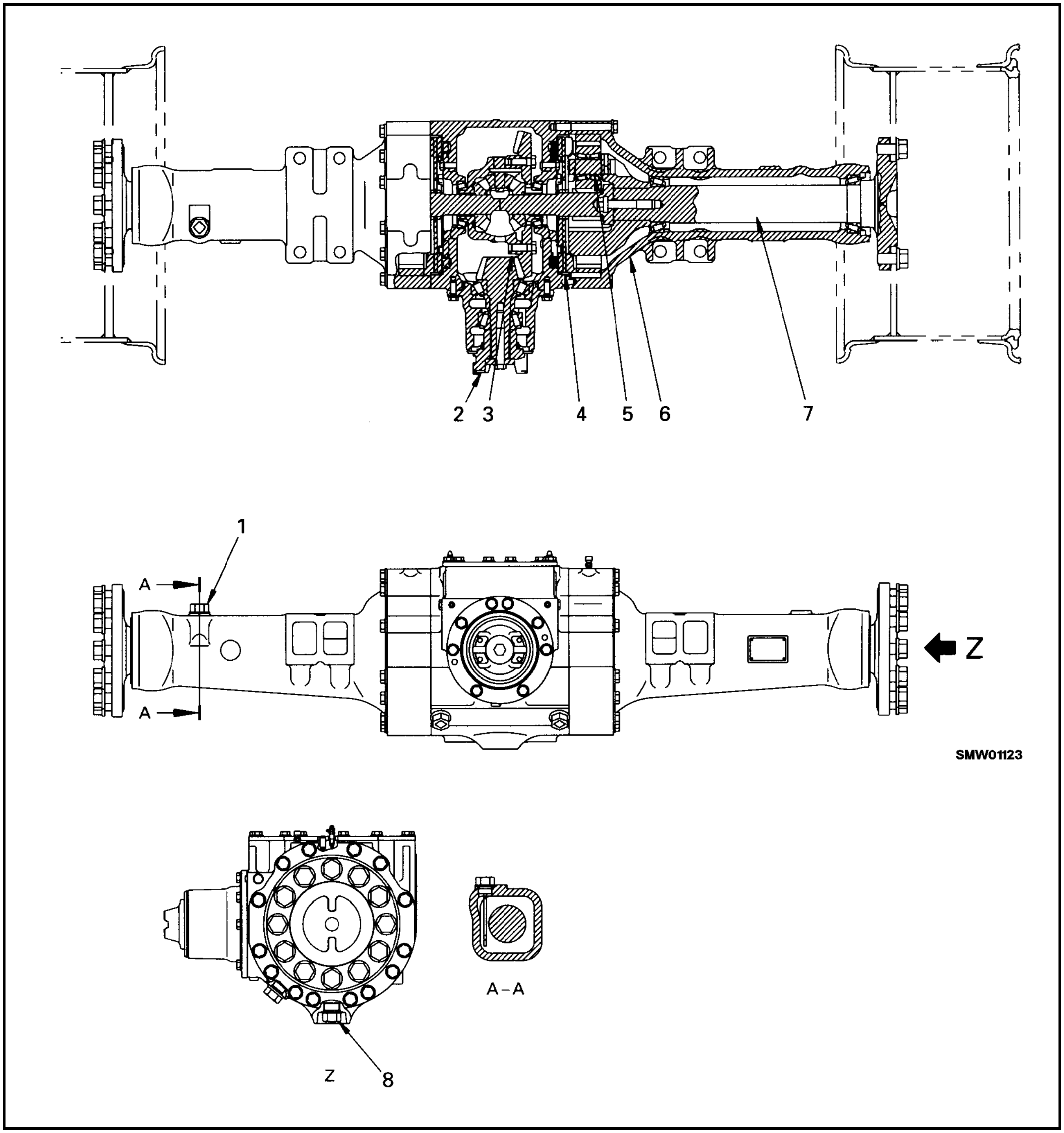
Outline

The motive force from the engine passes through the torque converter and the transmission. Some of it is transmitted from rear drive shaft (4) to the rear axle, while the rest goes from center drive shaft (3) through flange bearing (2) and front drive shaft (1) to the front axle.

- The drive shaft has the following purpose in addition to simply transmitting the power. The drive shaft has a universal joint and sliding joint to enable it to respond to changes in the angle and length. This enables the drive shaft to transmit the motive force when the machine is articulated and to protect the components from damage from shock when the machine is being operated or shock from the road surface when the machine is traveling.

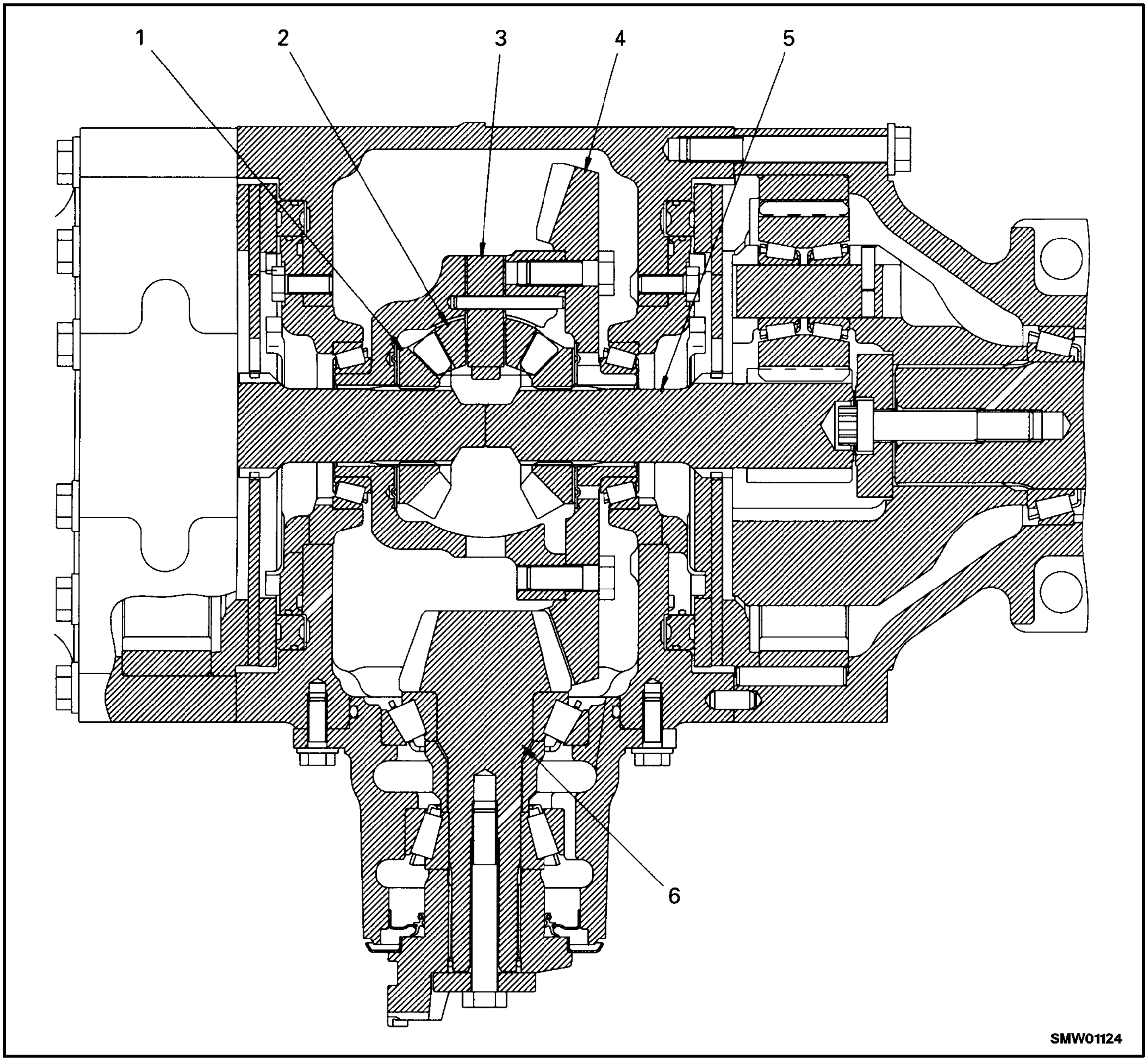
AXLE

FRONT AXLE



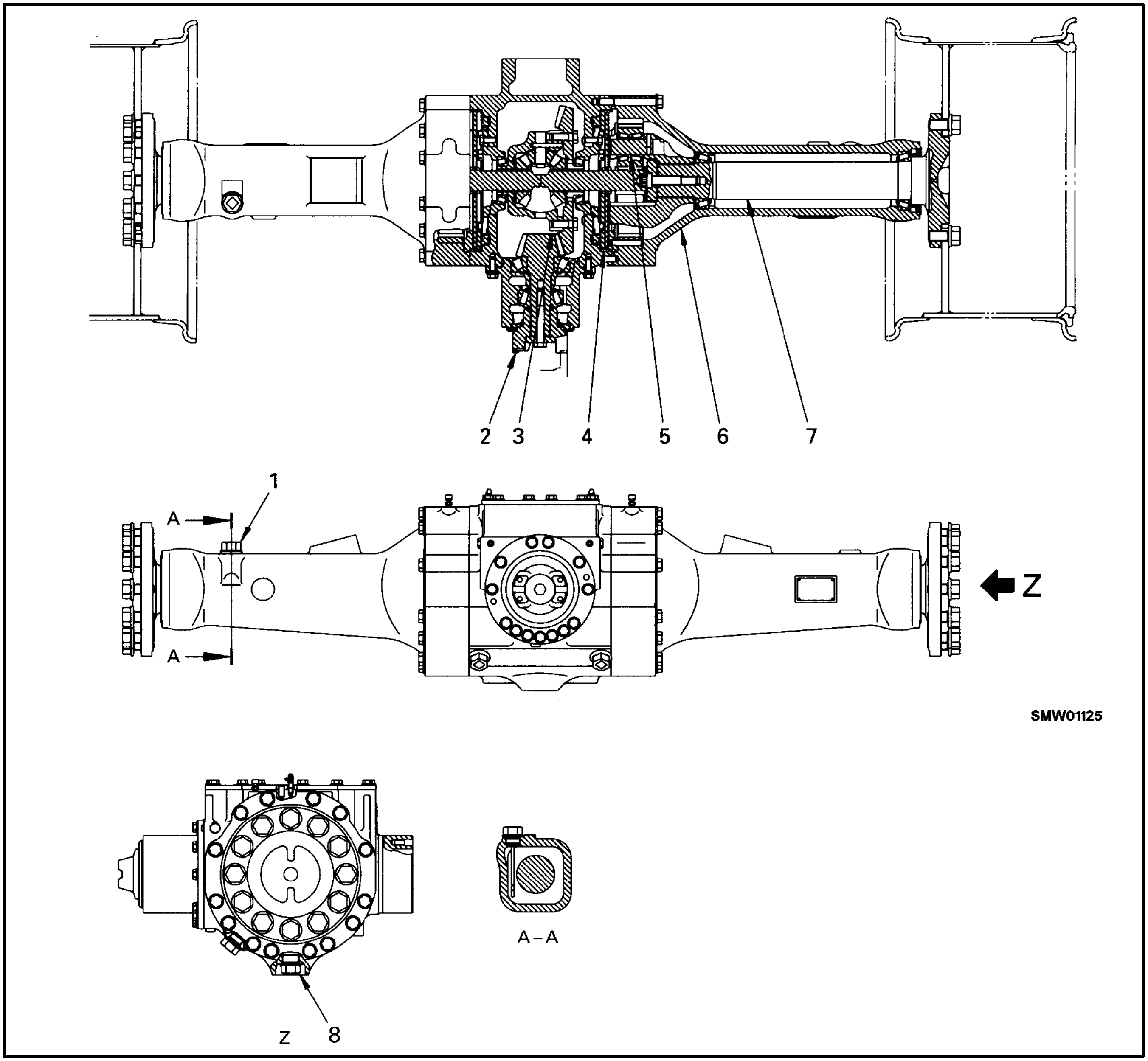
1. Oil filler port/level plug
2. Coupling
3. Differential
4. Wet type, single disc brake
5. Final drive
6. Axle housing
7. Axle shaft
8. Drain plug

FRONT DIFFERENTIAL



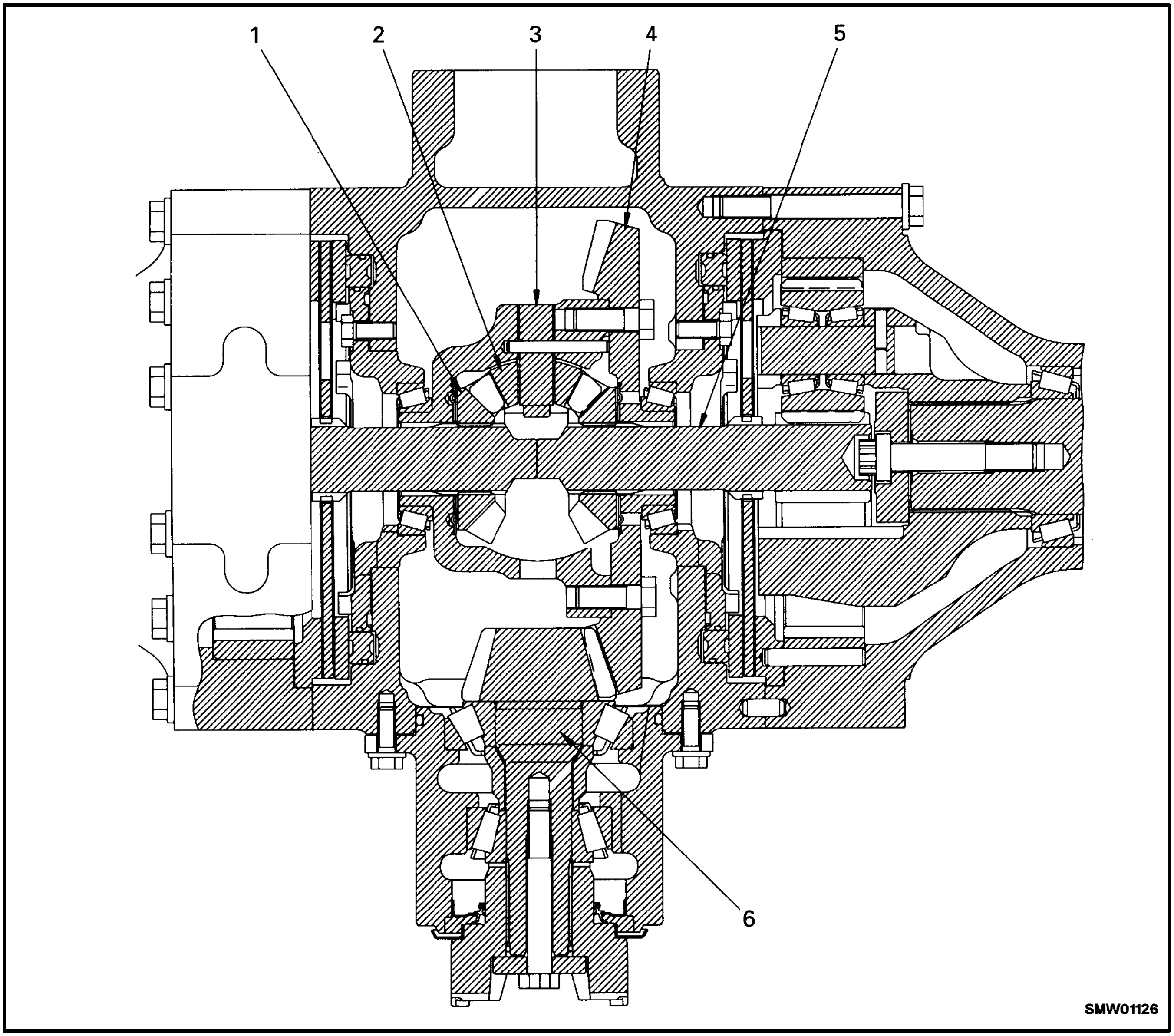
1. Side gear (No. of teeth: 12)
2. Pinion gear (No. of teeth: 9)
3. Shaft
4. Bevel gear (No. of teeth: 43)
5. Sun gear shaft
6. Bevel pinion (No. of teeth: 12)

REAR AXLE



1. Oil filler port/level plug
2. Coupling
3. Differential
4. Wet type, single disc brake
5. Final drive
6. Axle housing
7. Axle shaft
8. Drain plug

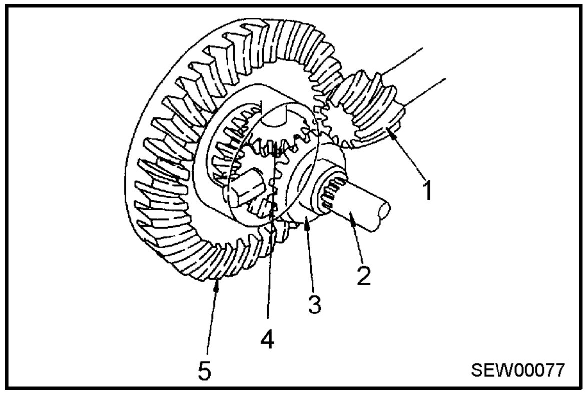
REAR DIFFERENTIAL



1. Side gear (No. of teeth: 12)
2. Pinion gear (No. of teeth: 9)
3. Shaft
4. Bevel gear (No. of teeth: 47)
5. Sun gear shaft
6. Bevel pinion (No. of teeth: 13)

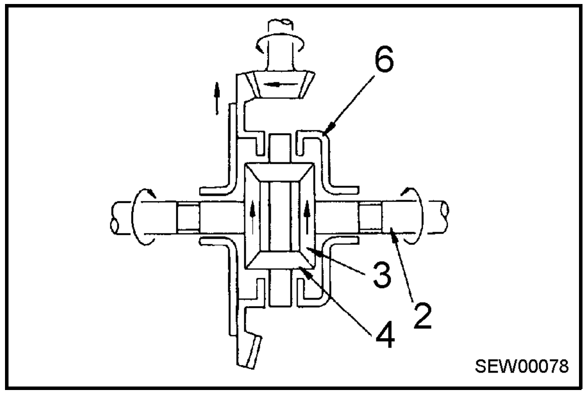
Outline

- The motive force from the engine is transmitted to the front and rear axles via the torque converter, the transmission and the propeller shaft.
- In the axle, the motive force is transmitted from pinion gear (1) to bevel gear (5), shifted 90° and reduced, and transmitted to sun gear shaft (2) via differential (4).
- The motive force of the sun gear is further reduced by planetary gear-type final drive, and transmitted to the axle shaft and wheel.



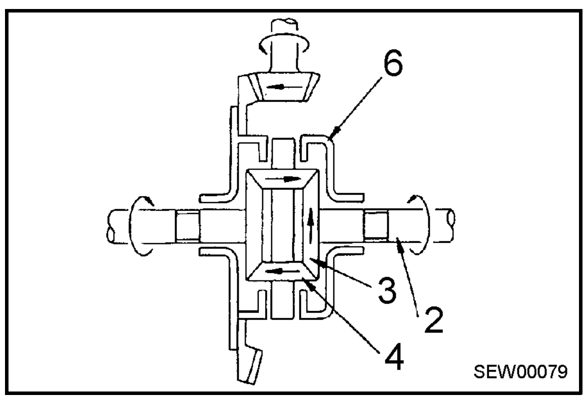
When moving straight forward

- When moving straight forward, the speed of rotation of the left and right wheels is equal, so pinion gear (4) in the differential assembly does not rotate, and the motive force of carrier (6) is transmitted equally to the left and right sun gear shafts (2) via the pinion gear (4) and side gear (3).

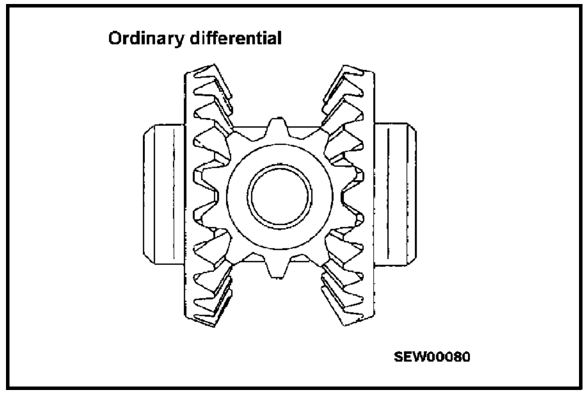


When stewing

- When slewing, the speed of rotation of the left and right wheels is unequal, so pinion gear (4) and side gear (3) in the differential assembly rotate according to the difference in the left and right rotation speeds, and the motive force of carrier (6) is transmitted to the sun gear shafts (2).

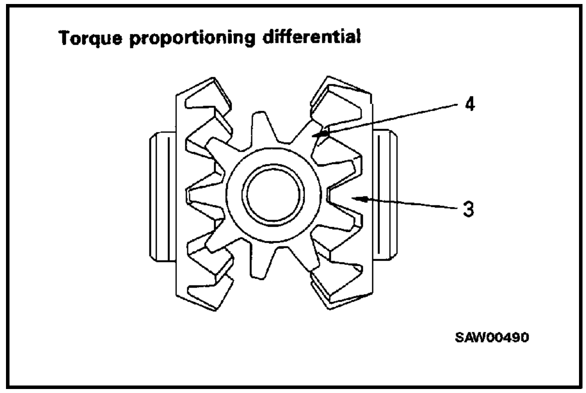


TORQUE PROPORTIONING DIFFERENTIAL



Function

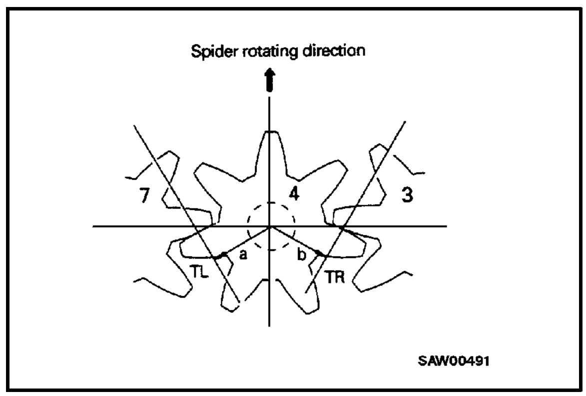
- Because of the nature of their work, 4-wheel drive loaders have to work in places where the road surface is bad. In such places, if the tires slip, the ability to work as a loader is reduced, and also the life of the tire is reduced. The torque proportioning differential is installed to overcome this problem.
- In structure it resembles the differential of an automobile, but differential pinion gear (4) has an odd number of teeth. Because of the difference in the resistance from the road surface, the position of meshing of pinion gear (4) and side gear (3) changes, and this changes the traction of the left and right tires.



Operation

When traveling straight (equal resistance from road surface to left and right tires)

- If the resistance from the road surface to the left and right wheels is the same, the distance between pinion gear (4) and meshing point **"a"** of left side gear (7) is the same as the distance between pinion gear (4) and meshing point **"b"** of right side gear (3).
- Therefore the left side traction TL and the right side traction TRANSMISSION are balanced.



When traveling on soft ground (resistance from road surface to left and right tires is different)

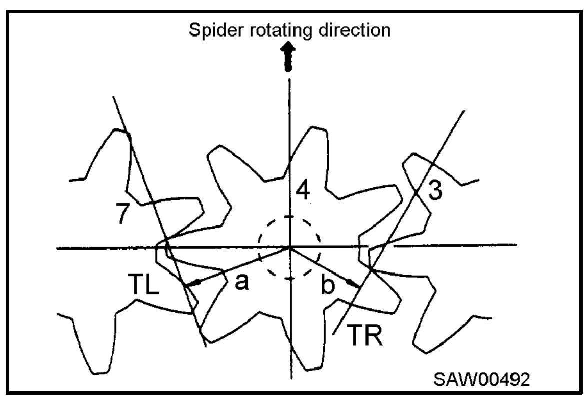
- On soft ground, if the tire on one side slips, the side gear of the tire on the side which has least resistance from the road surface tries to rotate forward. Because of this rotation, the meshing of pinion gear (4) and side gear changes.

- If left side gear (7) rotates slightly forward, the distance between the pinion gear and the meshing point **"a"** of the left side gear becomes longer than the distance between the pinion gear and the meshing port **"b"** of the right side gear. The position is balanced as follows.

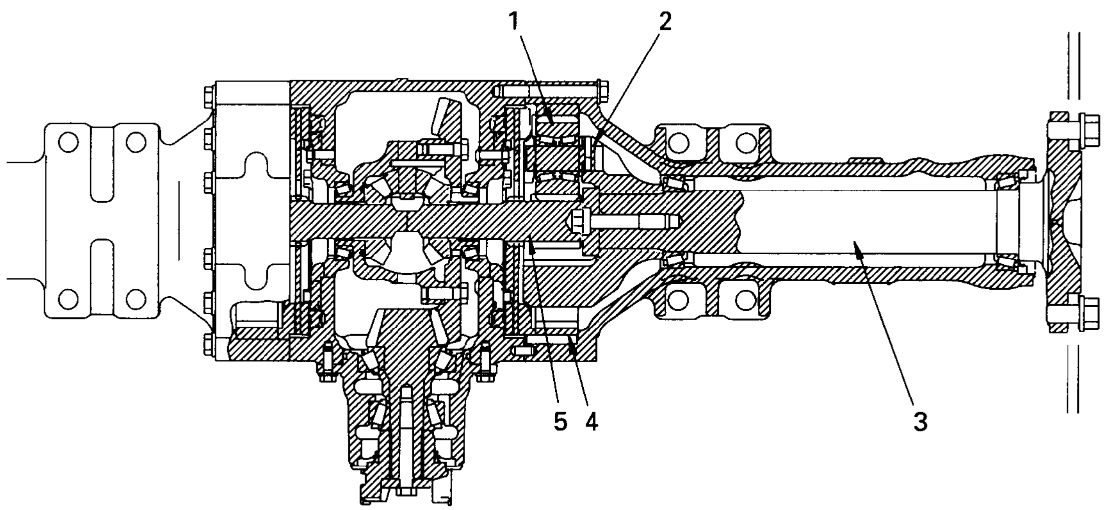
  a x TL = **b** x TRANSMISSION

  The ratio between the distances to **"a"** and **"b"** can change to 1 : 1.38.
- Therefore when the ratio of the distances to **"a"** and **"b"** is less than 1 : 1.38 (that is, the difference between the resistance from the road surface to the left and right tires is less than 38%), the pinion gear will not rotate freely, so drive force will be given to both side gears, and the tires will not slip.

  Because of this effect, the tire life can be increased by 20 - 30%, and at the same the operating efficiency is also increased.



FINAL DRIVE

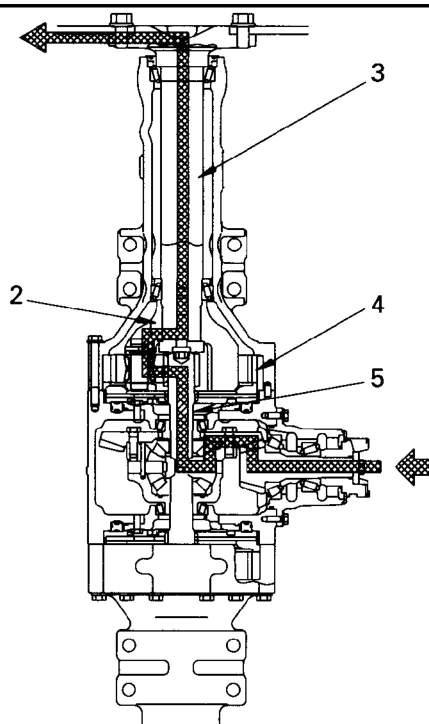


1. Planetary gear (Teeth 26)
2. Planetary carrier
3. Axle shaft
4. Ring gear (Teeth 69)
5. Sun gear shaft (Teeth 15)

SMW01127

Outline

- As the final function the final drive operates to reduce the rotative speed of the motive force from the engine and increases the driving force.
- Ring gear (4) is press-fitted in the axle housing and fixed in place by a pin.
- The motive force transmitted from the differential to the sun gear shaft (5) is reduced using a planetary gear mechanism, increasing the driving force.
  The increased driving force is transmitted to the tires via planetary gear (2) and axle shaft (3).



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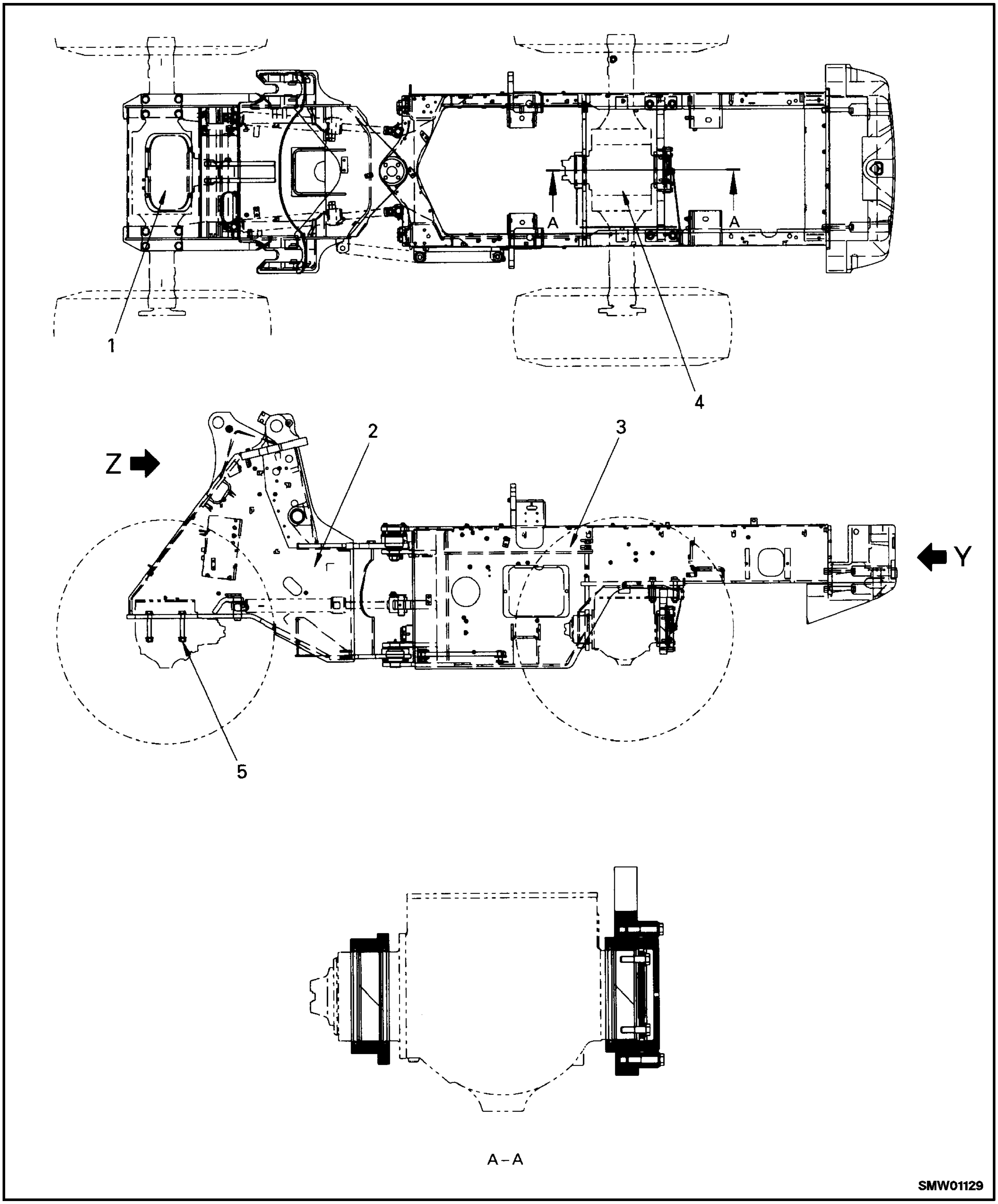
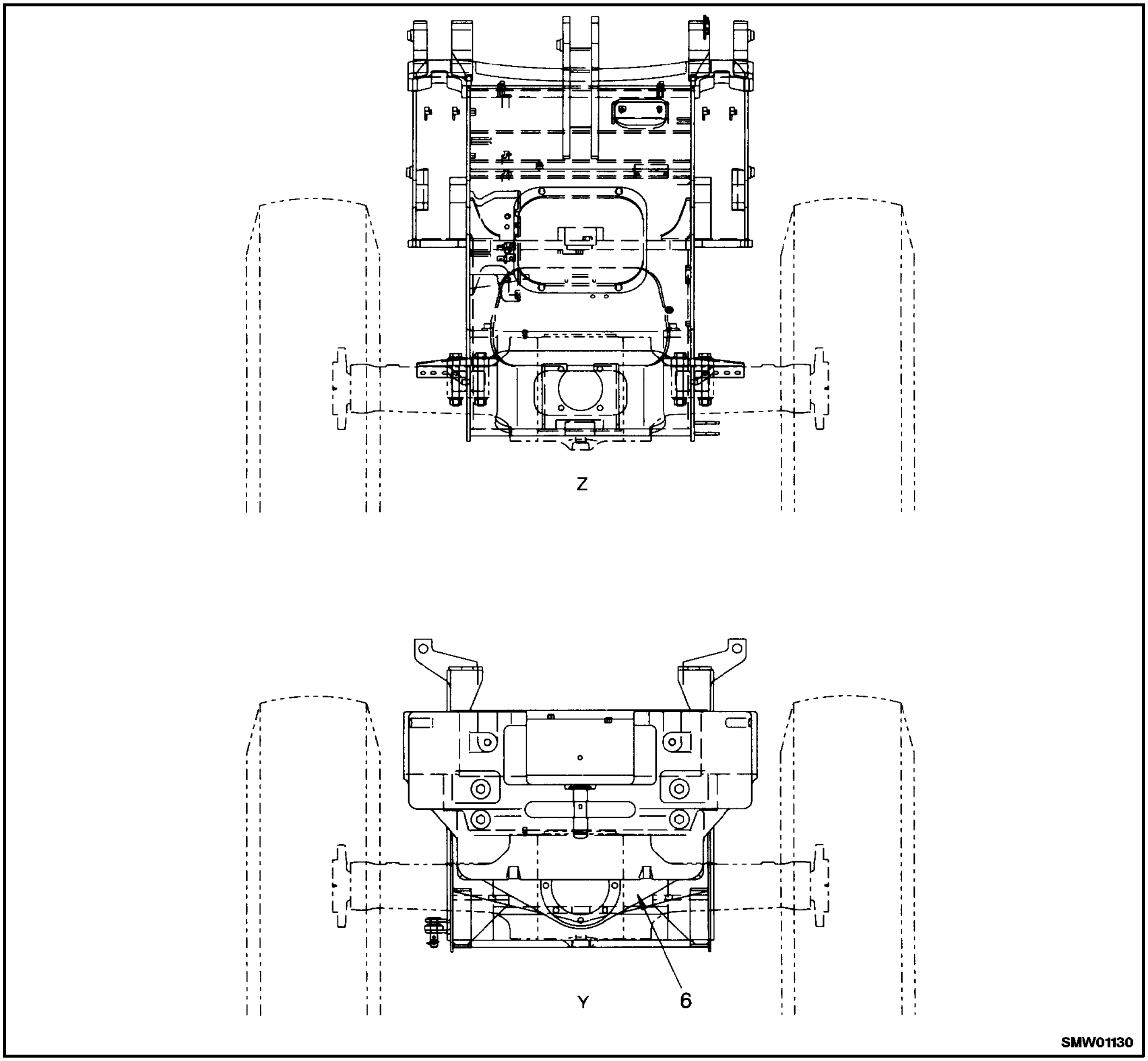
AXLE MOUNT



AXLE MOUNT



1. Front axle
2. Front frame
3. Rear frame
4. Rear axle
5. Tension bolt
6. Pivot

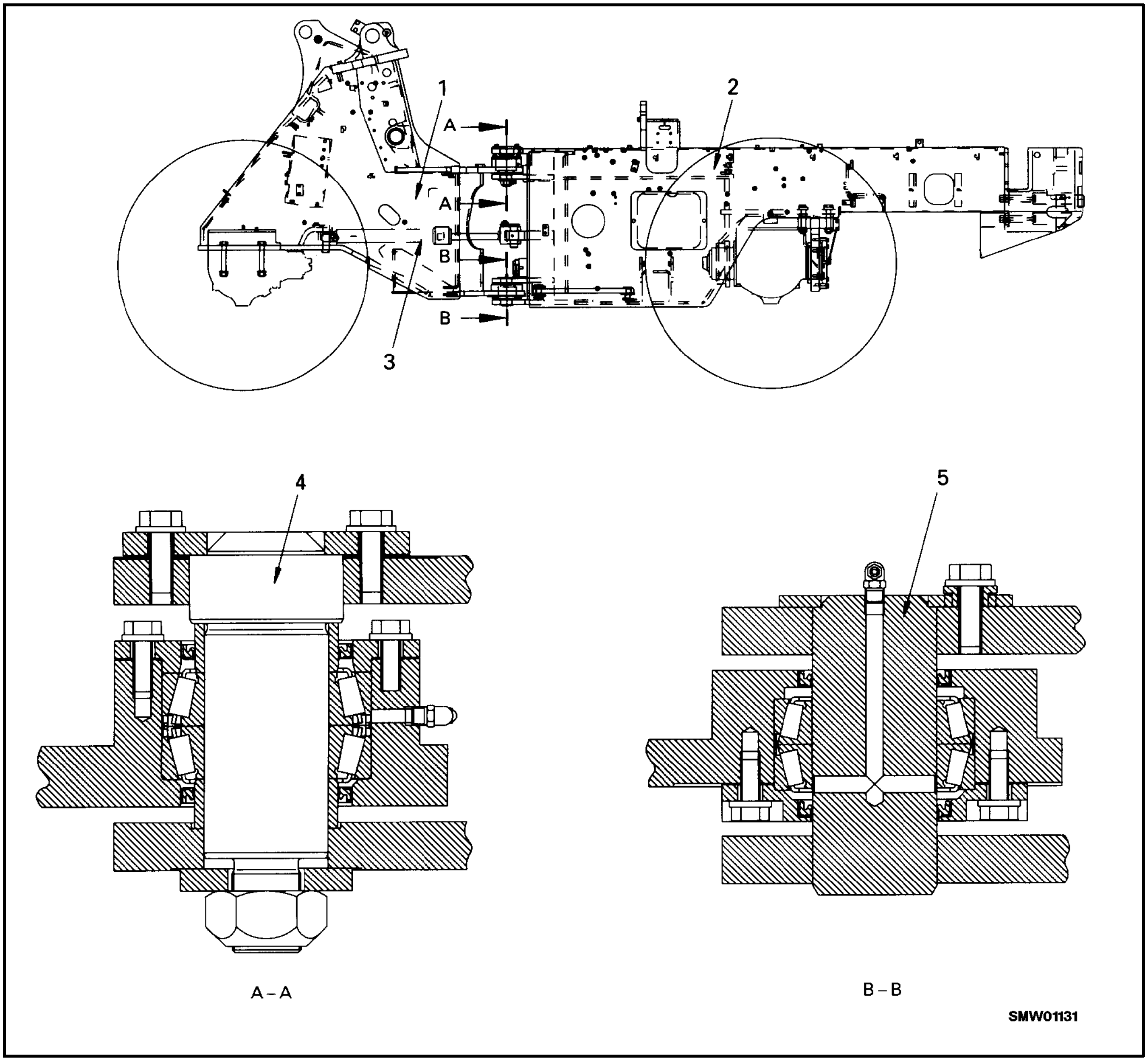
FRONT AXLE

- Front axle (1) receives the force directly during operations, so it is connected directly to front frame (2) by tension bolt (5).

REAR AXLE

- Rear axle (4) is designed so that it pivots at the center of the axle. This enables all four tires to remain in contact with the ground surface even when traveling on soft ground.

CENTER HINGE PIN

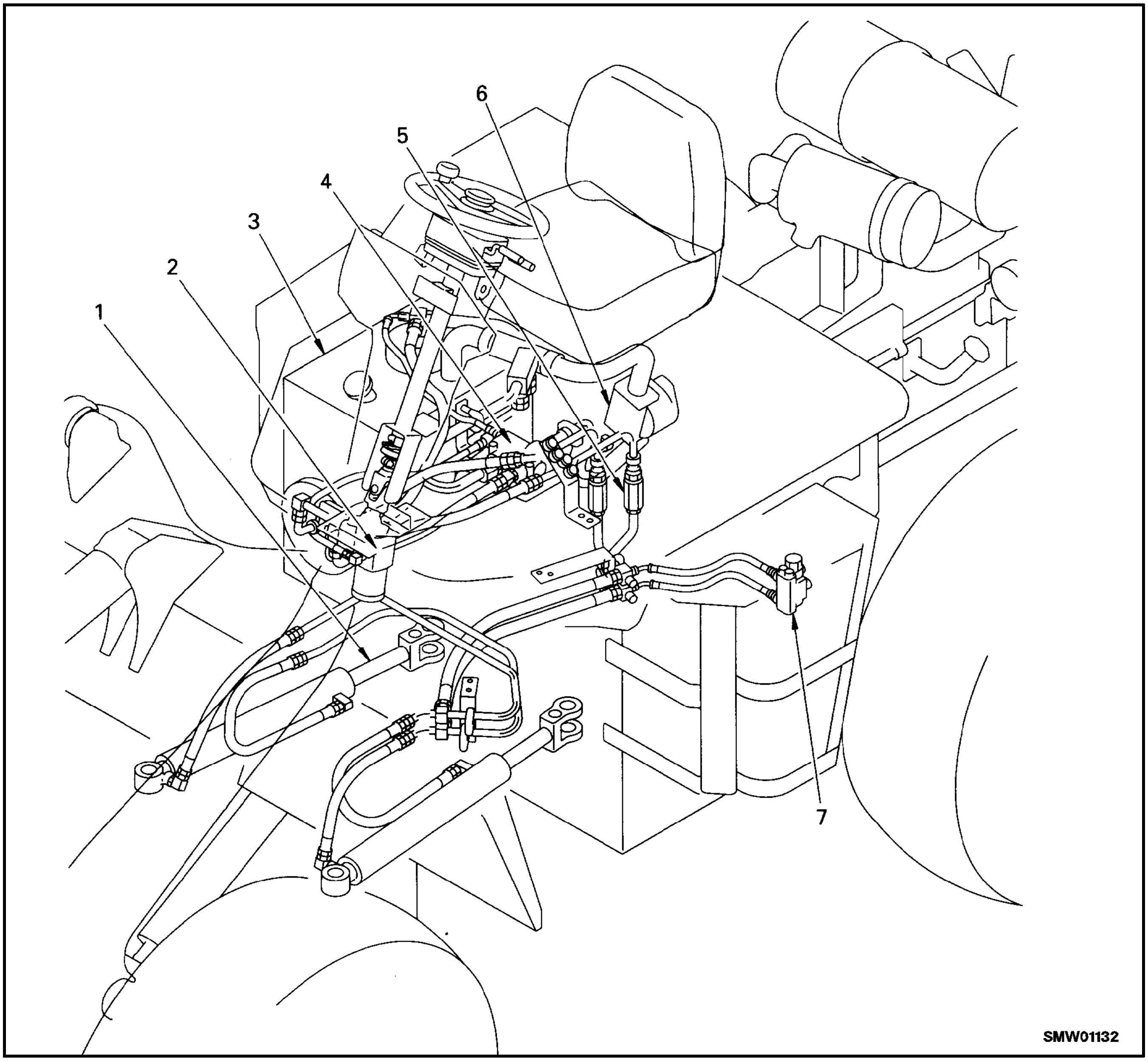


1. Front frame
2. Rear frame
3. Steering cylinder
4. Upper hinge pin
5. Lower hinge pin

Outline

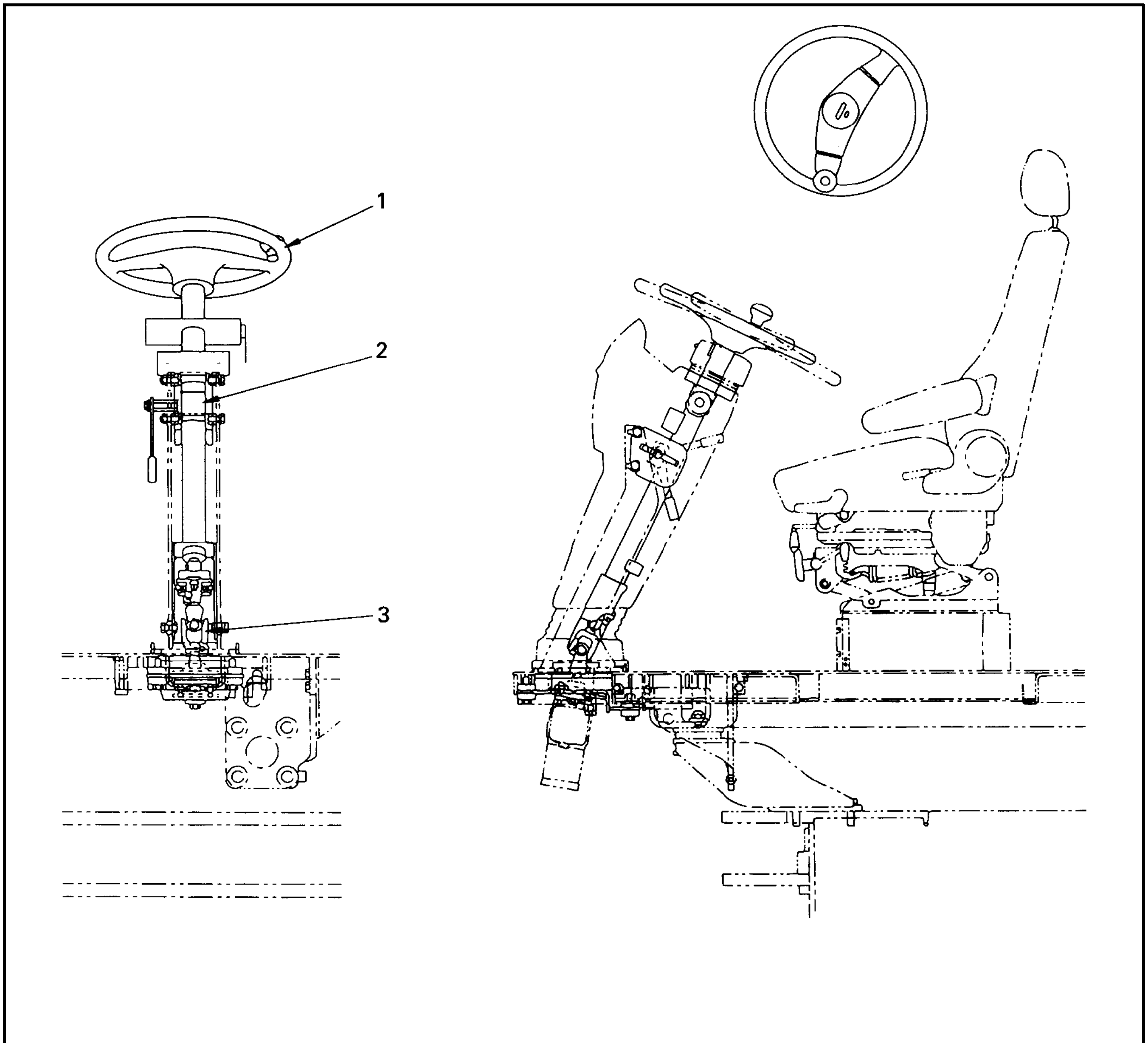
- The front frame and rear frame are connected by the center hinge pin through a bearing. The steering cylinder is also connected to the left and right front and rear frames, so the angle of articulation of the frame (the turning radius) is adjusted by the movement of the cylinder.

STEERING PIPING



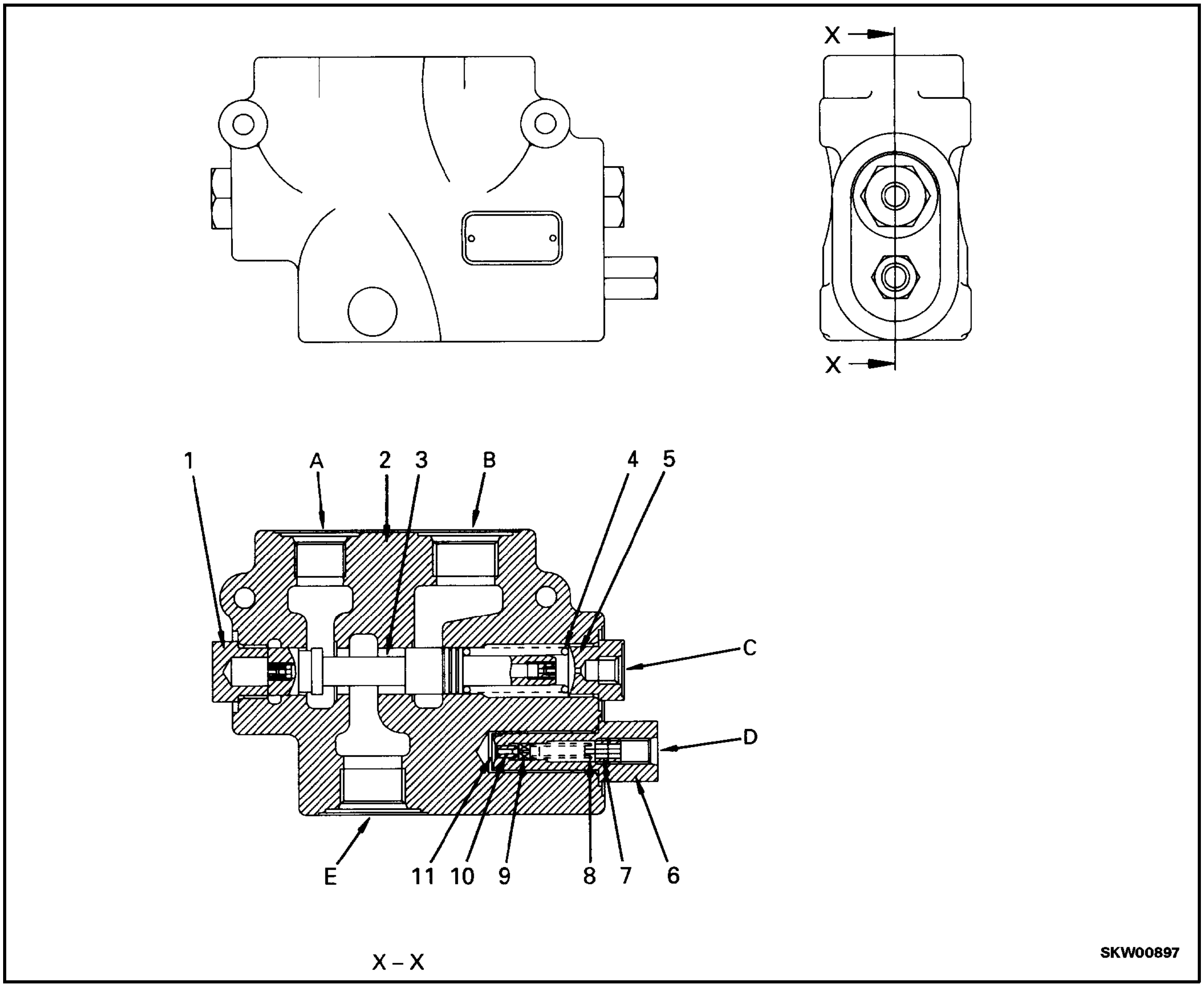
1. Steering cylinder
2. Steering valve
3. Hydraulic tank
4. Priority valve
5. 2-way restrictor valve
6. Hydraulic, steering pump
7. Cushion valve

STEERING COLUMN



1. Steering wheel
2. Steering column
3. Joint

PRIORITY VALVE



Outline

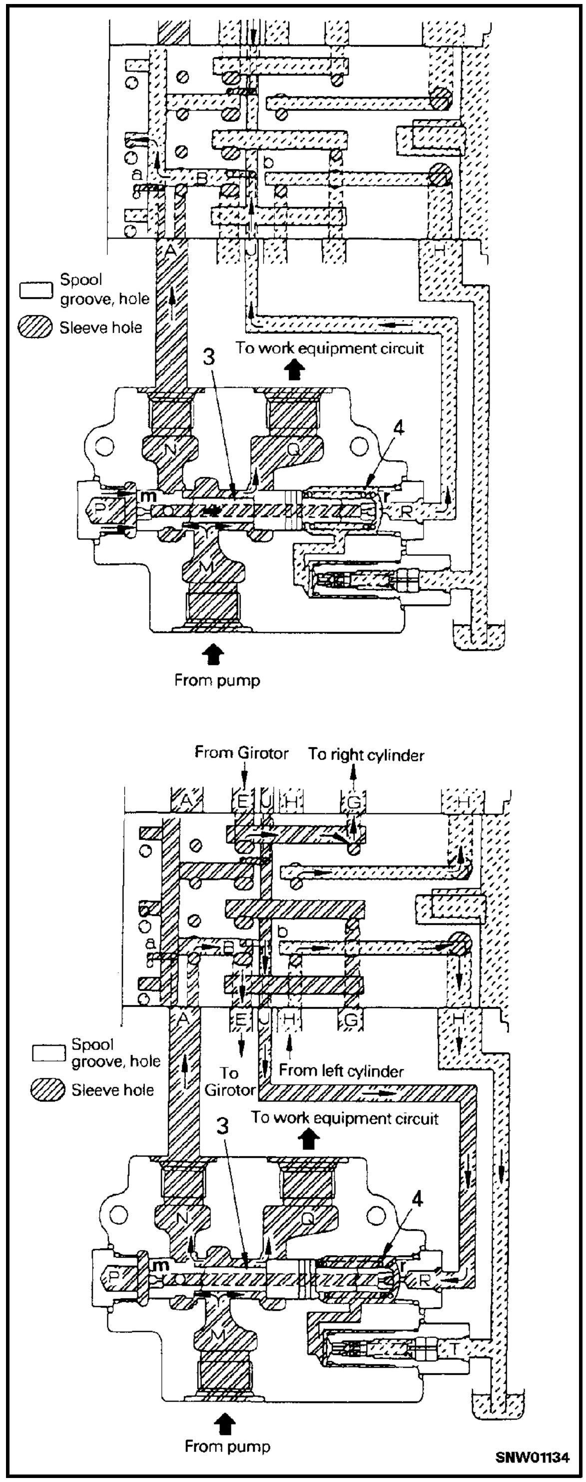
- The priority valve is in the circuit between the steering pump and the steering valve. It acts to divide the flow of oil from the steering pump and send it to the steering valve or oil cooler circuit. It also sets the oil pressure in the circuit from the priority valve to the steering valve to 18.6 MPa (190 kg/cm²) to protect the circuit.

1. Plug
2. Valve body
3. Spool
4. Return spring
5. Plug
6. Relief valve body
7. Spring seat
8. Valve spring
9. Poppet
10. Seat
11. Screen

A. To steering valve
B. To main control valve
C. From steering valve
D. Drain
E. From pump

1. **Steering wheel at neutral**
When the engine is stopped, spool (3) is pushed fully to the left by the tension of spring (4). The circuit between ports **M** and **N** is fully open, while the circuit between ports **M** and **Q** is fully closed.
In this condition, if the engine is started and the steering pump is rotated, the oil from the pump goes from port **M** to port **N,** and then enters port **A** of the steering valve. The oil entering port **A** is throttled by orifice a, so the pressure in the circuit rises.
When this happens, the oil passing through orifice **m** in spool (3) enters port **P.** It then compresses spring (4), and moves spool (3) to the right in the direction of the arrow. This stabilizes the condition so that the circuit between ports **M** and **Q** is almost fully open and the circuit between ports **M** and **N** is almost fully closed. Therefore, the oil from the pump almost all flows to the work equipment circuit.

2. **Steering wheel turned to left**
When the steering wheel is turned to the left, an angle variation is generated between the spool and sleeve of the steering valve, and the oil flow is switched. (For details, see STEERING VALVE.)
The oil from the pump flows from port **M** to port **N,** and enters port **A.** The degree of opening of the sleeve (port **A)** and spool (port **B)** creates a difference between the pressure up to port **A** and the pressure beyond port **B.** Some of the oil from port **B** flows to the Girotor, and then goes to the front right cylinder. The remaining oil passes through orifice **b,** flows to port **J,** and then enters port **R.**
When this happens, spool (3) stabilizes at a position where the differential pressure between the circuit up to port **A** and circuit beyond port **B** (pressure of port **P -** pressure of port **R)** and the load of spring (4) are balanced. It adjusts the degree of opening from port **M** to ports **N** and **Q,** and distributes the flow to both circuits.
The ratio of this distributed flow is determined by the degree of opening of port **A** and port **B,** in other words, the angle variation between the sleeve and spool of the steering valve. This degree of opening is adjusted steplessly by the amount the steering wheel is turned.

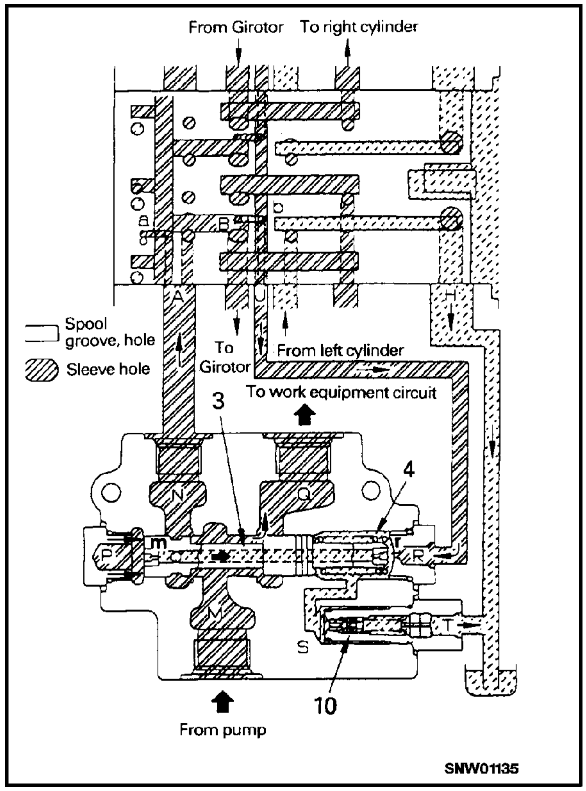


3. Steering cylinder at end of stroke

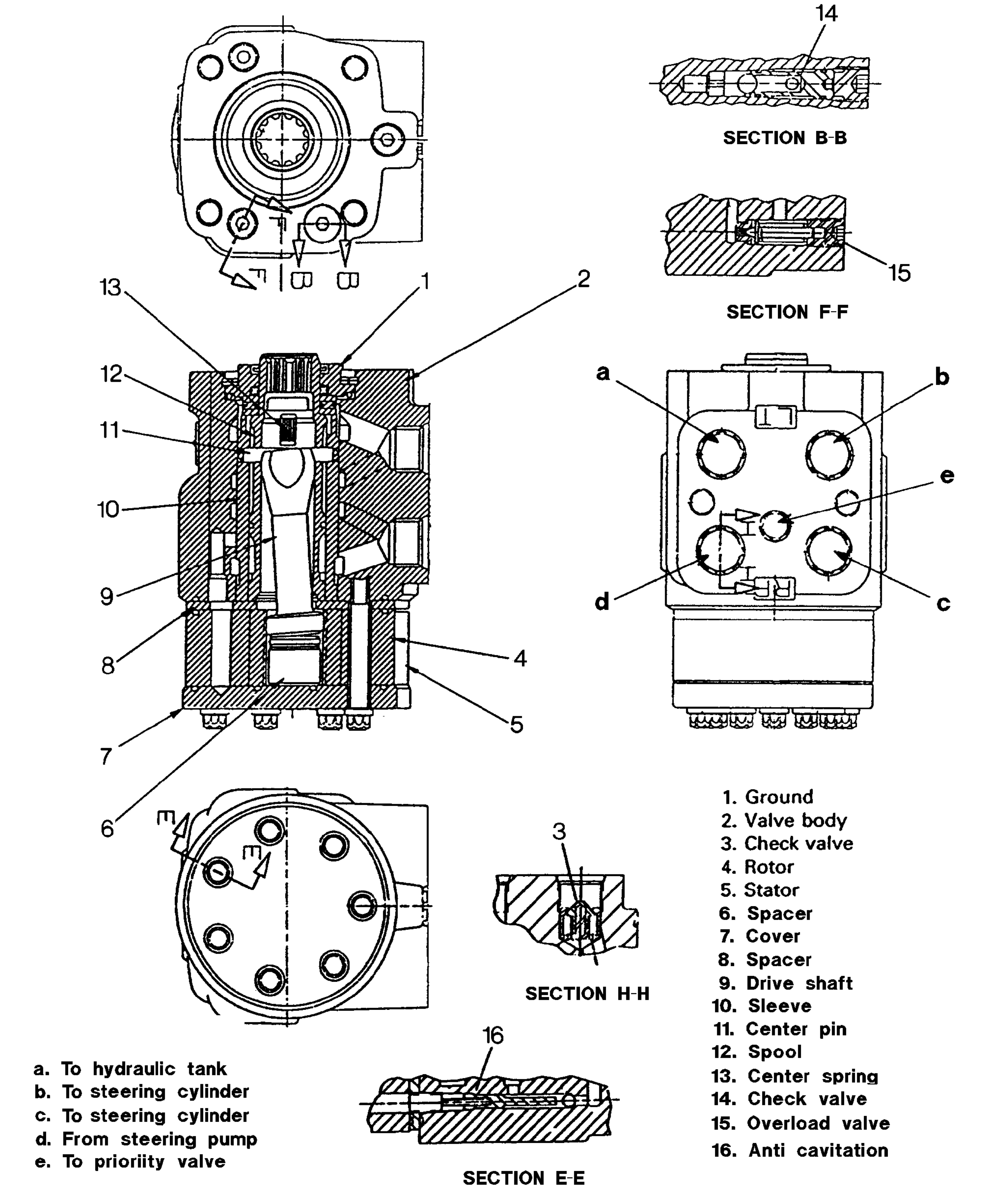
If the operator tries to turn the steering wheel further when the steering cylinder has reached the end of its stroke, the circuit from port **M** through port **N** to port **S** is kept open and the pressure rises.

When this pressure rises above 190 kg/cm', relief valve (10) opens and the oil is relieved to the hydraulic tank. Because of this flow of oil, a differential pressure is created on both sides of orifice **r.** Therefore, the balance is lost between the load of spring (4) and the pressure up to port **A** and the pressure beyond port **B.** As a result, the pressure up to port A becomes relatively higher.

For this reason, the pressure at port **P** moves spool (3) even further to the right from the condition in Item 2. It stabilizes the condition at a position where the circuit between ports **M** and **N** is almost fully closed, and the circuit between ports **M** and **Q** is almost fully open.



STEERING VALVE (ORBIT-ROLL)



1. Ground
2. Valve body
3. Check valve
4. Rotor
5. Stator
6. Spacer
7. Cover
8. Spacer
9. Drive shaft
10. Sleeve
11. Center pin
12. Spool
13. Center spring
14. Check valve
15. Overload valve
16. Anti cavitation

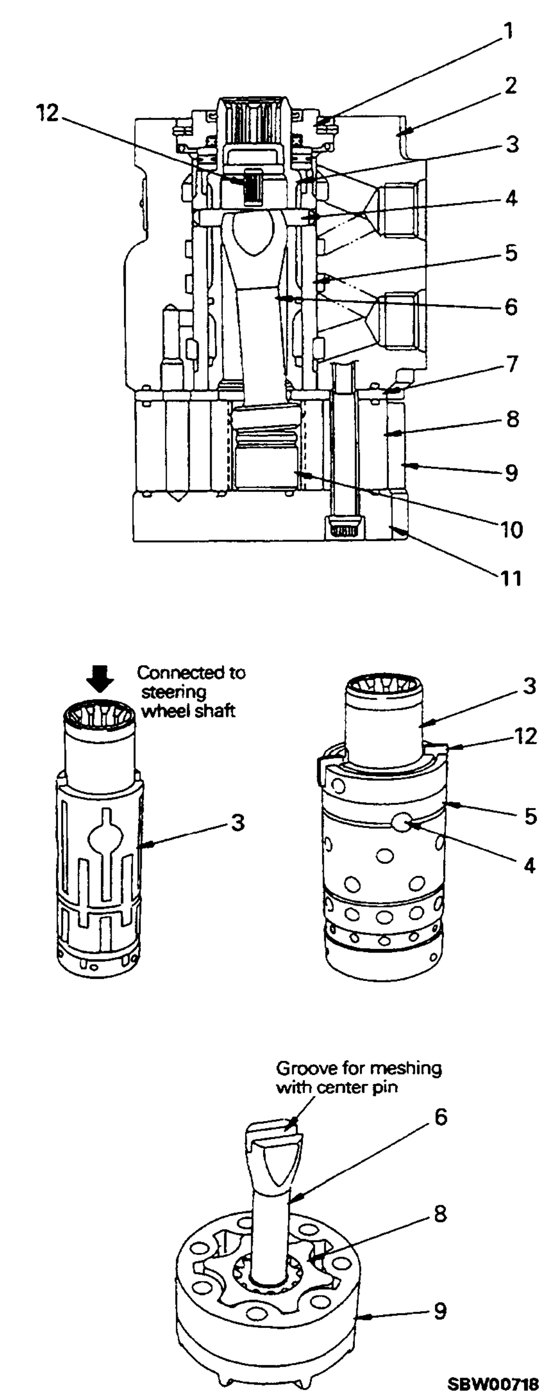
a. To hydraulic tank
b. To steering cylinder
c. To steering cylinder
d. From steering pump
e. To prioriity valve

Outline

- The steering valve is connected directly to the shaft of the steering wheel. It switches the flow of oil from the steering pump to the left and right steering cylinders to determine the direction of travel of the machine.
- The steering valve, broadly speaking, consists of the following components: rotary type spool (3) and sleeve (5), which have the function of selecting the direction, and the Girotor set (a combination of rotor (8) and stator (9)), which acts as a hydraulic motor during normal steering operations, and as a hand pump (in fact, the operating force of the steering wheel is too high, so it cannot be operated) when the steering pump or engine have failed and the supply of oil has stopped.

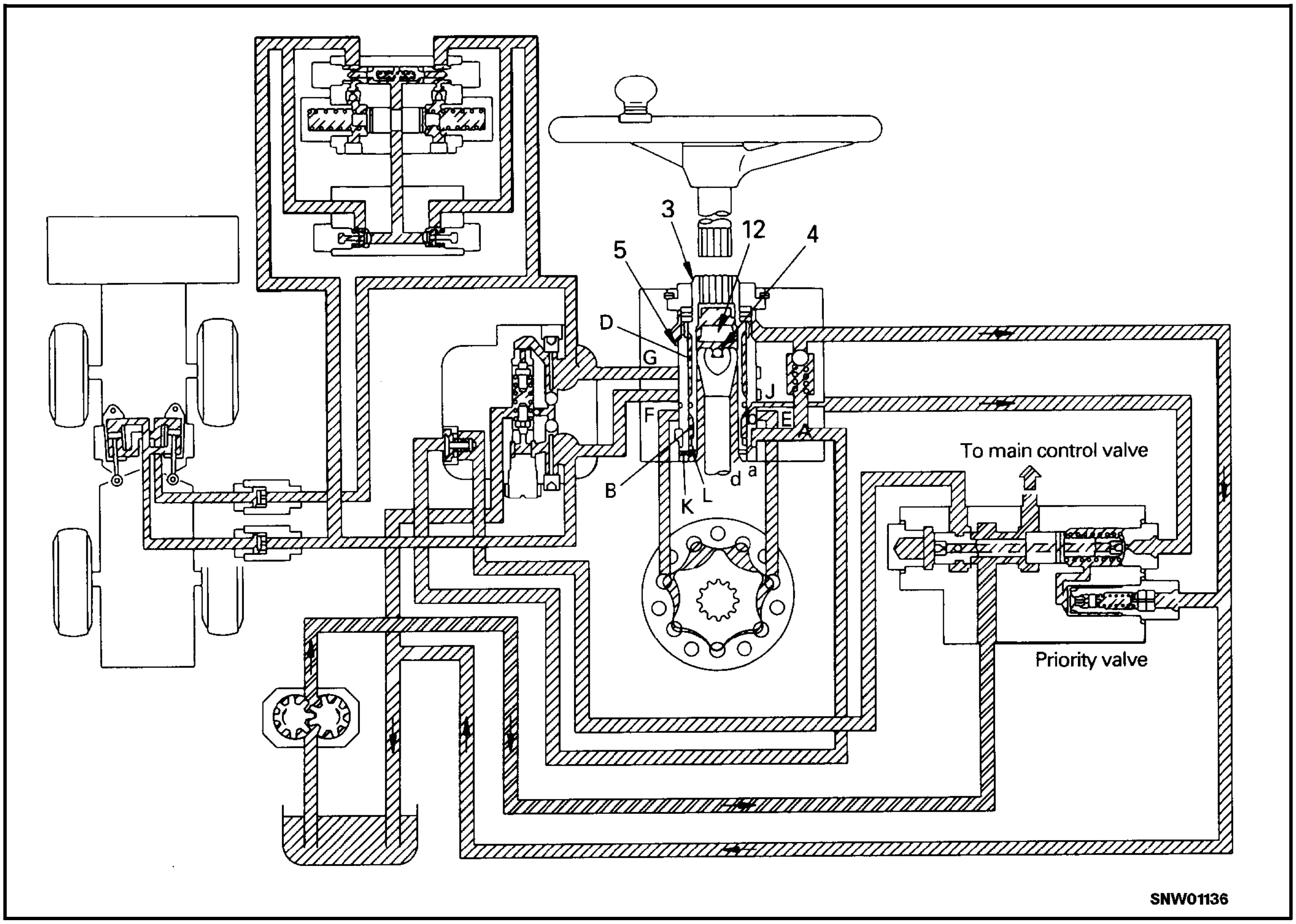
Structure

- Spool (3) is directly connected to the drive shaft of the steering wheel, and is connected to sleeve (5) by center pin (4) (it does not contact the spool when the steering wheel is at neutral) and centering spring (12).
- The top of drive shaft (6) is meshed with center pin (4), and forms one unit with sleeve (5), while the bottom of the drive shaft is meshed with the spline of rotor (8) of the Girotor.
- There are four ports in valve body (2), and they are connected to the pump circuit, tank circuit, and the circuits at the head end and bottom end of the steering cylinders. The pump port and tank port are connected by the check valve inside the body. If the pump or engine fail, the oil can be sucked in directly from the tank by this check valve.

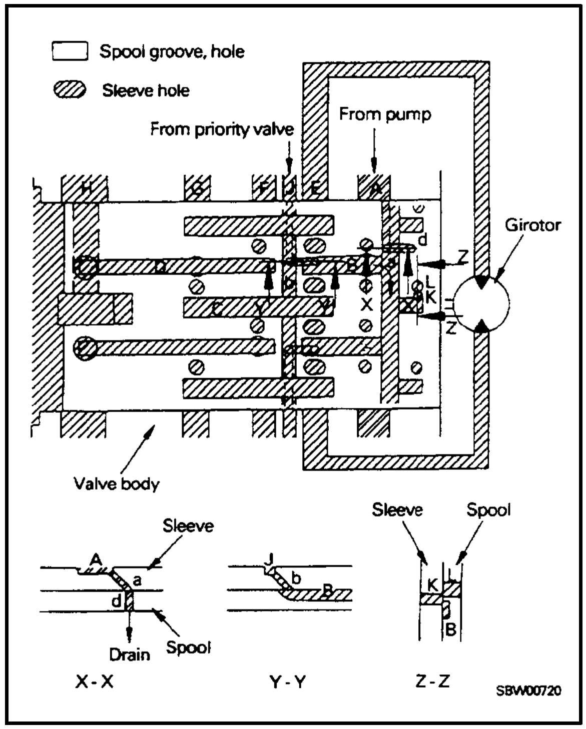


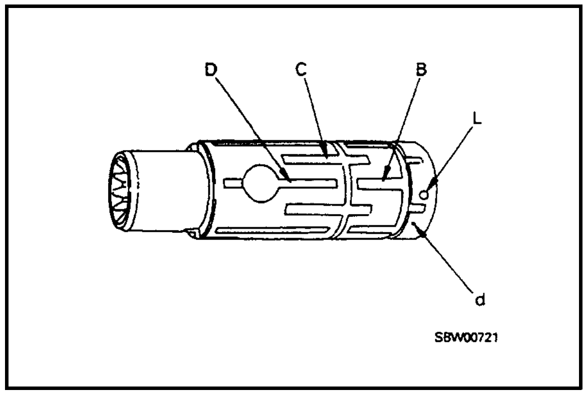
Operation

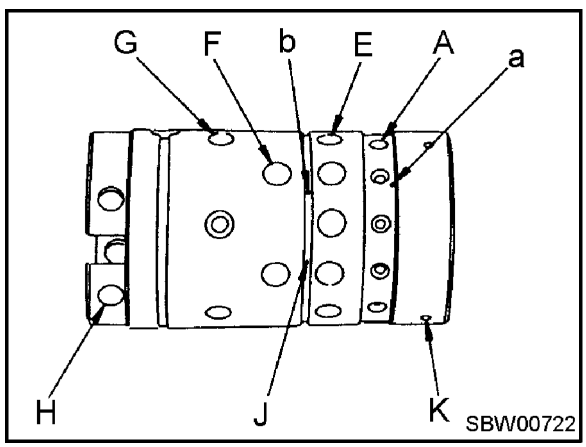
1. Steering wheel at neutral



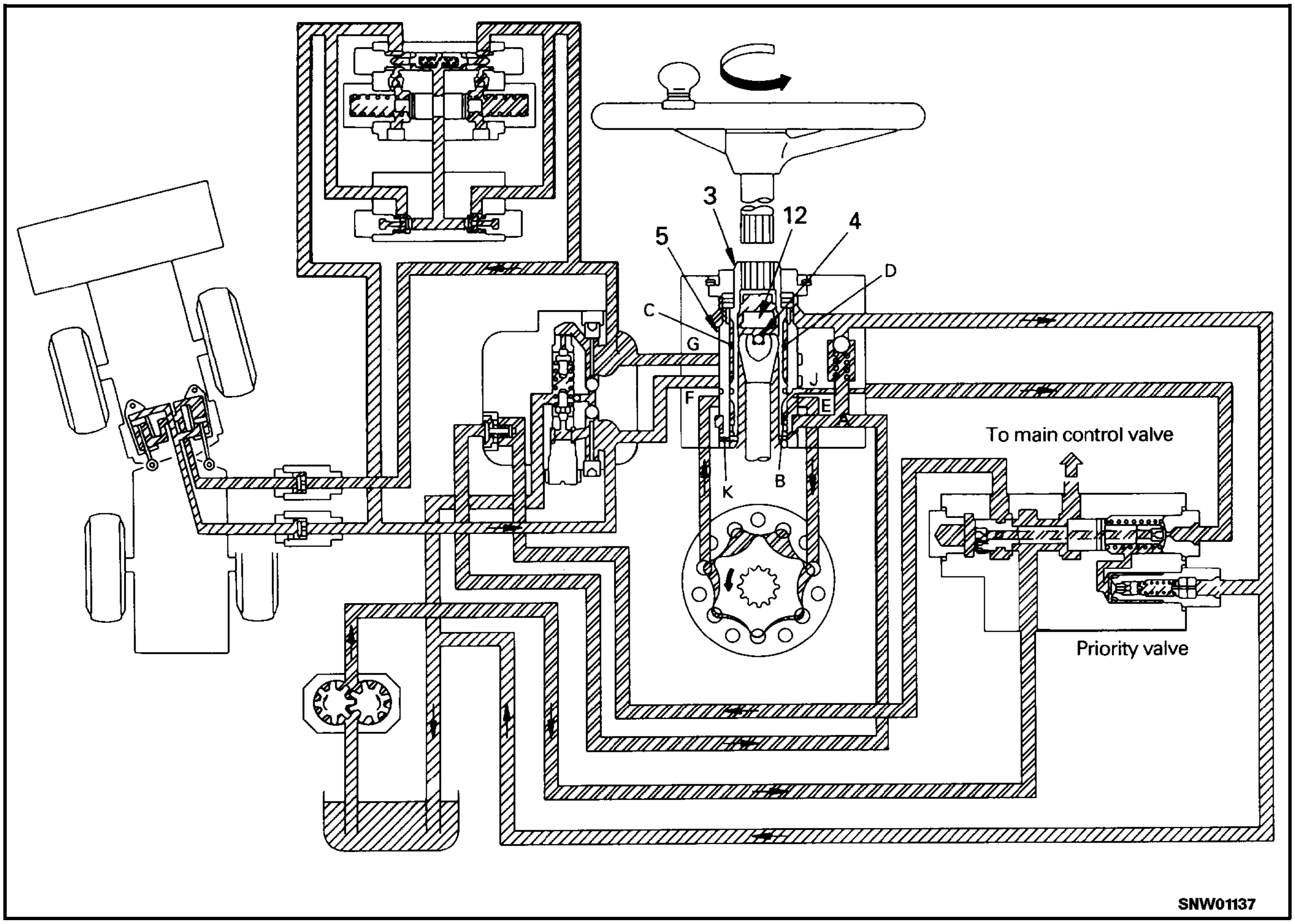
- When the steering wheel is at neutral, centering spring (12) makes spool (3) and sleeve (5) stop at a position where center pin (4) is at the center of the oblong hole in spool (3).
  At this point, pump port **A** of the sleeve and ports **E, F,** and **G** to the steering cylinder and Girotor, and vertical grooves **B, C,** and **D** of the spool are shut off.
  However, orifice **a** of pump port **A** is connected to orifice **d** (connected to drain port **H)** of the spool.
  Orifice **b** of port **J** from the priority valve is connected to vertical groove **B** of the spool. In addition, port **K** of the sleeve is connected to drain port **L** of the spool and vertical groove **B.**
- By shutting off and connecting these ports and grooves, the oil from the pump passes from port **A** through orifices **a** and **d,** and is drained to the hydraulic tank.
  In addition, the oil which forms the pilot pressure of the priority valve passes from port **J** through orifice **b,** then through vertical groove **B** and port **K,** and is returned to the hydraulic tank from port **L.**

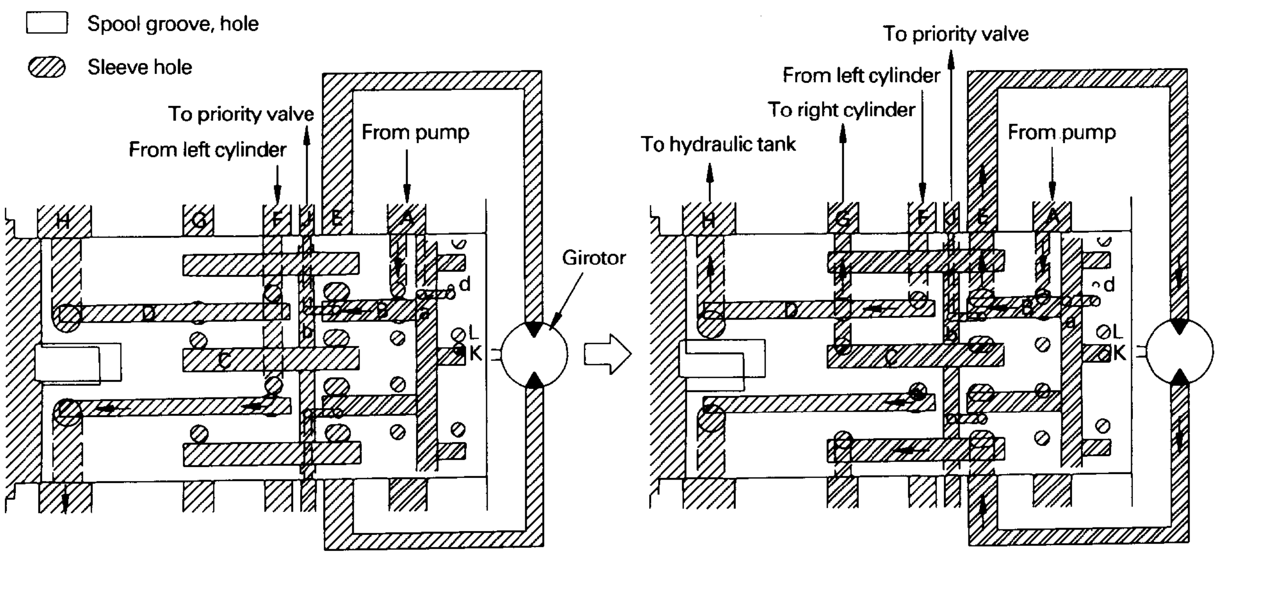






2. Steering wheel turned (turning left)

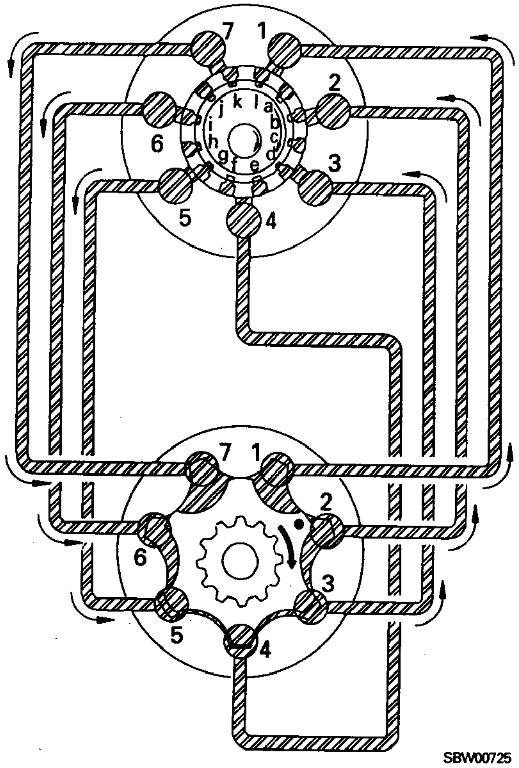


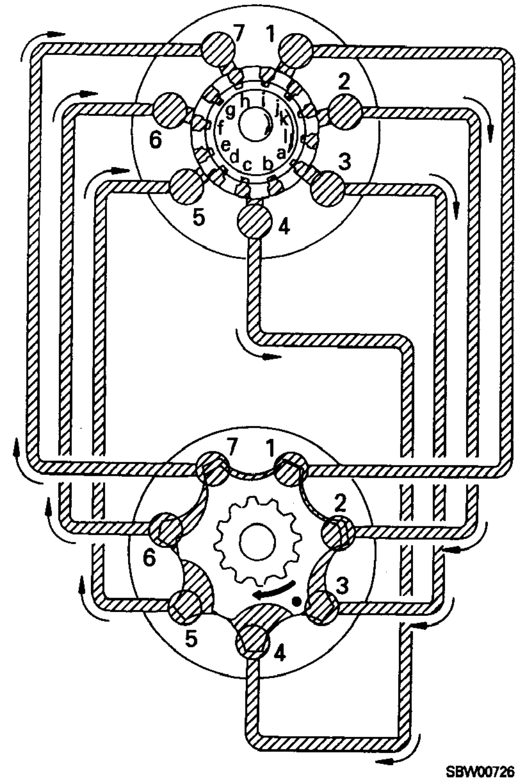


- When the steering wheel is turned to the left, spool (3), which is connected by the spline of the steering shaft, also turns to the left. The spool and sleeve (5) are interconnected by centering spring (12), so the spool compresses the centering spring.
  Therefore, a difference in the angle of rotation (angle variation) is generated between the spool and sleeve equal to the amount that the centering spring is compressed.
  When this happens, first, port **A** and vertical groove **B** are connected. Then vertical groove **B** and port **E** to the Girotor, and port **E** from the Girotor to vertical groove **C** are connected. Finally, vertical groove **C** and port **G** to the head end of the right cylinder are connected.
  In addition, vertical groove **B** is kept connected to orifice **b** of port **J** to the priority valve, but port **K** of the sleeve gradually closes the connection of vertical groove **B** and port **L.**
  Port **F** from the head end of the left cylinder is connected to vertical groove **D** (connected to drain port **H)** at the same time as port **A** and vertical groove **B** are connected.
- By shutting off and connecting the above ports and grooves, the oil from the pump enters vertical groove **B** from port **A,** then flows to port **E** to the Girotor, and turns the Girotor. The oil discharged from the Girotor enters vertical groove **C** from port **E,** and flows from port **G** to the head end of the right cylinder.
  The oil entering vertical groove **B** passes through orifice **b** and flows to port **J.** From port **J,** it becomes the pilot pressure of the priority valve.
  The oil from the head end of the left cylinder enters vertical groove **D** from port **F** and is drained to the hydraulic tank.

3. **Steering wheel stopped**
   When the operation of the steering wheel is stopped, the difference in rotation between the spool and sleeve is returned to the neutral condition by the reaction of centering spring (12).

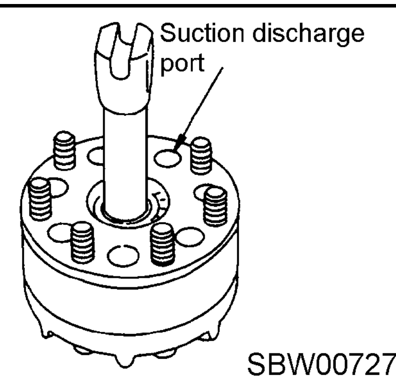
CONNECTION BETWEEN HAND PUMP AND SLEEVE

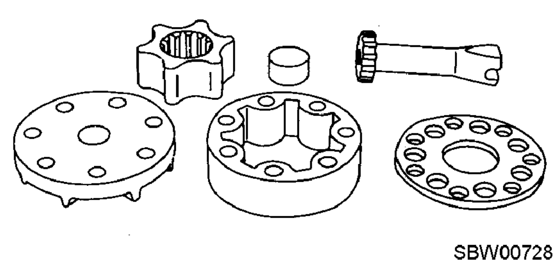




- The diagrams above show the connections with the sleeve ports used to connect the suction and discharge ports of the Girotor. If the steering wheel has been turned to the right, ports **a, c, e, 9, i** and **k** are connected by the vertical grooves in the spool to the pump side. At the same time, ports **b, d, f, h, j,** and **l** are connected to the head end of the left steering cylinder in the same way.
- n the condition in Fig. 1, ports **1**, **2,** and **3** are the discharge ports of the Girotor set. They are connected to ports **l**, **b,** and **d,** so the oil is sent to the cylinder.
  Ports **5, 6,** and **7** are connected and the oil flows in from the pump.

  If the steering wheel is turned 90°', the condition changes to the condition shown in Fig. 2. In this case, ports **1**, **2,** and **3** are the suction ports, and are connected to ports **i**, **k,** and **c.** Ports **5, 6,** and **7** are the discharge ports, and are connected to ports **d, f,** and **h.**

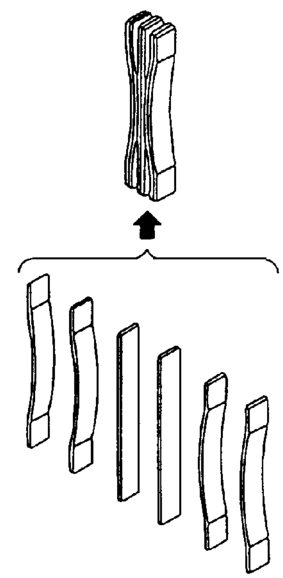




- In this way, the ports acting as the discharge ports of the Girotor are connected to the ports going to the steering cylinder, while the ports acting as the suction ports are connected to the pump circuit.
- Adjustment of discharge according to amount steering wheel is turned.
  For each 1/7 turn of the steering wheel, the inside teeth of the Girotor advance one tooth, and the oil from the pump is discharged in an amount that matches this movement. Therefore, the amount of oil discharged is directly proportional to the amount the steering wheel is turned.

Role of centering spring

- Centering spring (12) consists of four X-shaped leaf springs and two flat leaf springs. It is assembled between spool (3) and sleeve (5) as shown in the diagram on the right. When the steering wheel is turned, the spool compresses the spring, and a difference (angle variation) is generated in the turning angle of the spool and sleeve.
- Centering spring (12) consists of four X-Shaped leaf springs and two flat leaf springs. It is assembled between spool (3) and sleeve (5) as shown in the diagram on the right. When the steering wheel is turned, the spool compresses the spring, and a difference (angle variation) is generated in the turning angle of the spool and sleeve.
  As a result, the port of the spool and sleeve is connected and oil is sent to the cylinder.
  However, when the rotation of the steering wheel is stopped, the rotation of the Girotor also stops, so no more oil is sent to the cylinder, and the oil pressure rises.
  To prevent this, when the turning of the steering wheel is stopped, the action of the centering spring only allows it to turn by an amount equal to the difference in angle of rotation (angle variation) of the sleeve and spool, so the steering wheel returns to the NEUTRAL position.



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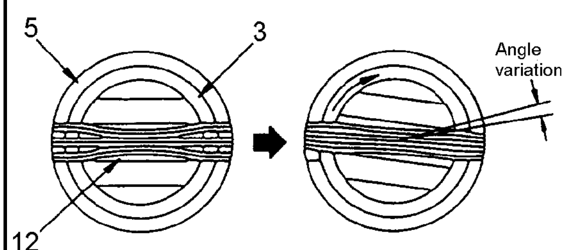

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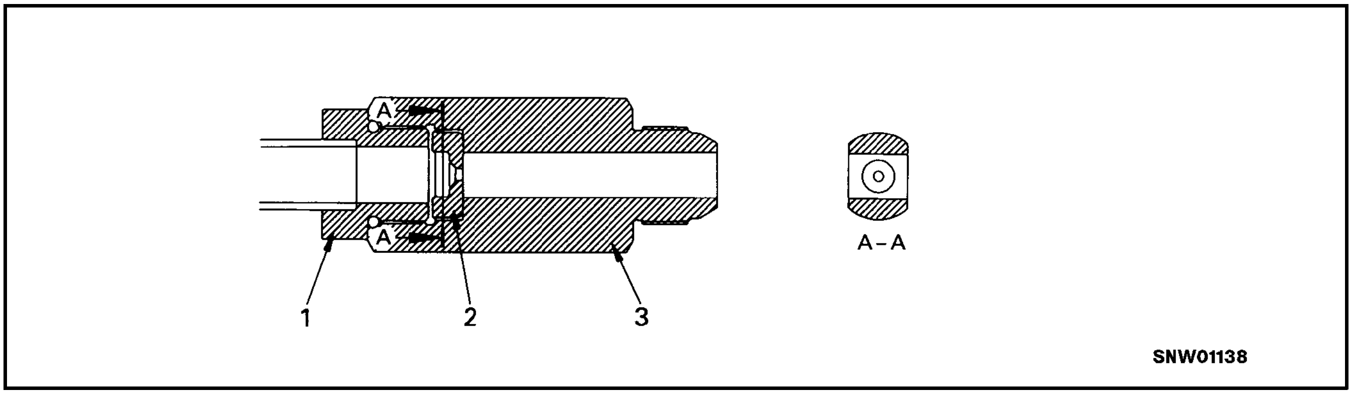
2-WAY RESTRICTOR VALVE



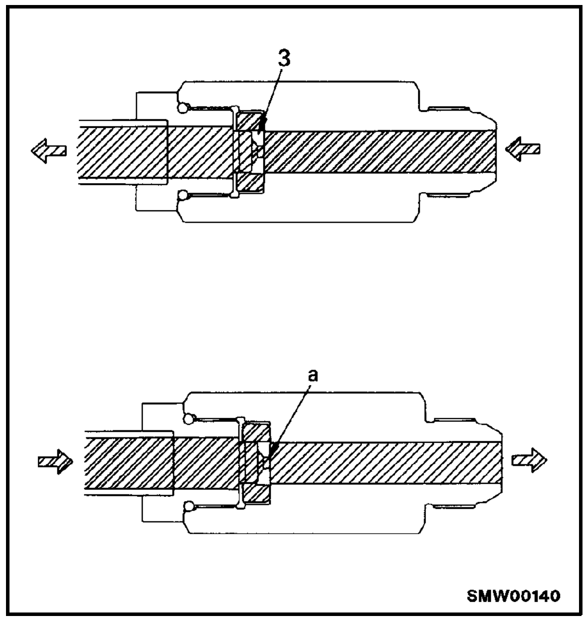
1. Tube
2. Union
3. Body

Function

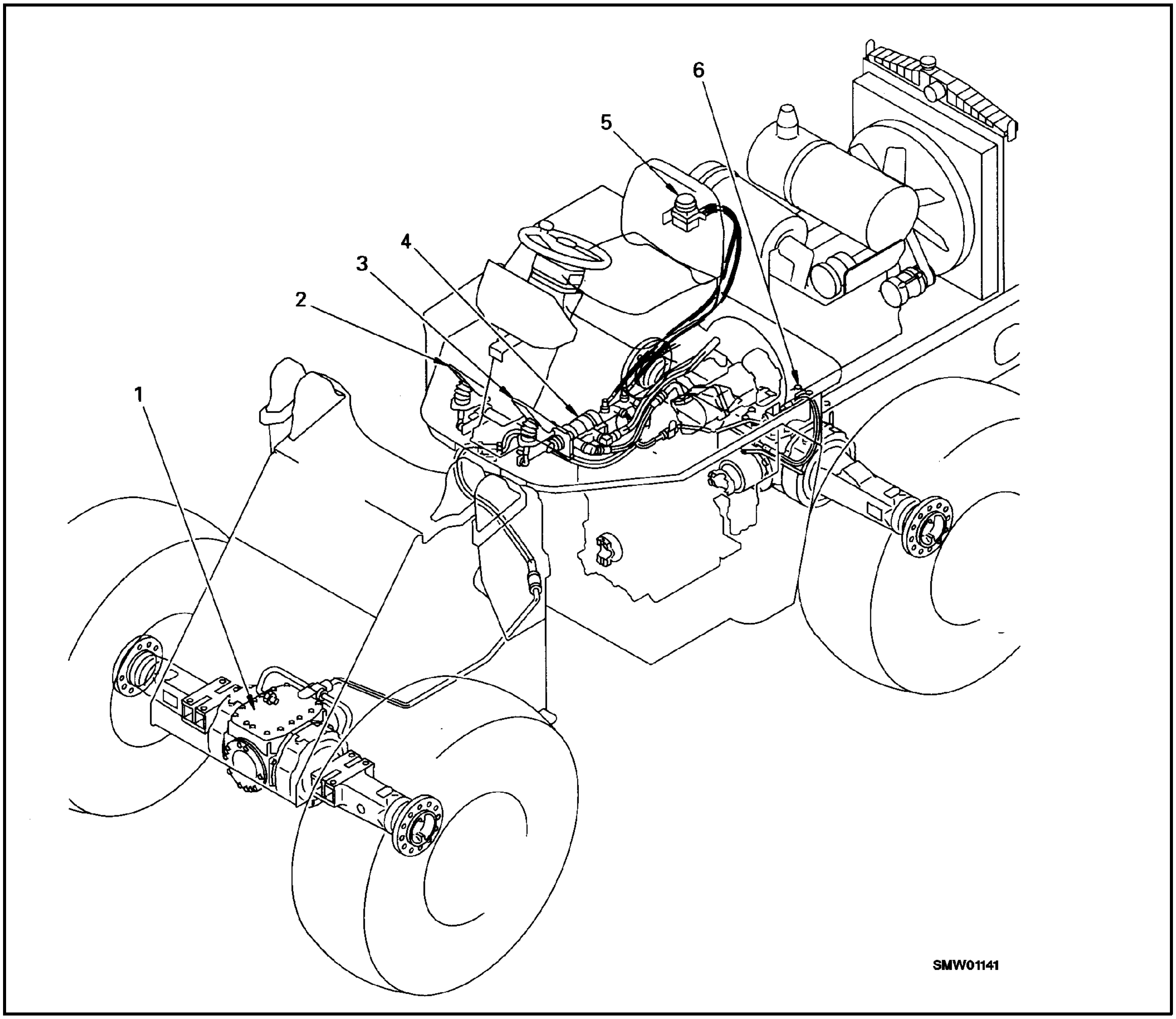
- To reduce the shock caused by the inertia of the machine when the steering is operated, an orifice is provided in the return circuit from the cylinder. This gives pressure to the returning oil and acts to control the movement of the cylinder piston.

Operation

- When the oil is flowing to the left in the direction of the arrow, it pushes open poppet (3), and the oil flows from the poppet a orifice and the poppet notch.
- When the oil is flowing to the right in the direction of the arrow, the oil flows only from portion **a** of the poppet orifice, so the oil flow is restricted.



Brake piping

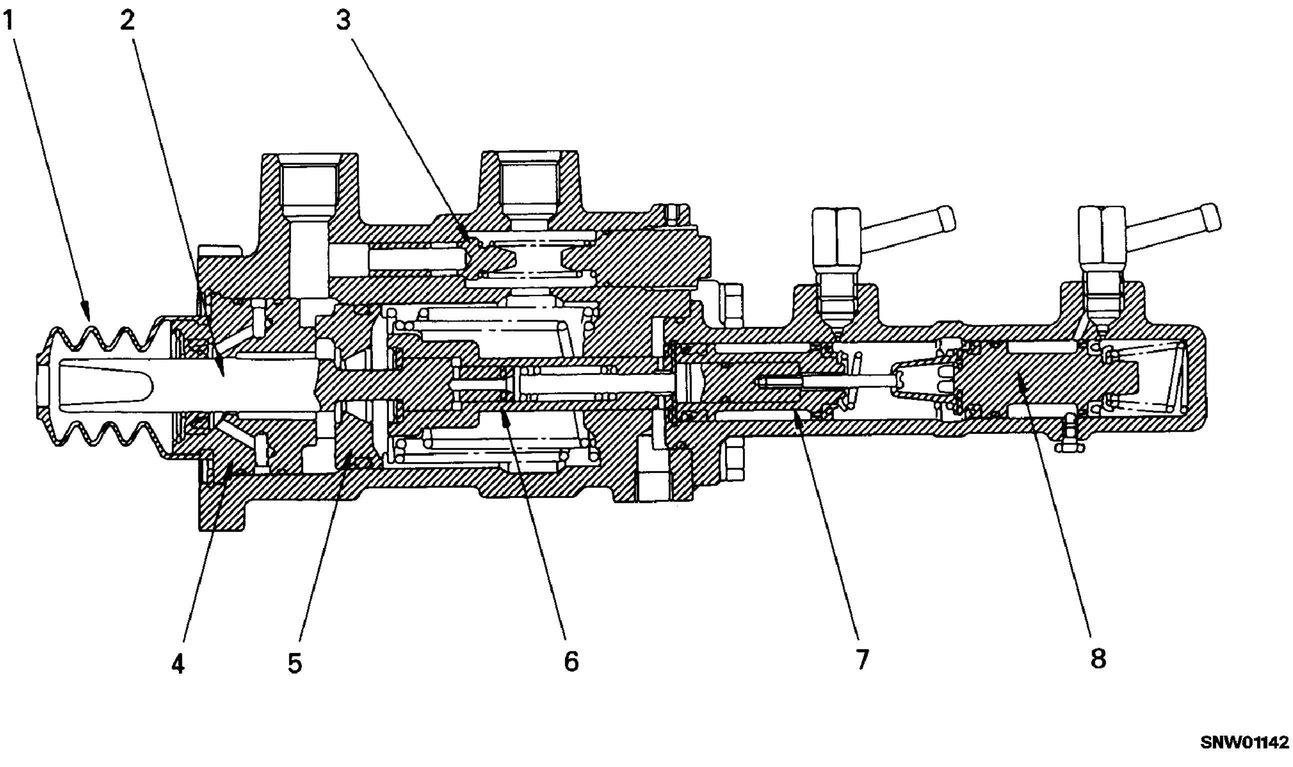


1. Front axle (with single disc plate)
2. Right brake
3. Left brake pedal (with transmission cut-off selector)
4. Power master cylinder
5. Brake oil tank
6. Rear axle (with single disc brake)

Outline

- The power master cylinder consist of a hydraulically actuated booster mechanism. It reduces the operating force of the pedal and also ensures a powerful braking force.
  A relief valve is installed to protect the circuit if any abnormal pressure should be generated in the power master cylinder.
- When the brake pedal is depressed, the oil sent from the pump shuts of the drain circuit inside the valve and actuates the piston to apply the front and rear brakes.

POWER MASTER CYLINDER

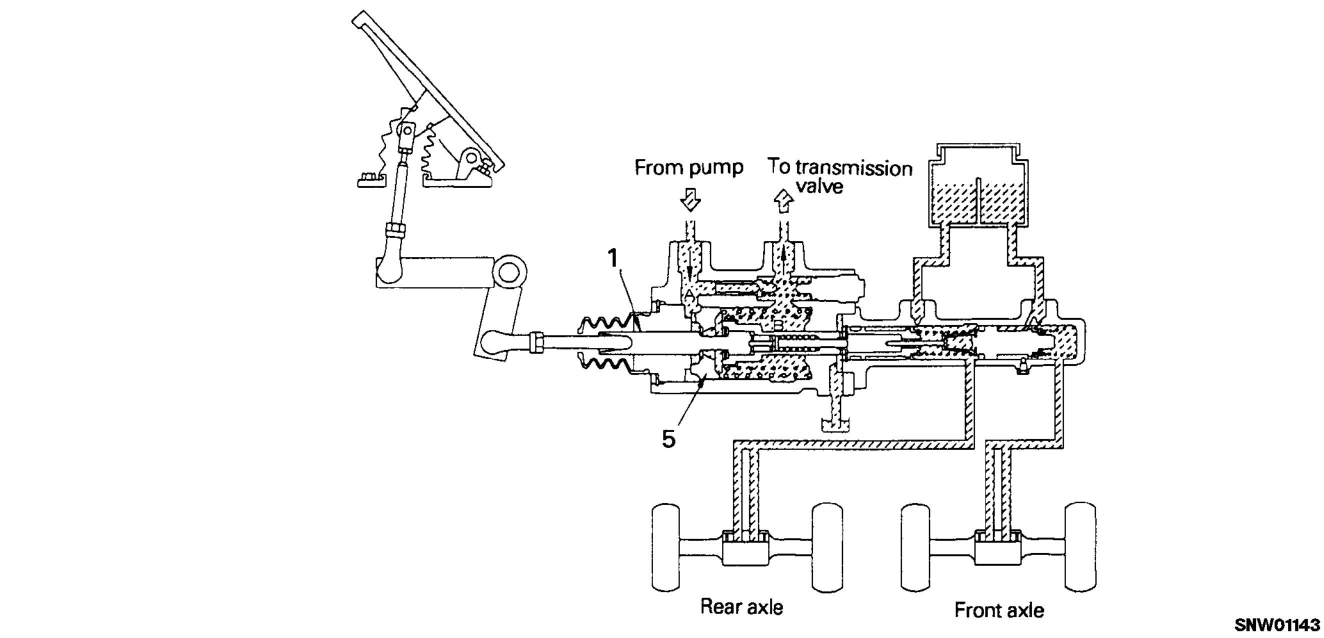


1. Dust cover
2. Spool
3. Relief valve
4. Cylinder cover
5. Power piston
6. Connector
7. Secondary piston
8. Primary piston

Outline

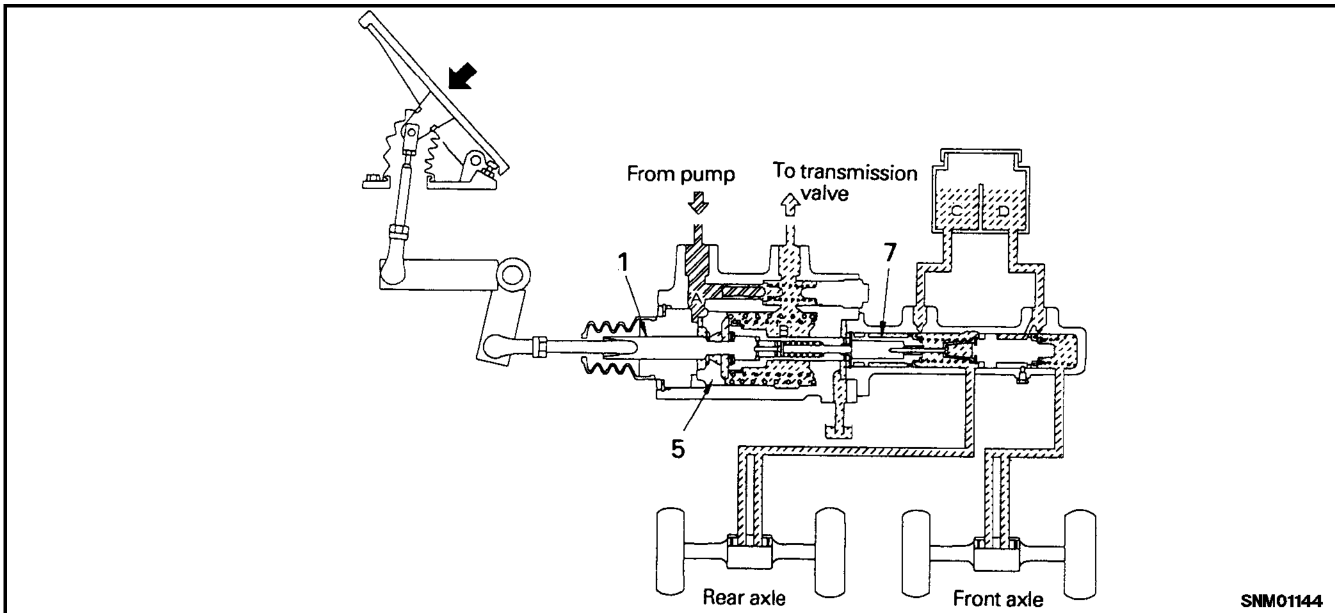
- The power master cylinder is an oil type booster mechanism. When the brake pedal is depressed, the oil from the pump acts on power piston (5) and boosts the brake hydraulic pressure to the wheel cylinder.
- If any abnormal pressure should be generated in the pump circuit, relief valve (3) is actuated and sends the oil to the transmission lubrication circuit.

BRAKE OFF



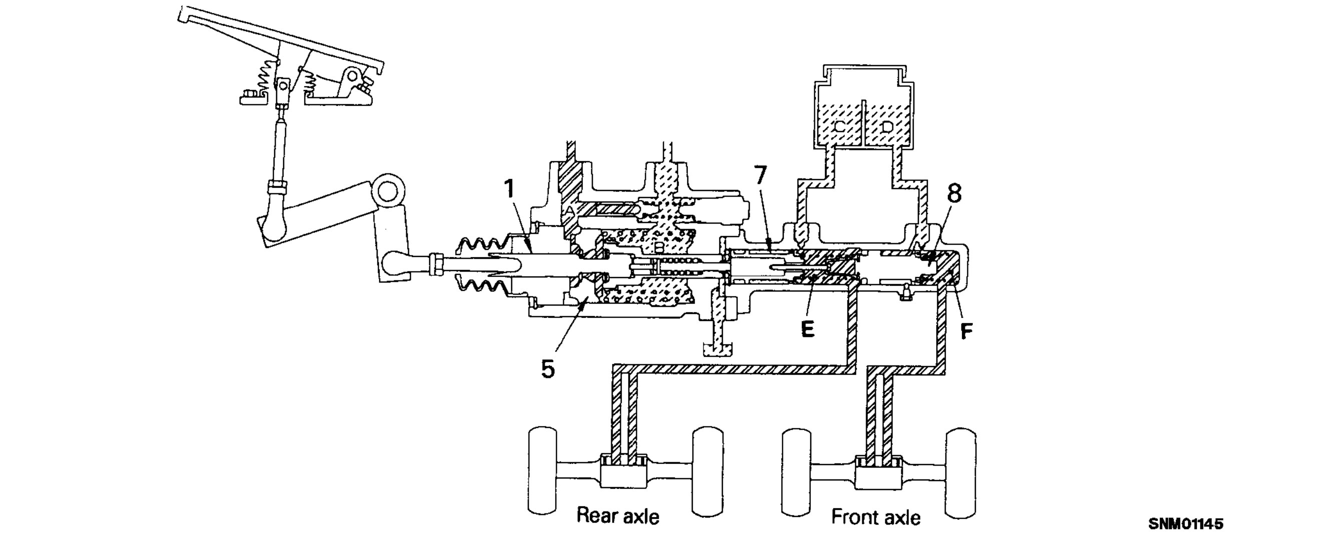
- When the brake is OFF, spool (1) and power piston (5) are not actuated.
- The oil from the pump flows from port **A** to port **B,** and then flows to the transmission lubrication circuit.
  The oil from the master cylinder is connected to the front and rear axle brakes.

OIL PRESSURE STARTING TO RISE



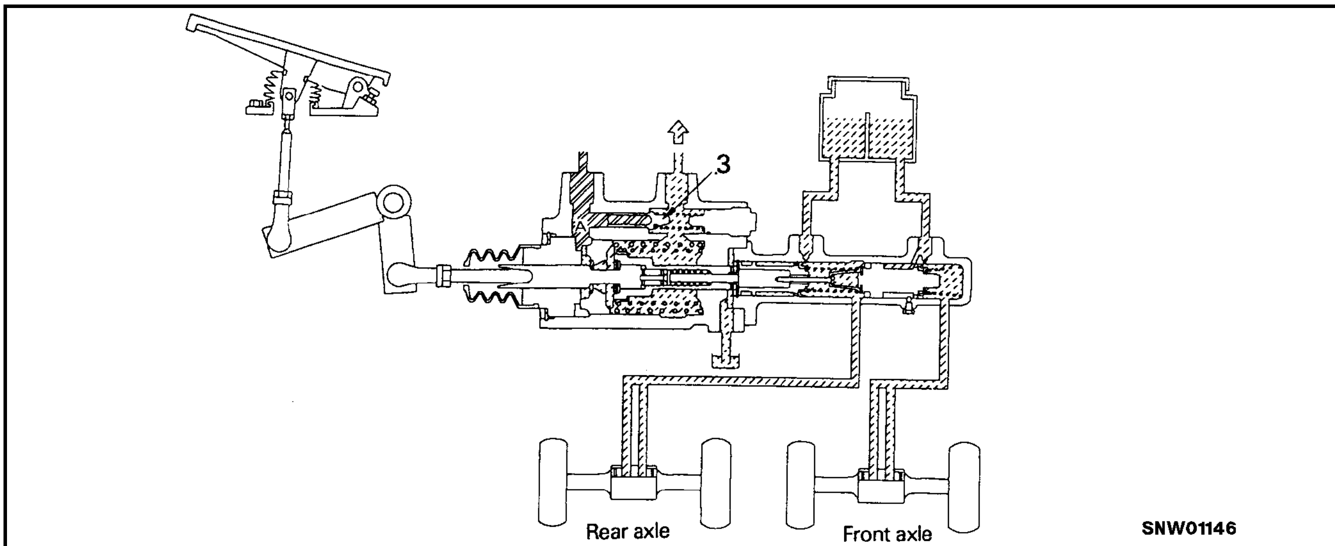
- When the brake pedal is depressed, spool (1) is pushed out, contacts power piston (5), and port **A** and port **B** are shut off.
- The oil from the pump enters port **A** and an amount of oil equal to the stroke of the spool is supplied.
  Spool (1) contacts secondary piston (7).

PRESSURE RISING



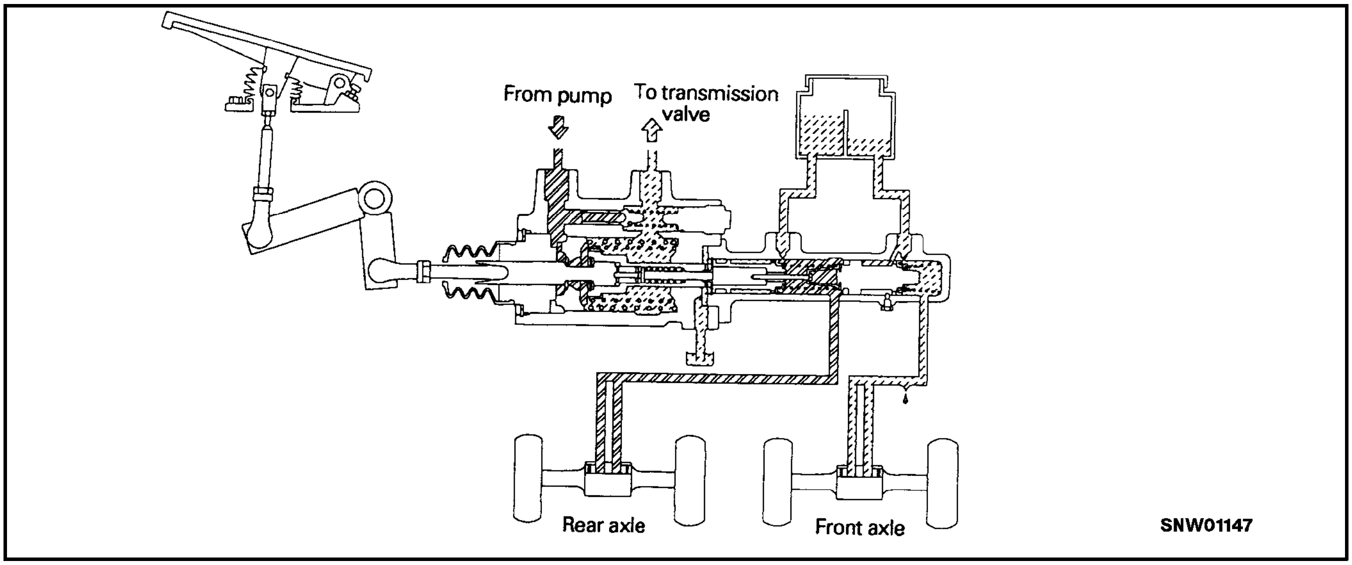
- Spool (1) pushes secondary piston (7), and the secondary piston pushes primary piston (8). Therefore, each piston shuts off ports **A** and **B,** and sends the brake oil from ports **C** and **D** to the front brake system and rear brake system to actuate the brakes.
- If the brake pedal is depressed further, power piston (5) moves to the right, the pressure of the oil at ports **E** and **F** rises further, and the pressure at port **A** makes the operating force of the brake pedal lighter, while the braking force is increased.

RELIEF VALVE



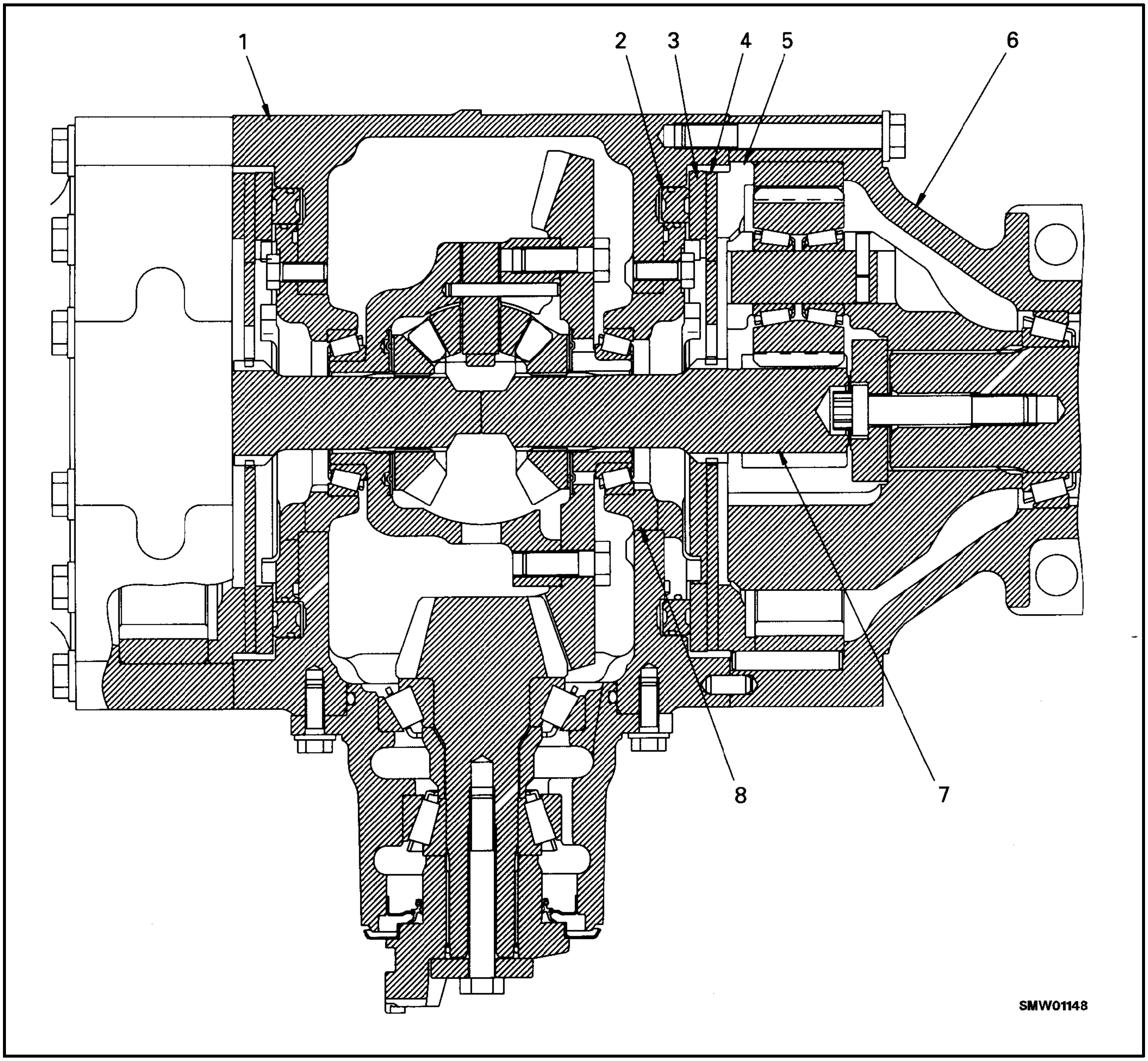
- If the pressure inside the power cylinder (port **A)** goes above the specified pressure while the brake is being actuated, relief valve (3) is actuated to send the oil to the transmission circuit and prevent abnormal pressure from occurring in the brake system.

ONE BRAKE LINE ACTUATED (when oil leakage has occurred in front brake)



- Even if any oil leakage occurs in the front or rear brake systems, the brake oil tanks are independent for each brake line, so either the front or rear brake can still be actuated to stop the machine, thereby increasing safety.

BRAKE



1. Differential housing
2. Piston
3. Inner ring
4. Disc
5. Outer ring
6. Axle housing
7. Sun gear shaft
8. Bearing carrier

Outline

- The brake is a wet type, single disc plate. It consist of piston (2), inner ring (3), disc (4), and outer ring (5).
- The brake cylinder consist of differential housing (1)and bearing carrier (8), with piston (2) assembled in it.

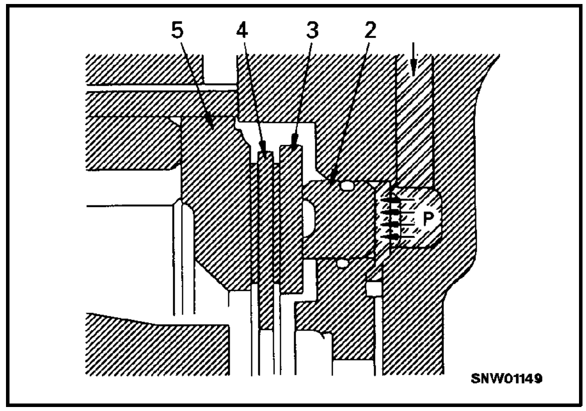
Inner ring (3) is installed to the notched portion of bearing carrier (8). Outer ring (5) is secured to axle housing (6) by a pin.

There is a lining stuck to both sides of disc (4). The disc is assembled between inner ring (3) and outer ring (5), and is joined to the sun gear shaft by a spline.

Operation

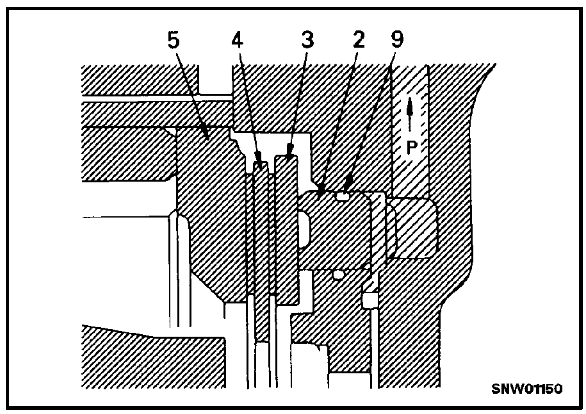
Brake applied

- When the brake pedal is depressed, the rod of the master cylinder is pushed, oil pressure P is generated, and actuates the piston inside the brake cylinder, so piston (2) slides slightly.
  Therefore, disc (4), which is assembled between inner ring (3) and outer ring (5), stops rotating and the brakes are applied to stop the machine.

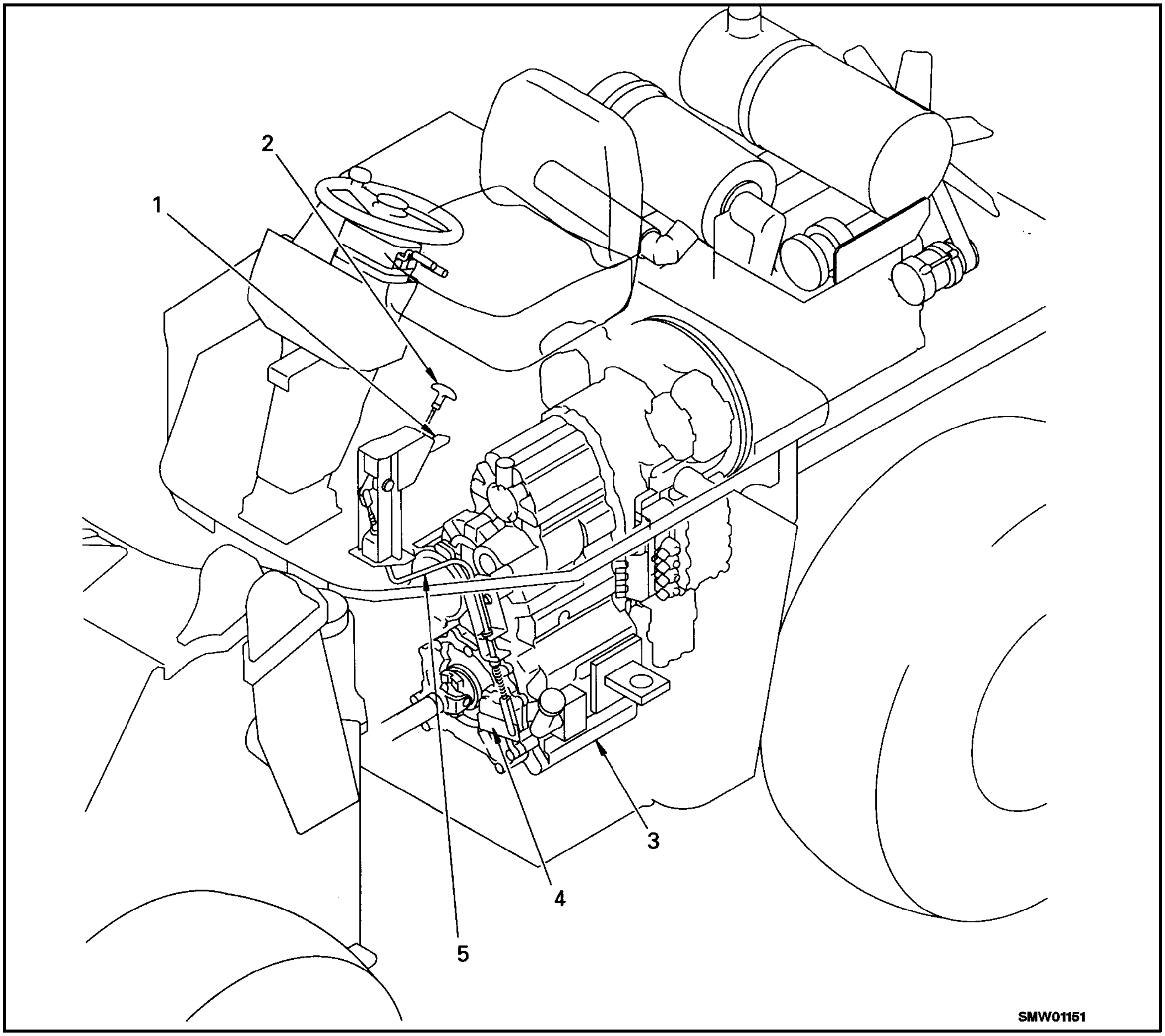


Brake released

- When the oil pressure is released, piston (2) is returned slightly by the restoring force of piston 0-ring (9), so a clearance is formed between inner ring (3) and outer ring (5), and disc (4) is made free.
  The lining stuck to disc (4) has grooves cut into it to form a lattice. When the disc is rotating, oil flows in these grooves to cool the lining.



PARKING BRAKE CONTROL

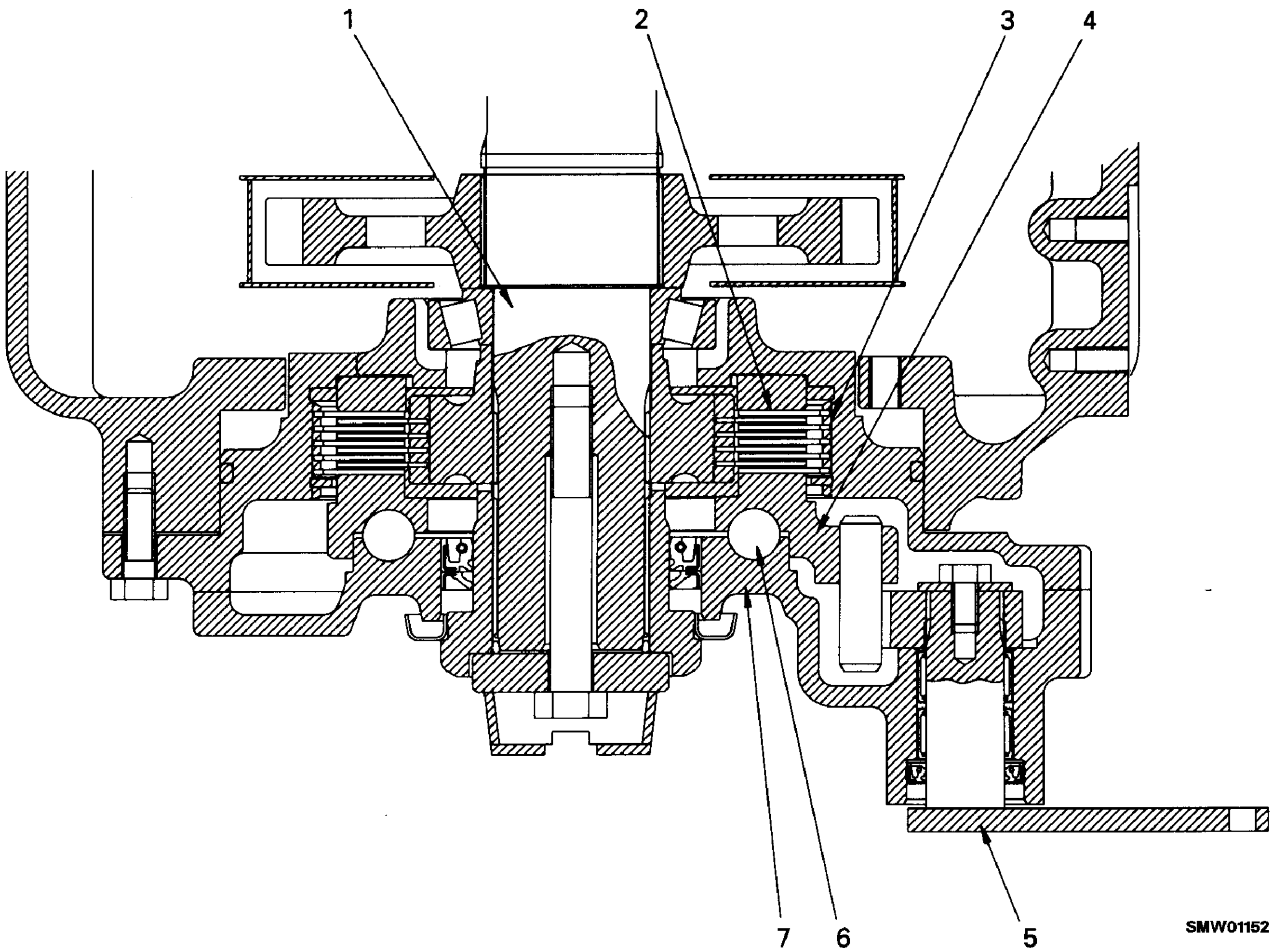


1. Parking brake pedal
2. Parking brake release lever
3. Transmission
4. Multiple disc brake lever
5. Wire cable

Outline

- The parking brake is a wet type, multiple disc brake built into the transmission. Brake lever (4) is connected by a wire cable to the parking brake pedal, and the brake is mechanically applied and released.
- When parking brake pedal (1) in the operator's compartment is depressed, brake lever (4) is pulled up and the brake is applied.
  The parking brake is held by a ratchet, so it is kept actuated. When the parking brake release lever is pulled up, the ratchet is disengaged and the brake is released.
- While the parking brake is being actuated, the flow of electricity to the transmission solenoid valve is shut off by the neutralizer relay, and the transmission is kept in neutral.

PARKING BRAKE



1. Output shaft
2. Disc
3. Plate
4. Piston
5. Lever
6. Ball
7. Cover

Outline

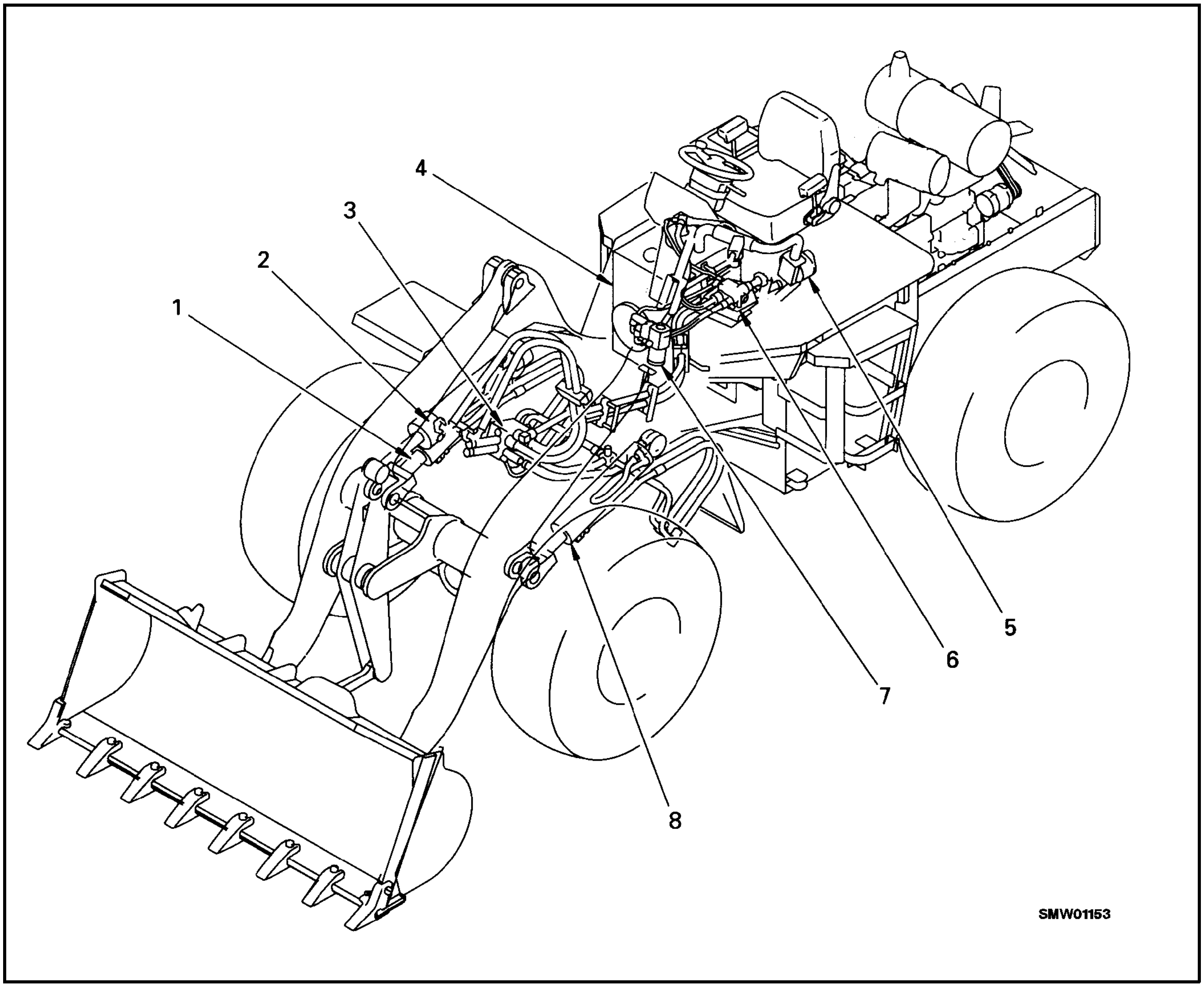
- The parking brake is a mechanically operated wet type multiple disc brake which applies braking force to transmission output shaft (1).
- Lever (5) is connected to the control cable, and when the lever is pulled, ball (6), which is between cover (7) and piston (4) connected to the lever, moves on the slope of the piston groove. The piston pushes the discs and plates together, and applies braking force to output shaft (1).

HYDRAULIC PIPING

Outline

- The hydraulic system consists of the work equipment circuit and steering circuit. The work equipment circuit controls the operation of the bucket or other attachments.
- The oil from hydraulic tank (4) is sent from hydraulic pump (6) to priority valve (6). The amount of the oil flow is controlled and sent to main control valve (3).
  If the bucket and boom spools of main control valve (3) are at neutral, the oil passes through the drain circuit of the main control valve, is filtered by the filter inside the hydraulic tank, and returns to the tank.
- When the work equipment control lever is operated, the bucket or boom spool of the main control valve moves, oil flows from the main control valve to boom cylinder (1) or (8) or to bucket cylinder (2), and operates the boom or bucket.
- The maximum pressure of the hydraulic circuit is controlled by the relief valve inside the main control valve and the steering valve. A safety valve (with suction) is installed in the bucket cylinder circuit to protect the circuit.
- Hydraulic tank (4) is a pressurized sealed type and has a breather with a relief valve. It pressurizes the inside of the tank and also prevents negative pressure in order to prevent cavitation of the pump.

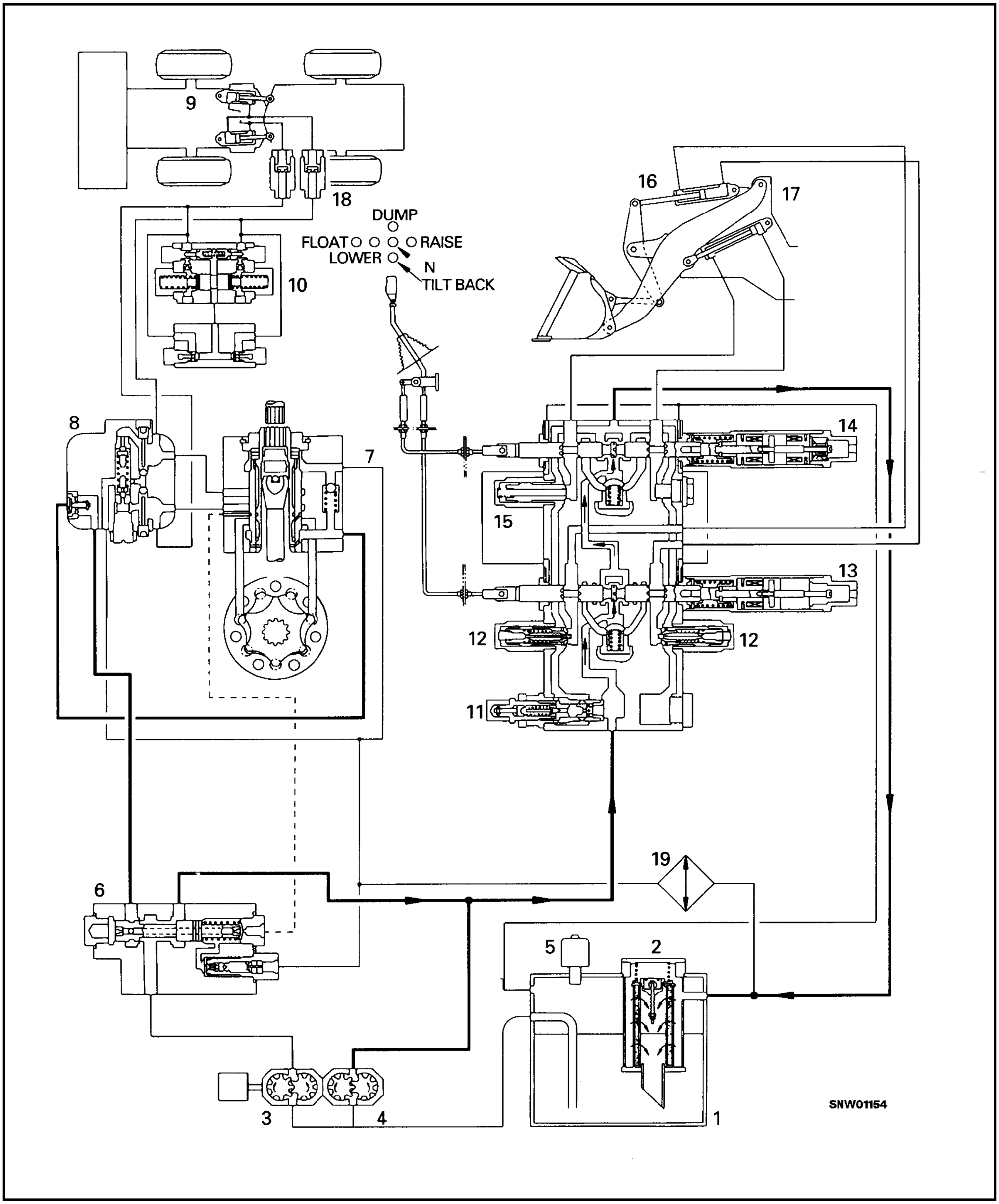
HYDRAULIC PIPING



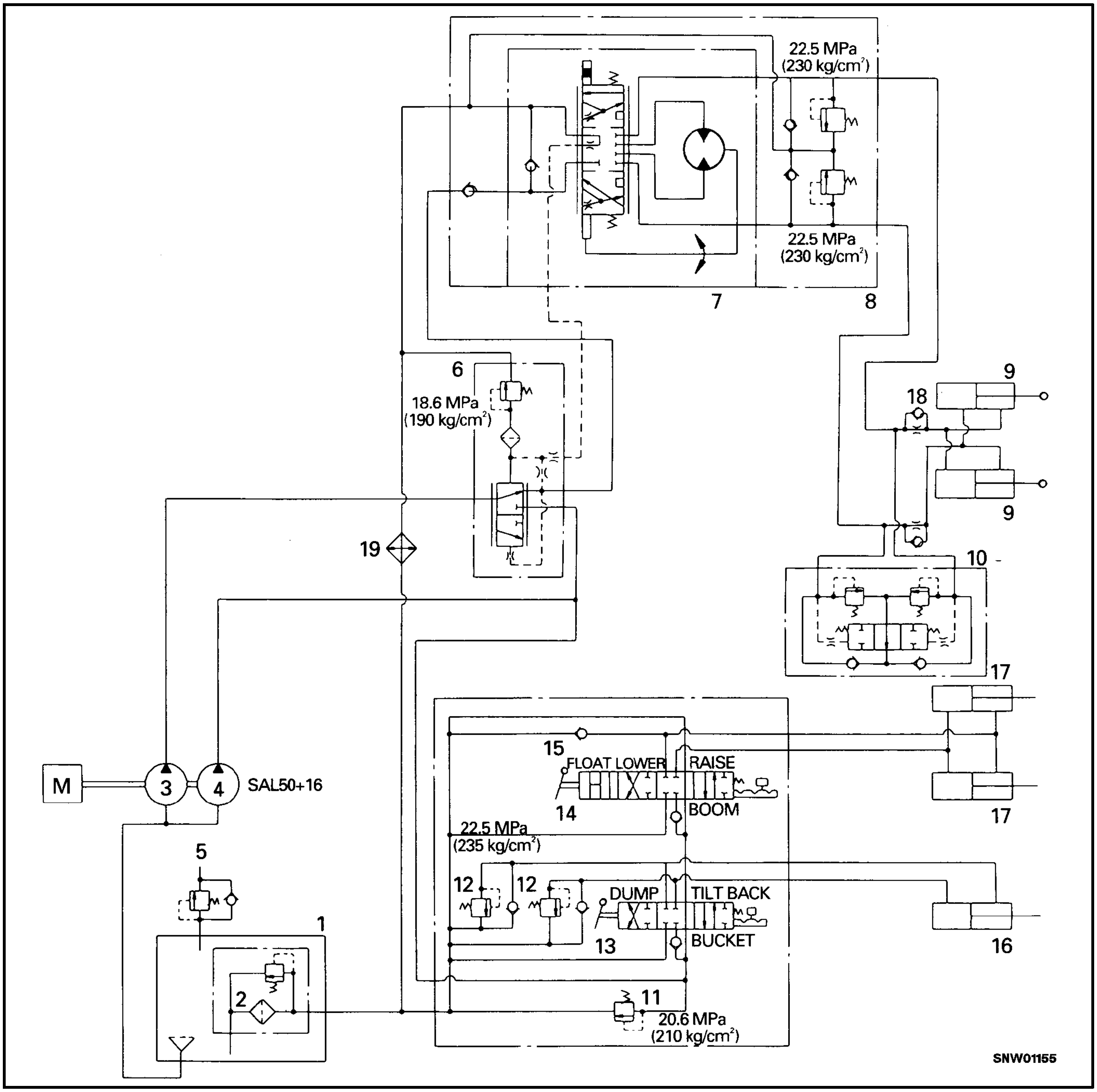
1. Boom cylinder
2. Bucket cylinder
3. Main control valve
4. Hydraulic tank
5. Hydraulic pump
6. Priority valve
7. Steering valve
8. Boom cylinder

STEERING, HYDRAULIC PUMP HYDRAULIC SYSTEM DIAGRAM

(Engine at low idling, steering valve at neutral, main control valve at HOLD)

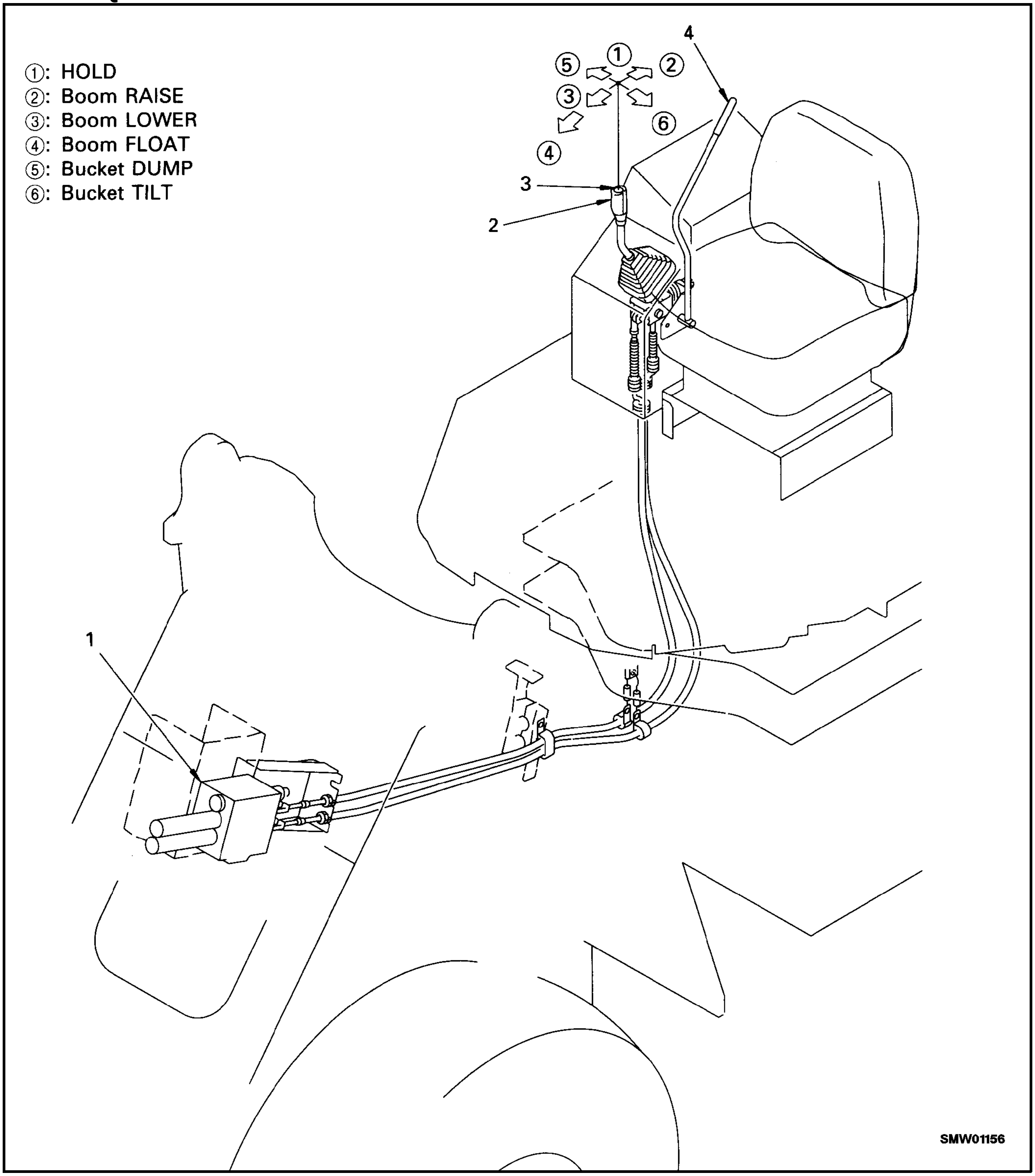


STEERING, HYDRAULIC PUMP HYDRAULIC CIRCUIT DIAGRAM



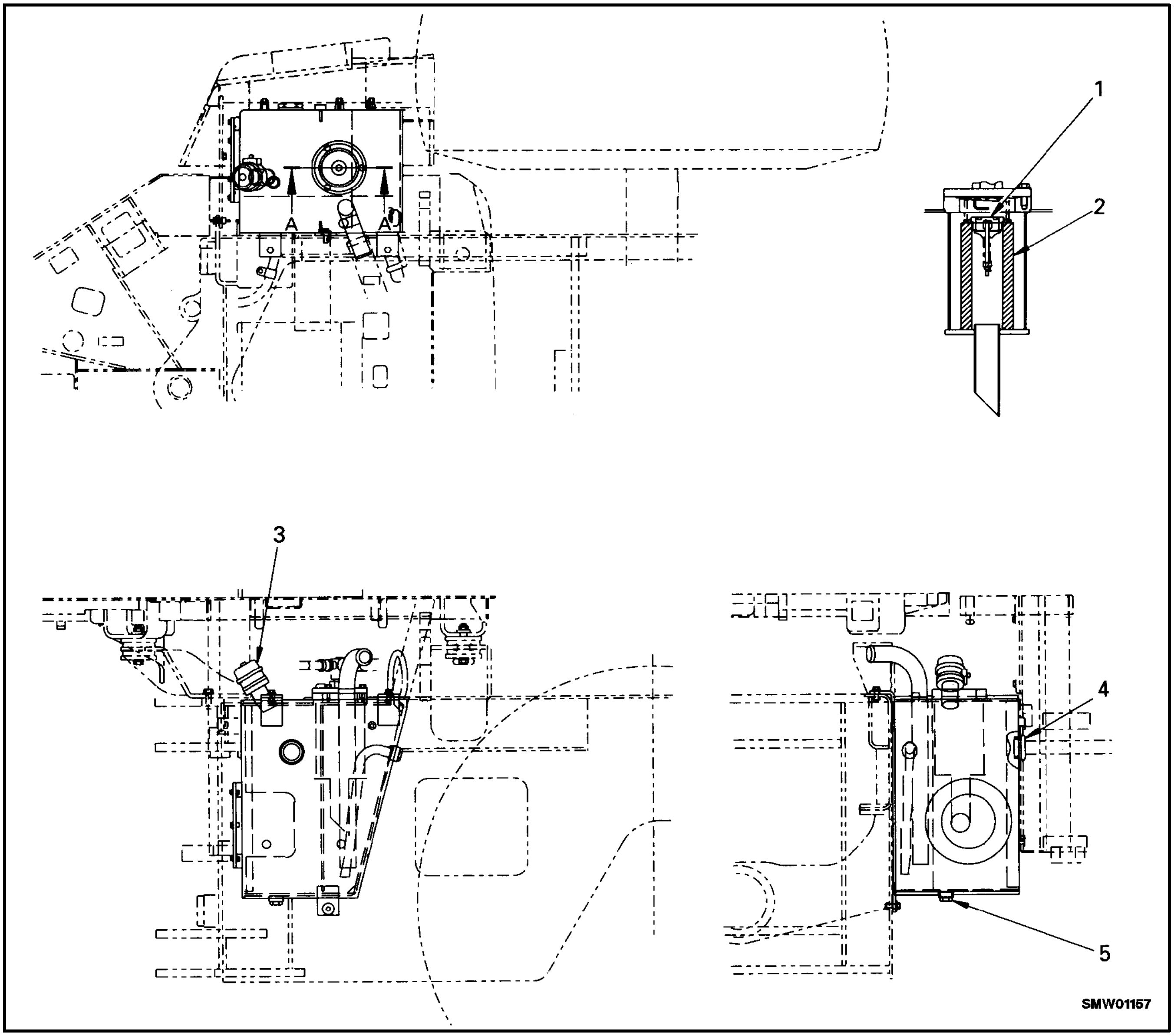
1. Hydraulic tank
2. Filter
3. Hydraulic pump (steering)
4. Hydraulic pump (work equipment)
5. Breather
6. Priority valve
7. Steering valve
8. Overload anti-hypoid valve
9. Steering cylinder
10. Cushion valve
11. Relief valve
12. Safety valve (with suction)
13. Bucket spool
14. Boom spool
15. Suction valve
16. Bucket cylinder
17. Boom cylinder
18. 2-way restrictor valve
19. Oil cooler (air cooled)

WORK EQUIPMENT LEVER LINKAGE



1. Main control valve
2. Work equipment control lever
3. Kick down switch
4. Lock lever

HYDRAULIC TANK



1. Filter bypass valve
2. Filter
3. Breather
4. Oil level gauge
5. Drain valve

Outline

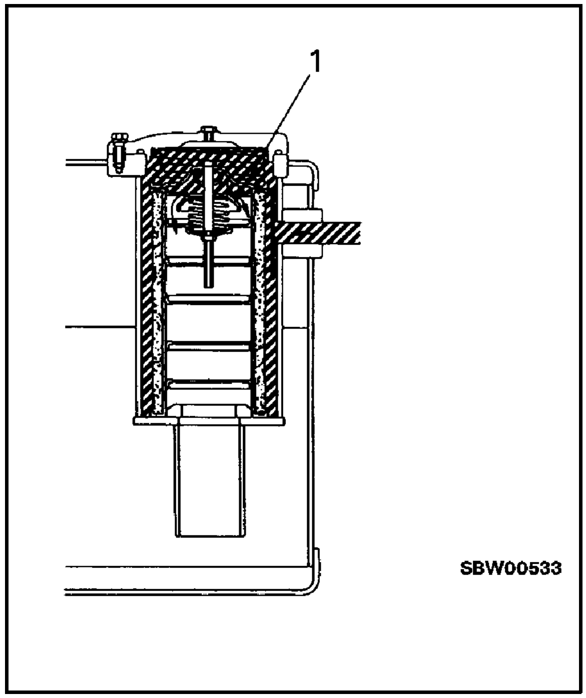
- The oil from the hydraulic tank is sent from the pump through the priority valve and main control valve to each cylinder. In the return circuit, it is filtered by the oil filter, and returns to the tank.
- The oil filter filters the whole oil flow in the circuit. When the oil filter becomes clogged, the bypass valve is actuated to allow the oil to return directly to the tank and prevent damage to the filter. The bypass valve is also actuated when negative pressure is generated in the circuit.

OIL FILTER BYPASS VALVE

When the filter is clogged
Bypass valve (1) opens and the oil returns directly to the tank without passing through the filter.

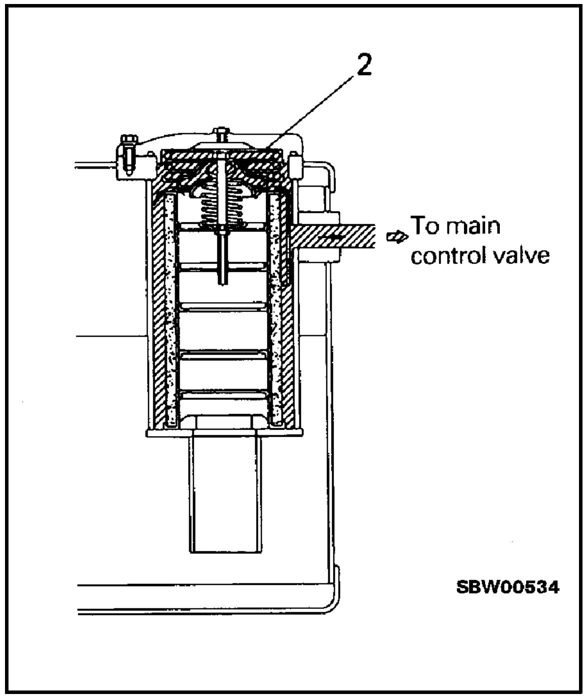
Bypass valve set pressure:

0.15 ± 0.02 MPa (1.5 ± 0.2 kg/ cm^2)



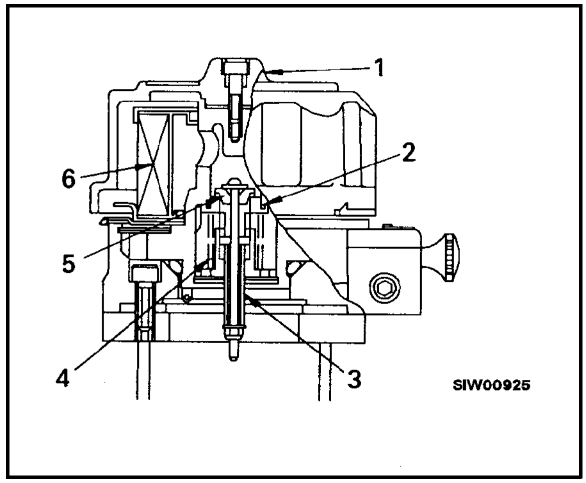
When negative pressure is formed in the return circuit.
Valve (2) moves up and acts check valve.

Check valve set pressure:
0.024 MPa (0.24 kg/ cm^2)



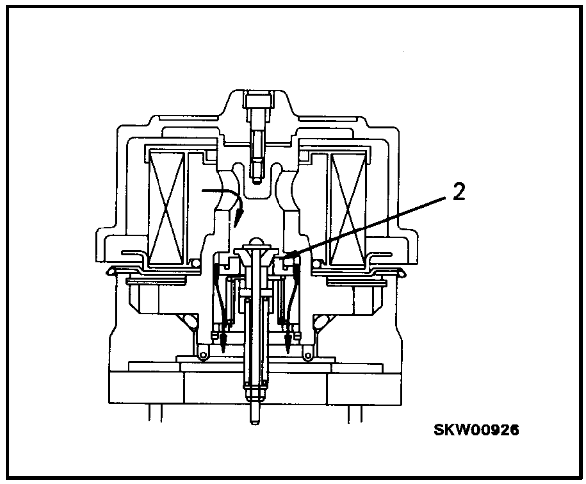
BREATHER

1. Cover
2. Sleeve
3. Spring
4. Spring
5. Poppet
6. Filter element



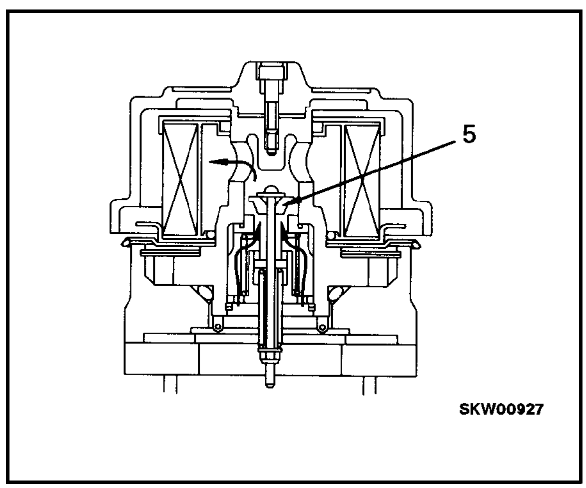
Preventing negative pressure inside tank

- The tank is a pressurized sealed type, so if the oil level inside the hydraulic tank goes down, there will be negative pressure in the tank. If this happens, a sleeve (2) is opened by the difference between the pressure inside the tank and the atmospheric pressure, and air is let in to prevent negative pressure from forming inside the tank.

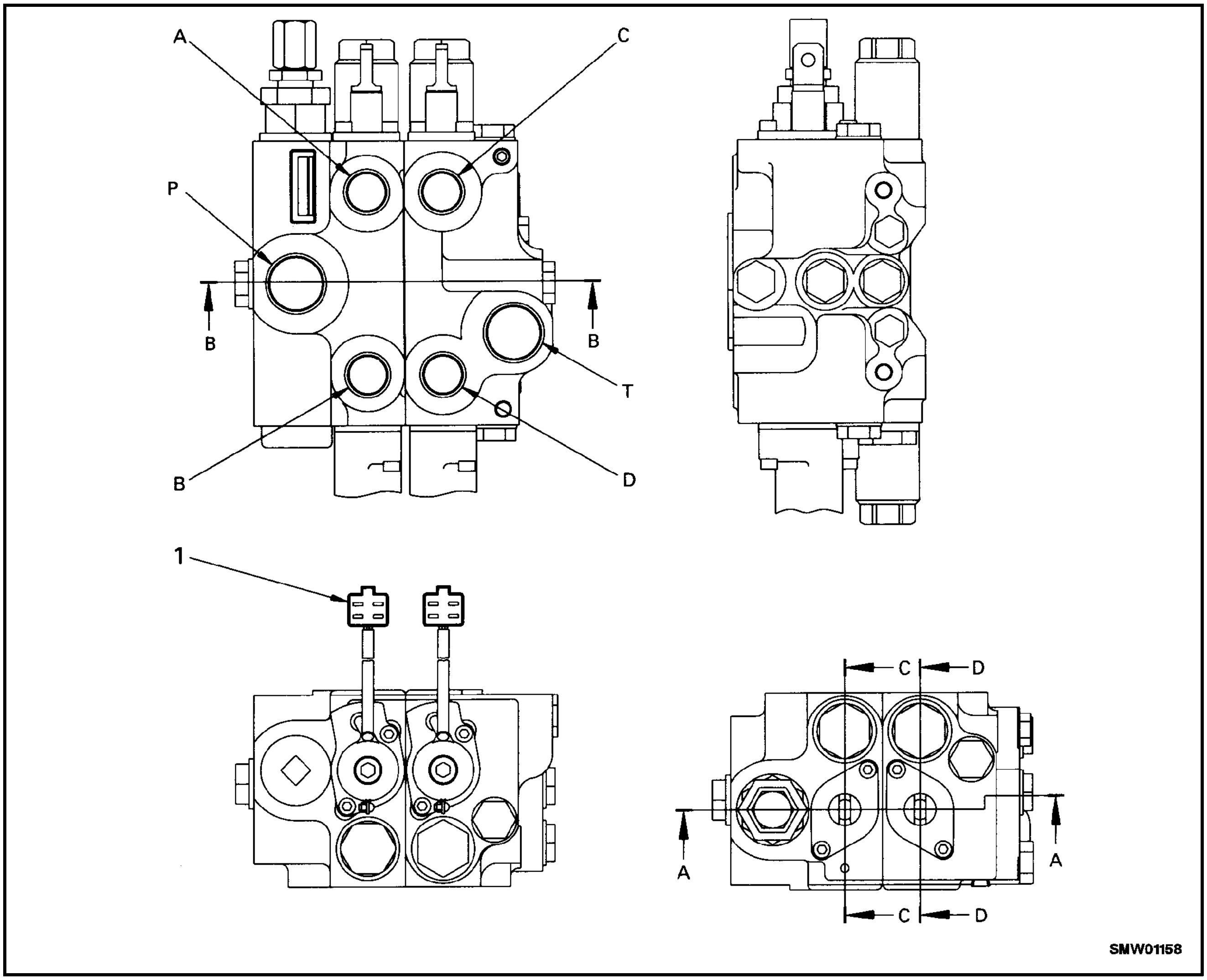


Preventing rise in pressure inside tank

- If the pressure in the circuit rises above the set pressure during operations because of the change in the oil level in the hydraulic cylinders or the rise in the temperature, the poppet (5) is actuated to release the pressure inside the hydraulic tank.

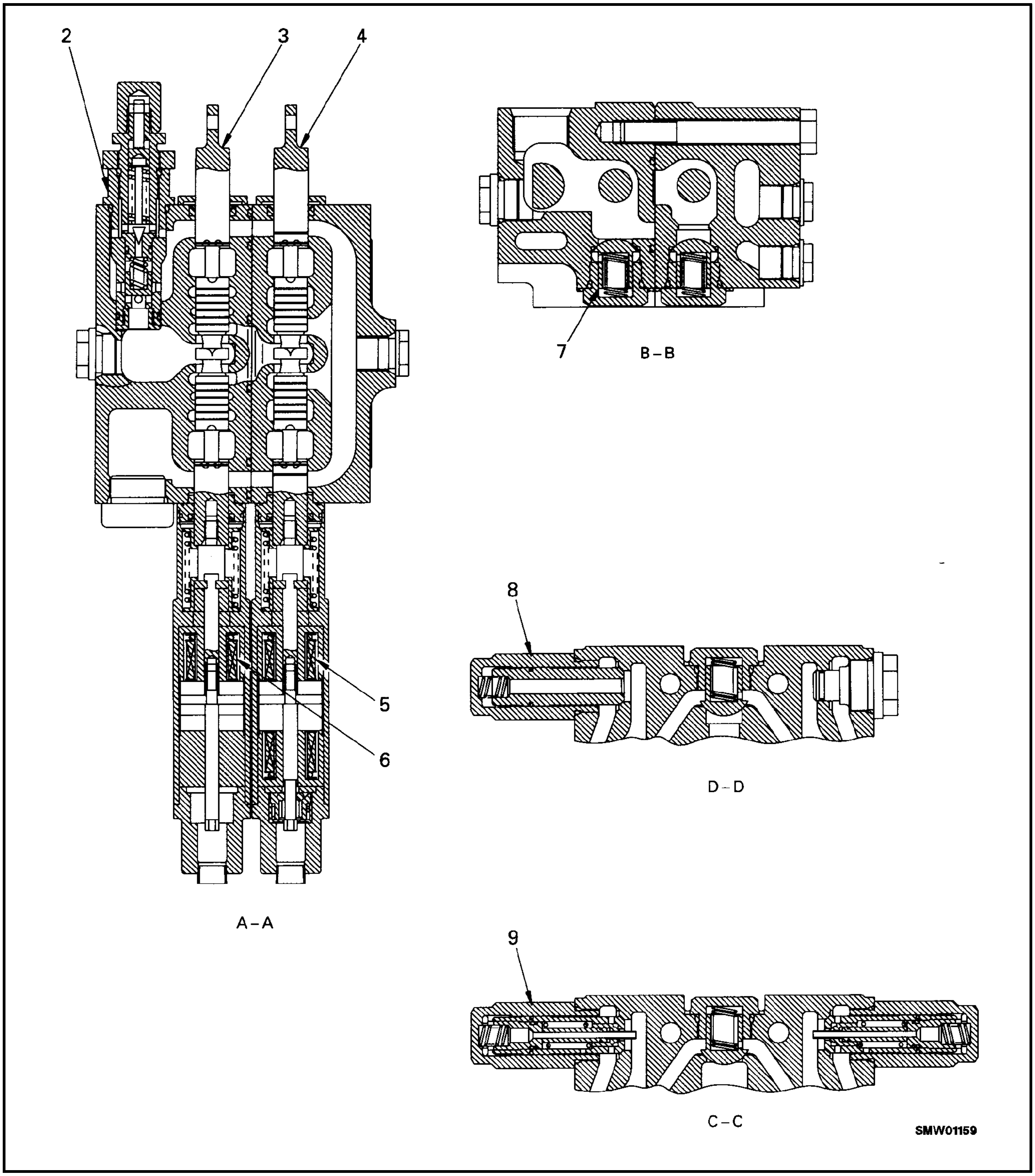


MAIN CONTROL VALVE
2-SPOOL VALVE

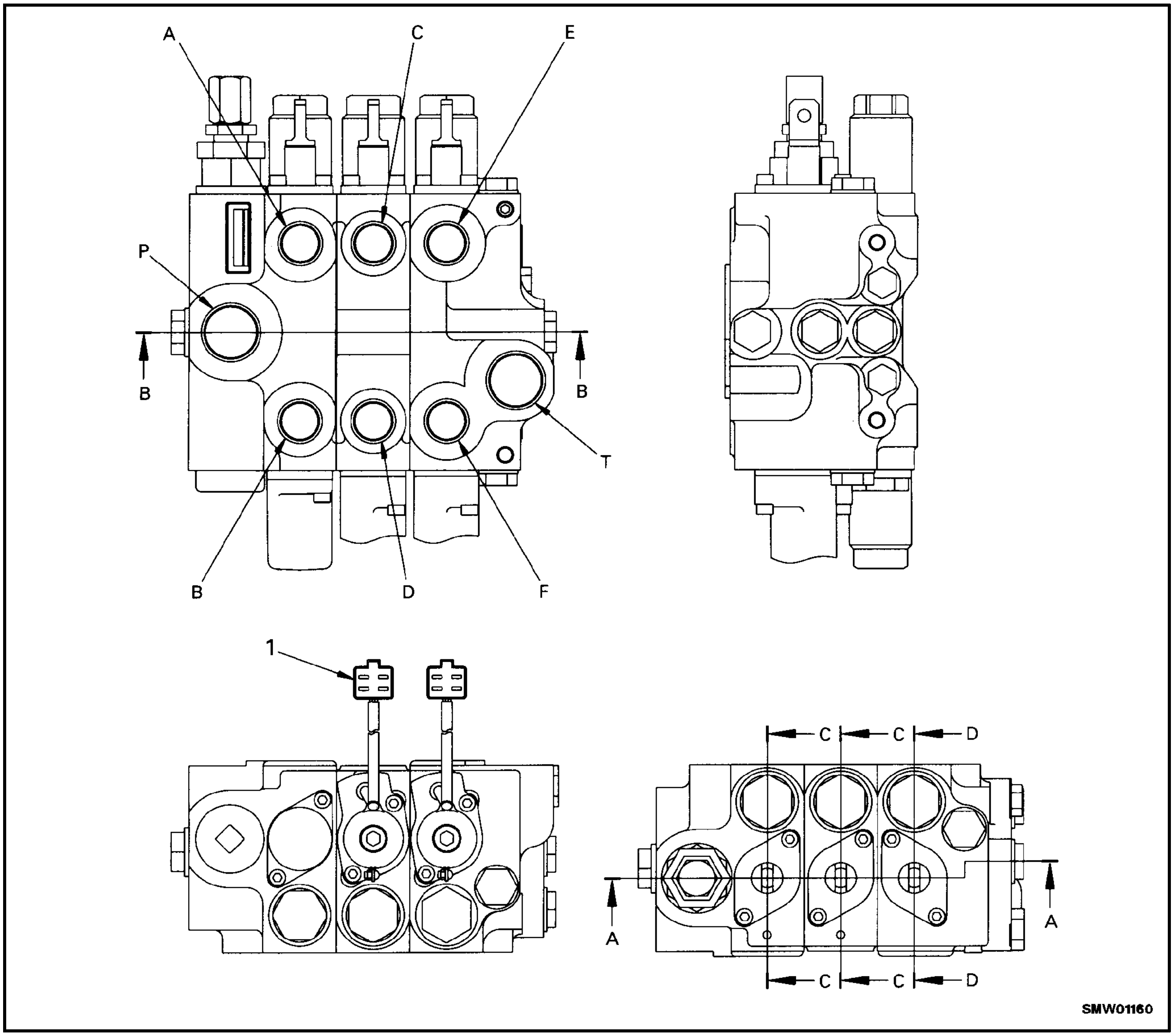


1.	Connector		
2.	Main relief valve	A.	To bucket cylinder rod side
3.	Bucket spool	B.	To bucket cylinder bottom
4.	Boom spool	C.	To boom cylinder rod side
5.	Boom magnet	D.	To boom cylinder bottom
6.	Bucket magnet	P.	Pump port
7.	Check valve	T.	Drain port (to tank)
8.	Suction valve		
9.	Safety valve (with suction)		

2-SPOOL VALVE

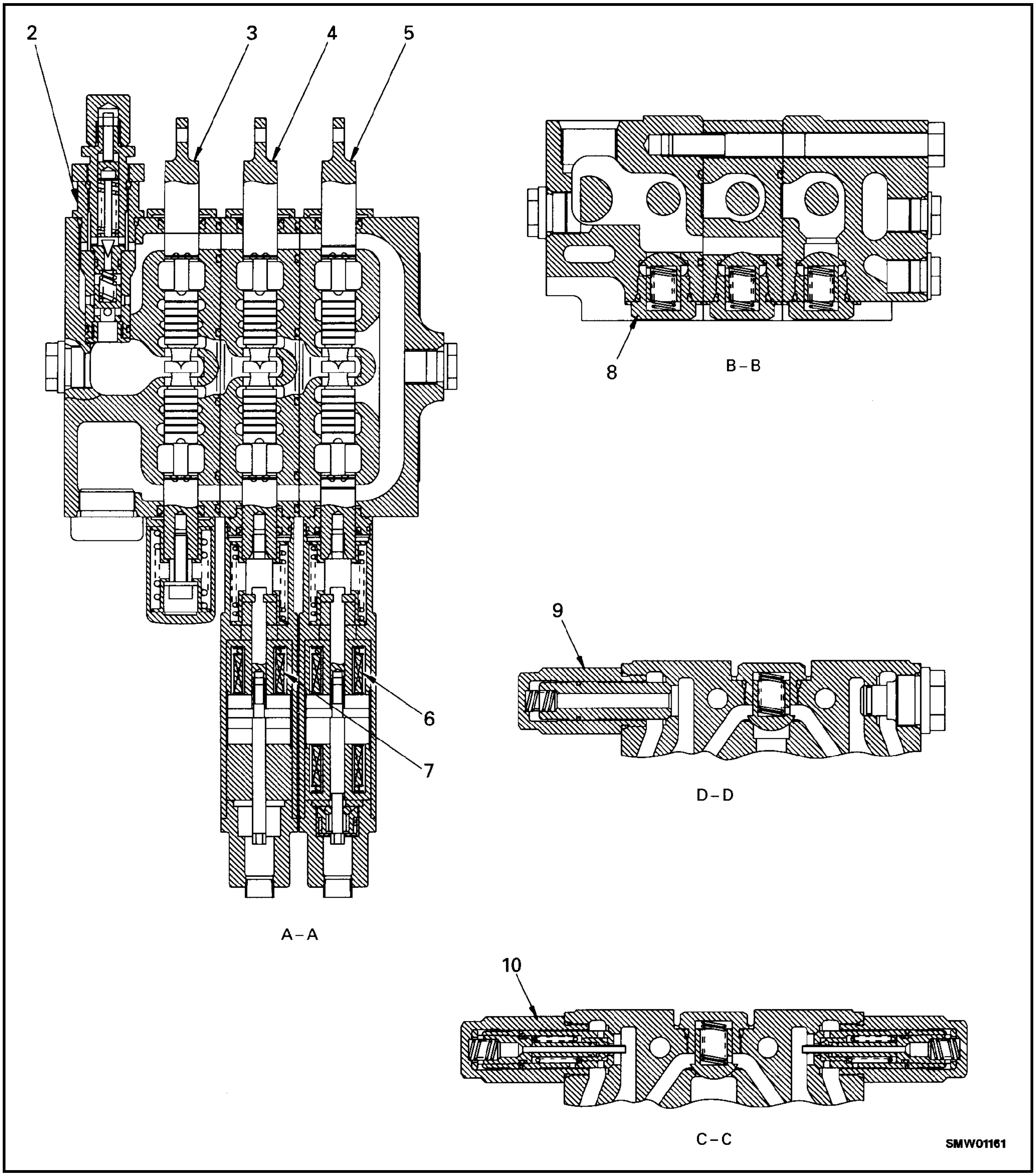


3-SPOOL VALVE



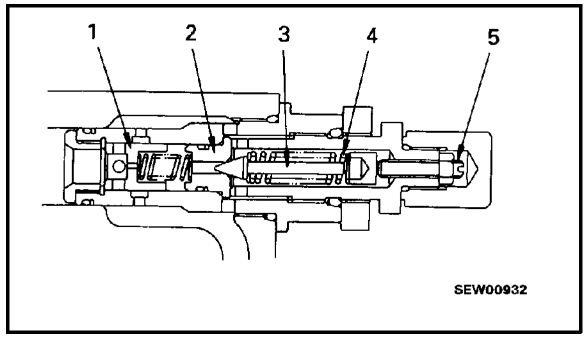
1. Connector
2. Main relief valve
3. Service spool
4. Bucket spool
5. Boom spool
6. Boom magnet
7. Bucket magnet
8. Check valve
9. Suction valve
10. Safety valve (with suction)

A. To service cylinder
B. To service cylinder
C. To bucket cylinder rod side
D. To bucket cylinder bottom
E. To boom cylinder rod side
F. To boom cylinder bottom
P. Pump port
T. Drain port (to tank)


2
3
4
5
6
7
A – A
8
B – B
9
D – D
10
C – C
SMW01161

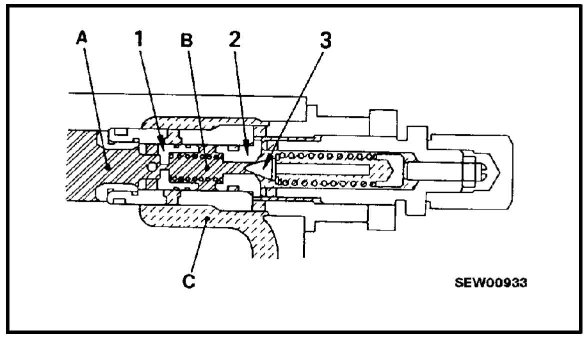
RELIEF VALVE

1. Main valve
2. Valve seat
3. Pilot poppet
4. Spring
5. Adjustment screw



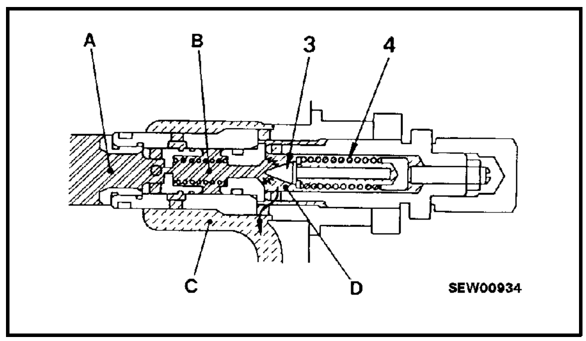
Function

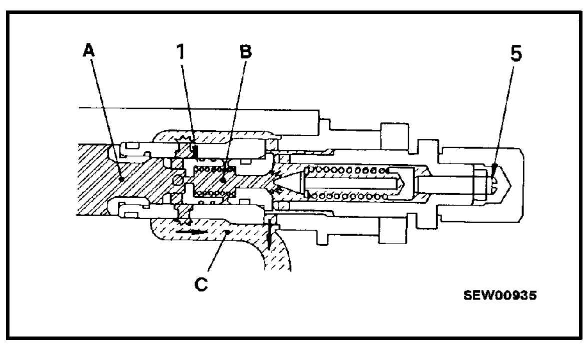
The relief valve is installed to the inlet portion of the main control valve. If the oil goes above the set pressure, the relief valve drains the oil to the tank to set the maximum pressure for the work equipment circuit, and to protect the circuit.



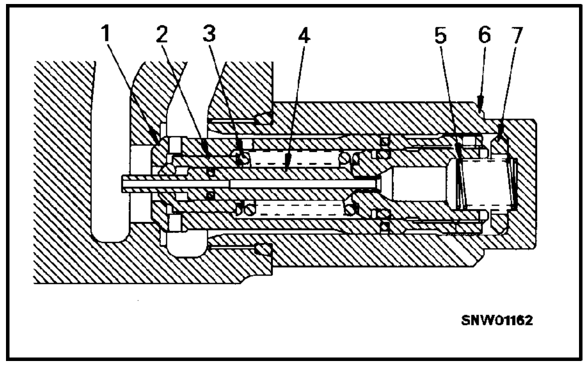
Operation

- Port **A** is connected to the pump circuit and port **C** is connected to the drain circuit. The oil passes through the orifice in main valve (1), and fills port **B.** Pilot poppet (3) is seated in valve seat (2).
- If the pressure inside ports **A** and **B** reaches the set pressure of pilot poppet spring (4), pilot poppet (3) opens and the oil pressure at port **B** escapes from port **D** to port **C,** so the pressure at port **B** drops.
- When the pressure at port **B** drops, a difference in pressure between ports **A** and **B** is created by the orifice of main valve (1). The main valve is pushed open and the oil at port **A** passes through port **C,** and the abnormal pressure is released to the drain circuit.
- The set pressure can be changed by adjusting the tension of pilot poppet spring (4). To change the set pressure, remove the cap nut, loosen the locknut, then turn adjustment screw (5) to adjust the set pressure as follows.
  TIGHTEN to INCREASE pressure
  LOOSEN to DECREASE pressure





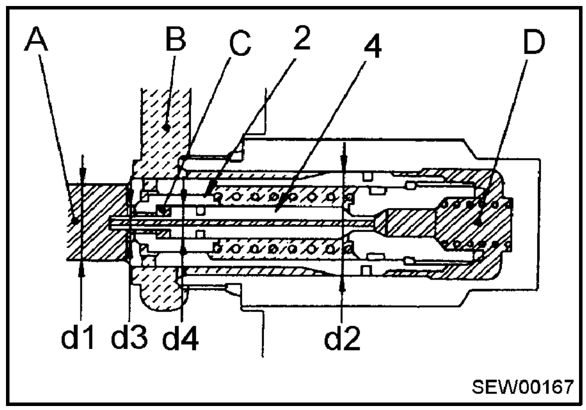
SAFETY VALVE (WITH SUCTION)



1. Suction valve
2. Main valve
3. Main valve spring
4. Pilot piston
5. Suction valve spring
6. Valve body
7. Spacer

Function

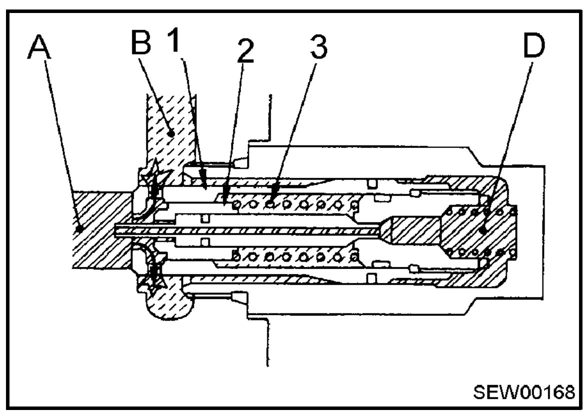
- The safety valve is in the bucket cylinder circuit inside the main control valve. If any abnormal pressure is generated by any shock to the cylinder when the main control valve is at the neutral position, this valve relieves the abnormal pressure to prevent damage to the cylinder.



Operation

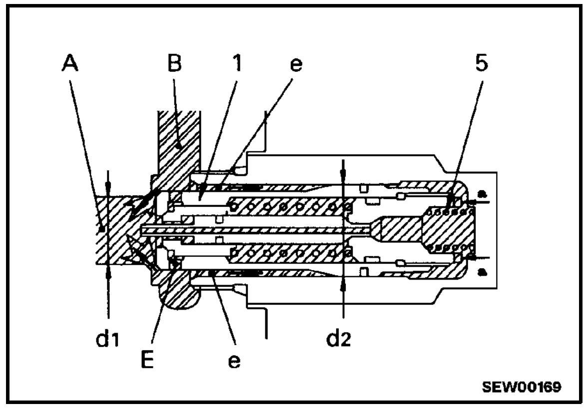
Operation as safety valve

- Port **A** is connected to the cylinder circuit and port **B** is connected to the drain circuit. The oil pressure at port **A** is sent to port **D** from the hole in pilot piston (4). It is also sent to port **C** by the orifice formed from main valve (2) and pilot piston (4).
  Pilot piston (4) is secured to the safety valve, and the size of the cross-sectional surface (cross-sectional area) has the following relationship: **d2** > **d1 > d3** > **d4**.
- If abnormal pressure is created at port **A,** suction valve (1) is not actuated because of relationship **d2** > **d1>,** but relationship between port **A** and port **C** is **d3** > **d4**, so main valve (2) receives oil pressure equivalent to the difference between the areas of **d3** and **d4**. If the oil pressure reaches the force (set pressure) of main valve spring (3), main valve (2) is actuated, and the oil from port **A** flows to port **B.**



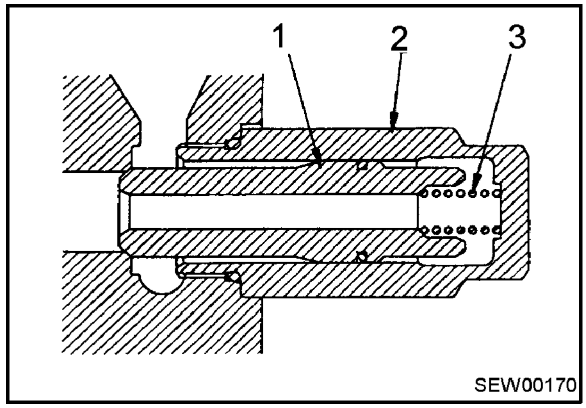
Operation as suction valve

- If any negative pressure is generated at port **A,** port **D** is connected with port **A,** so there is also negative pressure at port **D.** The tank pressure of port **B** is applied to port **E,** so the suction valve (1) receives oil pressure **a,** which is equal to the difference in the area of **d2** and **d1** because of the tank pressure at port **E.** Therefore, oil pressure **e** moves the valve in the direction of opening, and oil pressure **a** acts to move suction valve (1) in the direction of closing.
  When the pressure at port **A** drops (and comes close to negative pressure), it becomes lower than hydraulic pressure **e.** The relationship becomes oil pressure **e >** oil pressure **a +** force of valve spring (5), and suction valve (1) opens to let the oil from port **B** flow into port **A** and prevent any negative pressure from forming at port **A.**



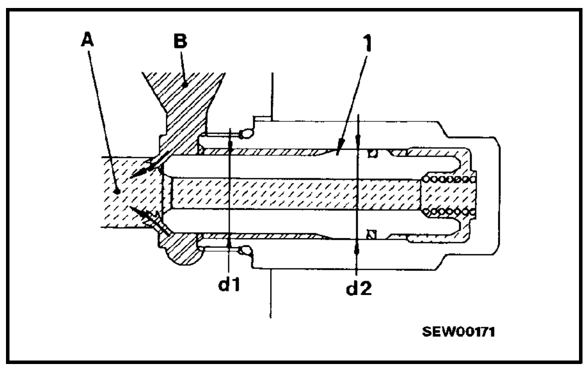
SUCTION VALVE

1. Main poppet
2. Sleeve
3. Spring



Function

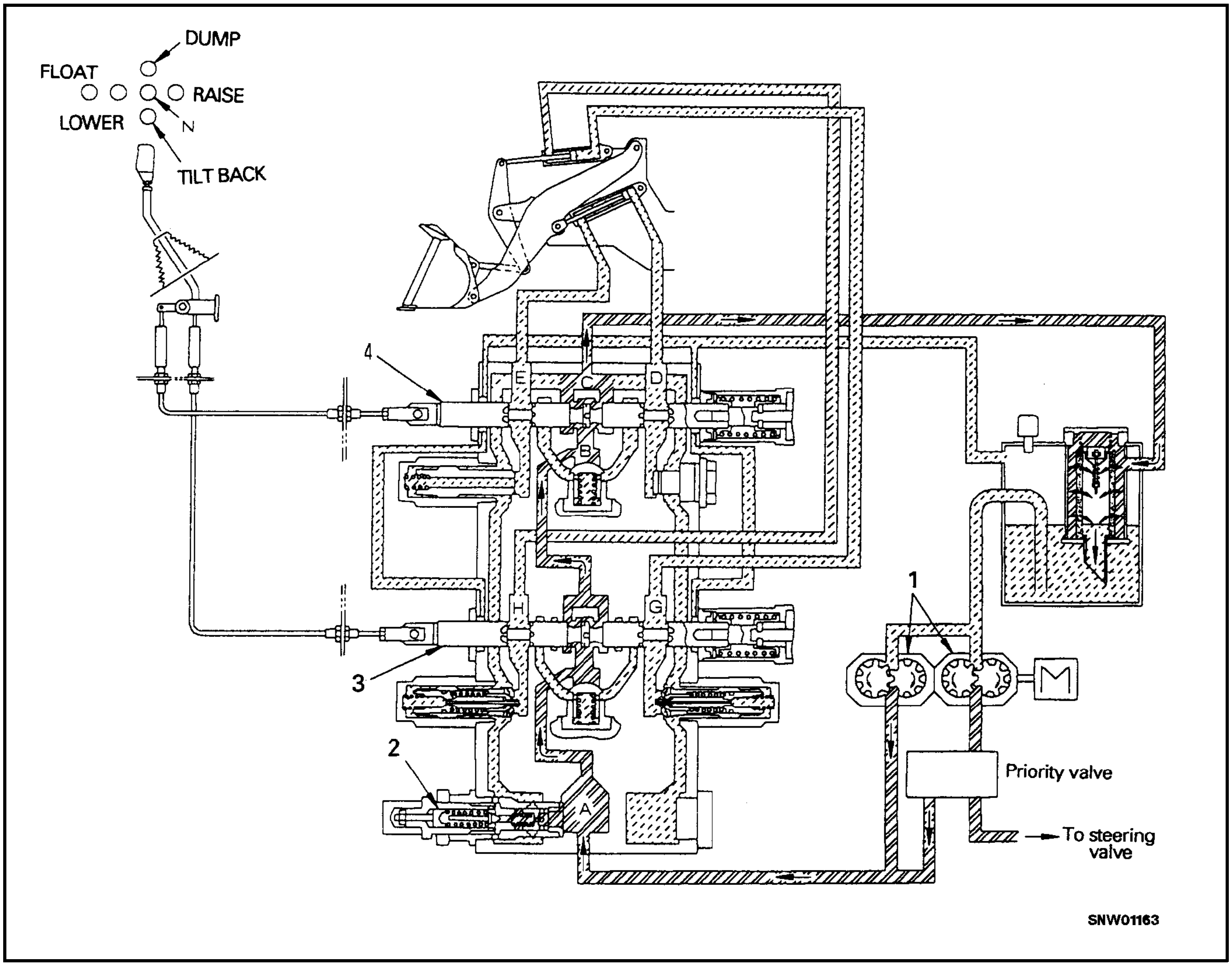
- This valve acts to prevent any negative pressure from forming in the circuit.



Operation

- If any negative pressure is generated at port **A** (boom cylinder rod end) (when a pressure lower than tank circuit port **B** is generated), main poppet (1) is opened because of the difference in area between **d1** and **d2,** and oil flows from port **B** at the tank end to port **A** at the cylinder port end.

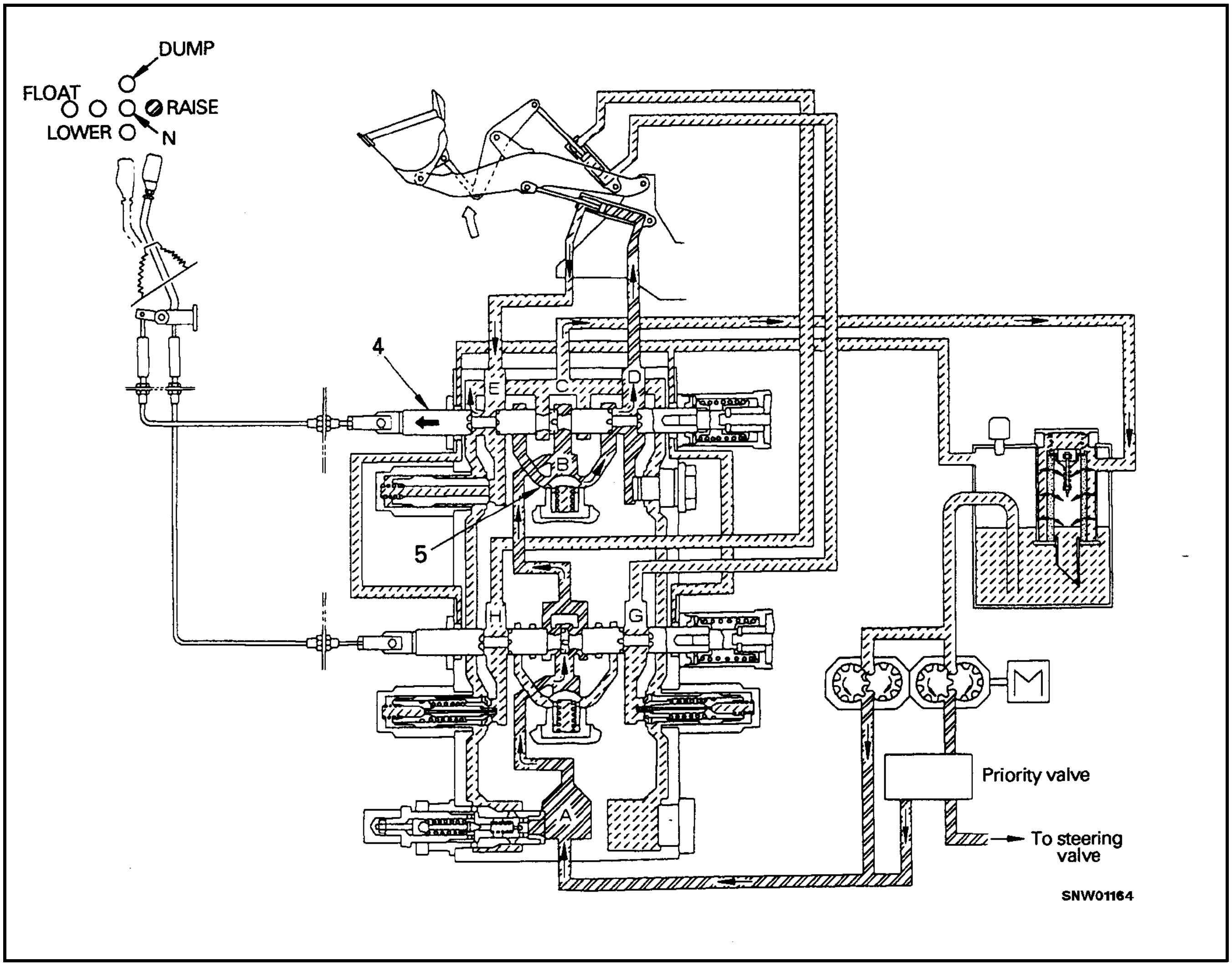
Boom and bucket spool at neutral position



Operation

- The oil from pump (1) passes through the priority valve, and enters port **A.** The maximum pressure is set by relief valve (2).
- Bucket spool (3) is at the HOLD position, so the bypass circuit is open and the oil in chamber **A** passes around the spool and flows to port **B.** Boom spool (4) is also at the HOLD position, so the bypass circuit is open and the oil in chamber **B** passes around the spool, enters chamber **C** of the drain circuit, passes through the filter, and returns to the tank.

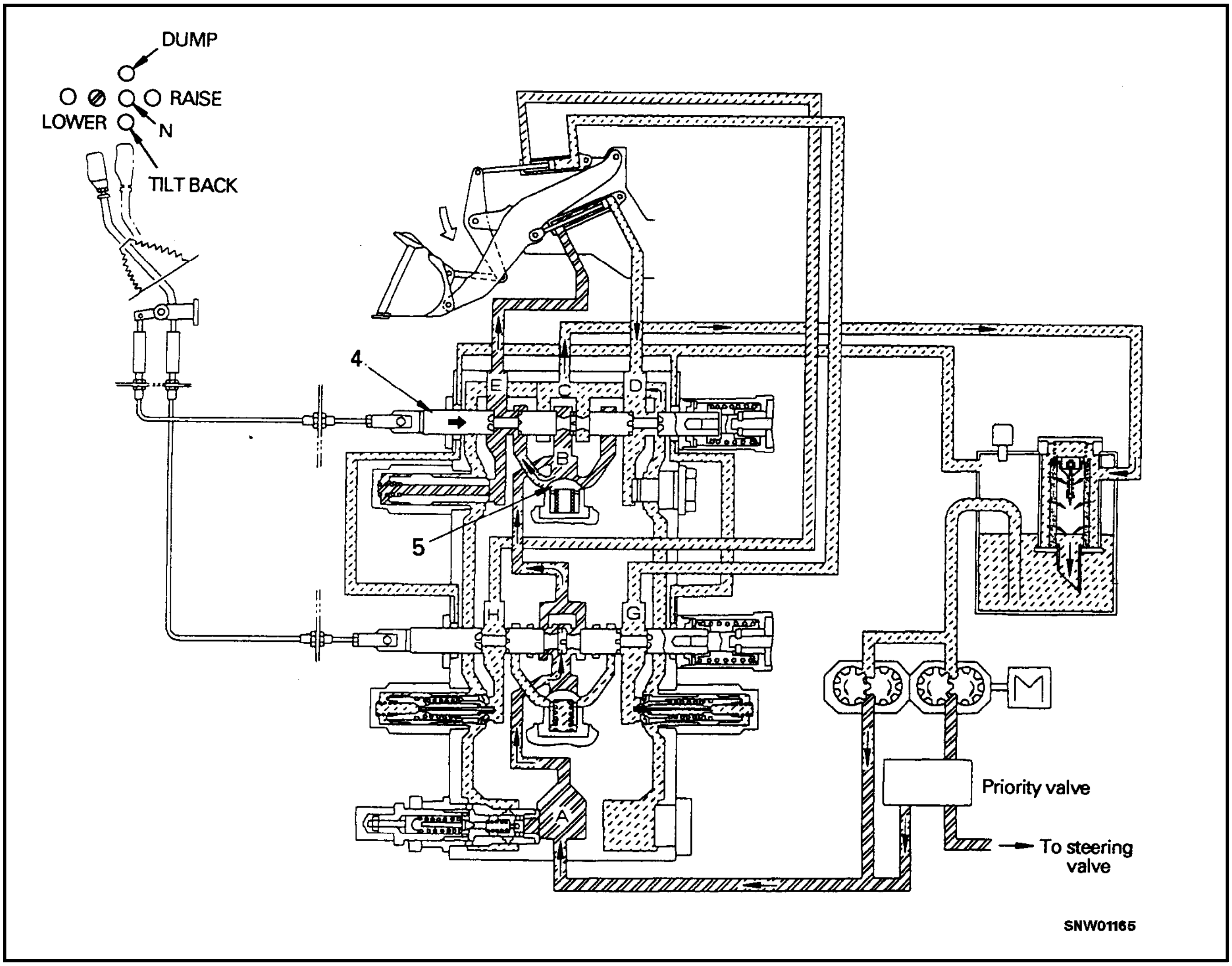
Boom spool at RAISE position



Operation

- When the work equipment control lever is pulled, boom spool (4) is pulled out to the RAISE position.
- The oil from the pump flows through the bypass circuit of the bucket spool and flows to the bypass circuit of boom spool (4). The bypass circuit is closed by the spool, so the oil from port **B** pushes check valve (5) open. The oil from port **B** then flows from port **D** to the bottom end of the cylinder.
- At the same time, the oil at the cylinder rod end flows from port **E** to drain port **C** and returns to the tank. As a result, the boom is raised.

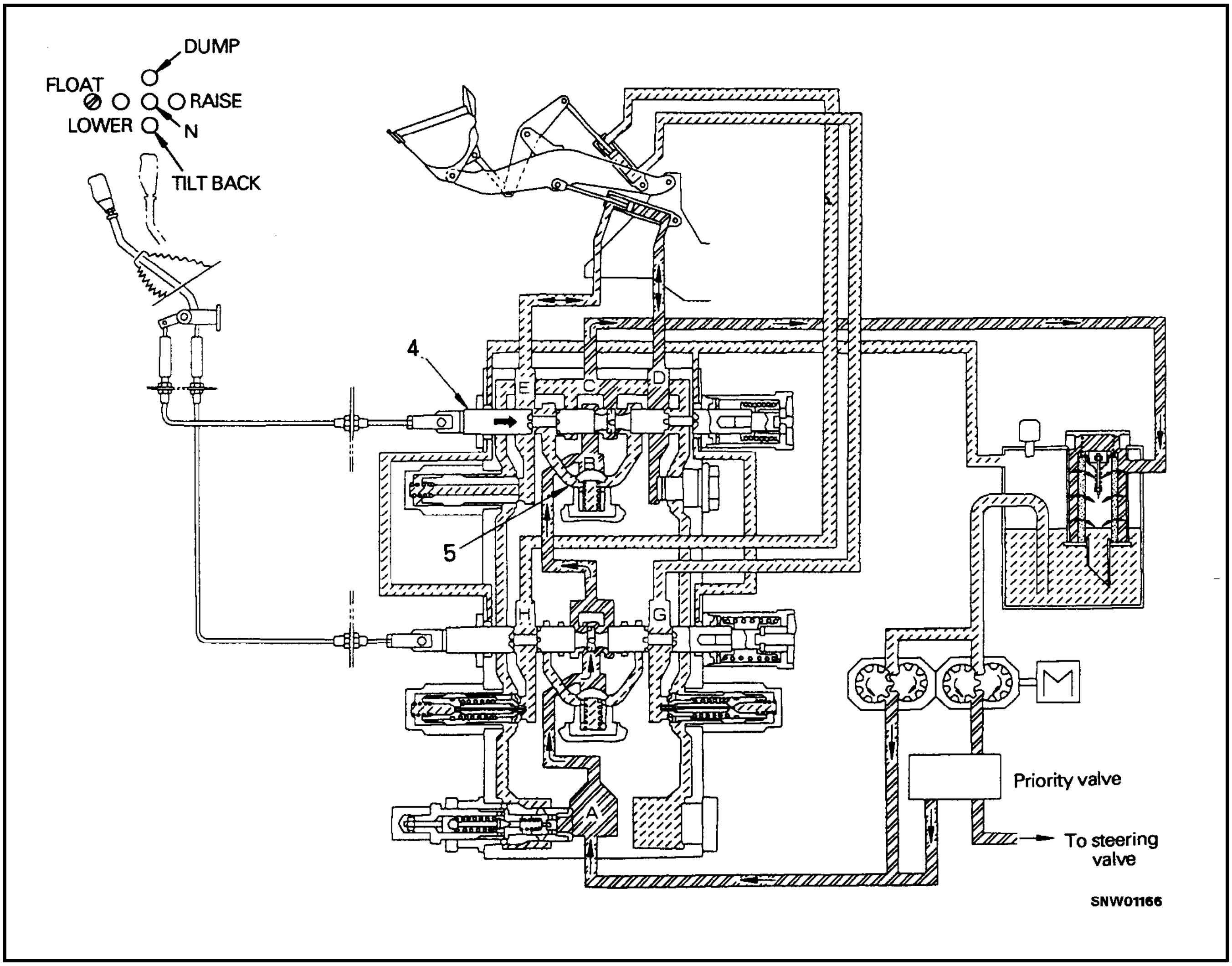
Boom spool at LOWER position



Operation

- When the work equipment control lever is pushed, boom spool (4) is pushed in to the LOWER position.
- The oil from the pump flows through the bypass circuit of the bucket spool and flows to the bypass circuit of boom spool (4). The bypass circuit is closed by the spool, so the oil from port **B** pushes check valve (5) open. The oil from port **B** then flows from port **E** to the rod end of the cylinder.
- At the same time, the oil at the cylinder bottom end flows from port **D** to drain port **C** and returns to the tank. As a result, the boom is lowered.

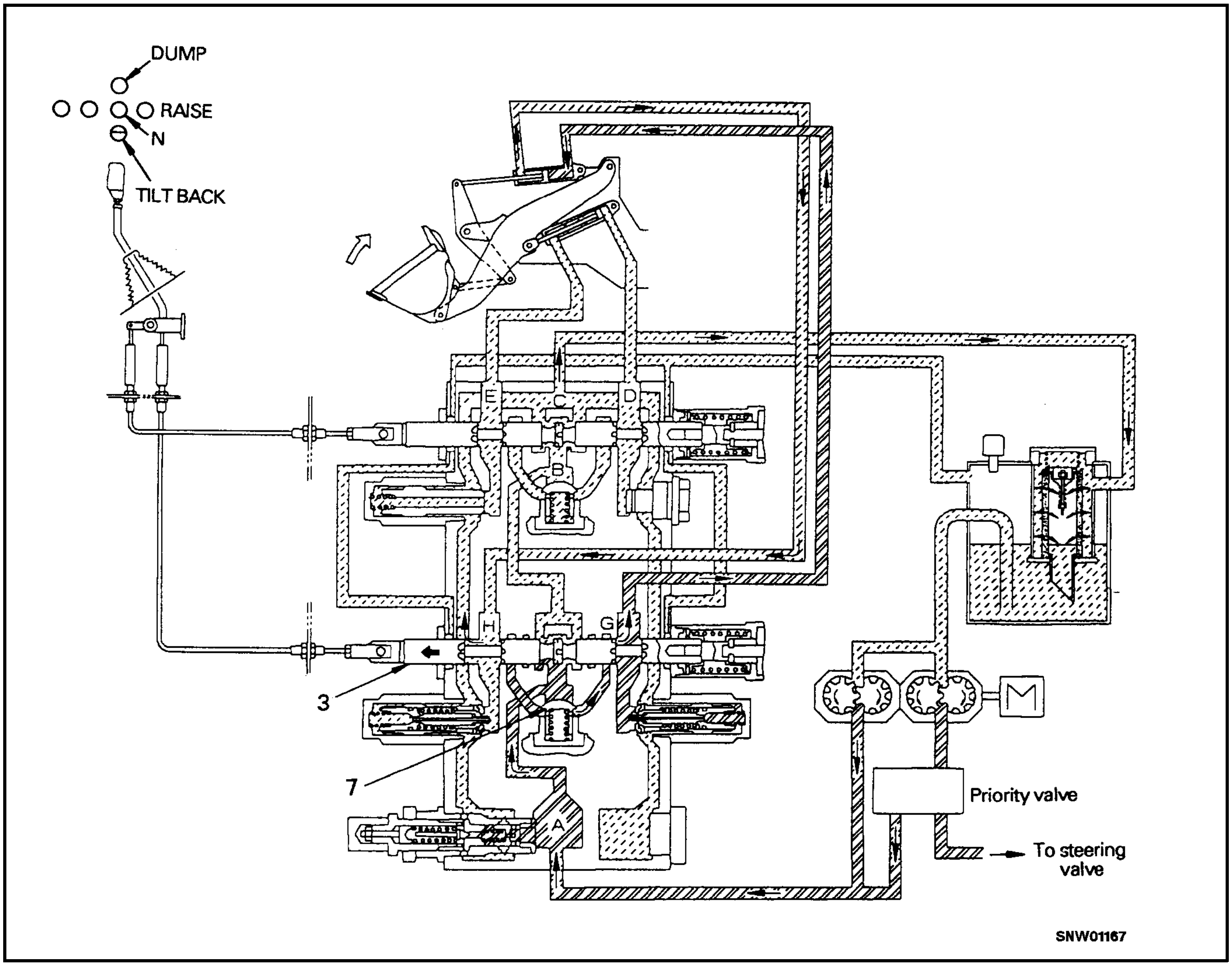
Boom spool at FLOAT position



Operation

- If the work equipment control lever is pushed beyond the LOWER position, boom spool (4) is pushed in to the FLOAT position.
- The oil from the pump passes around the bypass circuit of the bucket spool and flows to the boom spool bypass circuit. The oil in the bypass circuit is sent to the drain circuit by the spool and cannot push open check valve (5). Both the RAISE circuit **D** and LOWER circuit **E** of the boom cylinder are connected to the drain circuit, so the boom goes down under its own weight.
- When the bucket is in contact with the ground surface, the bucket can move up or down in accordance with the shape of the ground surface.

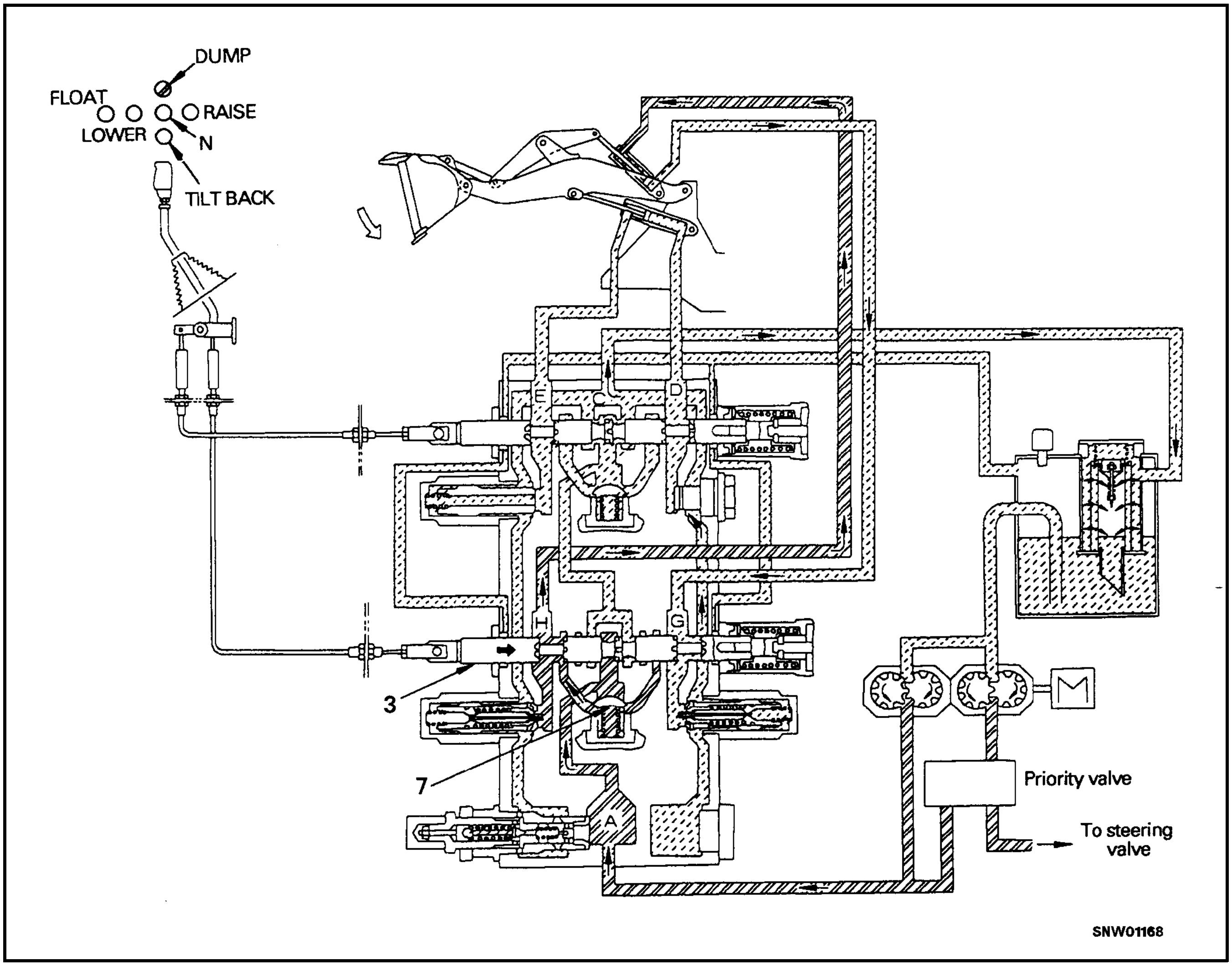
Bucket spool at TILT BACK position



Operation

- When the work equipment control lever is pulled, bucket spool (3) is pulled out to the TILT BACK position.
- The bypass circuit is closed by the spool, so the oil from port **A** pushes open check valve (7). The oil from port **G** then flows to the bottom end of the cylinder.
- At the same time, the oil at the cylinder rod end flows from port **H** to drain port **C,** and returns to the tank. As a result, the bucket is tilted back.

Bucket spool at DUMP position

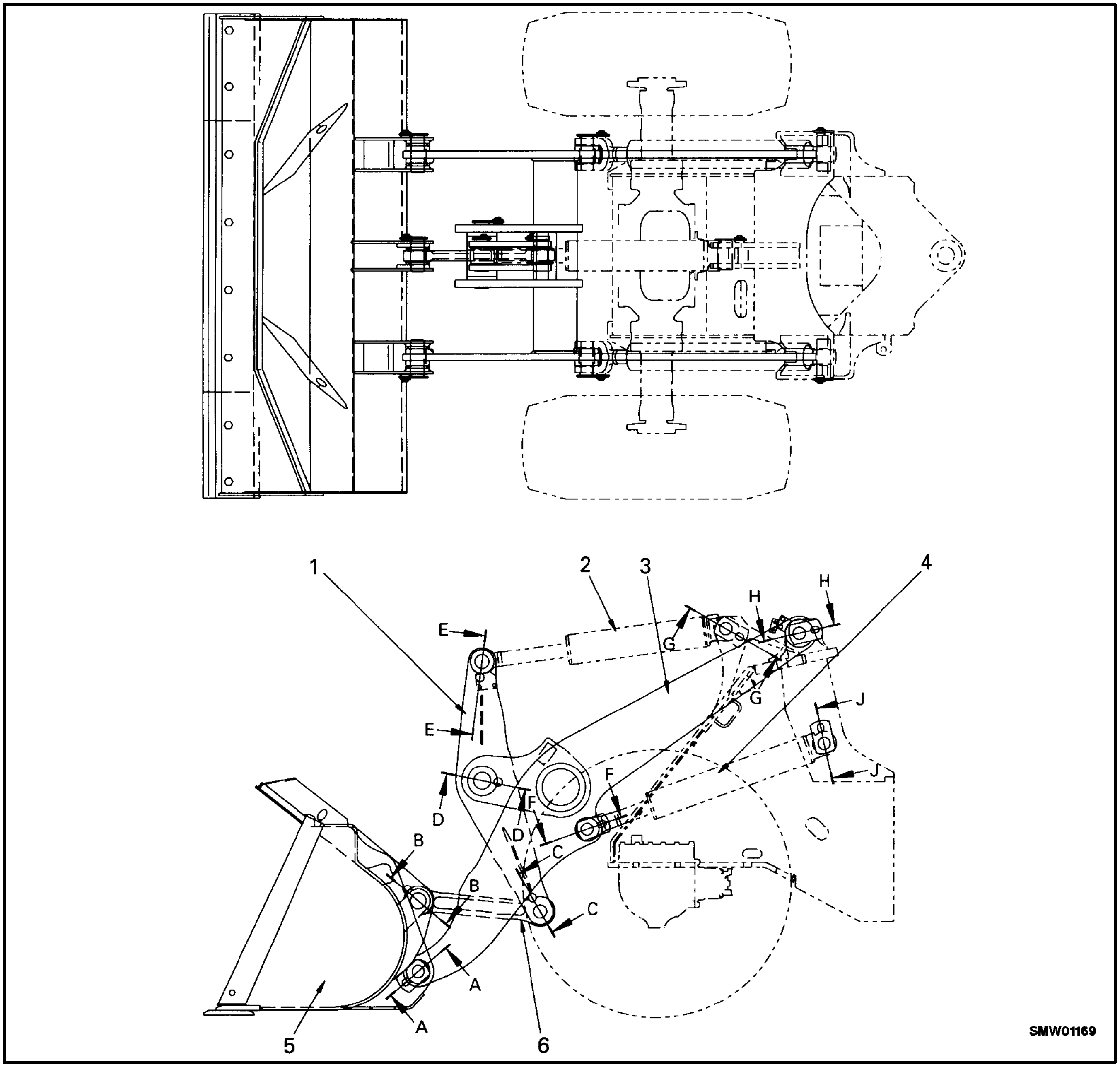


Operation

- When the work equipment control [ever is pushed, bucket spool (3) is pushed in to the DUMP position.
- The bypass circuit is closed by the spool, so the oil from port **A** pushes open check valve (7). The oil from port **H** then flows to the rod end of the cylinder.
- At the same time, the oil at the cylinder bottom flows from port **G** to drain port **C,** and returns to the tank. As a result, the bucket is tilted forward.

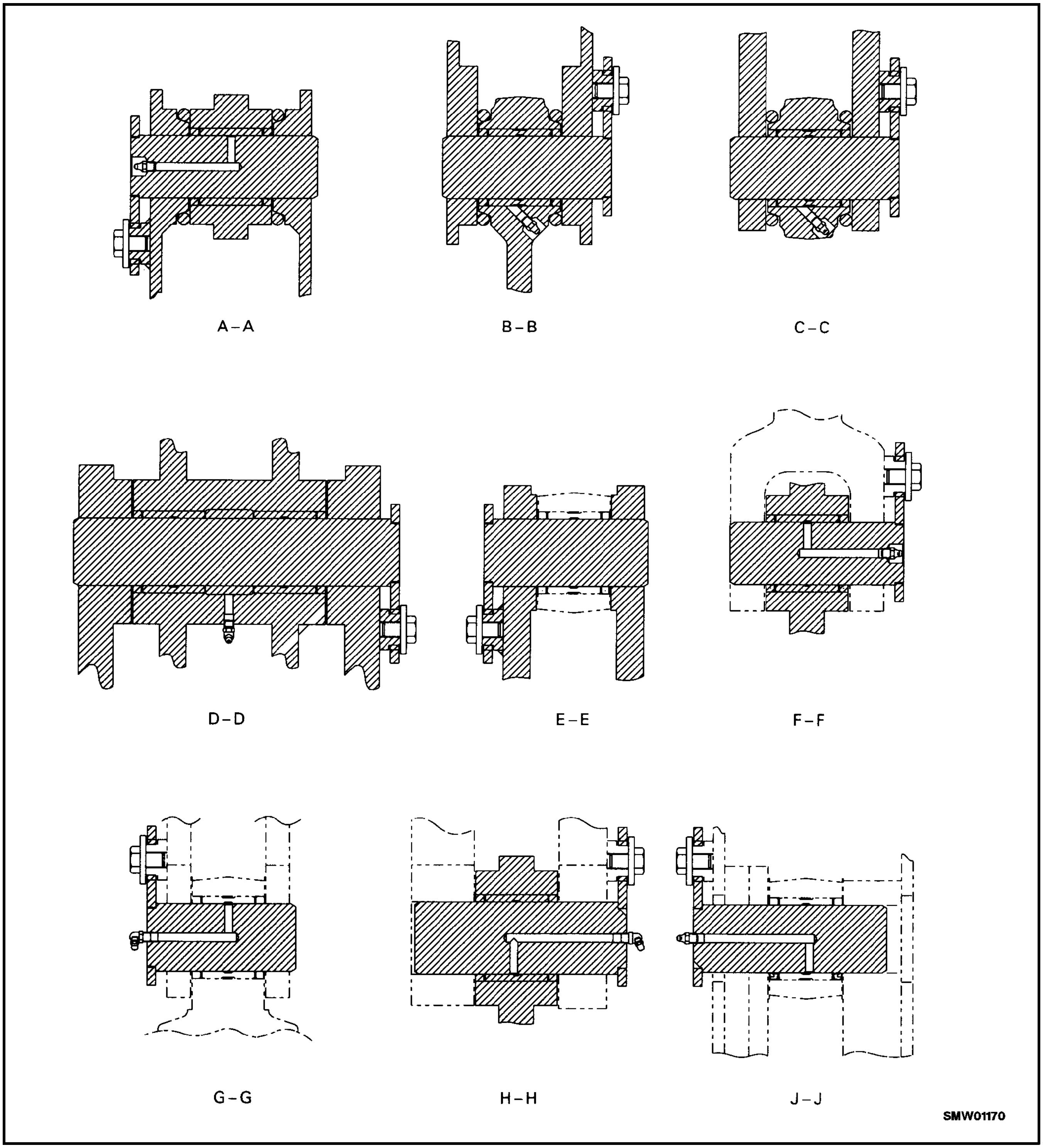
MEMORANDA

WORK EQUIPMENT LINKAGE

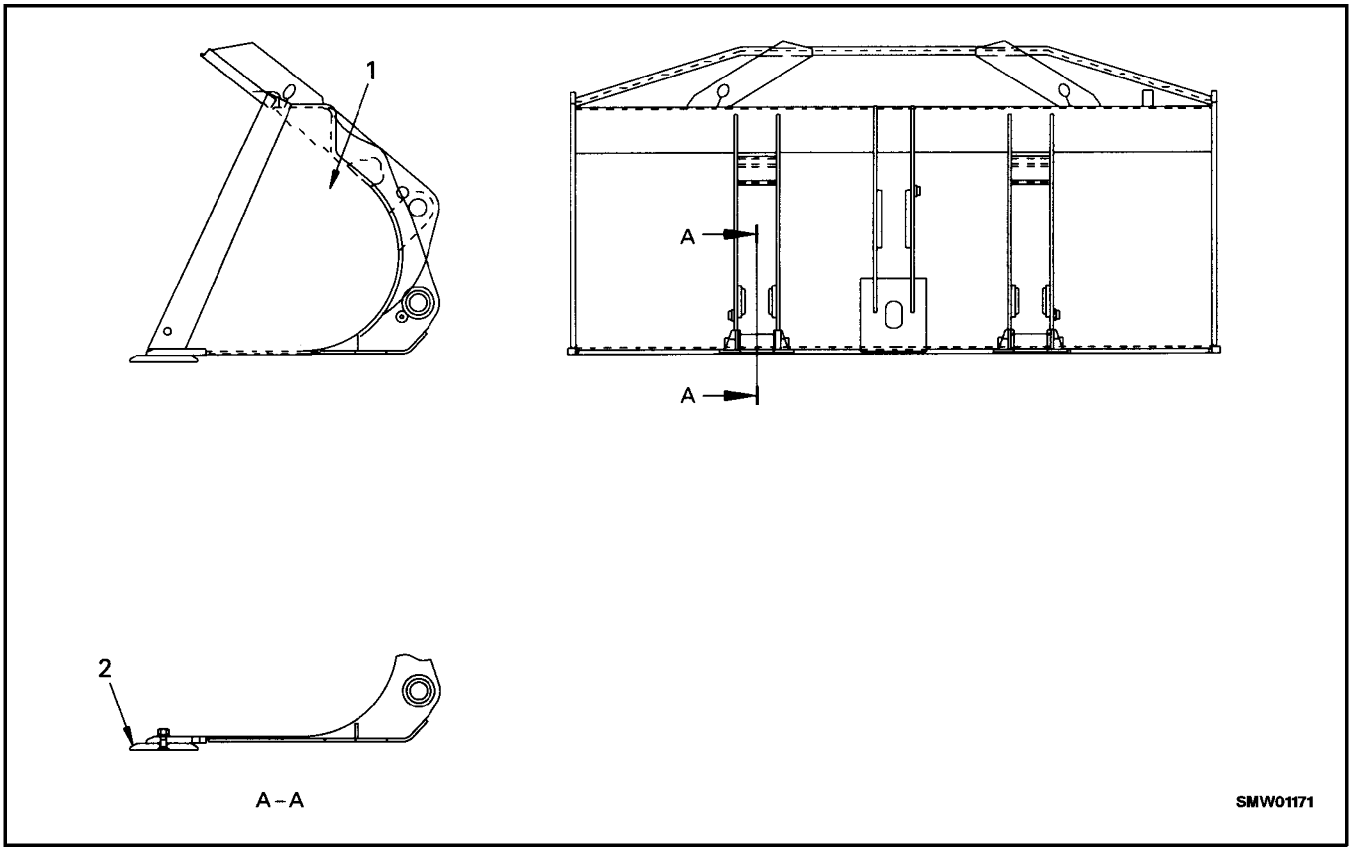


1. Belicrank
2. Bucket cylinder
3. Boom
4. Boom cylinder
5. Bucket
6. Bucket link

WORK EQUIPMENT LINKAGE

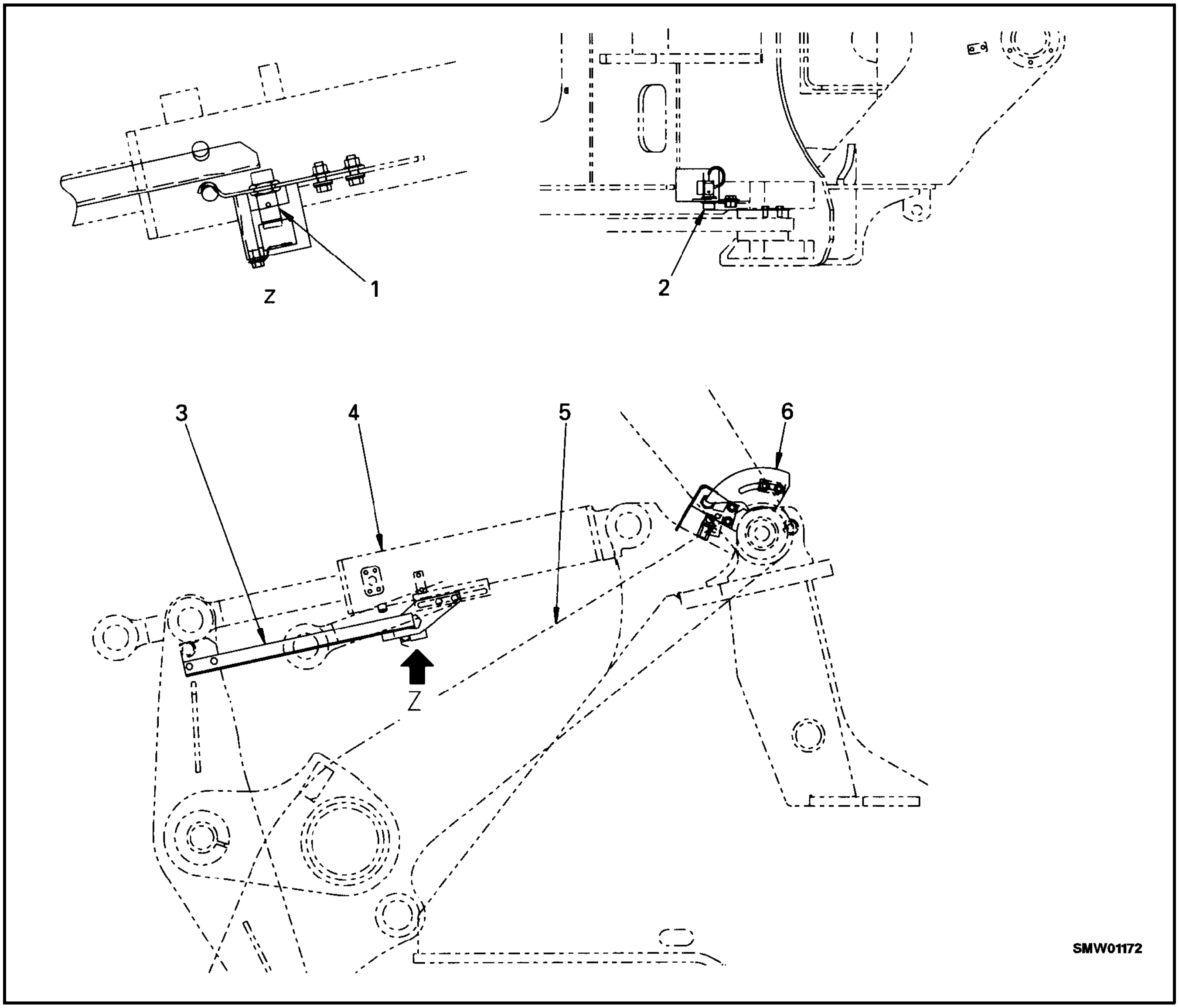


BUCKET



1. Bucket
2. Bolt-on cutting edge

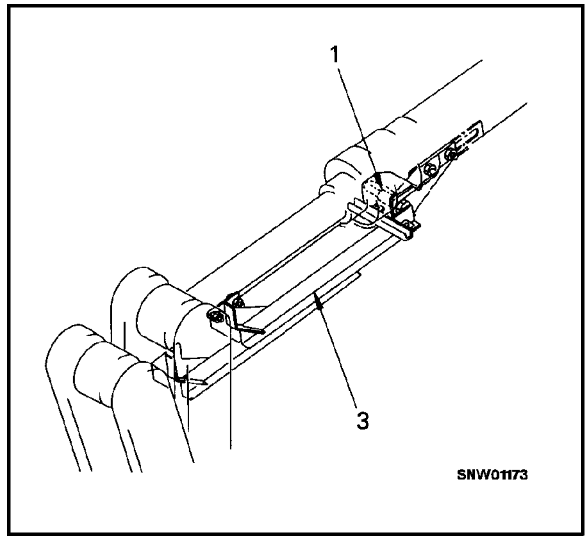
BUCKET POSITIONER AND BOOM KICK-OUT



1. Bucket positioner proximity switch
2. Boom KICK OUT proximity switch
3. Lever
4. Bucket cylinder
5. Boom
6. Plate

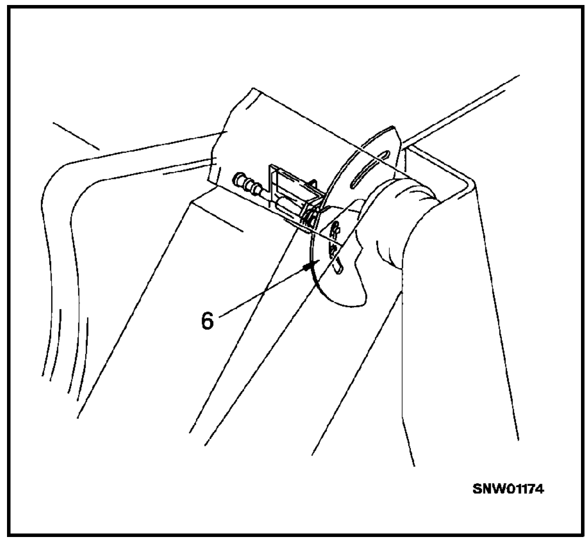
BUCKET POSITIONER

- The bucket POSITIONER is an electrically actuated system which is used to set the bucket to the desired angle when the bucket is moved from the DUMP position to the TILT position. When the bucket reaches the desired position, the bucket lever is returned from the TILT position to the HOLD position, and the bucket is automatically set to the suitable digging angle.
- Lever (3) is secured to bucket cylinder rod by bolts. In addition, proximity switch (1) fixed to the cylinder by bolts.
- When the bucket is moved from the DUMP position to the TILT position, the bucket cylinder rod moves to the left, and at the same time, lever (3) also moves to the left. Proximity switch (1) separates from lever (3) at the desired position, and the bucket lever is returned to neutral.



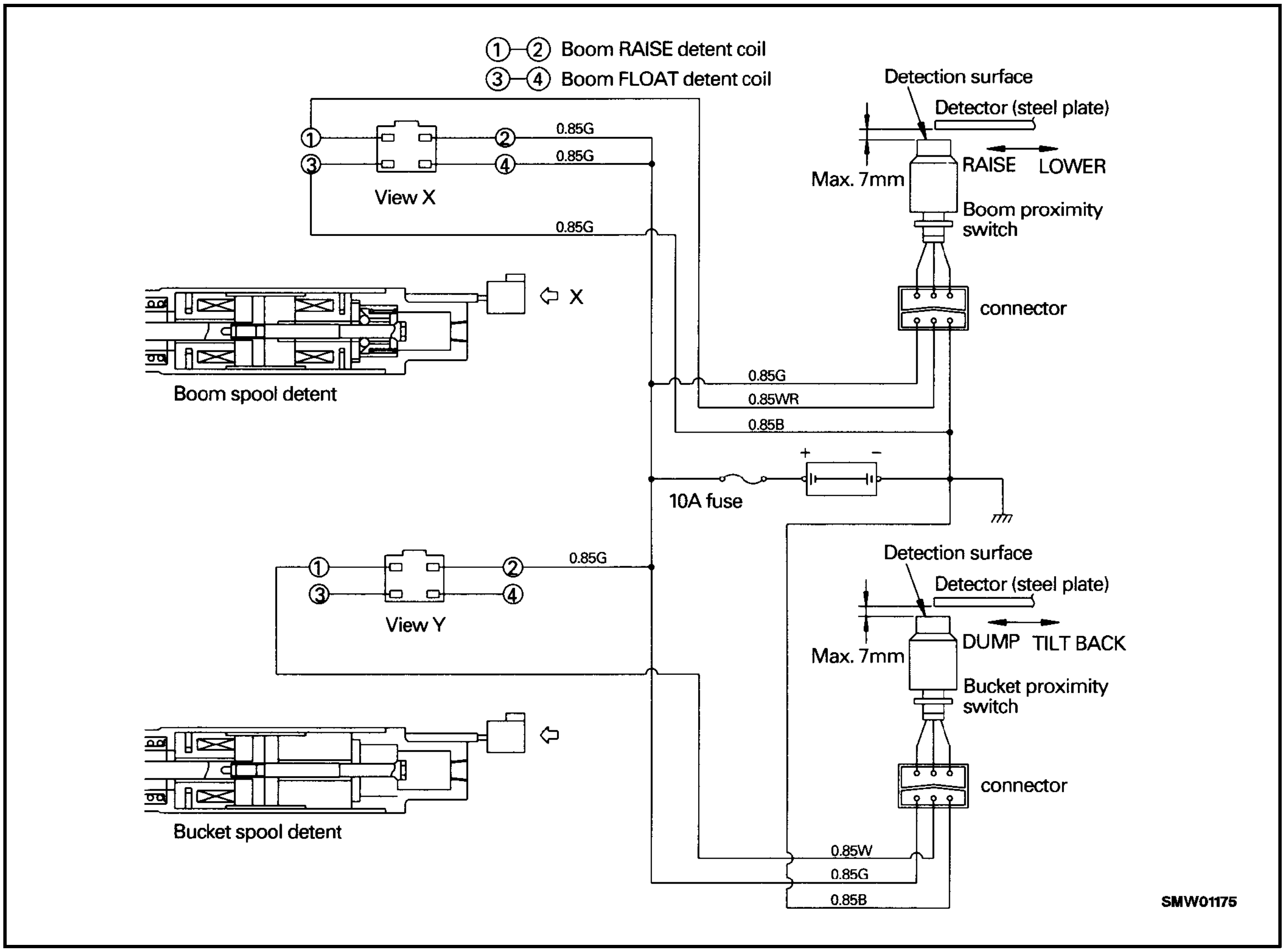
BOOM KICK-OUT

- The boom kick-out is an electrically actuated system. It acts to move the boom lever to the HOLD position and stop the boom at the desired position before the boom reaches the maximum height.
- Plate (6) is fixed to the boom. In addition, proximity switch is fixed to the frame.
  When the boom is moved from the LOWER position to the RAISE position, the boom rises, and when it reaches the desired position, the proximity switch and lever come together and the system is actuated to return the boom lever to the HOLD position.



PROXIMITY SWITCH

- The proximity switches are installed to the boom and bucket cylinder by a support. In accordance with the operating condition, a pulse is generated from the sensor at the desired point when moving to the boom RAISE position and bucket TILT BACK position. This electric current is transmitted to a magnet, and the work equipment control levers are returned to neutral. Therefore, the main control valve also returns to neutral and the movement of the boom and bucket is stopped.



Operation of proximity switch Boom RAISE switch

- If the boom goes below the set position for the boom kick-out, the detector (steel plate) is above the detector surface of the boom proximity switch, so the proximity switch sends the battery current to the magnet switch coil.
- When the work equipment control lever is operated to the RAISE position, the boom spool is held at the RAISE position by the magnet at the boom spool detent of the main control valve, and the boom rises.
- When the boom rises and reaches the set position for the boom kick-out, the detector (steel plate) separates from the proximity switch detector surface. When this happens, the proximity switch cuts the electric current to the magnet coil. The boom spool is then returned to the neutral position by the return spring.

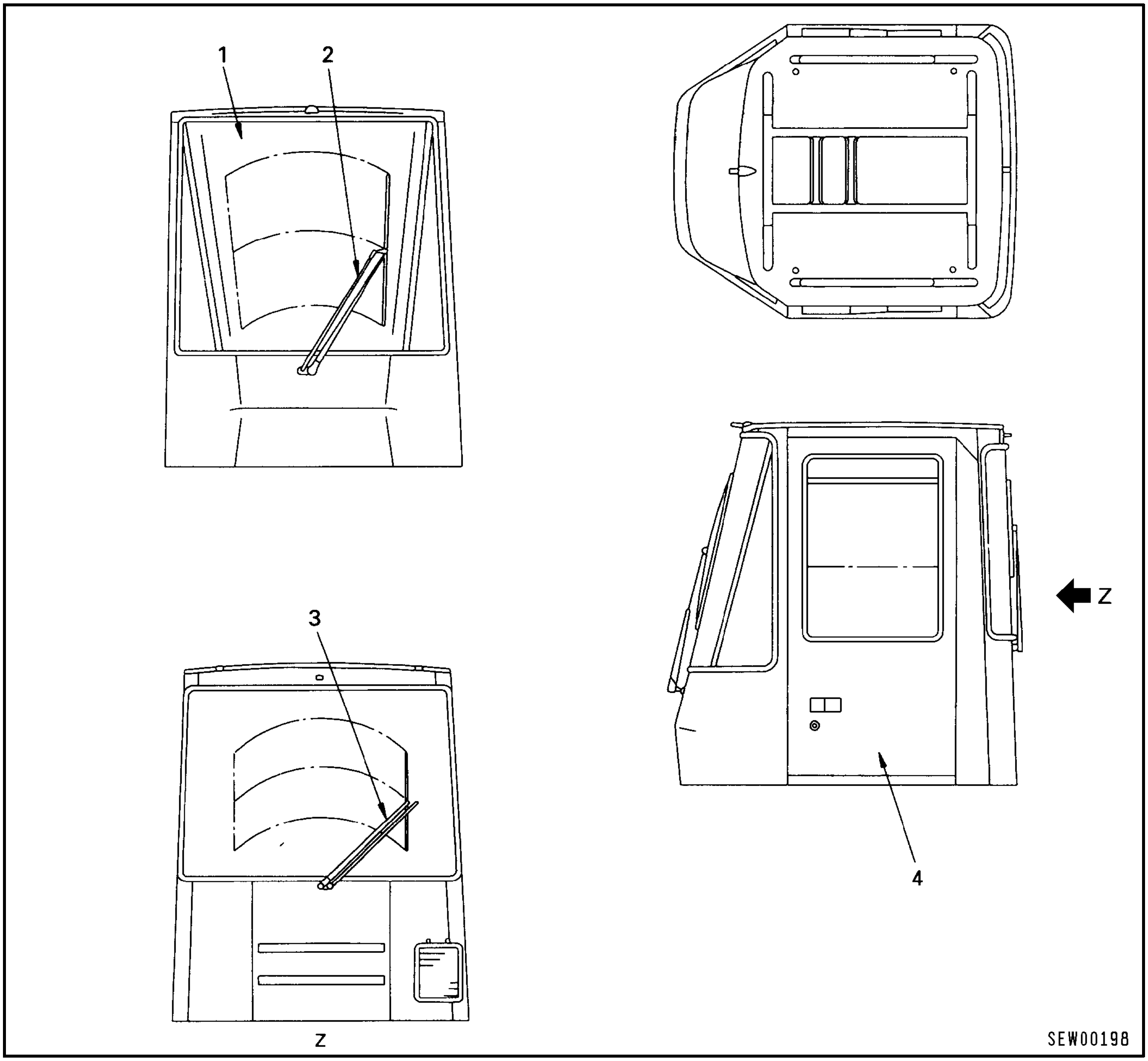
Bucket TILT BACK switch

- If the bucket is dumped beyond the set position for the bucket positioner, the detector (steel plate) is above the detector surface of the bucket proximity switch, so the proximity switch sends the battery current to the magnet switch coil.
- When the work equipment control lever is operated to the TILT BACK position, the bucket spool is held at the TILT BACK position by the magnet at the bucket spool detent of the main control valve, and the bucket is tilted back.
- When the bucket tilts back and reaches the set position for the bucket positioner, the detector (steel plate) separates from the proximity switch detector surface. When this happens, the proximity switch cuts the electric current to the magnet coil. The bucket spool is then returned to the neutral position by the return spring.

Action of proximity switch

	POSITION	
Proximity switch	When detector is positioned at detection surface of proximity switch	When detector is separated from detection surface of proximity switch.
Boom, bucket proximity switch	Proximity switch sends electric current to magnet coil. (magnet is actuated)	Proximity switch cuts electric current to magnet coil. (magnet is not actuated)

ROPS CAB

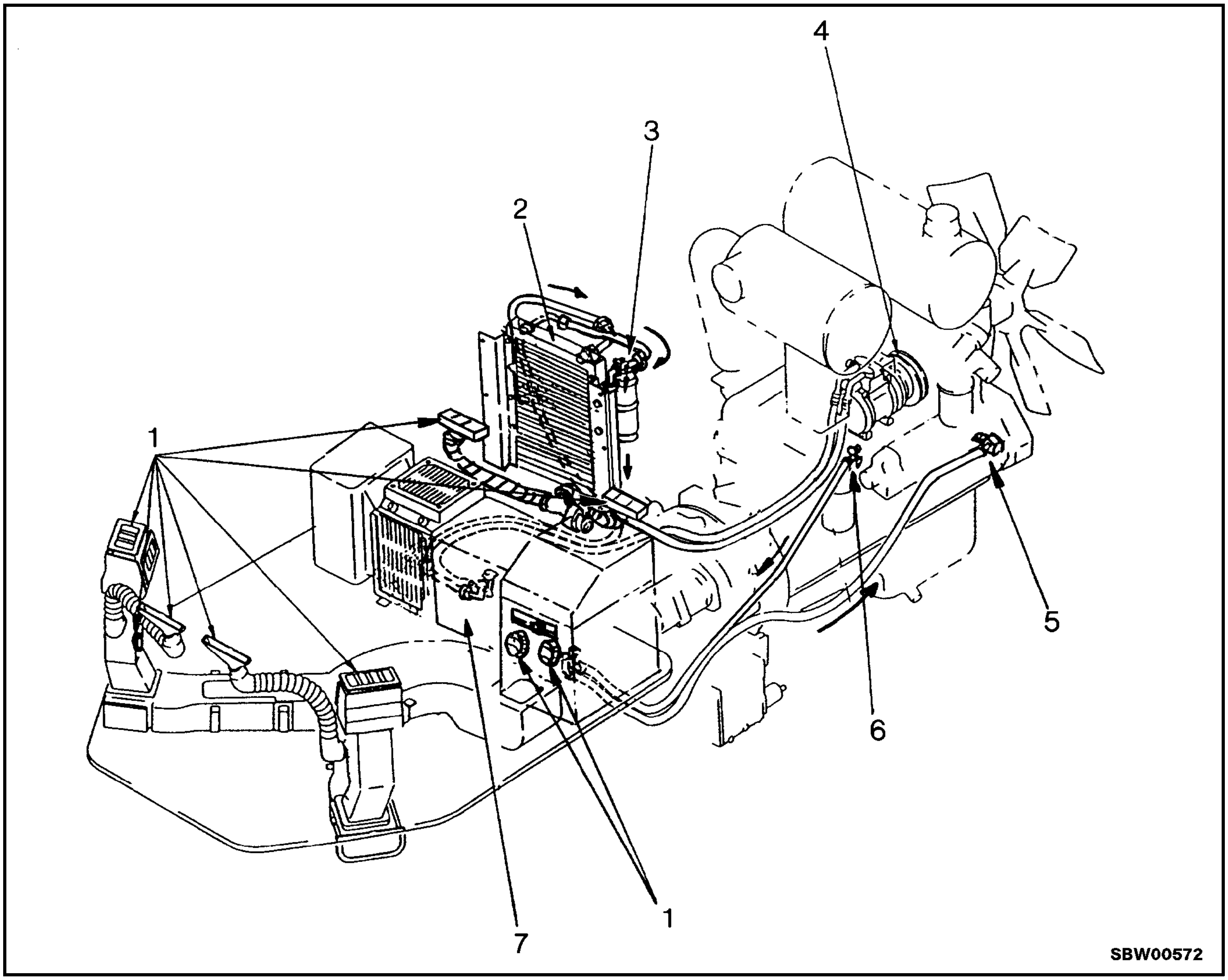


1. Front glass
2. Front wiper
3. Rear wiper
4. Door

MEMORANDA

AIR CONDITIONER

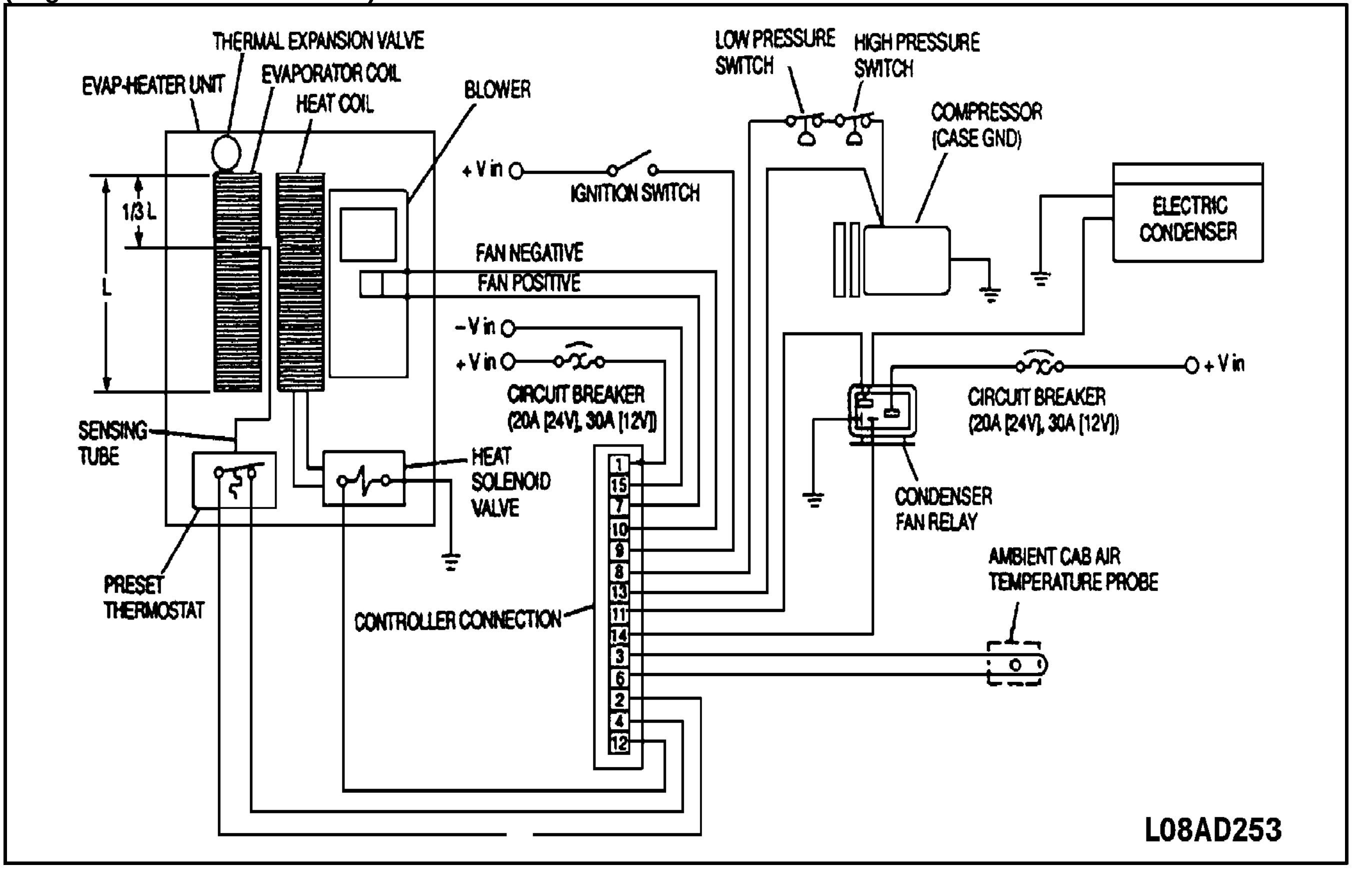
AIR CONDITIONER PIPING



1. Vent
2. Air conditioner condenser
3. Dry receiver
4. Compressor
5. Hot water inlet port
6. Hot water outlet port
7. Air conditioner unit

ELECTRIC CIRCUIT DIAGRAM

(Eagle air conditioner/ Heater)



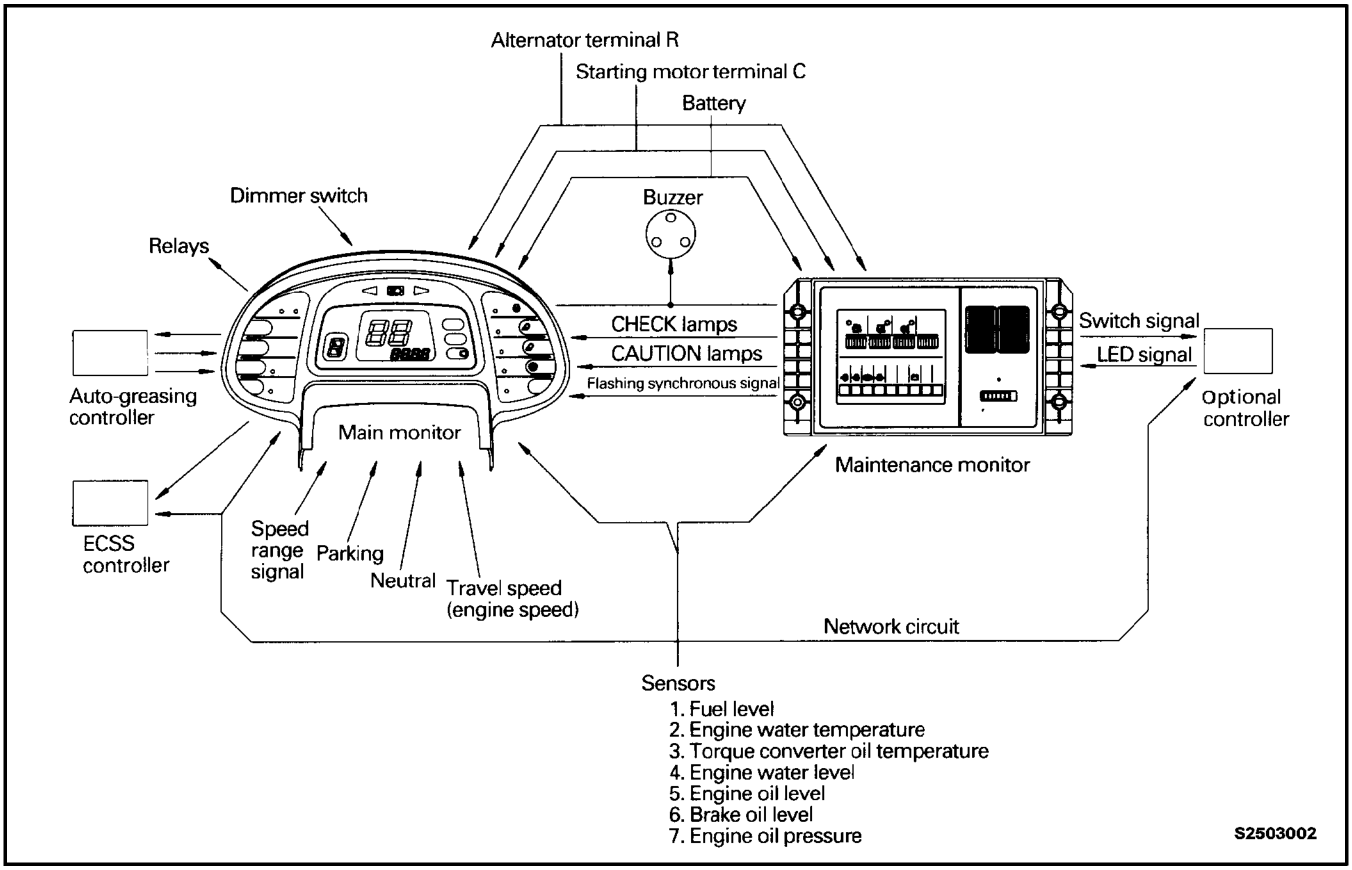
NOTES:

1. Position the ambient temperature probe near waist high level, out of air flow and sun load.
2. Insert the sensing tube from present thermostat down into the evaporator coil, parallel to the coil face, between the 1st and 2nd rows, to a depth of the coil height minus 1 inch.

Wire chart

Socket	Size	Color	Wire function
1	10GA	Red	Battery positive in
2	18GA	Red	½ evap coil thermostat in
3	18GA	Black	½ ambient thermistor in
4	18GA	Red	½ evap coil thermostat in
5	N/A	N/A	Not used
6	18GA	Black	½ ambient thermistor in
7	14GA	Orange	Fan positive out
8	16GA	Dk. Green	Clutch out
9	18GA	DK. Blue	Ignition switch in
10	14GA	Black	Fan negative out
11	18GA	Brown	Condenser blown fuse in
12	16GA	White	Heat solenoid out
13	18GA	Tan	Pressure switch detect in
14	16GA	Yellow	Condenser fan relay out
15	12GA	Black	Battery negative in
16	N/A	N/A	Not used

MACHINE MONITOR SYSTEM

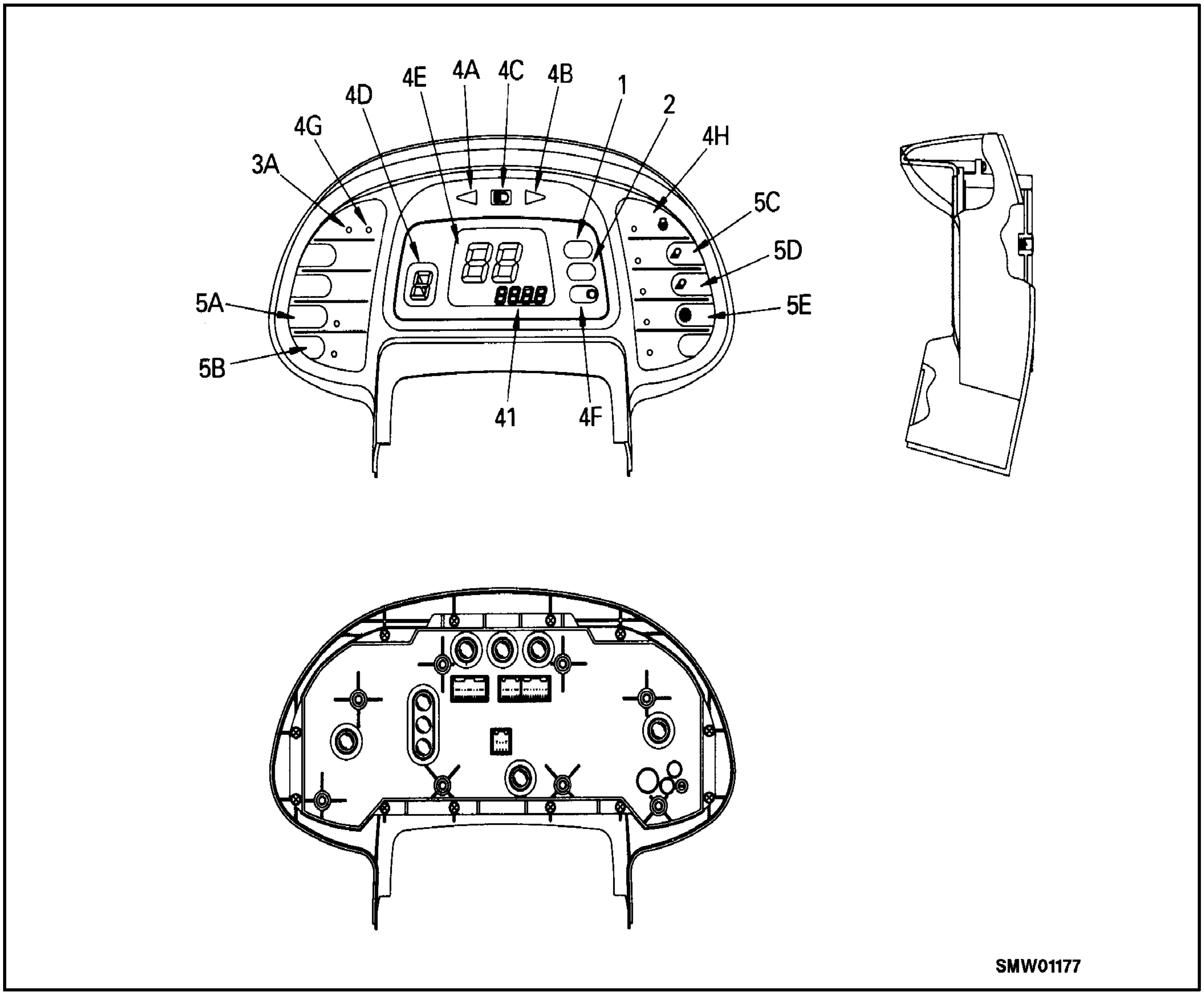


Outline

- The machine monitor system uses the sensors and other devices installed to various parts of the machine to observe the condition of the machine. It processes this information swiftly and displays it on the monitor panel to inform the operator of the condition of the machine.
- The machine monitor system consists of the main monitor, maintenance monitor, sensors, switches, relays, alarm buzzer, and power source.
- The displays can be broadly divided into the following: Cautions displayed on the monitors (abnormalities in the machine where an alarm is given) and normal conditions which are always displayed on the instrument panel (pilot lamps and readings for the gauges, speedometer, and service meter).
- There are also various switches built into the monitor panel which function to operate the machine.

※ When the optional controller are installed, the main monitor communicates with the controller through the network wiring and functions to display the controller failure action code and failure code together with the time elapsed since the failure (trouble data display mode).

MAIN MONITOR

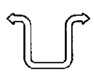
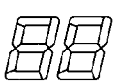


1. CHECK lamp
2. CAUTION lamp
3. Caution item
   3A. Emergency steering actuated
4. Pilot item
   4A. Turn signal (left)
   4B. Turn signal (right)
   4C. Hi beam
   4D. Shift indicator
   4E. Speedometer
   4F. Parking brake
   4G. Emergency steering normal
   4H. Preheating
   4I. Failure action code
5. Switches
   5A. Auto-greasing switch
   5B. E.C.S.S. switch
   5C. Working lamp (front) switch
   5D. Working lamp (rear) switch
   5E. Transmission cut off switch

Outline

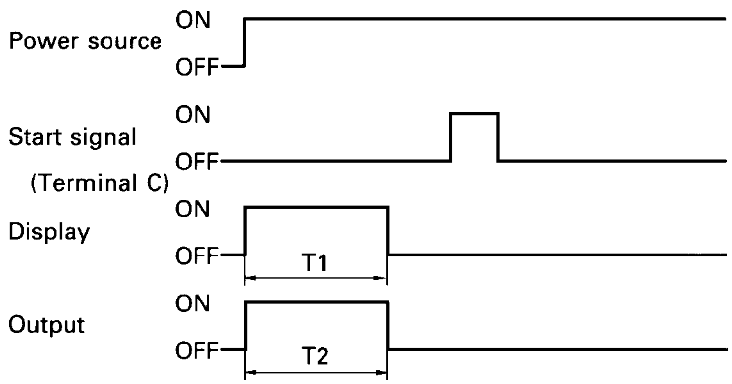
- The main motor has a display function for the speedometer and other gauges and a switching function to control the electric components and controllers.
- There is one CPU (Central Processing Unit) installed internally, and this processes the signals from the sensors and outputs the display.
- A liquid crystal display and LEDs are used for the display. The switches are embossed sheet switches.

MAIN MONITOR DISPLAY FUNCTION

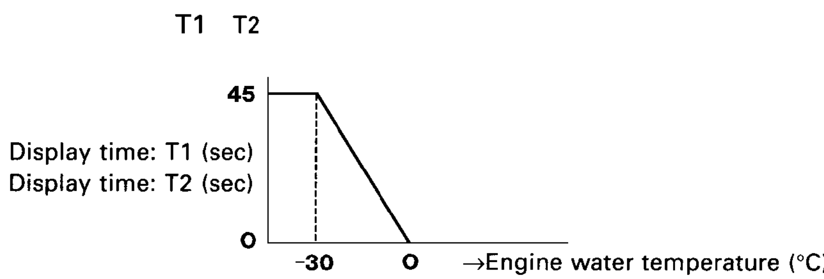
Display category	Symbol	Display item	Display range	Display method
Check		Check	When there is abnormality display on maintenance monitor	Display flashes (for details, see MAINTENANCE MONITOR DISPLAY FUNCTION)
Caution		Emergency steering actuated	When actuated	Display flashes
		Caution	Parking brake actuated, Transmission not at neutral	Display flashes and buzzer sounds
			When there is abnormality display on maintenance monitor	Display flashes (buzzer may also sound) (for details, see MAINTENANCE MONITOR DISPLAY FUNCTION)
Pilot		Hi beam	When operated	Display lights up
		Turn signal (left, right)	When operated	Display lights up
		Parking brake	When operated	Display lights up Buzzer sounds when parking brake is applied and shift lever is not at N
		Emergency steering normal	When normal (oil is flowing in hydraulic circuit)	Display lights up
		Preheating	When preheating	Lights up Lighting up time changes according to engine water temperature when starting switch is turned ON (for details, see PREHEATING OUTPUT FUNCTION)
Speedo-meter		Travel speed	0 - 99 km/h	Digital display (display switches between tachometer and speedometer)
Shift indicator		Shift indicator	1 - 4 N	Digital display
Failure action code		Failure action code	When controller detects failure and action by operator is needed, CALL is display, or CALL and E □□ (action code) are displayed in turn	Digital display Buzzer sounds (for details of the travel data display mode, see TROUBLE DATA DISPLAY MODE)

Item	Function	Display	Actuation
Auto-greasing	Forced greasing is carried out while switch is being pressed when display is lit up	Lights up (goes out momentarily when switch is turned ON)	Auto-greasing control actuated (automatic greasing carried out at fixed interval)
		Flashes (slowly)	Grease empty
		Flashes (slowly)	Abnormality in auto-greasing controller system
		Goes out	Auto-greasing controller not installed
E.C.S.S.	E.C.S.S. function is actuated or stopped each time switch pressed	Lights up	E.C.S.S. function actuated
		Goes out	E.C.S.S. function stopped
Working lamp (front)	Front working lamp lights up or goes out each time switch is pressed when side lamps are lit up	Lights up	Front working lamp lights up
		Goes out	Front working lamp goes out
Working lamp (rear)	Rear working lamp lights up or goes out each time switch is pressed when side lamps are lit up	Lights up	Rear working lamp lights up
		Goes out	Rear working lamp goes out
Transmission cut-off	Transmission cut-off function is actuated or stopped each time switch is pressed	Lights up	Cut-off function actuated
		Goes out	Cut-off function stopped

PREHEATING OUTPUT FUNCTION

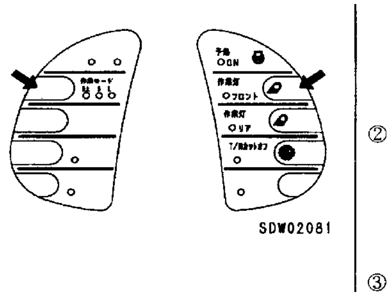
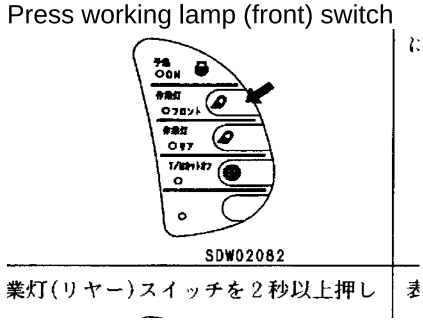
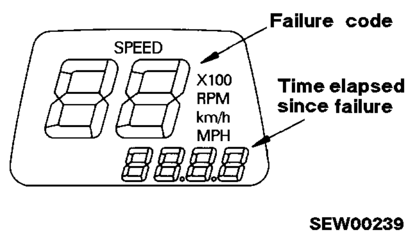
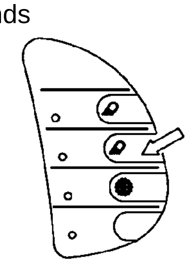
<table>
<tr><th>Item</th><th>Operation</th></tr>
<tr><td>Q.H.S.
(Quick Heater Sytem)</td><td>


Relationship between engine water temperature and display and output time

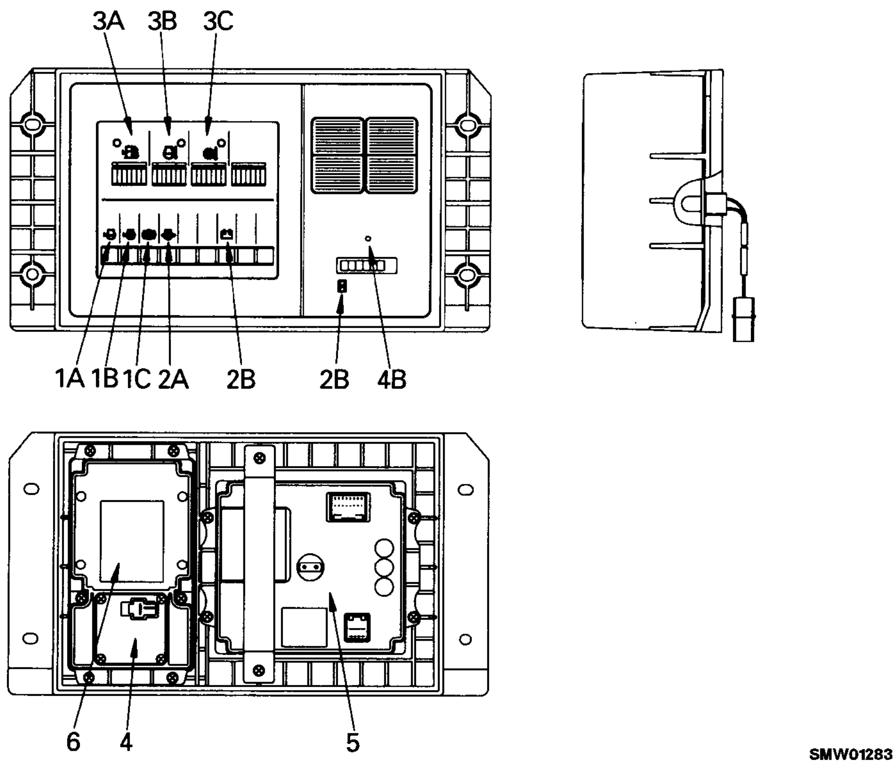


</td></tr>
</table>

TROUBLE DATA DISPLAY MODE

Item	Switch operation	Actuation
Method of switching to trouble data display mode	With engine stopped and starting switch turned ON, press 2nd switch from top on left side of main monitor (switch below emergency steering display) and working lamp (front) switch simultaneously for at least 5 seconds. 	All switch display (LEDs) go out, and failure code is displayed on speedometer display and time elapsed since failure is displayed on failure action code display. (1) Failure code is a two-digit display given in numbers or letters. The display for the failure now occurring flashes and the display for past failures lights up. If there is no failure, CC is displayed (000 is displayed for time elapsed since failure) (2) The time elapsed since failure is displayed as a three-digit number to show how long ago the failure occurred (the oldest failure time is displayed. Any time greater than 999H is displayed as 999H). (3) A maximum of 9 items are stored in memory for the failure code.
Method of sending failure code	Press working lamp (front) switch 	Failure code and time elapsed since failure change to next item. 
Clearing failure code	Press working lamp (rear) switch for at least 2 seconds  SDW00243	Failure code and time elapsed since failure being displayed are cleared. Failure code for problem now occurring (flashing display) cannot be cleared
Resetting from travel data display mode	Press 2nd switch from top left side of main monitor(switch below emergency steering display) and working lamp (front) switch simultaneously for at least 5 seconds, or start the engine.	Changes to normal display

MAINTENANCE MONITOR DISPLAY FUNCTION



1. Check items (CHECK BEFORE STARTING)
   1A. Engine water level
   1B. Engine oil level
   1C. Brake oil level
2. Caution items (CAUTION)
   2A.Engine oil pressure
   2B. Battery charge
   (lA. Engine water level)
   (lC. Brake oil level)
3. Gauges
   3A. Fuel level
   3B. Engine water temperature
   3C. Torque converter oil temperature
4. Service meter
   4A. Service meter counter
   4B. Service meter pilot lamp
5. Monitor module
6. Switch module

- The maintenance monitor has a display function for the caution items and gauges, and switch functions to control the work equipment controller (if equipped).
- The maintenance monitor consists of the monitor module, switch module, service meter, case, and other mechanisms.
- The monitor module has a built-in CPU (Central Processing Unit). It processes the signal from the sensors, and carries out the display and output.
- A liquid crystal display and LEDs are used for the display portions. The switches are embossed sheet switches.

MAINTENANCE MONITOR DISPLAY FUNCTION

Display category	Symbol	Display item	Display range	Display method
Check		Engine water level	Below low level	Display when engine is stopped and starting switch is ON Displays when normal: OFF Display when abnormal: Flashes CHECK lamp flashes
		Engine oil level	Below low level	
		Brake oil level	Below low level	
Caution		Engine water level	Below low level	Display when engine is running Displays when normal: OFF Display when abnormal: Flashes CAUTION lamp flashes Buzzer sounds
		Brake oil level	Below low level	
		Engine oil pressure	Below specified pressure	
		Engine water temperature	Above 102°C	Buzzer sounds if above 105°C
		Torque converter oil temperature	Above 120° C	Buzzer sounds if above 130°C
		Fuel level	Below low level	Display when engine is running Displays when normal: OFF Display when abnormal: Flashes CAUTION lamp flashes
		Battery charge	When change is defective	Display when engine is running Displays when normal: OFF Display when abnormal: Flashes CHECK lamp flashes
Service meter		Service meter	0 - 99999.9 h	Actuated when charge is normal Advance 1 for ever hour
		Service meter indicator		Lights up when service is running
Gauges		Fuel level	EMPTY FULL 1 2 3 4 5 6 7 E F Red Green	All lamps lights up below applicable level Flashes when level is 1
		Engine water temperature	67 80 90 97 102 106 °C 1 2 3 4 5 6 7 C H White Green Red	One place lights up to show applicable level Flashes when level is 6 or 7
		Torque converter oil temperature	50 70 90 110 120 130 °C 1 2 3 4 5 6 7 C H Green Red	One place lights up to show applicable level Flashes when level is 6 or 7

MEMORANDA

SENSORS AND SWITCHES

Function

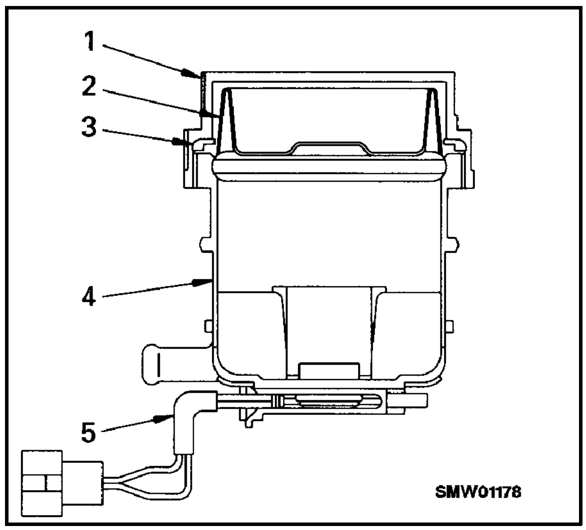
- There are three types of sensor: contact type, resistance type, and electromagnetic type.
- One end of the contact type sensor wiring is connected to the chassis ground; the other end either sends the signal from the sensor directly to the monitor or sends it through a relay.

For the sensors which send the signal directly to the monitor, if the contacts are closed (when the monitor is connected to the ground), the monitor judges that the signal is normal.
For the sensors which send the signal to the monitor through a relay, if the contacts are open, the monitor judges that the signal is normal. (The signal is reversed by the relay).

Sensor detection item	Sensor type	When normal	When abnormal
Brake oil level	Contact	OFF	ON
Engine oil level	Contact	ON	OFF
Radiator water level	Contact	ON	OFF
Fuel level	Resistance		
Engine oil pressure	Contact	OFF	ON
Engine water temperature	Resistance		
Torque converter oil temperature	Resistance		
Travel speed	Electromagnetic		

BRAKE OIL LEVEL SENSOR

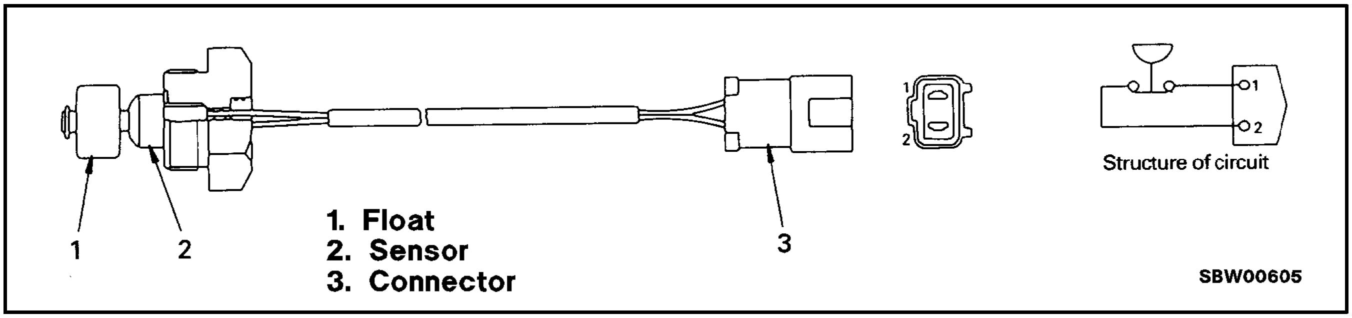
1. Cap
2. Ring
3. Diaphragm
4. Tank
5. Connector



Function

- The brake oil sensor is installed to the bottom of the brake oil tank. If the brake oil goes below the specified level, the float goes down and the switch is turned ON. This actuates the relay, turns the relay output OFF, and makes the machine monitor lamp flash to warn the operator of the abnormality.

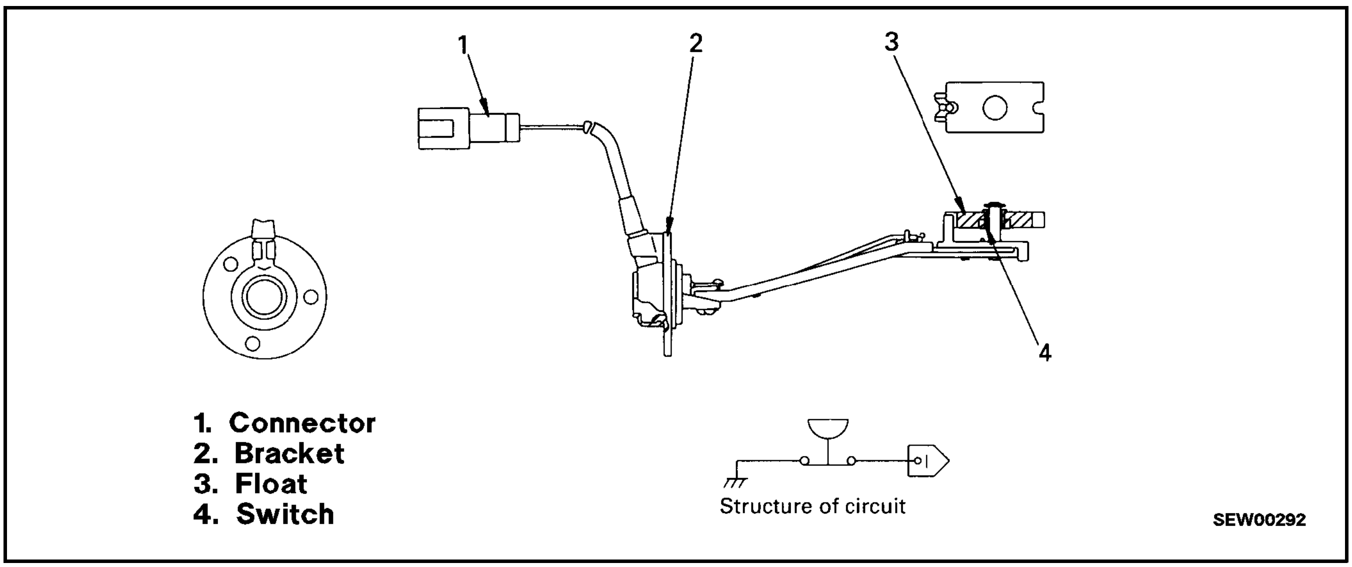
RADIATOR WATER LEVEL



Function

- This sensor is installed to the top of the radiator. If the coolant goes below the specified level, the float goes down and the switch is turned OFF. The caution lamp and alarm buzzer are also actuated at the same time to warn of the abnormality.

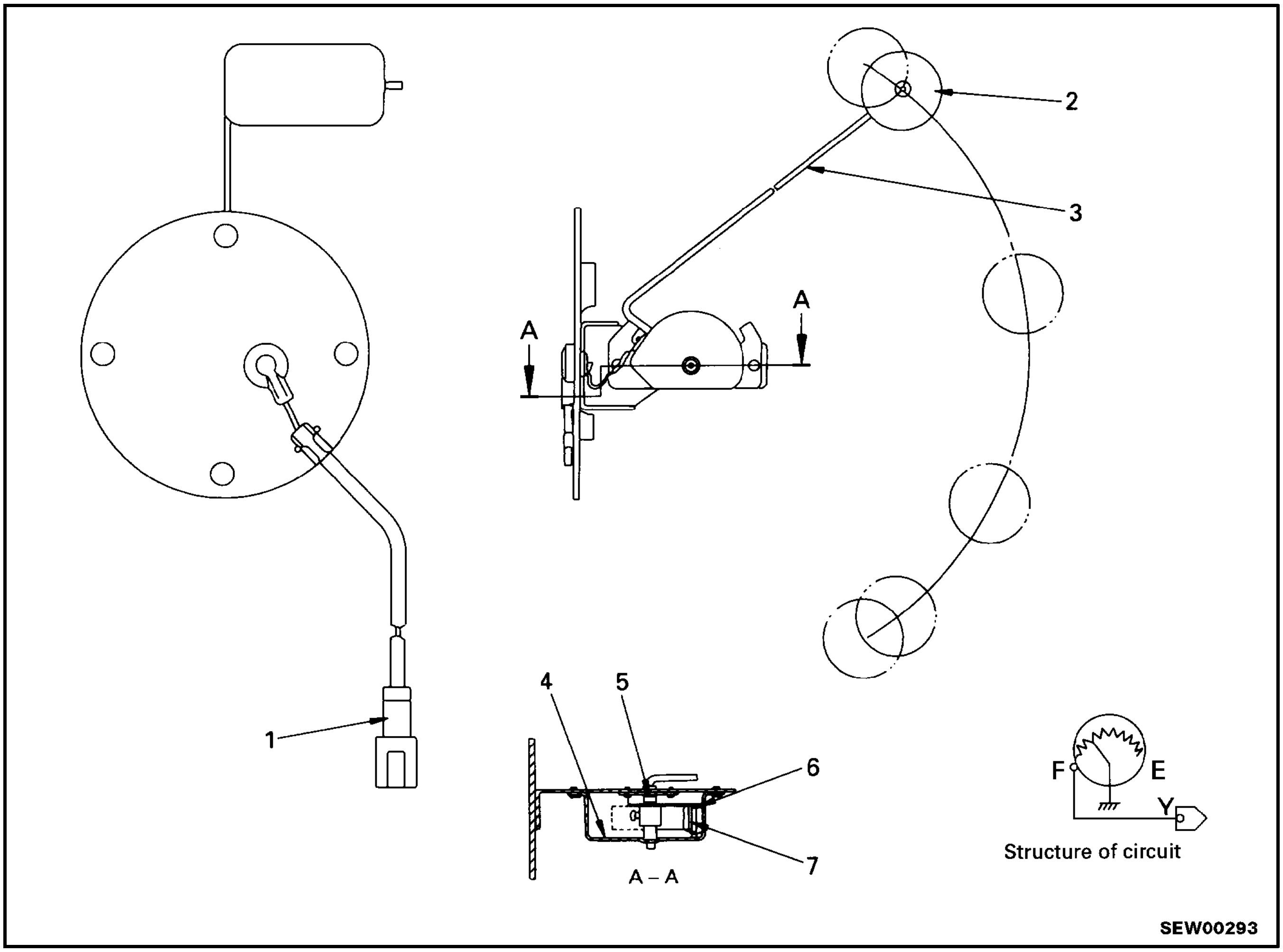
ENGINE OIL LEVEL SENSOR



Function

- This sensor is installed to the side face of the oil pan. When the oil goes below the specified level, the float goes down and the switch is turned OFF. This makes the maintenance monitor flash to warn of the abnormality. The check lamp also lights up at the same time to warn of the abnormality.

FUEL LEVEL SENSOR

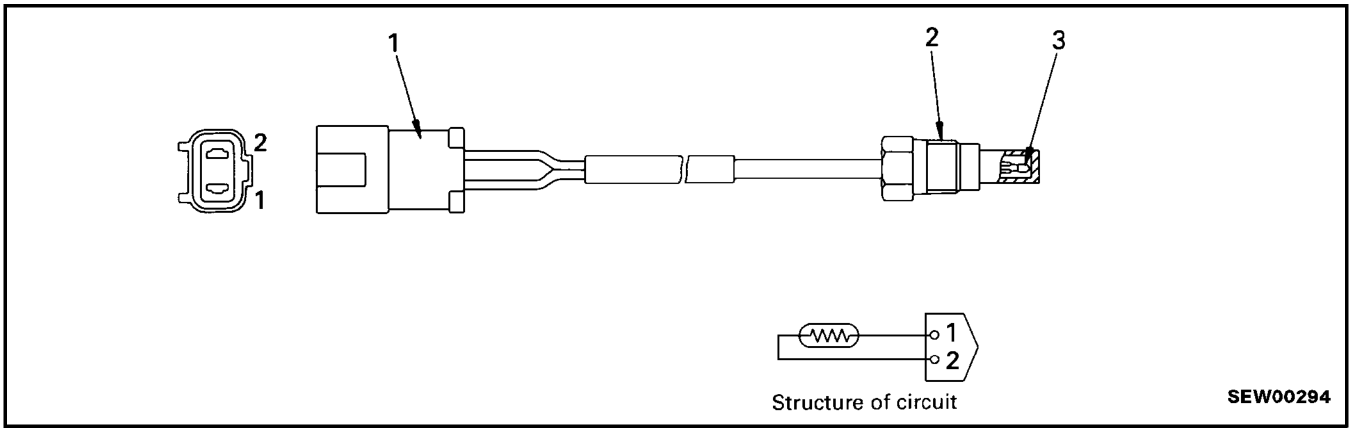


1. Connector
2. Float
3. Arm
4. Body
5. Spring
6. Contact
7. Spacer

Function

- The fuel level sensor is installed to the side face of the fuel tank. The float moves up and down as the level of the fuel changes. As the float moves up and down, the arm actuates a variable resistance, and this sends a signal to the maintenance monitor to display the fuel level. When the display on the maintenance monitor reaches the specified level, the warning lamp flashes.

ENGINE WATER TEMPERATURE SENSOR
TORQUE CONVERTER OIL TEMPERATURE SENSOR

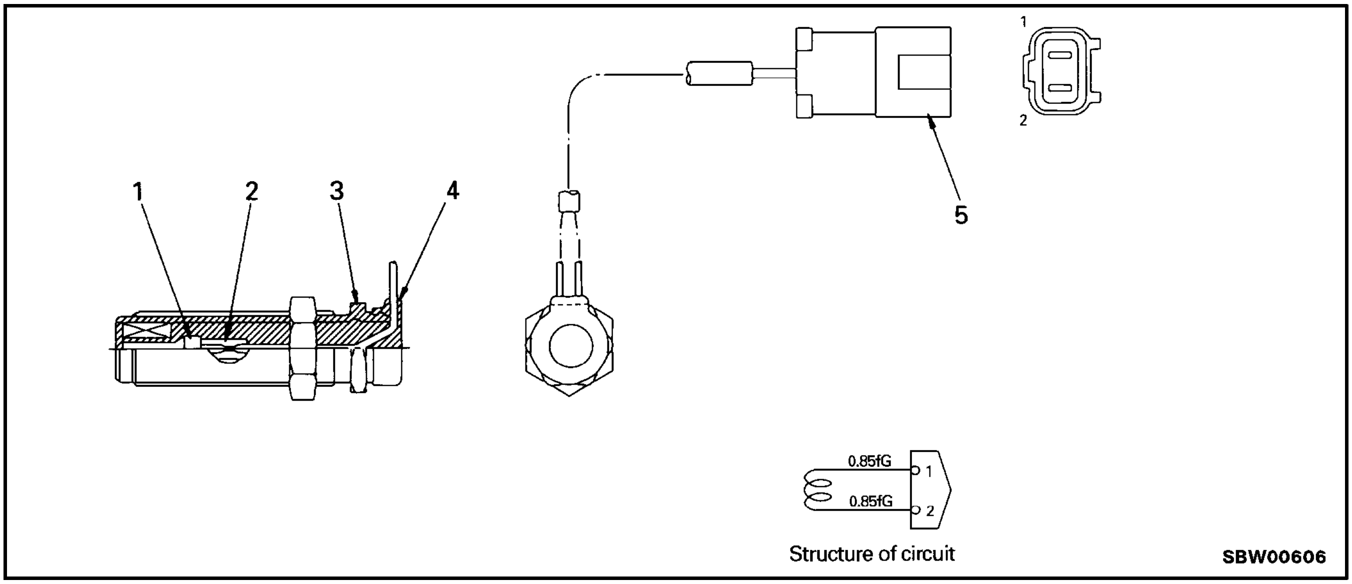


1. Connector
2. Plug
3. Thermistor

Function

- These sensors are installed to the engine cylinder block and transmission case. The change in the temperature changes the resistance of the thermistor, and a signal is sent to the maintenance monitor to display the temperature. If the display on the maintenance monitor reaches the specified position, the lamp flashes and the buzzer sounds to warn of the abnormality.

ENGINE SPEED SENSOR



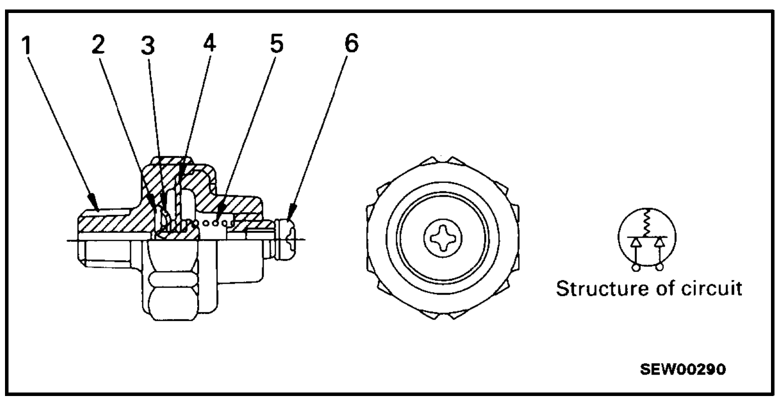
1. Magnet
2. Terminal
3. Case
4. Boot
5. Connector

Function

- The engine speed sensor is installed to the ring gear portion of the flywheel housing. A pulse voltage is generated by the rotation of the gear teeth, and a signal is sent to the controller and monitor panel.

ENGINE OIL PRESSURE SENSOR

1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

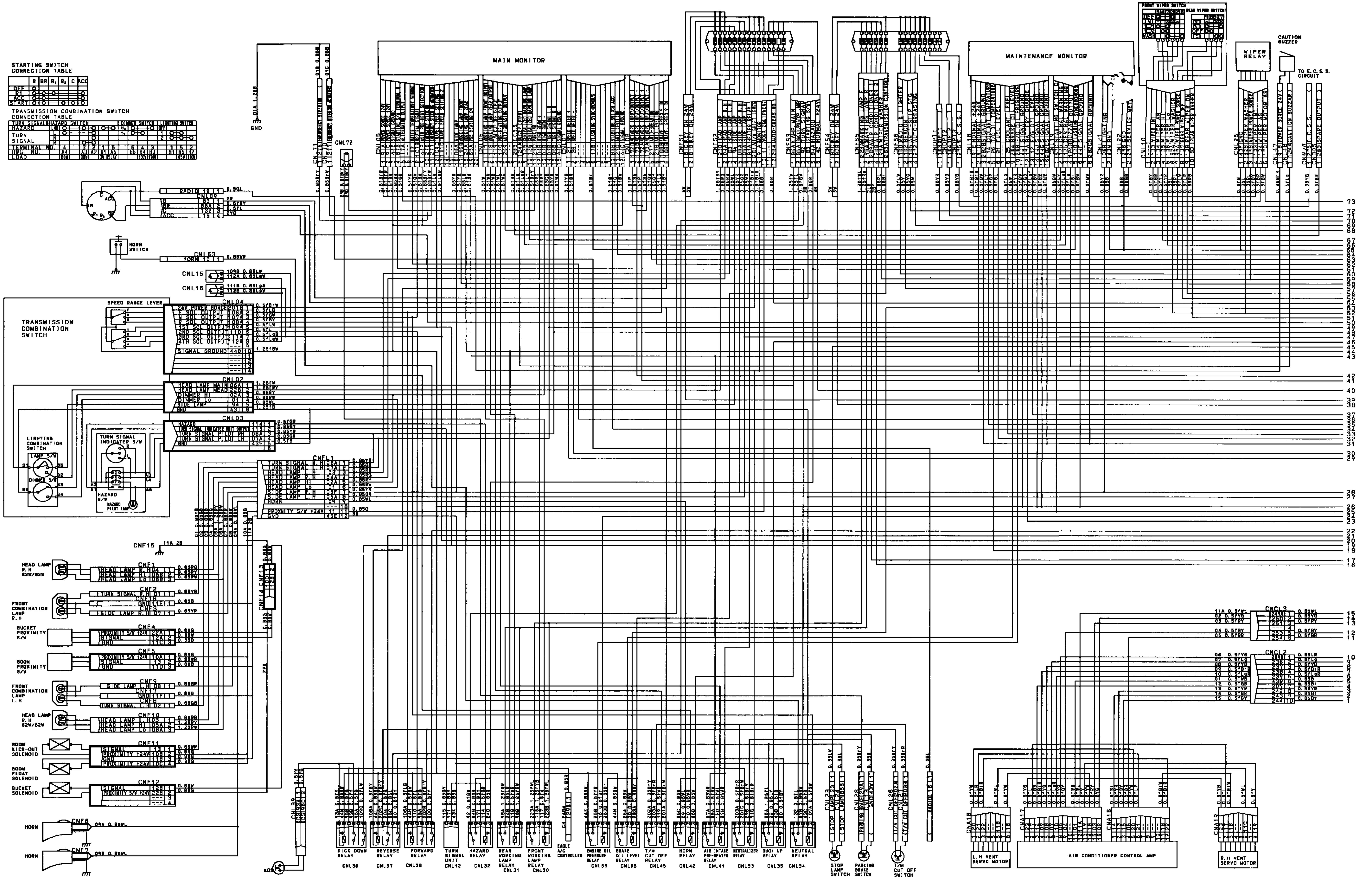


Function

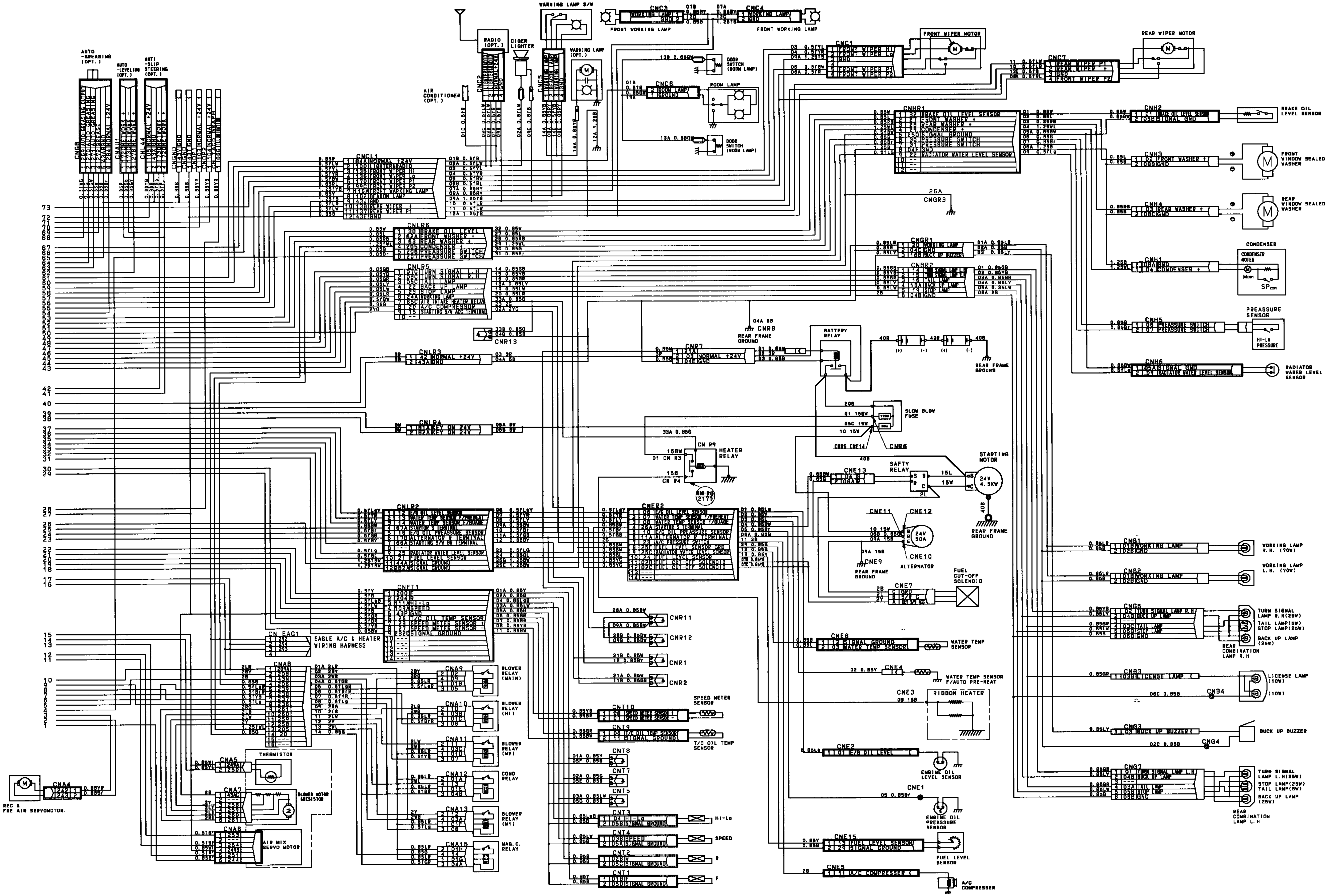
- This sensor is installed to the engine block and the diaphragm detects the oil pressure. If the pressure goes below the specified pressure, the switch is turned ON, and a relay is actuated to turn the output OFF. This makes the maintenance monitor flash to warn of the abnormality. The caution lamp and alarm buzzer are also actuated at the same time to warn of the abnormality.

MEMORANDA

ELECTRICAL WIRING DIAGRAM (1/2)

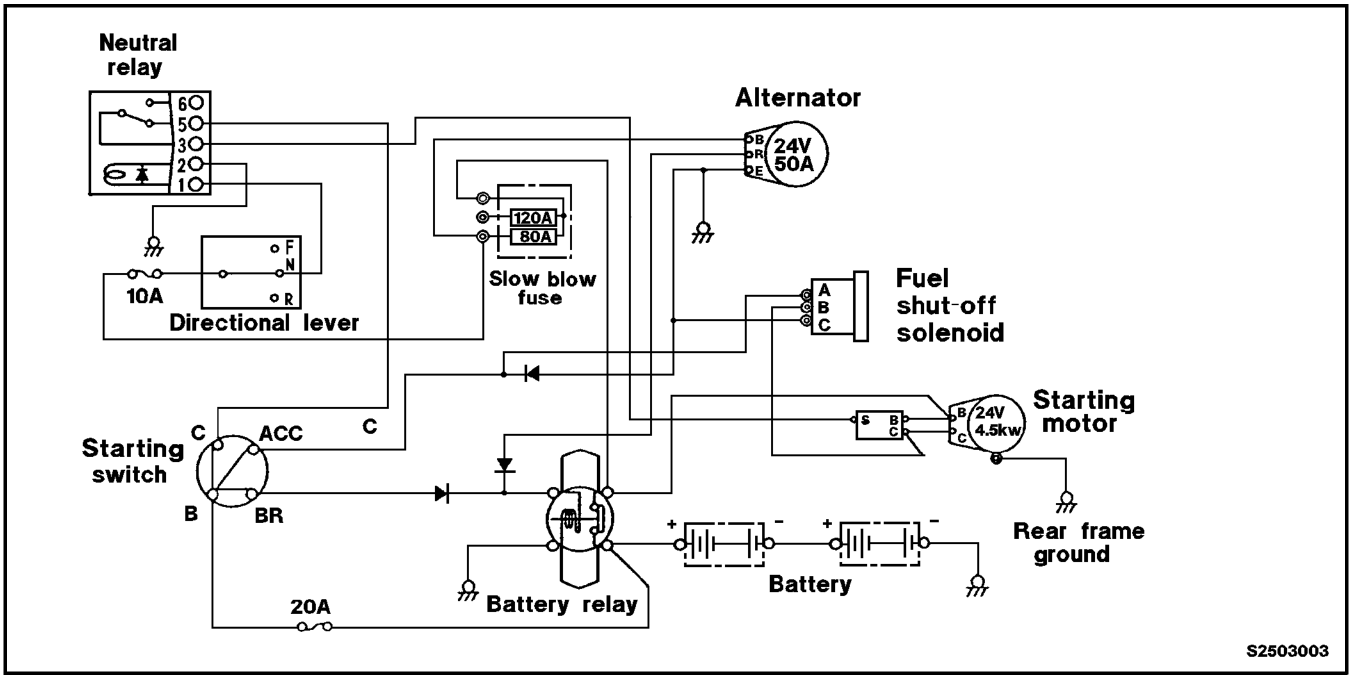


ELECTRICAL WIRING DIAGRAM (2/2)



MEMORANDA

ENGINE STARTING CIRCUIT



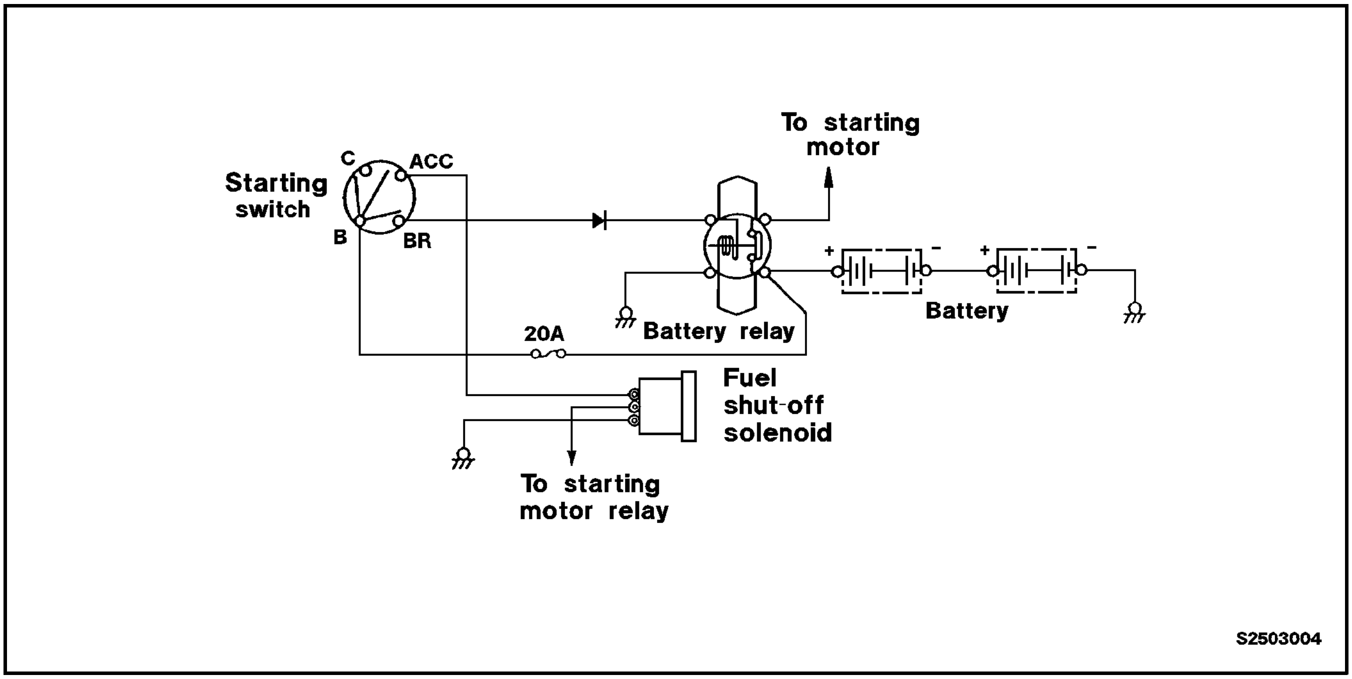
Function

- A neutral safety circuit is used to prevent the engine from starting if the directional lever is not at the **N** position. This ensures safety when starting the engine.

Operation

- When the directional lever is placed at the **N** position, the **N** contacts of the directional lever switch are closed.
- When the starting switch is turned to the **ON** position, Electric current flows from battery (+) starting switch terminal **B** - **BR** battery relay. The battery relay is closed, so current flows in the following circuit: (1) battery(+) slow blow fuse directional switch terminal **N** neutral relay terminals 1 - 2 ground, and the relay coil is excited. When this happens, neutral relay terminals 3 - 5 are closed.
- In addition, electric current flows from switch terminal **ACC** Fuel shut-off solenoid ground, and then fuel shut-off solenoid pulls the stop lever of fuel injection pump to the full position which sets the operating condition.
- If the starting switch is turned to the **START** position, current flows from starting switch terminals **B** - **C** neutral relay terminals 5 - 3 starting motor terminal **S** ground, and a circuit is also formed from the battery battery relay starting motor terminal **B**, so the engine starts.
- If the directional lever is not at the **N** position, circuit (1) is not formed, so the engine does not start.

ENGINE STOP CIRCUIT



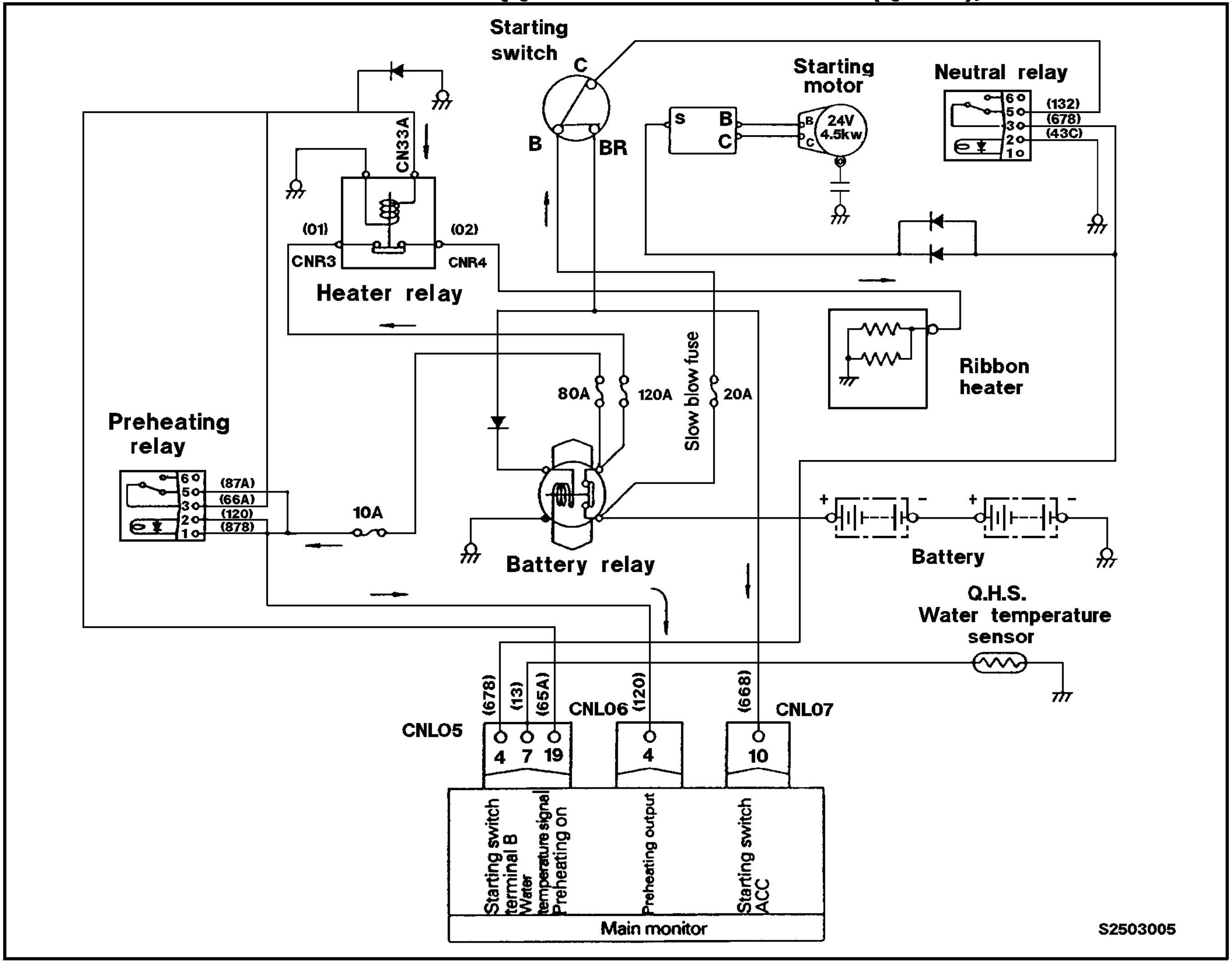
Function

- The system is equipped with an electrical fuel cut device (Fuel shut-off solenoid) which makes it possible to start the engine by turning the switch **ON** or **OFF**. This improves the ease of operation.

Operation

- When the starting switch is turned **OFF**, starting switch terminals **B** and **ACC** are opened.
- The current in the Fuel shut-off solenoid is shut off by the starting switch, so the coil is not excited. Therefore, the stop lever of fuel injection pump is released to the stop position which cuts off the fuel supply to the injection pump and causes the engine to stop.

AUTOMATIC PREHEATING CIRCUIT {QUICK HEATING SYSTEM (Q.H.S.)}



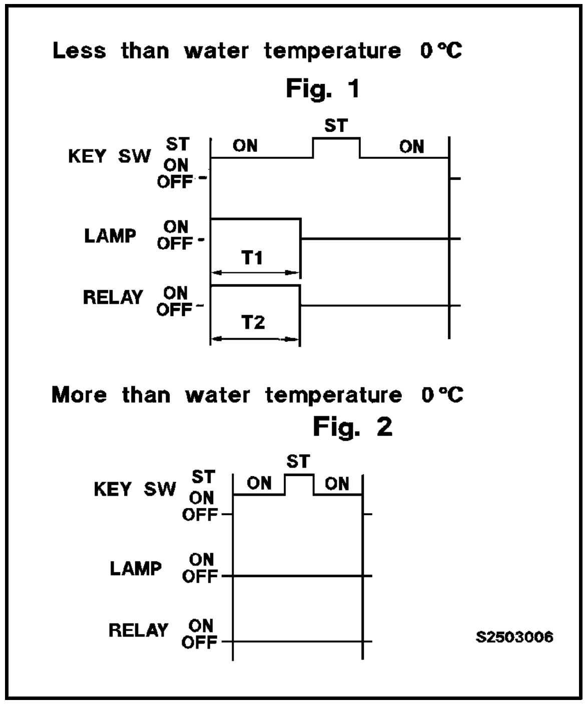
OUTLINE

- To make it easier to start the engine in cold weather, a Q.H.S. (Quick Heating System) automatic preheating system is installed. This consist of a controller, a water temperature sensor, and a large capacity ribbon heater.
- The Q.H.S. automatically sets the preheating time to match the coolant temperature simply by turning the starting switch **ON**. It also acts to reduce the preheating time.
- When the starting switch is turned to the **ON** position, the preheating pilot lamp lights up, and the ribbon heater carries out preheating while the lamp is lit up. The water temperature sensor detects the water temperature and the preheating time is set by the controller in the main monitor.
- While the preheating pilot lamp is lit up, preheating is being carried out, so keep the starting switch at the **ON** position. When the ribbon heater reaches a temperature which makes it possible to start the engine, the preheating pilot lamp goes out to indicate the engine can now be started.
- If the starting switch is turned to the **ON** position while the preheating lamp is **ON**, the current from the battery is divided to not only the starting motor but also to the ribbon heater,and might cause the engine not to start.

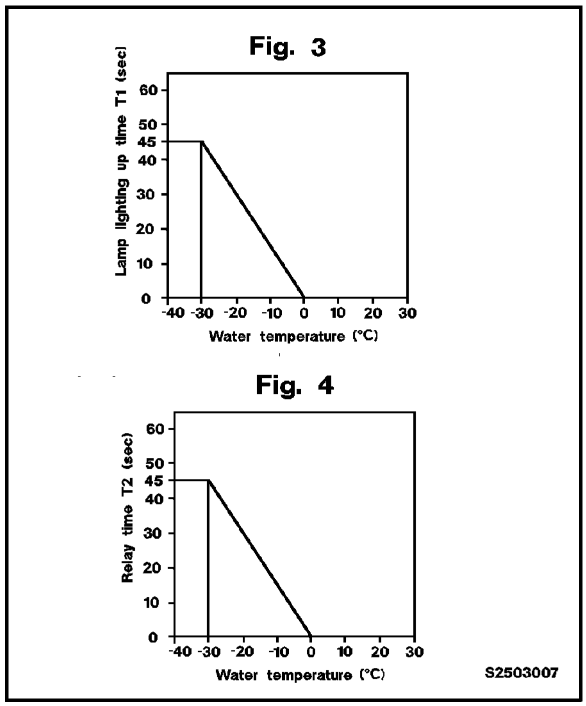
Operation

- When the starting switch is turned to the **ON** position, A signal flows from the starting switch terminal BR to the controller in the main monitor terminal **CNL07-10**. The controller instantaneously detects the water temperature and determines the length of time for lighting up the preheating pilot lamp and the preheating time for the ribbon heater.
- Controller terminal **CNL06-4** is connected to the ground, and lights up the preheating pilot lamp. At the same time, it sends a signal from terminal **3** to the heater relay to actuate the heater relay and make the ribbon heater red hot.
- When the preheating end signal is sent from the controller, the heater relay is turned OFF and preheating is completed.

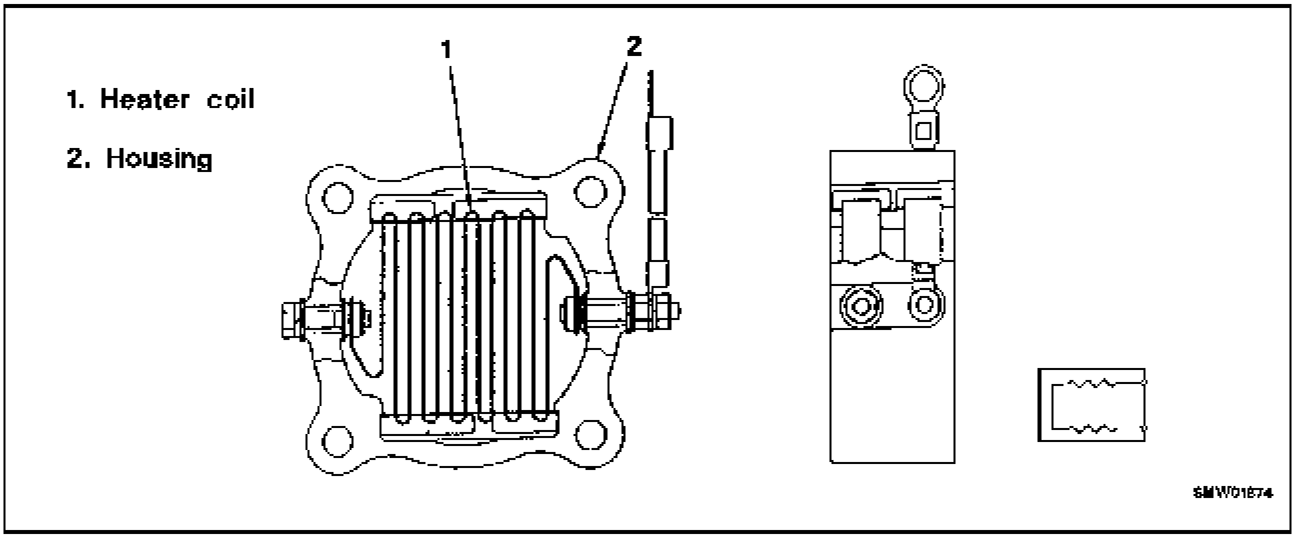
- The diagrams on the right show the actuation sequence. (Fig, 1, Fig. 2)



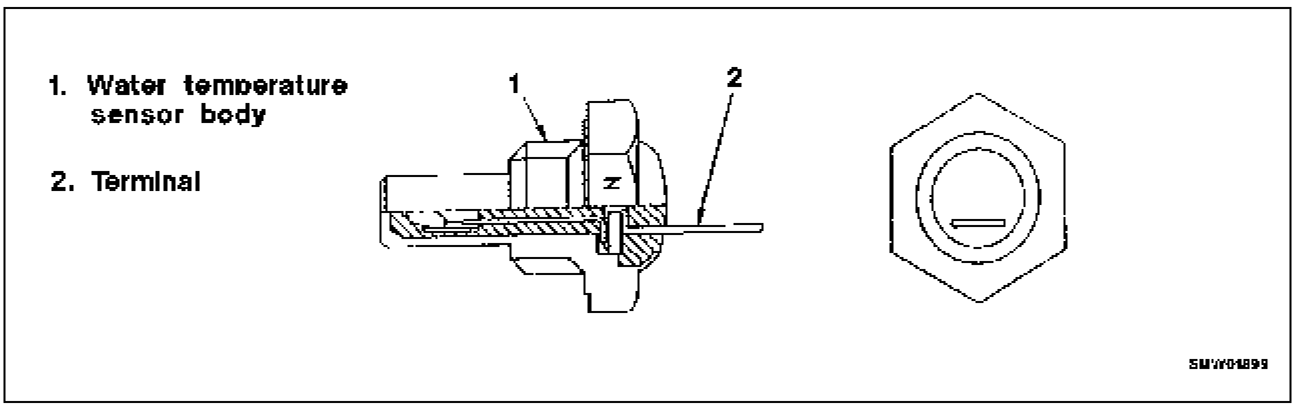
- The diagrams on the right show lighting up time T1 for the preheating lamp and preheating/post heating time T2 according to the water temperature. (Fig. 3 Fig. 4)



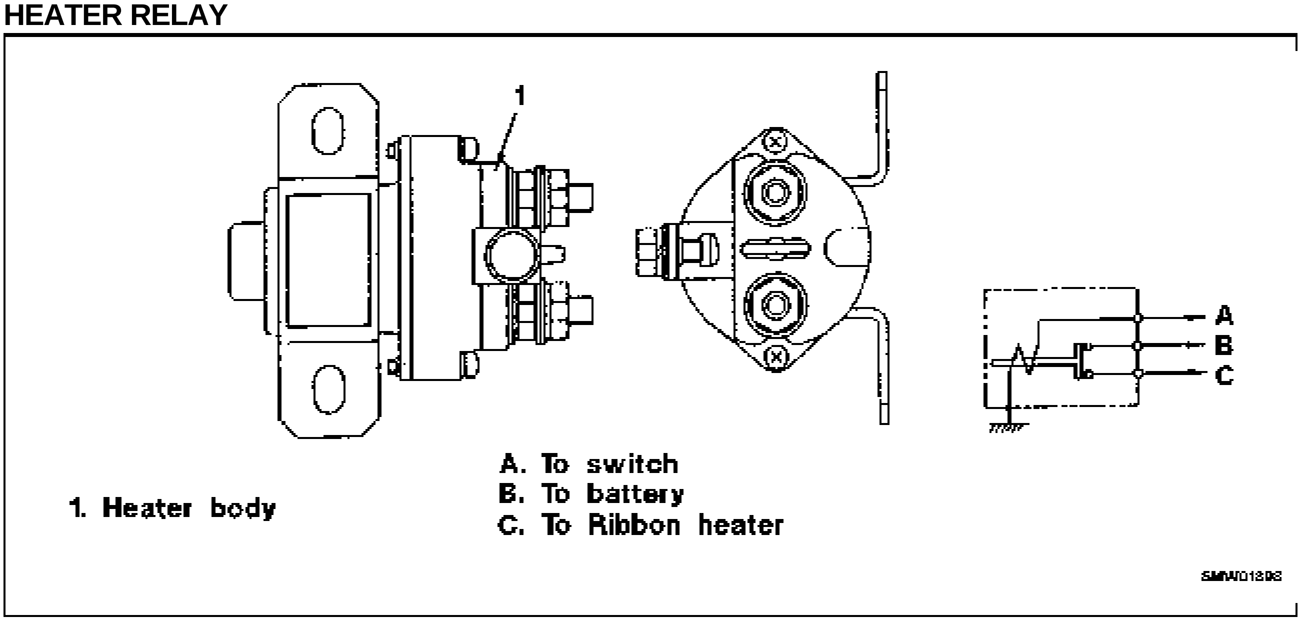
RIBBON HEATER



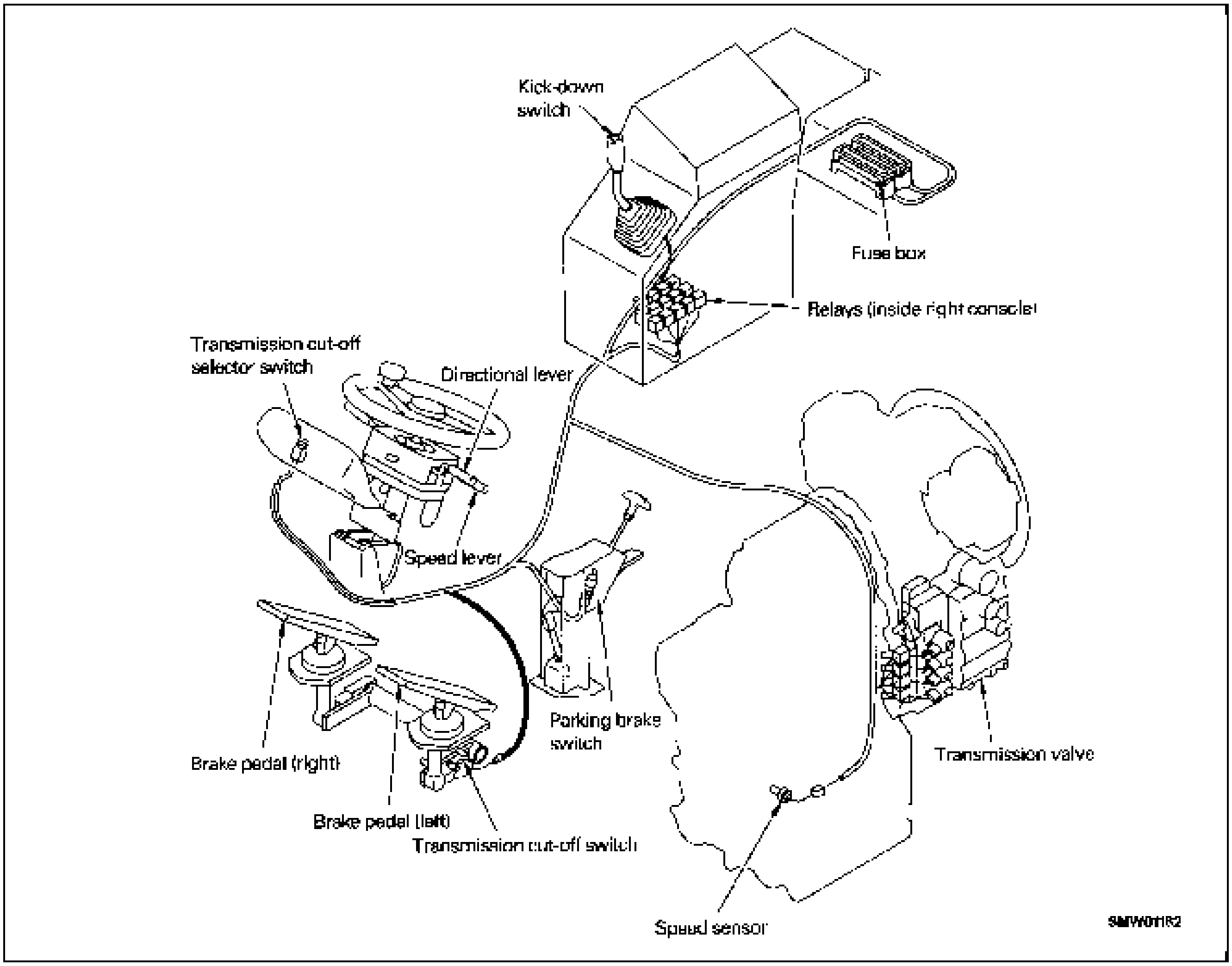
Q.H.S. WATER TEMPERATURE SENSOR



HEATER RELAY

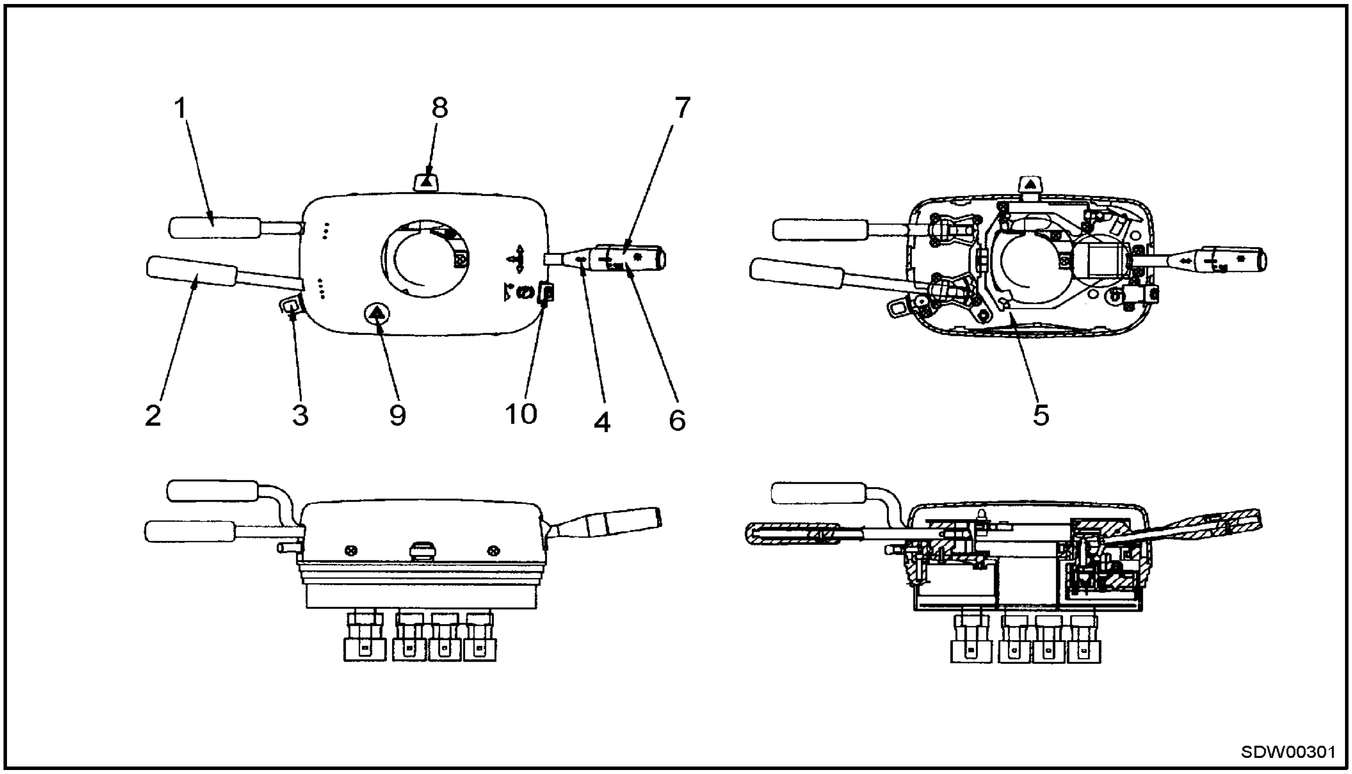


ELECTRICAL TRANSMISSION CONTROL



Function

1	Selection of F, R, or N position.	Use directional lever
2	Selection of speed range	Use speed lever
3	Transmission cut-off function	When the left brake is operated, the transmission is returned to neutral.
4	Transmission cut-off selector function	This is used to select between actuation and non actuation of the transmission cut-off function. When carrying out scooping work or when loading on a trailer, the left brake pedal can be used to make operations easier than on conventional loaders.
5	Neutralizer function	To prevent seizure of the parking brake, the transmission is returned to neutral when the parking brake is applied.
6	Neutral safety function	If the directional lever is not at neutral, the engine will not start even if the starting switch is turned to the START position. This prevents accidents if the machine should start suddenly. (For details, see STARTING CIRCUIT)
7	Warning function	When the machine is traveling in reverse, the backup lamp lights up and the buzzer sounds to warn people in the surrounding area.



Outline

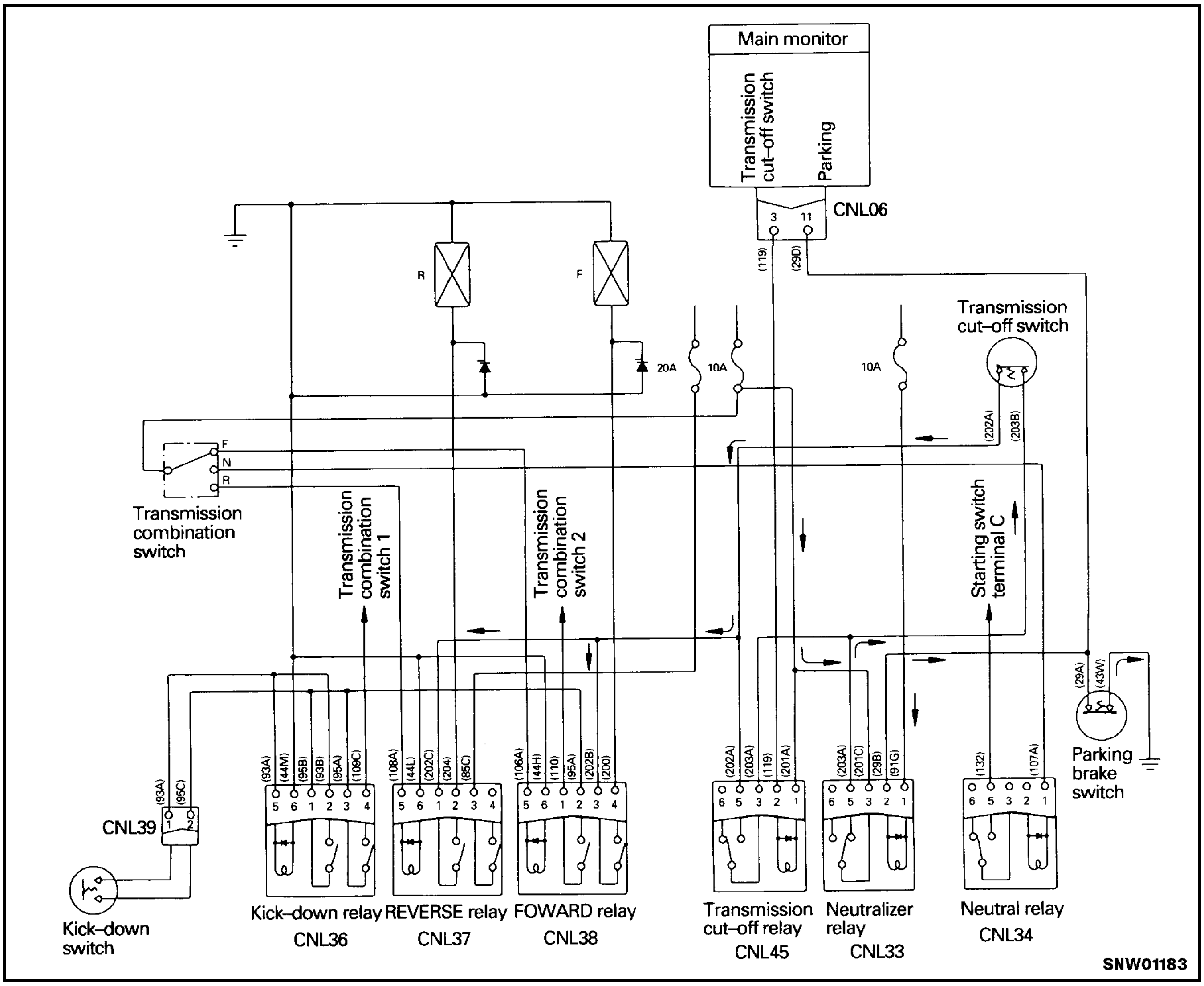
- The directional lever has three positions and the speed lever switch has four positions. As an individual part, the switch does not have a detent mechanism; the detent mechanism is in the combination switch.

Each switch is positioned by two pins, and is secured to the body by three screws. When each lever is operated to the desired position, the switch, which is interconnected by a shaft, acts to allow electric current to flow to that circuit only.-

General locations, function

1	Directional lever switch	Switches between F, R, and N
2	Speed lever switch	Selects speed range
3	Speed lever stopper	Stopper used to prevent speed lever from entering 3rd or 4th during operations
4	Turn signal indicators	Direction indicator lamps used when turning left or right
5	Self cancel	Turn signal indicator lever automatically returns to central position after machines turns left or right
6	Turn signal indicators	Switches on clearance lamp, head lamp, parking lamp, etc.
7	Dimmer switch	Selects high beam for travel and low beam for passing
8	Hazard switch	Makes both left and right turn signal indicator lamps flash at the same time
9	Emergency flashing pilot lamp	Flashes at the same time as the emergency flashing lamp flashes

TRANSMISSION CUT-OFF FUNCTION



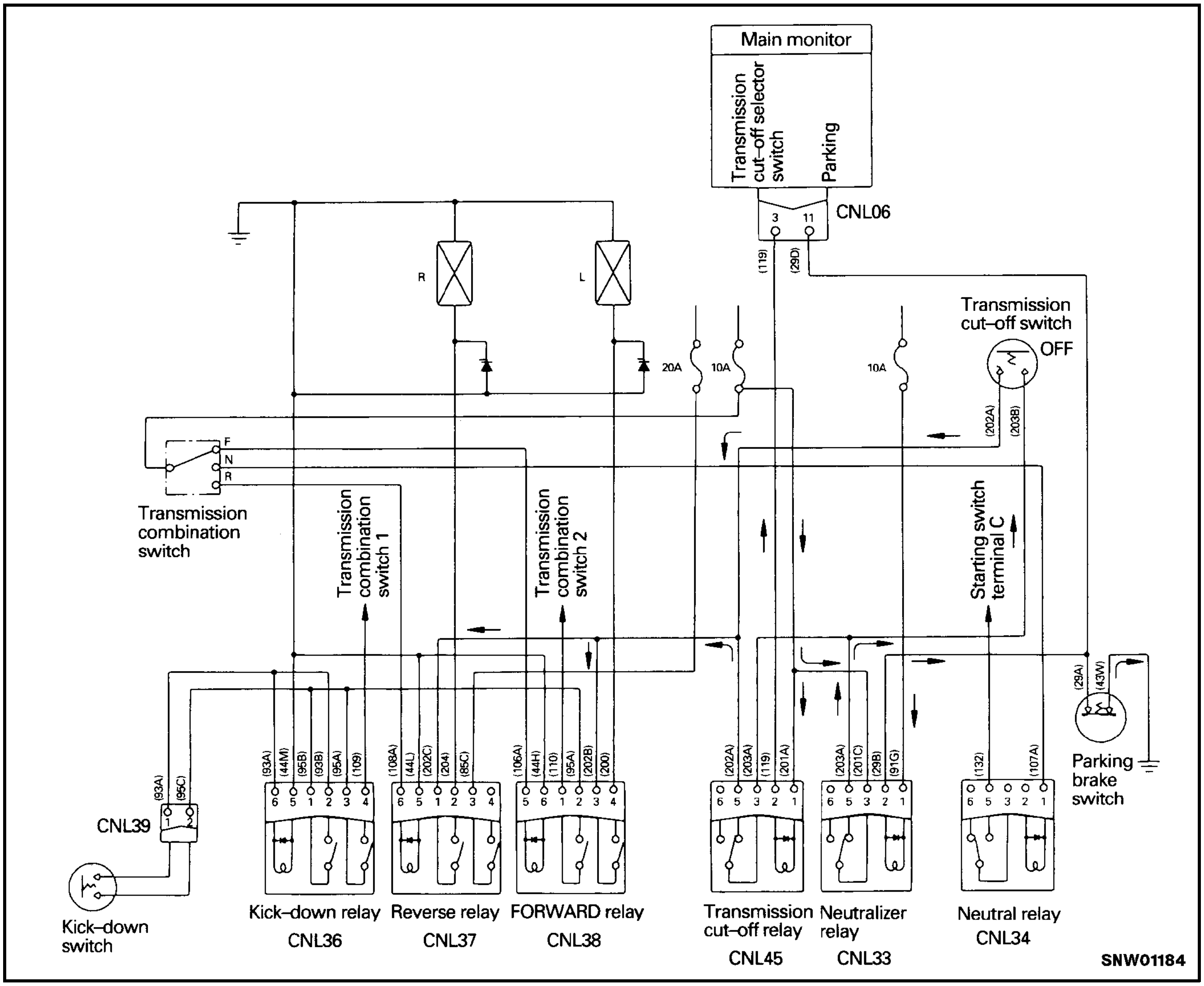
Outline

- If the transmission cut-off selector switch on the main monitor is turned ON (pilot lamp lights up), the transmission cut-off switch installed to the left brake pedal is actuated. When the left brake pedal is operated, the brakes are applied, and the transmission is shifted to neutral at the same time. If the transmission cut-off selector switch is set to the OFF position (pilot lamp goes out), the transmission is not shifted to neutral even when the brake is operated, so the left brake functions only as a brake in the same way as the right brake.

Operation

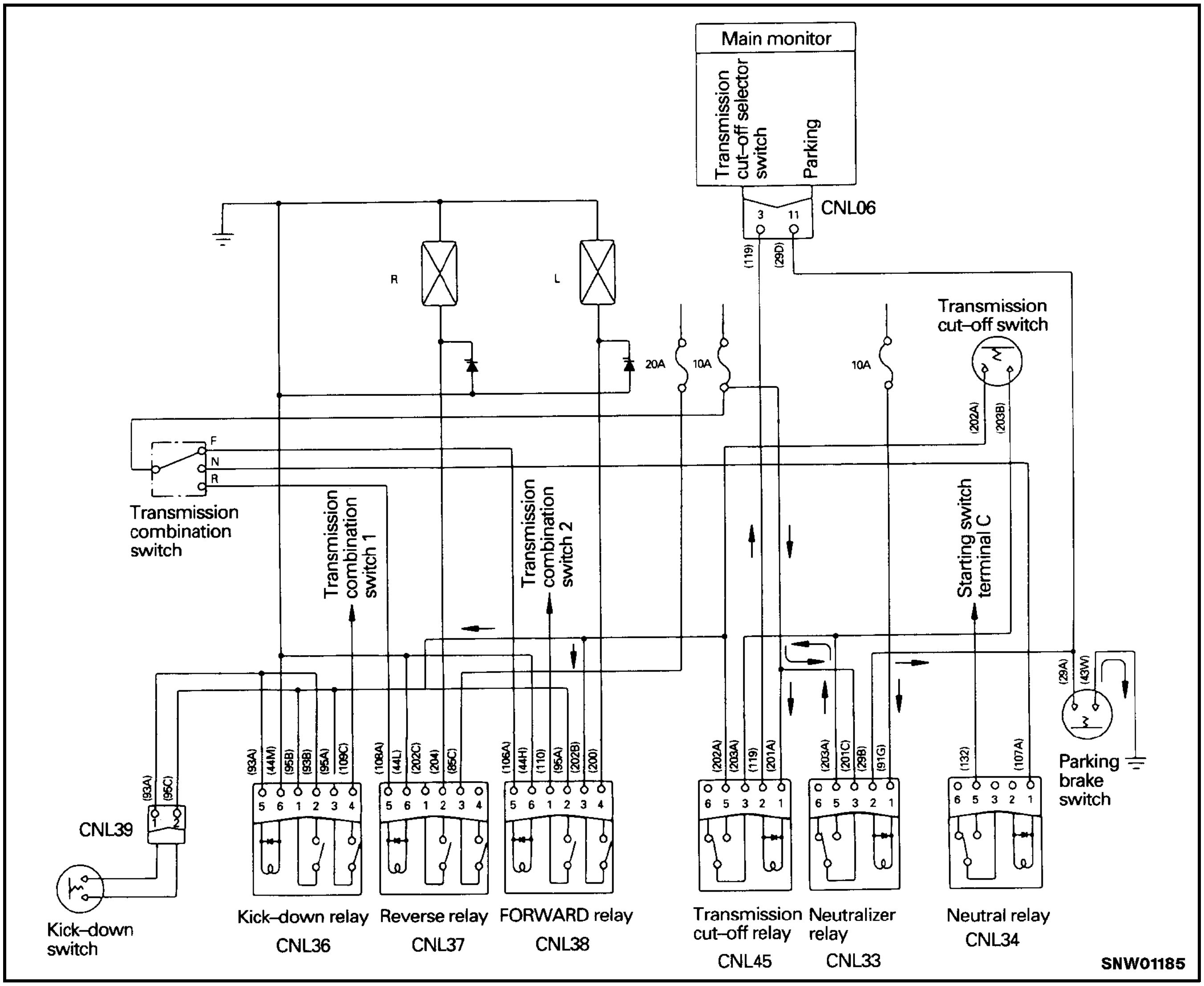
1. Transmission cut-off selector switch ON

- If the transmission cut-off selector switch is turned ON, the transmission cut-off relay solenoid is not excited, so transmission cutoff relay terminals 3 - 5 are not connected. In this condition, +24V voltage is applied through only the transmission cut-off switch to transmission control valve solenoids **R** and **F.**
- When the left brake pedal is depressed, the contacts of the transmission cut-off switch are opened, so the voltage to solenoids **R** and **F** is shut off. As a result, the brakes are applied as normal, and the transmission is also shifted to neutral at the same time.



2. **Transmission cut-off selector switch OFF** If the transmission cut-off selector switch is turned OFF, the transmission cut-off relay solenoid is excited, and transmission cut-off relay terminals 3 - 5 are connected. In this condition, +24V voltage is applied to transmission solenoids **R** and **F** regardless of the position of the transmission cut-off switch. As a result, even when the left brake pedal is depressed, the transmission is not shifted to neutral.

PARKING BRAKE NEUTRALIZER RELAY FUNCTION



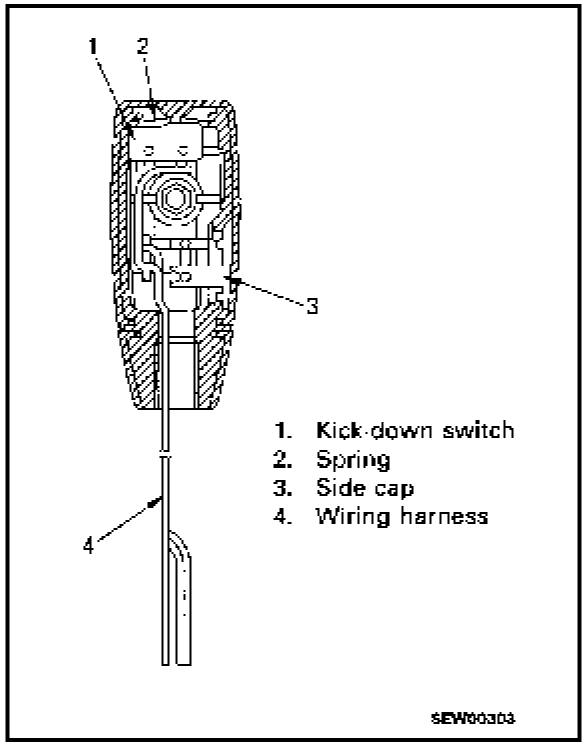
Outline

- When the parking brake is applied, the transmission is kept at neutral. This means that even when the engine is run at full throttle, there is no load on the parking brake, and this prevents any dragging caused by mistaken operation.

Operation

- When the parking brake pedal is depressed, the parking brake switch contacts open, so the neutralizer relay coil is not excited, and relay terminals 3 - 5 are not connected. As a result, no electric voltage is applied to the transmission solenoid and the transmission is placed in neutral.

KICK DOWN SWITCH



Operation

- The kick-down (shifting down from **2nd û 1st**) is actuated only when traveling in **F2**.
- When traveling in **F2**, if it is desired to shift down to lst without operating the speed lever, operate the kick-down switch on the boom lever to ON to shift down to **F1**.
- After this, even if the kick-down switch is pressed, the transmission is kept at **F1**.

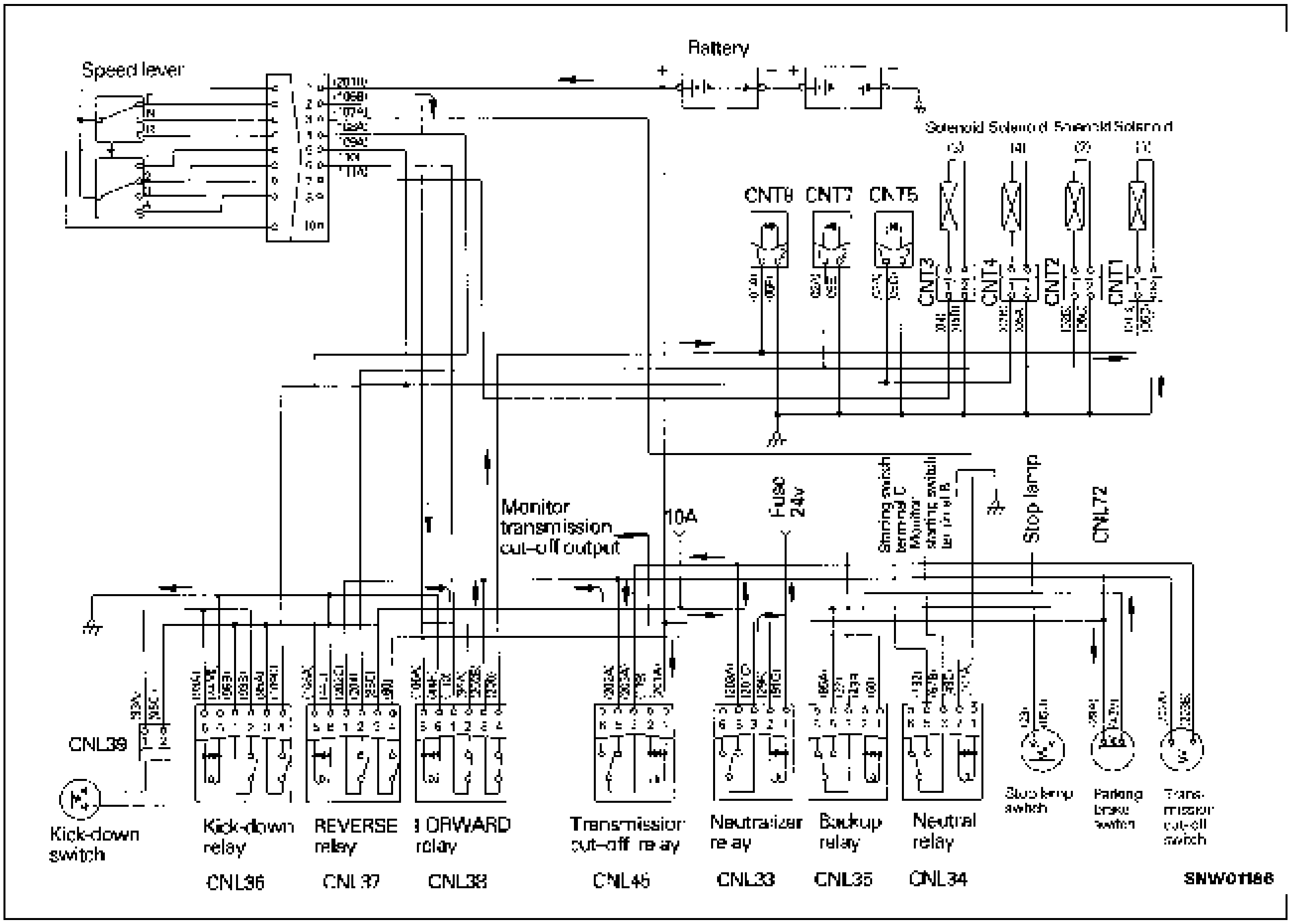
Cancellation (or not actuated)

- When directional lever is at **N**
- When directional lever is at **R**
- When speed lever is not at **2nd**
- When starting switch is **OFF**

KICK DOWN ELECTRIC CIRCUIT DIAGRAM

Normal operation

(directional lever at **F**, speed lever at **2**)



Directional lever set to F

! When the directional lever is set to the F position, electric current flows from the battery ¾û directional lever switch terminal 1 - 2 û FORWARD relay terminal 5 - 6 û ground.
As a result, the FORWARD relay is actuated and terminals 1 and 2 and terminals 3 and 4 are connected.

! Next, the current flows from the battery ¾ û parking brake safety relay terminal 5 - 3 û parking brake switch terminal 3 - 2 û neutralizer relay terminal 1 - 2 û ground, and neutralizer relay terminal 3 - 5 are connected. In addition, electric current flows from the battery ¾ û transmission cut-off relay terminal 1 - 2 û monitor, and transmission cut-off relay terminals 3 - 5 are connected.

! Electric current flows from the battery ¾û neutralizer terminal 3 - 5 û transmission cut-off relay terminal 3 - 5 û FORWARD relay terminal 1 - 2 û solenoid 1 û ground, and solenoid (1) is actuated.

Speed lever set to 2

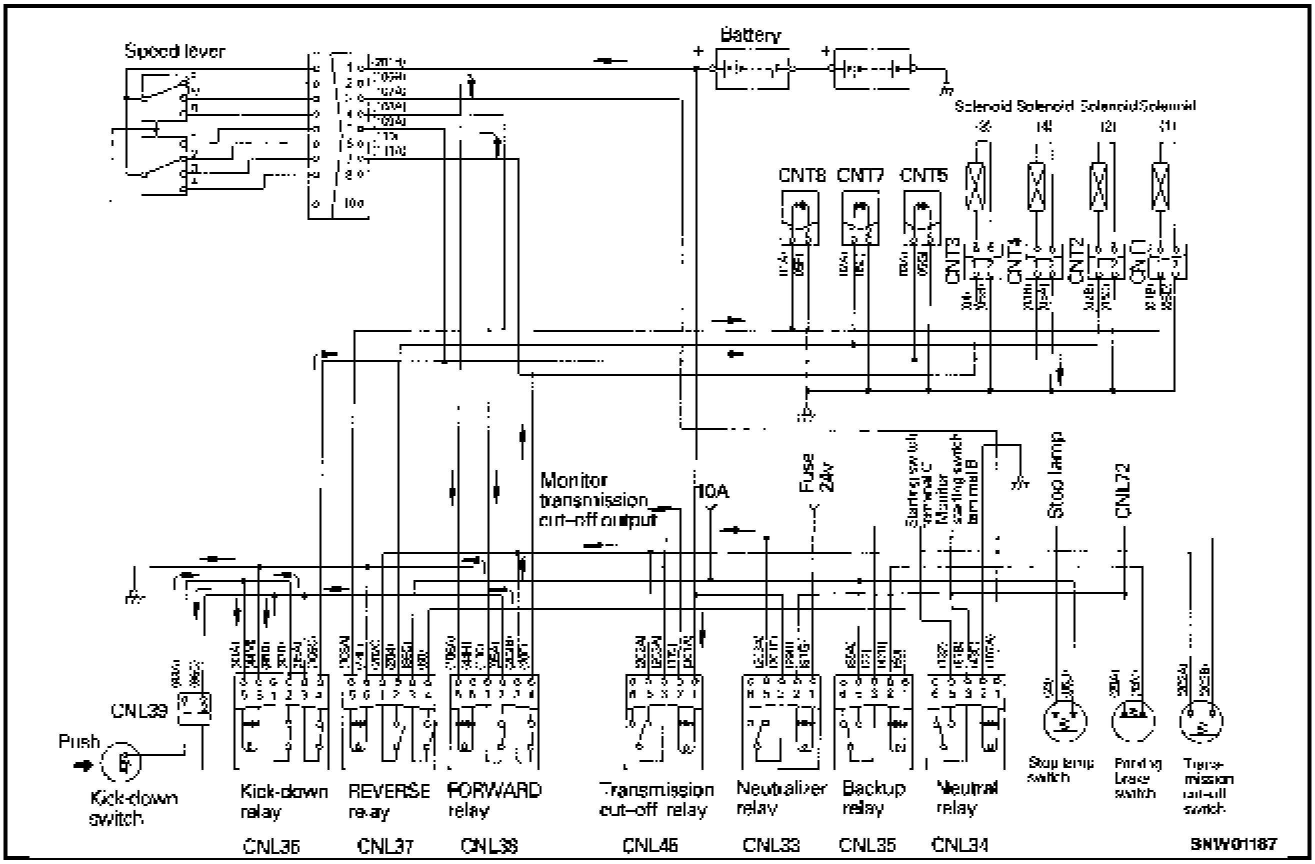
! When the speed lever is at position 2, no electric current flows to solenoids (2), (3), or (4). In this condition, the transmission valve is set to **F2** by the action of solenoid (1). No current flows to the coil (relay terminals 5 - 6) of the kick-down relay if the kick-down is not pressed. Therefore, the kick-down relay is not actuated, and the transmission is held in **F2.**

Solenoid actuation table

Solenoid		F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	F	M	F	F					
REVERSE	(2)						F	F	F	F
H-L select	(3)			F	F				F	F
Speed select	(4)	F			F		F			F

Kick-down switch operated

(when operating or traveling in **F2**)
(When kick-down switch is pressed **ON**)



! When the kick-down switch is pressed, electric current flows from the battery ¾û speed lever 2 û FORWARD relay terminal 3 - 4 û kick-down switch û kick-down relay terminal 5 - 6 û ground.
As a result, the kick-down is actuated, and kick-down relay terminals 1 and 2 and terminals 3 and 4 are closed. A circuit from kick-down relay terminal 1 - 2 û kick-down relay terminal 5 - 6 û ground is formed, so the kick-down relay continues to be actuated even if the kick-down switch is returned. (Self-hold circuit of kick-down relay)

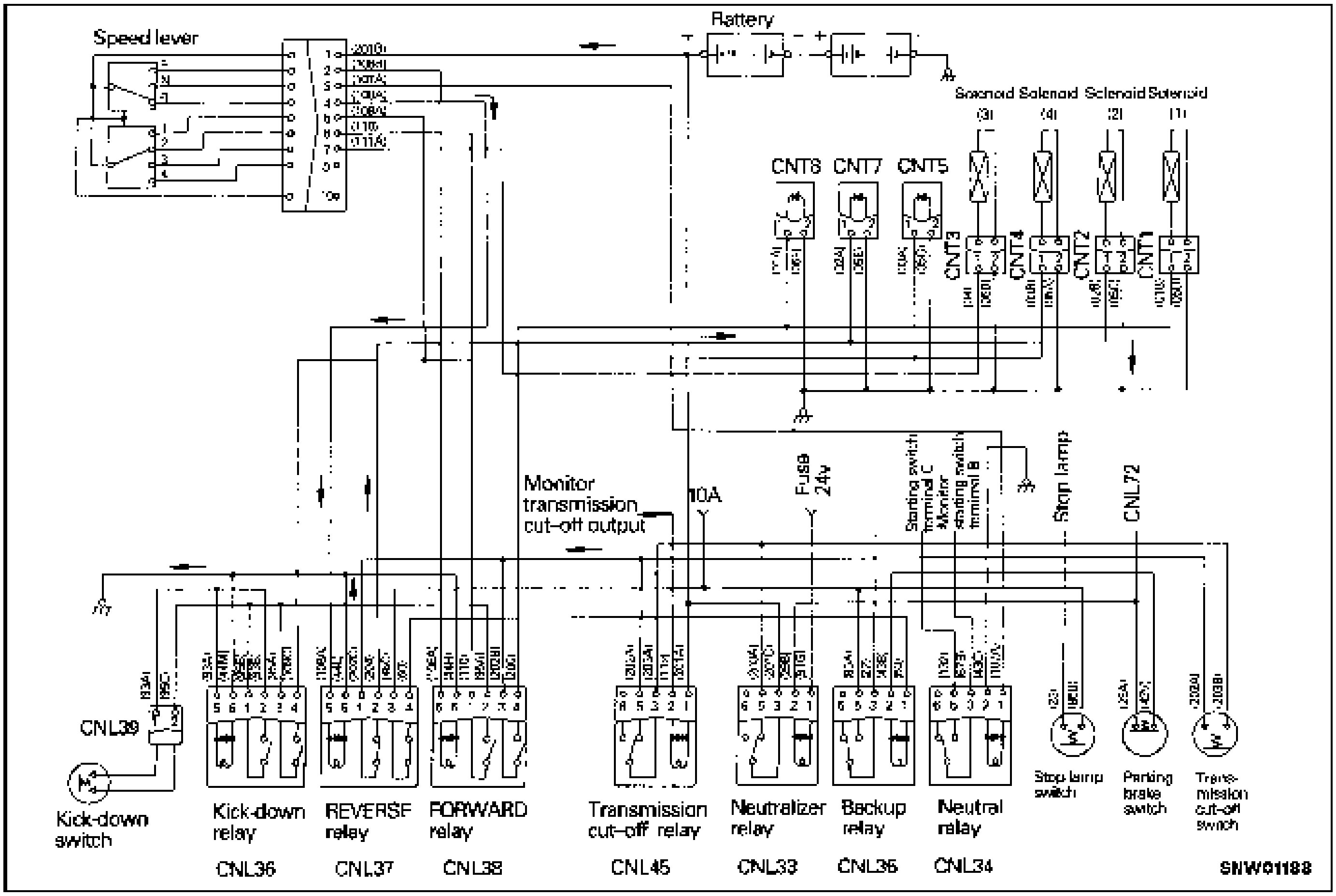
! When the kick-down relay is actuated and terminals 3 and 4 are closed, electric current flows from the battery ¾û kick-down relay terminal 3 - 4 û solenoid 4 û ground, and solenoid (4) is actuated. Solenoids (1) and (4) are actuated, so the transmission is set to **F1**.

In this way, if the kick-down switch is pressed when the speed lever is at **F2**, the transmission will shift to **F1.** At the same time, it will be held in **F1** by the self-hold function of the kick-down relay even when the kick-down switch is released. However many times the kick-down switch is pressed, the transmission will stay in **F1**.

Solenoid actuation table

Solenoid		F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	M	F	F	F					
REVERSE	(2)						F	F	F	F
H-L select	(3)			F	F				F	F
Speed select	(4)	M			F		F			F

Canceling actuation of kick-down switch (case I)
(Directional lever moved to **N** or **R**)



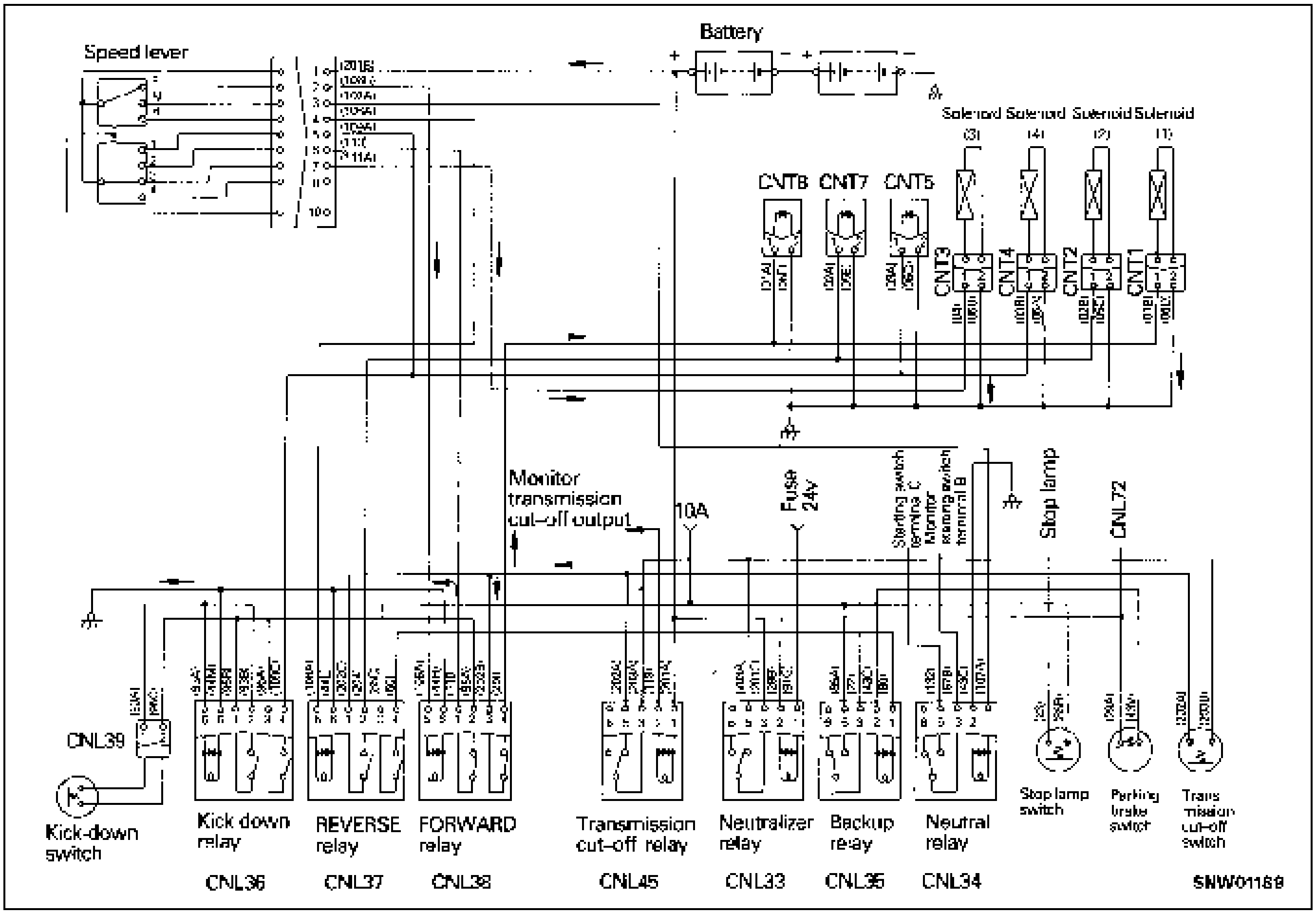
- ! When the directional lever is moved to the R position, the F terminal contacts are turned OFF, so the electric current stops flowing from the battery ¾û directional lever F û FORWARD relay terminal 5 - 6 û ground, and the FORWARD relay is reset.
- ! FORWARD relay terminals 1 and 2 and terminals 3 and 4 are opened, so the electric current stops flowing to the solenoid of the kick-down relay, and the kick-down relay is reset.
- ! In this way, the self-hold circuit of the kickdown relay is canceled, and terminals 3 and 4 are opened, so solenoid (4) is no longer actuated. (When the directional lever is moved to the N position, the actuation is the same as above and the kick-down relay is canceled.)
  In addition, FORWARD relay terminal 1 and 2 are opened, so solenoid (1) is no longer actuated.
- ! When the directional lever is moved to the R position, current flows from the battery¾û directional lever R -û REVERSE relay terminal 5 - 6 û ground, so the REVERSE relay is actuated and REVERSE terminals 1 and 2 and terminals 3 and 4 are closed.
- ! As a result, electric current flows from the battery ¾û REVERSE relay terminal 1 - 2û solenoid 2 û - ground, and solenoid (2) is actuated. Therefore, only solenoid (2) is actuated, and the transmission is set to the **R2** position.

Solenoid actuation table

Solenoid		F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	F	F	F	F					
REVERSE	(2)						F	M	F	F
H-L select	(3)			F	F				F	F
Speed select	(4)	F			F		F			F

Canceling actuation of kick-down switch (case II)

(Speed lever moved to position other than 2)



- ! If the speed lever is moved to any position other than 2, the electric current stops flowing from the battery¾û speed lever 2û FORWARD relay terminals 3 - 4, and the current to the kick-down relay is also shut off.
- ! Therefore, the kick-down relay is canceled, and solenoid **(4)** is no longer actuated.
- ! If the speed lever is moved to **3,** solenoid (3) is actuated. In addition, the directional lever is at the F position, so solenoid (1) is actuated. Therefore, solenoids (1) and (3) are actuated and the transmission is set to **F3.**

Solenoid actuation table

Solenoid		F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	F	F	M	F					
REVERSE	(2)						F	F	F	F
H-L select	(3)			M	F				F	F
Speed select	(4)	F			F		F			F

Canceling actuation of kick-down switch (Case III)
(starting switch turned **OFF**)

- When the starting switch is turned **OFF**, the electric current stops flowing from the battery ¾û speed lever 2û FORWARD relay terminal 5 - 6 û ground, and the kick-down relay is reset.
- Therefore, the kick-down relay is canceled.
- If the starting switch is turned **ON** again, the self-hold circuit of the kick-down relay has been canceled, so the transmission will work as normal.

2 0 TESTING AND ADJUSTING

* See **ENGINE SHOP MANUAL**.

i When using the standard value tables to make judgement for testing, adjusting, and troubleshooting, the following precautions are necessary:

1. The standard values in the tables are the values for a new machine and are given as reference values for the time when the machine is shipped from the factory. These values should be used as a guide when estimating wear after the machine is operated, and when carrying out repairs.
2. The permissible values given in the tables are values estimated based on the results of various tests carried out on the machines shipped from the factory, so they should be used together with the information on the repair condition and other information such as the operating history of the machine when judging the condition of the machine.
3. These standard values **do not** form a basis for judging claims.

⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground and use the safety pins and blocks to prevent the machine from moving

⚠ When carrying out work together with co- workers, always use signals and **do not** let unauthorized people near the machine.

⚠ When checking the coolant level, always wait for the coolant to cool down. If the radiator cap is removed when the coolant is still hot, the coolant will spurt out and cause burns.

⚠ Be careful not to get caught in the fan, fan belt or other rotating parts.

MEMORANDA

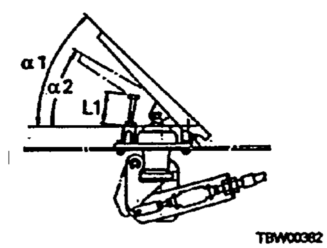
STANDARD VALUE TABLE FOR ENGINE - In Chassis

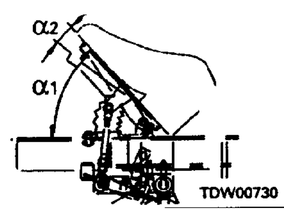
Machine model			WA250-3L	
Engine model			Komatsu S6D102E-1	
Item	Measurement condition	Unit	Standard value for new machine	Service limit value
Engine speeds	High idle	rpm	2650 ± 50	2650 ± 50
	Low idle		850 ± 25	850 ± 25
Engine rating	Rated gross power / rated speed	kW / rpm	101 / 2400	101 / 2400
Intake manifold pressure	At T.C. stall and W.O.T (Wide Open Throttle)	mm Hg	900-1100	900-1100
Intake air restriction	At T.C. stall and W.O.T. at restriction indicator port	mm H_2O	New element: 380 Used Element: 635	Max. 635
Lubricating oil pressure with SAE 15W-40 oil & coolant temperature in operating range	Minimum at low idle	kPa (kg/cm^2)	70 (0.70)	70 (0.70)
	Minimum at rated speed & load	kPa (kg/cm^2)	276 (2.81)	276 (2.81)
Fuel filter inlet restriction	Maximum restriction at high idle	mm Hg	100	200
Blow-by pressure	Coolant temperature in operating range: • Service Tool orifice size: 5.613 mm • At T.C. stall and W.O.T. • With SAE 15W-40 oil	mm H_2O	180	360
Exhaust back pressure	Maximum at T.C. stall and W.O.T.	mm Hg	77	77
Coolant temperature	Maximum operating temperature	°C	100	100
Valve clearance	Engine cold: Intake valves Exhaust valves	mm	0.25 0.51	0.25 0.51

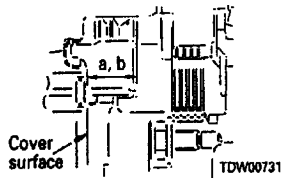
★ For further detailed information, refer to Engine Shop Manual.

STANDARD VALUE TABLE FOR CHASSIS

Machine model			WA250-3L	
Engine model			Komatsu S6D102E-1	
Item	Measurement condition	Unit	Standard value for new machine	Service limit value
Engine stall speeds:	• Coolant temperature in operating range • Torque converter oil temperature in operating range • Hydraulic oil at normal operating temperature	rpm		
Torque converter			2500 ± 100	2500 ± 200
Hydraulic			2500 ± 100	2500 ± 200
Full			1900 ± 200	1900 ± 300

Cate gory	Item		Measurement Condition	Unit	Standard value for new machine	Service limit value
Accelerator pedal	Operating Force			N (kg)	49-98 (5-10)	147 (15)
	Operating Angle	∢1		deg.	48 ± 3	---
		∢2			30 ± 2	---
	Stopper Height	L1		mm	48 ± 5	---
Directional lever	Operating Force	N-FORWARD	• Engine stopped • Torque converter oil temperature: 60-80°C (140-176°F)	N (kg)	5.9 +4.9, -2.9 (0.6 +0.5, -0.3)	13.7 (1.4)
		N-REVERSE			5.9 + 4.9, -2.9 (0.6 +0.5, -0.3)	13.7 (1.4)
	Travel	N-FORWARD		mm	40 ± 10	40 ± 20
		N-REVERSE			40 ± 10	40 ± 20
Speed lever	Operating Force	1st ➜2nd		N (kg)	5.9 +4.9, -2.9 (0.6 +0.5, -0.3)	13.7 (1.4)
		2nd➜3rd			5.9 +4.9, -2.9 (0.6 +0.5, -0.3)	13.7 (1.4)
		3rd➜4th			5.9 +4.9, -2.9 (0.6 +0.5, -0.3)	13.7 (1.4)
	Travel	1st 2nd		mm	40 ± 10	40 ± 20
		2nd 3rd			40 ± 10	40 ± 20
		3rd 4th			40 ± 10	40 ± 20

Category	Item	Measurement Condition	Unit	Standard value for new machine	Service limit value
Transmission Valve	Priority valve pressure	• Torque converter oil temperature: 60-80°C (140-176°F) • Engine speed: Low idling	Mpa (kg/cm²)	2.3 ± 0.2 (23 ± 2)	2.3 ± 0.2 (23 ± 2)
	Pilot reducing valve pressure			1.0 ± 0.1 (10 ± 1)	1.0 +0.1, -0.2 (10+1,-2)
	Clutch pressure			2.3 ± 0.2 (23 ± 2)	2.3+0.3,-0.4 (23+3,-4)
	Torque converter outlet port pressure			0.38 ± 0.05 (3.9 ± 0.5)	0.38 ± 0.10 (3.9 ± 1.0)
Steering wheel	Play	• Engine speed: Low idling • Machine facing straight to front	mm	20 ± 20	Max. 60
	Operating Force	• Flat, horizontal, straight, dry paved road surface • Hydraulic oil temperature: 45-55°C (113-131°F) • Engine speed: Low idling	N (kgf)	9.8 - 12.8 (1.0 - 1.3)	Max. 14.2 (Max. 1.5)
	Operating time — Low idle		Sec.	Max. 5.4	Max. 6.0
	Operating time — High idle			2.9 ± 0.3	2.9 ± 1.0
Steering valve	Relief pressure	• Engine speed: High idle • Hydraulic oil temperature: 45-55°C (113-131°F)	Mpa (kg/cm²)	18.6 ± 0.69 (190 ± 7)	18.6 ± 2.0 (190 ± 20)
Brakes	Operating angle ∢2	• Brake pedal operating force : 206 N (21kg) 	deg.	18.5 ± 4	18.5 ± 6
	Operating angle ∢1			48	---
	Performance	• Flat, horizontal, straight, dry paved road surface • Speed when applying brake: 20 km/h, braking delay: 0.1 sec • Brake pedal operating force: 490 N (40 kg) • Tire inflation pressure: Specified pressure	m	Max. 5.0	Max. 5.0
	Drop in hydraulic pressure	• 4.1 Mpa (42 kg/cm²) in 5 min.	Mpa (kg/cm²)	Max. 0.34 (Max. 3.5)	Max. 0.34 (Max. 3.5)
	Wear of disc	• Thickness of disc	mm	1.0 ± 0.1	Min. 0.6

Parking brake	Performance			• Tire inflation pressure: Specified pressure • Flat paved road with 1/5 (11°20') grade • Dry road surface Machine at operating condition	---	Stopped	Stopped
Parking brake	Piston stroke (X)			 • Parking brake ON: a • Parking brake OFF: b • X = a - b	mm	1.185 ± 0.28	Min. 3.5
Work equipment	Operating force	Boom	HOLD RAISE	• Engine speed: Low idle • Hydraulic oil temperature: 60 - 80°C (140-176°F)	N (kgf)	Max. 31.4 (Max. 3.2)	Max 47.1 (Max 4.8)
			RAISE HOLD			Max. 34.3 (Max 3.5)	Max 44.1 (Max 4.5)
			HOLD LOWER			Max. 31.4 (Max 3.2)	Max 47.1 (Max 4.8)
			LOWER HOLD			---	---
			LOWER FLOAT			Max. 49.0 (Max.5.0)	Max 81.4 (Max 8.3)
			FLOAT HOLD			Max. 34.3 (Max.3.5)	Max 52.0 (Max 5.3)

Category	Item			Measurement Conditions	Unit	Standard Value	Permissible Value
Work equipment control valve	Operating Force	Bucket	HOLD DUMP	• Engine speed: Low idle • Hydraulic oil temperature: 60-80°C (140-176°F)	N (kgf)	Max 29.4 (Max 3.0)	Max 44.1 (Max 4.5)
			HOLD TILT			Max 29.4 (Max 3.0)	Max 44.1 (Max 4.5)
			TILT HOLD			Max 36.3 (Max 3.7)	Max 52.0 (Max 5.6)
	Travel	Boom	HOLD RAISE		mm	80 ± 15	80 ± 20
			HOLD LOWER			80 ± 15	80 ± 20
			LOWER FLOAT			75 ± 15	75 ± 20
		Bucket	HOLD DUMP			70 ± 15	70 ± 20
			HOLD TILT			70 ± 15	70 ± 20

Cate gory	Item			Measurement Conditions	Unit	Standard Value	Permissible Value
Main control valve	Relief pressure			• Hydraulic oil temperature: 45 - 55°C • Engine speed: High idle	Mpa (kg/cm^2)	20.6 +0.4, -0.5 (210 +4, -5)	20.6 ± 2.0 (210± 2.0)
	Boom spool operating travel		HOLD RAISE	• Hydraulic oil temp: 45 - 55°C (113-131°F) • Engine speed: Low idle	mm	8	---
			HOLD LOWER			8	---
			HOLD FLOAT			15.5	---
	Bucket spool operating travel		HOLD DUMP			7	---
			HOLD TILT			8	---
Work equipment	Work equipment speed	Boom lifting time		• Hydraulic oil temp: 45 - 55°C (113-131°F) • Engine speed: High idle • Steering valve: Neutral • No load	Sec.	5.5 ± 0.3	Max. 7.4
		Boom lowering time				3.0 ± 0.5	Max. 4.2
		Bucket dumping time w/ Standard bucket cylinder				1.2 ± 0.3	Max. 1.9
		Bucket dumping time w/ large bucket cylinder				1.7	Max. 2.4
		Bucket tilting time standard bucket	At full stroke			1.8 ± 0.3	Max. 3.1
			Bucket horizontal			1.2 ± 0.3	Max. 1.8
		Bucket tilting time large bucket	At full stroke			2.4	Max. 3.7
			Bucket horizontal			1.6	Max. 2.2
	Hydraulic drift	Retraction of boom cylinder rod		• Hydraulic oil temp: 45 - 55°C (113-131°F) • Leave for 5 minutes after stopping engine then measure for next 15 minutes • Bucket empty, boom, bucket horizontal • No load	mm	Max. 20	Max. 20
		Retraction of bucket cylinder rod				Max. 17	Max. 20
Proximity switch	Clearance of bucket positioner switch			• Hydraulic oil temp: 45 - 55°C (113-131°F)	mm	3 - 5	---
	Clearance of boom kick-out switch					3 - 5	---

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

System	Name of Component	Connector No.	Inspection method	Judgment table	Measurement conditions
Main monitor	Alternator	Between alternator terminal R and chassis	Measure voltage	When engine is running (half throttle or above) 27.5 - 29.5 V ★ If the battery is old, or after starting in cold, areas, the voltage may not rise for some time.	1) Start engine
Main monitor	OHS sensor	CNE4 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. Normal temperature (25°C) / Between CNE4 (male) - GND / Approx. 2 kΩ 5°C / Approx. 4 kΩ	1) Turn starting switch OFF. 2) Disconnect CNE4.
Main monitor	Speed sensor	CNT9 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. Between (1) - (2) / 500 - 1000 Ω	1) Turn starting switch OFF. 2) Disconnect CNT9.
Maintenance monitor	Fuel level sensor	CNE15 (male)	Measure resistance	If the condition is as shown in the table below, the sensor is normal. FULL stopper / Between (1) - (2) / Approx. 4 Ω EMPTY / Between (1) - (2) / 85 Ω	1) Turn starting switch OFF. 2) Disconnect CNE 15.
Maintenance monitor	Engine water temperature sensor	CNE6 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. 25°C / Between (1) - (2) / Approx. 40 Ω 130°C / Between (1) - (2) / Approx. 1.7 Ω	1) Turn starting switch OFF. 2) Disconnect CNE6.
Maintenance monitor	Torque converter oil temperature sensor	CNT9 (male)	Measure resistance	If the condition is as shown in the table below, the sensor is normal. 25°C / Between (1) - (2) / Approx. 40 kΩ 130°C / Between (1) - (2) / Approx. 1.7 kΩ	1) Turn starting switch OFF. 2) Disconnect CNT9.
Maintenance monitor	Engine water level sensor (radiator water level)	CNH6 (male)	Continuity	If the condition is as shown in the table below, the sensor is normal. Water level normal / Between (2) - (1) / Continuity Water level abnormal / Between (2) - (1) / No continuity	1) Turn starting switch OFF. 2) Disconnect CNH6.

System	Name of Component	Connector No.	Inspection method	Judgment table			Measurement conditions
	Engine oil level sensor	CNE2 (male)	Continuity	If the condition is as shown in the table below, the sensor is normal.			1) Turn starting switch OFF. 2) Disconnect CNE2.
				Engine oil level normal.	Between (1) - chassis ground	Continuity	
				Engine oil level abnormal.		No continuity	
Maintenance monitor	Brake oil level sensor	CNH2 (male)	Continuity	If the condition is as shown in the table below, the sensor is normal.			1) Turn starting switch OFF. 2) Disconnect CNH2.
				Brake oil level normal	Between (1) - (2)	No continuity	
				Brake oil level abnormal		Continuity	
	Engine oil pressure sensor	CNE1 (male)	Continuity	If the condition is as shown in the table below, the sensor is normal.			1) Turn starting switch OFF. 2) Disconnect CNE1.
				Oil pressure normal	Between CNE1 - Chassis ground	No continuity	
				Oil pressure normal		Continuity	
	Alternator	Between alternator terminal R and chassis	Measure voltage	When engine is running (half throttle or above) 27.5 - 29.5 V ★ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.			1) Start engine.

SERVICE TOOLS FOR TESTING, ADJUSTING & TROUBLESHOOTING

Check or measurement item	Symbol		Tool Number	Tool Description	Remarks
Engine speeds	A	1	799-203- 8001	Multi-tachometer	Digital display (799-203-9000) L: 60-2000 rpm R: 60-19999 rpm
		2	795-790-2500	Adapter	See engine shop manual
Coolant & oil temperatures	B		799-101-1502	Digital temperature gauge	-99.9 - 1299°CI
Oil pressure	C	1	799-101-5001	Analog hydraulic tester	Pressure gauge 2.45, 5.88, 39.2, 58.8Mpa (25, 60, 400, 600 kg/cm^2)
			799-261-1201	Digital hydraulic tester	Pressure gauge 0 - 68.6 Mpa (0 - 700 kg/cm^2)
		2	790-401-2320	Hydraulic gauge	Pressure gauge 1.0 Mpa (10 kg/cm^2)
		3	790-261-1310	Adapter	---
			790-261-1320		---
Compression pressure	D	1	795-502-1590	Compression gauge	0 - 69MPa (0-70kg/cm^2) Kit part#: 799-502-1205
		2	795-502-1700	Adapter	---
Blow-by pressure	E	1	799-201-1541	Gauge	Kit part#: 799-201-1504
		2	799-201-1571	Tube	
		3	799-201-1450	Adapter	
		4	795-790-1950	Nozzle	5,613 mm dia
Valve clearance	F		Commercially available	Feeler Gauge	---
	F1		795-799-1130	Gear	
Exhaust color	G	1	799-201-9000	Handy smoke detector	Discoloration 0-70% w/ standard color % x 1/10 Bosch index
		2	Commercially available	Smoke meter	
Troubleshooting of wiring harnesses and sensors	H		799-601-7400	T-adapter	---
Operating Force	I		Commercially available	Push-pull scale	
Pushing force	J		Commercially available	Push gauge	---
Stroke	K		Commercially available	Scale	---

Check or measurement item	Symbol		Tool Number	Tool Description	Remarks
Brake oil pressure	L	1	793-605-1001	Brake test kit	6.9 Mpa (70 kg/cm^2)
		2	790-101-1430	Coupler	---
Pushing angle	R		Commercially available	Angle gauge	---
Length measurement	S		Commercially available	Slide calipers	---
Measuring clearance	O		Commercially available	Feeler gauge	---
Speed	P		Commercially available	Stop watch	---
Boom holding tool	Q		793-463-1100	Stopper	---

MEASURING ENGINE SPEEDS

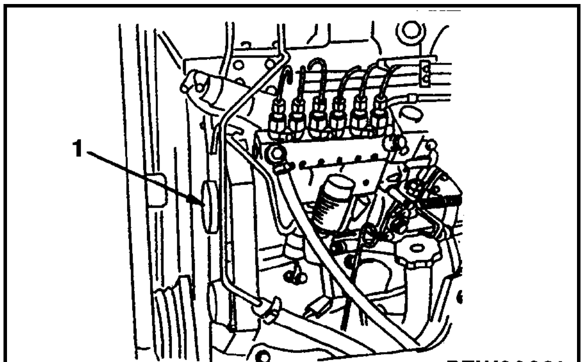
⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature parts.

★ Measure the engine speed under the following conditions.
- Coolant temperature: Within operating range
- Torque converter oil temperature: 70 to 90°C (158 - 194°F)
- Hydraulic oil temperature: 45 to 55°C (113 - 131°F)

1. Install the digital optical tachometer using the instruction supplied with it.
   1) Remove the cap 1 of engine speed output, and then install adapter ass'y A2.
   2) Connect the tachometer A1 and adapter ass'y A2 with cable.

⚠ When measuring engine speeds, be careful not to touch any high temperature parts or rotating parts.

2. Start the engine, and measure the engine speed when it is set to the conditions for measuring.
   1) Measuring low idle and high idle speeds.
   2) Measure the speed at near the rated speed.
      ★ When measuring speeds for items other than the above, such as torque converter stall, see the procedure for the item as described in this section.



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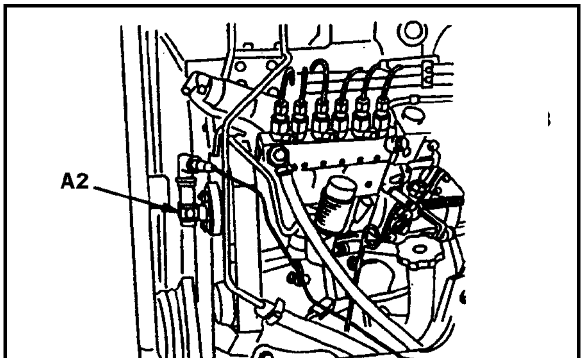

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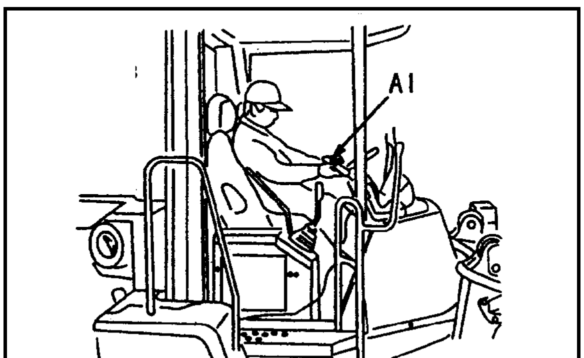

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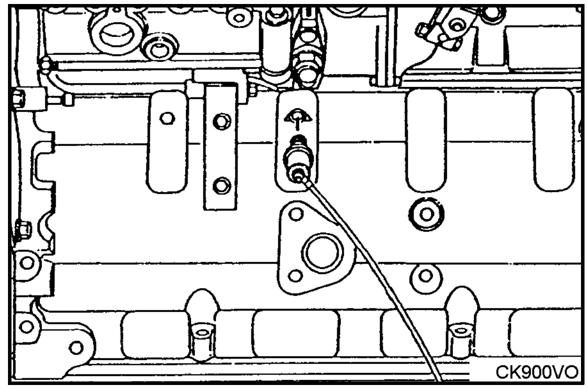
MEASURING ENGINE LUBRICATING OIL PRESSURE

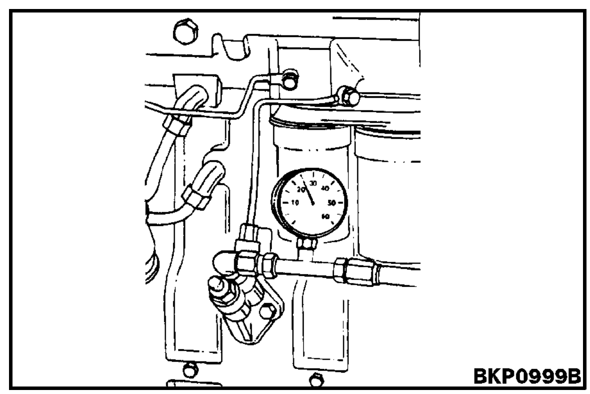
Remove oil pressure sensor then install pressure gauge.

★ Refer to ENGINE SHOP MANUAL for tools and proper procedure.



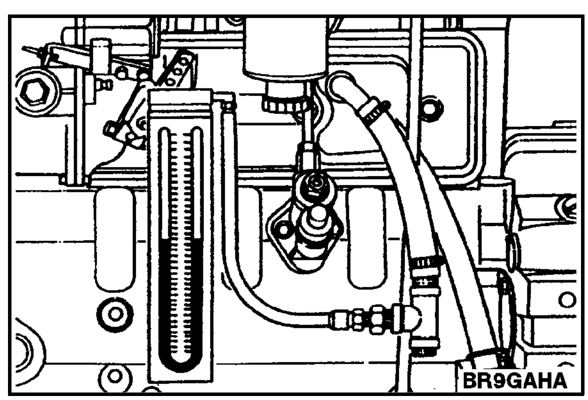
MEASURING FUEL FILTER INLET RESTRICTION

★ Refer to ENGINE SHOP MANUAL for tools and proper procedure.



MEASURING BLOW-BY PRESSURE

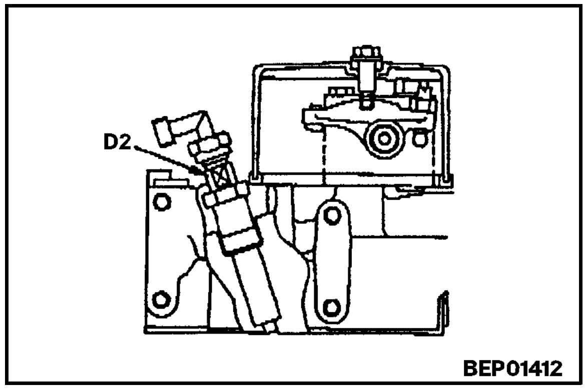
★ Refer to ENGINE SHOP MANUAL for tools and proper procedure.

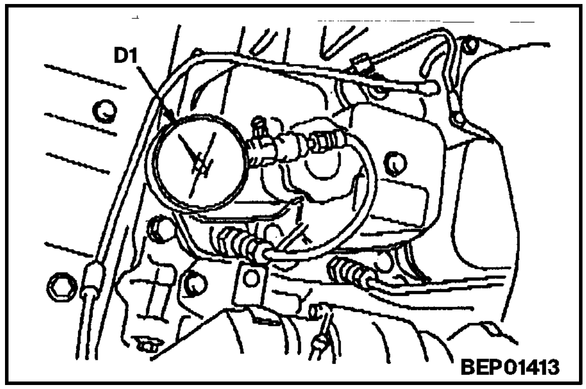


MEASURING COMPRESSION PRESSURE

⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature parts.

⚠ When measuring, be careful not to let your clothes get caught in any rotating part.





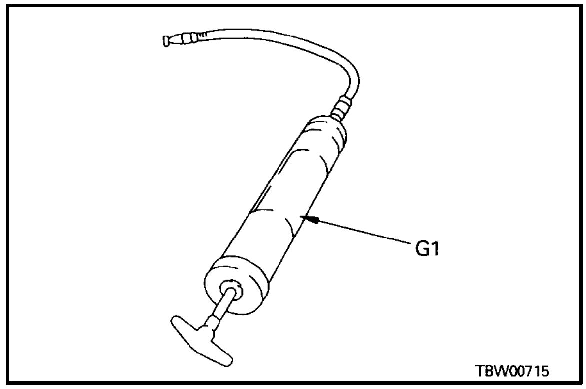
1. Before measuring the compression pressure, check the value clearances. Refer to “Engine Shop Manual” and adjust them if necessary.
2. Measurement conditions
   Engine water temperature: 40 - 60°C (104 - 140°F)
3. Remove the nozzle holder of the cylinder which is necessary to be measured.
4. Install adapter D2 and connect the compression pressure guage D1
5. Set the multi tachometer A.
   Refer to “Measuring engine speeds.”
6. Cut off fuel control rod and then fix the governor lever of fuel pump to “no inspection” position. After that, measure compression pressure of cylinder while starting engine by starter motor.

   Do not crank the starting motor for periods longer than 30 seconds.
   Allow 2 minutes between the 30 second cranking periods so the starting motor can cool.

★ Read scale of compression pressure guage after being stable.
★ Measure and check the engine speed while measuring compression pressure.
★ After measuring, install the nozzle holder again.

MEASURING EXHAUST COLOR

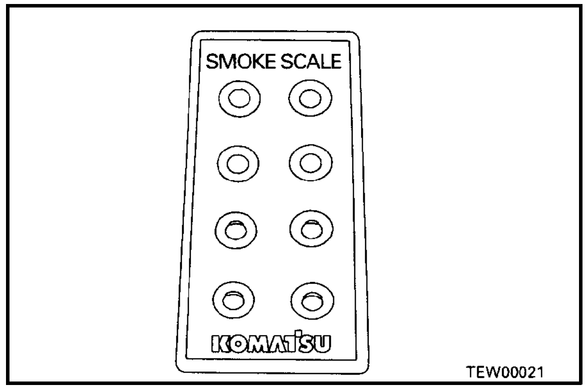
★ When measuring in the field when there is no air or power supply, use smoker the checker; when recording official data, use the smoke meter.



Measure with handy smoke checker G1

When measuring the exhaust gas color, be careful not to touch the exhaust pipe or any other high temperature part.

★ Warm up the engine (oil temperature: 60°C) before measuring the exhaust gas color.
1) Fit filter paper in tool **G1**.
2) Insert the exhaust gas intake port into the exhaust pipe, accelerate the engine suddenly, and at the same time operate the handle to catch the exhaust gas on the filter paper.
3) Remove the filter paper and compare it with the scale provided to judge the condition.

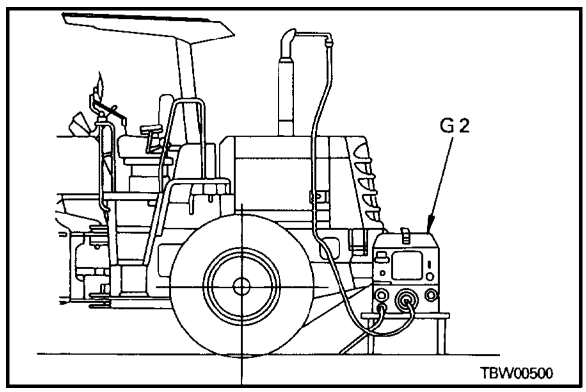


Measuring with smoke meter G2

When measuring the exhaust gas color, be careful not to touch the exhaust pipe or any other high temperature part.

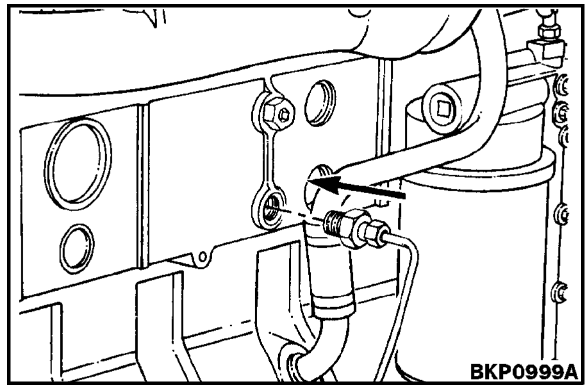
★ Warm up the engine (oil temperature: 60°C) before measuring the exhaust gas color.
1) Insert the probe into the outlet port of the exhaust pipe, then tighten the clip to secure it to the exhaust pipe.
2) Connect the probe hose, accelerator switch plug, and air hose to tool **G2**.
   ★ The pressure of the air supply should be less than 1.5 Mpa (15 kg/cm^2).
3) Connect the power cord to the AC100V outlet.
   ★ When connecting the cord, check first that thepower switch is OFF.

fit the filter paper.
   ★ Fit the filter paper securely so that the exhaust gas does not leak.
5) Turn the power switch.
6) Accelerate the engine suddenly, and at the same time, depress the accelerator pedal and operate the relief valve to catch the exhaust gas color on the filter paper..
7) Lay the filter paper used to catch the exhaust gas color on top of unused filter papers (10 sheets or more) inside the filter paper holder, and read the indicated value.



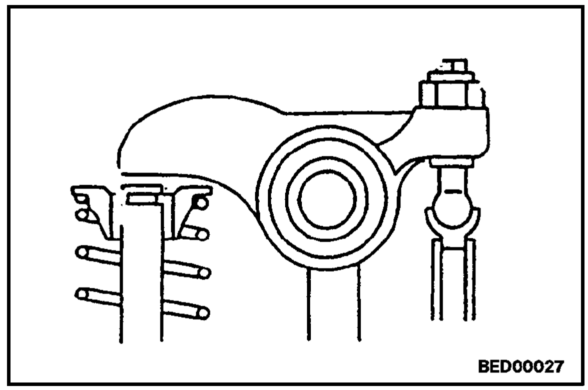
MEASURING COOLANT TEMPERATURE

★ Refer to ENGINE SHOP MANUAL for tools and proper procedure.



MEASURING AND ADJUSTING VALVE CLEARANCE

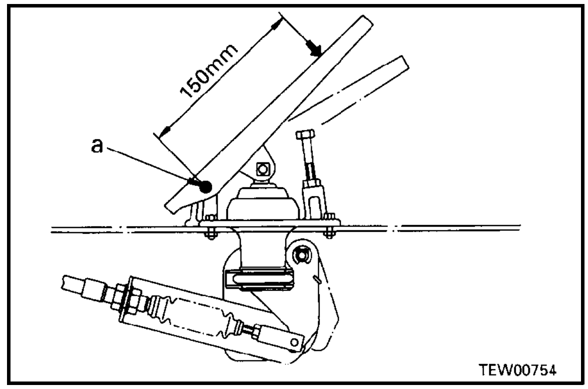
★ Refer to ENGINE SHOP MANUAL for tools and proper procedure.



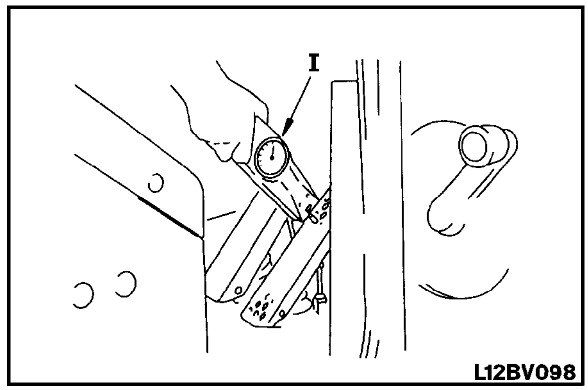
MEASURING ACCELERATOR PEDAL

OPERATING FORCE OF ACCELERATOR PEDAL

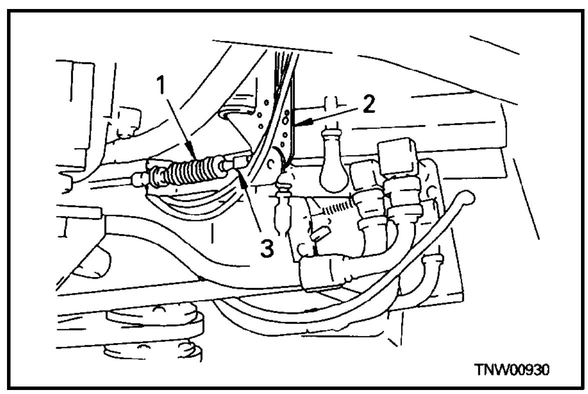
1. **Measuring**
   1) Set tool **I** at a position 150 mm from pedal fulcrum **a**.
      ★ Put the center of tool **I** in contact with a point 150 mm from the pedal fulcrum.



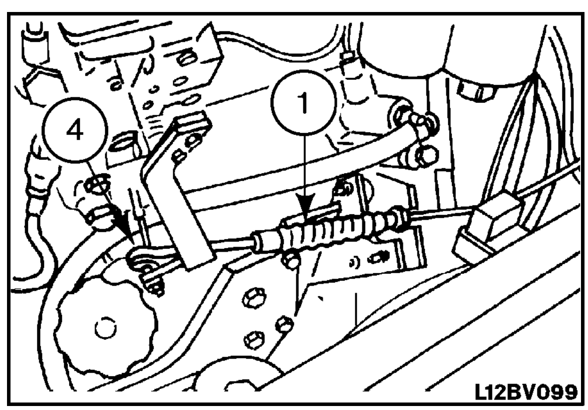
   2) Start the engine, then measure the maximum value when the pedal is moved from the pushed position (low idling) to the end of its travel (high idling).



2. **Testing**
   1) Stop the engine.
   2) Disconnect the cable (1) at the bottom of the accelerator pedal, and check that the plate (2) and ball joint (3) at the bottom of the pedal move smoothly.



   ★ Carry out the above inspection, and adjust or replace parts if necessary. Then carry out the measurement of the operating force again to check that it is within the standard value

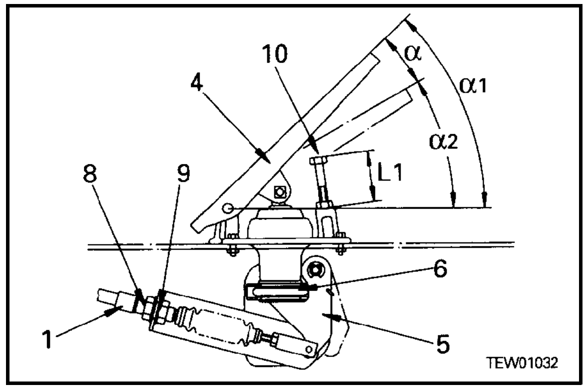


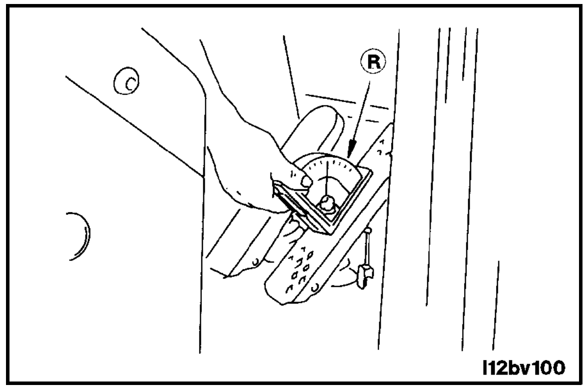
OPERATING ANGLE OF ACCELERATOR PEDAL

1. Measuring

1) Stop the engine.

2) Measure the operating angle when the pedal is operated from the low idling position to the high idling position.
Put angle gauge R in contact with the accelerator pedal, and measure operating angle ∢(∢= ∢1-∢2) when the pedal is operated from low idling position ∢1 to high idling position ∢2.

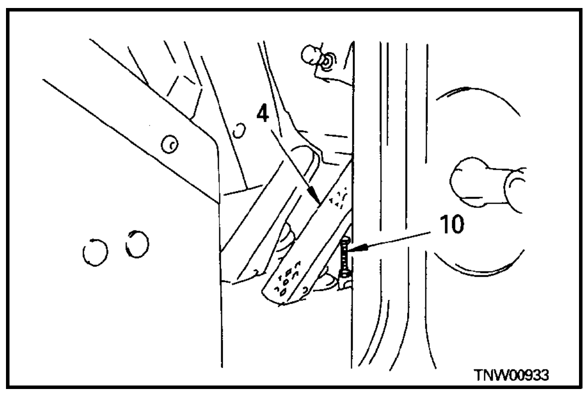




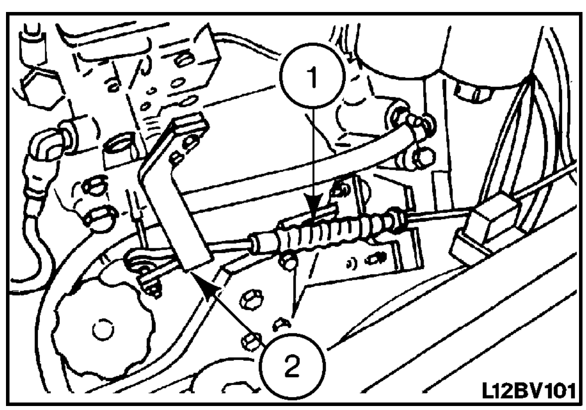
Adjusting

1) Open the inspection cover of the engine hood.

2) Set accelerator pedal (4) to the FREE position (lever (5) in contact with U-bolt (6)), adjust cable (1) so that governor lever (2) is at the low idling position, then tighten nuts (8) and (9).

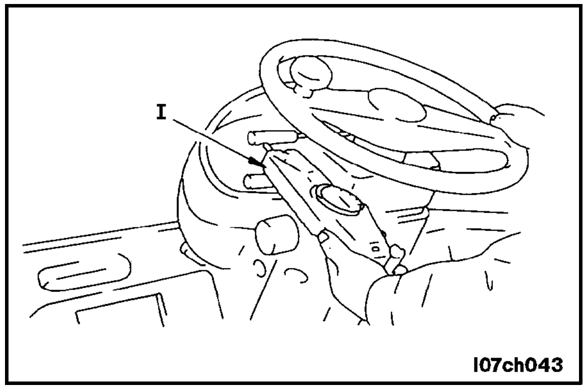


3) Adjust stopper bolt (10) so that governor lever (2) is at the high idling position when accelerator pedal (4) is depressed.



MEASURING SHIFT LEVER

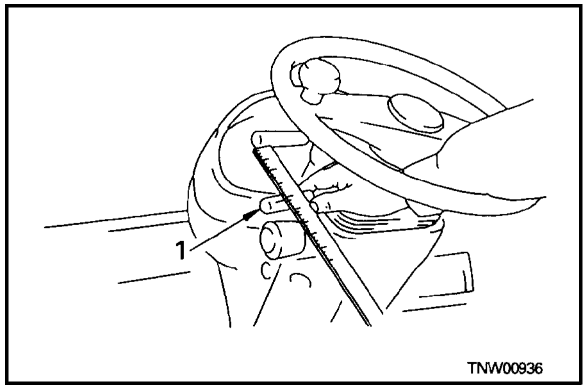
Put blocks under the tires securely



OPERATING FORCE OF SHIFT LEVER

1. Stop the engine.

2. Install tool I or a spring balance to the center of the control lever knob, and measure the operating effort when the lever is pulled in the direction of operation.
   ★ Carry out the measurement for each speed range.



TRAVEL OF SHIFT LEVER

1. Stop the engine.

2. Make mark (1) at the center of the control lever knob, and measure the travel when the lever is operated in the direction of operation.

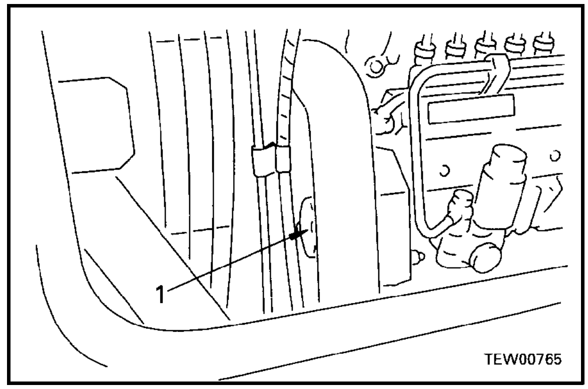
MEASURING STALL SPEEDS

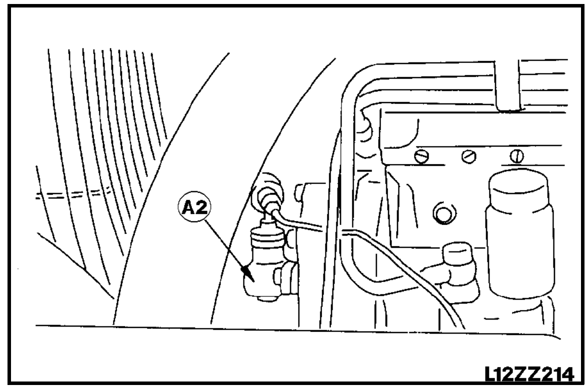
★ **Measurement conditions**
- Engine water temperature: Within white range on engine water temperature gauge
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Engine speed: high idling
- Torque converter oil temperature: 60 - 80°C (140 - 176°F)

⚠ Apply the parking brake and put blocks under the tires.

⚠ When measuring each stall speed, be careful not to touch any rotating part of high temperature part.

★ Check that low idling and high idling are the standard values.
★ Before measuring each stall speed, remove cover (**1**) from the speed pickup port, install adapter **A2** of tachometer **A1**, then connect tachometer A1 and the adapter with a cable.
★ Check that the engine speed is the standard value. If it is not within the standard range, check for loose linkage or play.





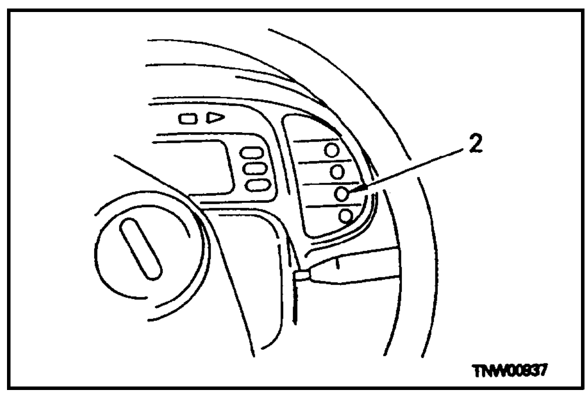
TORQUE CONVERTER STALL SPEED

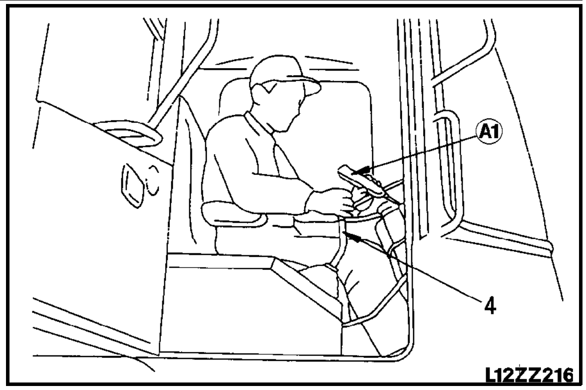
★ Before starting the operation, check that the tires are chocked and release the parking brake.

1. Start the engine and run at low idling.

2. Place directional lever (**4**) at FORWARD or REVERSE, and set speed lever (**3**) to the highest position.

3. Use the brakes to stop the machine, then use multi-tachometer **A1** to measure the speed when the engine is run at high idling.
★ Turn transmission cut-off selector switch (**2**) OFF and use the left brake. (Check that the pilot lamp goes out.)
★ Do not keep the stall condition for more than 20 seconds. Make sure that the torque converter oil temperature does not exceed 120°C.





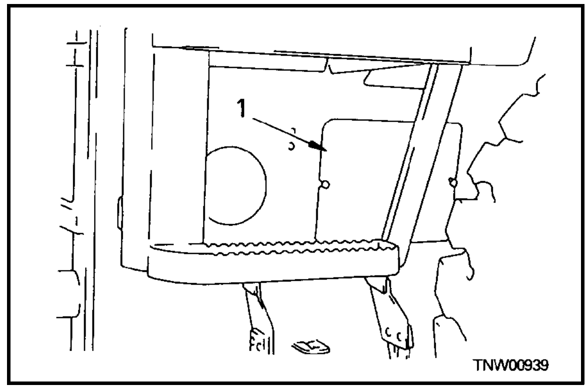
HYDRAULIC STALL SPEED

1. Start the engine and run at high idling.
2. Operate the work equipment control lever (**4**), set the cylinder to the stroke end, and activate the work equipment valve relief valve.
3. Use multi-tachometer **A1** to measure the engine
   ★ Do not keep the stall condition for more than 20 seconds. Operate the control lever quickly.

FULL STALL SPEED

- Measure the engine speed when the torque converter stall and hydraulic stall are both carried out at the same time.
  ★ Before measuring the full stall, check that the torque converter stall and hydraulic stall speeds are normal.
  If either of the stall speeds are abnormal, correct the problem and measure again.

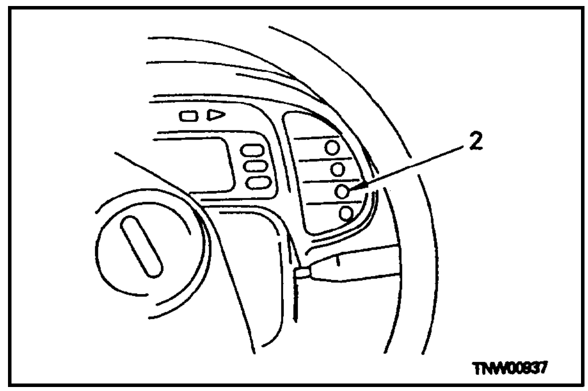
MEASURING TORQUE CONVERTER, TRANSMISSION OIL PRESSURE



★ **Measurement conditions**

- Engine water temperature: within white range on engine water temperature gauge
- Torque converter oil temperature: 60 - 80°C (140 - 176°F)

Apply the parking brake and put blocks under the tires.



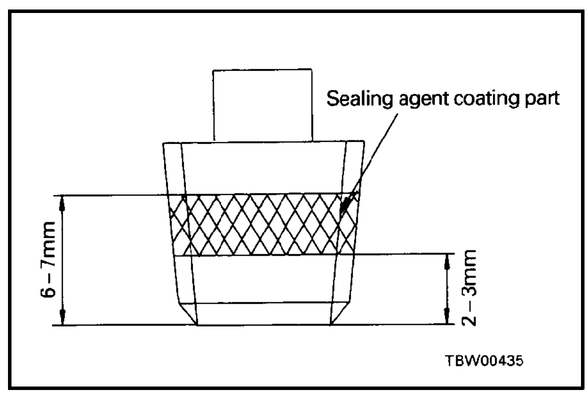
Preparatory Work

★ The following preparatory work is necessary when measuring all oil pressures.

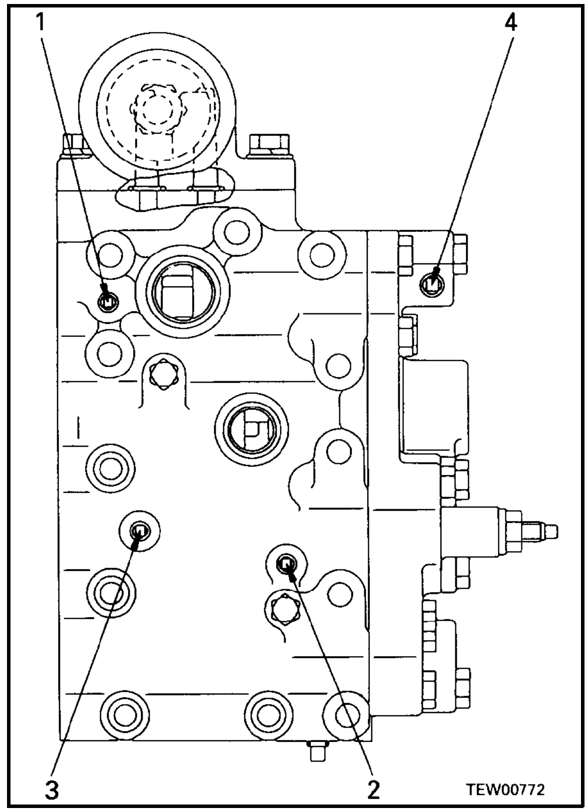
★ Before starting the operation, check that there are blocks under the tires, then release the parking brake.
- Remove cover (**1**) on the left side of the rear frame.
- Check that there are blocks under the tires, then release the parking brake.
- Turn transmission cut-off selector switch (**2**) OFF and use the left brake. (Check that the pilot lamp is OFF.)
- Remove the plug from the measurement port of the transmission valve.
- Install hydraulic tester kit **B** to the measurement port, extend the gauge to the operator’s compartment, then start the engine and measure the pressure.

★ Check that no oil is leaking from any connection.

★ After removing the measurement plug, always coat the plug with adhesive.



Plug: **sealing agent (LG-1)**



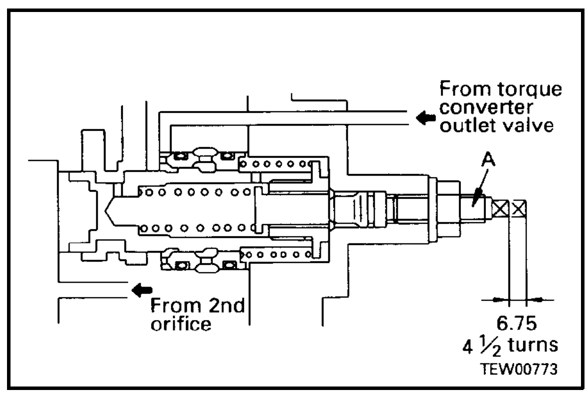
1. **Measuring pilot pressure**
   1) Measurement port: 1
   2) Start the engine and measure the pressure at high idling.

2. **Measuring priority pressure**
   1) Measurement port: 2
   2) Start the engine and measure the pressure at high idling.

3. **Measuring all clutch pressure**
   1) Measurement port: 3
   2) Start the engine and measure the pressure at high idling.

4. **Measuring torque converter outlet port pressure**
   1) Measurement port: 4
   2) Start the engine and measure the pressure at torque converter stall.

5. **Adjusting modulating time**
   Turn screw (**A**) to make the modulating time shorter or longer.
   1) TIGHTEN screw to give PATTERN 1).
   2) LOOSEN screw to give PATTERN 2).



★ The standard length is 6.75 mm (return fully, then screw in 4 1/2 turns).
★ Do not adjust excessively. After adjusting, always check that there is no abnormality in the pressure.
★ Keep the range of adjustment to within ± 1 turn.

METHOD OF OPERATING EMERGENCY MANUAL SPOOL

Outline

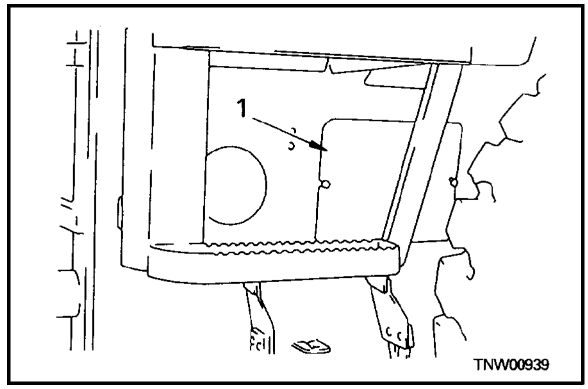
The transmission valve is contrlled electrically, but if there should be any failure in the electrical system, or if there is any failure in the solenoid valve or spool and the machine cannot move, it is possible to operate the emergency manual spool to move the machine.

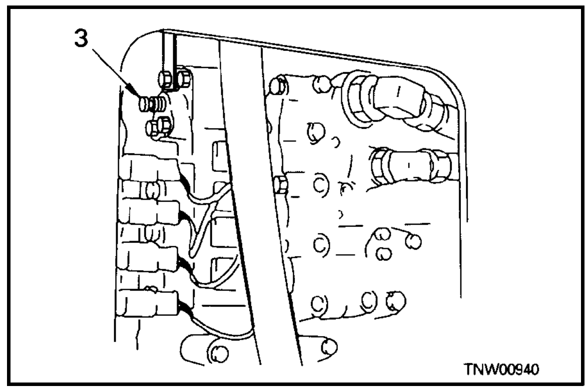
⚠ This operation of the spool is designed only for use if the machine cannot be moved because of a failure in the transmission control, and it is necessary to move themachine from a dangerous working area to a safe place where repairs can be carried out. This spool must not be operated except when there has been a failure.

⚠ When carrying out this operation, keep strictly to theorder of operation and pay careful attention to safety when moving the machine.

⚠ To prevent the machine from moving, lower thepbucket to the ground, apply the parking brake, and put blocks under the tires.

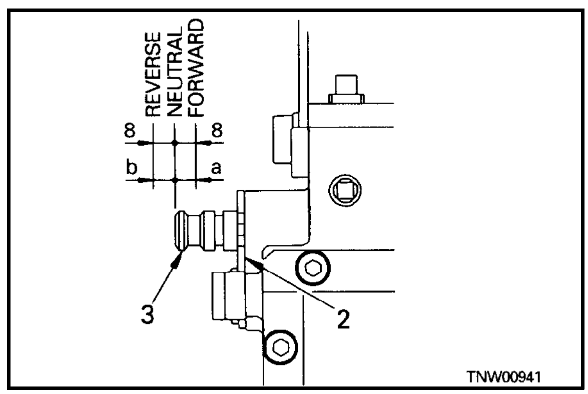
⚠ Always stop the engine before operating the spool.





1. Remove cover (1) from the left side of the rear frame.

2. Remove lock plate (2) from emergency manual spool (3) of the transmission valve.
   ★ The lock plate can be removed simply by loosening the mounting bolts.

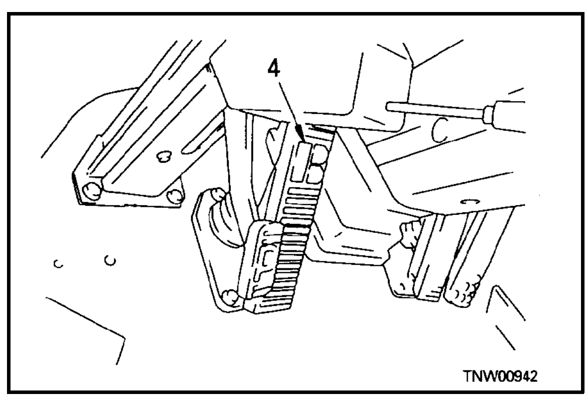


3. Operate emergency spool (3) to the operating position according to the direction of movement of the machine (forward or reverse).
   ★ FORWARD: Push in the spool until it enters the detent.
   a = Approx. 8mm

   ★ REVERSE: Pull the spool until it enters the detent.
   b = Approx. 8mm

4. Check that the area around the machine is safe, then remove the blocks from under the tires.

5. Sit in the operator's seat and depress the left brake pedal (4) fully.



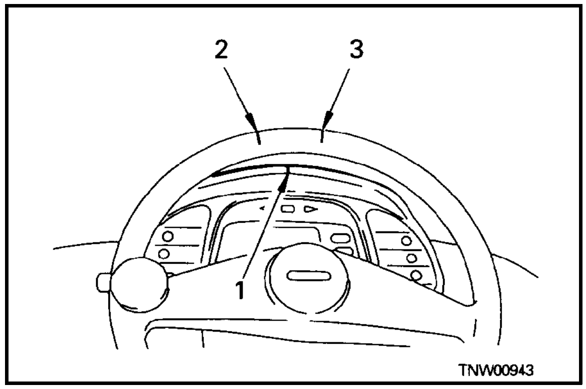
6. Start the engine, then release the parking brake and slowly let the brake pedal out to start the machine.

⚠ When the engine is started, the transmission is also engaged and the machine will start, so always check carefully that the area around the machine and in the direction of travel is safe,and keep the brake pedal depressed fully when starting the engine.

7. After moving the machine, stop the engine, then apply the parking brake and put blocks under the tires.

8. Return the manual spool to the neutral position and install the lock plate.

TESTING AND ADJUSTING STEERING WHEEL

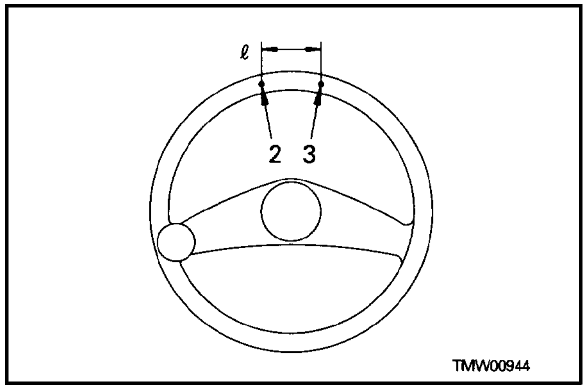


Measuring steering wheel play

★ Measurement conditions
- Engine: Stopped.
- Vehicle posture: Facing straight.

Measuring procedure

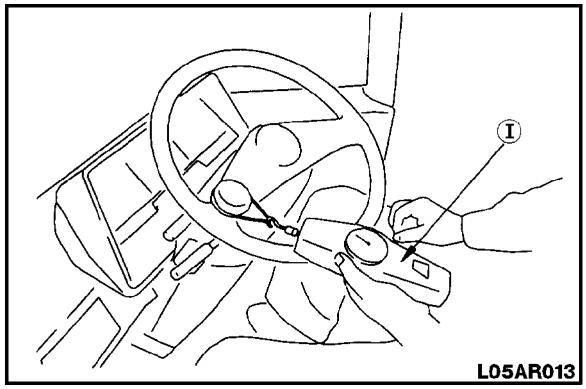
1. Turn the steering wheel lightly clockwise and counterclockwise two or three times to check that the steering mechanism is in neutral, then put a mark (1) on the outer frame of the vehicle monitor.



2. Turn the steering wheel lightly clockwise, align the position where it stops with mark (1), and place mark (2) on the steering wheel.

3. Turn the steering wheel lightly counterclockwise, align the position where it stops with mark (1), and place mark (3) on the steering wheel. Measure the straight distance ℓ between mark (3) and the position marked in step 2.

MEASURING OPERATING FORCE OF STEERING WHEEL



★ **Measurement conditions**

- Road surface: Flat, horizontal, dry paved surface
- Engine water temperature: within white range on engine water temperature gauge
- Hydraulic oil temperature: 45 - 55°C (113-131°F)
- Tire inflation pressure: Specified pressure
- Engine speed: Low idling (bucket empty)

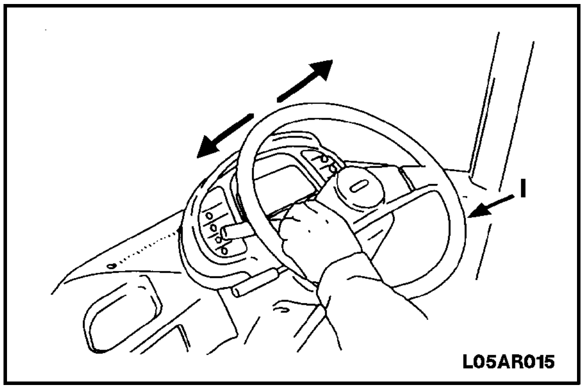
Measurement method.

1. Install push-pull scale **I** to the steering wheel knob.

2. Start the engine.
★ After starting the engine, raise the bucket approx. 400 mm and remove the safety bar.

3. Pull push-pull scale **I** in the tangential direction and measure the value when the steering wheel moves smoothly.
★ Avoid measuring when the steering wheel starts to move.

MEASURING OPERATING TIME FOR STEERING WHEEL



★ **Measurement conditions**

- Road surface: Flat, horizontal, dry paved surface
- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 - 55°C (113-131°F)
- Tire inflation pressure: Specified pressure
- Engine speed: Low and high idle

Measurement method

1. Start the engine.

★ After starting the engine, raise the bucket approx. 400mm and remove the safety bar.

2. Operate the steering wheel (1) to the end of its stroke to turn the machine to the left or right.

3. Measure the time taken to operate the steering wheel to the end of the stroke to the right (left).
   ★ Operate the steering wheel as quickly as possible without using force.
   ★ Carry out the measurements both at low idling and high idling, and to both the left and right.

MEASURING STEERING OIL PRESSURE

★ **Measurement conditions**

- Hydraulic oil: 45 - 55°C (113 - 131°F)
- Engine speed: High idling

METHOD OF MEASURING MAIN RELIEF PRESSURE

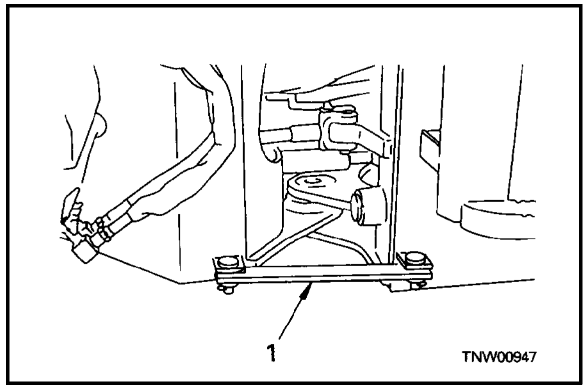
⚠ Loosen the oil filler cap to release the pressure inside the hydraulic tank, then turn the steering wheel several times to release the remaining pressure inside the piping.

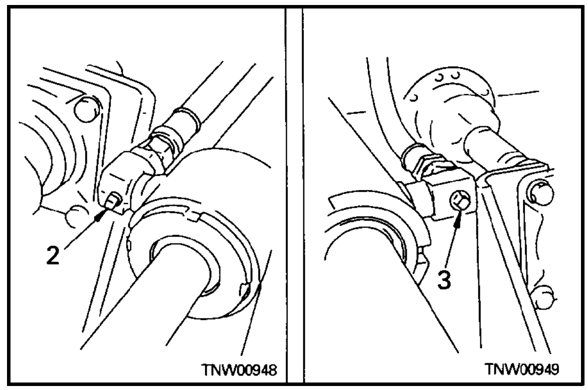
1. Fit safety bar (1) to the frame.

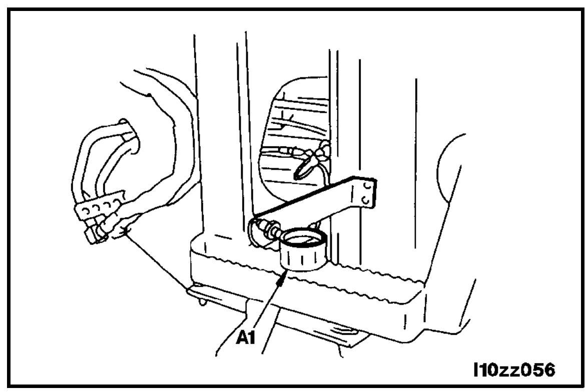
2. Remove plug (2) for measuring the right turn steering circuit.

3. Install tool **A1** (39.2 Mpa (400 kg/cm^2)) to the measurement port.

4. Start the engine, run the engine at high idling, then turn the steering wheel to the right and measure the pressure when the relief valve is actuated.
  ★ To measure the pressure when turning the steering wheel to the left, remove the plug (3)for the left turn steering circuit.







METHOD OF ADJUSTING MAIN RELIEF PRESSURE

⚠ Always stop the engine before adjusting the pressure.

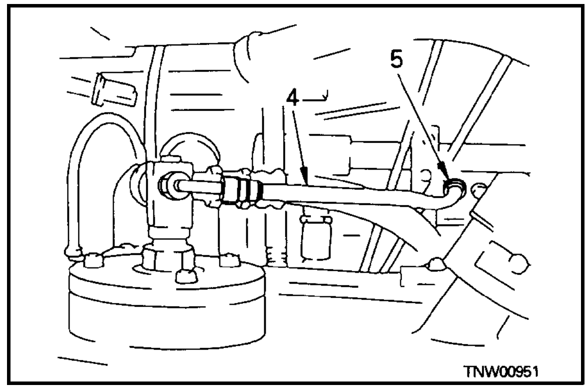
1. Stop the engine.

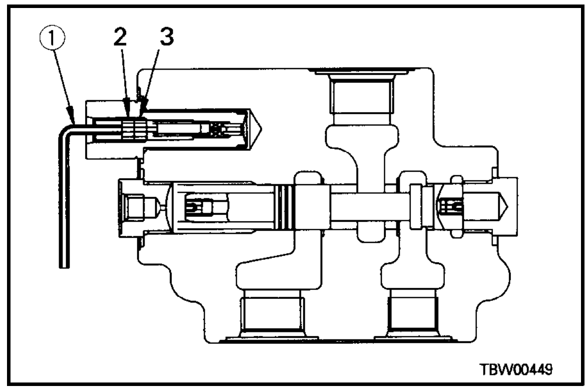
2. Remove hose (4) and fitting (5) connected to port **T** of the priority valve.

3. Loosen lock screw (2), then turn adjustment screw (3) to adjust.
   - ★ Pressure adjustment for one turn of adjustment screw: Approx. 6.9 Mpa (70 kg/cm^2).
   - ★ Turn the adjustment screw to adjust the set pressure as follows.
     TIGHTEN to INCREASE pressure.
     LOOSEN to DECREASE pressure.
   - ★ Tool 1 for adjusting adjustment screw: Size 7/32 inch, hexagonal
   - ★ Do not carry out any adjustment if the relief pressure cannot be measured accurately.

Adjustment screw: **2.26 - 6.77 Nm (0.23 - 0.69 kgm)**

Lock screw (6):) **4.7 ± 2 Nm (1.5 ± 0.2 kgm)**

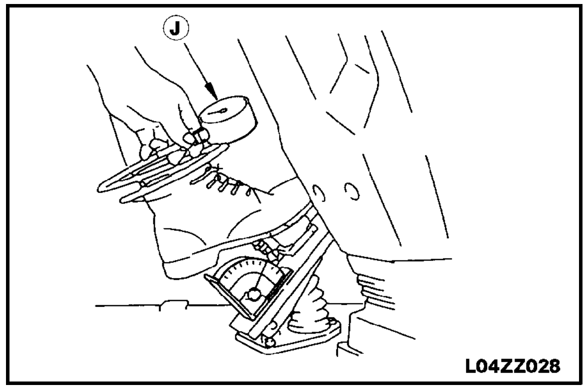




MEASURING BRAKE PEDAL

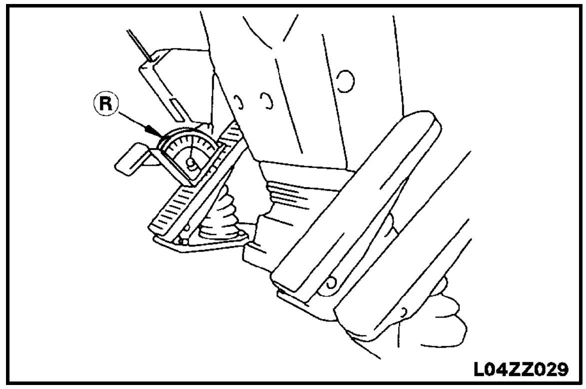
★ **Measurement conditions**

- Engine water temperature: Within white range on engine water temperature gauge
- Engine speed: Low idling



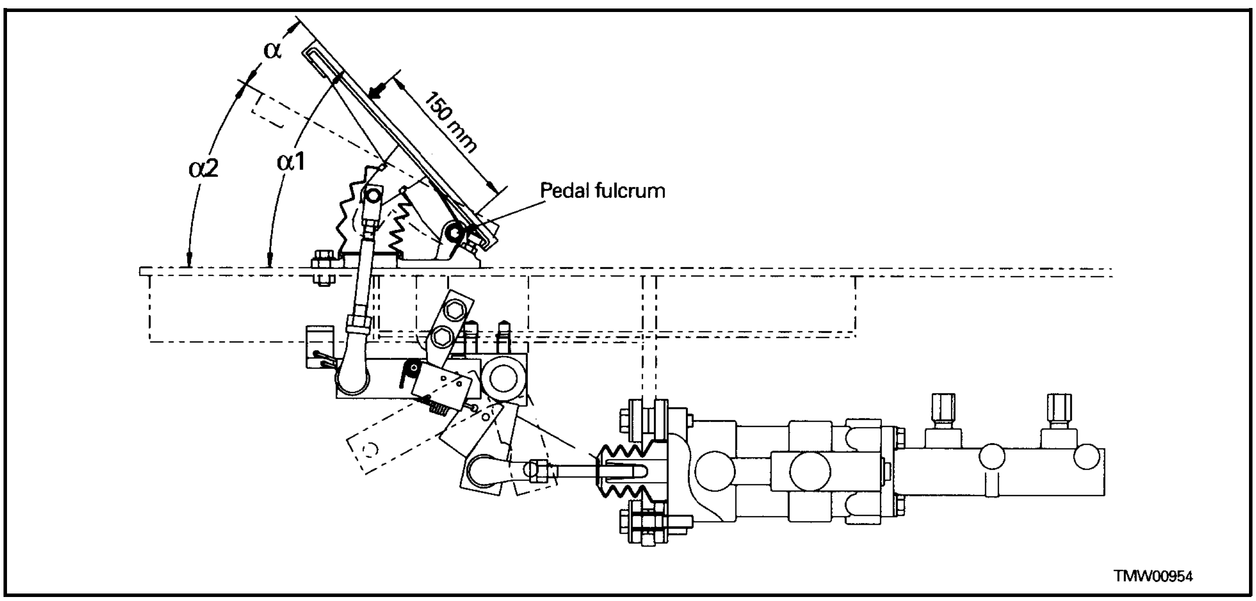
Operating effort of pedal

1. Install push gauge (**J**) to the operator's foot.
   ★ Align the center of the push gauge with a point 150 mm from the fulcrum of the pedal.
2. Start the engine, run at low idling, and measure the operating effort when the pedal is depressed.



Travel of pedal

1. Install push gauge (**J**) to the operator's foot.
   ★ Align the center of the push gauge with a point 150 mm from the fulcrum of the pedal.
2. Start the engine and measure the pedal angle when running at low idle with a pedal depressed with a force of 205.9 N (21 kg).
3. Next, put angle meter (**R**) in contact with the pedal and measure operating angle a from position ∢1 to position ∢2 when the pedal is depressed with a force of 205.9 N (21 kg).
   ★ Operating angle ∢ = ∢1 - ∢2



TESTING AND ADJUSTING BRAKE PEDAL LINKAGE

Testing

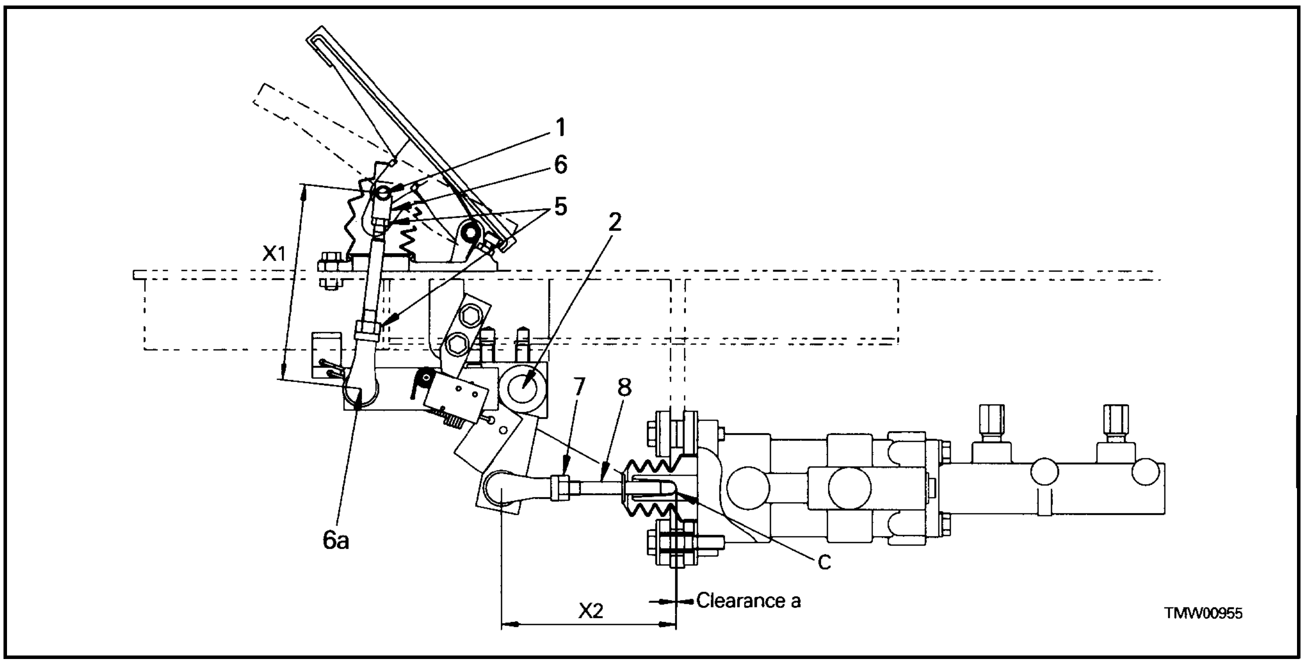
1. Check for play in linkage mounting pin (1), pin hole of lever (2), and lever bushing.
2. Measure length of linkage X1 = 175 mm, and check that it is within the standard value.
   ★ Measure the length from the center of pin (1) to the center of ball joint (6a).
3. Measure the distance of movement of rod (8) and check that clearance **a** is within the standard value.
   ★ When doing this, check that the brake pedal is in contact with the stopper.

Adjusting

1. Adjusting link X1

1) Remove pin (1) and ball joint (6a), remove rod and loosen locknut (5), then turn yoke (6) and ball joint (6a) to adjust the length.
2) After adjusting the length of rod X1, connect it to the brake pedal.

Standard values
X1 = 175mm
X2 = 154.3mm
a = 0 - 0.7

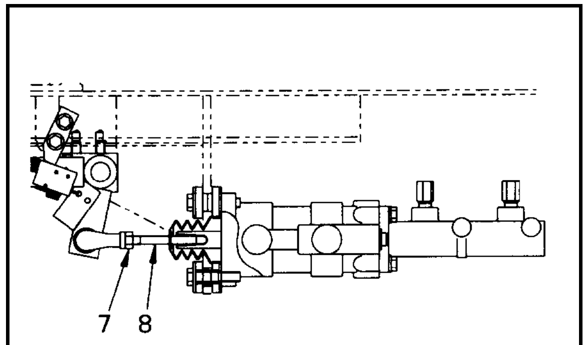


2. Adjusting rod X2

1) Loosen locknut (7), turn rod (8) so that tip C of rod contacts the master cylinder piston, then turn rod (8) back 1/4 turn.

★ Movement for ½ turn of rod: 0.75 mm

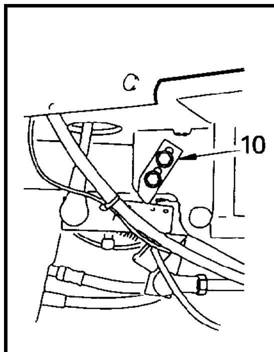
2) Tighten locknut (7) to hold in position.



TMW00956

3. Adjusting switches

1) Transmission cut-off switch (left pedal)
Loosen mounting screw of switch (9) and adjust switch (9) so that protrusion **b** of the tip of the switch from the end face of the transmission cut-off switch plate is the standard value.
★ Dimension **b**: 1.1 - 1.9 mm
★ When doing this, check that the switch is ON.
To adjust the cut-off timing, adjust plate (10) so that the dimension **d** from the center of the stopper bolt of plate (10) to the end face of plate (10) is 27 mm.
★ When doing this, check that plate (10) contacts portion **e** of the switch plate.
★ Adjust with the pedal in the FREE condition.



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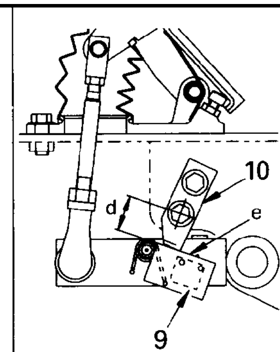
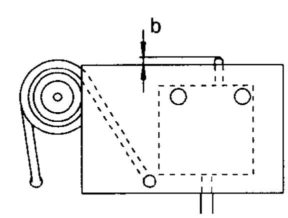
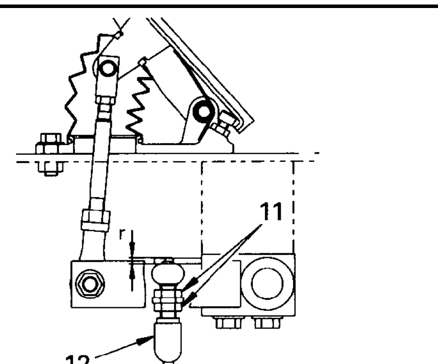


TMW00958



TMW00959

2) Stop lamp switch (right pedal)
Install with mounting nut (11) of stop lamp switch (12), and adjust.
Install so that the tip of the switch is pushed in 3.5 - 5.0 mm.
★ Amount that tip of switch is pushed in: 3.5 - 5.0 mm
When doing this, check that the switch is OFF.
★ Adjust with the pedal in the FREE. condition



TMW00960

MEASURING BRAKE PERFORMANCE

★ **Measurement conditions**
- Road surface: Flat, horizontal, dry paved surface
- Travel speed: 20 km/h when brakes are applied
- Delay in applying brakes: 0.1 sec
- Tire inflation pressure: Specified pressure

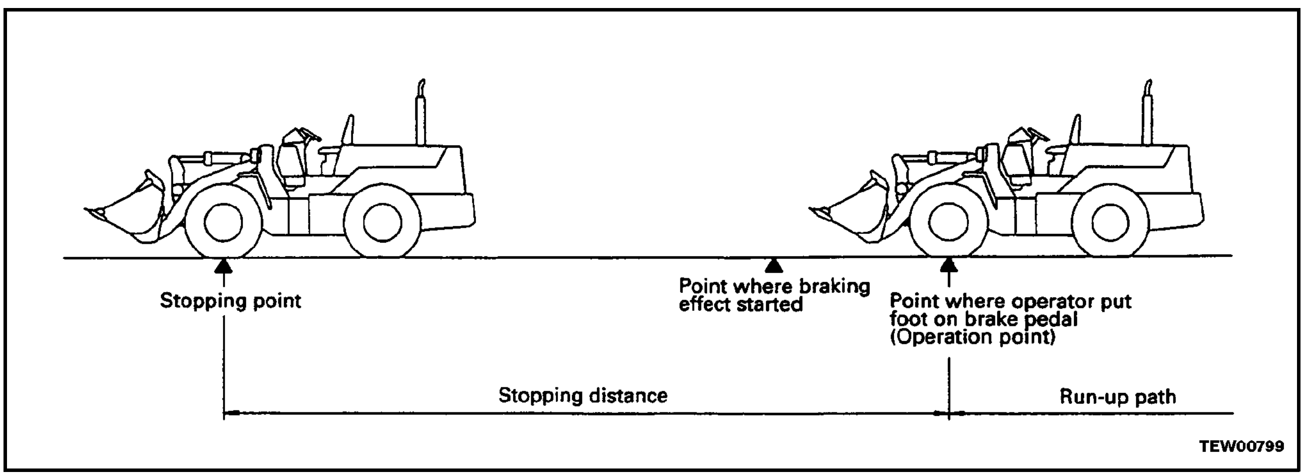
Measurement method

1. Start the engine and move the machine.

2. Set the speed lever to the highest speed position and drive the machine.

3. When the travel speed reaches 20 km/h, depress the left brake pedal with the specified operating force.
★ Before carrying out this operation, determine the run-up path and the point for applying the brakes, then apply the brakes when the machine reaches that point.

4. Measure the distance from the point where the brakes were applied to the point where the machine stopped.
★ Repeat this measurement three times and take the average.

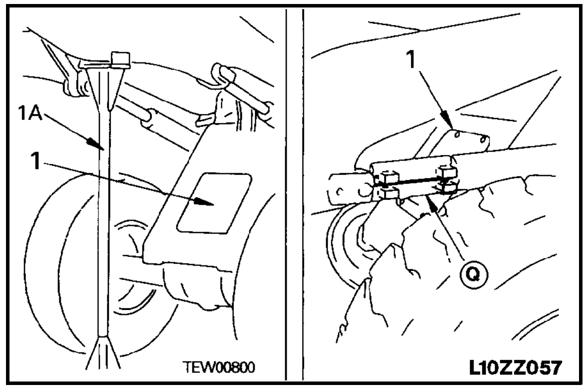


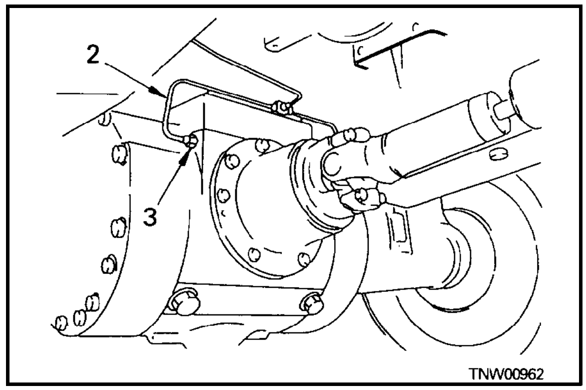
MEASURING BRAKE OIL PRESSURE

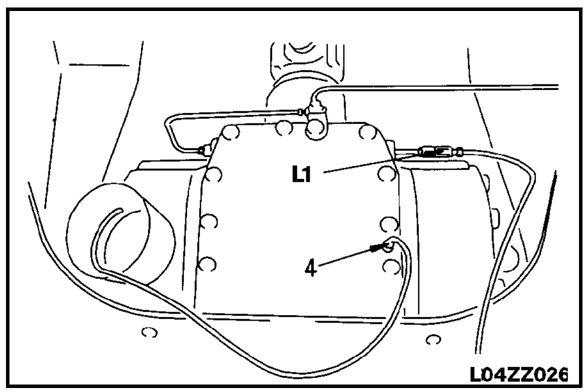
★ **Measurement conditions**
- Engine water temperature: Within white range on engine water temperature gauge
- Brake pressure: 4.1 Mpa (42 kg/cm^2)

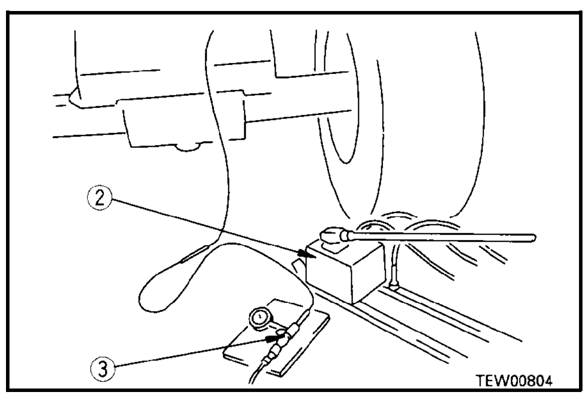
⚠ Apply the parking brake and put blocks under the tires.

Measuring
1. Raise the boom, set support (**1A**) or tool **Q** in position, then remove front cover (**1**).
2. Stop the engine.
   ★ When leaving the operator's seat, apply the lock to the work equipment control levers securely.
3. Remove brake tube (**2**) on the side to be measured, then remove adapter (**3**).
4. After removing the adapter, install BRAKE TEST KIT **L1**, **L2**.
   ★ Connect the quick coupler of tool **L1**, **L2**.
5. Loosen bleeder screw (**4**) and bleed the air.
   ★ Operate pump ② to bleed the air.
6. Tighten the bladder screw, operate pump ②, raise the pressure to 4.1 Mpa (42 kg/cm^2), then tighten stop valve ③.
7. After applying the pressue, leave for 5 minutes and measure the drop in the pressure.
   ★ If the hose is moved while measuring the pressure, the pressure will change, so do not move the hose.
   ★ When removing BRAKE TEST KIT **L1**, **L2** after testing, operate pump ② to lower the pressure of **L1**, **L2**, then remove it.
   ★ After completing the operation, install the brake tube, then bleed the air from the brake circuit.









MEASURING WEAR OF BRAKE DISC

★ **Measurement conditions**
- Engine water temperature: Within green range on engine water temperature gauge

Apply the parking brake and chocks under the tires.

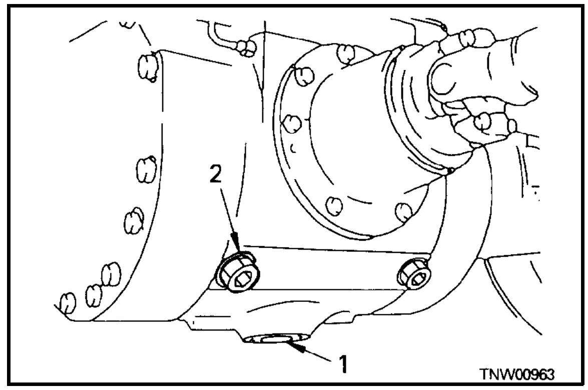
Measuring

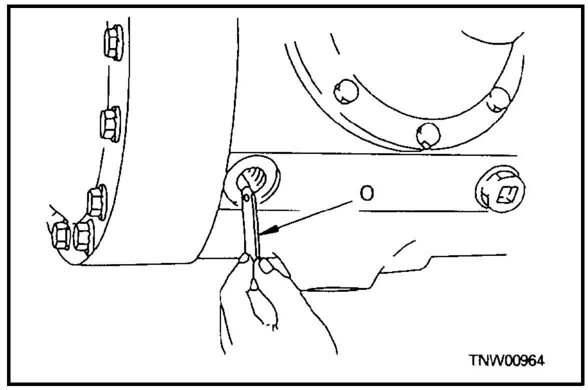
1. Loosen drain plug (1) and drain the axle oil.

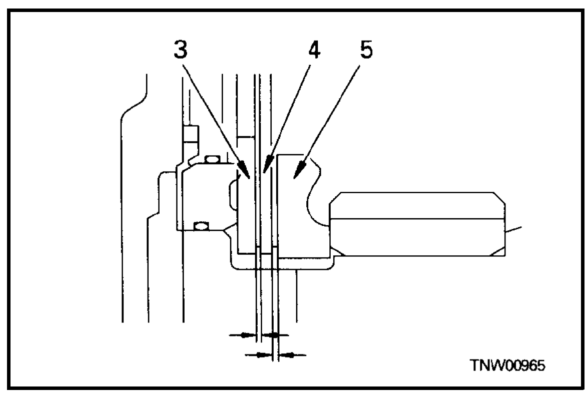
Axle oil: 17ℓ

2. Remove measurement plug (2).
3. Lightly press the brake pedal.
   ★ Check that plate (3)and plate (5) are pressed tightly against the disc.
4. Insert tool O between disc (4) and plate (3), and measure the clearance.
5. Tighten the drain plug and add axle oil through the oil filter to the specified level.

Axle oil: 17ℓ





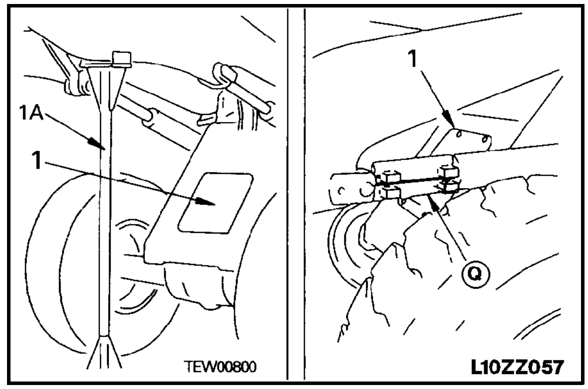


BLEEDING AIR FROM BRAKE SYSTEM

⚠ Apply the parking brake and put blocks under the tires.

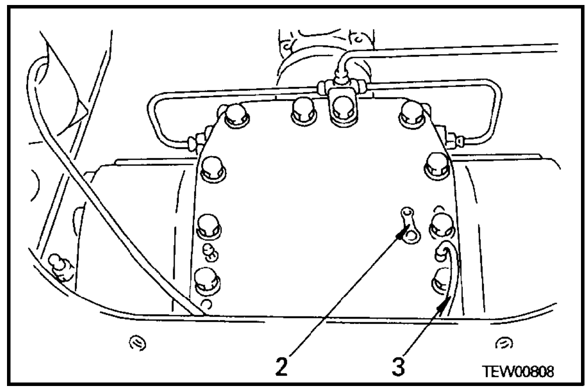
Procedure

1. Raise the boom, set support (1A) or tool Q in position, then remove front cover (1).

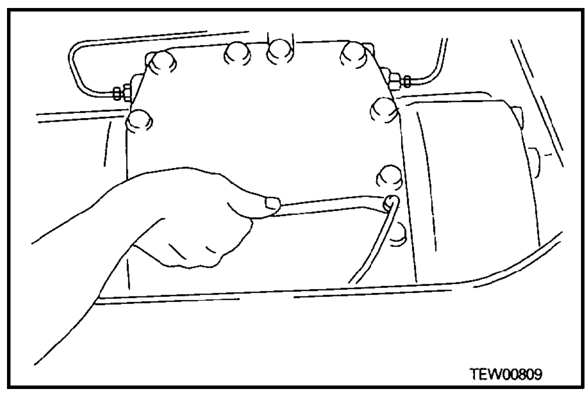


2. Remove cap (2) of the bleeder screw, insert vinyl hose (3) into the screw, and insert the other end in a container.

3. Start the engine.



4. Depress the brake pedal, then loosen the bleeder screw and bleed the air. Keep the brake pedal depressed, tighten the bleeder screw, then release the brake pedal slowly.
   ★ Add brake oil when necessary during the operation to keep brake oil tank full.



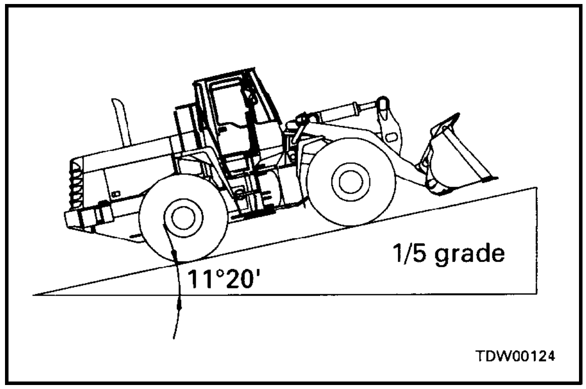
come out with the fluid from the hose, depress the pedal fully and tighten the bleeder screw while the oil is still flowing.

★ Repeat the operation to bleed the air from the other cylinders, and after completing the operation, check th elevel in the oil tank and add more oil if necessary.

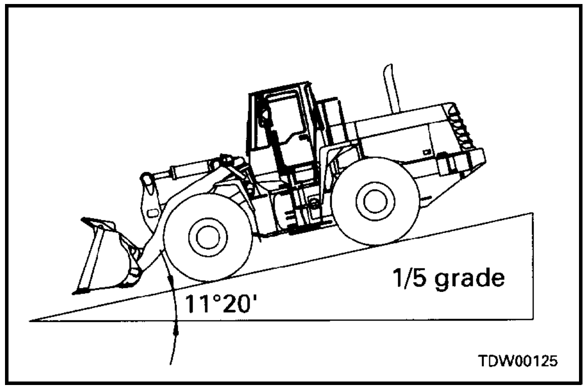
★ To bleed the air completely, bleed the air first from the cylinder which is farthest from the brake pedal.

★ After bleeding the air, carry out a brake performance test then bleed the air again and check that there is no air in the circuit.

MEASURING PARKING BRAKE PERFORMANCE



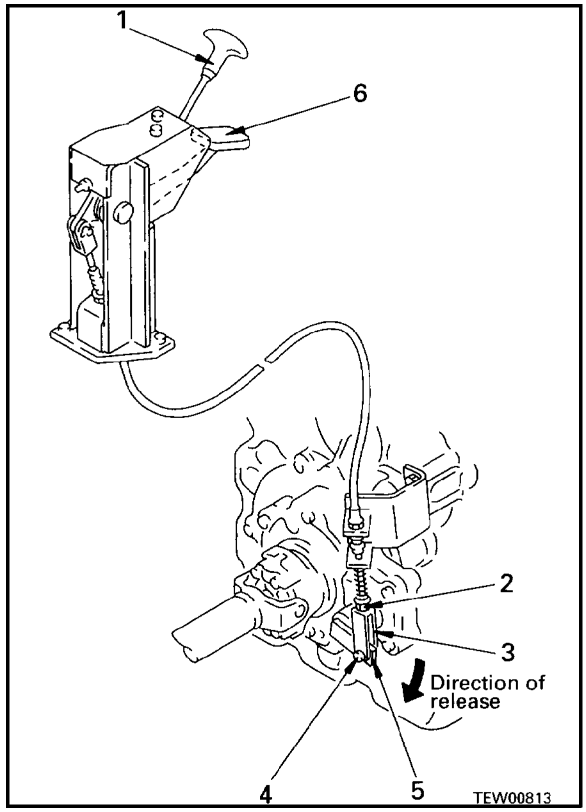
★ **Measurement conditions**
- Tire inflation pressure: Specified pressure
- Road surface: Flat, dry paved road surface with slope of 1/5 grade (11°20').
- Machine: Operating condition
- Operating effort: 392.3 N (40 kg)



Measurement method
1. Start the engine, set the machine facing in a straight line, then drive the machine up a 1/5 grade slope with the bucket empty.
2. Depress the brake, stop the machine, set the directional lever to the neutral position, then stop the engine.
3. Depress the parking brake pedal, then gradually release the brake pedal and check that the machine is held in position.
   ★ Carry out the measurement in two ways: Once with the machine facing uphill, and once more with the machine facing downhill.

TESTING AND ADJUSTING PARKING BRAKE LINKAGE

⚠ Apply the parking brake and put blocks under the tires.



Testing

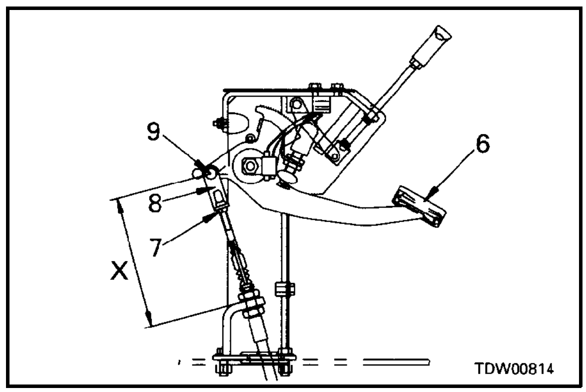
Depress the parking brake pedal with a force of approx. 294.2 N (30 kg). If the travel of brake pedal is more than 13 clicks, check for looseness of the control cable mount (pedal end and brake end). If any looseness is found, tighten and then adjust as follows.

Adjusting linkage

1. Pull release lever (1) and release the parking brake.
2. Loosen locknut (2) and remove clevis pin (4).
3. Set lever (5) at the parking brake end in the release position.
   ★ With lever (5) at the FREE position, move the link up by the amount of play.
4. Screw in clevis (3), align the hole with the pin hole in lever (5) at the parking brake end, then assemble clevis pin (4) and tighten locknut (2).
5. After adjusting, depress parking brake pedal (6) with a force of approx. 294 N (30 kg), and check that the travel of the pedal is 7 - 11 clicks.

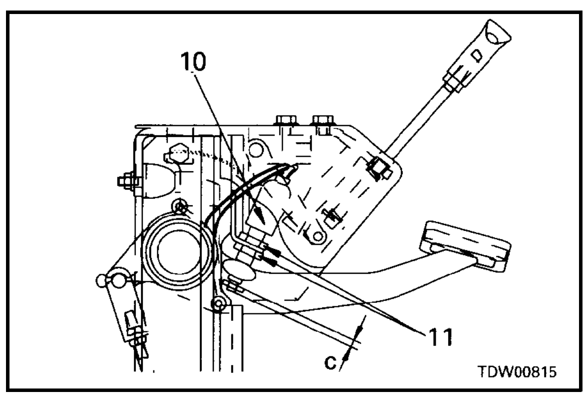
If it is impossible to adjust only at parking brake end

6. Loosen locknut (7) at pedal (6) end, then remove clevis pin (9).
7. Screw in clevis (8) and adjust so that the mounting dimension is **X**.
   ★ Standard dimension **X**: 148 mm

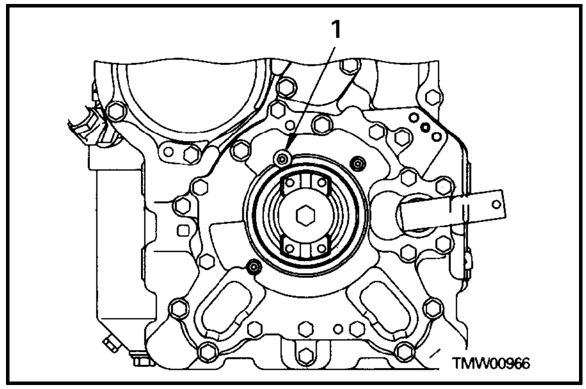


Adjusting parking brake switch

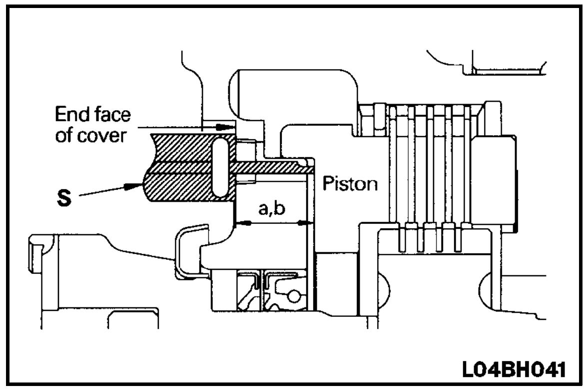
1. Adjust with nut (11) so that the mounting dimension at the tip of parking brake switch (10) is "**c**".
   ★ Mounting dimension "**c**" of switch: 4 - 6 mm
   ★ When doing this, check that the parking brake switch is OFF.



TESTING PARKING BRAKE PISTON STROKE



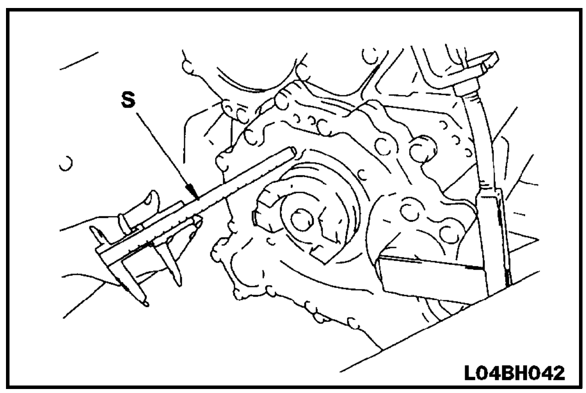
⚠ Stop the machine on level ground, install the safety bar to the frame, lower the bucket to the gruond, stop the engine, then apply the parking brake and put blocks under the wheels.



Testing

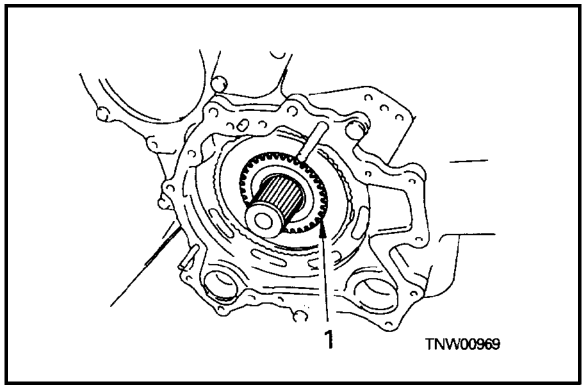
★ Check that the parking brake is applied.

1. Remove plug (1).
2. Insert tool **S** into the measurement port and measure dimension **a** from the end face of the cover to the piston.
   ★ Check that there are blocks under the tires.
3. Release the parking brake.
4. Insert tool **S** into the measurement port and measure dimension **b** from the end face of the cover to the piston.
   ★ Piston stroke (X) = a - b
   If (X)   3.5 mm, the brake disc is worn, so replace the disc.
   ★ After measuring, check the transmission oil level.



MEASURING WEAR OF PARKING BRAKE DISC

⚠ Put blocks under the tires.



Measuring

1. Disassemble the parking brake and take out the disc.

2. Check that the thickness of brake disc (1) is greater than the value given below.

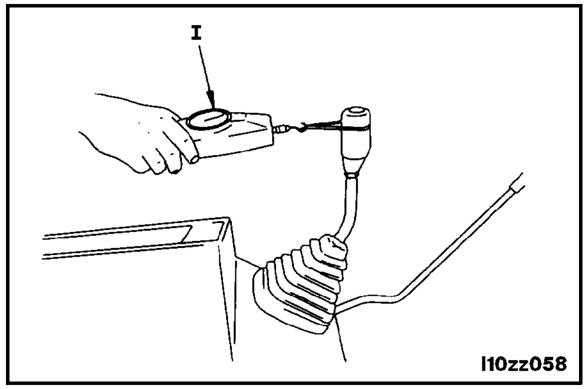
★ Thickness of disc 2.97 mm

★ For details of the procedure for adjusting the parking brake linkage, see TESTING AND ADJUSTING OF PARKING BRAKE PEDAL.

MEASURING AND ADJUSTING WORK EQUIPMENT CONTROL LEVER

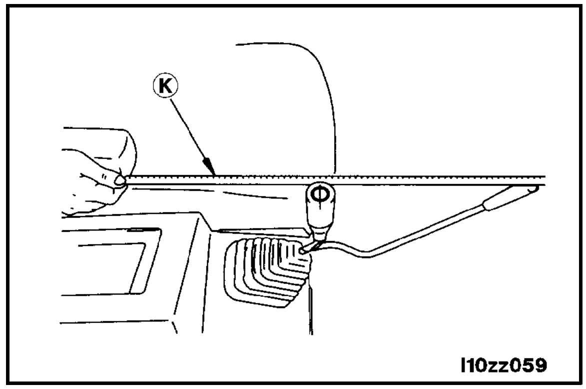
★ **Measurement conditions**
- Engine water temperature: Within white range on engine water temperature gauge.
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Engine speed: Low idling.

⚠ Install the safety bar to the frame.

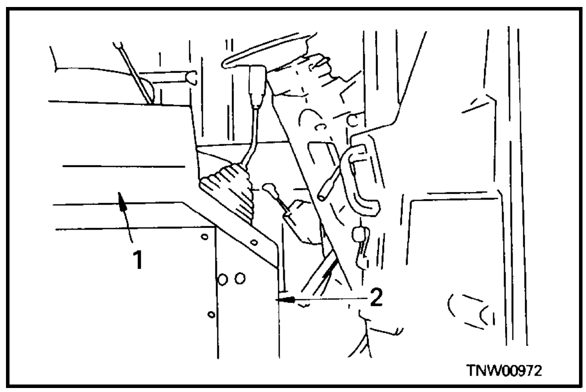


Measurement method

1. **Operating effortof work equipment control lever**
   Install tool **I** to the work equipment control lever and measure the operating force.
   ★ Install tool **I** to the center of the knob.
   ★ Operate the control lever at the same speed as for normal operations, and measure the minimum value for the force needed to operate the knob.

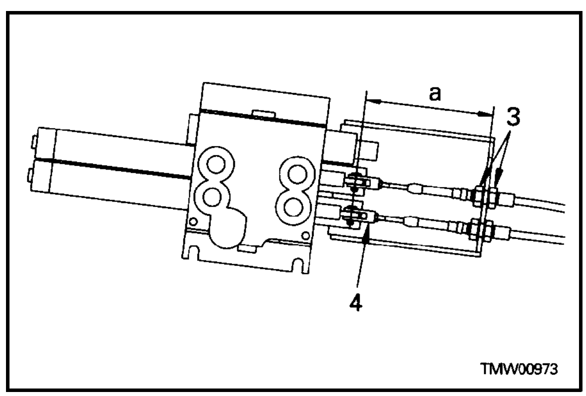


2. **Travel of work equipment control lever**
   Measure travel at each position when operating the work equipment control lever.
   ★ Mark the lever knob and use scale **K** to measure.
   ★ If the travel is not within the standard value, check for play of the linkage and wear of the bushing.



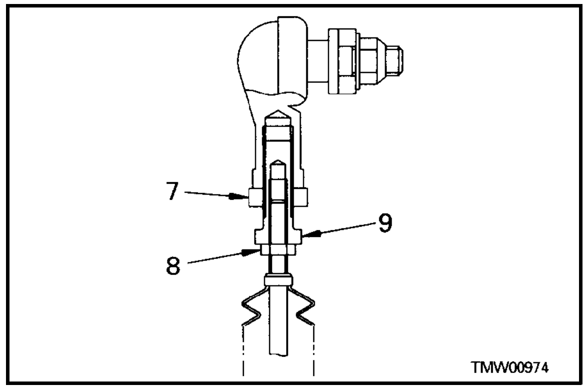
Adjusting

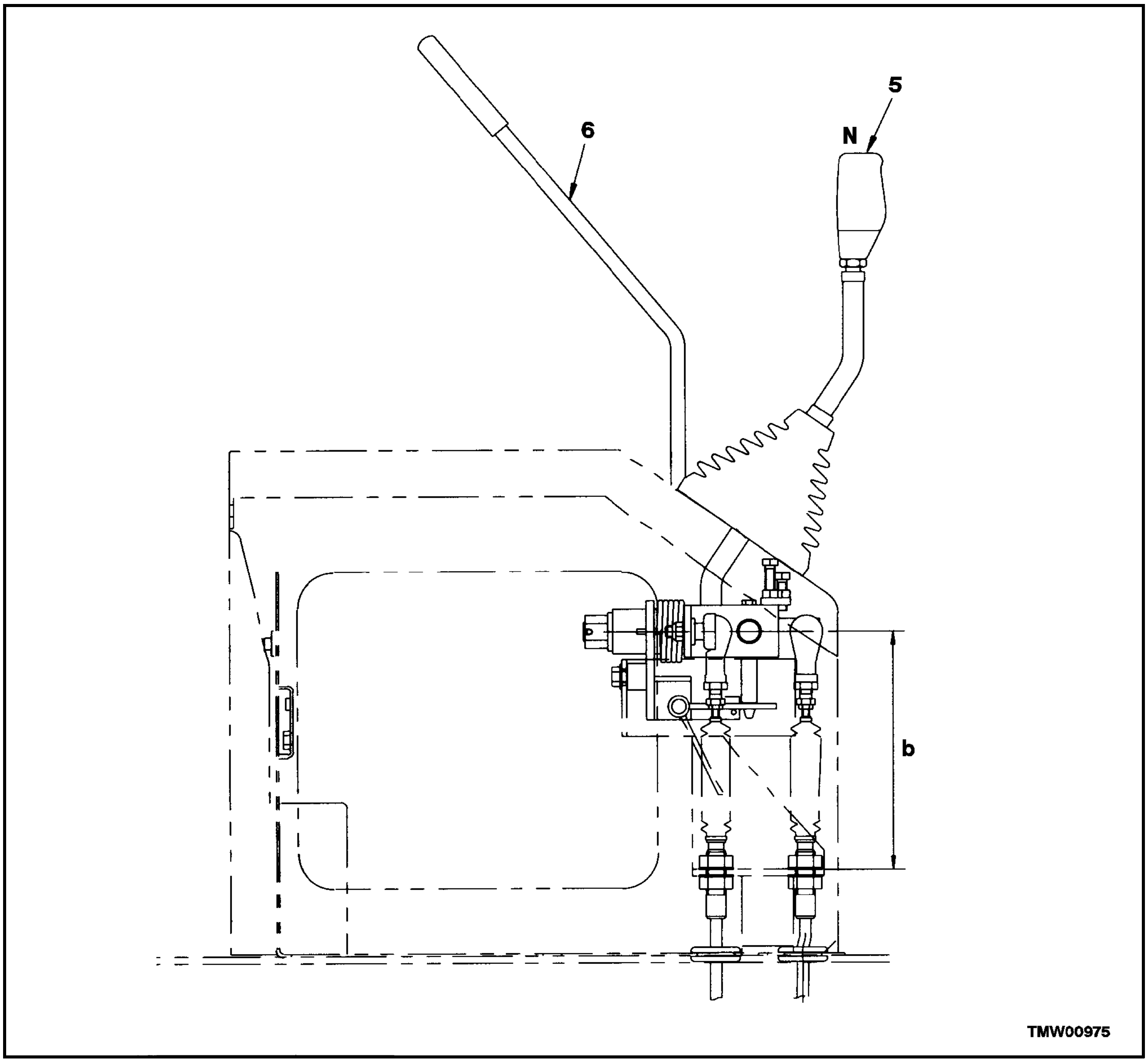
1. **Adjusting linkage rod of work equipment control lever**
   1) Remove top cover (1) and front cover (2) of the right console.
   2) Assemble the work equipment cable at the control valve end (inside front frame) to standard length **a**. Adjust the length with control cable mounting nut (3) or yoke (4).
   ★ Standard length **a**: 173 mm



(3) Loosen nuts (7) and (8) under the ball joint so that it is possible to lock work equipment control lever (5) at the HOLD position with lock lever (6), then turn joint (9) to adjust to standard length **b**. After adjusting, tighten nuts (7) and (8) to hold joint (9) in position.

★ Standard dimension **b**:
200.5 mm (standard length)



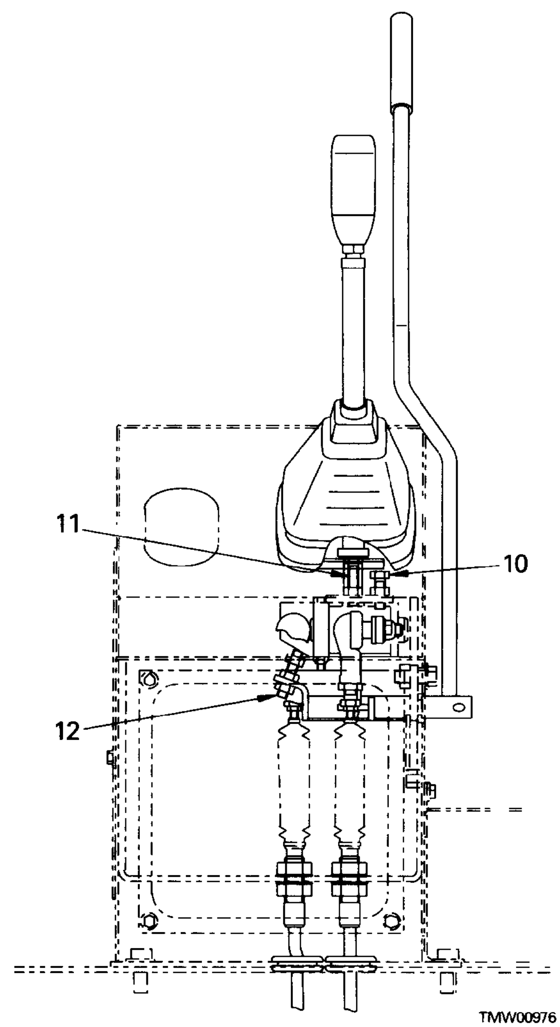


2. Adjusting stopper of work equipment control lever

(1) Adjusting boom RAISE stopper bolt (10). After connecting the cable, operate the work equipment control lever gradually to the RAISE position and adjust the length of stopper bolt (10) so that stopper bolt (10) contacts the control lever at the point where the control lever suddenly starts to feel heavy.

(2) Adjusting boom FLOAT stopper bolt (11). After connecting the cable, operate the work equipment control lever gradually to the FLOAT position and adjust the length of stopper bolt (11) so that stopper bolt (11) contacts the control lever at the point where the control lever suddenly starts to feel heavy.

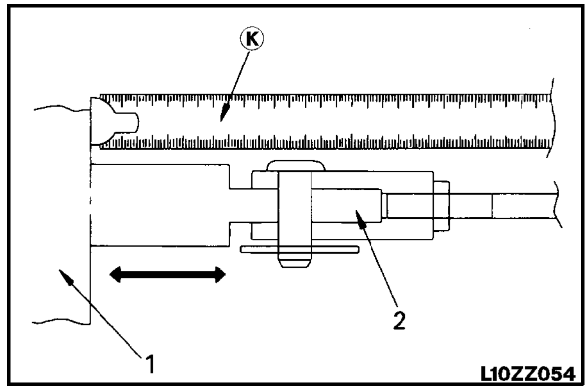
(3) Adjusting bucket DUMP stopper bolt (12). After connecting the cable, operate the work equipment control lever gradually to the DUMP position and adjust the length of stopper bolt (12) so that stopper bolt (12) contacts the control lever at the point where the control lever suddenly starts to feel heavy.



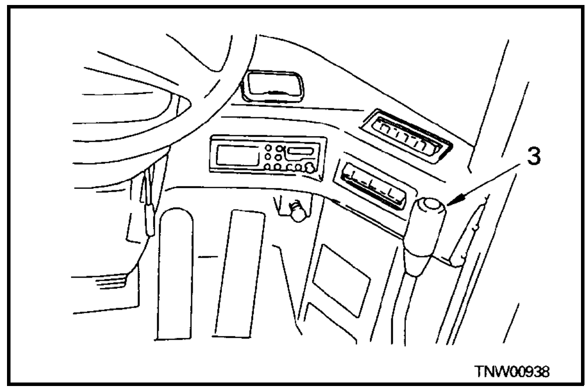
MEASURING STROKE OF WORK EQUIPMENT VALVE SPOOL

★ **Measurement conditions**
- Engine water temperature: Within white range on engine water temperature gauge
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Engine speed: Stopped

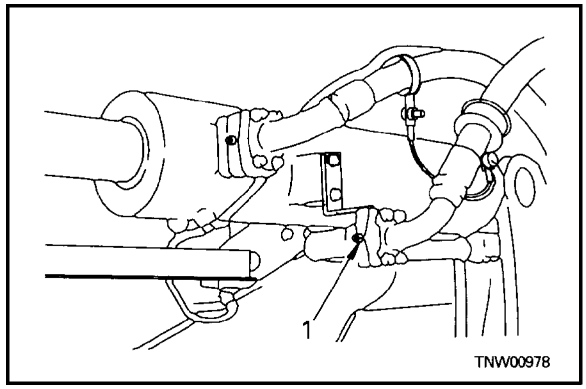
⚠ Stop the machine on level ground, install the safety bar to the frame, lower the bucket to the ground, stop the engine, then apply the parking brake andput blocks under the wheels.

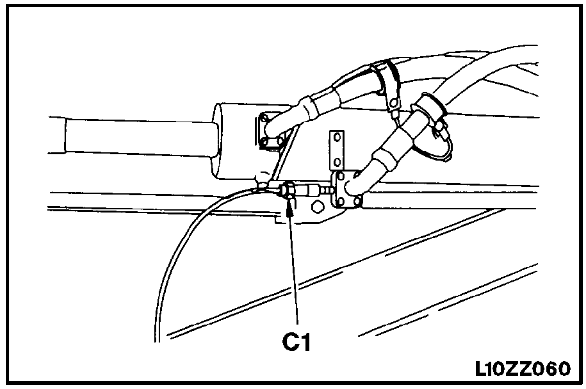


Measuring
1. Adjusting stroke of valve spool
   1) Measure the stroke of the spool of main control valve (1) from under the front frame.
   2) Measure the stroke of the valve spool (2) when work equipment control lever (3) is moved to each position.
      ★ Carry out the measurement with two workers and give signals while carrying out the operation.
      ★ One worker operates the control lever, and the other worker measures the stroke.



MEASURING WORK EQUIPMENT HYDRAULIC PRESSURE





★ **Measurement conditions**

- Engine water temperature: Within white range on engine water temperature gauge
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Engine speed: High idling

Work equipment relief valve pressure measuring procedure

Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

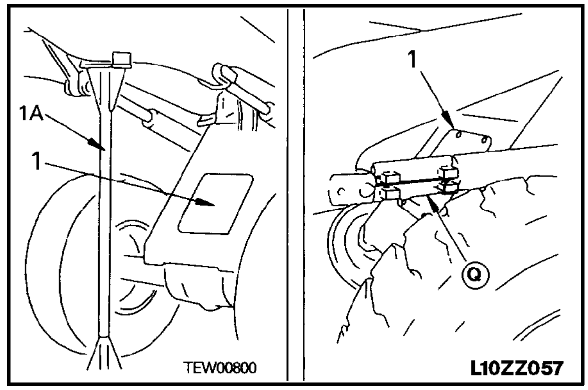
1. Remove plug (1) for measuring the hydraulic pressure in the bucket cylinder circuit.
2. Install tool **C1** (39.2 Mpa (400 kg/cm^2)) to the measurement port.
   ★ Check that there is no oil leakage from any joints.
   ★ Use a hose which is long enough to reach the operator's compartment.
3. Start the engine, raise the boom about 400 mm, run the engine at high idling, then operate the control lever to tilt back the bucket, and measure the pressure when the relief valve is actuated.
   ★ Be careful not to apply any sudden pressure to the pressure gauge.

When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when it was installed.

Adjusting

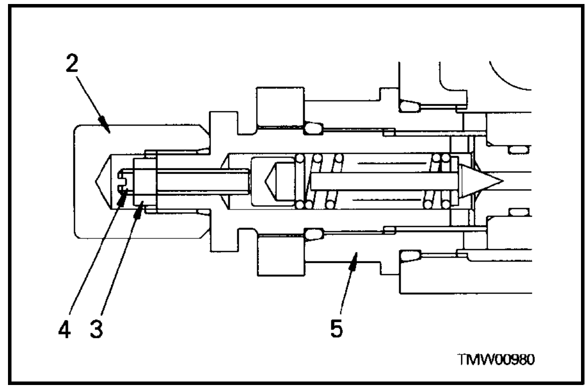
Always stop the engine when adjusting the oil pressure.

1. Raise the boom, set support (1A) or tool Q in position, then remove front cover (1).



2. Remove cap nut (2) of relief valve (5).

3. Loosen lock nut (3), then turn adjust screw (4) to adjust.
   ★ Pressure adjustment for one turn of adjustment screw: Approx. 2.43 Mpa (2.43 kg/cm^2)
   ★ Turn the adjustment screw to adjust the set pressure as follows.
   TIGHTEN to INCREASE pressure
   LOOSEN to DECREASE pressure
   ★ Do not carry out any adjustment if the relief pressure cannot be measured accurately.

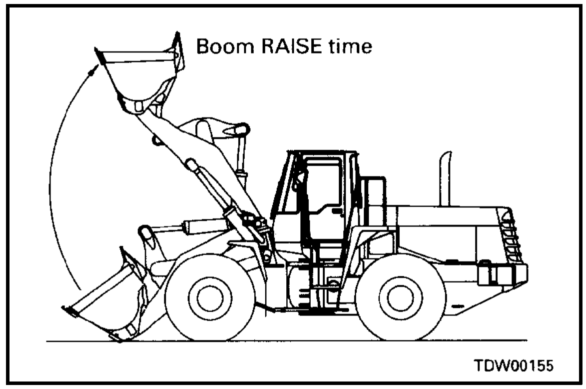


MEASURING WORK EQUIPMENT

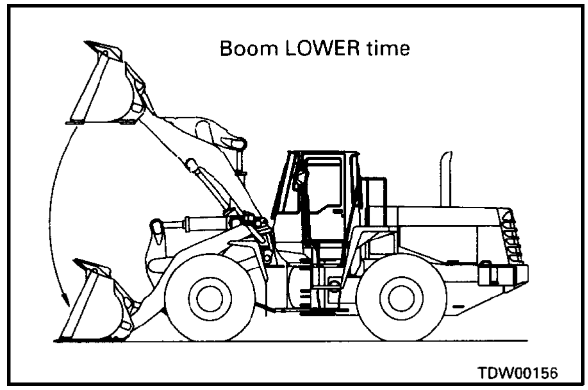
★ **Measurement conditions**
- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Engine speed: High idling
- Steering position: Neutral
- No load

Measurement method

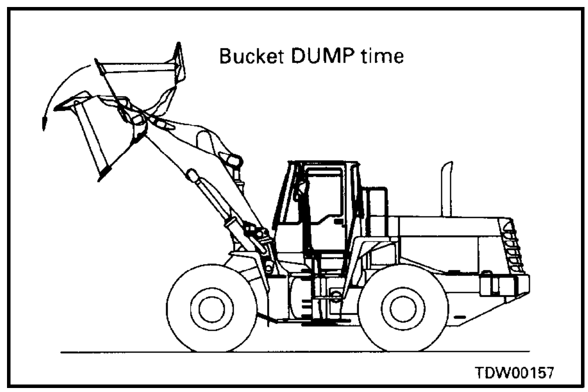
1. **Boom RAISE time**
Set the bucket at the lowest position from the ground with the bucket tilted back fully, then raise it and measure the time taken for the bucket to reach the maximum boom height.



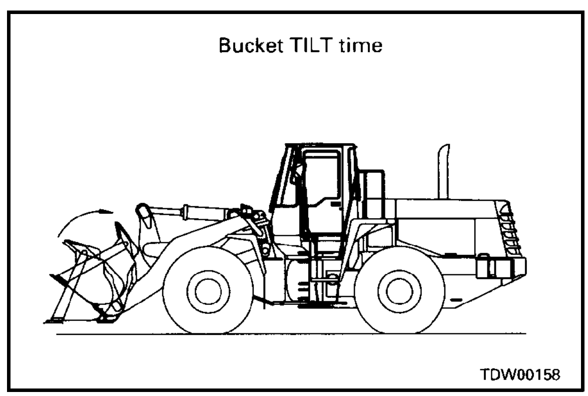
2. **Boom LOWER time**
Set the bucket horizontal, then lower the boom from the maximum height and measure the time taken for the bucket to reach the lowest position from the ground.



3. **Bucket DUMP time**
Raise the boom to the maximum height, and measure the time taken to move the bucket from the tilt position (bucket fully tilted back) to the dump position (bucket fully tipped forward).



4. **Bucket TILT time**
   1) Raise the boom to the maximum height, and measure the time taken to move the bucket to the tilt position (bucket fully tilted back).
   2) Set the bucket horizontal to the ground and measure the time taken to move the bucket from the horizontal position to the tilt position (bucket fully tilted back).



MEASURING HYDRAULIC DRIFT WORK EQUIPMENT

★ **Measurement conditions**

- Engine water temperature: Within green range on engine water temperature gauge.
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Stop the engine, leave for 5 minutes, then measure for 15 minutes.
- Boom: Horizontal
- Bucket: Horizontal
- No load

⚠ Apply the safety lock to the work equipment control levers.

⚠ Never go under the work equipment.

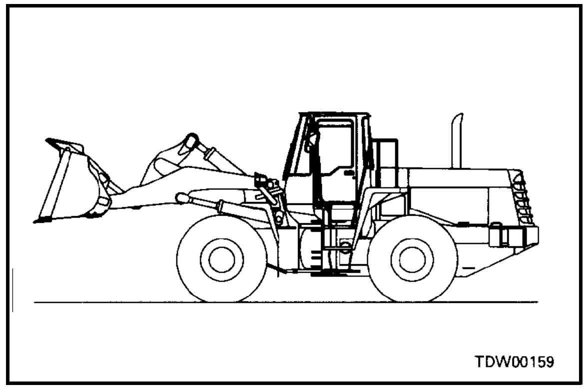
Measurement method

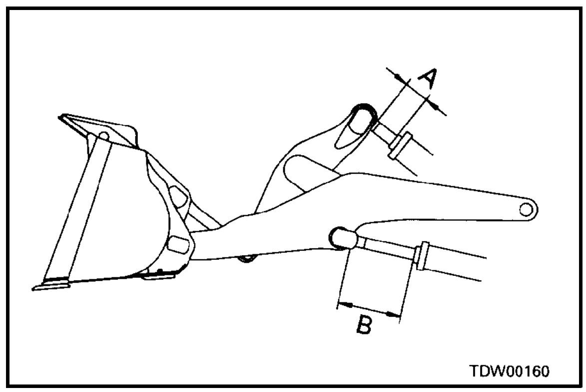
1. Set the boom and bucket in a horizontal position, then stop the engine.

2. Leave for 5 minutes, then start the measurement.

3. Wait for 15 minutes, then measure retraction amount **A** of the bucket cylinder rod and retraction amount **B** of the boom cylinder rod.

A: Retraction amount of bucket cylinder rod
B: Retraction amount of boom cylinder rod



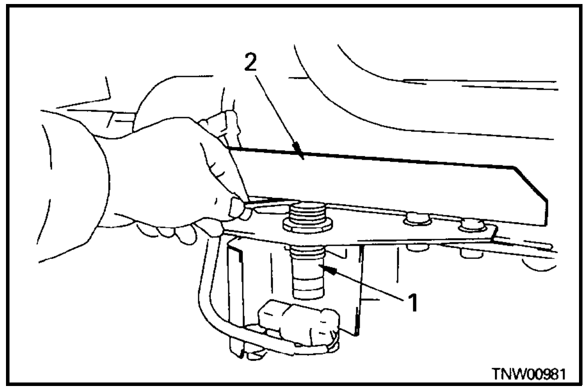


TESTING AND ADJUSTING BUCKET POSITIONER

Testing

1. Stop the engine and check that clearance **b** between switch (1) and angle (2) is the standard value.
   ★ Clearance **b**: 3 - 5 mm

2. Start the engine, run at idling and check the actuation position. (Check three times and take the average value.)

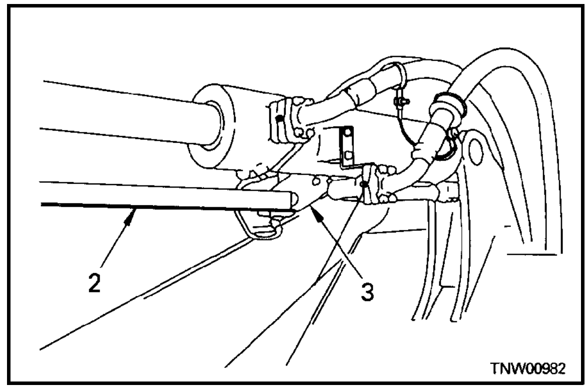


Adjusting

1. Lower the bucket to the ground, operate the bucket to the desired digging angle, then return the lever to HOLD and stop the engine.

2. Adjust mounting nut (4) of switch (1) so that clearance **b** between switch (1) and angle (2) is the standard value, then secure in position.

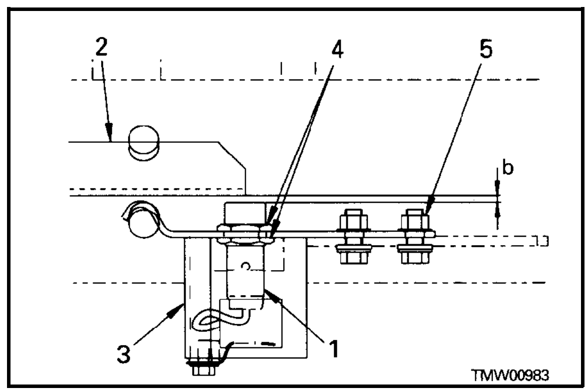
   Switch mounting nut: **17.7 ± 2 Nm (1.8 ± 0.2 kgm)**



3. Loosen bolt (5) and adjust the position of bracket (3) so that the rear face of angle (2) and the center of switch (1) are aligned.

   Bracket mounting bolt: **88.3 ± 34.3 Nm (9 ± 3.5 kgm)**

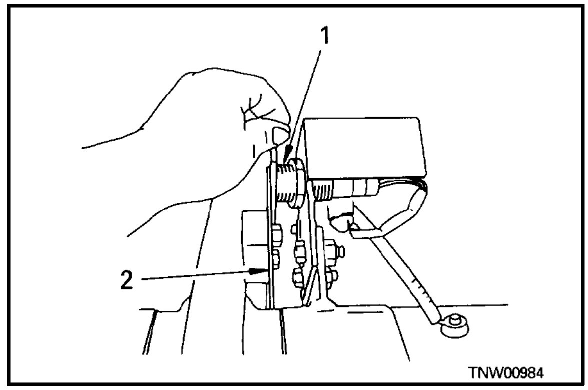
   ★ After adjusting, operate the bucket lever, check that the positioner is actuated at the desired position, then secure in position.
   ★ Clearance **b**: 3 - 5 mm



TESTING AND ADJUSTING BOOM KICK-OUT (IF EQUIPPED)

Testing

1. Stop the engine, and check that clearance **b** between switch (1) and plate (2) is the standard value.
   ★ Clearance **b**: 3 - 5 mm
2. Start the engine, run at high idling, and check the actuation position. (Check three times and take the average value.)



Adjusting

1. Raise the boom to the desired height, and mark the boom at the position where the center of the switch is aligned with the bottom of the plate.
   Always apply the safety lock to the work equipment control lever.
2. Lower the boom and stop the engine.
3. Align the marks and adjust the position of the plate so that the center of switch (1) is aligned with the bottom of plate (2), then secure in position with bolt (3).

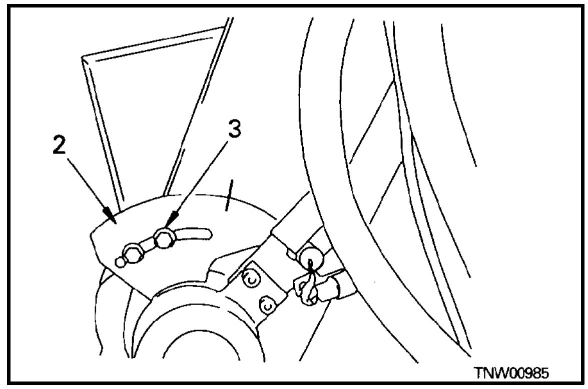
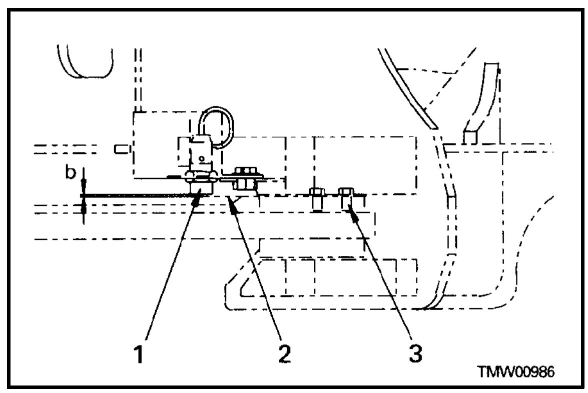


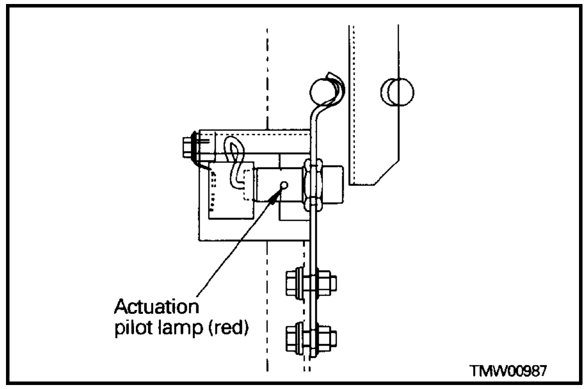
Plate mounting bolt: **88.3 ± 34.3 Nm (9 ± 4.5 kgm**)

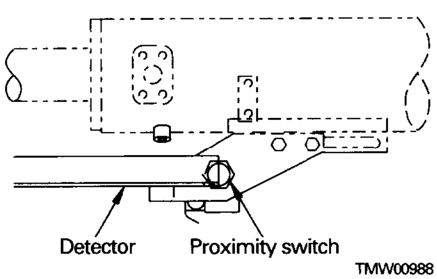
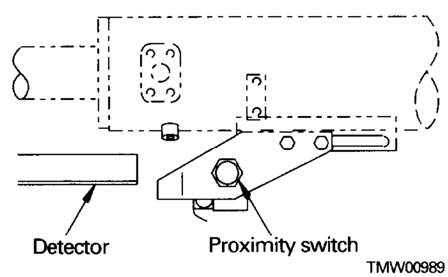
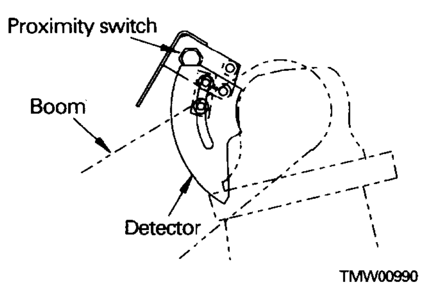
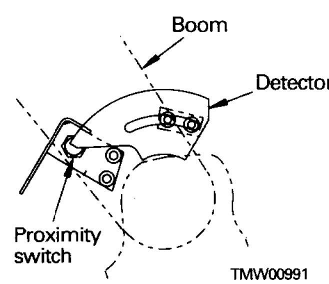
4. Adjust the switch so that the clearance between the detection surface of the switch and plate (2) is standard value **b.**
   ★ After adjusting, operate the work equipment and check that the kick-out is actuated at the desired position.
   ★ Clearance **b**: 3 - 5 mm



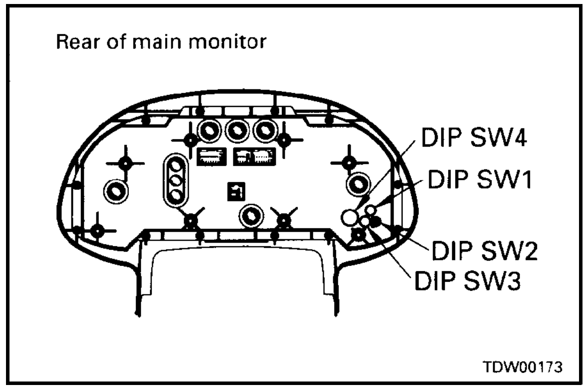
Proximity switch actuation pilot lamp (red)

The proximity switch is equipped with a pilot lamp which shows when it is being actuated, so use this when adjusting.



Proximity switch actuation pilot lamp	Lights up	Goes out
Detector position	When sensor is positioned at detection surface of proximity switch	When sensor has moved away from detection surface of proximity switch
Bucket positioner		
Boom kick-out		

ADJUSTING MAIN MONITOR (SPEEDOMETER MODULE)

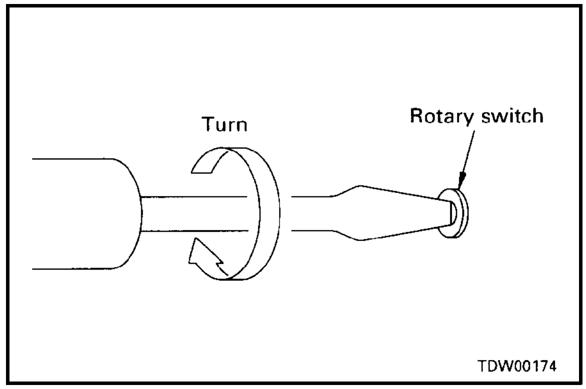


- The speedometer on the main monitor is a common part for all machines, and the input signal for the travel speed differs according to the machine, so it is necessary to adjust the monitor for use with the particular model.
- In addition, the tire diameter also differs according to the type of tire fitted, so it is necessary to adjust to give the correct travel speed.
- It is also necessary to change the switches if the optional E.C.S.S. (Electronically Controlled Suspension System) is installed.

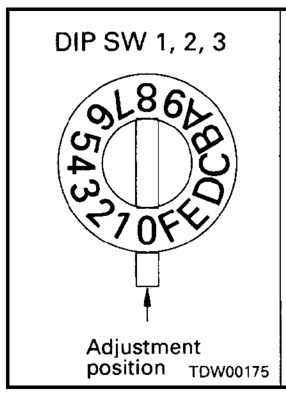
Adjustment procedure

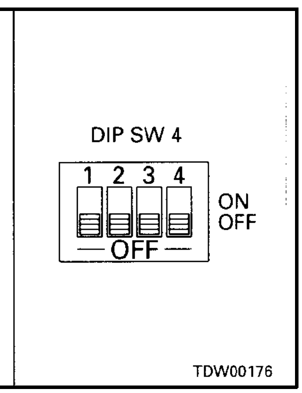
- Turn off the power, then remove the main monitor and adjust the switches at the back of the speedometer.

1. **Setting machine model**
   1) Remove the rubber caps from dipswitches (1), (2), (3), and (4) at the back of the speedometer.
   2) When the rubber cap is removed, a rotary switch can be seen inside. Using a flat-headed screwdriver, turn this switch to adjust it to the settings in the table on the following page.



Tire size		Switch 1 (model selection)	Switch 2 (speedometer correction)	Switch 3 (tachometer input selection)
17.5X25 Std.	km/h	0	7	0
17.5x25 Std.	MPH	8	7	0
20.5x25 Opt.	km/h	0	2	0
20.5x25 Opt.	MPH	8	2	0





   3) When the cap is removed from dipswitch (4) at the back of the speedometer, an ON/OFF switch can be seen.
      Adjust the setting if the E.C.S.S. (Electronically Controlled Suspension System) is installed.

Switch No.	Switch 4	
	Without E.C.S.S.	Without E.C.S.S.
1	ON	ON
2	ON	ON
3	ON	OFF
4	ON	ON

   4) After completing the adjustment, fit the rubber caps securely and install the main monitor.

Reference

Amount of correction for switch (2)

Switch position	0	1	2	3	4	5	6	7
Amount of correction (%)	+14	+12	+10	+8	+6	+4	+2	+0

Switch position	8	9	A	B	C	D	E	F
Amount of correction (%)	0	-2	-4	-6	-8	-10	-12	-14

CHECKING FOR ABNORMALITY IN FUEL LEVEL SENSOR

- If there is a marked difference between the actual amount of fuel remaining in the fuel tank and the display on the fuel gauge (the fuel tank is full but the fuel gauge does not indicate FULL), check the fuel level sensor as an individual part and measure the resistance at the three positions for the float.

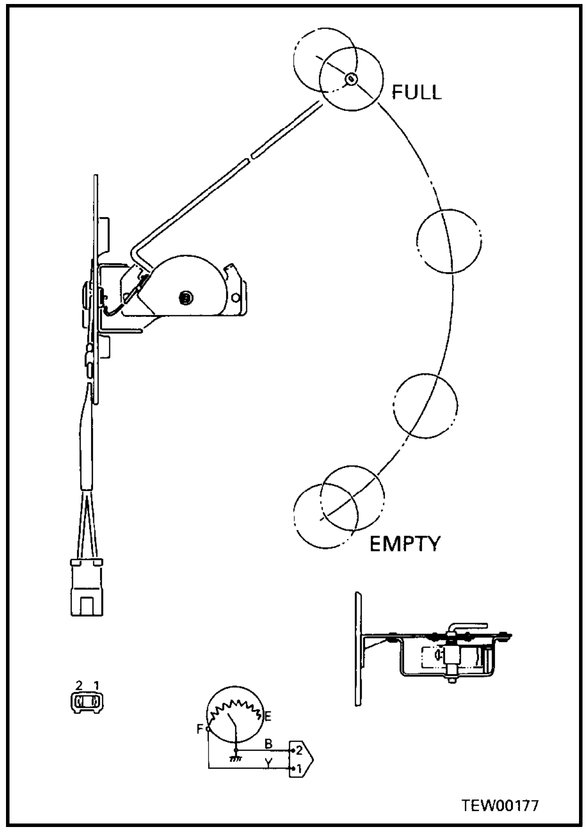
Measurement Method

- Connect one end of the probe of terminal (1), contact the other probe with terminal (2), and measure the resistance.

Resistance for fuel level sensor at each point

FULL (top)	½ (horizontal)	EMPTY (bottom)
10 + 1,-3	32	85 +10,0

★ The resistance values are only given as a guideline.



TROUBLESHOOTING

MEMORANDA

POINTS TO REMEMBER WHEN TROUBLESHOOTING

Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.

When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.

If the radiator cap is removed when the engine is hot, hot coolant may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.

Be extremely careful not to touch any hot parts or to get caught in any rotating parts.

When disconnecting wiring, always disconnect the negative (-) terminal of the battery first.

When removing the plug or cap from a location which is under pressure from oil, water or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.
When carrying out troubleshooting, an important point is to understand the structure and function of the machine. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

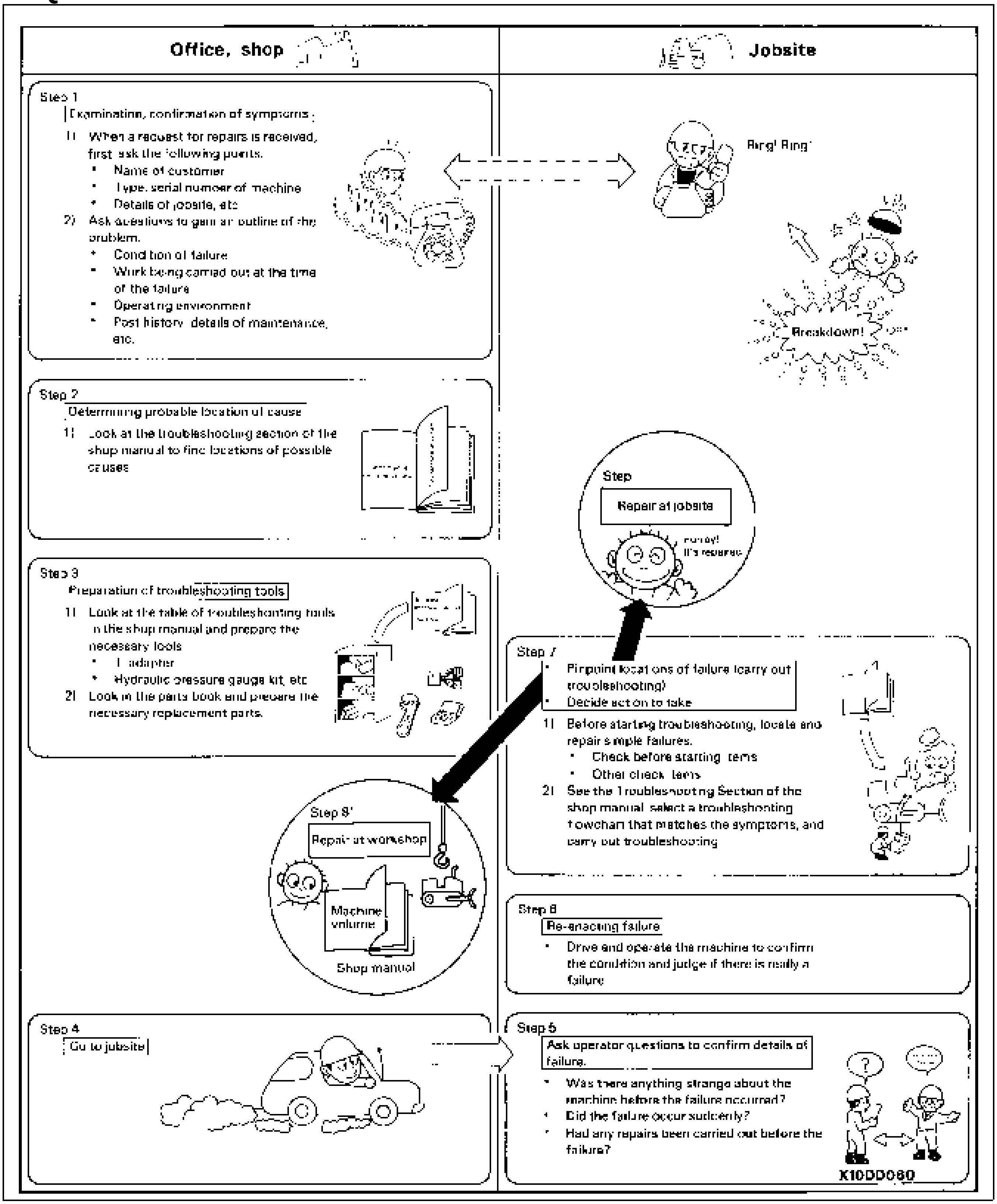
1. When carrying out troubleshooting, do not hurry to disassemble the components. If components are disassembled immediately after a failure occurs:
   ! Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   ! It will become impossible to find the cause of the failure.

   It will also cause a waste of man hours, parts, or oil and grease. At the same time, it will also lose the confidence of the user or operator. For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask the user or operator.
   1. Have any other problems occurred apart from the problem that has been reported?
   2. Was there anything strange about the machine before the failure occurred?
   3. Did the failure occur suddenly, or were there problems with the machine condition before this?
   4. Under what conditions did the failure occur?
   5. Had any repairs been carried out before the failure? When were these repairs carried out?
   6. Has the same kind of failure occurred before?
3. Check before troubleshooting.
   1. Check the oil level.
   2. Check for any external leakage of oil from the piping or hydraulic equipment.
   3. Check the travel of the control levers.
   4. Check the stroke of the control valve spool.
   5. Other maintenance items can be checked externally, so check any item that is considered to be necessary.
4. Confirming the failure.
   1. Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.

   i When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. Troubleshooting
   1. Use the results of the investigation and inspection in Steps 2 - 4 to narrow down the causes of the failure, then use the troubleshooting flowchart to locate the position of the failure exactly.

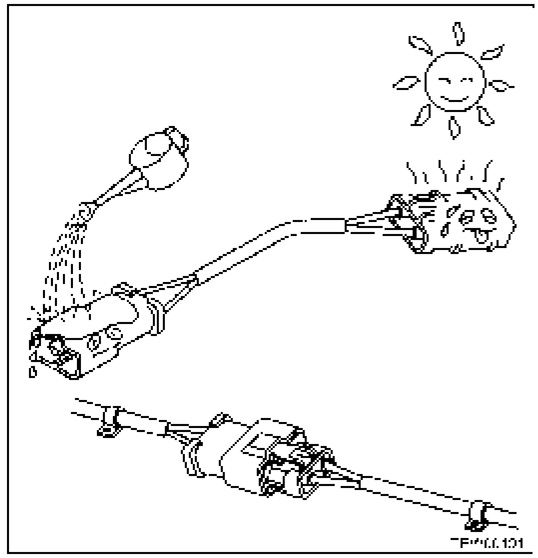
   b The basic procedure for troubleshooting is as follows.
      1. Start from the simple points.
      2. Start from the most likely points.
      3. Investigate other related parts or information.
6. Measures to remove root cause of failure.
   1. Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
   2. To prevent this, always investigate why the problem occurred. Then, remove the root cause.

SEQUENCE OF EVENTS IN TROUBLESHOOTING



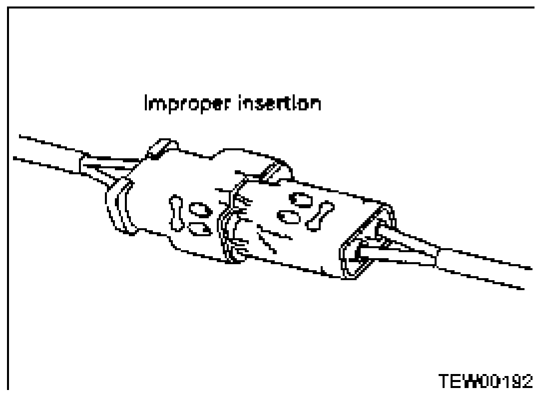
PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on 'Handling electric equipment' and 'Handling hydraulic equipment' (particularly hydraulic oil).



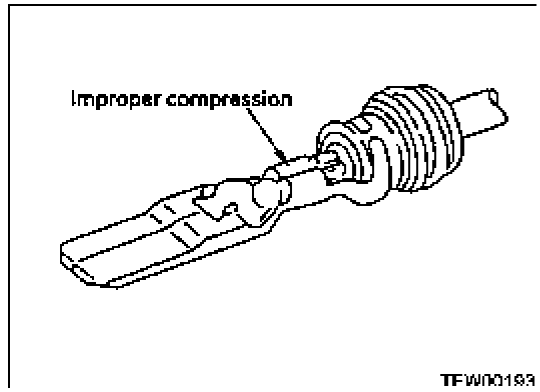
1. PRECAUTIONS WHEN HANDLING ELECTRIC EQUIPMENT

1) **Handling wiring harnesses and connectors**
Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protector or tubes used for protecting the wiring. Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.



2) **Main failures occurring in wiring harness**
a) **Faulty contact of connectors**
(faulty contact between male and female).
Problems with faulty contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.

b) **Defective compression or soldering of connectors**
The pins of the male and female connectors are in contact at the compressed terminal or soldered portion, but there is excessive force on the wiring, and the plating peels to cause improper connection or breakage.



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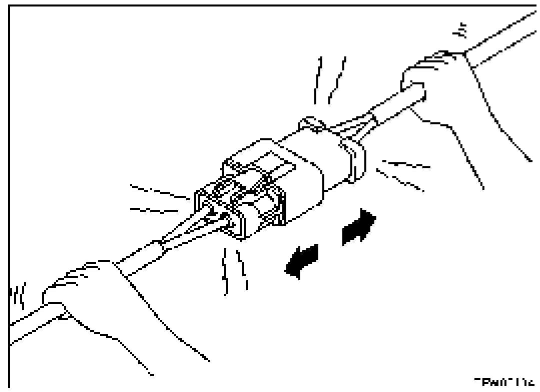
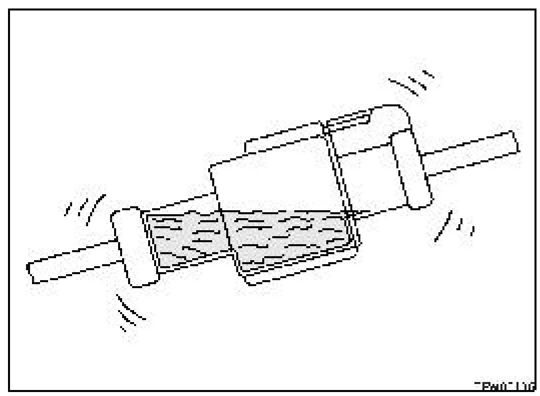
c) **Disconnections in wiring**
If the wiring is held and tugged and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping compression of the connectors to the wire may be loosened, or the soldering may be damaged, or the wiring may be broken.

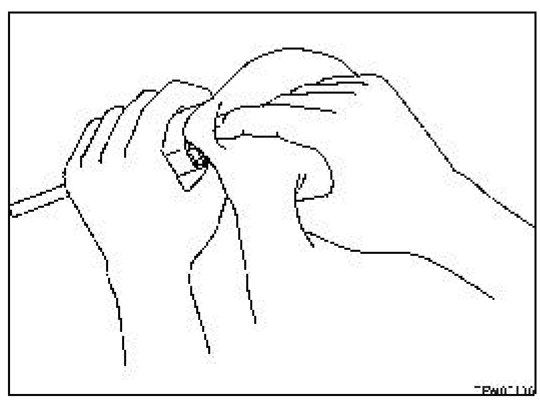


d) **High pressure water entering a connector**
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector depending on the direction of the water jet.
The connector is designed to prevent water from entering, but if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.



e) **Oil, grease or dirt stuck to connector**
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, and this will cause a defective contact.
If there is oil or grease or dirt stuck to the connector, wipe it off with a dry cloth or blow dry with air, and spray it with a contact restorer.

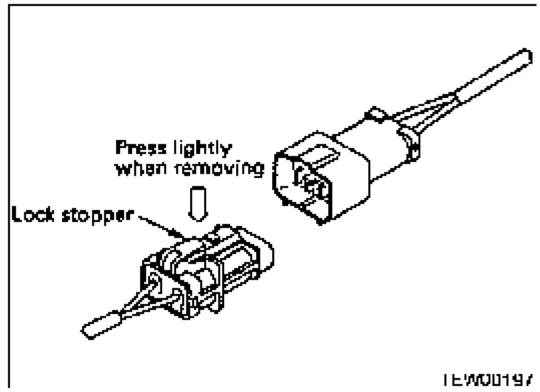
- When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
- If there is water or oil present, it will increase the contamination of the points, so clean with air until all water and oil has been removed.



3) **Removing, installing, and drying connectors and wiring harnesses.**

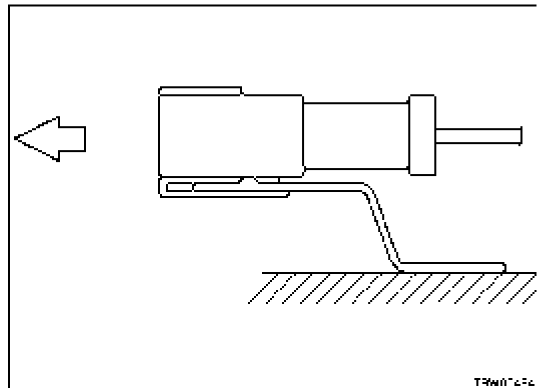
a) **DISCONNECTING CONNECTORS**

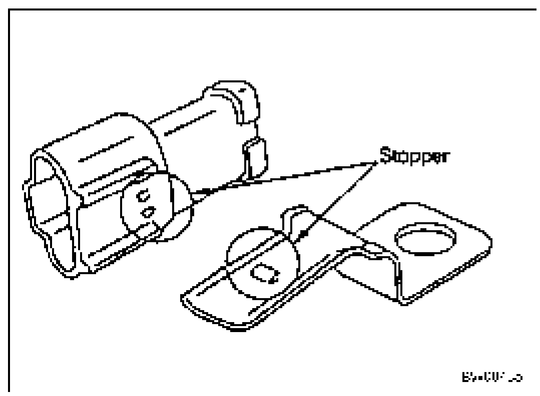
(1) Hold the connectors when disconnecting.
When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.



(2) When removing the connectors from the clips, pull the connector in a parallel direction to the clip.

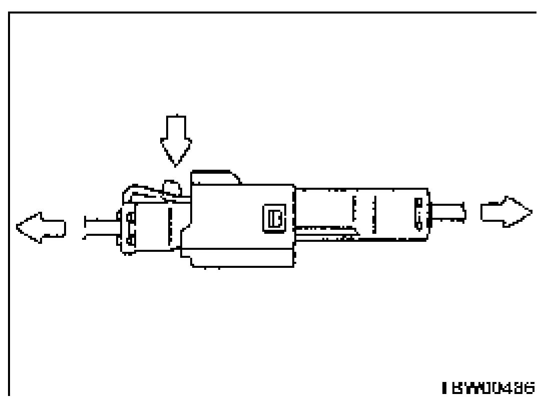
i If the connector is twisted to the left and right or up and down, the housing may break.



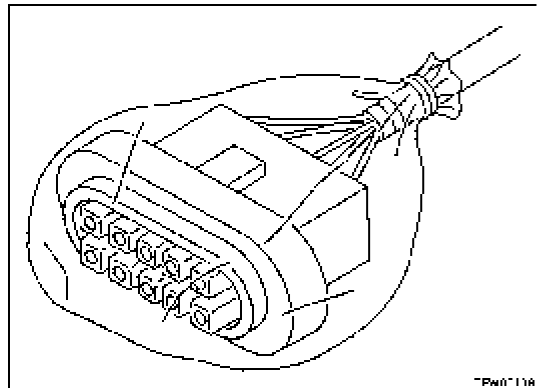


(3) When disconnecting male and female connectors, release the lock and pull in parallel with both hands.

i Never try to pull apart with one hand.



(4) **Action to take after removing connectors.**
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.

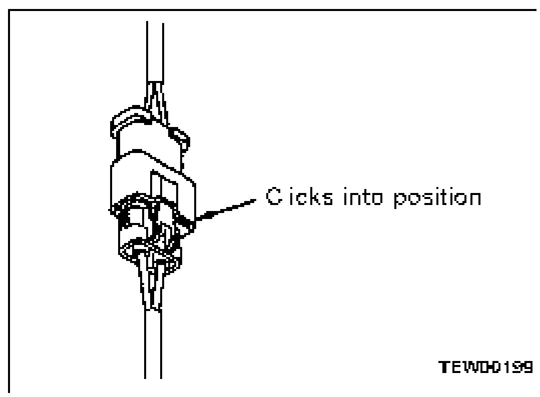


b) **CONNECTING CONNECTORS**

(1) **Check the connector visually.**

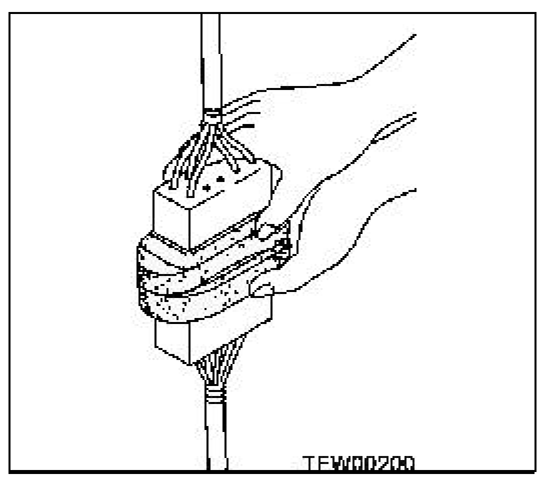
! Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
! Check that there is no deformation, faulty contact, corrosion, or damage to the connector pins.
! Check that there is no damage or breakage to the outside of the connector.
i If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has gotten inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.
i If there is any damage or breakage, replace the connector.

(2) **Assemble the connector securely.**
Align the position of the connector correctly, then insert it securely.
For connectors with a lock stopper:
Push in the connector until the stopper clicks into position.

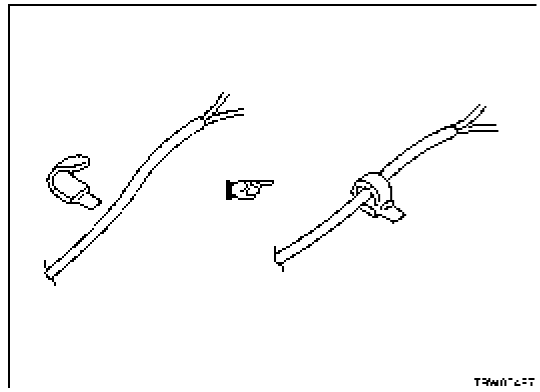


(3) **Correct any protrusion of the boot and any misalignment of the wiring harness.**
For connectors fitted with boots, correct any protrusion or the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

i When blowing with dry air, there is danger that the oil in the air may cause improper contact, so clean with properly filtered air.



(4) When the wiring harness clamp of the connector has been removed, always return it to its original condition and check that there is no looseness of the clamp.

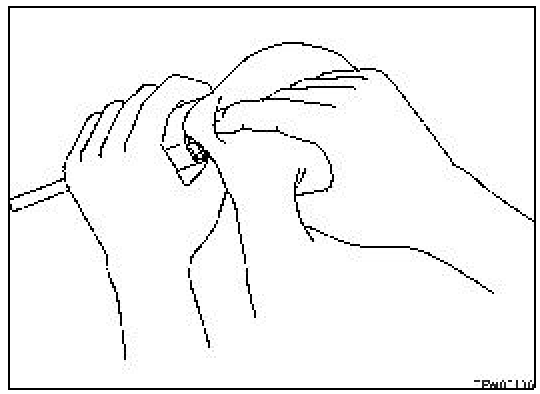


c) **DRYING WIRING HARNESS**

If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows:

(1) Disconnect the connector and wipe off the water with a dry cloth.

i If the connector is blown dry with air, there is the risk that oil in the air may cause a faulty contact, so avoid blowing with air.



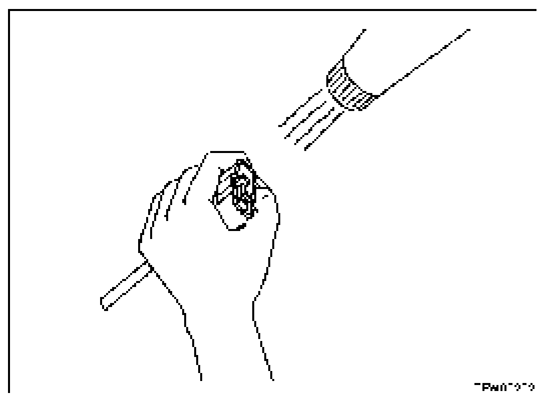
(2) Dry the inside of the connector with a dryer. If water gets inside the connector, use a dryer to dry the connector.

i Hot air from the dryer can be used, but be careful not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.

i

(3) Carry out a continuity test on the connector. After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.

Ú After completely drying the connector, spray it with contact restorer and reassemble.



2. HANDLING CONTROL BOX

1) **The control box contains a microcomputer and electronic control circuits.**
   This controls all of the electronic circuits on the machine, so be extremely careful when handling the control box.

2) **Do not open the cover of the control box unless necessary.**

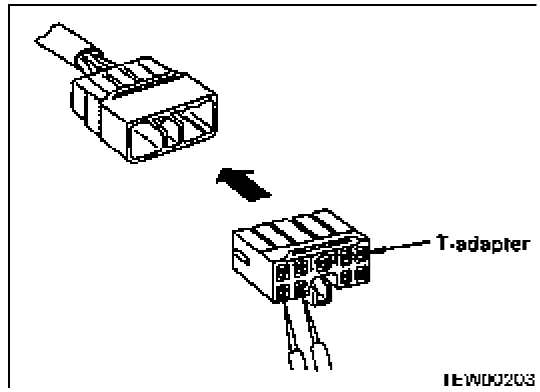
3) **Do not place objects on top of the control box.**

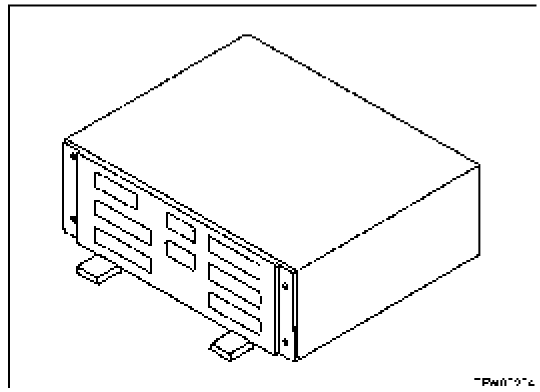
4) **Cover the control connectors with tape or a vinyl bag.**

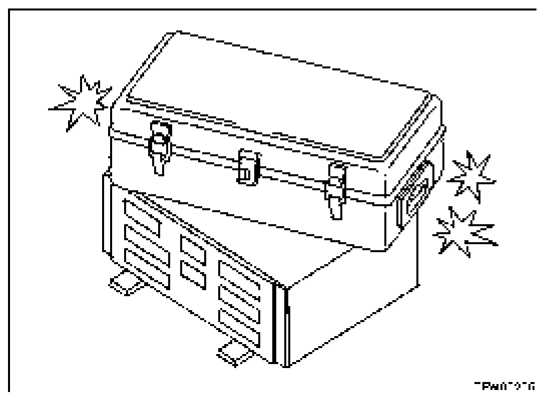
5) **Do not leave the control box in a place where it is exposed to rain.**

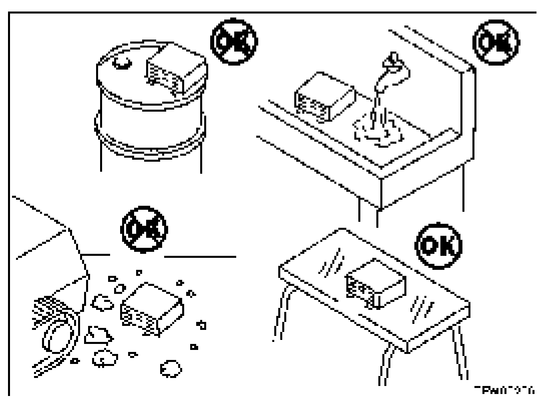
6) **Do not place the control box on oil, water, or soil, or in any hot place, even for a short time.**
   (Place it on a suitable dry stand)

7) **Precautions when carrying out arc welding**
   When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.



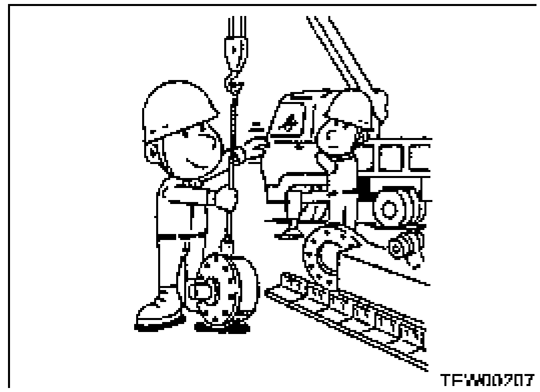






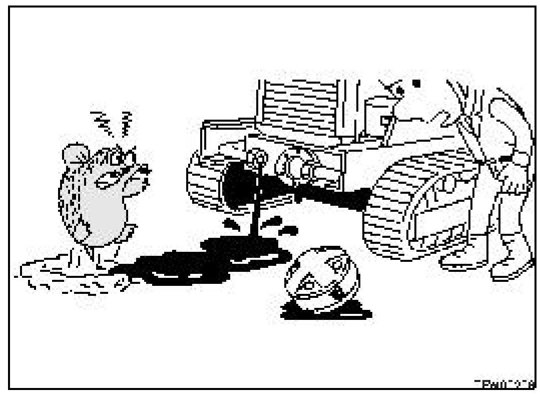
3. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

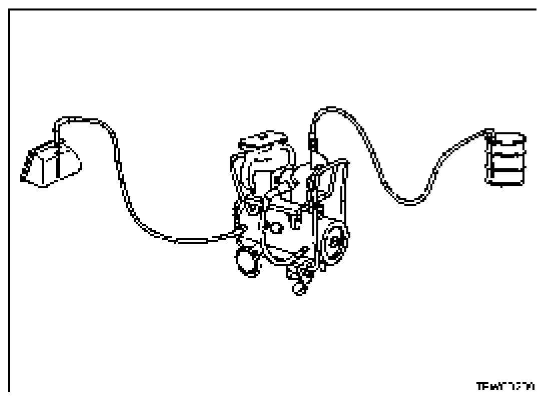


1) **Be careful of the operating environment.**
Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

2) **Disassembly and maintenance work in the field**
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried out in a specially prepared dust proof workshop, and the performance should be confirmed with special test equipment.

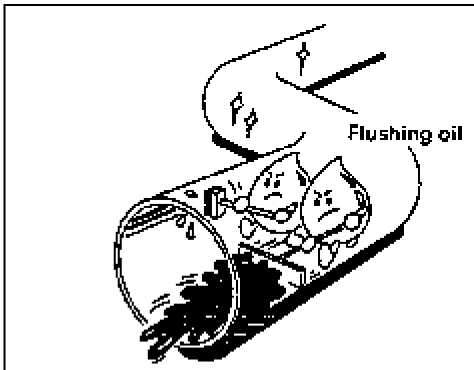


3) **Seal or cover all openings of disconnected piping**
After any piping or equipment is removed, the openings should be sealed with caps, tape, or vinyl bags to prevent any dirt or dust from entering. Never leave any openings opened or blocked with a rag, this could cause particles or dirt to get into the system.
Drain all oil into a container and not unto the ground and be sure to follow the proper environmental regulation for any disposal of oil.



4) **Do not let any dirt, or dust get in during refilling operations.**
Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.

5) **Change hydraulic oil when the temperature is high.**
When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Do not drain the oil from the hydraulic tank; but drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.



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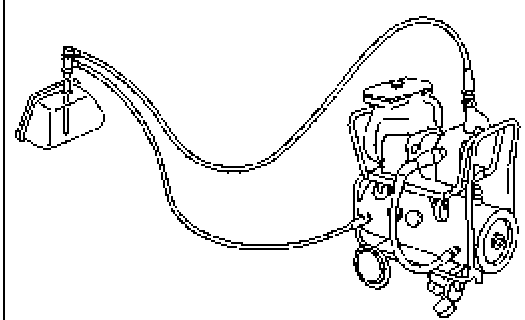
6) **Flushing operations**
After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit. Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



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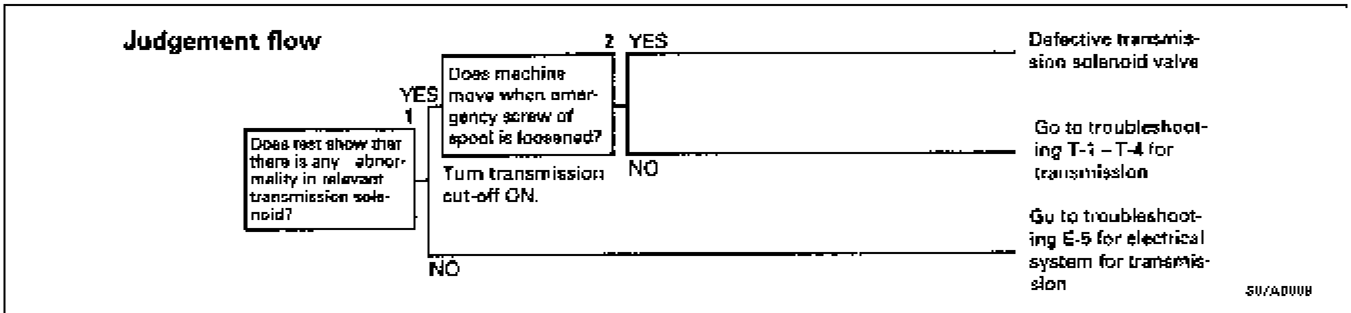
7) **Cleaning operations**
After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.
The oil cleaning equipment is used to remove the ultra fine (about 3**F) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.**

CHECKS BEFORE TROUBLESHOOTING

		Item	Judgement standard	Remedy
Checks before starting	Lubricant, coolant	1. Check fuel level, type of fuel	—	Add fuel
		2. Check for dirt or water in fuel	—	Clean, drain
		3. Check hydraulic oil level	—	Add oil
		4. Check filter (hydraulic, transmission, torque converter)	—	Replace
		5. Check oil level	—	Add oil
		6. Check engine oil	—	Add oil
		7. Check coolant level	—	Add coolant
		8. Check clogging of dust indicator	—	Clean or check
	Electrical components	9. Check for loose or corroded battery terminals or wiring	—	Tighten or replace
		10. Check for loose or corroded alternator terminals or wiring	—	Tighten or replace
		11. Check for loose or corroded starting motor terminals or wiring	—	Repair or replace
		12. Check operation of gauges	—	Repair or replace
Other check items	Hydraulic, mechanical components	13. Check for abnormal noise or smell	—	Repair
		14. Check for oil leakage	—	Repair
		15. Bleed air from system	—	Bleed air
		16. Check effect of brakes	—	Adjust or repair
	Electrical components	17. Check battery voltage (engine stopped)	23 - 26V	Repair or replace
		18. Check battery electrolyte level	—	Add electrolyte or replace
		19. Check for discolored, burned, or bare wiring	—	Replace
		20. Check for missing wiring clamps, hanging wires	—	Repair
		21. Check for water on wiring (check carefully for water at connectors and terminals)	—	Dry place affected by water
		22. Check for broken or corroded fuses	—	Replace
		23. Check alternator voltage (engine running at over half throttle) (If the battery charge is low, it may reach approx. 25 V immediately after starting)	— 27.5 - 29.5V	Replace Repair or check
		24. Noise when battery relay is operated (turn starting switch ON-OFF)	—	Replace

JUDGEMENT OF POWER TRAIN

To judge if any abnormality in the power train is in the electrical system of the transmission or in the transmission itself, use the following judgement flow chart. If the abnormality is in the electrical system, carry out troubleshooting for E-5, and if the abnormality is in the transmission system, go to troubleshooting T-1 - T-4.



Testing transmission solenoid

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Install a T-adapter checker to connector CNFT1, and check the voltage between the connector pins and the chassis ground.
2. Turn the start switch ON.

i Do not start the engine under any circumstances.

3. Turn the parking brake switch ON ö OFF (release).
4. When using the foot brake, press the right brake so that the transmission cut-off is not turned off.

Testing solenoid circuit

Normal condition

Lever operation		CNFT1 connector Pin No. 1 (F)	2 (R)	3 (H-L)	4 (SPEED)	5 (GND)
Directional lever	FORWARD	●	○			○
	REVERSE	○	●			○
Speed lever	1st			○	●	○
	2nd			○	○	○
	3rd			●	○	○
	4th			●	●	○

Normal actuation table

○ : [Continuity]

● : [Battery voltage]

Result of check (abnormal)	Troubleshooting
Normal	T1 – T4
○ Continuity at 2 places	E – 5(d)
○ No continuity	E – 5 (b), (c)
● No battery voltage at all	E – 5(a)
Normal	T1 – T4
○ Continuity higher than normal	E – 5(f)
○ No continuity at all	E – 5(e)
● No battery voltage at all	E – 5(e)

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PRECAUTIONS WHEN TROUBLESHOOTING

1. SAFETY

! Stop the machine on level ground, and check that the safety pins and parking brake are correctly applied, and that the tires are blocked.

! When working in groups, use agreed upon signals and do not allow unauthorized persons near machine.

! Be careful not to get burned by hot parts or get caught in rotating parts.

! Always disconnect the cable from the negative (-) terminals of the battery before disconnecting any wiring.

! Always release the pressure before removing the plugs or caps of any place under hydraulic or air pressure, and connect all measuring tools correctly.

2. METHODS FOR TROUBLESHOOTING

Ú Just because a failure occurs, do not immediately start to disassemble the machine.

! The machine may be disassembled in such a way that the problem cannot be located, so the cause of the problem will be unknown.

As a result,

! The customer and operator will lose confidence in you.

! Time will be wasted, and unnecessary costs will be incurred for excess parts and greasing.

To avoid these problems, use the following procedure when troubleshooting.

1) Ask the customer and operator the following questions about the breakdown.

a. Have there been any other problems apart from the one reported?
b. Was there anything unusual before the machine broke down?
c. Did the breakdown occur suddenly, or had there been signs of trouble before?
d. What was the machine doing when break down occurred?
e. Had the machine been repaired before the breakdown? If so, who carried out the repair, and when?
f. Had the same kind of failure occurred before?

2) Check the following items which can be checked simply by visual checks etc.

a. Check oil level.
b. Check for leakage of oil from piping or hydraulic equipment.
c. Check travel of control levers.
d. Check stroke of spool in control valves.

3) Reenact the failure and check the condition of the machine (particular conditions at the time of failure).

a. Ask the user or operator if the decision about the failure was made based on measured values, or by comparison, or by feeling.
b. Compare extent of failure with standard values.
   ! Check safety before carrying out any check.
   ! Did not make any check or measurement that will make the condition worse.

4) Try to locate the possible causes for the failure.

The transmission system consists of the transmission itself, the transmission control valve, and the transmission electrical control.

In particular, when trouble occurs in the transmission system, the probable location of the failure can be divided as follows;

! Transmission itself, or transmission control valve.

! Transmission electric control.

To decide which of the two is the location of the failure, refer to “JUDGMENT ON POWER TRAIN”.

5) Carry out troubleshooting using the troubleshooting charts.

There are the following two types of troubleshooting charts.

1. TROUBLESHOOTING TABLE
   - POWER TRAIN
   - STEERING SYSTEM
   - BRAKE AND AIR SYSTEM
   - WORK EQUIPMENT SYSTEM
2. TROUBLESHOOTING FLOW CHART
   - ELECTRICAL SYSTEM

The troubleshooting charts consist of:

1) Items which can be checked easily.
2) Items which are likely to be the cause of such failures.

Follow theses charts to carry out troubleshooting. At the same time, do not forget the following points.

! Check related items.

! Check that there are no other failures or breakdowns.

6) Investigate causes of breakdown

! Even if the breakdown is repaired, if the original cause of the problem is not removed, the same breakdown will occur again. To investigate and remove the original cause, see "Actions to take to prevent failures from occurring again".

3. PRECAUTIONS WHEN REMOVING, INSTALLING, DISASSEMBLING OR ASSEMBLING PARTS DURING TROUBLESHOOTING

! Carry out the various testing and adjusting while observing the items on quality control given in "Testing and Adjusting".

! When removing parts, check their condition of mounting, and distinguish between front and rear, left and right, and top and bottom.

! Check the match marks, or make match marks to prevent mistakes when installing.

! If part cannot be removed even when the nuts and bolts have been removed, do not use excessive force to remove it. Check the part to see if there is any problem with it and remove the problem before trying to disassemble the part.

! When installing or assembling, clean off all dust and dirt and repair any scratches or dents. Remove all grease or oil before coating with gasket sealant.

PREVENTING RECURRENCE OF TROUBLE

- The troubleshooting table is used to establish the direct cause of damage or breakdown of a part or piece of equipment. It is not able to establish the root cause of the damage or failure, however.
- Also, this table only describes the action to be taken with the particular part or piece of equipment. It does not mention what action should be taken to prevent a recurrence of the root cause.
- In order to remove the root cause of a fault so as to prevent a recurrence, carefully investigate the real cause while referring to the following items.
- Regarding the method of checking and adjusting each part or piece of equipment, refer to "Testing and Adjusting" in the Shop Manual.

HYDRAULIC EQUIPMENT

1. Oil checks

- The fundamental cause of almost all faults occurring in hydraulic equipment is the inclusion of water, air or other foreign matter in the oil. Accordingly, it is necessary to check the oil to see whether or not it contains any of the above substances, and then take appropriate action.

1) Oil checks
   - Check for water contamination.
     Check the oil for possible water contamination by means of a diesel engine oil checker or a hot plate.
   - Check for contamination of other foreign matter. Remove the drain plug and filter, then check the bottom of the tank and also the filter to see if any foreign matter has collected there. Check the degree of contamination by means of a contamination checker.
   - Viscosity check
     Check the viscosity of the oil using a viscometer in order to confirm whether or not the oil is satisfactory.
2) Check of contamination point
   If, as a result of the above checks, it is discovered that the oil is contaminated by water or other foreign matter, it is necessary to find out where the contamination is occurring and also to take steps to prevent it.

   Water: Oil storage tank, breather, etc.
   Sand: Oil replenishing or replacing method, etc.
   Rubber: Cylinder packing, etc.
   Metal: Wear or damage to hydraulic equipment such as pump and motor, as well as transmission and torque converter, etc.
3) Oil cleaning and replacement
   - If a large amount of metal particles or other foreign matter is discovered in the oil, either wash the oil using an oil refresher or replace it.
     - Ú If the oil is contaminated by water, it is not possible to remove the water by means of an oil refresher.
     - Ú When washing the oil, also wash or replace the strainer and replace the filter.

2. Cleaning fragments of damaged parts

- If a part becomes damaged, fragments may pass into the oil line. It is thus necessary to wash the oil.
- In addition, disassemble and wash such parts as valves and cylinders which are liable to collect metal fragments and other foreign matter, thus helping to prevent a recurrence of faults due to such fragments becoming lodged in various parts of the engine or hydraulic equipment.

METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting code No.	Component
S-F F	Troubleshooting of engine
M-F F	Troubleshooting of main monitor
K-F F	Troubleshooting of maintenance monitor
E-F F	Troubleshooting of electrical system
T-F F	Troubleshooting of hydraulic and mechanical system
D-F F	Troubleshooting of ECSS (Electronically Controlled Suspension System)
W-F F	Troubleshooting of work equipment

2. Method of using troubleshooting table for each troubleshooting mode.

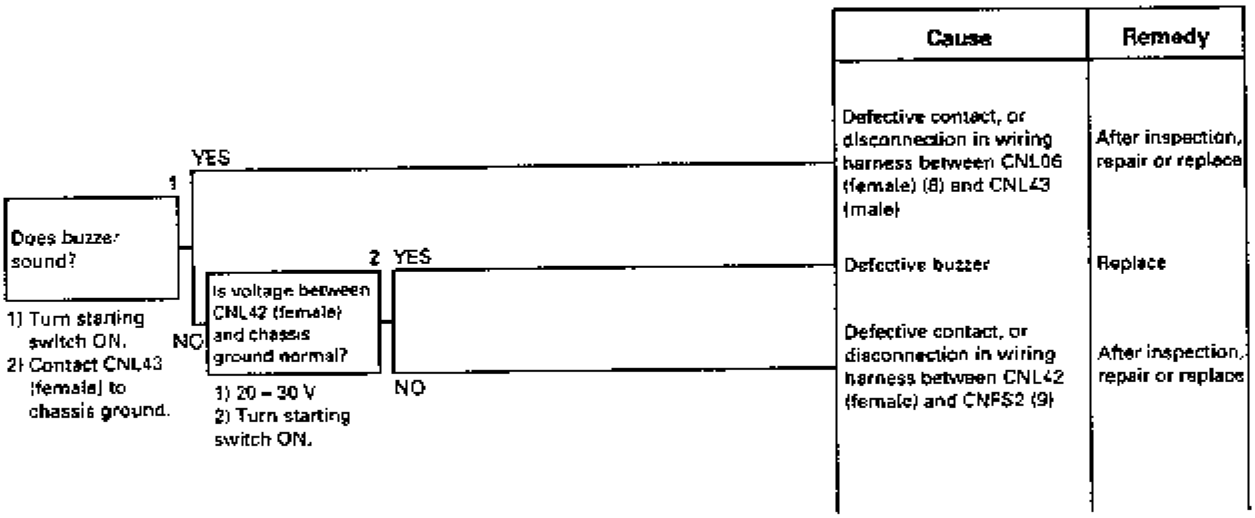
1) Troubleshooting code number and problem.
The title of the troubleshooting chart gives the troubleshooting code, service code and failure mode (problem with the machine). (See Example (1))
2) Distinguishing conditions.
Even with the same failure mode (problem), the method of troubleshooting may differ according to the model, component, or problem. In such cases, the failure mode (problem) is further divided into sections marked with small letters (for example, (a)), so go to the appropriate section to carry out troubleshooting.
If the troubleshooting table is not divided into sections, start the troubleshooting from the first check item in the failure mode .(See Example (2))
3) Method of following troubleshooting chart.
   - Check or measure the item inside YES NO, and according to the answer, follow either the YES line or the NO line to go to the next condition box. (Note: The number at the top right corner of the condition box is an index number; it does not indicate the order to follow.)
   - Following the YES or NO lines according to the results of the check or measurement will lead finally to the Cause column. Check the cause and take the action given in the Remedy column on the right .(See Example (3))
   - Below the condition box, there are the methods for inspection or measurement, and the judgement values.
   If the judgement values below the condition box are correct or the answer to the question inside the condition box is YES, follow the YES line. If the judgement value is not correct, or the answer to the question in NO, then follow the NO line.
   - Below the condition box is given the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is the danger that it may cause mistaken judgement or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from the first item 1.
4) General precautions
When carrying out troubleshooting for the failure mode (problem), precautions that apply to all the items are given at the top of the page and marked with a **i** . (See Example (4))
The precautions marked **i** are not given in the condition box, but must always be followed when carrying out the check inside the condition box.
5) Troubleshooting tools
When carrying out troubleshooting, prepare the necessary troubleshooting tools. For details, see TOOLS FOR TESTING, ADJUSTING AND TROUBLESHOOTING.
6) Installation position, pin number.
A diagram or chart is given for the connector type, installation position, and connector pin number connection. When carrying out troubleshooting, see this chart for details of the connector pin number and location for inspection and measurement of the wiring connector number appearing in the troubleshooting flow chart for each failure mode (problem).

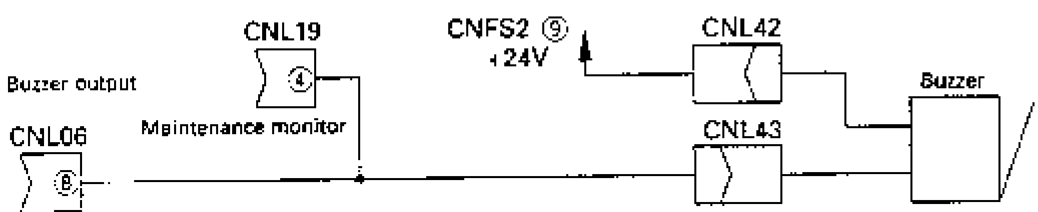
< Example >

(1) **M-15 Abnormality in buzzer**

(2) (a) Buzzer does not sound when starting switch is turned ON (during self-check)

(3)





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(4)

- Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- Always connect any disconnected connectors before going on to the next step.

3. Using troubleshooting chart for engine-related failure

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting.** The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspection without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are used to check the high probability causes to make the final confirmation.

[Question]

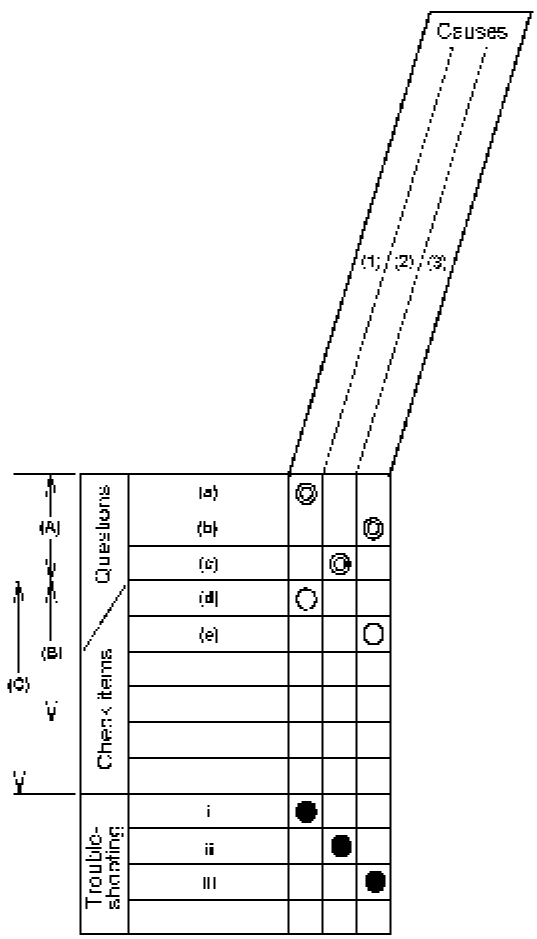
Sections (A) and (B) in the chart below corresponds to the items where the answers can be obtained from the user. The items in (B) are items that can be obtained from the user, depending on the user's level.

[Check items]

The serviceman carries out simple inspections to narrow down the causes. The items under (C) in the chart below correspond to this. The serviceman narrows down the causes from information (A) that he has obtained from the user and the results of (C) that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.



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The basic method of using the troubleshooting chart is as follows.
Items listed for **[Questions]** and **[Check Items]** that have a relationship with the Cause items are marked with **F**, and of these, causes that have a high probability are marked with **F**.

Check each of the [**Questions]** and **[Check Items]** in turn, and marke the **F** or **F** in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make the final confirmation of the cause.

※ 1. For **[Confirm recent repair history]** in the Question section, ask the user, and mark the Cause column with a Î to use as reference for locating the cause of the failure. However, do not use this when making calculation to narrow down the causes.

※ 2. Use the Î in the Cause column as reference for **[Degree of use (Operated for long period)]** in the Questions section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included in necessary to determine the order for troubleshooting.

			Causes: Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)
※1	Confirm recent repair history							
※2	Degree of use	Operatred for long period		Λ	Λ	Λ		

! **Example of troubleshooting when exhaust gas is black**

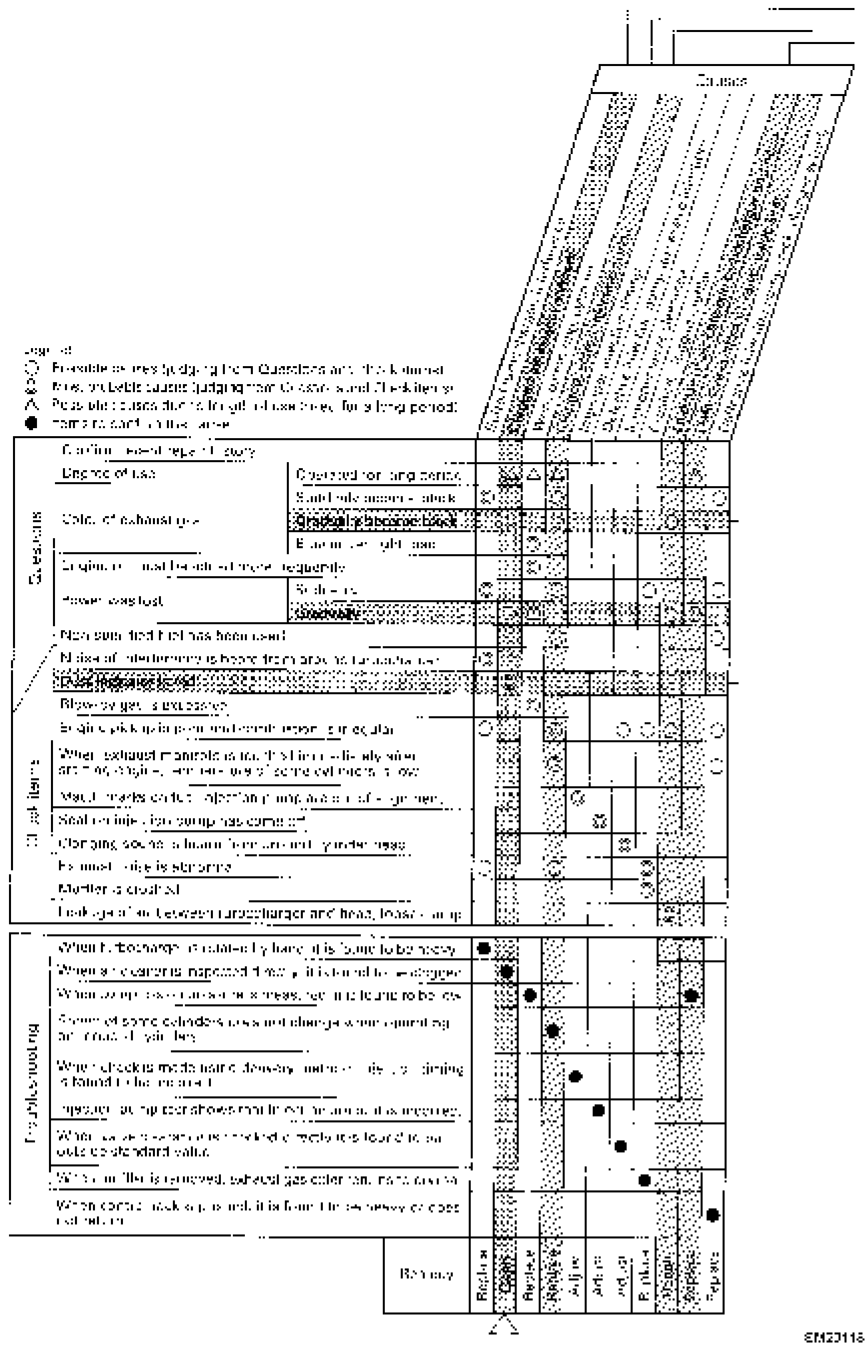
Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [Dust indicator is red].

If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- ! insufficient intake of air
- ! improper condition of fuel injection
- ! Excessive injection of fuel



Five causes

Step 1

Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the five Cause items in the vertical column.

Three symptoms

Step 2

Add up the total of ○ and ◎ marks where the horizontal lines for the three symptoms and the vertical columns for the causes intersect.

(1) Clogged air cleaner element: ◎○◎
(2) Air leakage between turbocharger and head: ○○
(3) Clogged, seized injection nozzle: ○
(4) Defective contact of valve, valve seat: ○
(5) Worn piston ring, cylinder: ○

Step 3

The calculation in Step 2 show that the closest relationship is with [Clogged air cleaner element]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ●. The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas color should return to normal.

4. **Method of using matrix troubleshooting tables**
The troubleshooting tables use the same method as for other troubleshooting table (YES/NO type) to locate the causes of failures in the machine. The troubleshooting tables are divided broadly into categories for the main components, such as the steering system and work equipment hydraulic system. Follow the procedure given below and carry out troubleshooting to locate the problems accurately and swiftly.

Step 1. Questioning the operator

The questions to ask the operator are given below the failure symptom. If the answers to the questions match the information given, follow the arrow to reach the probable cause of the failure.
Consider the contents of the questions and consult the table while proceeding to Steps 2 and 3 to grasp the true cause.

1. Steering does not work ² Symptom [Example]

Ask the operator about the following points.
! Did the steering suddenly stop working? ÿ Breakage in steering equipment
! Had the steering gradually been becoming heavy? ÿ Internal wear of steering equipment, defective seal.

Step 2. Checks before troubleshooting

Before starting the main troubleshooting and measuring the hydraulic pressure, first check the Checks before Starting items, and check for oil leakage and loose bolts. These checks may avoid time wasted on unnecessary troubleshooting.
The items given under Checks before Starting are items which must be considered particularly for that symptom before starting troubleshooting.

Checks before starting [Example]

! Is the oil level and type of oil in the hydraulic tank correct?
! Is there any leakage of oil from the steering control valve?

Step 3. Using cross-reference table

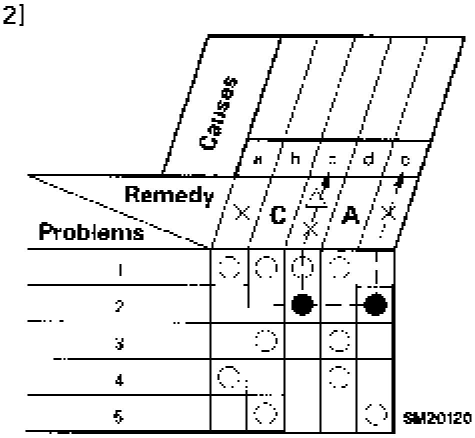
1) Operate the machine to carry out the checks in the troubleshooting item column.
Mark the items where the results match the symptom.
i It is not necessary to follow the troubleshooting checks in order; follow an order which is easiest to carry out troubleshooting.

2) Find the appropriate cause from the cause column. If the symptom appears, the **F**', marks on that line indicate the possible causes. (For item No. 2 in the table on the right, the possible causes are **c** or **e**.)
If there is only one **F**:
Carry out the other troubleshooting items (where the same cause is marked with check if the symptom appears, then repair.
If there are two **F** s:
Go on to Step 3) to narrow down the possible causes.

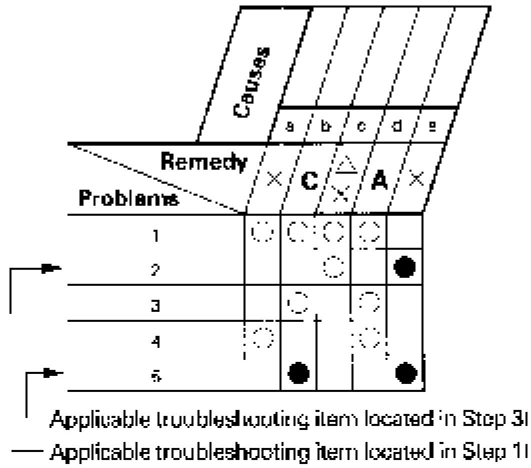
[Example 1]

No	Problems / Remedy
1	Steering does not work to the left or right
2	Same as item 1, but abnormality in actuation of work equipment
3	Steering can only be operated to one side.
4	Steering wheel is heavy and cannot be turned.

[Example 2]



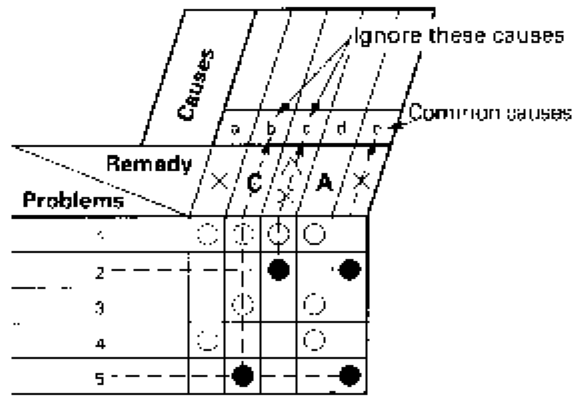
3) Operate the machine and check the troubleshooting items other than those in 1).
Operate the machine and check the items in the same way as in 1) and if the symptom appears, mark that item. (In the chart on the right, the symptom appears again for item 5).



4) Find the appropriate cause from the cause column. In the same way as in Step 2), if the symptom appears, the **F** marks on that line indicate the possible causes. (For item No.5 in the table on the right, the possible causes are **b** or **e**.)

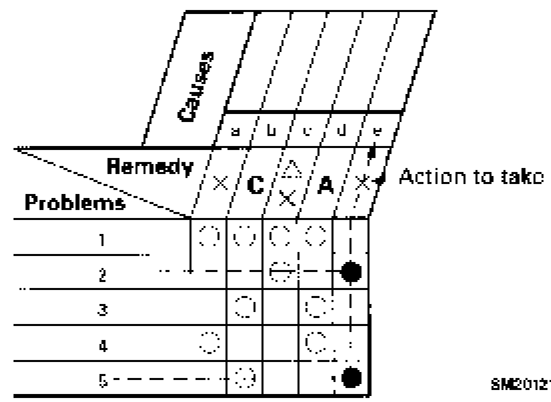
5) Narrow down the possible causes.
There is one common cause among the causes located in Steps 2) and 4). (One cause marked **F**, appears on the line for both items.) This cause is common to both the symptoms in troubleshooting Steps 1) and 3).

- **i** The causes which are not common to both troubleshooting items (items which are not marked **F** for both symptoms) are unlikely causes, so ignore them. (In the example given on the right, the causes for Troubleshooting Item 2 are **c** or **e,** and the causes for Troubleshooting Item 5 are **b** or **e,** so cause **e** is common to both.)



6) Repeat the operations in Steps 3), 4) and 5) until one cause (one common cause) remains.

- **i** If the causes cannot be narrowed down to one cause, narrow the causes down as far as possible.



7) Remedy
If the causes are narrowed down to one common cause, take the action given in the remedy column.
The symbols given in the remedy column indicate the following:

X: Replace, Î : Repair, **A**; Adjust, **C**: Clean

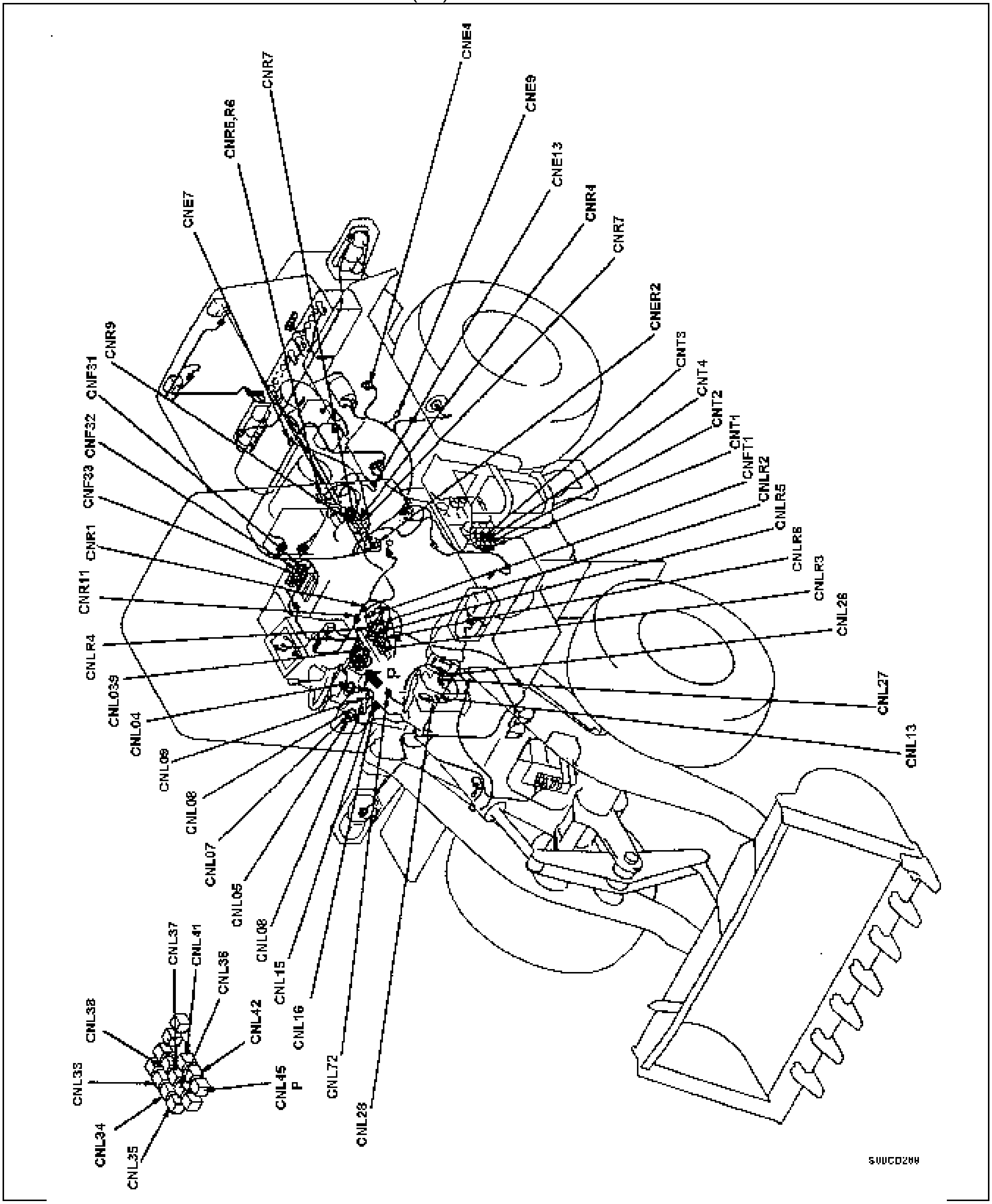
CONNECTOR TYPES AND MOUNTING LOCATIONS

i The address column in the table below shows the address in the connector pin arrangement diagram (3-dimensional drawing).
i Figures are indicated in ( ) for the connectors marked * in the table below.

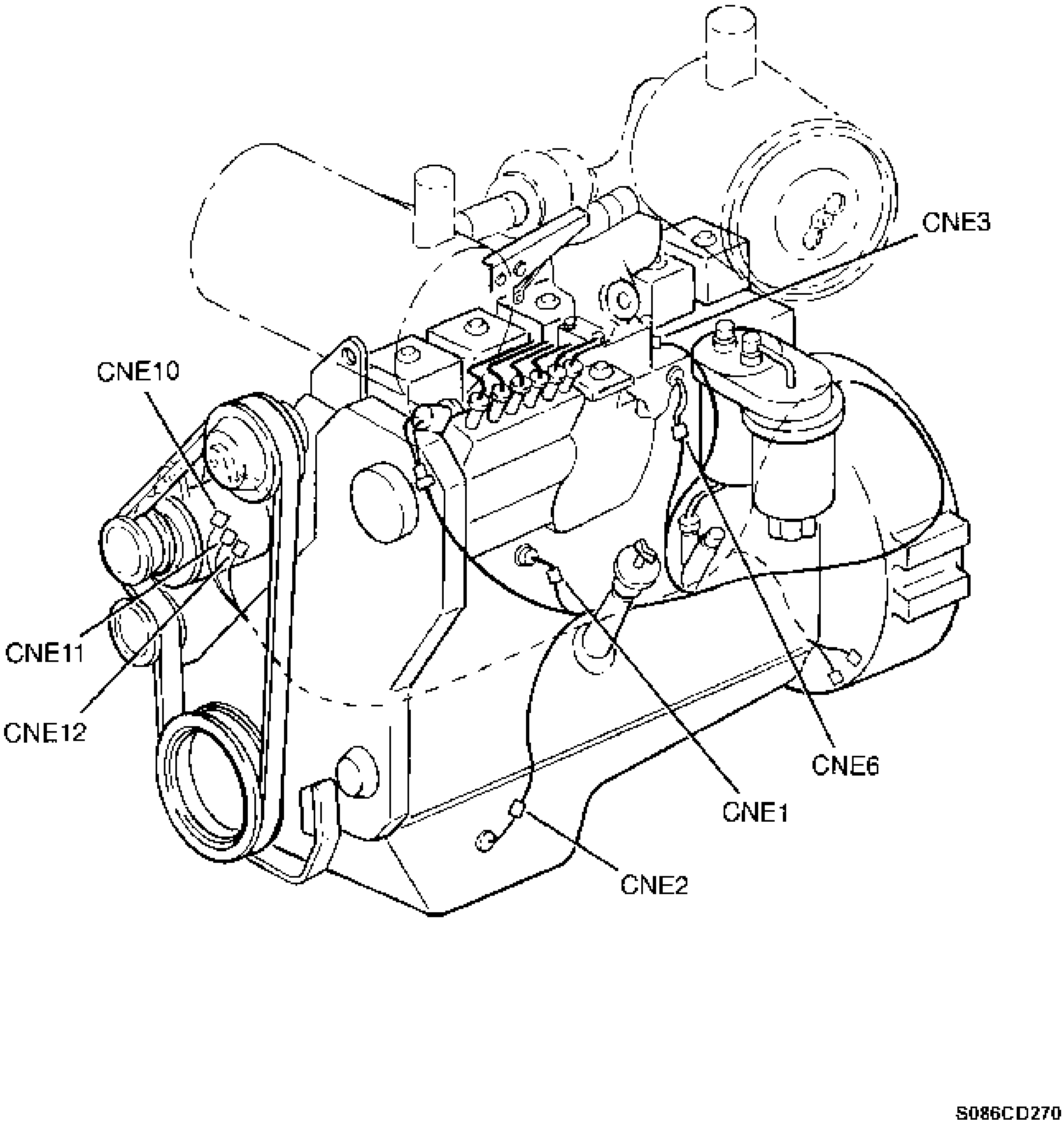
Connector No.	Type	No. of pins	Mounting locations	Address
CNE4	--	1	QHS water temperature sensor	N5
CNE7	--	3	Fuel shut-off solenoid	L8
CNE9	--	1	GND (rear frame)	M5
CNE13	X	2	Starter motor	M4
CNER2	SWP	14	Intermediate connector	K4
CNFS1	L	2	Fuse box	J9
CNFF2	S	12	Fuse box	J9
CNFS3	M	6	Fuse box	J9
CNFT1	SWP	14	Intermediate connector (to transmission)	I3
CNL4	SWP	14	Transmission combination switch	G9
CNL5	AMP040	20	Main monitor	E8
CNL6	AMP040	16	Main monitor	F8
CNL7	AMP040	12	Main monitor	F8
CNL8	AMP040	8	Main monitor	E7
CNL9	M	4	Starter switch	G8
CNL13	Single-pin connector	1	Parking brake switch	G1
CNL15	--	2	4th diode	D7
CNL16	--	2	4th diode	D7
CNL26	Single-pin connector	1	Transmission cut-off switch	H2
CNL27	Single-pin connector	1	Transmission cut-off switch	G1
CNL28	Single-pin connector	1	Parking brake switch	C6
*CNL33(3)	--	5	Nuetralizer relay	B9
*CNL34(2)	--	5	Nuetral relay	A9
*CNL35(1)	--	5	Backup relay	A9
*CNL36(6)	--	6	Kickdown relay	C8
*CNL37(7)	--	6	REVERSE relay	C8
*CNL38(8)	--	6	FORWARD relay	B9
CNL39	M	2	Kickdown relay	B9
*CNL41(12)	--	5	Preheating relay	C8
*CNL42(11)	--	5	Horn relay	B7
*CNL45(10)	--	5	Transmission cut-off relay	B7
CNL72	--	2	Nuetralizer diode	C7
CNLR2	SWP	12	Intermediate connector (bottom right of floor)	I3
*CNLR3(LR3)	L	2	Intermediate connector (bottom right of floor)	H2

Connector No.	Type	No. of pins	Mounting locations	Address
*CNLR4(LR4)	L	2	Intermediate connector (bottom right of floor)	H9
CNLR5	S	10	Intermediate connector (bottom right of floor)	I2
CNLR6	X	6	Intermediate connector (bottom right of floor)	I2
CNR1	--	2	Diode (from starter switch terminal BR)	I9
CNR3	--	1	Heater relay	M7
CNR4	--	1	Heater relay	L4
CNR5	--	1	Slow blow fuse (box)	M8
CNR6	--	1	Slow blow fuse (box)	M8
CNR7	M	3	Battery relay	L4
CNR9	X	2	Heater relay	K9
CNR11	--	2	Diode (to starter motor terminal S)	H9
*CNT1(1)	X	2	FWD solenoid	J3
*CNT2(2)	X	2	REV solenoid	J3
*CNT3(3)	X	2	Hi-Lo solenoid	K3
*CNT4(4)	X	2	Speed solenoid	J3
CNE1	--	1	Engine oil pressure switch	G5
CNE2	Single-pin connector	1	Engine oil level sensor	G3
CNE3	--	1	Air intake heater	H7
CNE6	X	2	Engine oil temperature sensor	H7
CNE10	--	1	Alternater (E)	E6
CNE11	--	1	Alternator (pos)	E5
CNE12	--	1	Alternator (B)	E5
CNE14	--	1	Slow blow fuse (80A)	M8

CONNECTOR PIN ARRANGEMENT DIAGRAM (1/2)

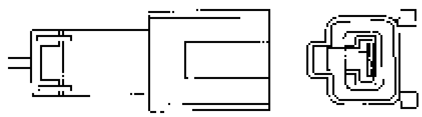
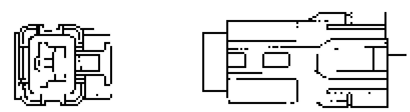
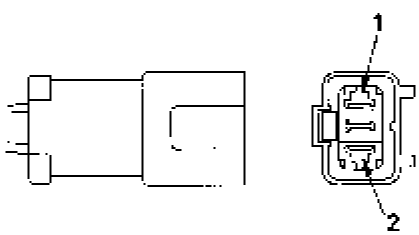
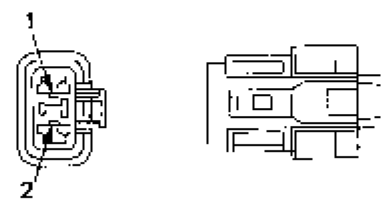
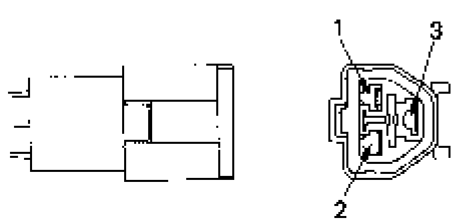
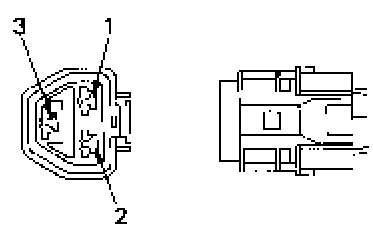
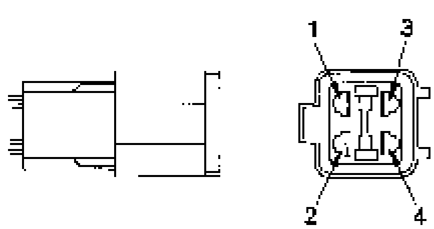
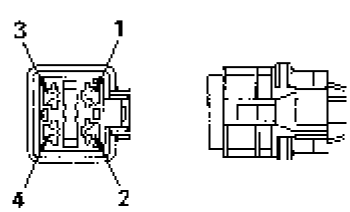


CONNECTOR PIN ARRANGEMENT DIAGRAM (2/2)



CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

i Theterms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

No. of pins	X type connector	
	Male (female housing)	Female (male housing)
1		
2		
3		
4		

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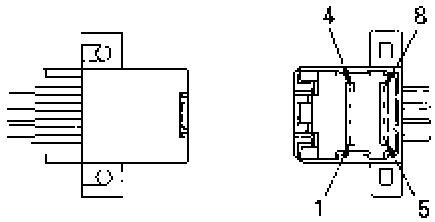
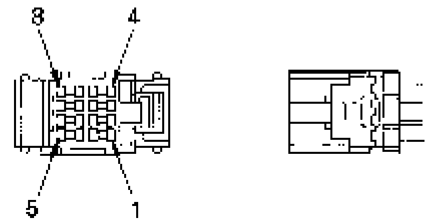
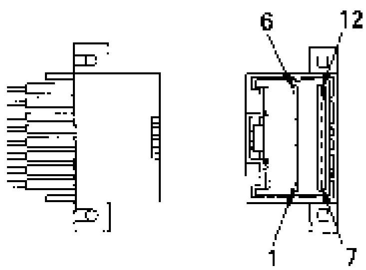
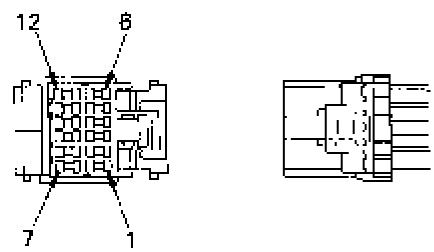
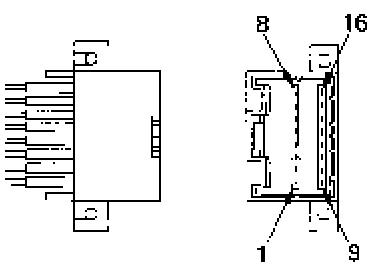
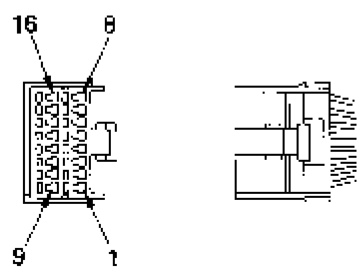
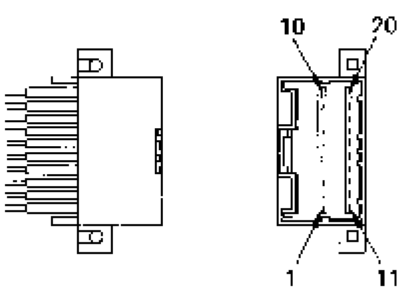
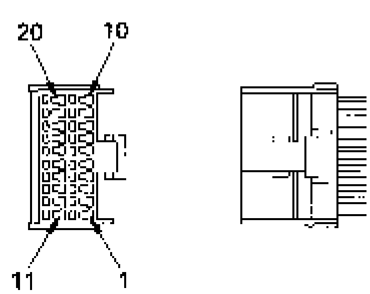
No. of pins	AMP040 type connector	
	Male (female housing)	Female (male housing)
8		
12		
16		
20		

S08CD272

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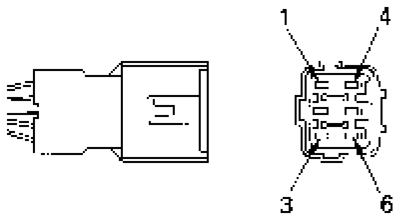
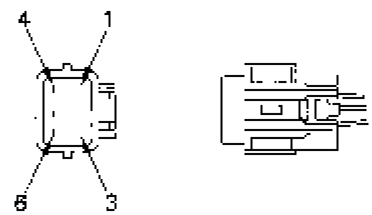
<tr><td>6</td><td>
</td><td>
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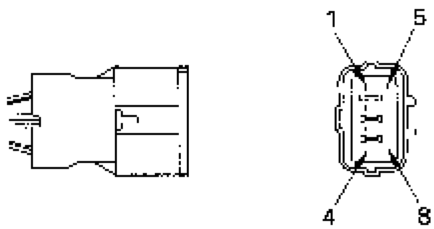
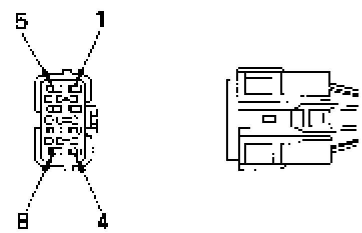
<tr><td>8</td><td>
</td><td>
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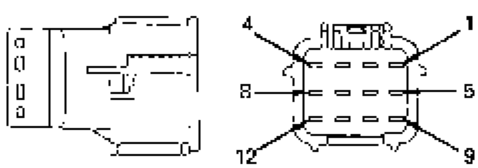
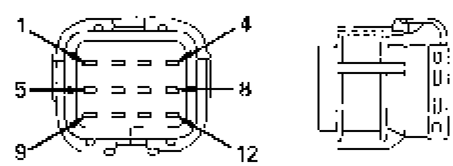
<tr><td>12</td><td>
</td><td>
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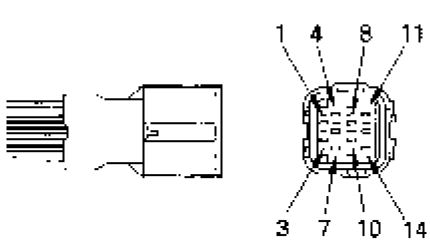
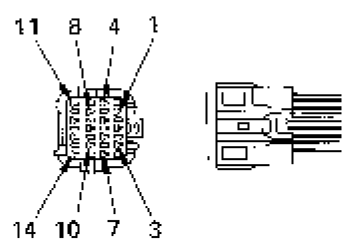
<tr><td>14</td><td>
</td><td>

S08CD273</td></tr>
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No. of pins	SWP type connector	
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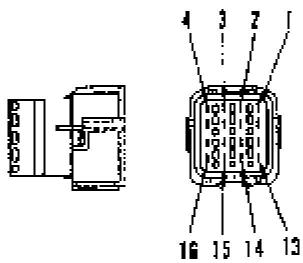
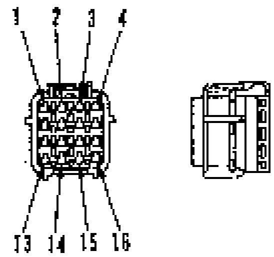
16		

S08CD274

No. of pins	Automobile connector	
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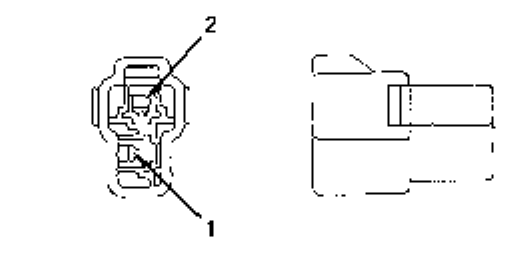
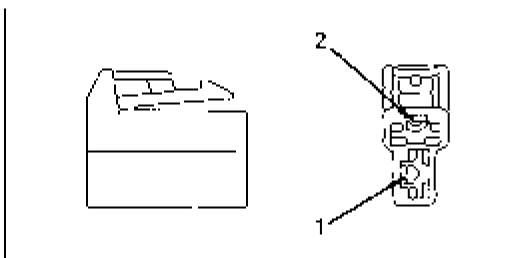
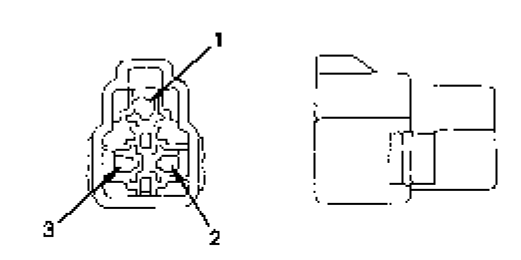
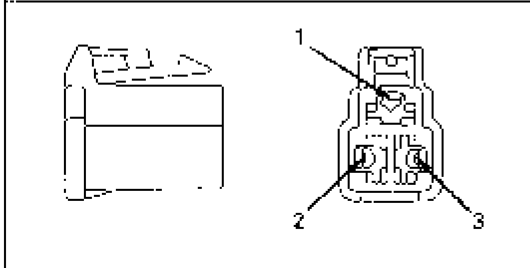
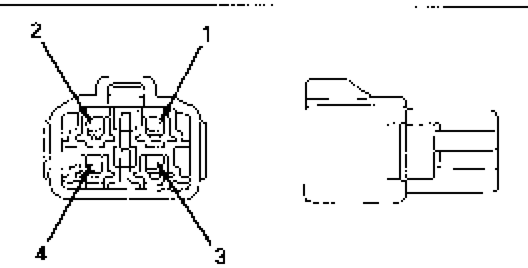
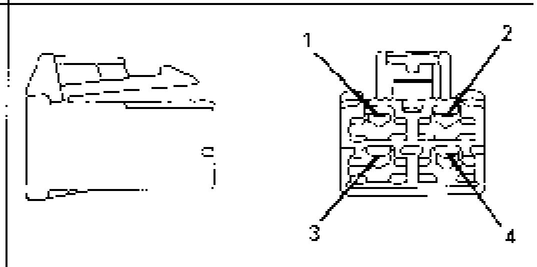
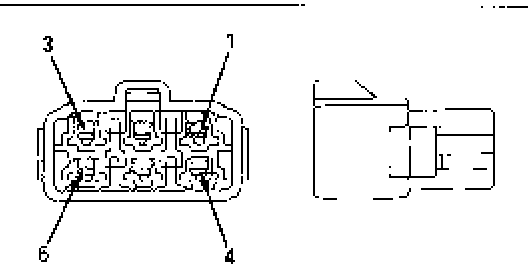
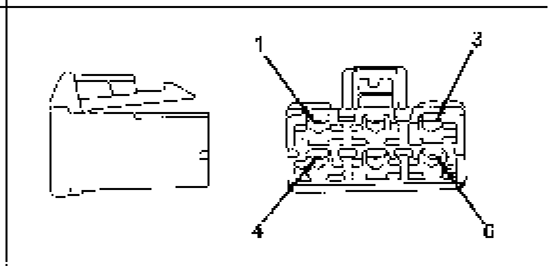
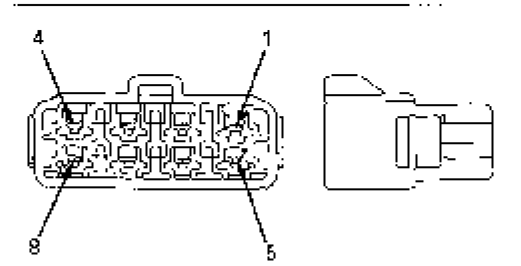
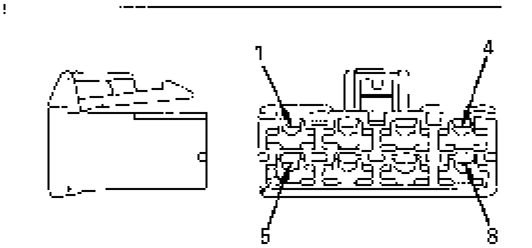
2		
3		
4		
6		
8		

S08CD275

No. of pins	M type connector	
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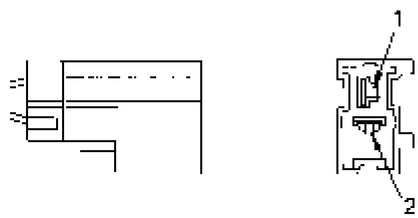
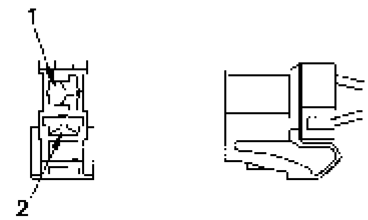
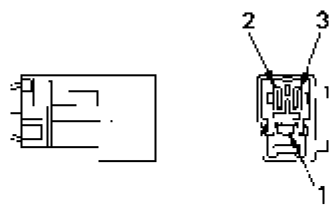
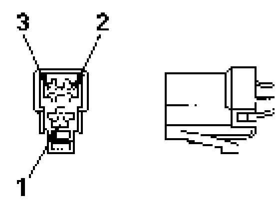
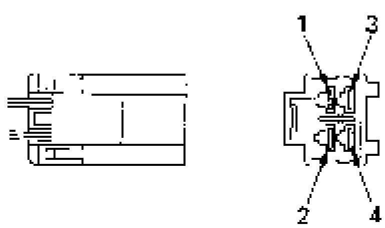
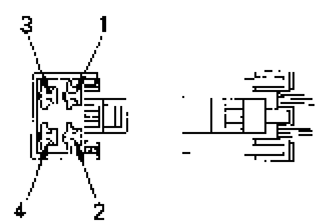
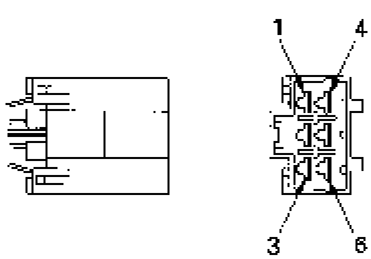
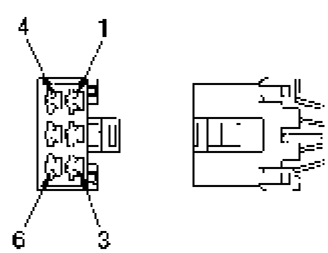
2		
3		
4		
6		

S06CD276

No. of pins	S type connector	
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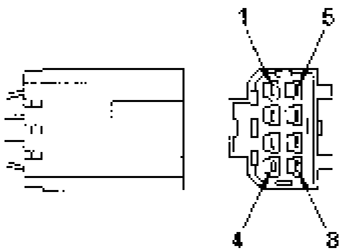
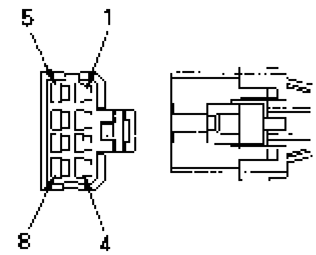
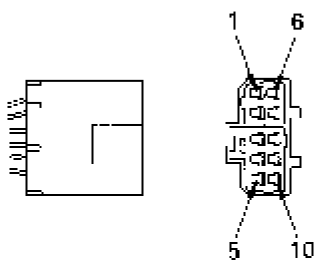
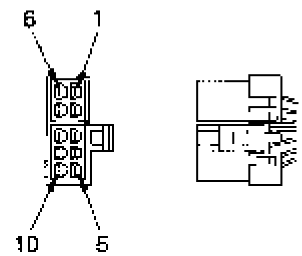
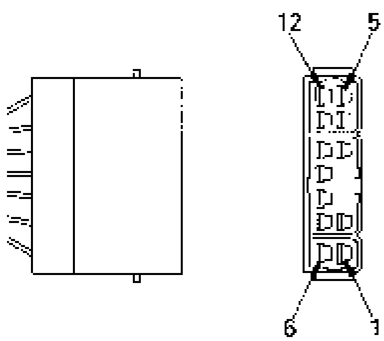
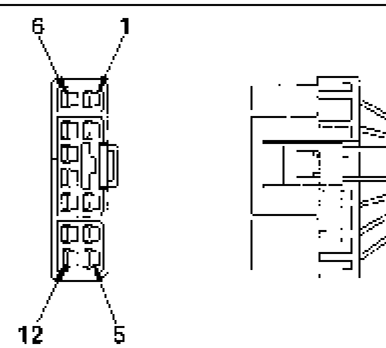
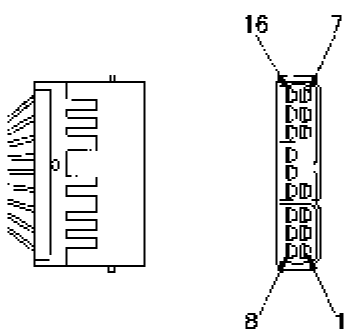
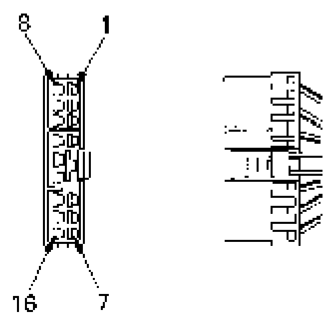
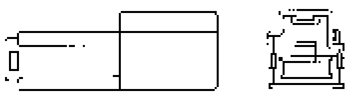
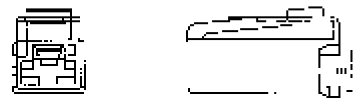
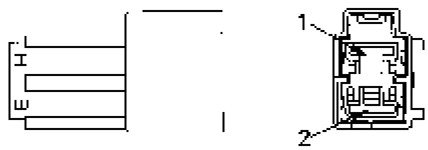
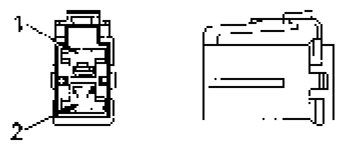
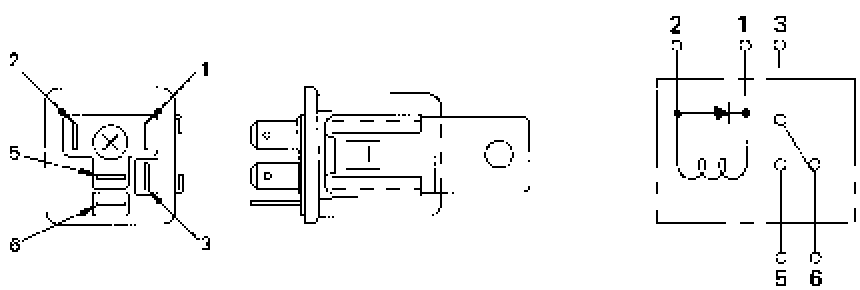
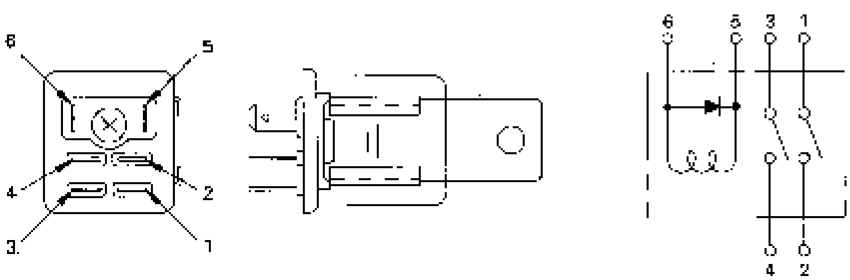
8		
10		
12		
16		

S08CD277

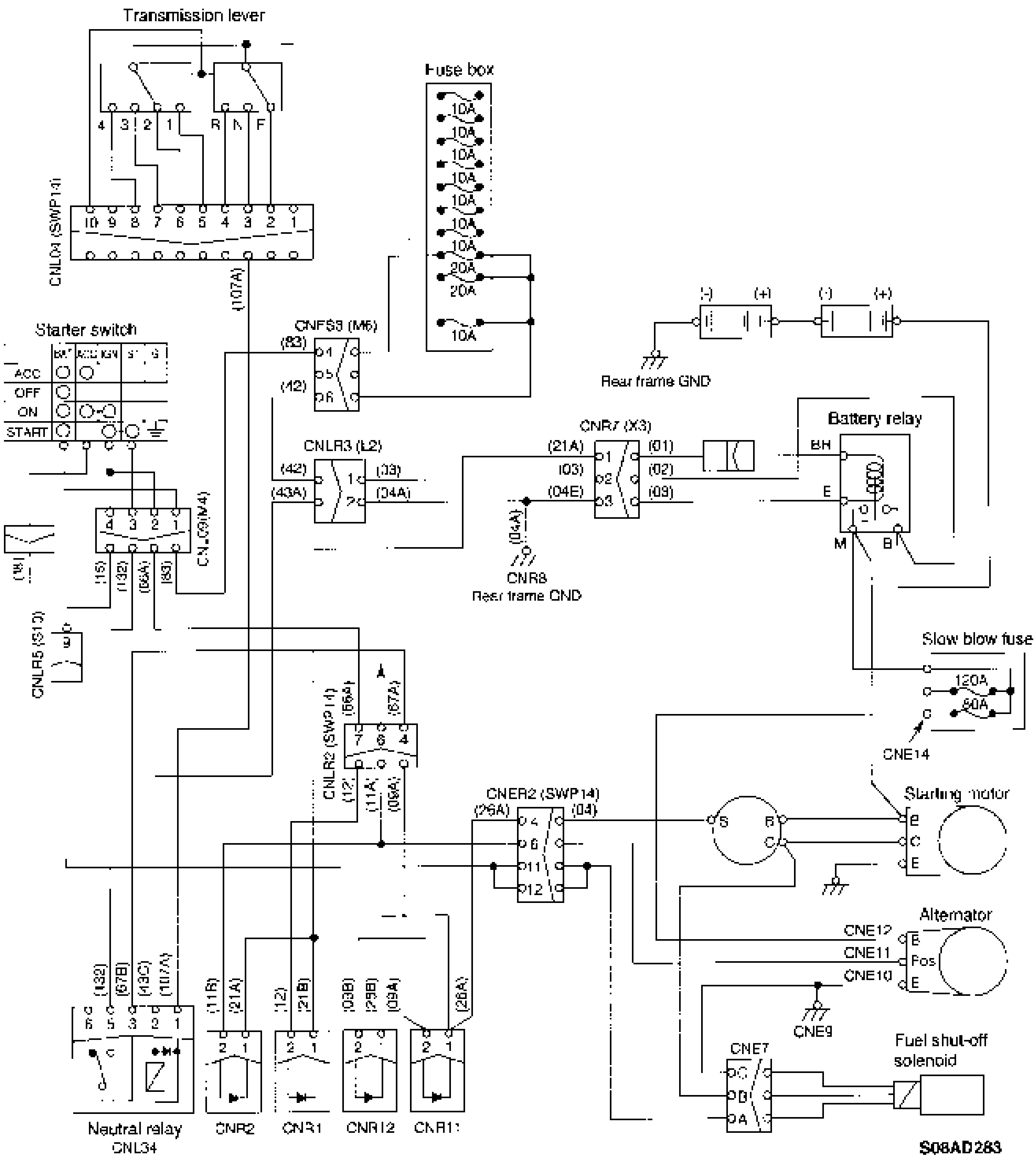
of pins	Male (male housing)	Female (female housing)
1		
2		

No. of pins	Relay connector
5	
6	

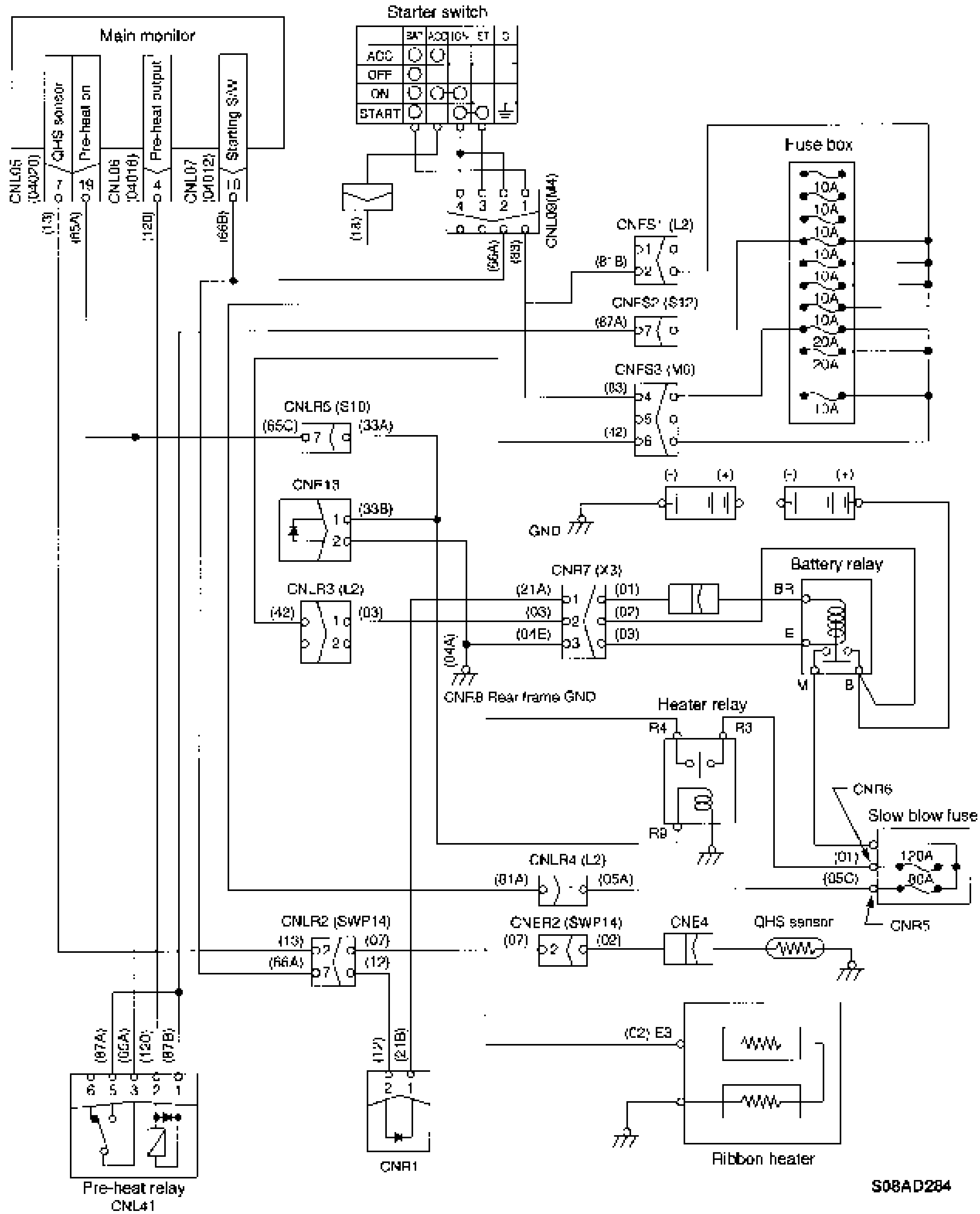
S0BCD278

ELECTRICAL CIRCUIT DIAGRAM FOR EACH SYSTEM

ENGINE START, STOP SYSTEM

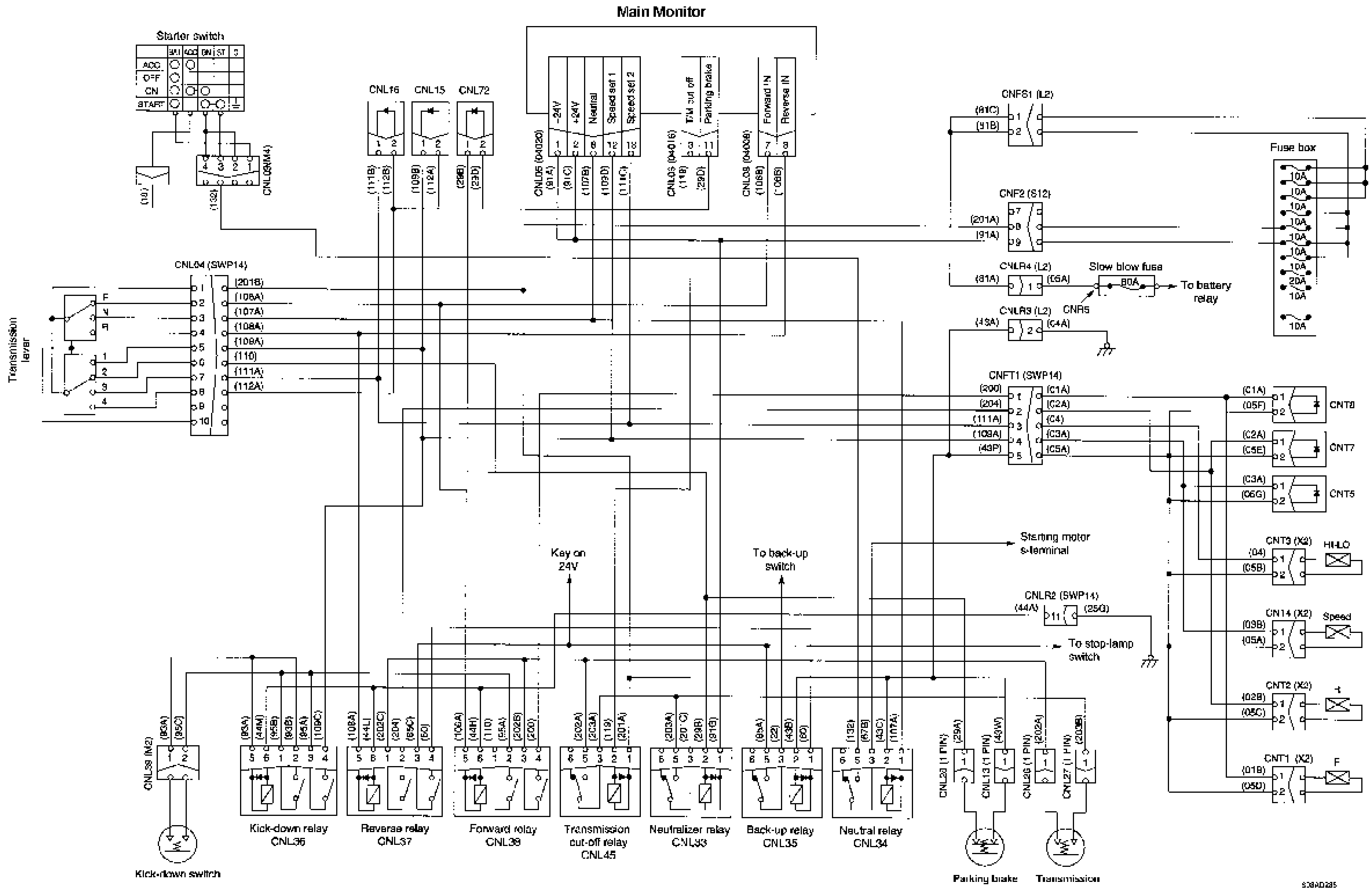


PREHEATING SYSTEM



TRANSMISSION CONTROL, PARKING BRAKE SYSTEM

FOLDOOUT 20-139



MEMORANDA

TROUBLESHOOTING OF ENGINE SYSTEM TABLE OF CONTENTS (S-MODE)

TABLE OF CONTENTS

S-1 Starting performance is poor
(Starting always takes time)

General causes why starting performance is poor
- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
  (At ambient temperature of – 10°C or below, use ASTM D975 No. 1, and – 10°C or above, use ASTM D975 No. 2 diesel fuel.)

★ Battery charging rate.

Ambient temperature \ Charging rate	100%	90%	80%	75%	70%
20°C	1.28	1.26	1.24	1.23	1.22
0°C	1.29	1.27	1.25	1.24	1.22
–10°C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should exceed the value for the charging rate of 70% in the above table.
- In cold weather the specific gravity must exceed the value for the charging rate of 75% in the above table.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause

Causes

		Worn piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Defective air intake heater	Defective regulator	Defective alternator	Defective or deteriorated battery	Defective injection nozzle	Defective injection timing	Defective injection pump (rack, plunger stuck)	Leakage, clogging, air in fuel system	Clogged fuel tank air breather hole
Questions	Confirm recent repair history														
	Degree of use: Operated for long period			△	△	△				△					
	Ease of starting: Gradually became worse	◎	◎	○	○	○									
	Ease of starting: Starts when warm						◎			◎					
	Indicator lamp does not light up						◎								
	Engine oil must be added more frequently	◎													
	Replacement of filters has not been carried out according to operation manual			◎	◎	◎					○		○		
	Dust indicator is red			◎											
	Non-specified fuel has been used				○	○					○		○		
Check items	Battery charge lamp is ON							◎	◎						
	Starting motor cranks engine slowly									◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low										◎				
	Engine does not pick up smoothly, and combustion is irregular	○	○								◎				
	Blow-by gas is excessive	◎													
	Match marks on fuel injection pump are out of alignment											○			
	Mud is stuck to fuel tank cap														○
	When engine is cranked with starting motor														
	1) Little fuel comes out even when injection pump sleeve nut is loosened												◎		
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎							◎		
	Leakage from fuel piping												○	◎	
	There is hunting from engine (rotation is irregular)				○	○								◎	○
Troubleshooting	When compression pressure is measured, it is found to be low	●	●												
	When air element is inspected directly, it is found to be clogged			●											
	When fuel filter, strainer are inspected directly, they are found to be clogged				●									●	
	When feed pump strainer is inspected directly, it is found to be clogged					●									
	Heater mount does not become warm						●								
	Voltage is 26 – 30V between alternator terminal B and terminal E with engine at low idling: Yes							●							
	Voltage is 26 – 30V between alternator terminal B and terminal E with engine at low idling: No								●						
	Either specific gravity of electrolyte or voltage of battery is low									●					
	Speed of some cylinders does not change when operating on reduced cylinders										●				
	When check is made using delivery method, injection timing is found to be incorrect											●			
	When control rack is pushed, it is found to be heavy or does not return (when blind plug at rear of pump is removed, it can be seen that plunger control sleeve does not move)												●		
	When fuel cap is inspected directly, it is found to be clogged														●
	Remedy	Replace	Repair	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Repair	Clean

S2603008

S-2 Engine does not start

(1) Engine does not turn

General causes why engine does not turn
- Internal parts of engine seized
  ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Failure in power train
- Defective electrical system

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection		Defective fuel shut-off solenoid	Defective starting switch
Questions	Confirm recent repair history											
Questions	Degree of use	Operated for long period		△		△						
Questions	Condition of horn when starting switch is turned ON	Horn does not sound	◎						○			○
Questions	Condition of horn when starting switch is turned ON	Horn sound level is low		◎								
Check items	When starting switch is turned to START, pinion moves out, but	Rotating speed is slow		◎								
Check items	When starting switch is turned to START, pinion moves out, but	Makes grating noise			◎	◎						
Check items	When starting switch is turned to START, pinion moves out, but	Soon disengages again					◎					
Check items	When starting switch is turned to START, pinion moves out, but	Makes rattling noise and does not turn		○	○		○					
Check items	When starting switch is turned to START, pinion does not move out		◎	○								○
Check items	When starting switch is turned to ON, there is no clicking sound			○				◎				
Check items	Battery terminal is loose								◎			
Check items	When starting switch is turned to ON, solenoid does not move										◎	
Check items	When battery is checked, battery electrolyte is found to be low			◎								
Troubleshooting	Specific gravity of electrolyte, voltage of battery is low			●								
Troubleshooting	For the following conditions 1) – 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON	1) When terminal B and terminal C of starting switch are connected, engine starts										●
Troubleshooting		2) When terminal B and terminal C of starting motor are connected, engine starts			●							
Troubleshooting		3) When terminal B and terminal C of safety relay are connected, engine starts					●					
Troubleshooting		4) When terminal of safety switch and terminal B of starting motor are connected, engine starts					●					
Troubleshooting		5) There is no 24V voltage between battery relay terminal B and terminal E						●				
Troubleshooting	When ring gear is inspected directly, tooth surface is found to be chipped					●						
Troubleshooting											●	
		Remedy	Carry out troubleshooting for defective wiring of starting circuit	Replace	Replace	Replace	Replace	Replace	Replace		Replace	Replace

S2503009

(2) Engine turns but no exhaust gas comes out (Fuel is not being injected)

General causes why engine turns but no exhaust gas comes out

- Supply of fuel impossible
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

Standards for use of fuel

Type of fuel	Ambient temprature °F (°C): -22 (-30) to 14 (-10)	14 (-10) to 122 (50)
Diesel fuel	ASTM D975 No.1	ASTM D975 No.2

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Broken injection pump drive shaft, key	Defective injection pump (rack, plunger seized)	Seized, broken feed pump piston	Clogged fuel filter, strainer	Clogged feed pump strainer	Lack of fuel	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective fuel shut-off solenoid	Improper fuel used
Questions	Confirm recent repair history										
	Degree of use: Operated for long period				△	△			△		
	Exhaust gas suddenly stops coming out (when starting again)	◎	◎	◎							
	Replacement of filters has not been carried out according to operation manual				◎	◎					
	Fuel tank is found to be empty						◎				
	There is leakage from fuel piping							◎			
	Mud is stuck to fuel tank cap								◎		
	When starting switch is turned ON, solenoid does not move									◎	
Check items	When fuel filter is drained, fuel does not come out										◎
	When engine is cranked with starting motor, 1) Injection pump coupling dose not rotate	◎									
	2) No fuel comes out even when fuel filter air bleed plug is loosened	○			○	○					○
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	◎	◎	◎							
	Rust and water are found when fuel is drained				○	○					
Troubleshooting	Check injection pump directly	●									
	When control rack is pushed, it is found to be heavy, or does not return		●								
	Check feed pump directly			●							
	When fuel filter, strainer are inspected directly, they are found to be clogged				●						●
	When feed pump strainer is inspected directly, it is found to be clogged					●					
	When fuel cap is inspected directly, it is found to be clogged								●		
	Remedy	Replace	Replace	Replace	Clean	Clean	Add	Repair	Repair	Replace	Replace

S2603010

(3) Exhaust gas comes out but engine does not start. (Fuel is being ejected)

General causes why exhaust gas comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

	Causes:	Defective, broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger stuck)	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Defective air intake heater	Defective or deteriorated battery	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged fuel tank air breather hole	Improper fuel used
Questions	Confirm recent repair history												
	Degree of use — Operated for long period			△	△	△					△		
	Suddenly failed to start	◎	◎										
	When engine is cranked, abnormal noise is heard from around head	◎											
	Engine oil must be added more frequently			◎									
	Non-specified fuel has been used		○								○		
	Replacement of filters has not been carried out according to operation manual				◎	◎	◎						
	Rust is found when fuel is drained				◎	◎							
	Dust indicator is red						◎						
	Indicator lamp does not light up							◎					
	Starting motor cranks engine slowly								◎				
Check items	Mud is stuck to fuel tank cap											○	
	When fuel lever is placed at FULL position, it does not contact stopper		○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened		◎										
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎							○
	There is leakage from fuel piping									◎			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinder is low										◎		
	When fuel filter is drained, no fuel comes out												◎
Troubleshooting	Remove head cover and check directly	●											
	When control rack is pushed, it is found to be heavy, or does not return		●										
	When compression pressure is measured, it is found to be low			●									
	When fuel filter, strainer are inspected directly, they are found to be clogged				●								●
	When feed pump strainer is inspected directly, it is found to be clogged					●							
	When air element is inspected directly, it is found to be clogged						●						
	Heater mount does not become warm							●					
	Either specific gravity of electrolyte or voltage of battery is low								●				
	When feed pump is operated, there is no response, or pump is heavy									●			
	Speed of some cylinders does not change when operating on reduced cylinders										●		
	When fuel cap is inspected directly, it is found to be clogged											●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Clean	Repair	Replace	Repair	Clean	Clean	[illegible]

S2503011

S-3 Engine does not pick up smoothly (Follow up is poor)

General causes why engine does not pick up smoothly
- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used

Legend
◯ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes: Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn piston, ring, cylinder	Seized turbocharger, interference	Improper valve clearance	Clogged fuel tank air breather hole	Clogged, leaking fuel piping	Defective contact of valve, valve seat
Questions	Confirm recent repair history											
Questions	Degree of use — Operated for long period	△	△	△			△					△
Questions	Replacement of filters has not been carried out according to operation manual	◎	◎	◎								
Questions	Non-specified fuel has been used		◎	◎	◎	◎						
Questions	Engine oil must be added more frequently						◎					
Questions	Rust and water are found when fuel is drained		◎	◎								
Questions	Dust indicator is red	◎										
Questions	Noise of interference is heard from around turbocharger							◎				
Questions	Engine pick-up suddenly became poor				◯			◎		◯	◯	
Check items	Color of exhaust gas — Blue under light load						◎					
Check items	Color of exhaust gas — Black	◎			◎			◎				◯
Check items	Clanging sound is heard from around cylinder head								◎			
Check items	Mud is stuck to fuel tank cap									◎		
Check items	There is leakage from fuel piping										◎	
Check items	High idling speed under no load is normal, but speed suddenly drops when load is applied		◎	◎						◯		
Check items	There is hunting from engine (rotation is irregular)		◯	◎	◯					◯		
Check items	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low				◎	◯						
Check items	Blow-by gas is excessive						◎					
Troubleshooting	When air element is inspected directly, it is found to be clogged	●										
Troubleshooting	When fuel filter, strainer are inspected directly, they are found to be clogged		●									
Troubleshooting	When feed pump strainer is inspected directly, it is found to be clogged			●								
Troubleshooting	Speed of some cylinders does not change when operating on reduced cylinders				●							
Troubleshooting	When control rack is pushed, it is found to be heavy, or does not return					●						
Troubleshooting	When compression pressure is measured, it is found to be low						●					●
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy							●				
Troubleshooting	When valve clearance is checked directly, it is found to be outside standard value								●			
Troubleshooting	When fuel cap is inspected directly, it is found to be clogged									●		
Troubleshooting	When feed pump is operated, operation is too light or too heavy										●	
	Remedy	Clean	Clean	Clean	Repair	Replace	Replace	Replace	Adjust	Clean	Repair	Replace

S2503012

S-4 Engine stops during operations

General causes why engine stops during operations

- Seized parts inside engine
- Insufficient supply of fuel
- Overheating
  - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.
- Failure in power train
  - ★ If the engine stops because of a failure in the power train, carry out troubleshooting for the chassis.

Legend
- ○ : Possible causes (judging from Questions and check items)
- ◎ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- ● : Items to confirm the cause.

			Broken, seized piston connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken pump auxiliary equipment	Broken fuel pump drive shaft, key	Lack of fuel	Clogged fuel filter, strainer	Clogged feed pump strainer	Broken, seized feed pump piston	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective injection pump (rack, plunger stuck)	Failure in chassis power train
Questions	Confirm recent repair history															
	Degree of use	Operated for long period								△	△					
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎	◎	◎				○			○	◎
		Engine overheated and stopped	◎	○			○									
		Engine stopped slowly							◎	○	○					
		There was hunting and engine stopped							◎	○	○			○		
	Fuel gauge lamp lights up								◎							
	Fuel tank is found to be empty								◎							
	Replacement of filters has not been carried out according to operation manual									◎	◎					
	Non-specified fuel has been used									○	○	○			○	
Check items	When feed pump is operated, there is no response or it is heavy									○	○		◎			
	Mud is stuck to fuel tank cap													◎		
	Engine turns, but stops when transmission control lever is operated															◎
	Try to turn by hand using barring tool	Does not turn at all	◎	◎												
		Turns in opposite direction			◎											
		Moves amount of backlash				◎	◎									
		Shaft does not turn						◎								
	Rust and water are found when fuel is drained									◎	◎					
	Metal particles are found when oil is drained		◎	◎						○	○					
Troubleshooting	Remove oil pan and check directly		●	●												Carry out troubleshooting in chassis volume
	Remove head cover and check directly				●											
	When gear train is inspected, it does not turn					●										
	Turns when pump auxiliary equipment is removed						●									
	When fuel filter, strainer are inspected directly, they are found to be clogged									●						
	When feed pump strainer is inspected directly, it is found to be clogged										●					
	Check feed pump directly											●				
	When control rack is pushed, it is found to be heavy or does not return														●	
	Remedy		Replace	Replace	Replace	Replace	Replace	Replace	Add	Clean	Clean	Replace	Repair	Clean	Replace	–

S2503013

S-5 Engine does not rotate smoothly (hunting)

General causes why engine does not rotate smoothly
- Air in fuel system
- Defective governor mechanism
- Defective engine throttle controller mechanism
  (engine throttle controller type)

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

Section	Item		Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	Low speed is too low	Lack of fuel	Clogged feed pump strainer	Clogged fuel filter, strainer	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and nozzle	Clogged fuel tank air breather hole
Questions	Confirm recent repair history											
Questions	Degree of use	Operated for long period						△	△			
Questions	Condition of hunting	Occurs at certain speed range	◎	◎	◎	○						
Questions	Condition of hunting	Occurs at low idling	○			◎		○	○	○	○	
Questions	Condition of hunting	Occurs even when speed is raised	○	○	○							○
Questions	Condition of hunting	Occurs on slopes					◎					
Questions	Fuel tank is found to be empty						◎					
Questions	Replacement of filters has not been carried out according to operation manual							◎	◎			
Questions	Rust is found when fuel is drained							○	○			
Check items	Leakage from fuel piping									◎	◎	
Check items	When feed pump is operated, 1) No response, light, return is quick									◎	◎	
Check items	When feed pump is operated, 2) No response, light, return is normal									◎		
Check items	Engine speed sometimes rises too high		◎	◎								
Check items	Engine is sometimes difficult to stop		◎		◎							
Check items	Seal on injection pump has come off			◎		◎						
Troubleshooting	When governor lever is moved it is found to be stiff		●		●							
Troubleshooting	When injection pump is tested, governor is found to be improperly adjusted			●								
Troubleshooting	When control rack is pushed, it is found to be heavy, or does not return				●							
Troubleshooting	When fuel cap is inspected directly, it is found to be clogged					●						●
Troubleshooting	When feed pump strainer is inspected directly, it is found to be clogged							●				
Troubleshooting	When fuel filter, strainer are inspected directly, they are found to be clogged								●			
Remedy			Adjust	Adjust	Adjust	Adjust	Add	Clean	Clean	Repair	Repair	Clean

S2503014

S-6 Engine lacks output (no power)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used
  (if non-specified fuel is used, output drops)
- Lack of output due to overheating
  - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes: Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Improper valve clearance	Defective contact of valve, valve seat	Bent fuel lever linkage, defective adjustment	Clogged, leaking fuel piping	Clogged fuel tank air breather hole
Questions	Confirm recent repair history												
	Degree of use: Operated for long period	△		△	△	△				△			
	Power was lost: Suddenly		◎										
	Power was lost: Gradually	○		○	○	○	○			○			
	Engine oil must be added more frequently			◎									
	Replacement of filters has not been carried out according to operation manual	◎			◎	◎							
	Non-specified fuel has been used				◎	◎	◎	◎					
Check items	Dust indicator is red	◎											
	Color of exhaust gas: Black	◎	◎										
	Color of exhaust gas: Blue under light load			◎									
	Noise of interference is heard from around turbocharger		◎										
	Blow-by gas is excessive			◎									
	Engine pickup is poor and combustion is irregular		◎				○					○	○
	High idling speed under no load is normal, but speed suddenly drops when load is applied				◎	◎							○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low						◎	○					
	There is hunting from engine (rotation is irregular)				○	○						○	○
	Clanging sound is heard from around cylinder head								◎				
	High idling speed of engine is low							○			◎		
	Leakage from fuel piping											◎	
Troubleshooting	When air element is inspected directly, it is found to be clogged	●											
	When turbocharger is rotated by hand, it is found to be heavy		●										
	When compression pressure is measured, it is found to be low			●						●			
	When fuel filter, strainer are inspected directly, they are found to be clogged				●								
	When feed pump strainer are inspected directly, it is found to be clogged					●							
	Speed of some cylinders does not change when operating on reduced cylinders						●						
	When control rack is pushed, it is found to be heavy, or does not return							●					
	When valve clearance is checked directly, it is found to be outside standard value								●				
	When lever is placed at FULL position, it does not contact stopper										●		
	When feed pump is operated, operation is too light or too heavy											●	
	When fuel cap is inspected directly, it is found to be clogged												●
	Remedy	Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean

S2503016

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black
- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
Questions	Degree of use	Operated for long period		△	△	△						△	
Questions	Color of exhaust gas	Suddenly became black	◎			○							○
Questions	Color of exhaust gas	Gradually became black		◎		○					○		
Questions	Color of exhaust gas	Blue under light load			◎								
Questions	Engine oil must be added more frequently				◎								
Questions	Power was lost	Suddenly	◎			○				○			○
Questions	Power was lost	Gradually		○	○						○	○	
Questions	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
Check items	Dust indicator is red			◎									
Check items	Blow-by gas is excessive				◎								
Check items	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
Check items	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
Check items	Match marks on fuel injection pump are out of alignment						◎						
Check items	Seal on injection pump has come off							◎					
Check items	Clanging sound is heard from around cylinder head								◎				
Check items	Exhaust noise is abnormal		○			○				◎			
Check items	Muffler is crushed									◎			
Check items	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
Troubleshooting	When air cleaner is inspected directly, it is found to be clogged			●									
Troubleshooting	When compression pressure is measured, it is found to be low				●							●	
Troubleshooting	Speed of some cylinders does not change when operating on reduced cylinders					●							
Troubleshooting	When check is made using delivery method, injection timing is found to be incorrect						●						
Troubleshooting	Injection pump test shows that injection amount is incorrect							●					
Troubleshooting	When valve clearance is checked directly it is found to be outside standard value								●				
Troubleshooting	When muffler is removed, exhaust gas color returns to normal									●			
Troubleshooting	When control rack is pushed, it is found to be heavy, or does not return												●
	Remedy		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace

S2503016

S-8 Oil consumption is excessive (or exhaust gas is blue)

★ Do not run the engine at idling for more than 20 minutes continuously. (Both low and high idling)

General causes why oil consumption is excessive

- Abnormal combustion of oil
- External leakage of oil
- Wear of lubrication system

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

Section	Item		Broken piston ring	Worn piston ring, cylinder liner	Clogged breather or breather hose	Leakage from oil filter, oil cooler	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan, cylinder head, etc.	Broken oil cooler	Worn seal at turbine end (Turbocharger)	Worn seal at blower end (Turbocharger)	Worn, broken rear seal, seal surface	Dust sucked in from intake system	Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history														
Questions	Degree of use	Operated for long period		△							△	△			△
Questions	Oil consumption suddenly increased		◎							○					
Questions	Engine oil must be added more frequently			◎						○					
Questions	Engine oil becomes contaminated quickly		○	◎	○										
Check items	Exhaust gas is blue under light load		◎	◎											
Check items	Amount of blow-by gas	Abnormally excessive	◎	◎								○			○
Check items	Amount of blow-by gas	None			◎										
Check items	Area around engine is dirty with oil					◎	◎	◎	◎						
Check items	There is oil in engine cooling water									◎					
Check items	When exhaust pipe is removed, inside is found to be dirty with oil										◎				○
Check items	Inside of turbocharger intake pipe is dirty with oil											◎			
Check items	Oil level in clutch or TORQFLOW transmission damper chamber rises												◎		
Check items	Clamps for intake system are loose													◎	
Troubleshooting	When compression pressure is measured, it is found to be low		●	●											
Troubleshooting	When breather element is inspected, it is found to be clogged with dirty oil				●										
Troubleshooting	There is external leakage of oil from engine					●	●	●	●						
Troubleshooting	Pressure tightness test of oil cooler shows there is leakage									●					
Troubleshooting	Excessive play of turbocharger shaft										●	●			
Troubleshooting	Check rear seal directly												●		
Troubleshooting	When intake manifold is removed, dust is found inside													●	
Troubleshooting	When intake manifold is removed, inside is found to be dirty with oil														●
	Remedy		Replace	Replace	Clean	Repair	Repair	Repair	Repair	Replace	Replace	Replace	Repair	Repair	Repair

S2603017

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly

- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper combustion
- Improper oil used
- Operation under excessive load

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Worn piston ring, cylinder	Clogged breather, breather tube	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger drain pipe	Defective seal at turbocharger turbine end	Defective safety valve	Exhaust gas is black
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△			△			△		
	Engine oil must be added more frequently		◎								
	Non-specified fuel has been used				○						
Check items	Color of exhaust gas	Blue under light load	◎								
		Black									◎
	Amount of blow-by gas	Abnormally excessive	◎			○		○	○		
		None		◎							
	Oil filter caution lamp stays on even when oil pressure rises				◎					○	
	When oil filter is inspected, metal particles are found		○		◎	○					
	When exhaust pipe is removed, inside is found to be dirty with oil					◎					
	Engine oil temperature rises quickly						◎				
Troubleshooting	When compression pressure is measured, it is found to be low		●			●					Carry out troubleshooting for "Exhaust is black"
	When breather element is inspected directly, it is found to be clogged with dirty oil, or hose is broken			●							
	When oil filter is inspected directly, it is found to be clogged				●						
	When oil cooler is inspected directly, it is found to be clogged						●				
	Turbocharger drain tube is clogged							●			
	Excessive play of turbocharger shaft								●		
	When safety valve is directly inspected, spring is found to be catching or broken									●	
		Remedy	Replace	Clean	Replace	Replace	Clean	Clean	Replace	Replace	—

S2503018

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive
- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Defective injection pump (excessive injection)	Defective injection nozzle spray	Defective injection pump plunger	Improper fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history									
	Degree of use	Operated for long period		△	△				△	
	Condition of fuel consumption	More than for other machines of same model	◎			○				
		Gradually increased		○	○					
		Suddenly increased					○	○		
	Exhaust gas color	Black	◎	○		○				○
		White						○		
Check items	Seal on injection pump has come off		◎							
	There is irregular combustion			◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			◎	○					
	Match mark on injection pump is misaligned					◎				
	There is external leakage of fuel from engine						◎			
	Engine oil level rises and smells of diesel fuel		○					◎	◎	
	Engine low idling speed is high		○							◎
Troubleshooting	Injection pump test shows that injection amount is excessive		●							
	Speed of some cylinders does not change when operating on reduced cylinders			●						
	When control rack is pushed, it is found to be heavy, or does not return				●					
	When check is made using delivery method, injection timing is found to be incorrect					●				
	Remove head cover and check directly							●		
	Remove feed pump and check directly								●	
	When engine speed is measured, low idling speed is found to be high									●
		Remedy	Adjust	Replace	Replace	Adjust	Repair	Repair	Repair	Adjust

S2603019

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why fuel consumption is excessive
- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Defective injection pump (excessive injection)	Defective injection nozzle spray	Defective injection pump plunger	Improper fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover		Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history									
Questions	Degree of use	Operated for long period		△	△					
Questions	Condition of fuel consumption	More than for other machines of same model	◎			○				
Questions	Condition of fuel consumption	Gradually increased		○	○					
Questions	Condition of fuel consumption	Suddenly increased					○	○		
Questions / Check items	Exhaust gas color	Black	◎	○		○				○
Questions / Check items	Exhaust gas color	White						○		
Check items	Seal on injection pump has come off		◎							
Check items	There is irregular combustion			◎						
Check items	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			◎	○					
Check items	Match mark on injection pump is misaligned					◎				
Check items	There is external leakage of fuel from engine						◎			
Check items	Engine oil level rises and smells of diesel fuel		○					◎		
Check items	Engine low idling speed is high		○							◎
Troubleshooting	Injection pump test shows that injection amount is excessive		●							
Troubleshooting	Speed of some cylinders does not change when operating on reduced cylinders			●						
Troubleshooting	When control rack is pushed, it is found to be heavy, or does not return				●					
Troubleshooting	When check is made using delivery method, injection timing is found to be incorrect					●				
Troubleshooting	Remove head cover and check directly							●		
Troubleshooting	Remove feed pump and check directly									
Troubleshooting	When engine speed is measured, low idling speed is found to be high									●
		Remedy	Adjust	Replace	Replace	Adjust	Repair	Repair		Adjust

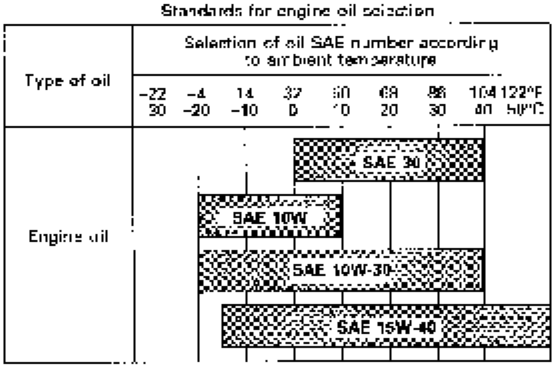
S2503020

S-12 Oil pressure lamp lights up (drop in oil pressure)

General causes why oil pressure lamp lights up

- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

Standards for engine oil selection



Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

Section	Item	Clogged oil filter	Worn bearing journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Insufficient oil in oil pan	Defective regulator valve	Defective relief valve	Leaking, crushed hydraulic piping	Defective oil level sensor	Defective oil pressure sensor	Water, fuel in oil
Questions	Confirm recent repair history													
	Degree of use — Operated for long period	△	△				△							
	Replacement of filter has not been carried out according to operation manual	◎												
	Caution lamp lights up	◎								○				
	Non-specified fuel has been used	○	○											
Check items	Condition when oil pressure lamp lights up — Lights up at low idling		◎							○				
	Condition when oil pressure lamp lights up — Lights up at low, high idling			◎	◎	◎	◎	○	○	○				
	Condition when oil pressure lamp lights up — Lights up on slopes							◎						
	Condition when oil pressure lamp lights up — Sometimes lights up								◎	◎		○	○	
	There is clogging, leakage from hydraulic piping (external)										◎			
	Oil level sensor lamp lights up							◎				◎		
	When oil level in oil pan is checked, it is found to be low							◎						
	Metal particles are found when oil is drained		◎											
	Metal particles are stuck to oil filter element		◎				○							
	Oil is cloudy white or smells of diesel oil													◎
Troubleshooting	When oil filter is inspected directly, it is found to be clogged	●	●											
	Remove oil pan and check directly			●	●	●								
	Oil pump rotation is heavy, there is play						●							
	There is catching of relief valve, regulator valve, spring, or valve guide is broken								●	●				
	When oil level sensor is replaced, oil pressure sensor lamp goes out											●		
	When oil pressure is measured, it is found to be within standard value												●	
Remedy		Clean	Clean	Clean	Clean	Repair	Replace	Add	Adjust	Adjust	Repair	Replace	Replace	

S2503021

S-13 Oil level rises

★ If there is oil in the cooling water, carry out troubleshooting for "Oil is in cooling water".

General causes why oil level rises

- Water in oil (cloudy white)
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

Legend

◌ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken head, head gasket (including precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective seal of pump of auxiliary equipment	Leakage of fuel from piping inside head cover	Defective inside injection pump (flange type)	Defective thermostat seat		Cracks inside cylinder block
Questions	Confirm recent repair history											
	Degree of use: Operated for long period		△		△	△	△					
	There is oil in radiator cooling water	◎	○	○								○
	Exhaust gas is white		◎					○		○		
	When engine is first started, drops of water come from muffler		◎									
Check items	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back			◎								
	Water pump breather hole is clogged with mud				◎							
	When water pump breather hole is clean, water comes out				◎							
	Oil level goes down in torque converter, transmission, or damper chamber					◎						
	Oil level goes down in hydraulic tank						◎					
	Engine oil smells of diesel fuel							◎	◎	◎		
	Fuel is added more frequently							◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage	●										
	Pressure-tightness test of cylinder head shows there is leakage		●									
	When compression pressure is measured, it is found to be low			●								
	Remove water pump and check directly				●							
	Check rear seal directly					●						
	When pump auxiliary equipment is removed, seal is found to be broken						●					
	Remove head cover and check directly							●				
	Remove injection pump and check directly								●			
	There is improper contact of thermostat seat valve									●		
	Remove oil pan and check directly											●
	Remedy	Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair		Replace

S2503022

S-14 Water temperature becomes too high
(overheating)

General causes why water temperature becomes too high
- Lack of cooling water (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system
- Rise in oil temperature of power train
  - ★ Carry out troubleshooting for chassis.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes											
			Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Insufficient cooling water	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken head, head gasket		Rise in torque converter oil temperature
Questions	Confirm recent repair history													
Questions	Degree of use	Operated for long period		△	△							△		
Questions	Condition of overheating	Suddenly overheated	◎					○	○					
Questions	Condition of overheating	Always tends to overheat		◎	◎	○			○					
Questions	Water temperature gauge	Rises quickly				◎		○						
Questions	Water temperature gauge	Does not go down from red range					◎							
Questions	Radiator water level sensor lights up							◎						
Check items	Fan belt whines under sudden load								◎					
Check items	Cloudy white oil is floating on cooling water									◎				
Check items	Cooling water flows out from overflow hose										◎			
Check items	Excessive air bubbles inside radiator, water spurts back											◎		
Check items	Engine oil level has risen, oil is cloudy white									○				
Check items	There is play when fan pulley is rotated		◎											
Check items	Radiator shroud, inside of underguard are clogged with dirt or mud			◎					◎					
Check items	When light bulb is held behind radiator, no light passes through			◎										
Check items	Water is leaking because of cracks in hose or loose clamps							◎						
Check items	Belt tension is found to be slack								◎					
Check items	Power train oil temperature enters red range before engine water temperature													◎
Troubleshooting	Temperature difference between top and bottom radiator tank is excessive		●											Carry out troubleshooting for chassis
Troubleshooting	Temperature difference between top and bottom radiator tank is slight			●										
Troubleshooting	When water filler port is inspected, the core is found to be clogged				●									
Troubleshooting	When a function test is carried out on the thermostat, it does not open even at the cracking temperature					●								
Troubleshooting	When water temperature is measured, it is found to be normal						●							
Troubleshooting	When oil cooler is inspected directly, it is found to be clogged									●				
Troubleshooting	When measurement is made with radiator cap tester, set pressure is found to be low										●			
Troubleshooting	When compression pressure is measured, it is found to be low													
Troubleshooting	Remove oil pan and check directly												●	
	Remedy		Replace	Repair	Repair	Replace	Replace	Add	Repair	Replace	Replace		Replace	–

S2503023

S-15 Abnormal noise is made

★ Judge if the noise is an internal noise or an external noise.

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion noise
- Air sucked in from intake system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Worn piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump (rack, plunger seized)	Defective injection pump (excessive injection)	Deformed fan, interference of fan belt	Improper adjustment of valve clearance	Broken valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and head	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	△											
	Condition of abnormal noise	Gradually occurred	○						○					
		Suddenly occurred		○	○						○			
	Non-specified fuel has been used					○	○							
	Engine oil must be added more frequently		◎											
Check items	Color of exhaust gas	Blue under light load	◎											
		Black		◎						○			○	
	Metal particles are found in oil filter		◎		◎									
	Blow-by gas is excessive		◎											
	Noise of interference is heard from around turbocharger			◎										
	Engine pickup is poor and combustion is irregular					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○							
	Seal on injection pump has come off							◎						
	Abnormal noise is loud when accelerating engine					○	○	○	○	○		○		
	Clanging sound is heard from around cylinder head									◎	◎			
	Leakage of air between turbocharger and head, loose clamp												◎	
	Vibrating noise is heard from around muffler													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	Remove gear cover and check directly				●							●		
	Speed of some cylinders does not change when operating on reduced cylinders					●								
	When control rack is pushed, it is found to be heavy or does not return						●							
	Injection pump test shows that injection amount is incorrect							●						
	Fan is deformed, or belt is loose								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	Remove cylinder head cover and check directly										●			
	When muffler is removed, abnormal noise disappears													●
Remedy			Replace	Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Repair	Replace

S2603024

S-16 Vibration is excessive

★ If there is abnormal noise together with the vibration, carry out troubleshooting for "Abnormal noise is made".

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment
- Abnormal combustion

Legend
○: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Worn connecting rod, main bearing	Worn balancer, cam bushing	Worn support pilot	Loose engine mounting bolts, broken cushion	Broken part inside output shaft (damper)	Misalignment between engine and power train	Improper gear train backlash	Stuck dynamic valve system (valve, rocker lever, etc.)	Defective injection pump (excessive injection)
Questions	Confirm recent repair history										
Questions	Degree of use of machine	Operated for long period	△	△	△	△					
Questions	Condition of vibration	Suddenly increased					○			○	
Questions	Condition of vibration	Gradually increased	○	○	○	○					
Questions	Non-specified fuel is being used		○	○							
Check items	Metal particles are found in oil filter		◎	◎							
Check items	Metal particles are found when oil is drained		◎	◎							
Check items	Oil pressure is low at low idling		○	○							
Check items	Vibration occurs at mid-range speed					○	○				
Check items	Vibration follows engine speed				○	○	○	○	○		
Check items	Exhaust gas is black									◎	○
Check items	Seal on injection pump has come off										◎
Troubleshooting	Remove oil pan and inspect directly		●								
Troubleshooting	Remove side cover and inspect directly			●							
Troubleshooting	Inspect support pilot directly for wear and play				●						
Troubleshooting	Inspect engine mounting bolts directly for loose bolts, broken cushions					●					
Troubleshooting	Remove output shaft (damper) and inspect directly						●				
Troubleshooting	When radial runout, face runout are measured, they are found to be outside standard value							●			
Troubleshooting	Remove front cover and inspect directly								●		
Troubleshooting	Remove head cover and inspect directly									●	
Troubleshooting	Injection pump test shows that injection amount is incorrect										●
	Remedy		Replace	Replace	Replace	Replace	Replace	Correct	Correct	Replace	Adjust

S2503025

MEMORANDA

TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (CHASSIS RELATED) (T-MODE)

TABLE OF CONTENTS

Explanation of symbols in Table

The following symbols are used on the Cause column to show the action to be taken to remove the cause.

X: Replace, **Î :** Correct, **A:** Adjust, **C:** Clean

POWER TRAIN

T-1 Machine does not start

Ask the operator the following questions.

! Did the problem suddenly start?
  Yes = Internal part seized or broken

! Was there any abnormal noise when this happened?
  Yes = Component broken.

Checks before troubleshooting

! Does the machine monitor function properly?

! Is the transmission oil level correct?

! Is the type of oil correct?

! Is the transmission filter or strainer clogged?

! Does the electrical circuit of the transmission control work properly?

! Is the transmission oil deteriorated?
  Does the oil smell of burning?

! Is there any damage or leakage of oil that can be seen externally?

! Is the drive shaft broken?

! Is the wheel brake or parking brake locked?

Legend
X: Replace △: Correct A: Adjust C: Clean

Causes
- a: Air sucked in at charging pump suction end
- b: Defective charging pump
- c: No drive for charging pump (defective PTO)
- d: Breakage inside torque converter (bearing, turbine, pump, stator, seal, etc.)
- e: Defective operation of torque converter relief valve
- f: Breakage inside transmission control valve
- g: Defective operation of clutch pressure regulator valve of control valve
- h: Defective operation of control valve (dirt caught, scuffing, etc.)
- i: Defective operation of solenoid valve
- j: Clogged orifice of control valve

		Charging pump			Torque converter		Transmission control valve				
		a	b	c	d	e	f	g	h	i	j
	Remedy	△ X	X	△ X	△ X	△ X	X	△ X	△ X	△ X	C
No.	Problems										
1	Does not start in any transmission range	○	○	○	○	○	○	○	○	○	○
2	Does not start in certain transmission ranges						○		○	○	
3	Does not start when oil temperature rises		○								
4	Torque converter stall speed does not go down to specified speed in any transmission range				○	○	○	○			○
5	Torque converter stall speed does not go down to specified speed in certain transmission ranges										
6	Torque converter charging pressure does not rise	○	○	○	○	○					
7	Transmission clutch pressure does not rise in any speed range	○	○	○			○	○			○
8	Transmission clutch pressure does not rise in certain speed ranges										
9	Metal particles (aluminum, copper, iron, etc.) stuck to filter or strainer		○		○						

SM20402

	Transmission			Accumulator valve
	Excessive leakage of oil from transmission clutch shaft seal portion (worn, broken)	Defective operation inside transmission clutch (seized, worn, oil leakage, broken)	Breakage inside transmission (bearing, gear, housing)	Breakage inside accumulator valve (abnormal wear of spool portion)
	k	l	m	n
	△	△	△	△
	×	×	×	×
			○	
	○	○	○	○
	○	○		
	○	○	○	
	○	○	○	○
		○	○	

Legend
X: Replace △: Correct
A: Adjust C: Clean

S2503059

T-2 Travel speed is slow, thrusting power is weak, lacks power on slopes

Checking for abnormalities

! Measure digging operations and speed when traveling on level ground and on slopes, and check if there is actually an abnormality or whether it is just the feeling of the operator.

Checks before troubleshooting

! Is the transmission oil level correct?
Is the type of oil correct?
! Is the transmission filter or strainer clogged?
! Is there any oil leaking from the joints of the piping or valves?
! Is there any dragging of the wheel brake or parking brake?
! Is the tire inflation pressure and tread pattern normal?
! Is the method of operation correct?

Legend
×: Replace △: Correct A: Adjust C: Clean

Causes

		Charging pump		Torque converter			Transmission control valve	
		a	b	c	d	e	f	g
		Air sucked in at charging pump suction end	Defective charging pump	Defective torque converter relief valve	Oil leakage inside torque converter (seal ring, bushing, snap ring, bearing, etc.)	Breakage inside torque converter (bearing, turbine, pump, stator, etc.)	Defect inside transmission control valve (wear, scratches on spool, etc.)	Defective operation of clutch pressure regulator valve of control valve
	Remedy	△ ×	△ ×	△ ×	△ ×	×	△ ×	△ ×
No.	**Problems**							
1	Abnormality in all transmission ranges	○	○	○	○	○		○
2	Abnormality in certain transmission ranges						○	
3	When oil temperature is low, abnormal noise comes from charging pump	○						
4	Torque converter oil overheats	○	○		○	○		
5	Abnormality in high idling and low idling speeds					○		
6	Abnormality in each stall engine speed		○	○	○	○		
7	Torque converter relief pressure is low	○	○	○	○	○		○
8	Transmission clutch pressure: Low in every transmission range	○	○					○
9	Transmission clutch pressure: Low in certain transmission ranges						○	
10	Transmission clutch pressure: Indicator is unstable and fluctuates violently	○						
11	Transmission oil level changes							
12	Metal particles stuck to transmission strainer or torque converter filter		○			○		

SM20404

Control valve	Torque converter, transmission circuit					Accumulator valve	Others	
Clogged orifice of control valve	Leakage of oil from seal ring of transmission clutch pack shaft	Leakage of oil from transmission clutch piston seal	Breakage inside transmission	Clogged transmission breather	Clogged torque converter cooler circuit	Breakage inside accumulator valve (abnormal wear of spool portion)	Leakage of oil from seal of shaft in work equipment and steering circuit pump	Defect in engine related part
h	i	j	k	l	m	n	o	p
C	△	△		C	△	△	△	△
A	X	X	X	△	X	X	X	
○			○	○	○		○	
		○	○			○		○
				○	○		○	○
			○	○				
								○
○			○					
		○	○			○		○
				○	○		○	
			○					

Legend
X: Replace △: Correct
A: Adjust C: Clean

SM20405

T-3 Excessive shock when starting machine or shifting gear

Checking for abnormalities

It is difficult to measure if the shock is excessive or normal, so judge that the shock is excessive in the following cases.

! When it is clear that the shock has become greater than before.

! When the machine is compared with another machine of the same class and the shock is found to be greater.

Checks before troubleshooting

! Is the engine idling speed too high?

! Is there play in any of the drive shafts?

Legend
X: Replace △: Correct A: Adjust C: Clean

	Causes	Control valve				Transmission		Accumulator valve
		Defective operation of transmission clutch pressure regulator valve	Stuck accumulator piston	Defective operation of modulation valve	Defective operation of quick return valve	Defective piston return due to broken or flattened return spring of clutch pack	Clogged oil drain hole around circumference of clutch pack cylinder	Defective operation of accumulator valve
		a	b	c	d	e	f	g
	Remedy	△ X	△ X	△ X	△ X	△ X	C △	△ X
No.	**Problems**							
1	Shock is excessive in every transmission range	○	○	○	○			
2	Shock is excessive in certain transmission ranges					○	○	○
3	Clutch pressure is too high	○						

SM20406

T-4 Excessive time lag when starting machine or shifting gear

Ask the operator the following questions.

! Was there excessive time lag? Was there any abnormality in the travel speed or thrusting force? Was there any lack of power when traveling up slopes?

Yes = Go to T-2 Travel speed is slow, thrusting power is weak, lacks power on slopes

Checks before troubleshooting

! Is the transmission oil level correct?

! Is the type of oil correct?

! Is there any oil leaking from the joints of the piping or valves?

Legend
X: Replace △: Correct A: Adjust C: Clean

Causes

	Transmission control valve				Transmission			Accumulator valve
	a	b	c	d	e	f	g	h
	Defective operation of accumulator	Clogged orifice	Defective operation of quick return valve	Leakage of oil due to wear of piston, spool, or bore	Leakage of oil from transmission clutch pack, piston seal	Leakage of oil from transmission clutch pack, shaft seal ring	Leakage of oil from joint of transmission housing and valve	Breakage inside accumulator valve (broken spring, worn spool)
Remedy	△ X	C △	△ X	△ X	△ X	△ X	△ X	△ X
No. Problems								
1 Time lag is excessive in every transmission range	◯	◯	◯	◯				
2 Time lag is excessive in certain transmission ranges						◯		◯
3 Clutch pressure is low in every transmission range		◯		◯				
4 Clutch oil pressure is low in transmission ranges where time lag is excessive				◯		◯		◯

SM20407

T-5 Torque converter oil temperature is high

Ask the operator the following questions.

! Does oil temperature rise during torque converter stall and go down when there is no load?
  Yes = Selection of transmission range
! Does oil temperature rise only when carrying out scooping work?
  Yes = Improvement in method of operation

Checks before troubleshooting

! Are the radiator water level and fan belt tension correct?
! Is the transmission oil level correct?
! Is the type of oil correct?
! Is the transmission filter or strainer clogged?

Checking for abnormalities

! Measure the torque converter oil temperature.
  Is it actually high?
  Yes = Defective oil transmission gauge

Legend
×: Replace △: Correct A: Adjust C: Clean

	Causes	a	b	c	d	e	f	g	h		i	k
		Charging pump		Torque converter			Transmission		Torque converter transmission circuit		Others	
		Air sucked in at charging pump suction end	Defective charging pump	Defective torque converter relief valve	Leakage of oil inside torque converter (seal ring, bushing, snap ring, bearing, etc.)	Breakage inside torque converter (bearing, pump, turbine, stator, etc.)	Defective transmission clutch pressure regulator valve	Breakage inside transmission	Clogged transmission breather	Defective bleeding of air from torque converter cooler or clogged circuit	Leakage of oil from seal of shaft in work equipment circuit and steering circuit pump	Defect in engine related part
	Remedy	△ ×	A ×	A ×	A ×	×	△ ×	×	C A	△ ×	A ×	A ×
No.	**Problems**											
1	When oil temperature is low, abnormal noise comes from charging pump	○										
2	Abnormality in high idling and low idling speeds					○		○	○			○
3	Abnormality in each stall engine speed		○	○	○	○						○
4	Abnormality in travel speed, thrusting force, and gradeability in all transmission ranges	○	○	○	○	○	○	○	○	○		○
5	Abnormality in travel speed, thrusting force, and gradeability in certain transmission ranges							○				
6	Torque converter relief pressure is low	○	○	○	○	○						
7	Transmission clutch pressure: Low in every transmission range	○	○				○	○				
8	Transmission clutch pressure: Low in certain transmission ranges							○				
9	Transmission clutch pressure: Indicator is unstable and fluctuates violently	○										
10	Transmission oil level changes								○	○	○	
11	Metal particles stuck to transmission strainer or torque converter filter		○			○		○				

SM20408

STEERING SYSTEM

T-6 Steering wheel does not turn

Ask the operator the following questions.

! Did the problem suddenly start?
Yes = Steering equipment damaged or broken

! Was there previously any symptom, such as heavy steering?
Yes = Wear of internal parts of steering equipment, defective seal

Checks before troubleshooting

! Is the hydraulic oil level correct?

! Is the type of oil correct?

! Has the safety bar been removed from the frame?

Legend
X: Replace △: Correct A: Adjust C: Clean

No.	Problems	a	b	c	d	e
	Causes	Pump: Defective steering pump, work equipment pump	Pump: Defective pump PTO	Valves: Defect inside priority valve (relief valve, plunger)	Valves: Defect inside Orbitrol	Defect inside steering cylinder (oil leakage from piston seal)
	Remedy	△ X	△ X	△ X	△ X	△ X
1	Steering wheel does not turn either to left or to right	○		○	○	○
2	In Item 1, movement of work equipment is abnormal	○		○		
3	Steering wheel turns only to one side (left or right)					○
4	Steering wheel is heavy and cannot be turned	○		○	○	
5	Oil pressure in steering circuit does not rise at al	○		○		
6	Steering wheel turns, but steering does not turn				○	○

SM20409

※ There is a close connection between the steering circuit and the work equipment circuit, so if any abnormality is felt in the steering, check the operation of the work equipment also.

T-7 Steering is heavy

Ask the operator the following questions.

- Did the problem suddenly start?
  Yes = Steering equipment damaged or broken
- Was there previously any symptom, such as heavy steering?
  Yes = Wear of internal parts of steering equipment, defective seal

Checks before troubleshooting.

- Is the hydraulic oil level correct? Is the type of oil correct?
- Is there any leakage of oil from the hydraulic hoses, valves, or cylinders?
- Is there any scuffing of the center hinge pin bearing or steering cylinder pin or bushing?
- Is the tire inflation pressure correct?

Checking for abnormalities.

- Measure the operating force of the steering wheel and the time taken to turn the steering, and check the values in the Standard Value Table to see if there is really any abnormality.

Legend
×: Replace △: Correct A: Adjust C: Clean

	Causes	Defective steering pump, work equipment pump	Defect inside priority valve (relief valve, plunger)	Defect inside orbitrol	Defect inside steering cylinder (oil leakage from piston seal)
		Pump	Valves		Others
		a	b	c	d
	Remedy	×	C, A ×	△ ×	△ ×
No.	**Problems**				
1	Steering is heavy when turned in either direction (left and right)	○	○	○	○
2	Steering is heavy when turned in one direction (left or right)			○	○
3	Steering is particularly heavy when engine is at low speed	○	○		○
4	Boom lifting speed is slow when engine is running at full throttle	○			
5	Steering is heavy and steering wheel jerks	○	○		
6	Oil pressure in steering circuit is low		○	○	○
7	Oil pressure rises in return piping for steering cylinder				

S25030060

T-8 Steering wheel shakes or there is excessive shock

Checks before troubleshooting

- Is the hydraulic oil level correct? Is the type of oil correct?
- Is there any play in the center hinge pin bearing or steering cylinder pin or bushing?
- Is there any variation in the tire inflation pressure?
- Is the steering wheel play correct?

Checking for abnormalities

- Operate at a safe place and check how the steering wheel shakes and under what conditions.

※ In cases where the steering wheel is heavy but does not shake, go to "T-7 Steering is heavy."

Legend
×: Replace △: Correct ▲: Adjust C: Clean

	Causes	Valves		Cylinder	Valves
		Defect inside orbitrol	Defective 2-way restrictor valve	Defect inside steering cylinder (inside surface of cylinder, piston seal, nut, body)	Defective cushion valve
		a	b	c	d
	Remedy	△ ×	×	△ ×	△ ×
No.	**Problems**				
1	Chassis shakes when traveling on rough road surface	○		○	○
2	Shakes when steering is suddenly turned during operation or travel	○	○	○	○
3	Chassis shakes when accelerating during travel operations	○		○	○
4	Chassis shakes when engine is started	○			
5	Excessive shock when steering wheel is turned back				○

S2503063

T-9 Machine deviates naturally to one side when traveling

Causes: Defective steering

- Defective operation of safety valve
- **Oil leakage inside steering cylinder**
- **Variation in tire inflation pressure**

BRAKE SYSTEM

T-10 Brakes do not work or braking effect is poor

Ask the operator the following questions

! Did the problem suddenly start?
    Yes = Brake equipment broken

! Did the problem gradually appear?
    Yes = Deterioration of seal, wear of lining, disc

Checks before troubleshooting

! Is the brake oil level correct?
! Is the brake pedal play correct?
! Is there any leakage of oil from the brake tube or connector?
! Is there any deformation of the tube?
! Is the tire inflation pressure and tread pattern normal?

Checking for abnormalities

! Measure the braking force and compare with the Standard Value Table to check if the braking effect is poor

Legend
X: Replace △: Correct A: Adjust C: Clean

Causes

		a	b	c	d	e	f	g	h	i
	Causes	Internal damage of master cylinder (Damaged piston cup or scuffed piston)	Defective brake booster	Defective brake piston seal inside axle	Defective operation of brake piston inside axle	Defective brake portion inside axle	Wear or other abnormality of brake lining inside axle	Contact with metal portion due to complete wear of brake lining inside axle	Defective pump	Air in brake circuit
		Booster		Inside axle						
	Remedy	△ X	△ X	△ X	△ X	△ X	△ X	△ X	△ X	△
No.	**Problems**									
1	Resistance is low when brake pedal is depressed	○		○						○
2	Brake pedal is heavy when it is depressed	○	○						○	
3	Abnormal operating force is needed to obtain specified braking force	○			○		○	○	○	
4	Abnormal noise is heard from axle brake when brake is applied						○	○		
5	Machine cannot travel (lacks rimpull)	○				○			○	
6	Jack up 4 wheels and set axles on stand. In F1, when brakes are applied, only certain wheels rotate quickly			○	○	○	○	○		
7	Air can be seen flowing out when air is bled from brake circuit. Returns to normal after air is bled.									○
8	Abnormal oil leakage is found when checking leakage of oil inside axle.			○						
9	Many metal particles are found in axle oil							○		

SM20413

T-11 Brake is not released, brake drags

Checks before troubleshooting

! Is the play of the brake pedal correct?

Checking for abnormalities

! Does the machine travel smoothly under inertia on flat ground?

! Jack up the four wheels and check the rotating resistance of the tires.

Legend
X: Replace △: Correct A: Adjust C: Clean

	Causes	Brake booster		Axle brake	
		Defect inside master cylinder (clogged oil port, piston scuffing)	Defect inside brake booster (spring, power piston, spool scuffing)	Defective return of brake piston inside axle	Defect in brake inside axle (inner lining, etc.)
		a	b	c	d
	Remedy	△ X	△ X	△ X	△ X
No.	Problems				
1	When oil is drained from air bleed plug in brakes fluid high pressure circuit, circuit pressure drops and brake is released	○	○		
2	When four wheels are jacked up, axles are put on stands, engine is stopped, parking brake is released, and tires are rotated by hand, certain wheels are heavy			○	○
3	When four wheels are jacked up, axles are put on stands, engine is stopped, parking brake is released, transmission is set to neutral, and tires are rotated by hand, wheels rotate smoothly, but become heavy when engine is started.		○		

SM20414

WORK EQUIPMENT

T-12 Boom does not rise

Ask the operator the following questions.

! Did the problem suddenly start?
Yes = Equipment seized, damaged Was there any abnormal noise when this happened? (from where?)

! Was there previously any symptom, such as the speed becoming slow?
Yes = Wear of internal parts, deterioration in spring

Checks before troubleshooting

! Is the hydraulic oil level correct?

! Is the travel of the boom control lever and spool properly adjusted?

Legend
X: Replace △: Correct A: Adjust C: Clean

		Causes					
		Tank–pump			[illegible]		Cylinder
		a	b	c	d	e	f
		Clogged suction port of pump or excessive air in oil	No PTO drive for pump	Defective hydraulic pump and steering pump	Defective operation of main relief valve	Breakage inside valve body (boom spool)	Damaged boom cylinder piston seal
	Remedy	C △	△ ×	△ ×	△ ×	×	×
No.	Problems						
1	Bucket cannot be operated and boom cannot be raised	○	○	○	○		
2	Chassis can be raised with boom but boom cannot be raised, or bucket can be operated but boom cannot be raised					○	○
3	Boom can be raised when there is no load but cannot be raised when there is a load	○		○	○		
4	Abnormal noise comes from hydraulic pump	○		○			
5	Excessive hydraulic drift of boom cylinder					○	○

SM20416

T-13 Boom movement is slow or boom lacks lifting power

Checks before troubleshooting

! Is the travel of the boom control lever and main control valve spool properly adjusted?

! Is there any seizure of the work equipment linkage? (Is there any abnormal noise?)

Checking for abnormalities

! There is a strong connection between lifting power and speed, so this problem first appears as a lack of lifting speed. Measure the boom lifting speed when the bucket is loaded and use the Standard Value Table to judge if there is any abnormality.

Legend
X: Replace △: Correct A: Adjust C: Clean

No.	Causes	Clogged suction part of pump, or air in oil	Defective hydraulic pump	Defective steering pump	Defective operation or defective adjustment of main relief valve	Breakage or wear inside valve body (boom spool)	Damaged boom cylinder piston seal
		Tank – pump			Main control valve		Cylinder
		a	b	c	d		e
	Remedy	C △	△ X	△ X	A X	X	△ X
No.	**Problems**						
1	Bucket tilting power and speed are abnormal and boom lifting speed is slow	○	○	○	○		
2	Bucket tilting power and speed are normal but boom lifting speed is slow					○	○
3	As in Item 1, but lifting speed is particularly slow when oil temperature rises		○	○		○	○
4	Abnormal noise comes from hydraulic pump	○	○	○			
5	Excessive hydraulic drift of cylinder					○	○
6	Relief pressure of relief valve in main control valve is low .				○	○	○

S2503064

T-14 When boom is raised, it moves slowly at a certain height

Checks before troubleshooting

! Can any deformation be seen in the boom cylinder?

Cause

! Swelling or internal damage to boom cylinder tube

i For other abnormalities when the boom is raised, go to **"T-13 Boom movement is slow or boom lacks lifting power."**

T-15 Bucket cannot be pushed with boom cylinder (bucket floats)

See "T-13 Boom movement is slow or boom lacks lifting power."

Checks before troubleshooting

! Is the oil level in the hydraulic tank correct?

! Is the stroke of the boom spool in the main control valve properly adjusted?

Cause

! Defective seating of suction valve at boom cylinder rod end of main control valve

! Oil leakage from boom cylinder piston seal

T-16 Excessive hydraulic drift of boom

Ask the operator the following questions.

! Did the problem suddenly start?
    Yes = Dirt caught in valve, broken part

! Did the problem gradually appear?
    Yes = Worn parts

Checks before troubleshooting

! Is the type and level of oil in the hydraulic tank correct?

! Is the boom spool at the HOLD position?
    Yes = Seized link bushing, defect in spool detent

Troubleshooting and Cause

! When measuring the hydraulic drift, is there any sound of oil leakage from inside the boom cylinder?
    Yes = Defective cylinder packing

T-17 Boom shakes during operation

When digging or leveling operations are carried out with the boom control lever at HOLD, the bucket and boom move up and down to follow the shape of the ground.

Troubleshooting and Cause
Measure the hydraulic drift of the boom and check if it is possible to lift the chassis with the boom cylinder.

1. If the hydraulic drift of the boom cylinder is outside the standard value, go to **"T-16 Excessive hydraulic drift of boom."**
2. If the chassis cannot be raised with the boom cylinder, go to **"T-15 Bucket cannot be pushed with boom cylinder."**
3. If the hydraulic drift of the boom is normal, operate the boom several times, and operate the boom cylinder to the end of its stroke. Is it now possible to raise the chassis with the boom cylinder?
   Yes = **Vacuum had formed inside cylinder**

i However, if this problem appears frequently, the suction valve at the boom cylinder rod end is defective.

T-18 Boom drops momentarily when control lever is operated from HOLD to RAISE

Checking problem
! When the engine is run at low idling and the boom control lever is operated slowly from **HOLD** to **RAISE,** the boom goes down under its own weight. When the lever is operated fully to the **RAISE** position, the condition returns to normal.

Cause
! Defective seating of check valve for boom spool in main control valve

T-19 Bucket does not tilt back

Ask the operator the following questions.

! Did the problem suddenly start?

Yes = Equipment seized, damaged Was there any abnormal noise when this happened? (from where?)

! Was there previously any symptom, such as the speed becoming slow?

Yes = Wear of internal parts, deterioration in spring

Checks before troubleshooting

! Is the travel of the bucket control lever and spool properly adjusted?

Legend

×: Replace △: Correct A: Adjust C: Clean

	Causes	Tank – pump			Main control valve			Cylinder
		a	b	c	d	e	f	g
		Clogged suction port of pump or excessive air in oil	No PTO drive for pump	Defective hydraulic pump and steering pump	Defective operation of main relief valve	Defective operation of safety valve (with suction valve) at bucket cylinder bottom end	Breakage inside valve body (bucket spool)	Damaged bucket cylinder piston seal
	Remedy	C △	△ ×	△ ×	A ×	△ ×	×	×
No.	**Problems**							
1	Boom cannot be operated and bucket cannot be tilted back	○	○	○	○			
2	Boom can be raised with bucket but bucket cannot be tilted back, or boom can be operated but bucket cannot be tilted back					○	○	○
3	Bucket can be tilted back when there is no load but cannot be tilted back during digging or scooping operations	○		○	○	○		
4	Abnormal noise comes from hydraulic pump	○		○				
5	Excessive hydraulic drift of bucket cylinder					○	○	○

S2503081

T-20 Bucket movement is slow or tilt-back lacks power

Checks before troubleshooting

! Is the travel of the bucket control lever and main control valve spool properly adjusted?

! Is there any seizure of the work equipment linkage? (Is there any abnormal noise?)

Checking for abnormalities

! Check if there is lack of tilt-back power during actual operations.

! Measure the operating speed of the bucket and use the Standard Value Table to check if there is any abnormality

Legend
×: Replace △: Correct A: Adjust C: Clean

No.	Causes	a	b	c	d	e	f	g
		Tank – pump			Main control valve			Cylinder
		Clogged suction port of pump, or air in oil	Defective hydraulic pump	Defective steering pump	Defective operation or defective adjustment of main relief valve	Defective operation of safety valve (with suction valve) at bucket cylinder bottom end	Breakage or wear inside valve body (bucket spool)	Damaged bucket cylinder piston seal
	Remedy	C △	△ ×	△ ×	△A ×	△ ×	×	×
No.	**Problems**							
1	Boom lifting power and speed are abnormal and bucket tilt-back power or speed are abnormal	○	○	○	○			
2	Boom lifting power and speed are normal but bucket tilt-back power or speed are abnormal					○	○	○
3	As in Item 1, but problem is particularly bad when oil temperature rises		○	○				
4	Abnormal noise comes from hydraulic pump	○	○	○				
5	Excessive hydraulic drift of bucket cylinder					○	○	○
6	Relief pressure of relief valve in main control valve is low				○	○	○	○
7	Discharge from hydraulic is low		○	○				

S2503062

T21 Bucket movement becomes slow during tilt-back operation

Checks before troubleshooting

- Can any deformation be seen in the bucket cylinder?

Cause

- Swelling or internal damage to bucket cylinder tube
- For other abnormalities when the bucket is operated, go to **"T-20 Bucket movement is slow or tilt back lacks power."**

T-22 Bucket cannot be pushed with bucket cylinder

See "T-20 Bucket movement is slow or tilt back lacks power."

Checks before troubleshooting

- Is the stroke of the bucket spool in the main control valve properly adjusted?

Cause

- Defective seating of safety valve (with suction valve) at bucket cylinder rod end of main control valve
- Oil leakage from bucket cylinder piston seal

T-23 Excessive hydraulic drift of bucket

Ask the operator the following questions.

- Did the problem suddenly start?
  Yes = Dirt caught in valve, broken part
- Did the problem gradually appear?
  Yes = Worn parts

Checks before troubleshooting

- Is the bucket spool at the neutral position?
  Yes = Seized link bushing, defect in spool detent

Checking for abnormalities

- Use the Standard Value Table to check if the hydraulic drift of the bucket is actually excessive.

Cause

- Oil leakage inside bucket cylinder
- Defective seating of safety valve (with suction valve) at bottom end
- Defective oil tightness of bucket spool

T-24 Bucket shakes during loading operation (Main control valve at HOLD)

Checks before troubleshooting

! Is there play in the work equipment linkage pin, bushing? (Is there any abnormal noise?)

Cause

! Defective bucket cylinder piston seal

! Defective operation of safety valve (with suction valve) at bucket cylinder rod end. If any other problem occurs at the same time, carry out troubleshooting according to the nature of the problem.

T-25 Bucket dumps momentarily when control lever is operated from HOLD to TILT

Checking problem

! When the engine is run at low idling and the bucket control lever is operated slowly from **HOLD** to **TILT,** the bucket dumps momentarily under its own weight. When the lever is operated fully to the **TILT** position, the condition returns to normal.

Cause

! Defective seating of check valve for bucket spool in main control valve

T-26 Boom, bucket control levers are heavy or do not move smoothly

Checking for abnormalities

! Compare operating force of the lever with the value in the Standard Value Table to see if it is actually excessive.

Legend
X: Replace △: Correct A: Adjust C: Clean

Causes:
- Lever
  - a: Seizure, stiffness of rotating portion of control lever, link
- Main control valve
  - b: Deformation of valve body due to uneven tightening of valve mounting bolts
  - c: Bent main control valve spool
  - d: Catching of main control valve spool detent
  - e: Defective clearance between main control valve body and spool
  - f: Defective out-of-roundness of main control valve body and spool
  - g: Dirt caught in main control valve spool

No.	Problems	a	b	c	d	e	f	g
1	Levers are heavy when there is a load and oil pressure is high		○			○	○	
2	Levers become heavy as oil temperature changes		○			○	○	
3	Levers become heavy at places during operation regardless of oil pressure or temperature				○			
4	Levers are always heavy during operation regardless of oil pressure or temperature	○	○	○				○
5	Levers are still heavy after control lever link is disconnected at valve connection	○						
	Remedy							

SM20423

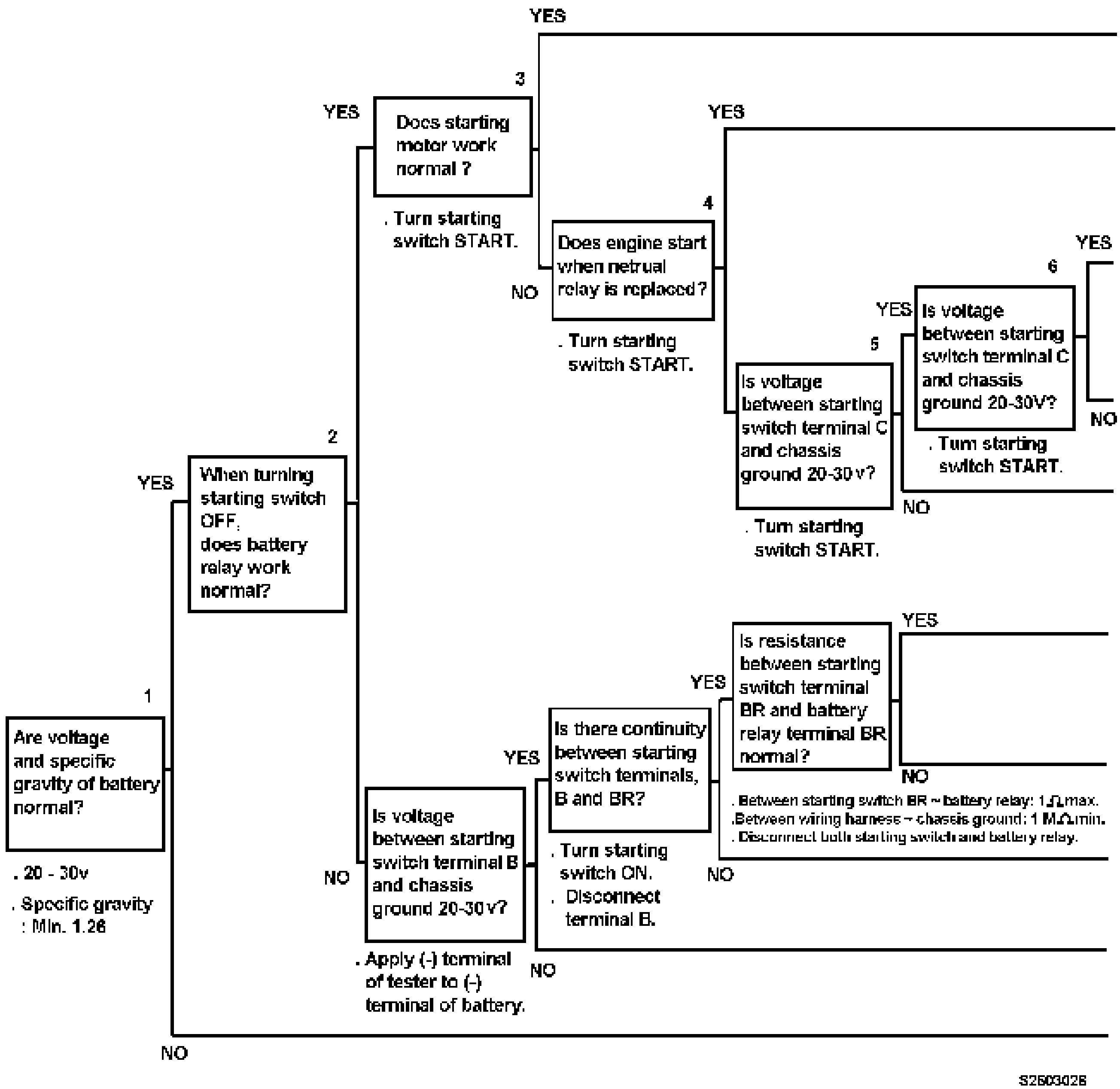
TROUBLESHOOTING OF ELECTRICAL SYSTEM FOR ENGINE, TRANSMISSION (E-MODE)

TABLE OF CONTENTS

E-1 Engine does not start

- If the front lamps or other electrical components are not working normally, carry out Troubleshooting (b) first.
- To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.

(a) check starting circuit



YES

Is voltage between alternator terminal R and chassis ground normal?

- Turn starting switch ON.
- Max. 1V

YES / NO

NO

Is there continuity between (-) terminal of battery and chassis ground?

- Turn starting switch OFF.

YES / NO

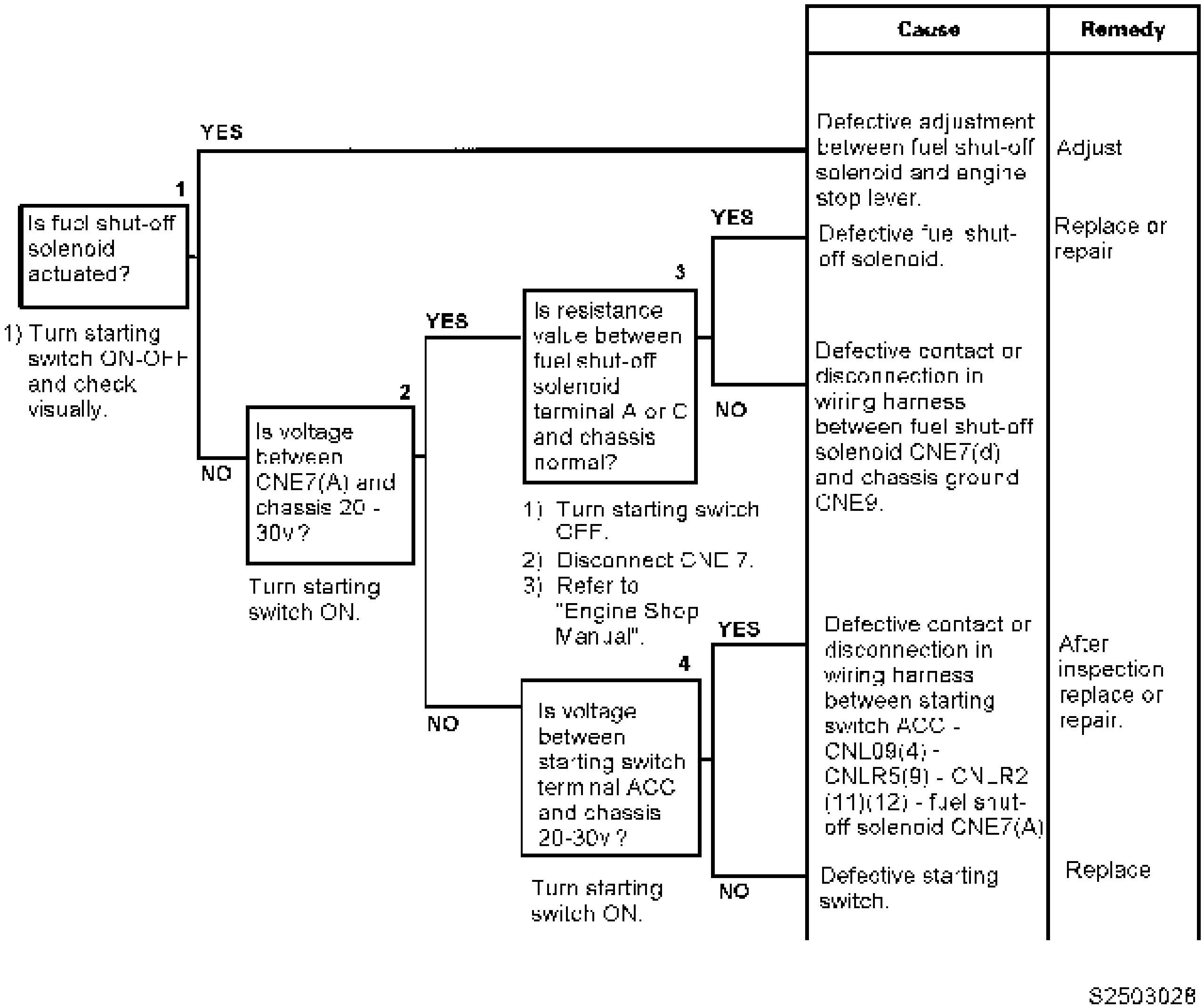
Cause	Remedy
Defective starting motor	Repair or replace
Defective "neutral" relay	Replace
Defective contact between battery relay and starting motor or defective starting motor.	Repair or replace
Defective "alternator safety" relay.	Replace
Defective contact or disconnection in wiring harness between starting motor terminal C CNL09 (3) CNL34 (5) (3) - CNLR2 (4) - CNL11, CNL12 (2) (1) - CNE13 (1) - starting motor relay terminal S or defective starting motor relay.	Repair or replace
Defective starting switch	Replace
Defective battery relay or defective contact, or disconnection in wiring harness between battery relay E - CNR7 (3) - CNR8.	Repair or replace
Defective contact in wiriing harness between (-) terminal of battery and chassis ground.	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR ~ CNL09 (2) ~ CNLR2 (7) ~ (CNLR1 (2). (1) ~ CNR7 (1) ~ battery relay terminal BR.	Repair or replace
Defective starting switch. (Between B and BR)	Replace
Defective contact, or disconnection in wiring harness between (+) terminal of battery ~ CNR7 (2) – CNLR3 (1) – CNFS3 (6) – fuse – CNFS3 (4) ~ CNL09 (1) ~ starting switch terminal B.	Repair or
Defective battery	Change or replace

S2503027

E-1 Engine does not start (2/2)

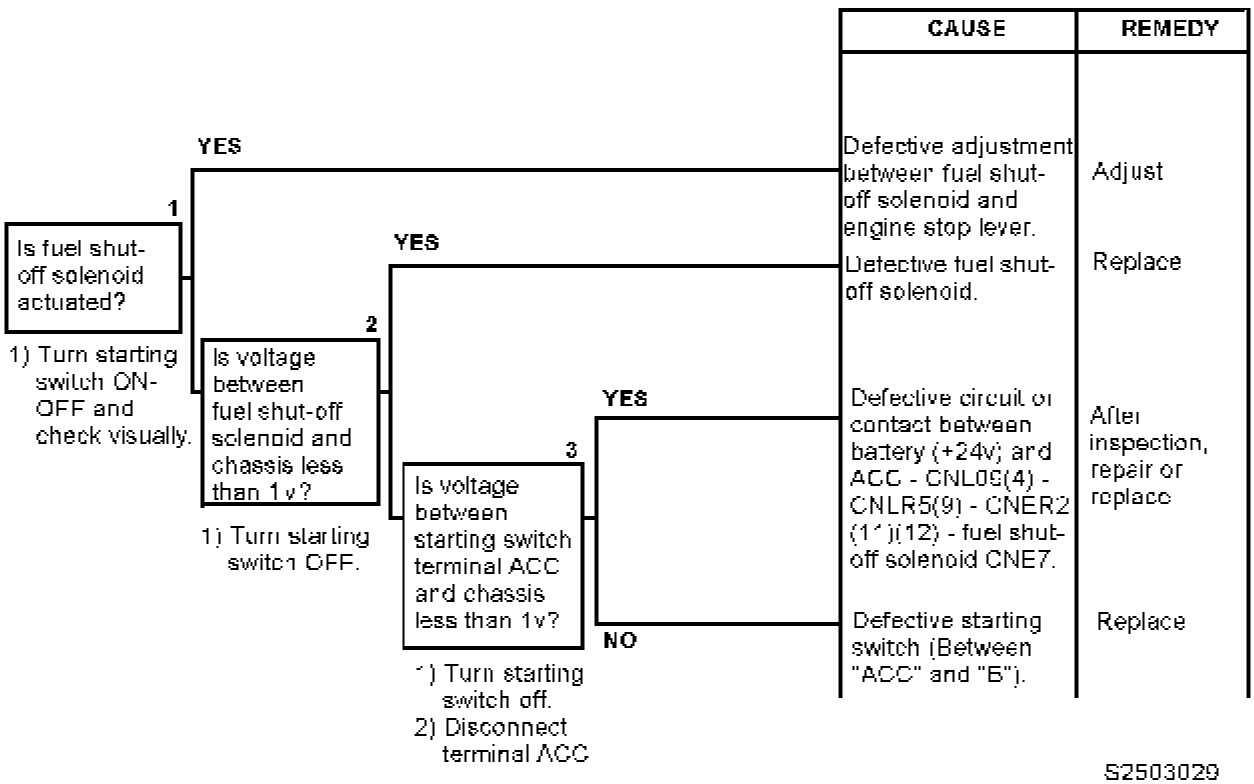
(b) Check fuel shut-off solenoid

- i To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- i When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- i After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.
- i Refer to electrical wiring diagram in section 20 TROUBLE SHOOTING
  "ELECTRICAL CIRCUIT DIAGRAM FOR EACH SYSTEM.
  ENGINE START, STOP SYSTEM"



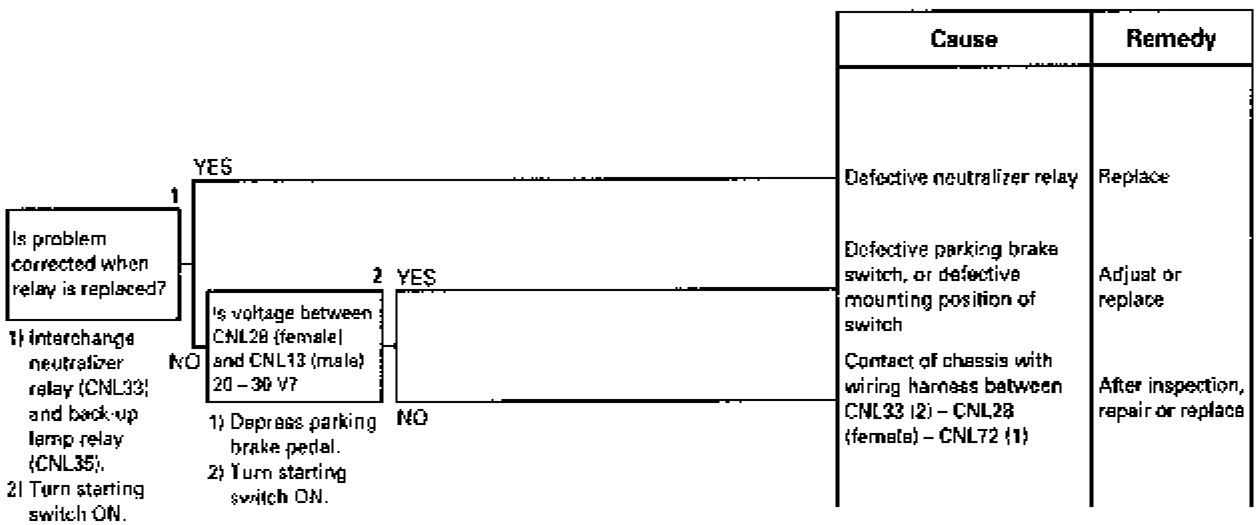
E-2 Engine does not stop

- i To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- i When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- i After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.
- i Refer to electrical wiring diagram in section 20 TROUBLE SHOOTING
  "ELECTRICAL CIRCUIT DIAGRAM FOR EACH SYSTEM.
  ENGINE START, STOP SYSTEM""



E-4 Transmission is not set to neutral when parking brake is applied (transmission cut-off is normal)

- To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.



S2502060

E-5 Transmission does not work normally

- Stop the machine on level ground when carrying out troubleshooting of the brake system.
- To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.

Carry out check of transmission solenoid control circuit

WARNING! Stop the machine on level ground and put blocks under the wheels.

1. Install a T-adapter checker to connector CNFT1, and check the voltage between the connector pins and the chassis ground.
2. Turn the starting switch ON.
   WARNING! Do not start the engine under any circumstances.
3. Turn the parking brake switch ON ° OFF (release).
4. When using the foot brake, depress the right brake so that the transmission cut-off is not turned off.
5. Check according to the normal actuation table below, and if there is any abnormality, use the result below and go to the Troubleshooting given in the column on the right.

Lever operation		CNFT1 connector Pin No. 1 (F)	2 (R)	3 (H-L)	4 (SPEED)	5 (GND)
Directional lever	FORWARD	●	○			○
	REVERSE	○	●			○
Speed lever	1st			○	●	○
	2nd			○	○	○
	3rd			●	○	○
	4th			●	●	○

Normal actuation table

○: 0 – 0.5 V [Continuity]

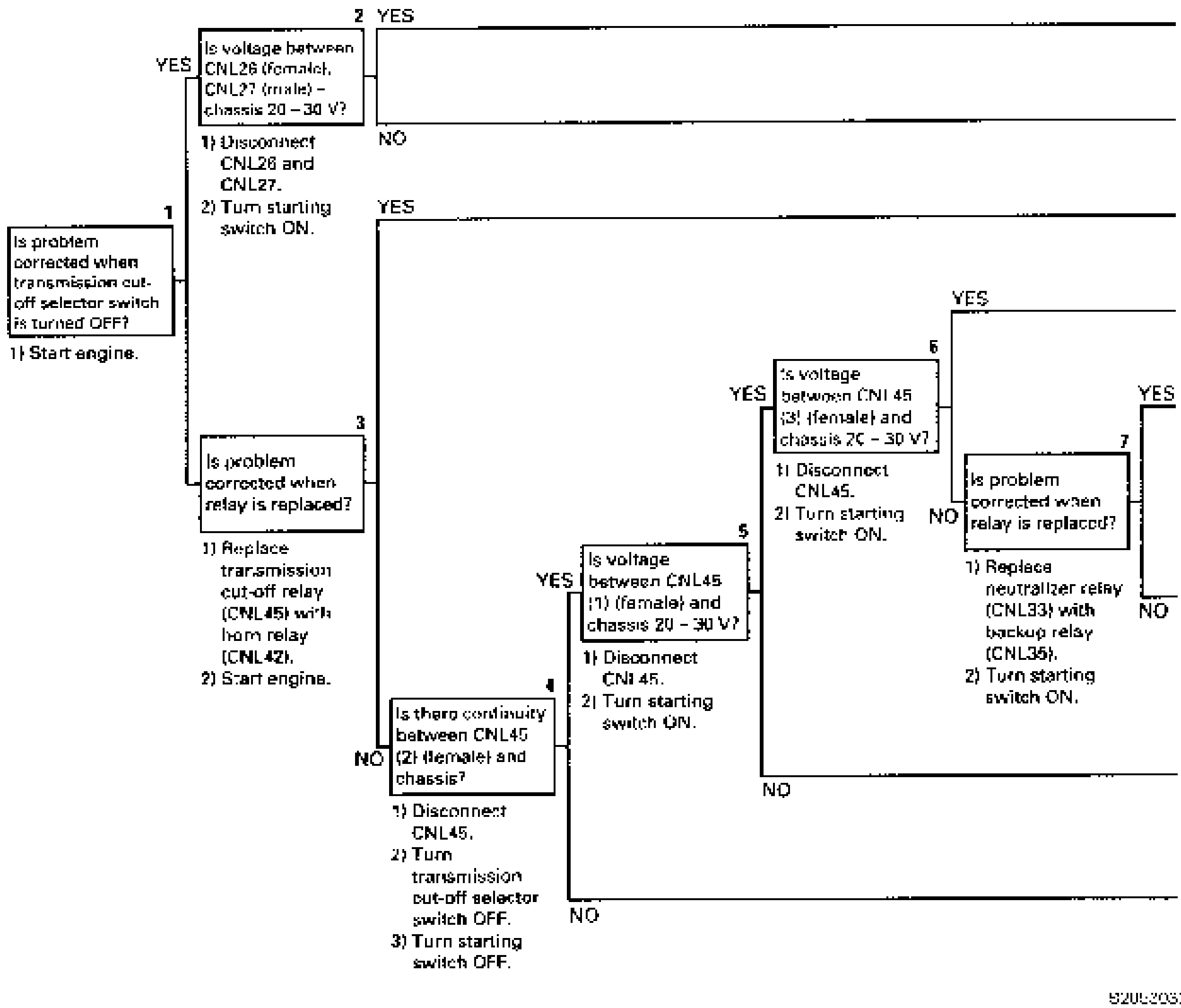
●: 20 – 30 V [Battery voltage]

Result of check (abnormal)	Cause	Trouble-shooting
● No battery voltage at all	Problem in transmission cut-off switch, parking brake, neutralizer circuit	E – 5(a)
○ No continuity (F)	Problem in FORWARD circuit	E – 5(b)
○ No continuity (R)	Problem in REVERSE circuit	E – 5(c)
○ Continuity at 2 places	Contact in FORWARD, REVERSE circuit	E – 5(d)
● No battery voltage at all	Problem in power source circuit	E – 5(e)
○ No continuity	Problem in speed circuit	E – 5(e)
○ Continuity higher than specified	Contact in speed circuit	E – 5(f)

S2603031

(a) Problem in parking brake, transmission cut-off switch, neutralizer relay circuit

Ú First, carry out troubleshooting E-5 "Transmission does not work normally", then carry out the troubleshooting below.



8

Is voltage between CNL33 (1) (female) and chassis 20 – 30 V?

1) Disconnect CNL33.
2) Turn starting switch ON.

YES

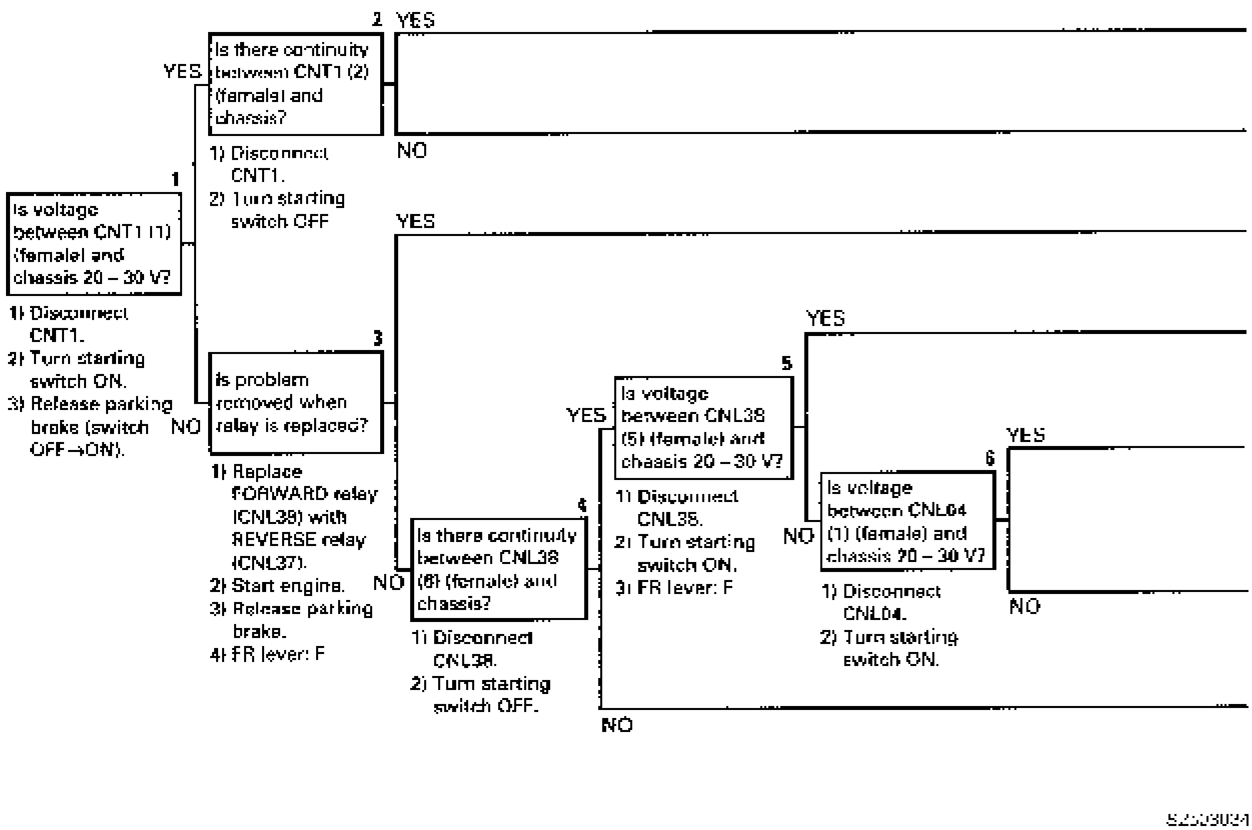
NO

Cause	Remedy
Defective transmission cut-off switch	Replace
Defective contact or disconnection in wiring harness between CNL45 (5) and CNL26, between CNL33 (5) and CN27	After inspection, repair or replace
Defective transmission cut off relay	Replace
Defective contact or disconnection in wiring harness between CNL45 (5) – CNL37 (1) – CNL38 (3)	After inspection, repair or replace
Defective neutralizer relay	Replace
Defective contact or disconnection in wiring harness between CNL33 (2) and CNL28, between CNL33 (3) – CNL45 (1) – CNFS2 (8) – fuse – CNFS1 (2), or defective parking switch	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL33 (1) – CNFS2 (9) – fuse – CNFS1 (2)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL45 (1) – CNL33 (3) – CNFS28 – fuse – CNFS1 (2)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL45 (2) – CNL06 (3) – monitor – chassis ground	After inspection, repair or replace

SYC03033

(b) Defective continuity in FORWARD solenoid circuit

Ú First, carry out Troubleshooting E-5 “Transmission does not work normally”, then carry out the troubleshooting below.

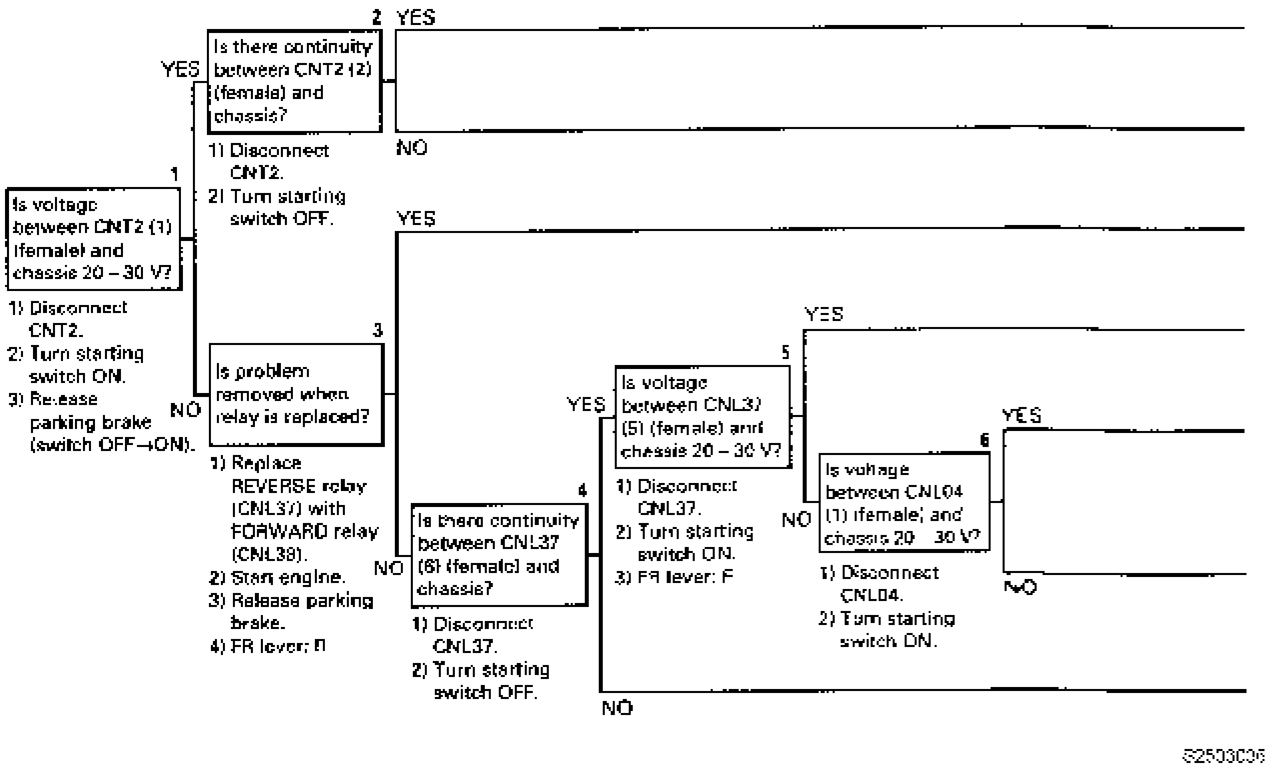


Cause	Remedy
Defective FORWARD solenoid	Replace
Defective contact or disconnection in wiring harness between CNT1 (2) (female) – CNFT1 (5) – CNLR3 (2) – chassis ground	After inspection, repair or replace
Defective FORWARD relay	Replace
Go to Troubleshooting E-5 (a)	—
Defective transmission control lever, or defective contact or disconnection in wiring harness between CNL04 (2) (female) and CNL38 (5) (female)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL04 (1) (female) – CNFS2 (8) – fuse – CNFS1 (2) (female)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL38 (6) (female) and chassis ground	After inspection, repair or replace

S2706036

(c) Defective continuit in REVERSE solenoid circuit

Ú First, carry out Troubleshooting E-5 “Transmission does not work normally”, then carry out the troubleshooting below.



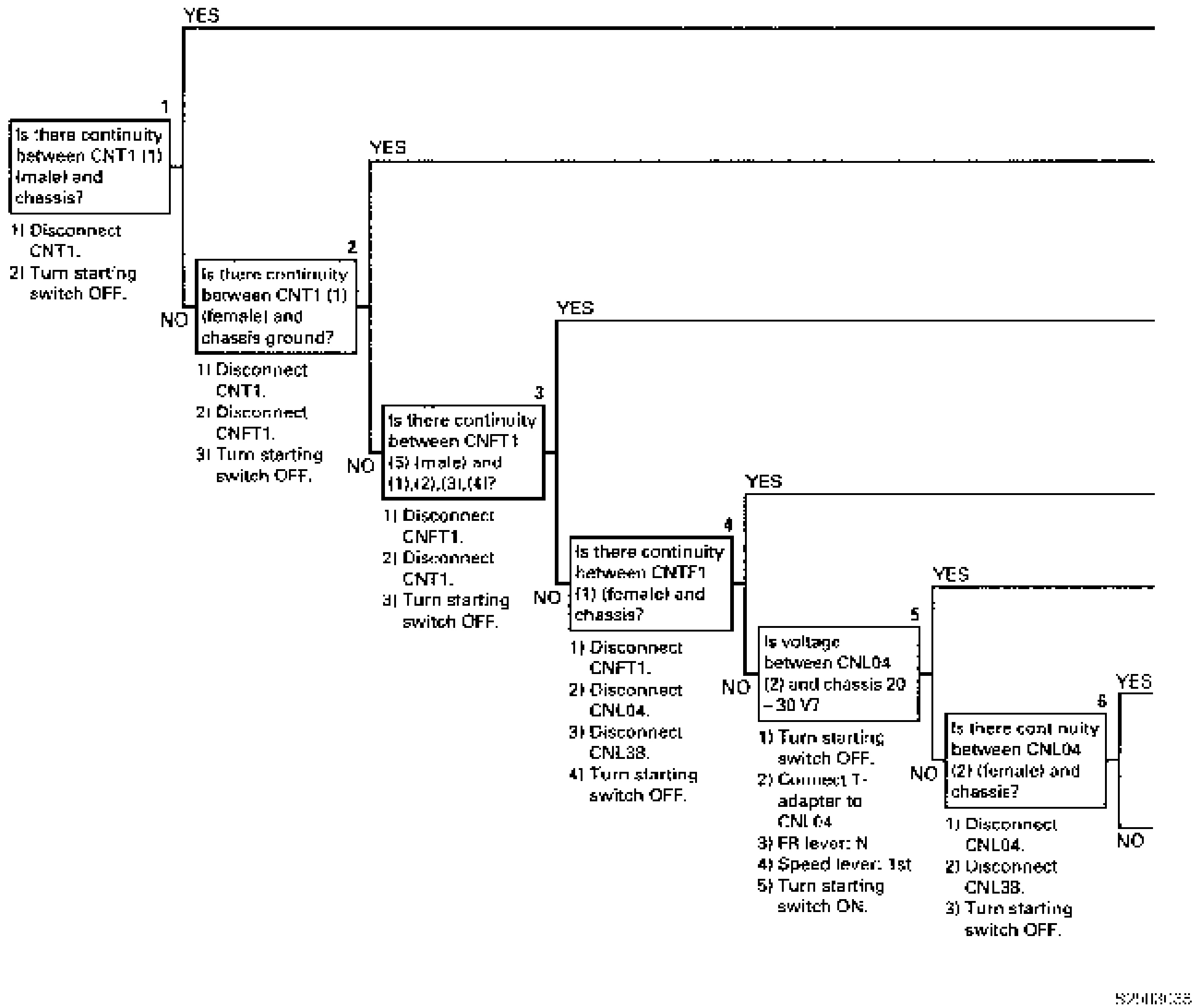
Cause	Remedy
Defective REVERSE solenoid	Replace
Defective contact or disconnection in wiring harness between CNT2 (2) (female) – CNFT1 (5) – CNLR3 (2) – chassis ground	After inspection, repair or replace
Defective REVERSE relay	Replace
Go to Troubleshooting E-5 (a)	—
Defective transmission control lever, or defective contact or disconnection in wiring harness between CNL04 (4) (female) and CNL37 (5) (female)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL04 (1) (female) – CNFS2 (8) – fuse – CNFS1 (2) (female)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL37 (6) (female) and chassis ground	After inspection, repair or replace

52503037

(d) Contact in directional circuit

Ú First, carry out Troubleshooting E-5 “Transmission does not work normally”, then carry out the troubleshooting below.

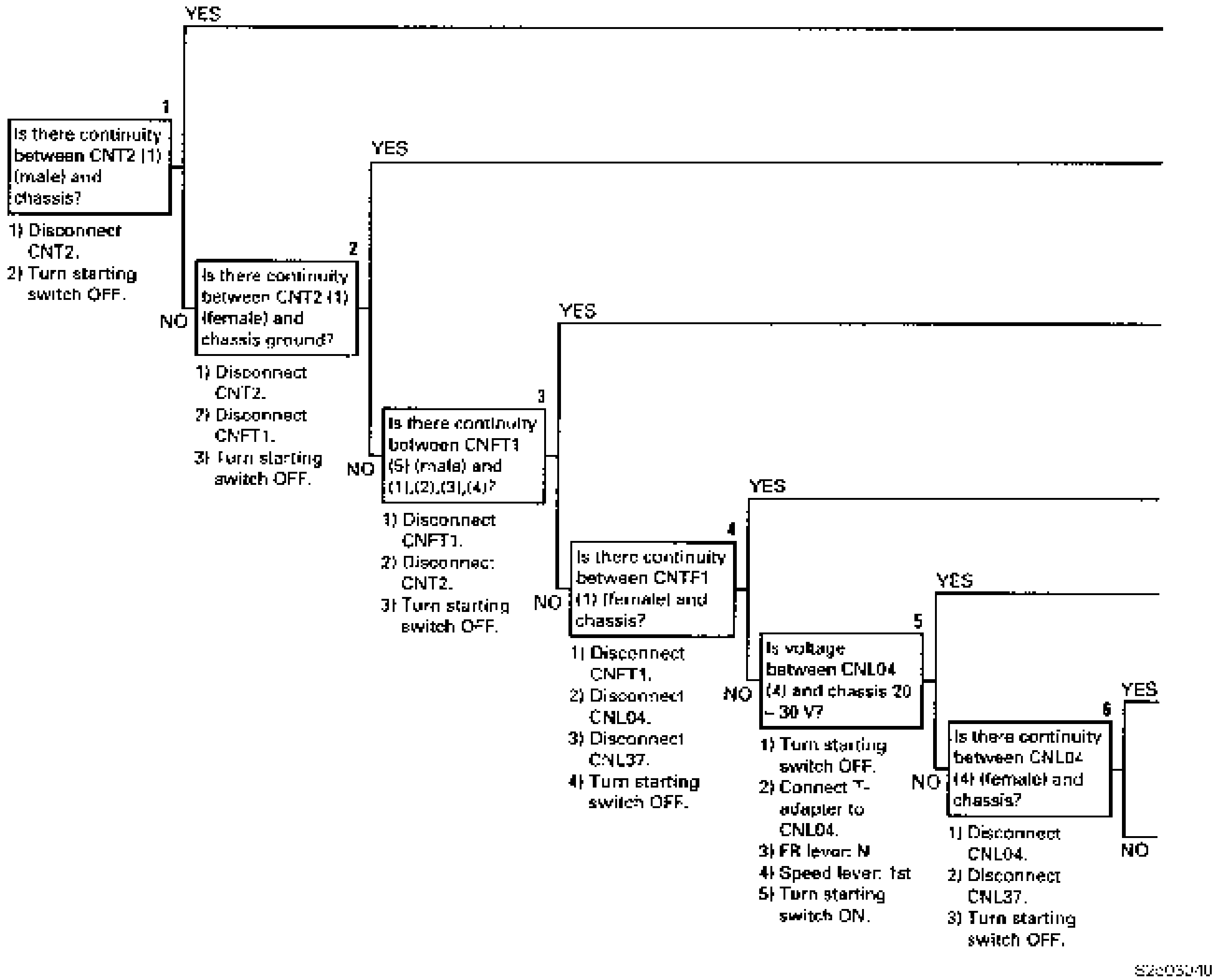
1) Forward is continuous



Cause	Remedy
Defective insulation between CNT1 (1) (male) and connector body, or abnormal contact of chassis ground with wiring harness of CNT1 (1) inside control valve	After inspection, repair or replace
Abnormal contact of chassis ground with wiring harness between CNT1 (female) – CNFT1 (1) (male)	After inspection, repair or replace
Abnormal contact of wiring harness between CNFT1 (5) (male) – CNT1 (2) – CNT2 (2) – CNT3 (2) – CNT4 (2) with wiring harness between CNFT1 (1) (male) – CNT1 (1), CNFT1 (2) (male) – CNT2 (1), CNFT1 (3) (male) – CNT3 (1), CNFT1 (4) (male) – CNT4 (1)	After inspection, repair or replace
Abnormal contact of chassis ground with wiring harness between CNFT1 (1) (female) and CNL38 (4) (female)	After inspection, repair or replace
Defective transmission control switch	Replace
Abnormal contact of chassis or ground with wiring harness between CNL04 (2) – CNL38 (5) – CNL08 (7)	After inspection, repair or replace
Defective FORWARD solenoid relay, or defective contact or disconnection in wiring harness between CNL38 (6) (female) and chassis ground	After inspection, repair or replace

S2503030

2) REVERSE is continuous

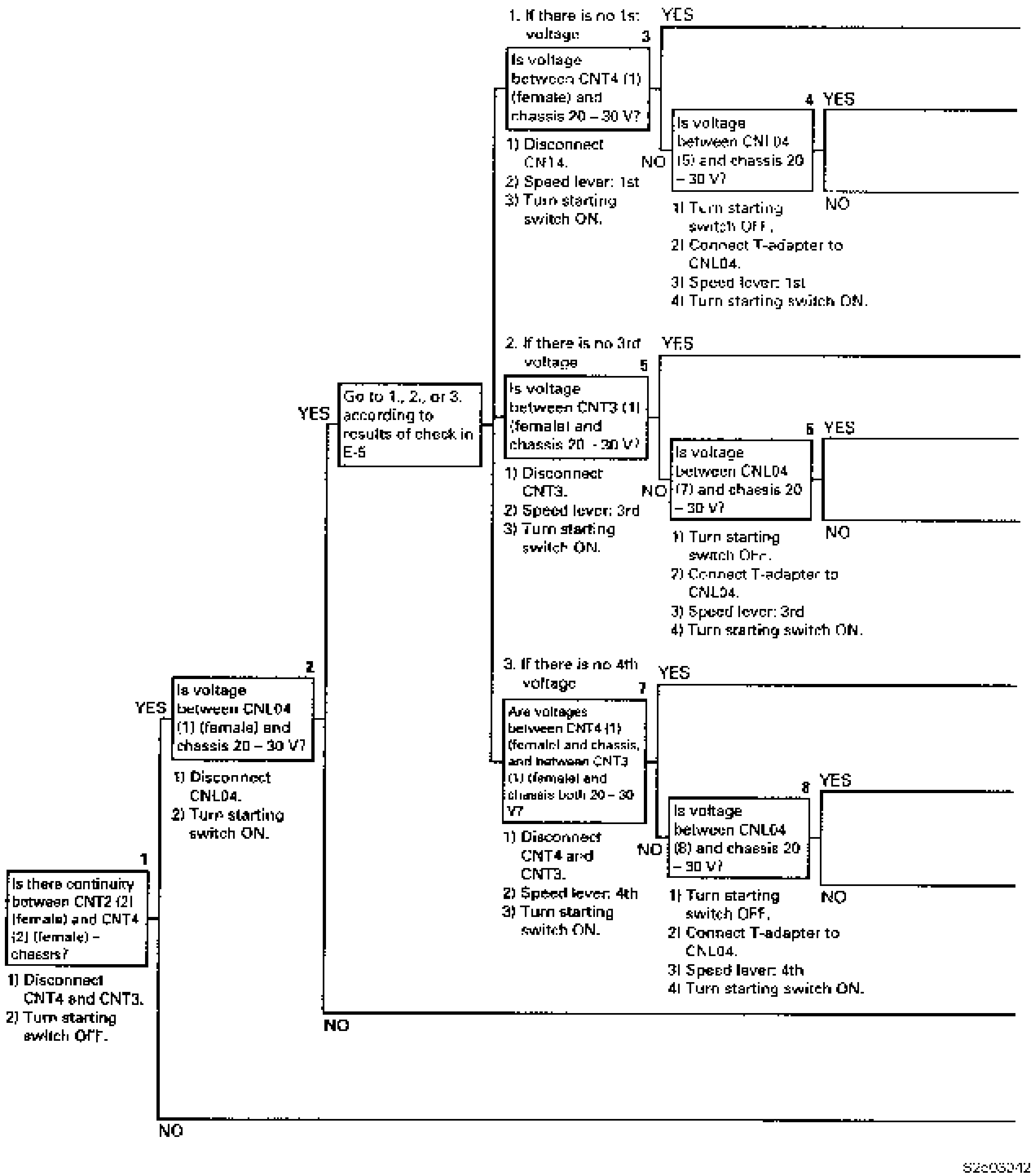


Cause	Remedy
Defective insulation between CNT2 (1) (male) and connector body, or abnormal contact of chassis ground with wiring harness of CNT2 (1) inside control valve	After inspection, repair or replace
Abnormal contact of chassis ground with wiring harness between CNT2 (1) (female) – CNFT1 (2) (male)	After inspection, repair or replace
Abnormal contact of wiring harness between CNFT1 (5) (male) – CNT1 (2) – CNT2 (2) – CNT3 (2) – CNT4 (2) with wiring harness between CNFT1 (1) (male) – CNT1 (1), CNFT1 (2) (male) – CNT2 (1), CNFT1 (3) (male) – CNT3 (1), CNFT1 (4) (male) – CNT4 (1)	After inspection, repair or replace
Abnormal contact of chassis ground with wiring harness between CNFT1 (2) (female) and CNL37 (2) (female)	After inspection, repair or replace
Defective transmission control switch	Replace
Abnormal contact of chassis or ground with wiring harness between CNL04 (4) – CNL37 (5) – CNL08 (8)	After inspection, repair or replace
Defective REVERSE solenoid relay, or defective contact or disconnection in wiring harness between CNL37 (6) (female) and chassis ground	After inspection, repair or replace

S2503041

(e) Problem with speed solenoid or always stays in 2nd.

Ú First, carry out Troubleshooting E-5 "Transmission does not work normally", then carry out the troubleshooting below.



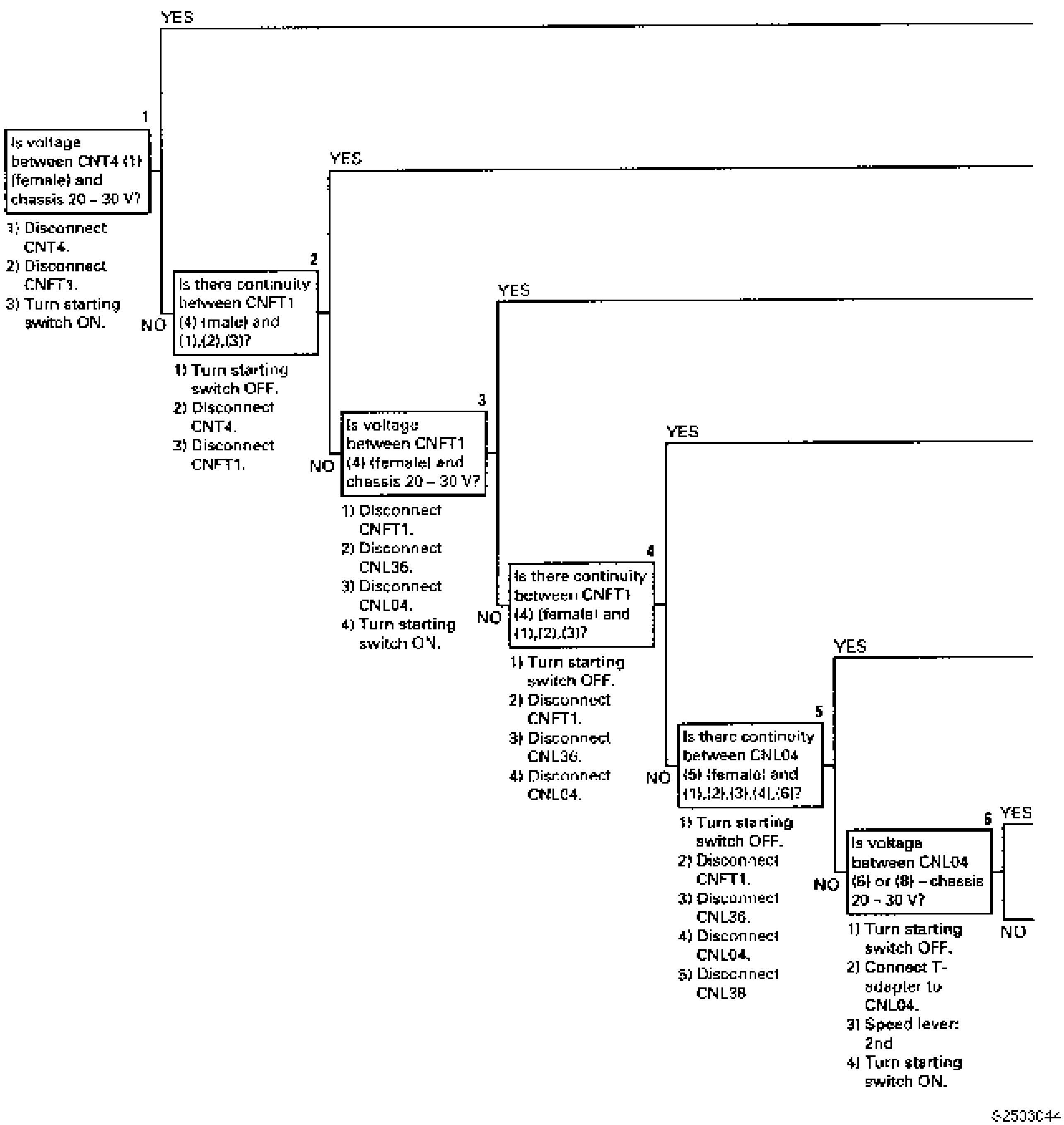
Cause	Remedy
Defective speed solenoid	Replace
Defective contact or disconnection in wiring harness between CNT4 (1) – CNFT1 (4) – CNL04 (5)	After inspection, repair or replace
Defective speed lever switch	Replace
Defective H-L solenoid	Replace
Defective contact or disconnection in wiring harness between CNT3 (1) – CNFT1 (3) – CNL04 (7)	After inspection, repair or replace
Defective speed lever switch	Replace
Defective speed solenoid or H-L solenoid	Replace
Defective contact or disconnection in wiring harness between CNT4 (1) – CNL15 (1) – diode – CNL15 (2) – CNL04 (8), or between CNT3 (1) – CNL16 (1) – diode – CNL16 (2) – CNL04 (8)	After inspection, repair or replace
Defective speed lever switch	Replace
Defective contact or disconnection in wiring harness between CNL04 (1) – CNFS2 (8) – CNFS1 (2) – CNLR4 (2) – slow blow fuse	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNT3 (2) and CNT4 (2) – chassis ground	After inspection, repair or replace

S2003043

(f) Contact in speed circuit

Ú First, carry out Troubleshooting E-5 "Transmission does not work normally", then carry out the troubleshooting below.

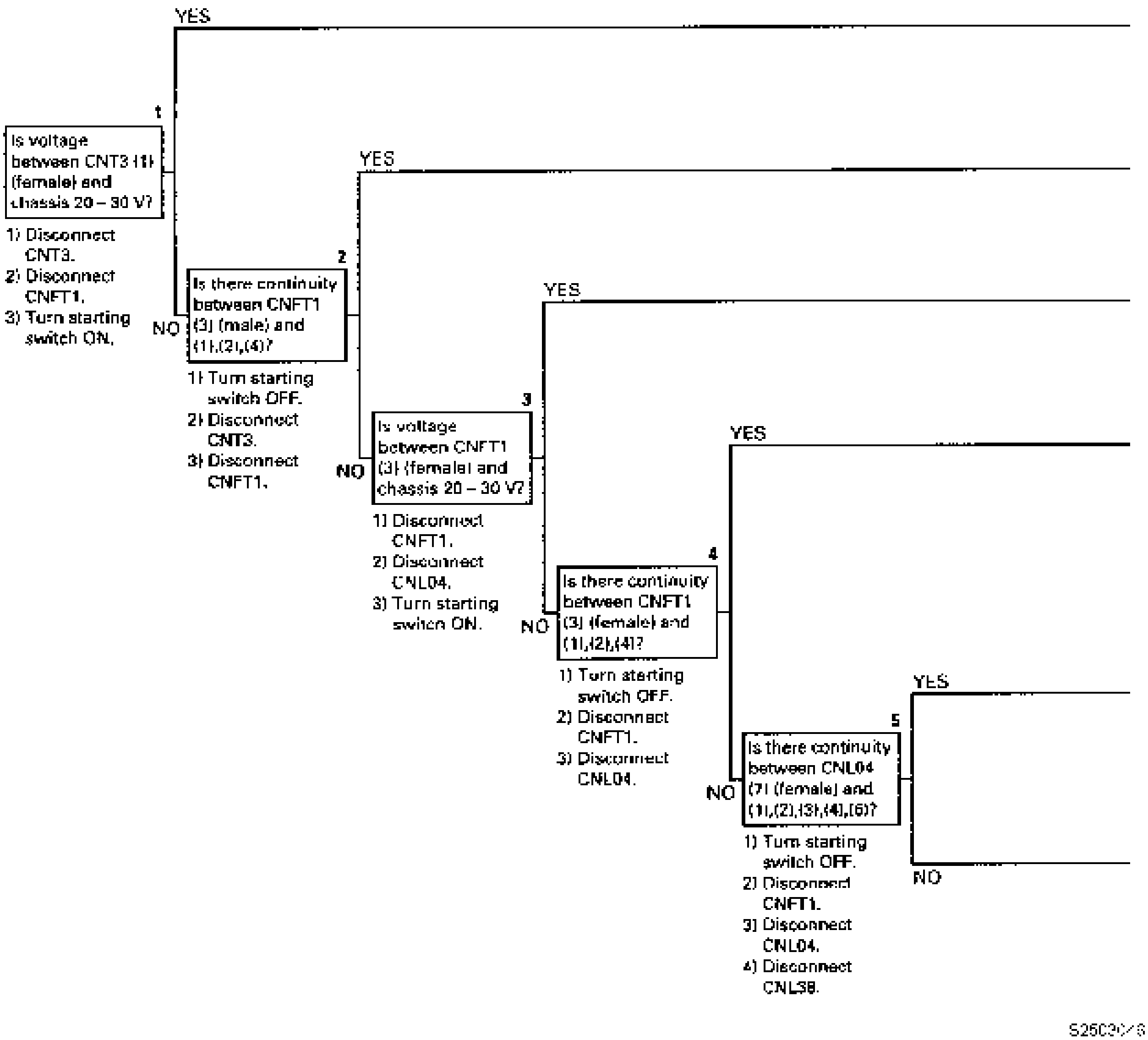
1) Battery voltage formed in 1st (speed) solenoid.



Cause	Remedy
Abnormal contact of +24 V wiring harness with wiring harness between CNT4 (1) (female) and CNFT1 (4) (male)	After inspection, repair or replace
Abnormal contact of wiring harness between CNFT1 (4) (male) and CNT4 (1) (female) with wiring harness between CNFT1 (1),(2),(3) (male) – CNFT1 (1) (female), CNT2 (1) (female), CNT3 (1) (female)	After inspection, repair or replace
Abnormal contact of +24 V wiring harness with wiring harness between CNFT1 (4) (female) – CNL04 (5) (female) – CNL36 (4) (female)	After inspection, repair or replace
Abnormal contact of wiring harness between CNFT1 (4) (female) and CNL04 (5) (female) with wiring harness between CNFT1 (1) (female) – CNL39 (4) (female) or CNFT1 (2) (female) – CNL37 (2) (female) or CNFT1 (3) (female) – CNL04 (7) (female)	After inspection, repair or replace
Abnormal contact of wiring harness between CNL04 (5) (female) and CNFT1 (4) (female) with wiring harness between CNL04 (1) (female) – CNTS2 (9) (female) or CNL04 (2) (female) – CNL38 (5) (female) or CNL04 (3) (female) – CNL34 (1) (female) or CNL04 (4) (female) – CNL37 (5) (female) or CNL04 (6) (female) – CNL38 (1) (female)	After inspection, repair or replace
Defective transmission control switch	Replace
CNL38 (3),(4) (male) continuous, and abnormal contact of +24 V wiring harness with wiring harness between CNL38 (1) (female) and CNL36 (1),(3) (female)	After inspection, repair or replace

S2503049

2) Battery voltage formed in 3rd (H-L) solenoid

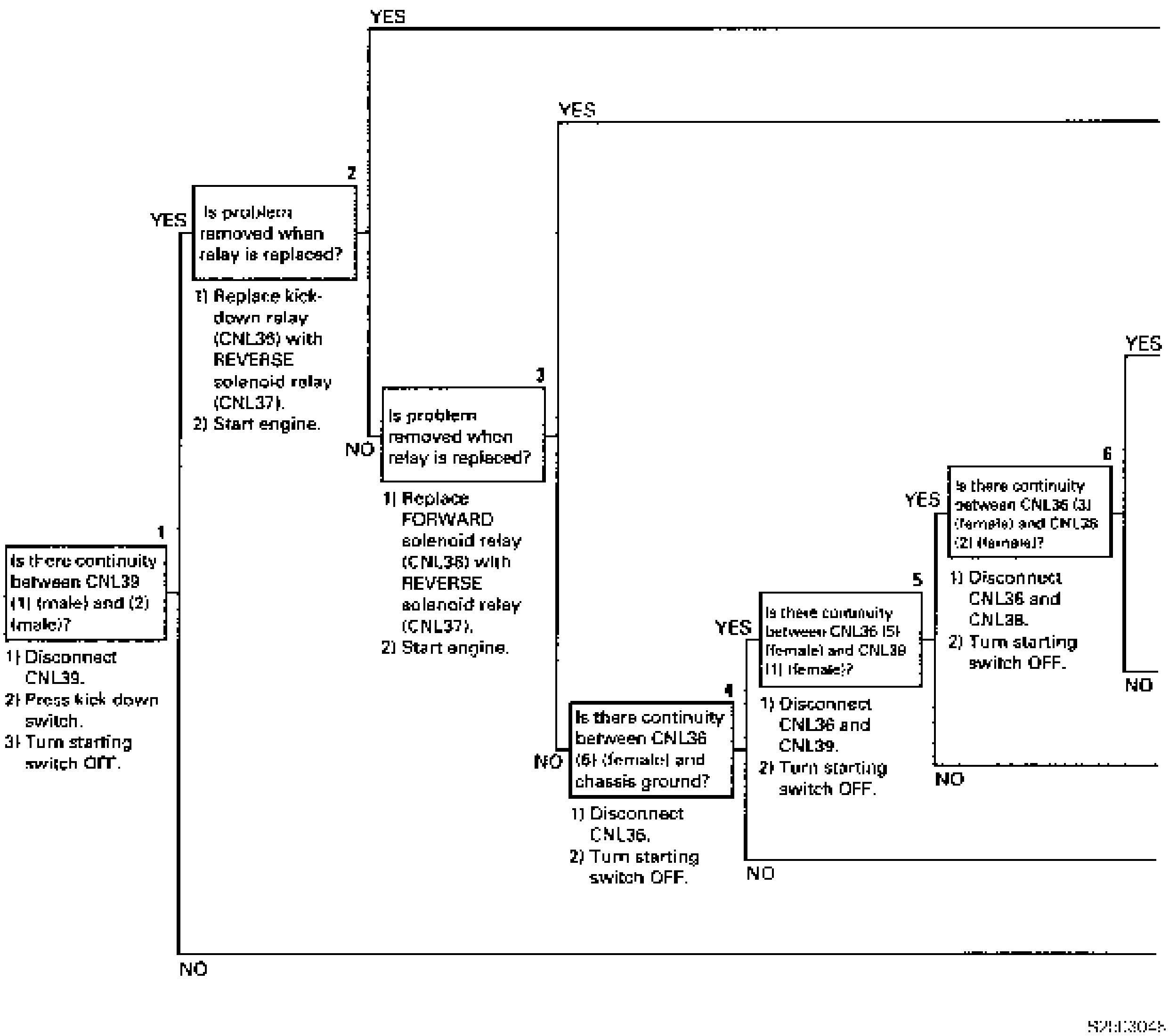


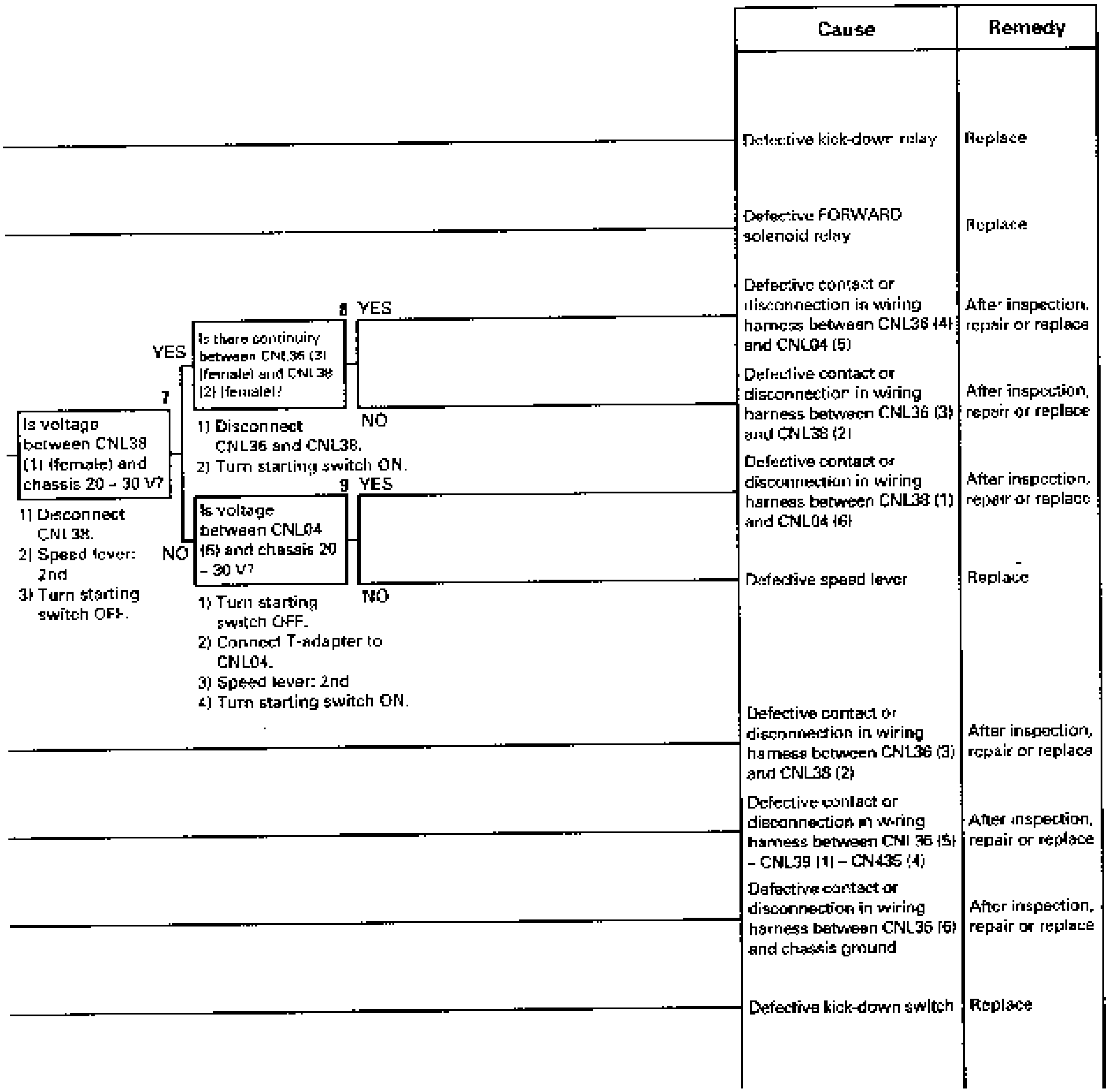
Cause	Remedy
Abnormal contact of +24 V wiring harness with wiring harness between CNT3 (1) (female) and CNFT1 (3) (male)	After inspection, repair or replace
Abnormal contact of wiring harness between CNFT1 (3) (male) and CNT3 (1) (female) with wiring harness between CNFT1 (1),(2),(4) (male) – CNFT1 (1) (female), CNT2 (1) (female), CNT4 (1) (female)	After inspection, repair or replace
Abnormal contact of +24V wiring harness with wiring harness between CNFT1 (3) (female) – CNL04 (7) (female)	After inspection, repair or replace
Abnormal contact of wiring harness between CNFT1 (3) (female) and CNL04 (7) (female) with wiring harness between CNFT1 (1) (female) – CNL38 (4) (female) or CNFT1 (2) (female) – CNL37 (2) (female) or CNFT1 (4) (female) – CNL04 (5) (female)	After inspection, repair or replace
Abnormal contact of wiring harness between CNL04 (7) (female) and CNFT1 (3) (female) with wiring harness between CNL04 (1) (female) – CNL52 (8) (female) or CNL04 (2) (female) – CNL38 (5) (female) or CNL04 (3) (female) – CNL34 (1) (female) or CNL04 (4) (female) – CNL37 (5) (female) or CNL04 (6) (female) – CNL38 (1) (female)	After inspection, repair or replace
Defective transmission control switch	Replace

S2505047

E-6 Kick-down switch does not work
(usual F1 - F4 shifts normally)

- i To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- i When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- i After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.

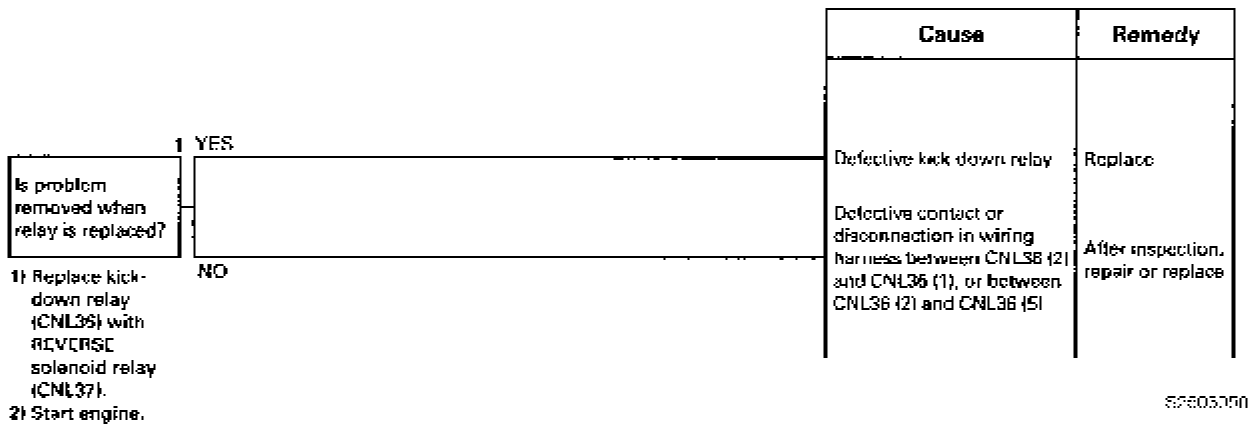



Cause
Remedy
Defective kick-down relay
Replace
Defective FORWARD solenoid relay
Replace
8 YES
Is there continuity between CNL36 (3) (female) and CNL38 (2) (female)?
YES
7
Is voltage between CNL38 (1) (female) and chassis 20 – 30 V?
1) Disconnect CNL38.
2) Speed lever: 2nd
3) Turn starting switch OFF.
NO
1) Disconnect CNL36 and CNL38.
2) Turn starting switch ON.
NO
9 YES
Is voltage between CNL04 (6) and chassis 20 – 30 V?
1) Turn starting switch OFF.
2) Connect T-adapter to CNL04.
3) Speed lever: 2nd
4) Turn starting switch ON.
NO
Defective contact or disconnection in wiring harness between CNL36 (4) and CNL04 (5)
After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL36 (3) and CNL38 (2)
After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL38 (1) and CNL04 (6)
After inspection, repair or replace
Defective speed lever
Replace
Defective contact or disconnection in wiring harness between CNL36 (3) and CNL38 (2)
After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL36 (5) – CNL39 (1) – CN435 (4)
After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL36 (6) and chassis ground
After inspection, repair or replace
Defective kick-down switch
Replace

S25C2C?9

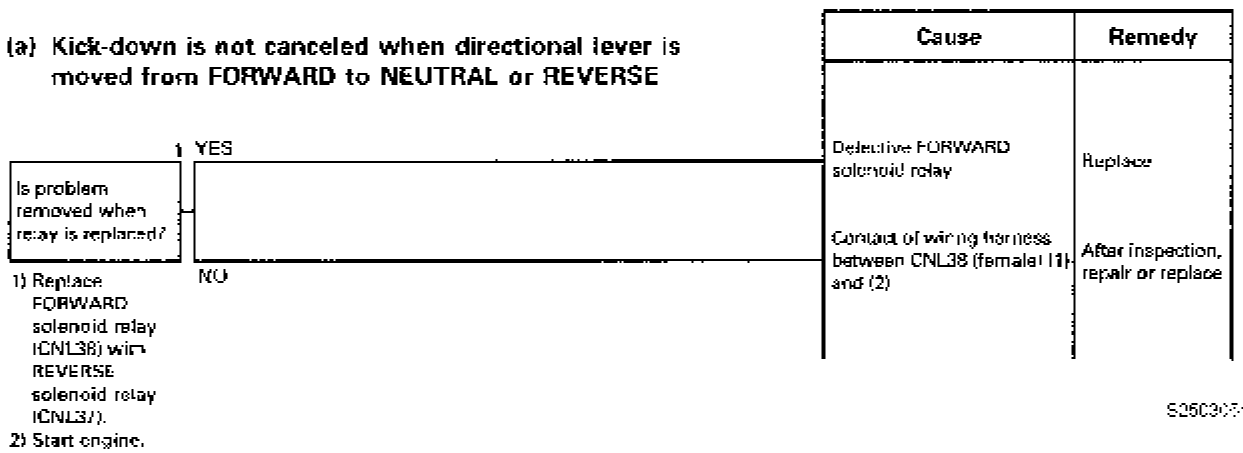
E-7 Kick-down is actuated only when kick-down switch is ON
(self-hold function of kick-down switch relay does not work)

- **i** To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- **i** When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- **i** After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.

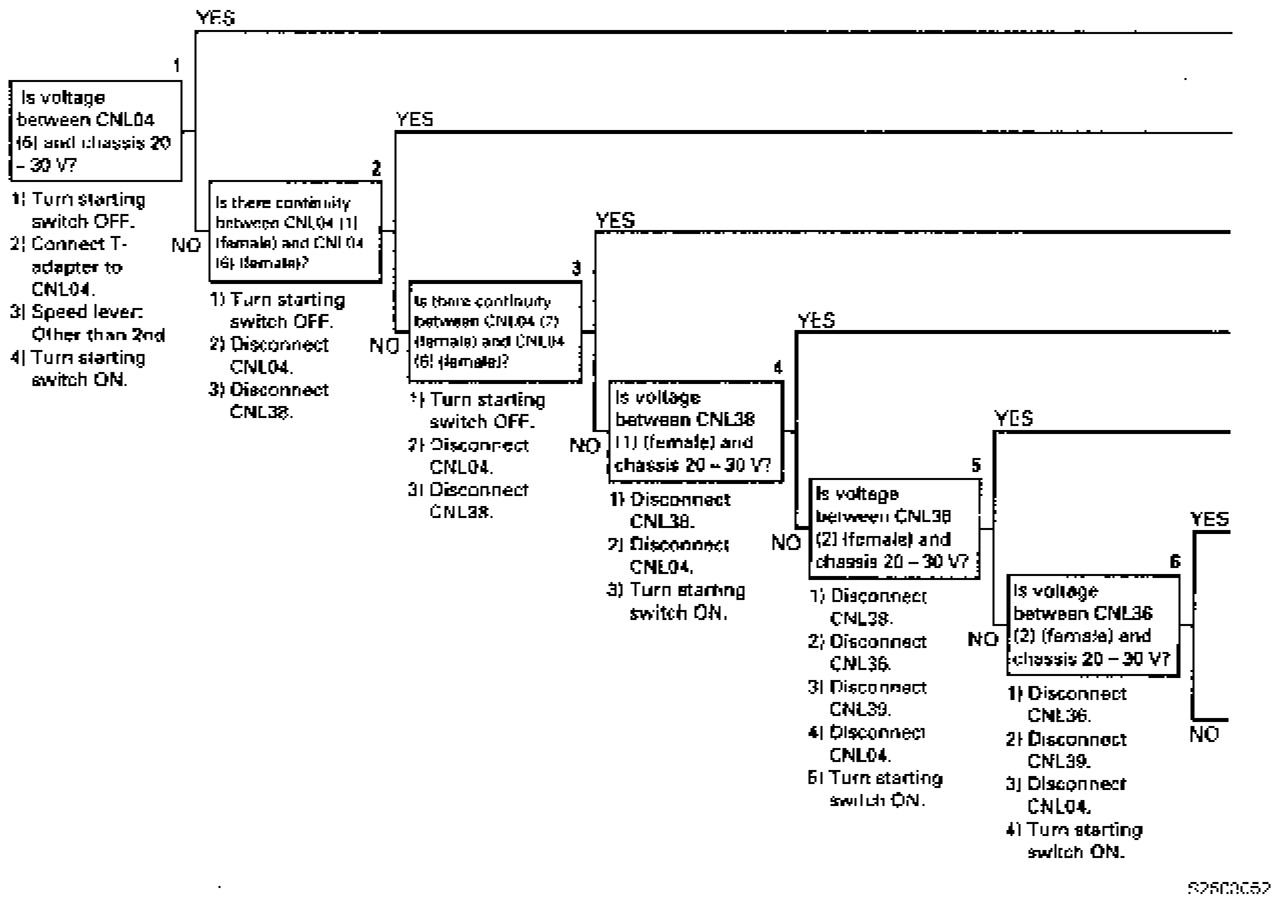


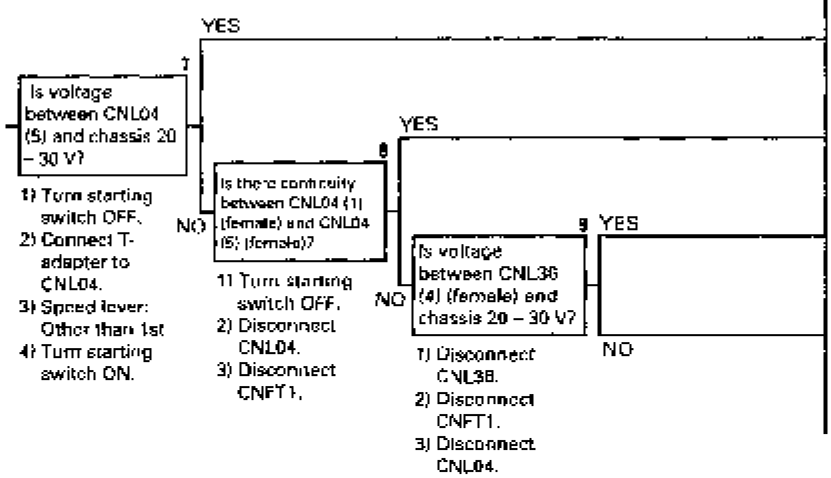
E-8 Kick-down is not canceled

- To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.



(b) Kick-down is not cancelled when speed lever is moved from 2nd to other speed range.

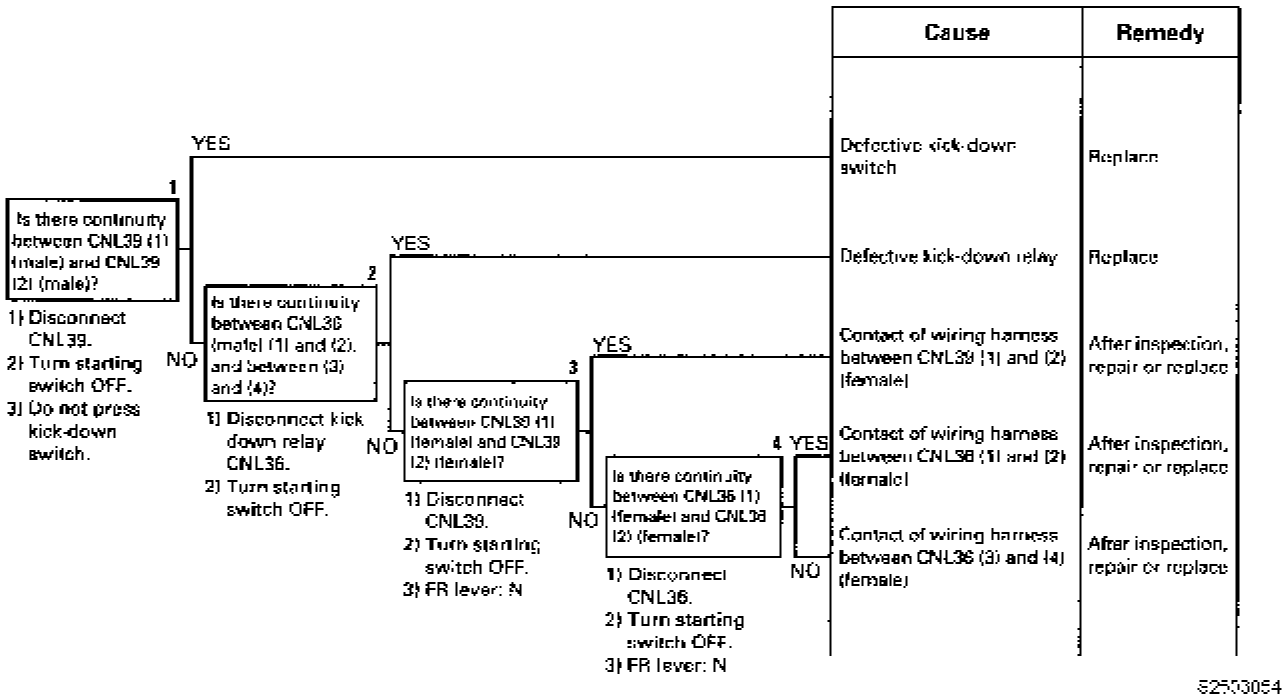




Cause	Remedy
Defective speed lever switch	Replace
Abnormal contact of wiring harness between CNL04 (1) and (6) (female)	After inspection, repair or replace
Abnormal contact of wiring harness between CNL04 (2) and (6) (female)	After inspection, repair or replace
Abnormal contact of +24V wiring harness with wiring harness between CNL04 (6) and CNL38 (1)	After inspection, repair or replace
Abnormal contact of +24 V wiring harness with wiring harness between CNL38 (2) – CNL36 (1) – CNL39 (2)	After inspection, repair or replace
Abnormal contact of +24 V wiring harness with wiring harness between CNL36 (2) – CNL39 (1) – CNL36 (5)	After inspection, repair or replace
Defective speed lever switch	Replace
Abnormal contact of wiring harness between CNL04 (1) and (5) (female)	After inspection, repair or replace
Abnormal contact of +24 V wiring harness with wiring harness between CNL04 (5) – CNL36 (4) – CNFT1 (4)	After inspection, repair or replace
Abnormal contact of +24 V wiring harness with wiring harness between CNFT1 (4) and CN14 (1)	After inspection, repair or replace

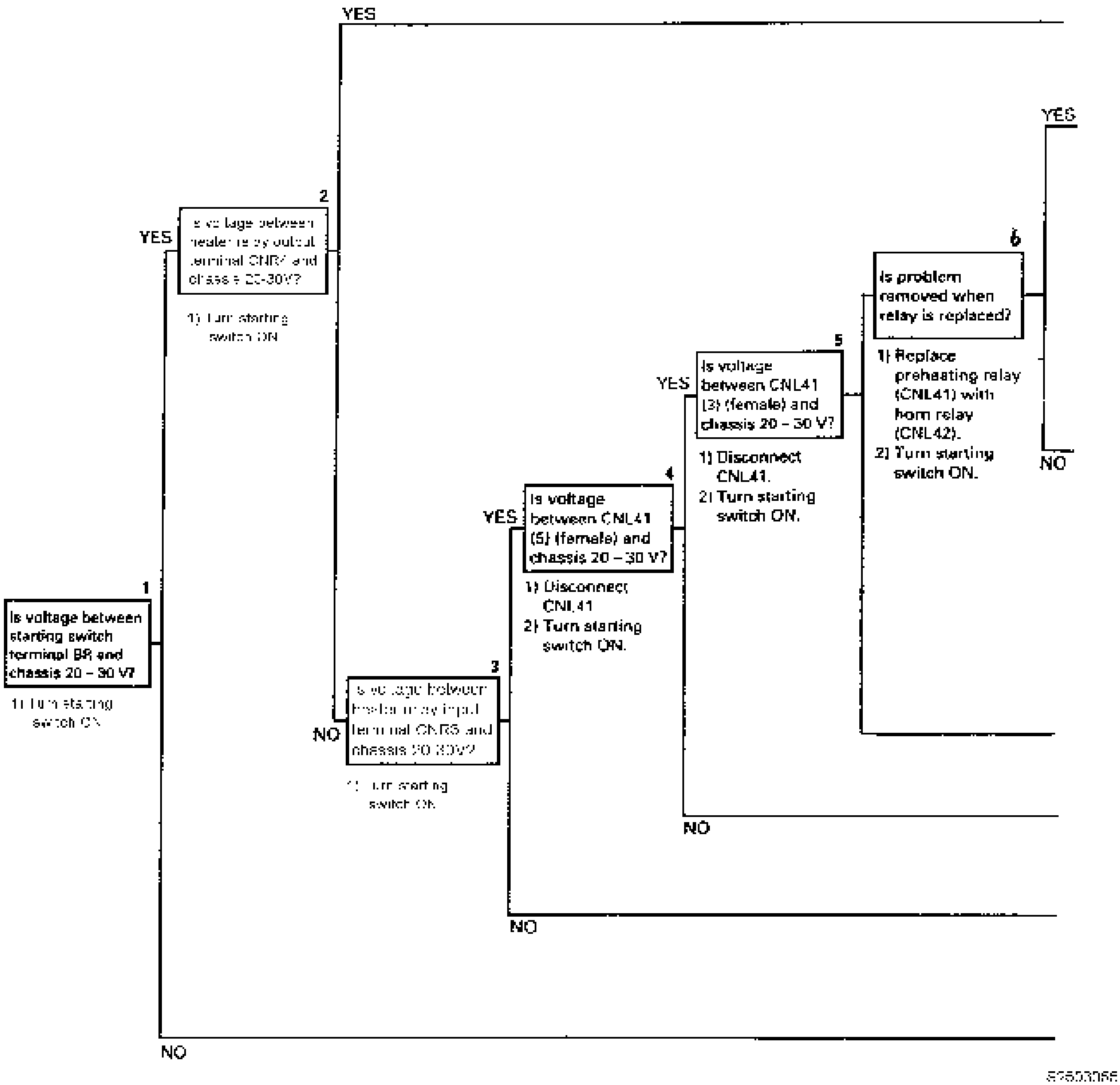
E-9 Kick-down switch is wrongly actuated when traveling in F2

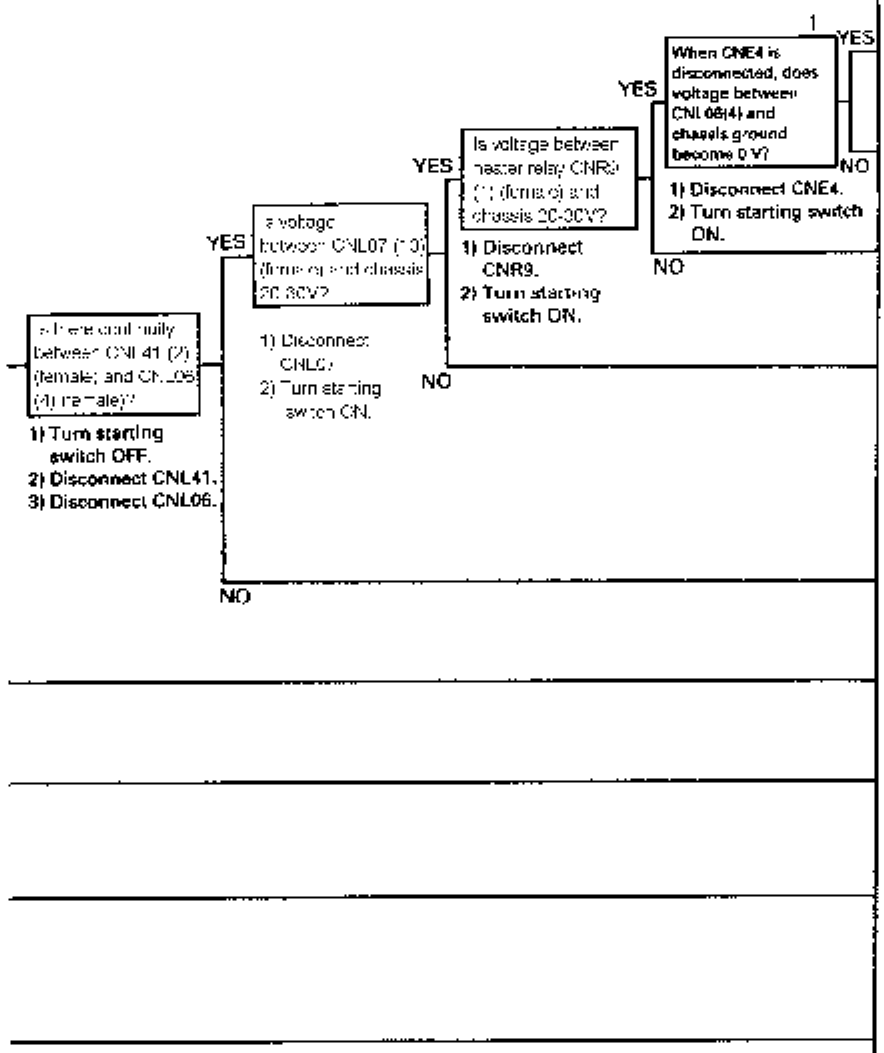
- To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.



E-10 Preheating is not carried out

- To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.
- Check that the water temperature is 0E C or below.
- Refer to electrical wiring diagram in section 20 TROUBLE SHOOTING
  "ELECTRICAL CIRCUIT DIAGRAM FOR EACH SYSTEM.
  PREHEATING SYSTEM"





Cause	Remedy
Defective contact or disconnection in wiring harness between heater relay output terminal CNR4 and ribbon heater terminal CNE3	After inspection, repair or replace
Defective heater relay	Replace
Defective QHS water temperature sensor	Replace
Defective QHS controller inside monitor	Replace
Defective contact or disconnection in wiring harness between CNL41 (3) - CNR8 (4) - CNR9	After inspection, repair or replace
Defective contact or disconnection in wiring harness between starting switch terminal BR CNL09 (2) - CNL07 (10)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL41 (2) and CNL06 (4)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL41 (1) and CNFS2 (7)	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL41 (5) - CNFS2 (7) - CNFS1 (7) CNLR4 (1) - CNR5.	After inspection, repair or replace
Defective contact or disconnection in wiring harness between battery relay M and heater relay terminal R3	After inspection, repair or replace
Defective contact or disconnection in wiring harness between battery - battery relay - CNR7 (2) - CNR2 (1) - CNFS3 (8), (4) - CNL09 (1) - starting switch terminal B or defective starting switch	After inspection, repair or replace

S7603058

E-11 Preheating remains actuated

- i To prevent failures, always turn the starting switch OFF when connecting or disconnecting connectors in order to connect the T-adapter (or socket adapter) or short circuit connector when carrying out checks.
- i When connecting the T-adapter (or socket adapter), connect to the connector specified in CNO) ( ).
- i After checking, disconnect the T-adapter and connect the disconnected connectors immediately before going on to the next step unless otherwise specified.
- i Refer to electrical wiring diagram in section 20 TROUBLE SHOOTING
  "ELECTRICAL CIRCUIT DIAGRAM FOR EACH SYSTEM.
  PREHEATING SYSTEM"

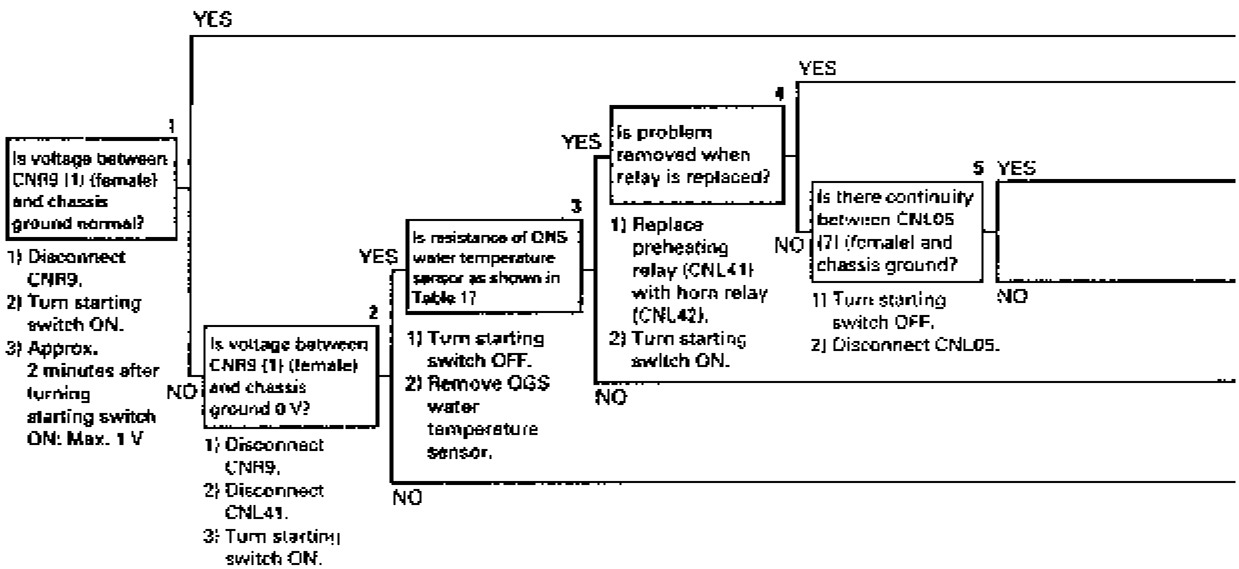


Table 1 (Reference)

Temperature	Resistance value
5°C	Approx. 4 kΩ
25°C	Approx. 2 kΩ

S2505067

Cause	Remedy
Defective heater relay	Replace
Defective preheating relay	Replace
Defective QHS controller inside monitor	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CNL05 (7) – CNE4 – QHS water temperature sensor terminal	After inspection, repair or replace
Defective QHS water temperature sensor	Replace
Abnormal contact of +24 V wiring harness with wiring harness between CNR9 (1) and CHL41 (3)	After inspection, repair or replace

S9..3058

TROUBLESHOOTING OF MAIN MONITOR SYSTEM (M-MODE)

TABLE OF CONTENTS

TROUBLE DATA DISPLAY

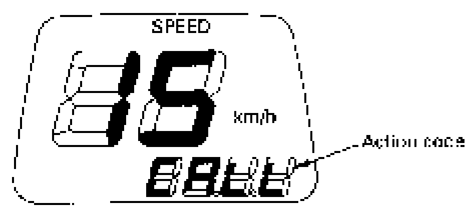
1. Outline

The speedometer display on the main monitor is used to display the troubleshooting for each control system. The nature of the troubleshooting is displayed as the failure action code, failure code, and the time elapsed since failure.
The signals between the main monitor and each controller are transmitted in serial through the network circuit. (Only the engine controller uses a special parallel signal.)

2. Abnormality in failure action code

This code informs the operator directly of the abnormality, and takes action, such as stopping the machine immediately.
There are four types of action code: E00, E01+CALL (E01 and CALL are displayed alternately), E03+CALL, and CALL. If a falure occurs suddenly, one of these codes is shown on the speedometer display.
For details of the action taken by operator for the action codes, see Item 4.

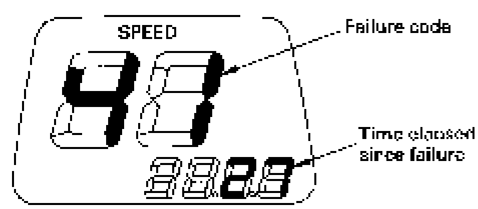
Example: When action code CALL is displayed



3. Falure code and time elapsed since failure

The failures detected by each controller are changed to a code and displayed. It is possible to tell from this code which system in which controller has failed, so carry out troubleshooting for the applicable controller.
For failures that have occurred and been reset, the faiure code and the time elapsed since failure are displayed to make it easy to check failures that are not occurring at present.
The failure codes for failures that are now occurring flash, and the codes for failures that are not occurring light up.
For details of the method of operating and transferring data to the trouble data display mode, see STRUCTURE AND FUNCTION for the main monitor.
Note: If the engine is not stopped, it is impossible to switch to the trouble data display mode, so the codes for failures which can only be detected when the engine is operating light up.
For the correspondence between the failure codes for each controller and the failed system, see Item 5.

Example: When failure code "41" has occurred 27 hours before



S5203065

4. Action code table

Action code: "E99+CALL" means that E99 and CALL are displayed alternately

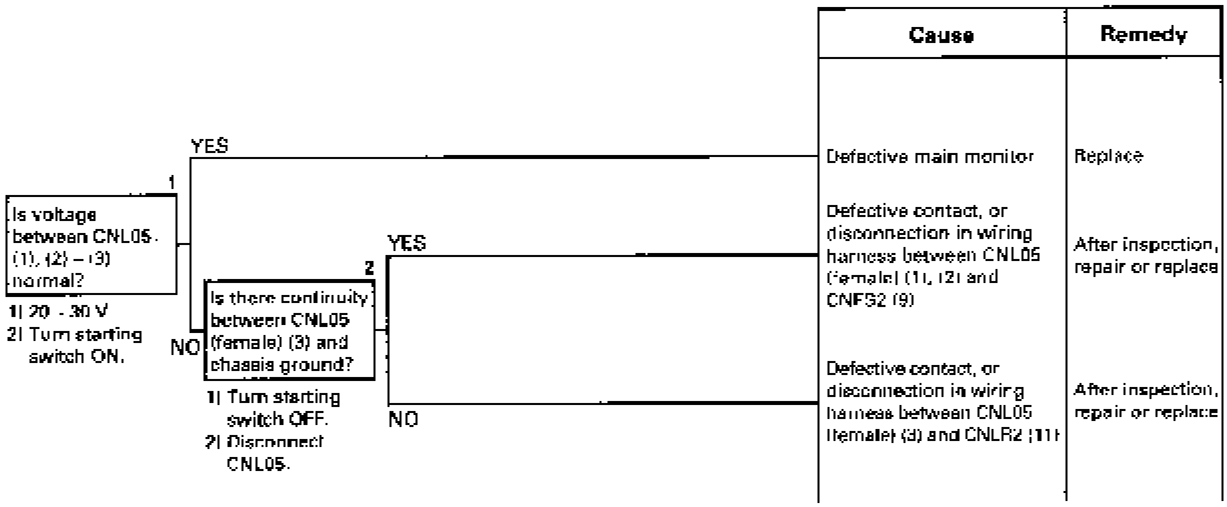
Action code	Transmission control system		Alarm buzzer	Action by operator
	Problem system	Action of machine		
E00			No	No Normal operation possible using manual gear shifting
E01+CALL			Yes	Travel under own power possible, call for service after moving to safe place
E03+CALL			Yes	Actuate emergency manual spool, open modulation solenoid manually. This action makes it possible to travel under own power. Call for service
CALL	Wiring harness on return side of bucket (tilt, dump) solenoid short circuiting with power source	Stops auto leveling function, buckets moves, possible that controller is burnt out	Yes	Stop machine immediately, turn staring switch OFF, then call for service

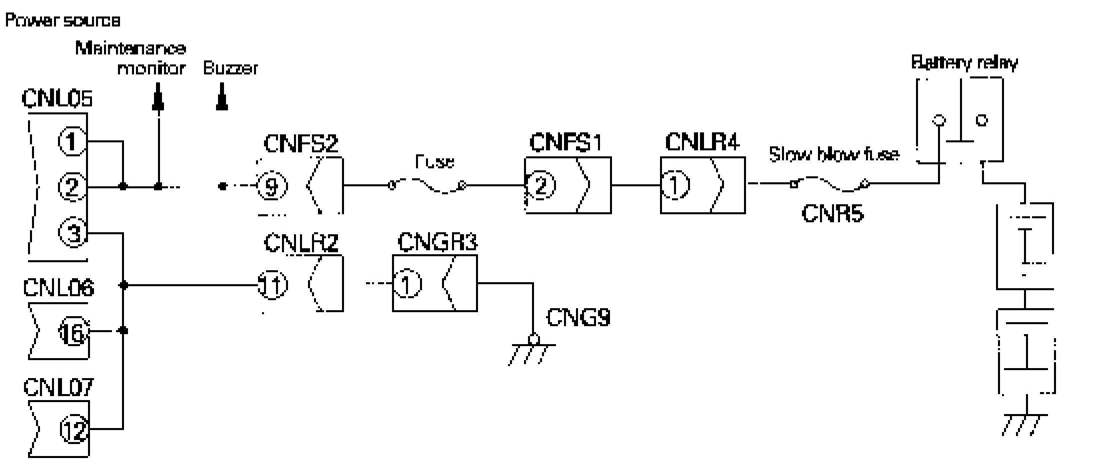
5. Failure code chart

Work equipment control system	
40	Bucket dump solenoid system
41	Dump/tilt solenoid system
42	Bucket tilt solenoid system
48	Bucket kickout relay system
50	Auto leveler relay system
52	Boom angle sensor system
53	Bucket angle sensor system

M-1 Main monitor does not work

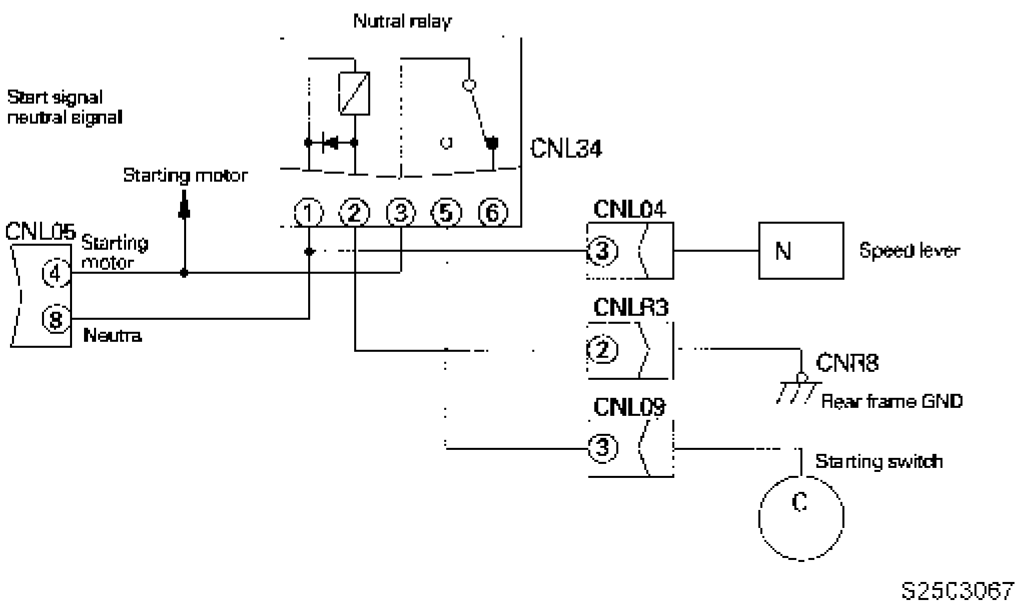
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.





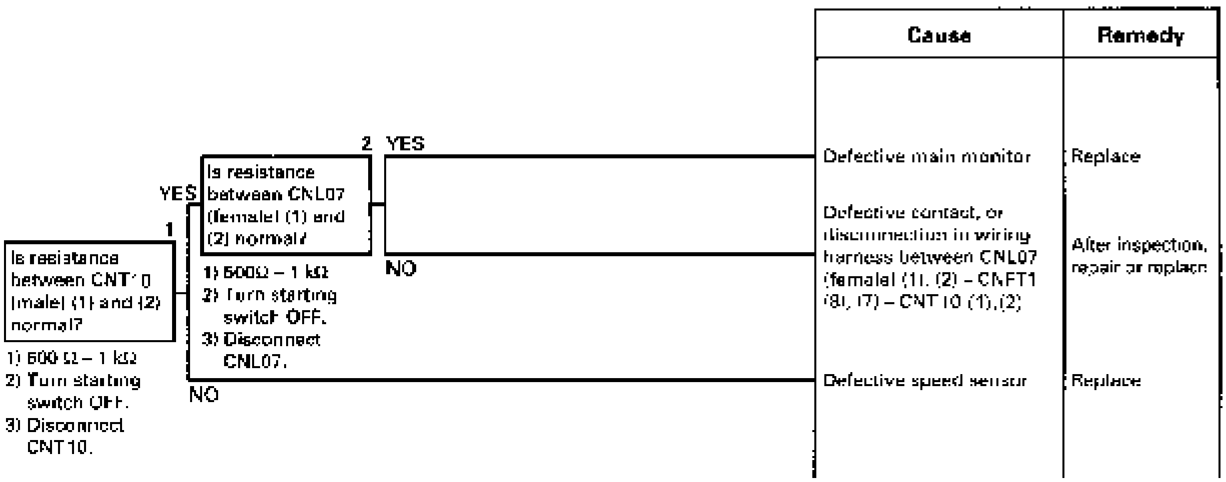
M-2 When starting switch is turned ON and engine is started immediately, all lamps stay lit

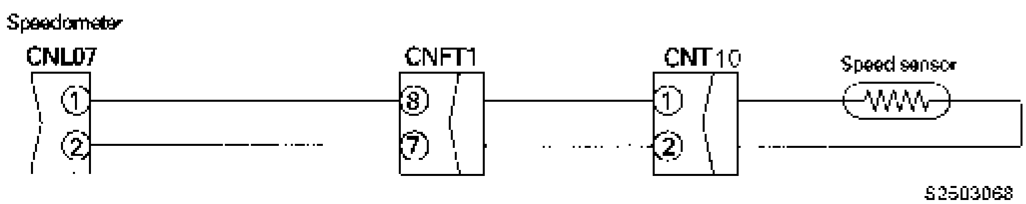
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.



M-3 Speedometer display does not work properly

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.
Ú Check that the gap between the speed sensor and gear is normal.





M-4 Abnormality in shift indicator

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.
Ú Check that the transmission shifts.

(a) Stays at N even when directional lever is at F

Step	Check	Result	Cause	Remedy
1	Is voltage between CNL08 (7) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Directional lever: F	YES	Defective main monitor	Replace
		NO	Defective contact, or disconnection in wiring harness between CNL08 (female) (7) and CNL04 (2)	After inspection, repair or replace

(b) Stays at N even when directional lever is at R

Step	Check	Result	Cause	Remedy
1	Is voltage between CNL08 (8) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Directional lever: R	YES	Defective main monitor	Replace
		NO	Defective contact, or disconnection in wiring harness between CNL08 (female) (8) and CNL04 (4)	After inspection, repair or replace

(c) Does not display N even when directional lever is at N and displays E when directional lever is at F

Step	Check	Result	Cause	Remedy
1	Is voltage between CNL08 (8) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON. 3) Directional lever: N	YES	Defective main monitor	Replace
		NO	Contact of power source with wiring harness between CNL08 (female) (8) and CNL04 (4), or defective control lever	After inspection, repair or replace

S2503069

(d) Does not display N even when directional lever is at N and displays E when directional lever is at R

Check	Result	Cause	Remedy
1 Is voltage between CNL08 (7) and chassis ground normal?	YES	Defective main monitor	Replace
	NO	Contact of power source with wiring harness between CNL08 (female) (7) and CNL04 (2), or defective control lever	After inspection, repair or replace

1) 0 – 5 V
2) Turn starting switch ON.
3) Directional lever: N

(e) Does not display 1st, 4th

Check	Result	Cause	Remedy
1 Is voltage between CNL05 (12) and chassis ground normal?	YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (12) and CNL04 (6)	After inspection, repair or replace

1) 20 – 30 V
2) Turn starting switch ON.
3) Speed lever: 1

(f) Does not display 3rd, 4th

Check	Result	Cause	Remedy
1 Is voltage between CNL05 (13) and chassis ground normal?	YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (13) and CNL04 (7)	After inspection, repair or replace

1) 20 – 30 V
2) Turn starting switch ON.
3) Speed lever: 3

Relationship between monitor input signal and display

H : 20 – 30 V
L : 0 V

CNL05(12)	CNL05(13)	Display
H	L	1
L	L	2
L	H	3
H	H	4

S2503070

(g) Does not display 2nd, 3rd

1 Is voltage between CNL05 (12) and chassis ground normal?

1) 0 – 5 V
2) Turn starting switch ON.
3) Speed lever: 2

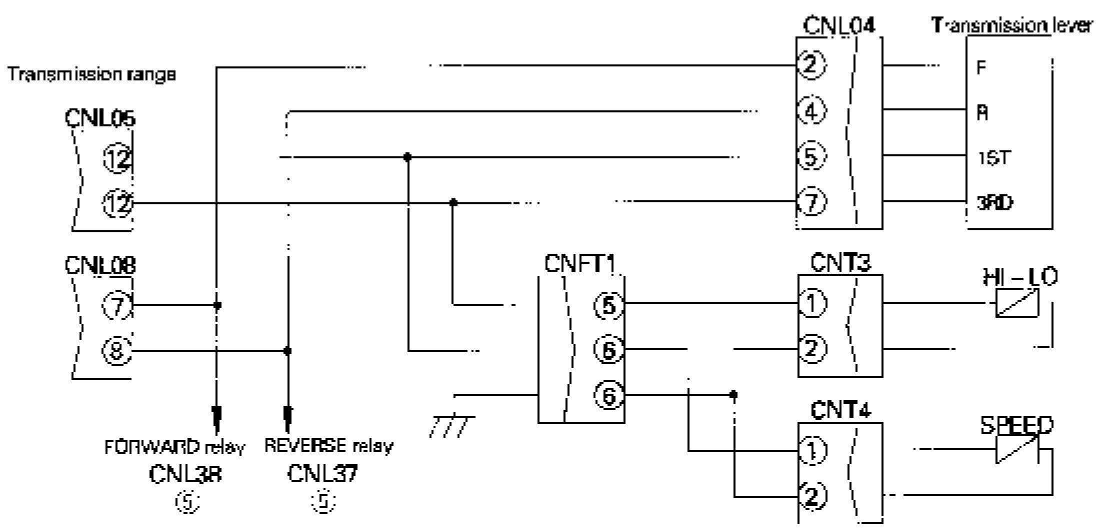
	Cause	Remedy
YES	Defective main monitor	Replace
NO	Contact of power source with wiring harness between CNL05 (female) (12) and CNL04 (6), or defective control lever	After inspection, repair or replace

(h) Does not display 1st, 2nd

1 Is voltage between CNL05 (13) and chassis ground normal?

1) 0 – 5 V
2) Turn starting switch ON.
3) Speed lever: 2

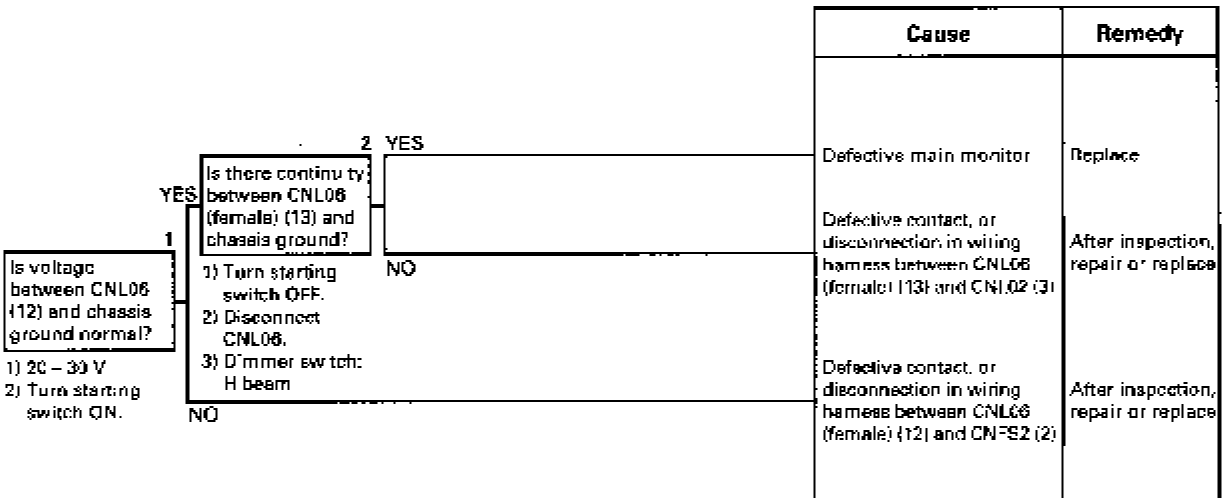
	Cause	Remedy
YES	Defective main monitor	Replace
NO	Contact of power source with wiring harness between CNL05 (female) (13) and CNL04 (7), or defective transmission lever	After inspection, repair or replace

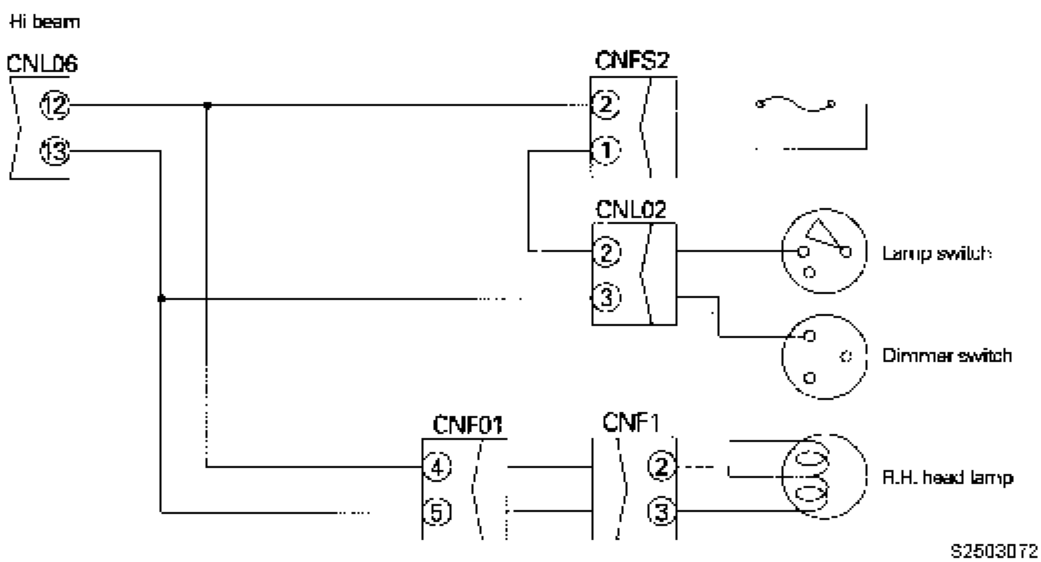


S25C3071

M-5 High beam does not light up

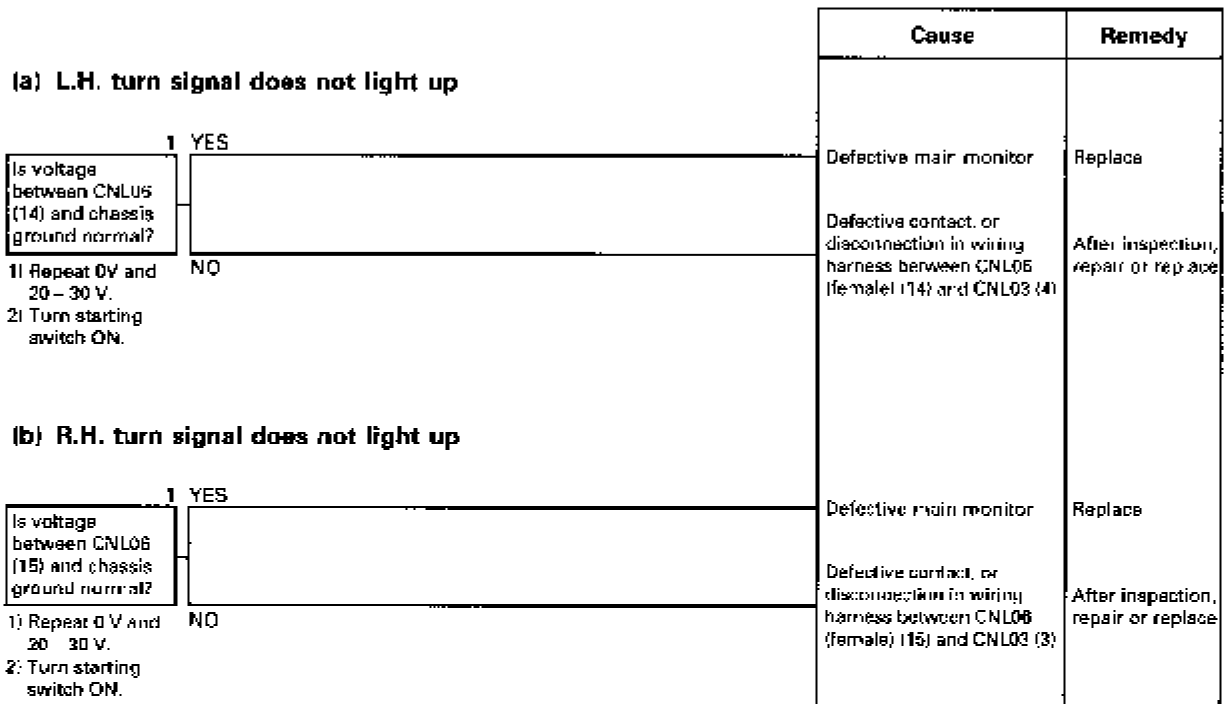
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.
Ú Before starting troubleshooting, check that the lamp bulb is not blown.

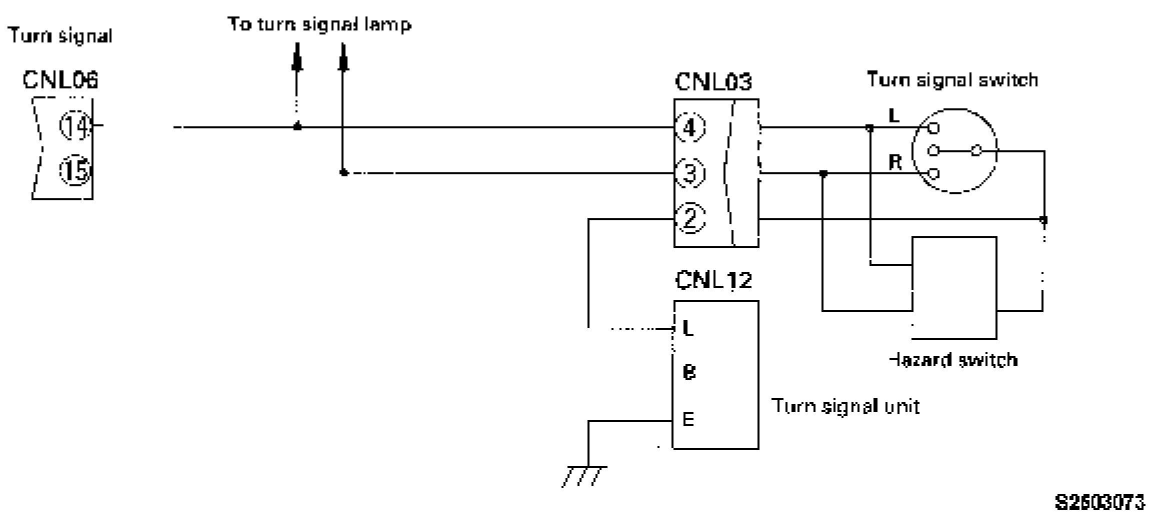




M-6 Turn signal display does not light up

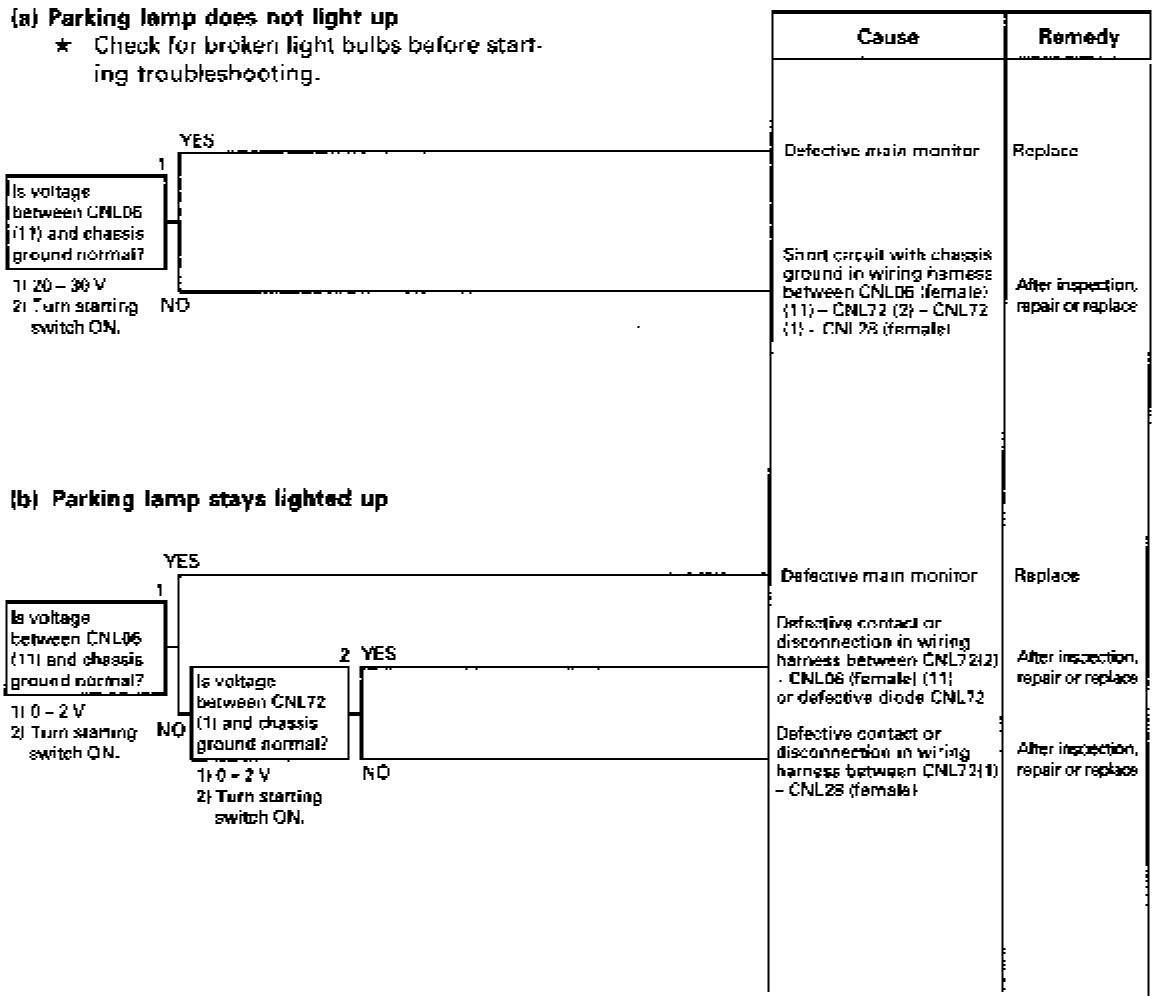
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.
Ú Before starting troubleshooting, check that the lamp bulb of the turn signal indicator on the monitor is not blown.

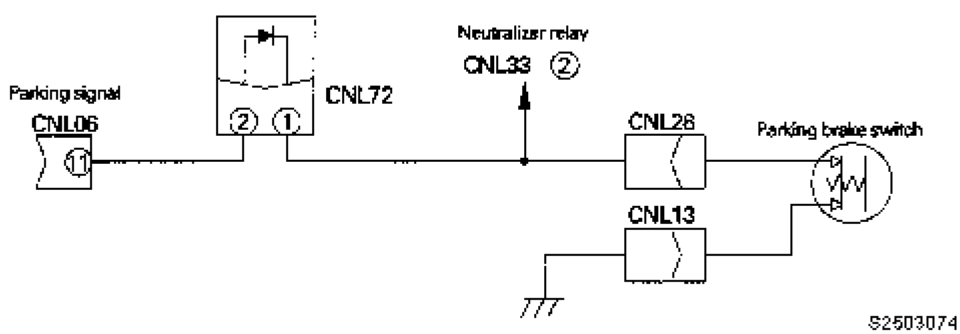




M-7 Abnormality in parking display

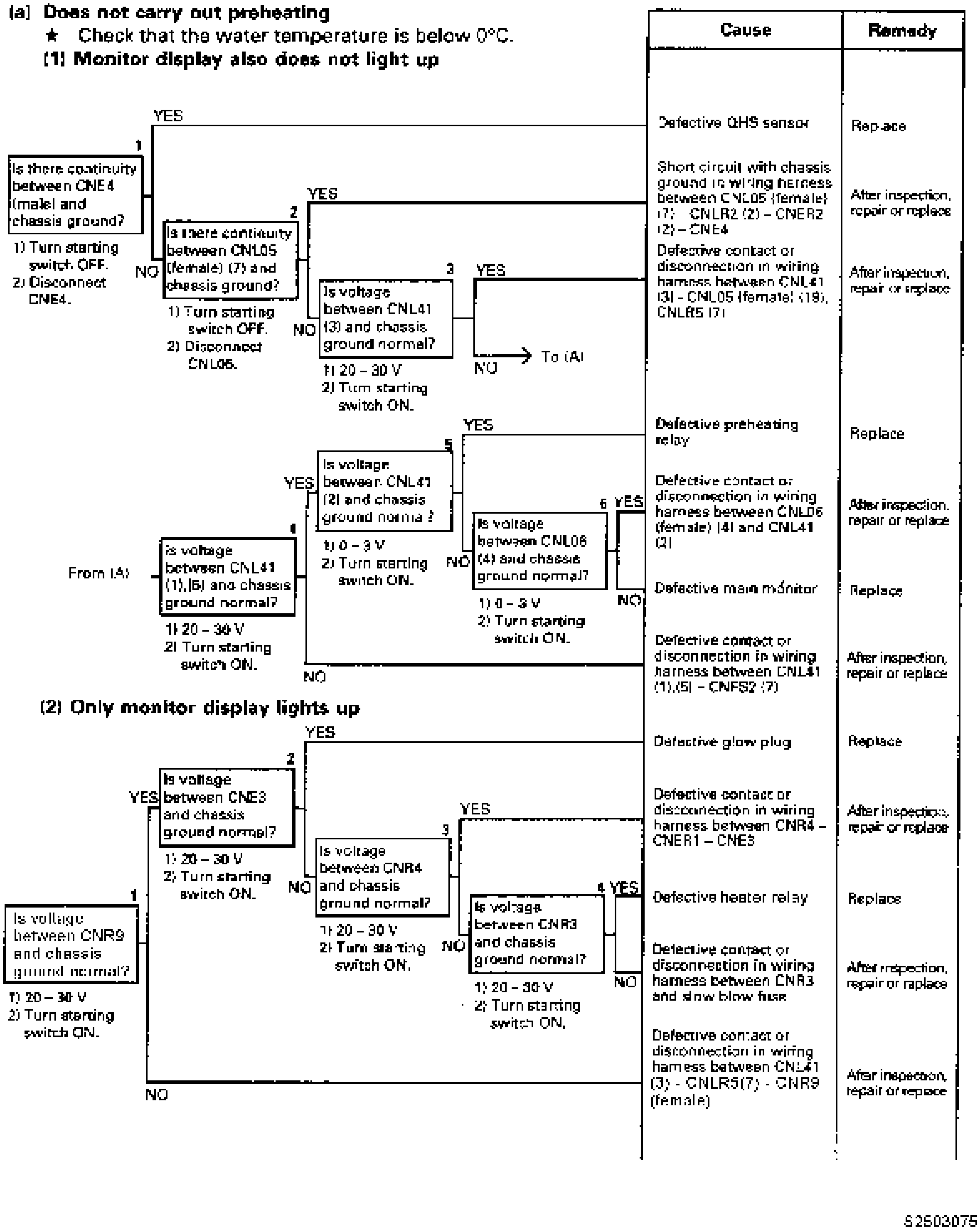
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.





M-8 Abnormality in preheating system

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.



(b) Only monitor display does not light up

1. Is voltage between CNL05 (19) and chassis ground normal?
   - 1) 20 – 30 V
   - 2) Turn starting switch ON.
   - YES → Defective main monitor
   - NO → Defective contact or disconnection in wiring harness between CNL05 (female) (19) and CNL41 (3)

Cause	Remedy
Defective main monitor	Replace
Defective contact or disconnection in wiring harness between CNL05 (female) (19) and CNL41 (3)	After inspection, repair or replace

(c) Always carries out preheating for 1 minute

★ Check that the water temperature is below –10°C.

1. Is resistance between CNE4 (male) and chassis ground normal?
   - 1) Max. 8 kΩ
   - 2) Turn starting switch OFF.
   - 3) Disconnect CNE4.
   - YES → 2
   - NO → Defective CHS sensor
2. Is resistance between CNL06 (female) (7) and chassis ground normal?
   - 1) Max. 8 kΩ
   - 2) Turn starting switch OFF.
   - 3) Disconnect CNL05.
   - YES → Defective main monitor
   - NO → Defective contact or disconnection in wiring harness between CNL05 (female) (7) – CNLR2 (2) – CNER2 (2) – CNE4 (female)

Cause	Remedy
Defective main monitor	Replace
Defective contact or disconnection in wiring harness between CNL05 (female) (7) – CNLR2 (2) – CNER2 (2) – CNE4 (female)	After inspection, repair or replace
Defective CHS sensor	Replace

(d) Preheating stays on

1. Has preheating stopped?
   - 1) Turn starting switch ON.
   - 2) Disconnect CNL06.
   - YES → Defective main monitor
   - NO → 2
2. Has preheating stopped?
   - 1) Turn starting switch ON.
   - 2) Remove preheating relay.
   - YES → 3
   - NO → Contact of power source with wiring harness between CNL41 (3) – CNLR5 (7), CNL05 (19)
3. Is voltage between CNL06 (4) and chassis ground normal?
   - 1) 20 – 30 V
   - 2) Turn starting switch ON.
   - YES → Defective preheating relay.
   - NO → Short circuit with chassis ground in wiring harness between CNL06 (female) (4) and CNL41 (2)

Cause	Remedy
Defective main monitor	Replace
Defective preheating relay.	Replace
Short circuit with chassis ground in wiring harness between CNL06 (female) (4) and CNL41 (2)	After inspection, repair or replace
Contact of power source with wiring harness between CNL41 (3) – CNLR5 (7), CNL05 (19)	After inspection, repair or replace

S2503076

(e) Preheating time becomes shorter, or is unstable

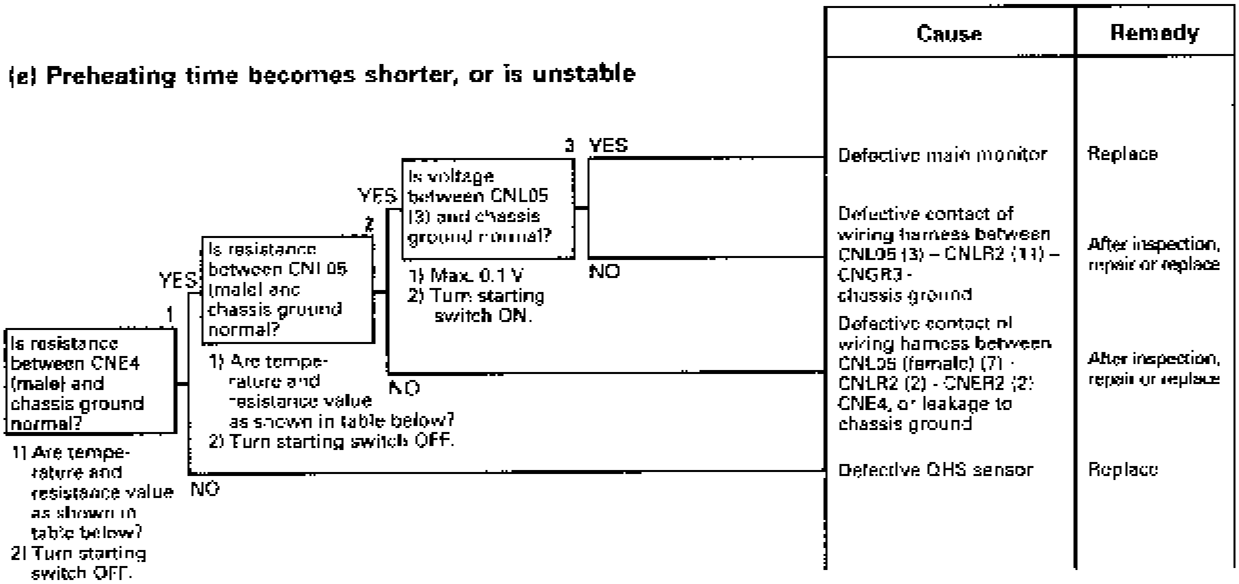
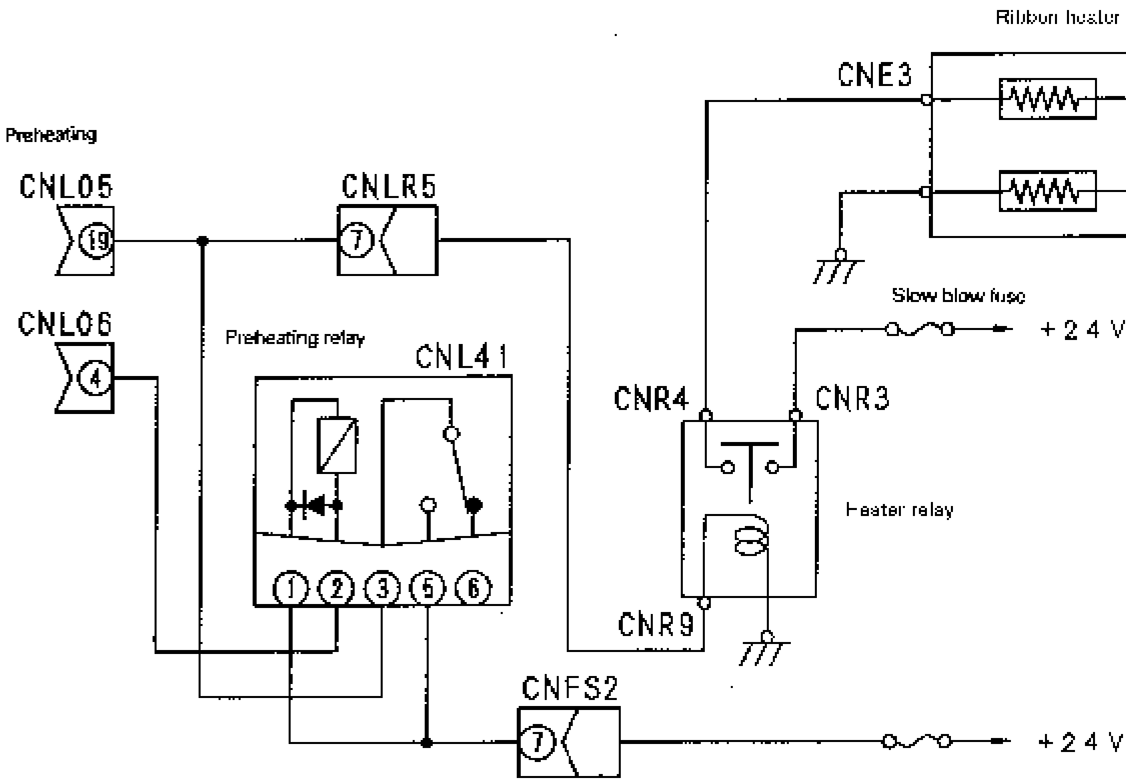
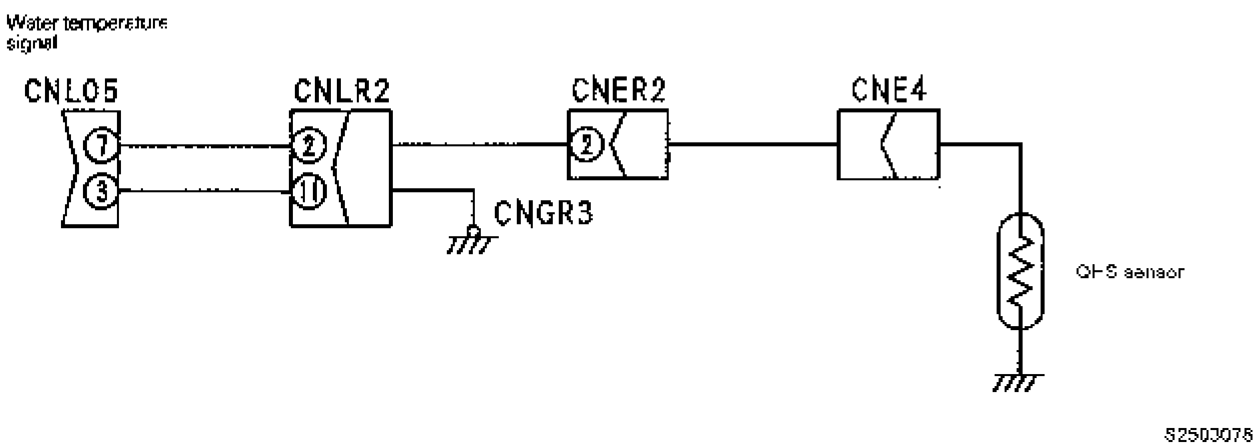


Table (Tolerance ± 0.5 kΩ)

Temperature(°C)	–10	–8	–6	–4	–2	0	2	4
Resistance value(kΩ)	7.7	7.1	6.5	6.0	5.5	5.1	4.7	4.3

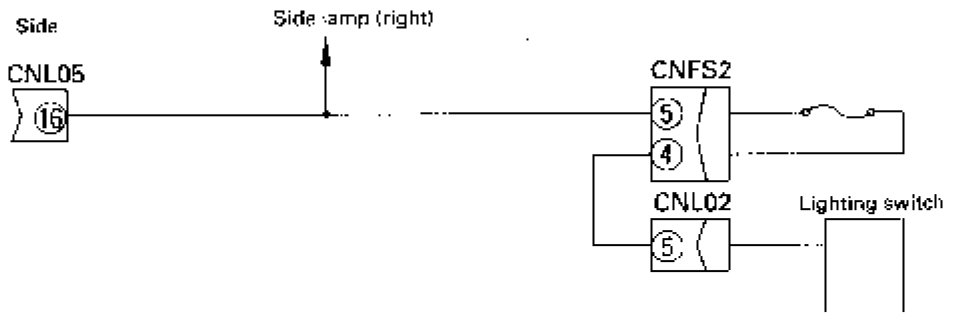
S2503077


Ribbon heater
CNE3
Preheating
CNL05
CNLR5
CNL06
Slow blow fuse
+24V
Preheating relay
CNL41
CNR4
CNR3
Heater relay
CNR9
CNFS2
+24V


Water temperature signal
CNL05
CNLR2
CNER2
CNE4
CNGR3
QHS sensor
S2503078

M-9 Night lighting does not light up

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.
Ú Before starting troubleshooting, check that the lamp bulb is not blown.



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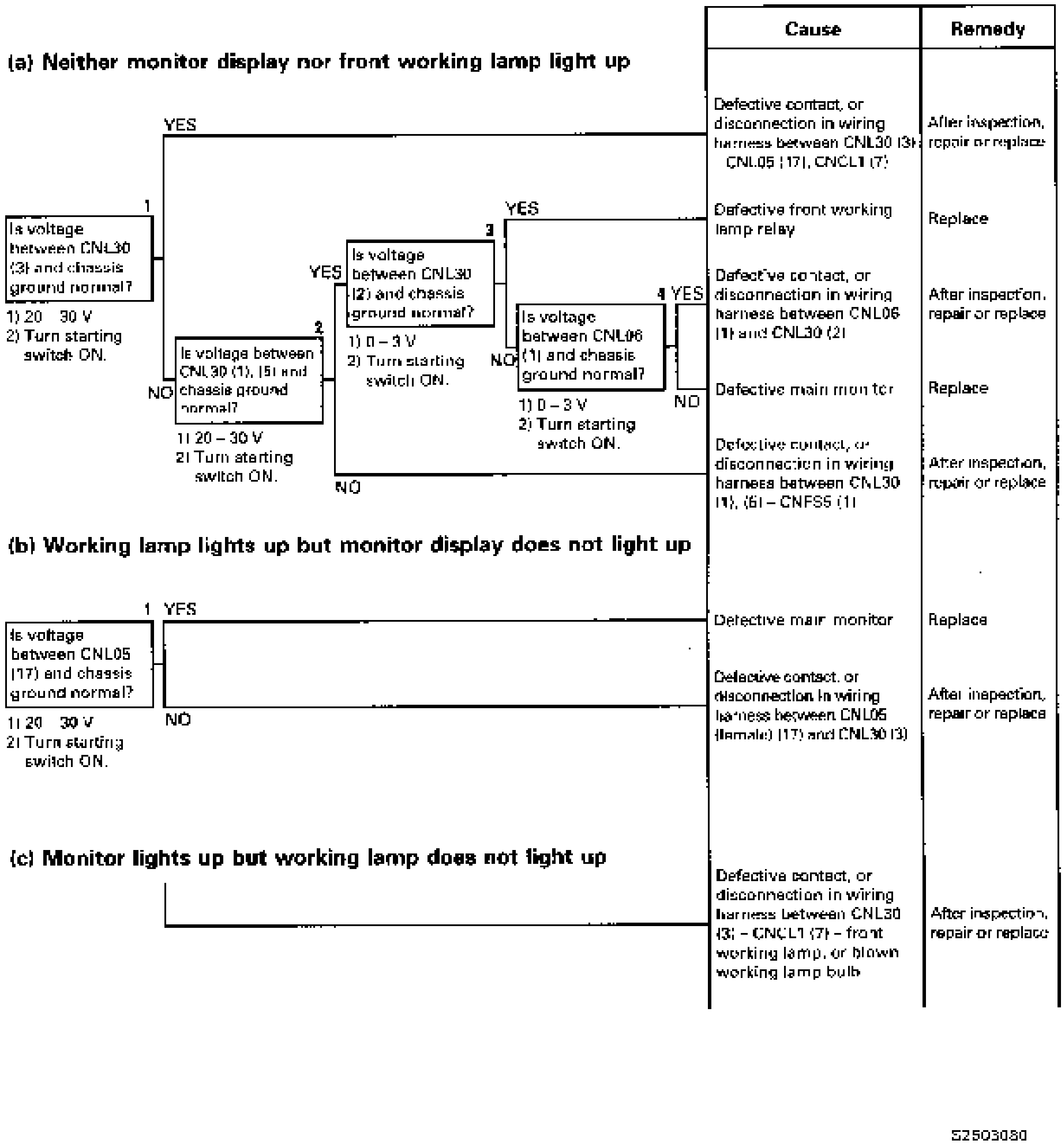
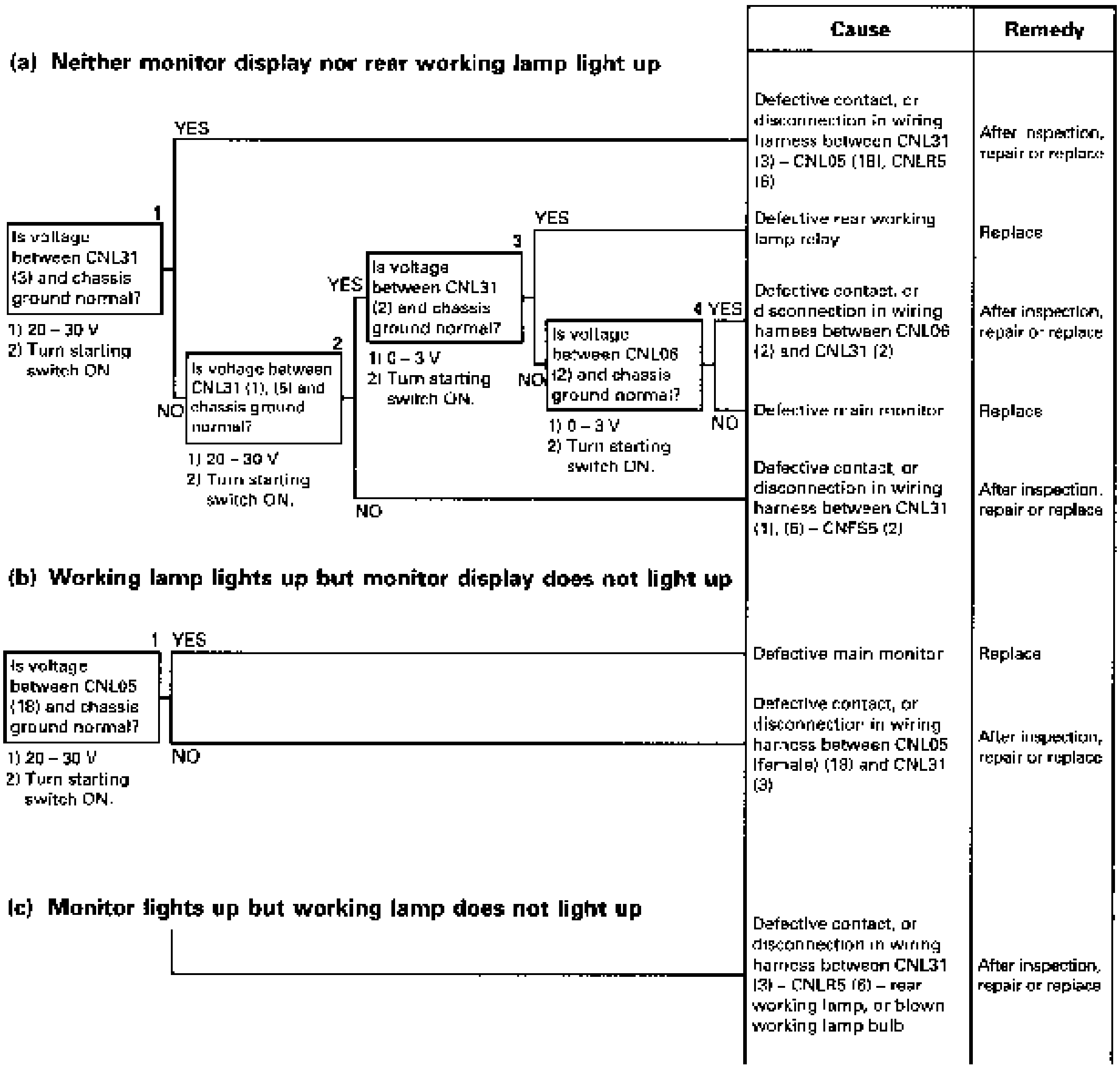
M-10 Abnormality in front working lamp

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.
Ú Before starting troubleshooting, check that the monitor lighting is lighted.

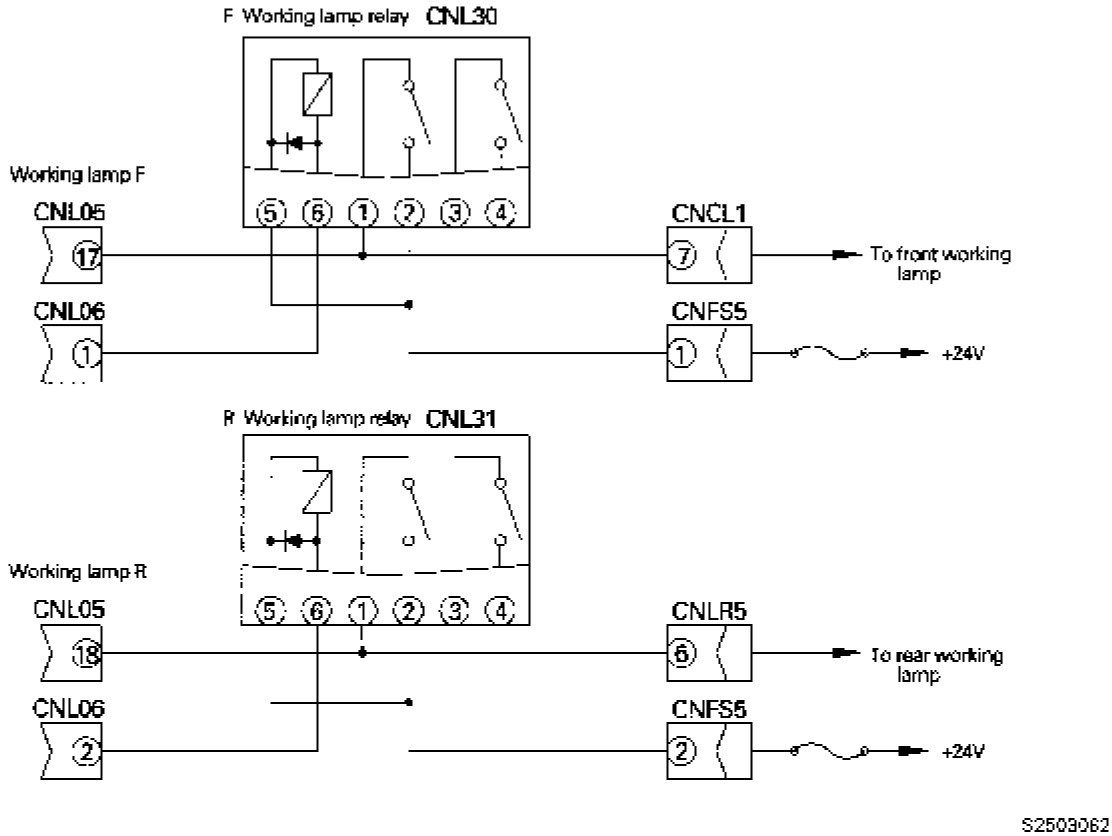


M-11 Abnormality in rear working lamp

- Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- Ú Always connect any disconnected connectors before going on to the next step.
- Ú Before starting troubleshooting, check that the monitor lighted is lighted.

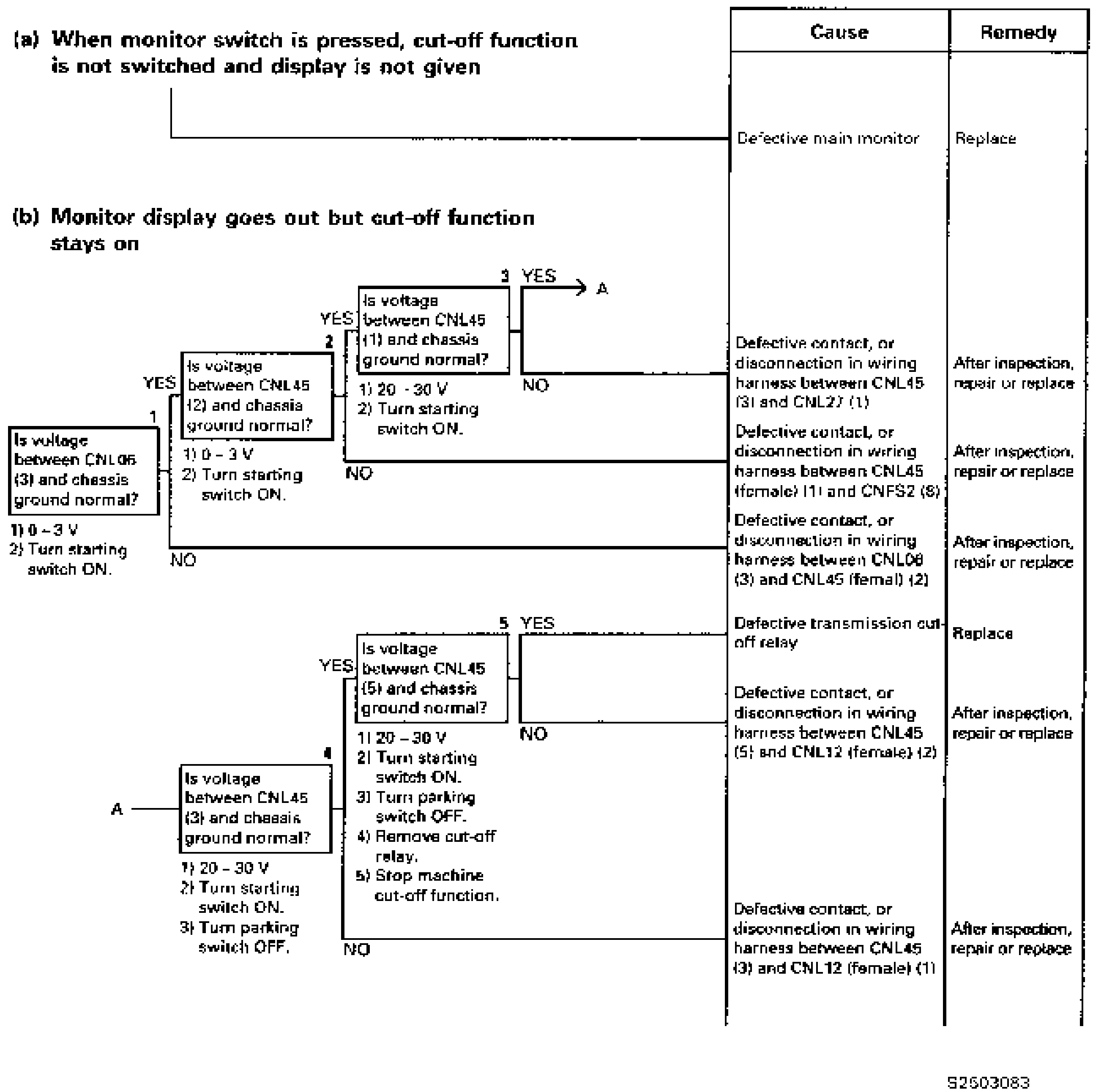


S2503081

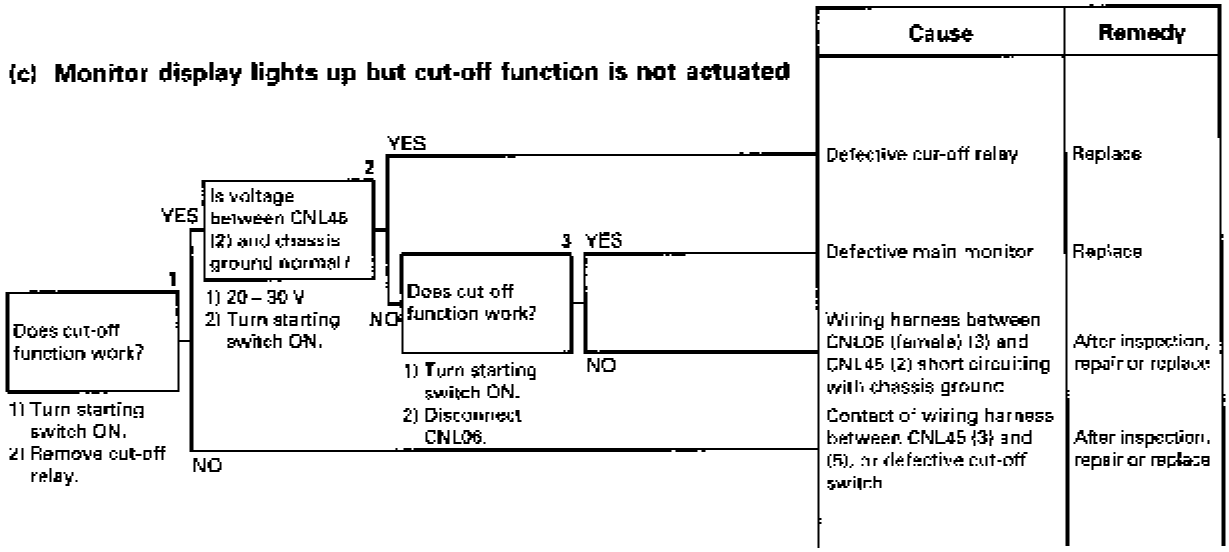

F Working lamp relay CNL30
Working lamp F
CNL05
CNL06
CNCL1
CNFS5
To front working lamp
+24V
R Working lamp relay CNL31
Working lamp R
CNL05
CNL06
CNLR5
CNFS5
To rear working lamp
+24V
S2503062

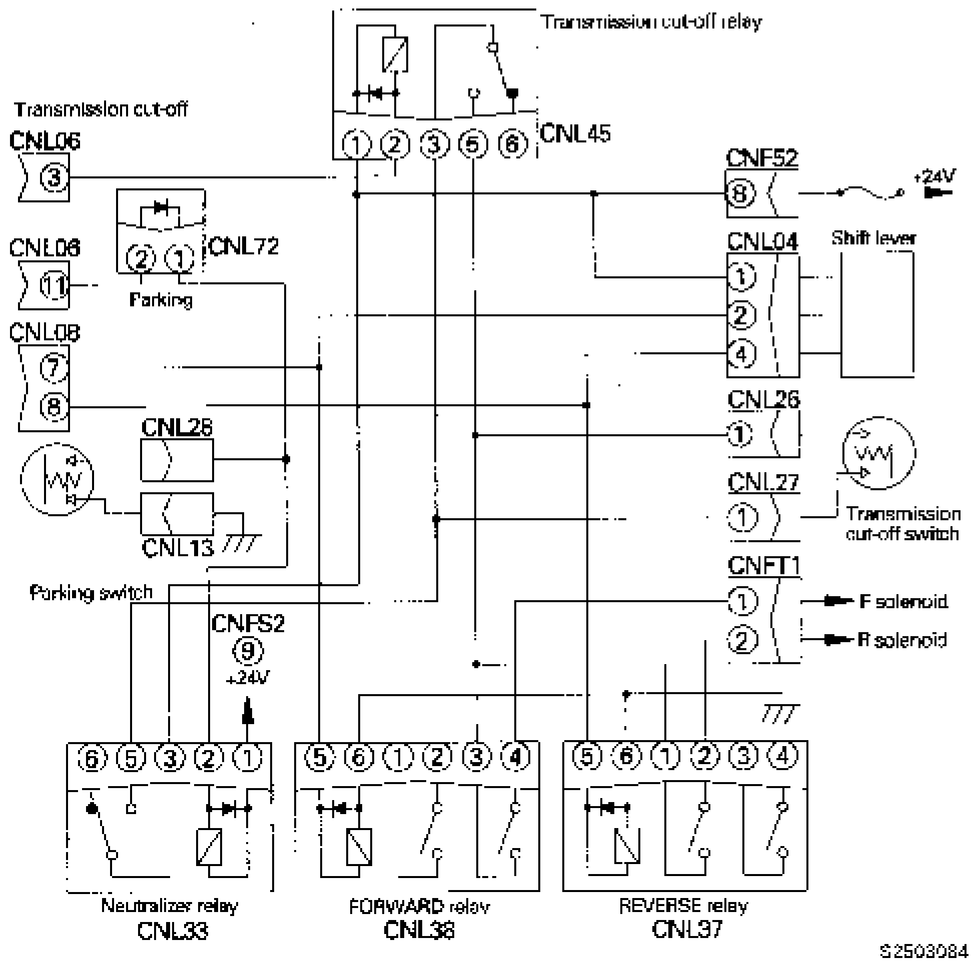
M-12 Abnormality in transmission cut-off

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.



(c) Monitor display lights up but cut-off function is not actuated





M-13 Abnormality in parking dragging warning

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

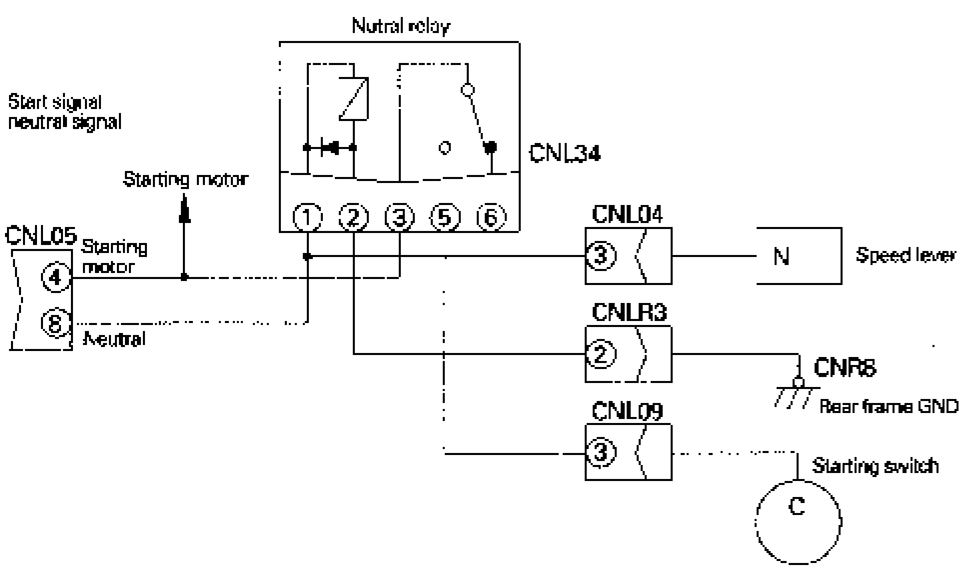
(a) When parking brake is applied, buzzer sounds (intermittently) even when directional lever is at N, and caution lamp flashes

Step	Check	Result	Cause	Remedy
1	Is voltage between CNL05 (8) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
		NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (8) and CNL04 (3)	After inspection, repair or replace

(b) When parking brake is applied, buzzer does not sound and caution lamp does not light up even when directional lever is at position other than N

★ Check that the synchronous flash signal is normal.

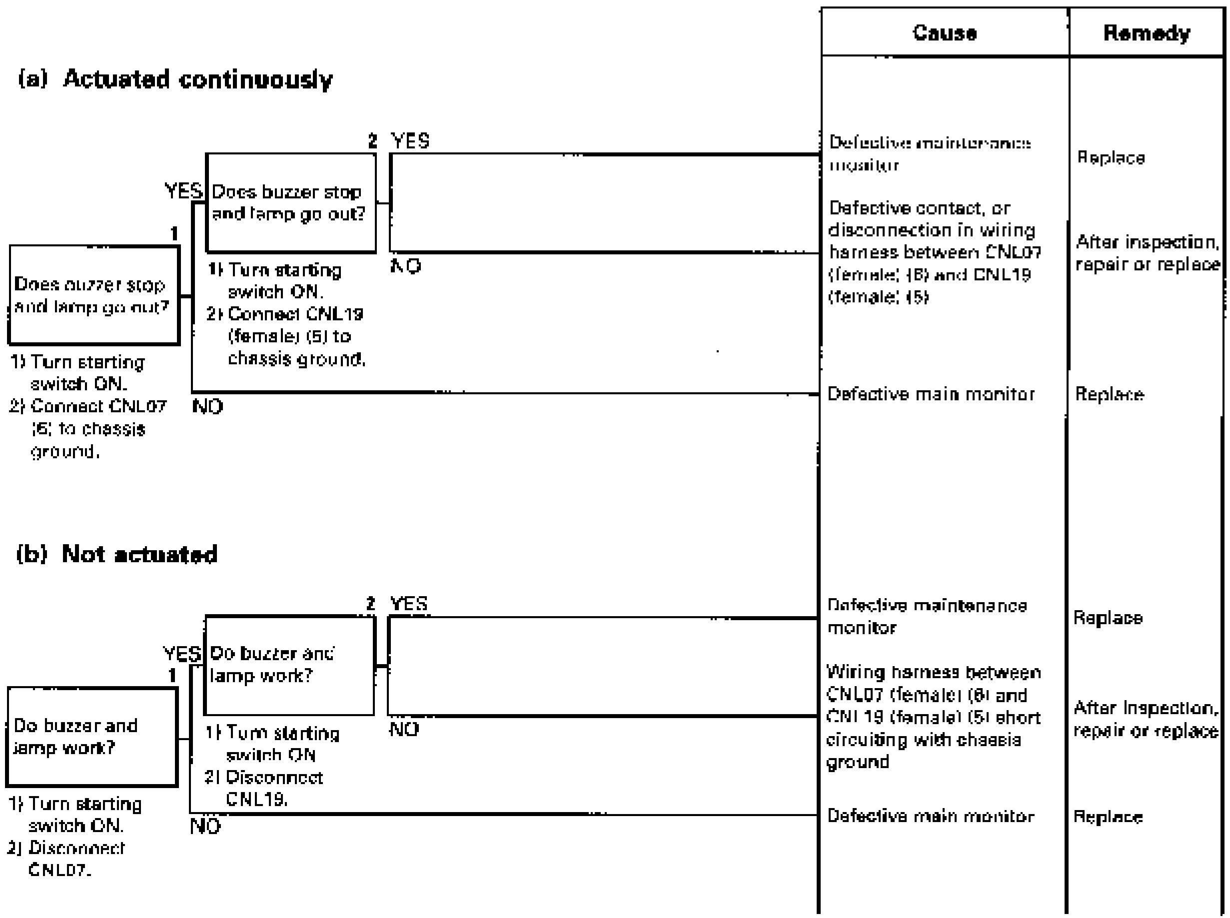
Step	Check	Result	Cause	Remedy
1	Is voltage between CNL05 (8) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
		NO → 2		
2	Is resistance between CNL05 (male) (8) and (3) normal? 1) 3 kΩ – 4 kΩ 2) Turn starting switch OFF. 3) Disconnect CNL05.	YES	Contact of power source with wiring harness between CNL05 (female) (8) and CNL04 (female) (3)	After inspection, repair or replace
		NO	Defective main monitor	Replace

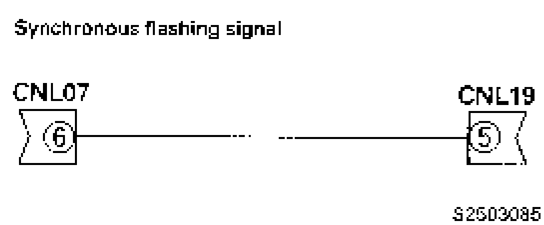


S25031C8

M-14 When parking brake dragging warning is given, buzzer and caution lamp are actuated continuously, or they are not actuated.

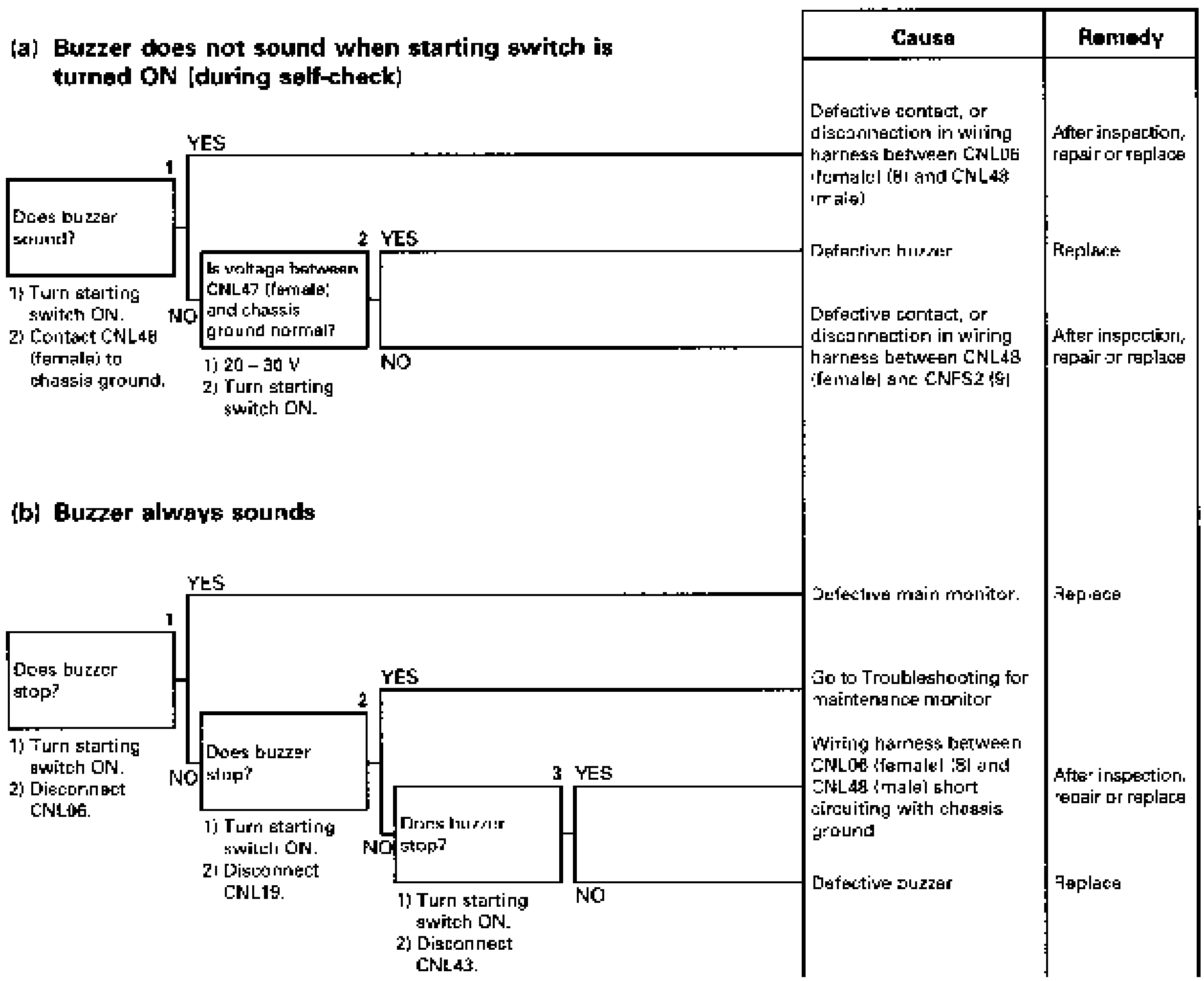
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

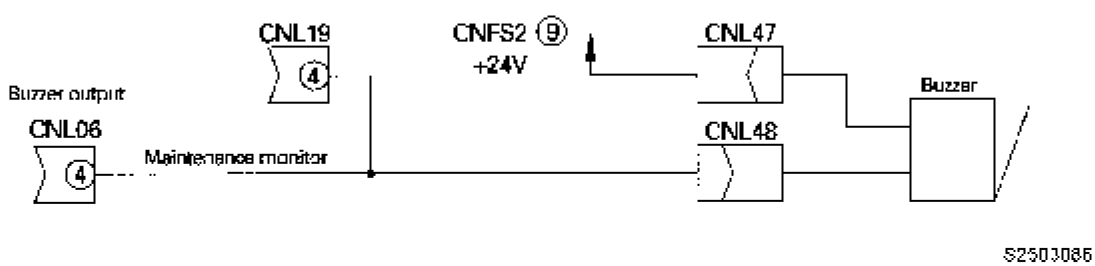




M-15 Abnormality in buzzer

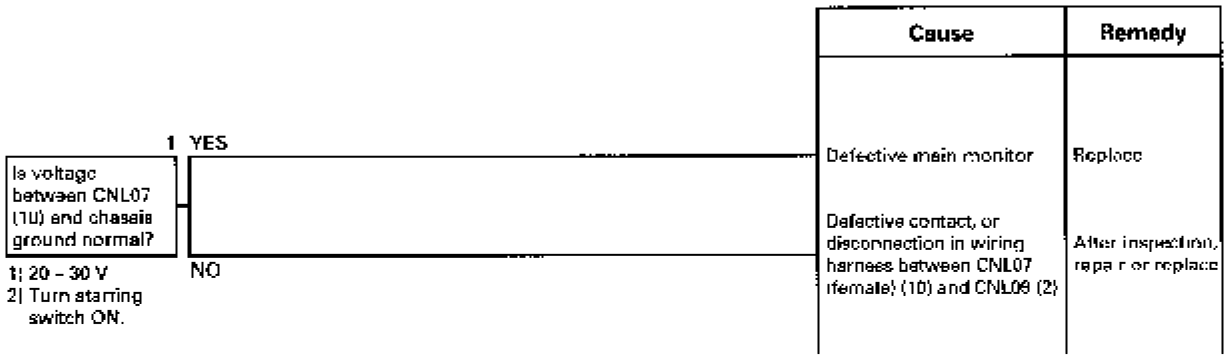
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

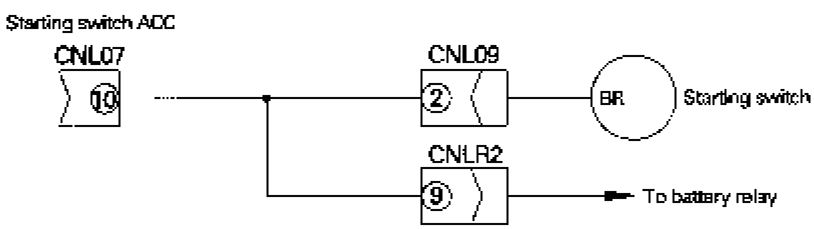




M-16 Condition of monitor switches is not stored in memory

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.





S2503087

M-17 Abnormality in failure display mode

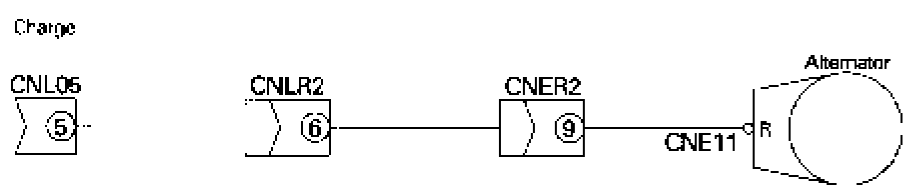
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

(a) Does not enter failure display mode

Step	Check	Result	Cause	Remedy
1	Is voltage between CNL05 (5) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
		NO	Contact of power source with wiring harness between CNL05 (female) (5) CNLR2 (6) CNER2 (9) - alternator terminal R, or defective alternator	After inspection, repair or replace

(b) Time for time elapsed since failure on failure display mode does not advance

Step	Check	Result	Cause	Remedy
1	Is voltage between CNL05 (5) and chassis ground normal? 1) 20 – 30 V 2) Start engine.	YES	Defective main monitor	Replace
		NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (5) CNLR2 (6) CNER2 (9) alternator terminal R, or defective alternator	After inspection, repair or replace



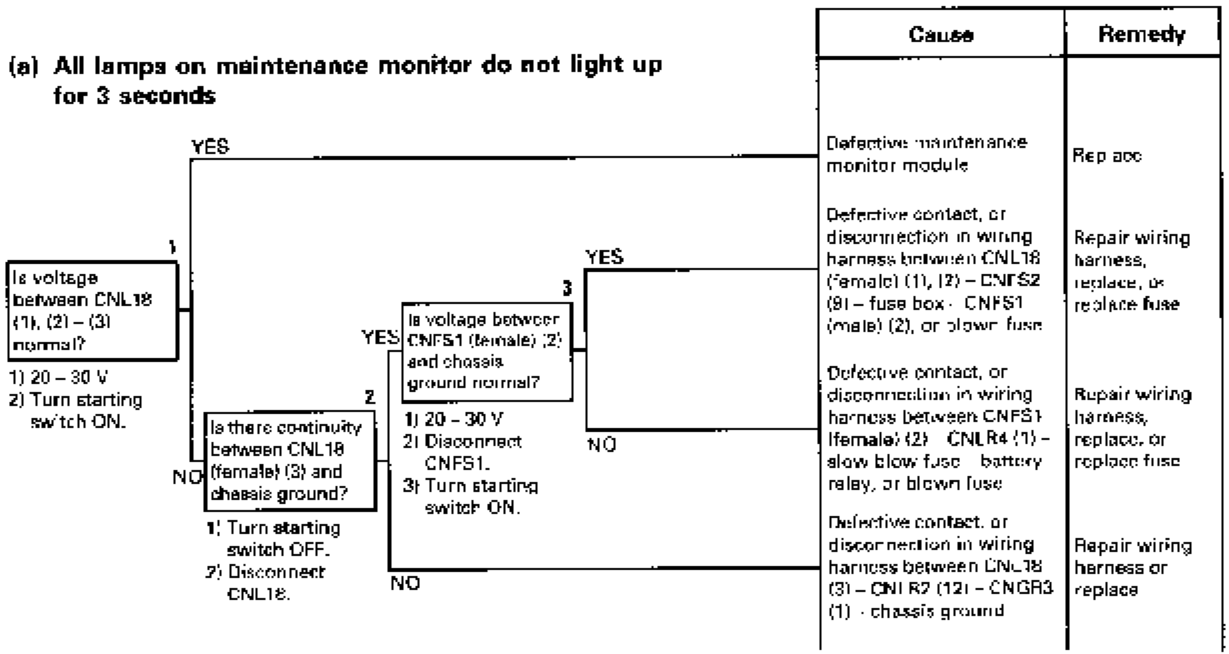
S2503088

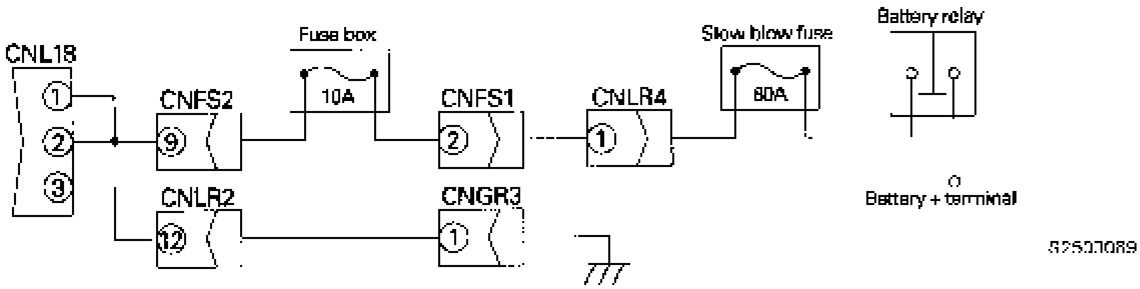
TROUBLESHOOTING OF MAINTENANCE MONITOR SYSTEM (K-MODE)

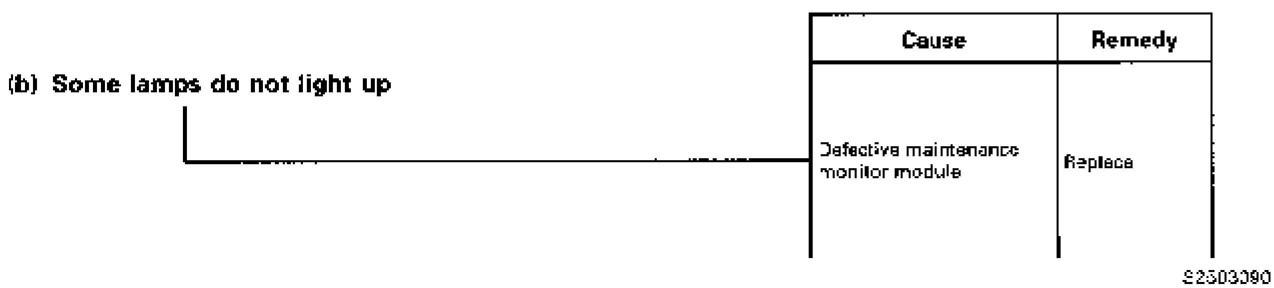
TABLE OF CONTENTS

K-1 When starting switch is turned ON, all lamps on maintenance monitor do not light up for 3 seconds, maintenance monitor does not work

Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.







K-2 When starting switch is turned ON, all lamps on maintenance monitor light up but do not go out

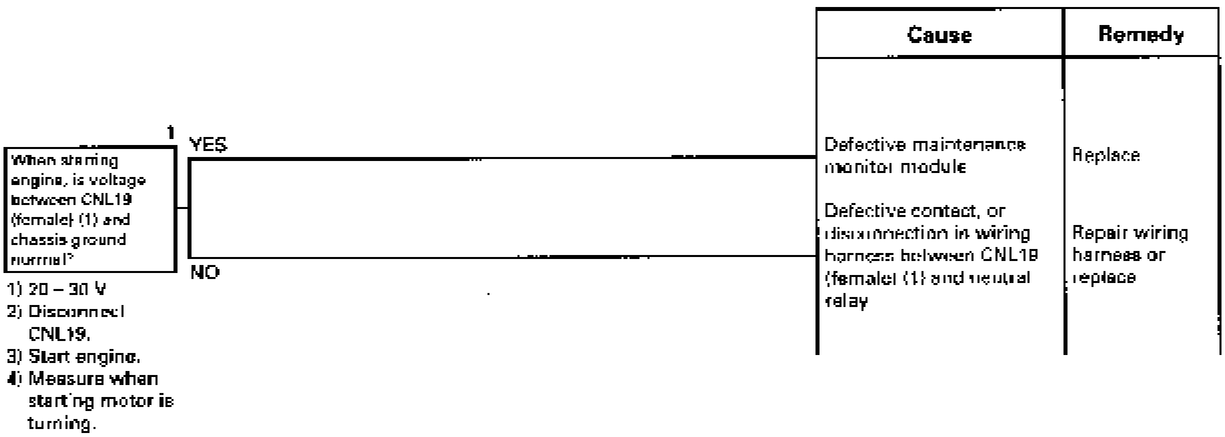
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

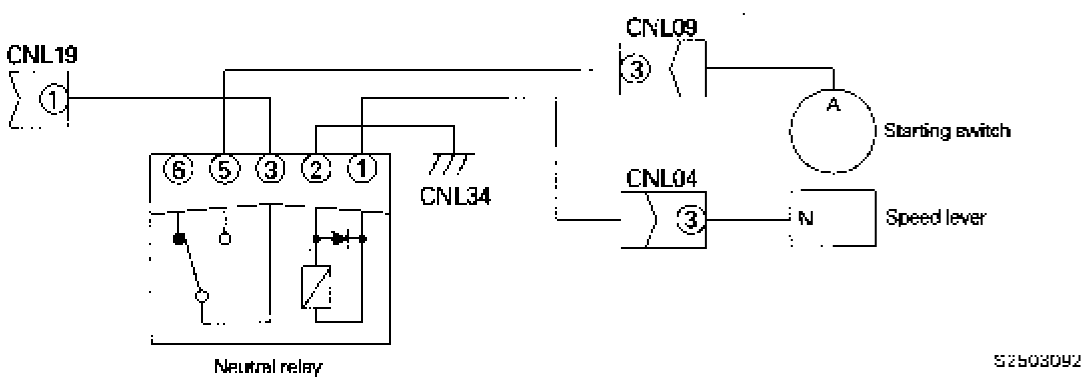
Cause	Remedy
Defective maintenance monitor module	Replace

S2503091

K-3 When engine is started immediately after starting switch is turned ON (within 3 seconds), all lamps on maintenance monitor do not go out

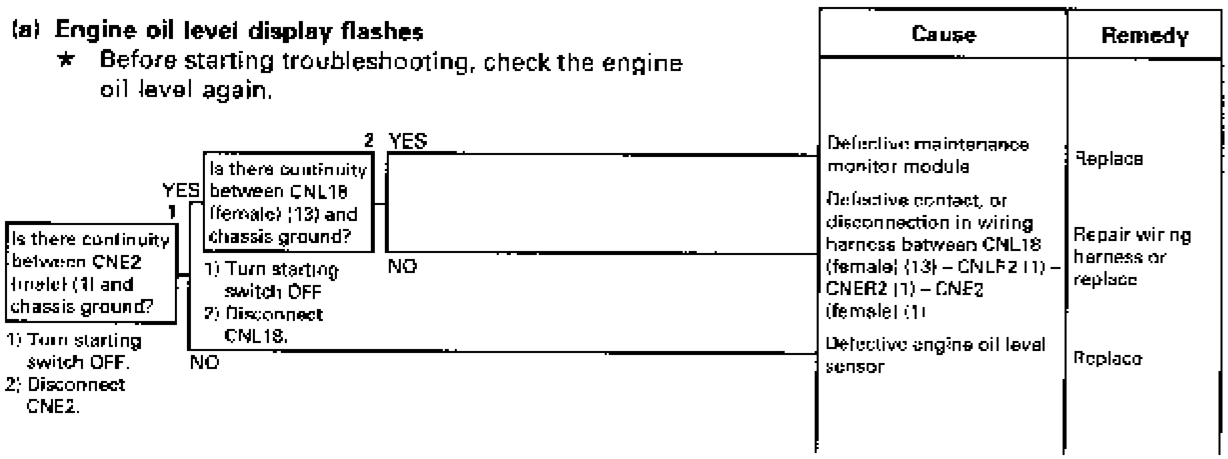
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

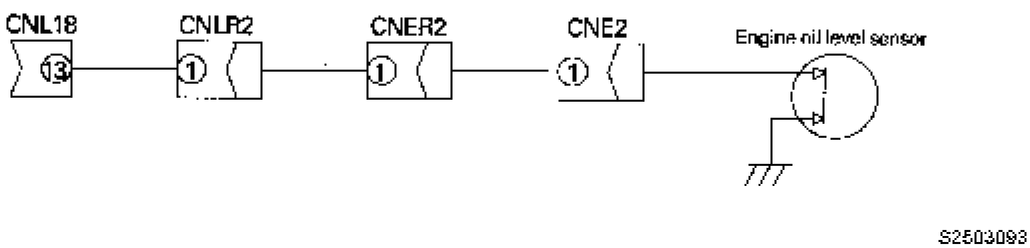




K-4 When starting switch is turned ON (engine stopped) CHECK items flash

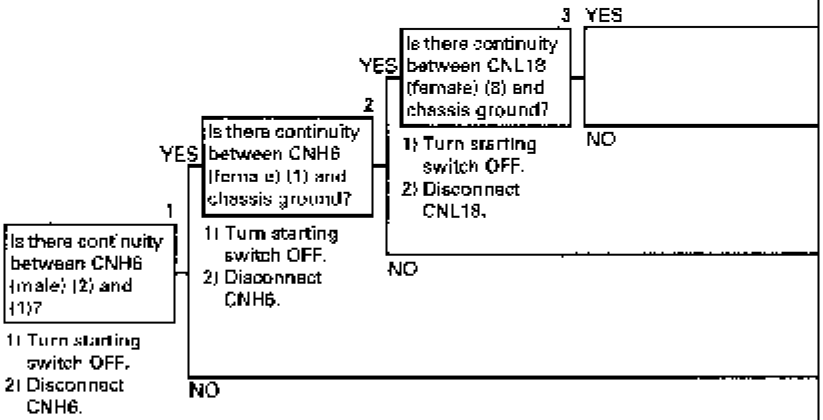
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.



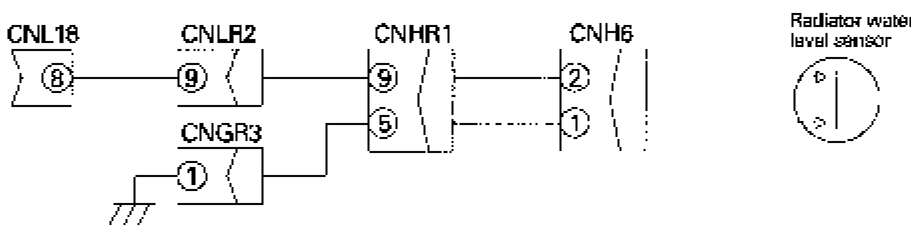


(b) Engine water level display flashes

★ Before starting troubleshooting, check the engine water level again.



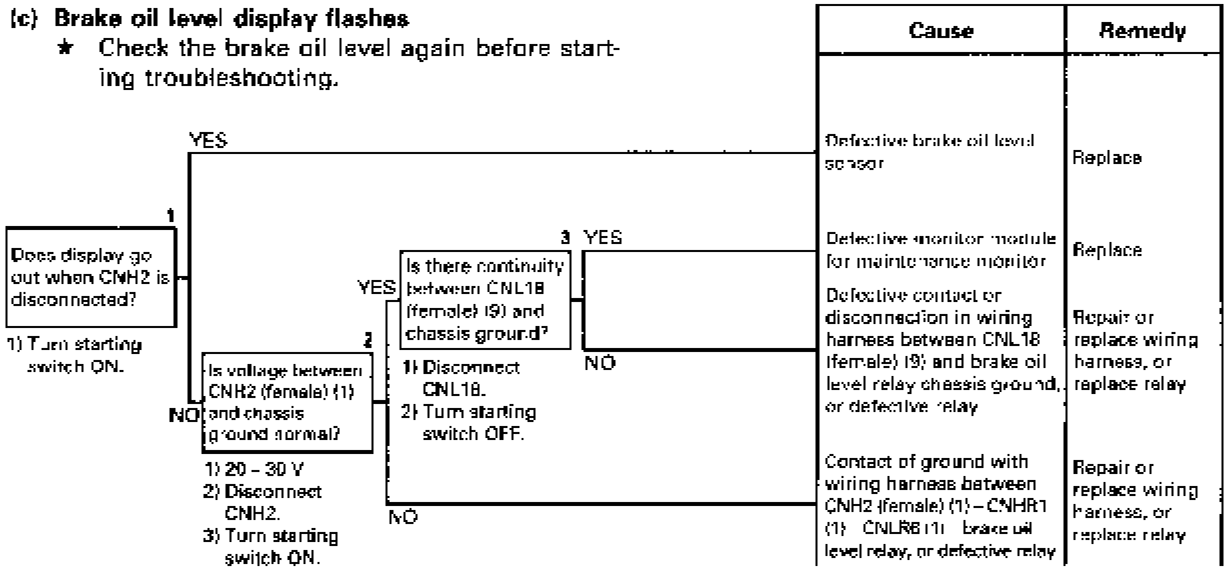
Cause	Remedy
Defective maintenance monitor module	Replace
Defective contact, or disconnection in wiring harness between CNL18 (female) (8) – CNLR2 (9) – CNH6 (female) (2)	Repair wiring harness or replace
Defective contact, or disconnection in wiring harness between CNH6 (female) (1), CNHR1 (5) – CNGR3 (1) and chassis ground	Repair wiring harness or replace
Defective radiator water level sensor	Replace

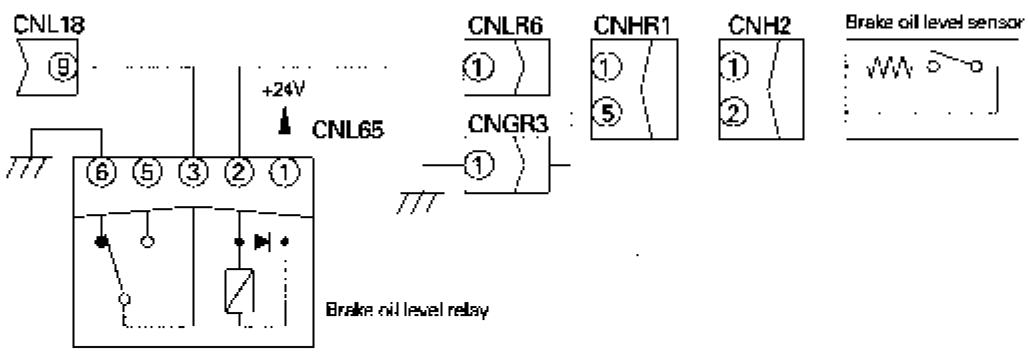


S2503094

(c) Brake oil level display flashes

★ Check the brake oil level again before starting troubleshooting.

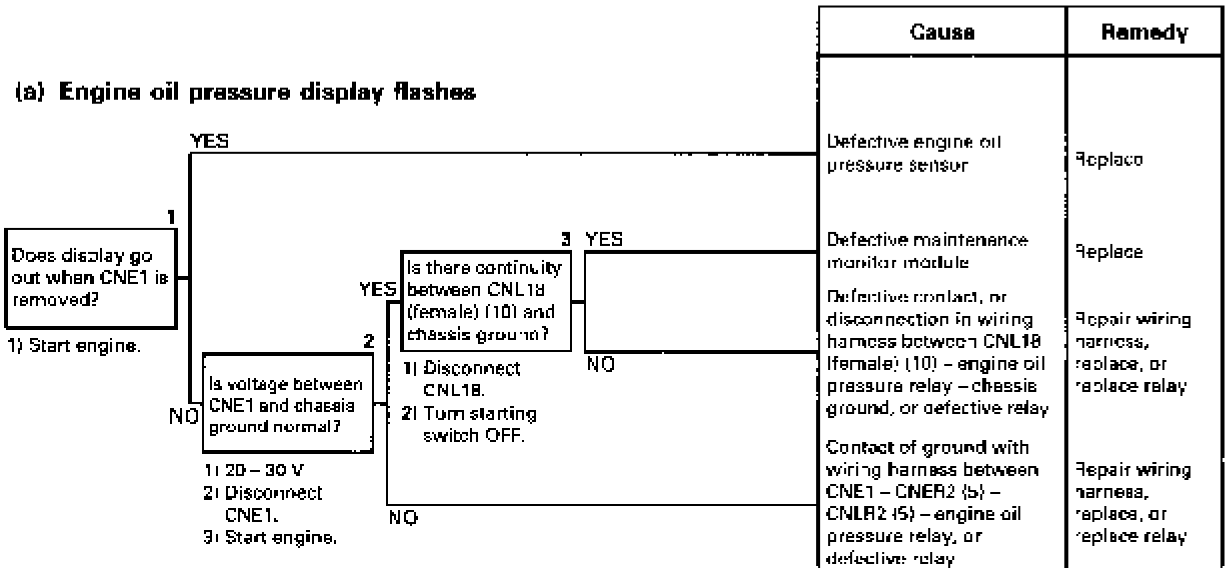


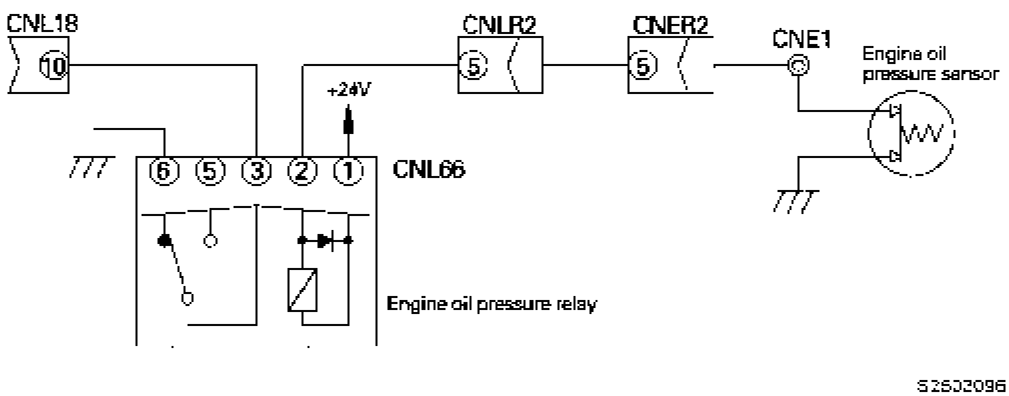


S2503095

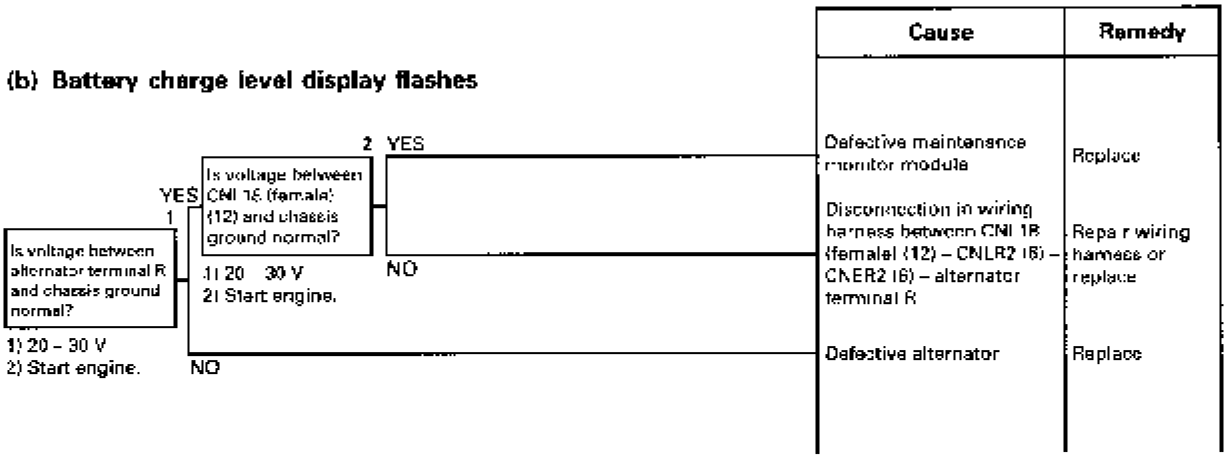
K-5 When starting switch is turned ON (engine started). CAUTION items flash

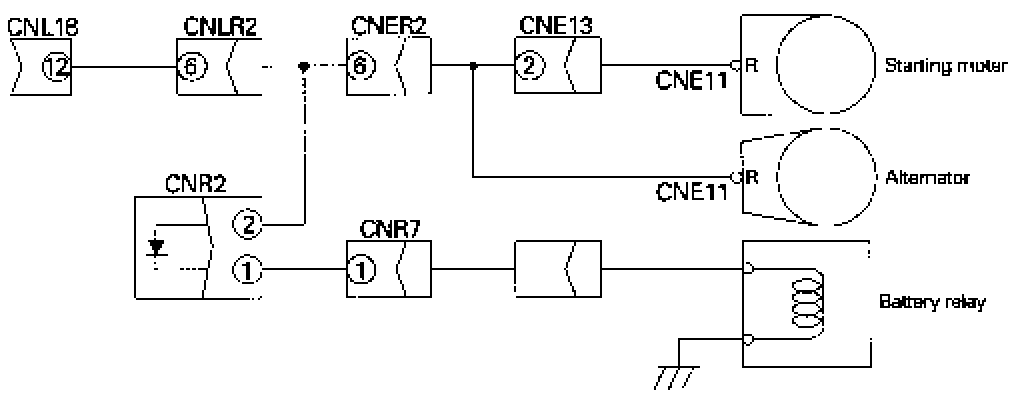
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.





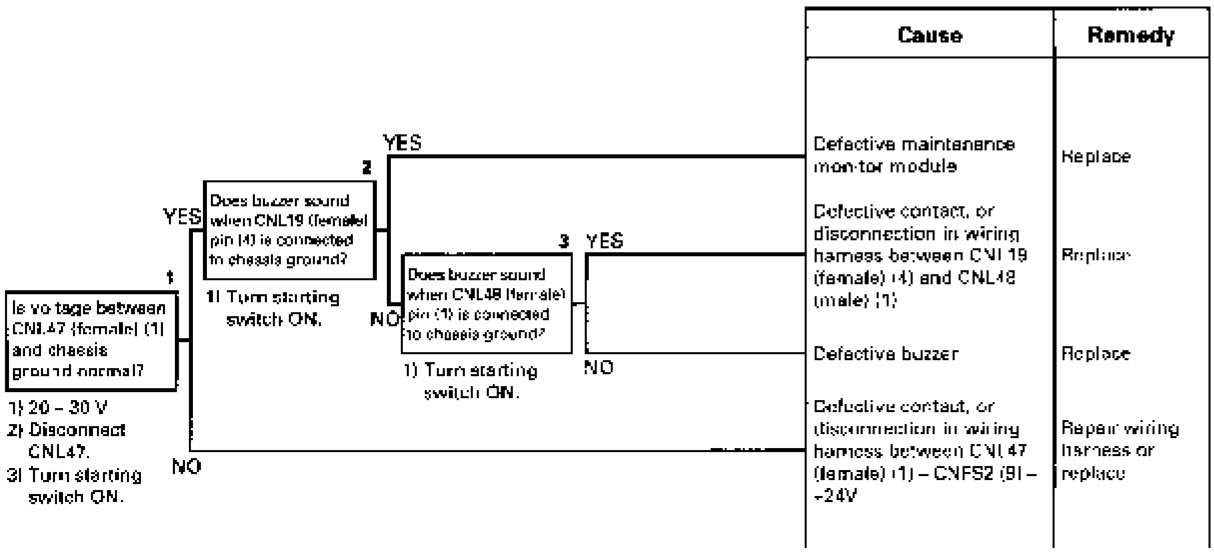
(b) Battery charge level display flashes

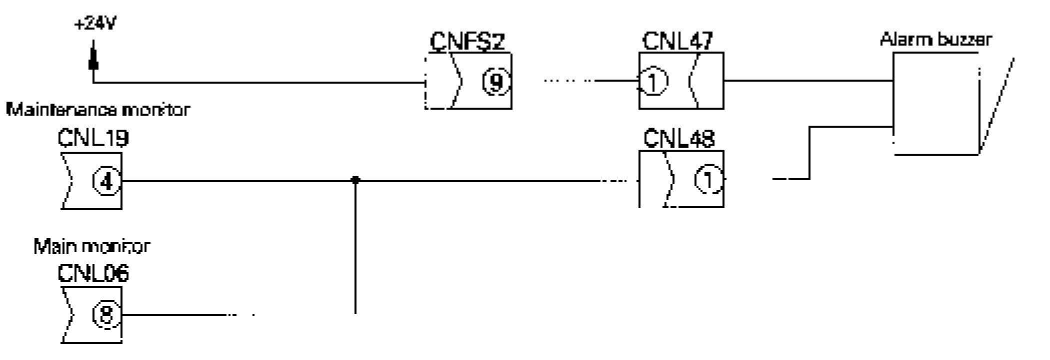




K-6 CAUTION items are flashing but alarm buzzer does not sound

Ú The buzzer does not sound for CHARGE or ENGINE OIL LEVEL.
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on the next step.

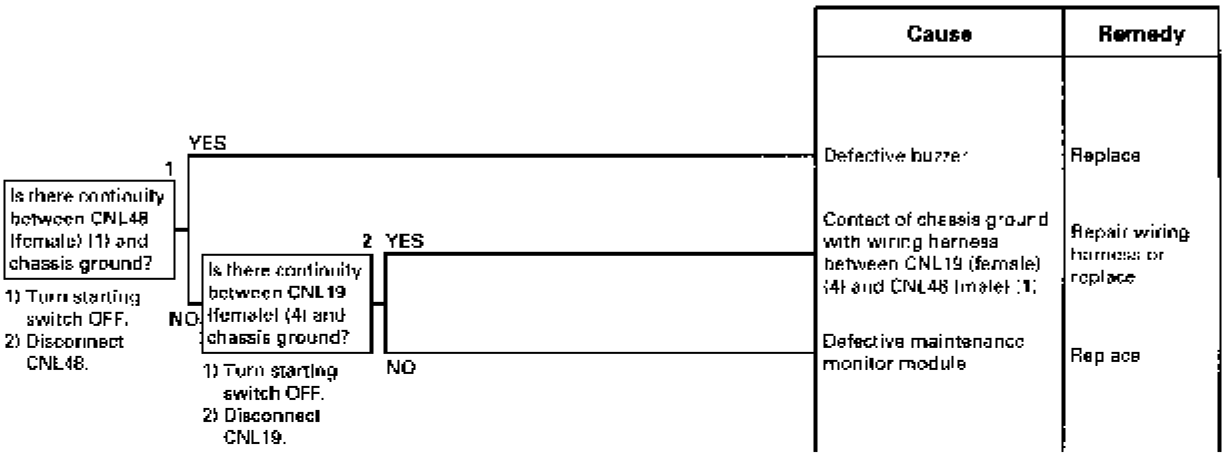


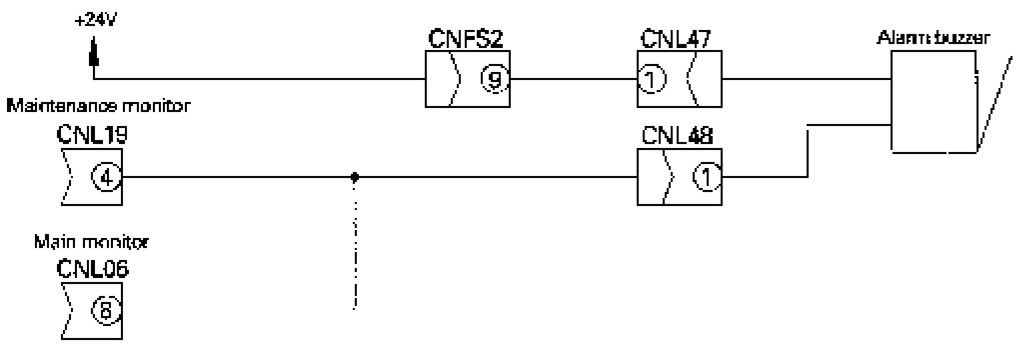


S2603098

K-7 There is no abnormality in monitor display but alarm buzzer sounds

Ú Before carrying out troubleshooting, check that there is no abnormality display on the main monitor.
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

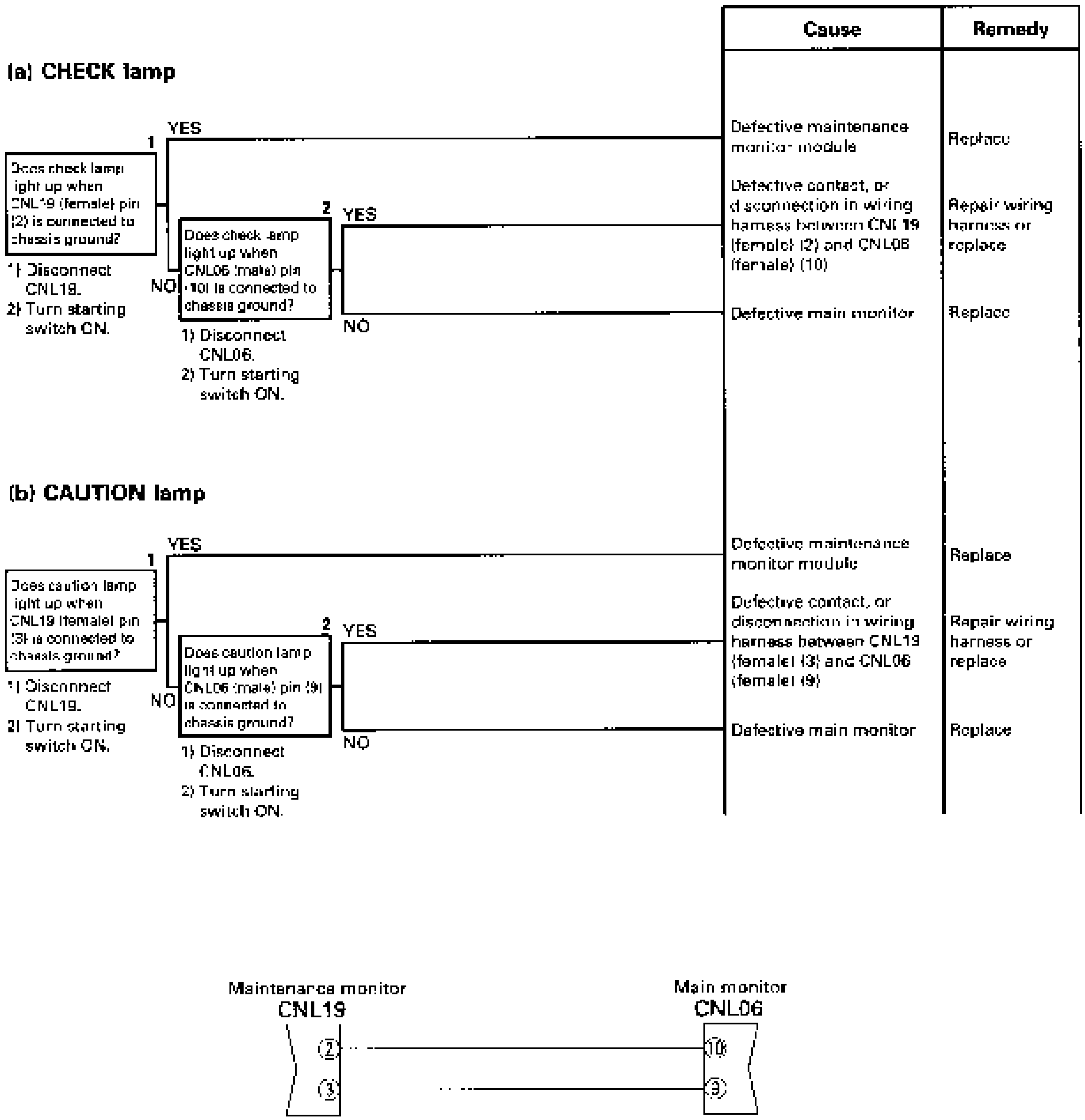




S2503099

K-8 CAUTION items are flashing but warning lamp (CHECK lamp, CAUTION lamp) do not light up

- Ú Before carrying out troubleshooting, check that there are no blown lamp bulbs.
- Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- Ú Always connect any disconnected connectors before going on to the next step.



32503100

K-9 There is no abnormality in maintenance display but warning lamp (CHECK lamp, CAUTION lamp) lights up

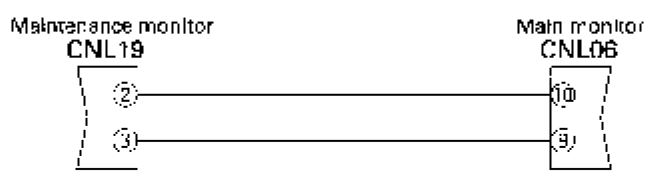
Ú Before carrying out troubleshooting, check that there is no abnormality displayed on the main monitor.
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

(a) CHECK lamp

Step	Result	Cause	Remedy
1 Is there continuity between CNL19 (female) (2) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL19.	YES	Contact of chassis ground with wiring harness between CNL19 (female) (2) and CNL06 (female) (10)	Repair wiring harness or replace
	NO	Defective maintenance monitor module	Replace

(b) CAUTION lamp

Step	Result	Cause	Remedy
1 Is there continuity between CNL19 (female) (3) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL19.	YES	Contact of chassis ground with wiring harness between CNL19 (female) (3) and CNL06 (female) (9)	Repair wiring harness or replace
	NO	Defective maintenance monitor module	Replace



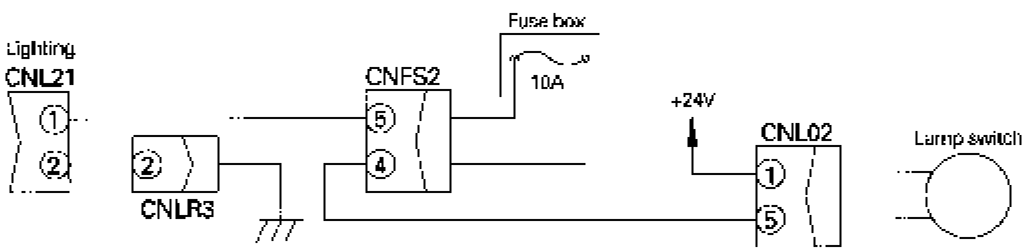
S2503101

K-10 Night lighting does not light up when lamp switch is turned ON (only lighting of maintenance monitor does not light up)

Ú Before carrying out troubleshooting, check that there are no blown lamp bulbs.
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.

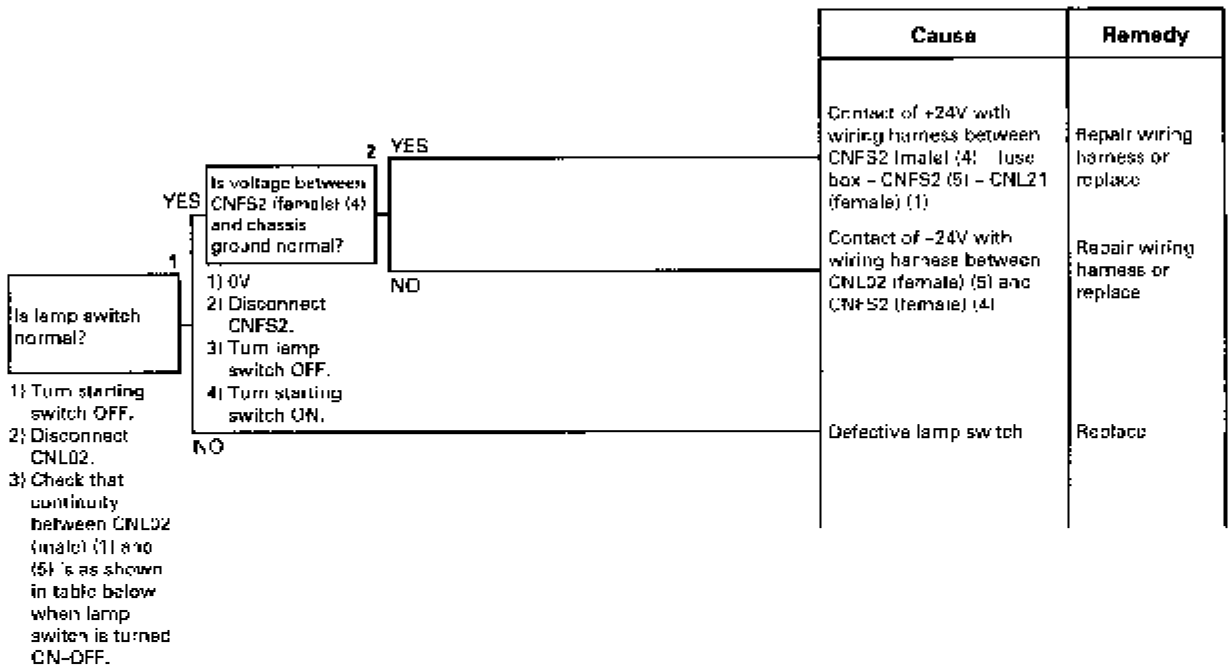
Step	Answer	Cause	Remedy
1. Is voltage between CNL21 (female) (1) and (2) normal?	YES	Disconnection in wiring harness of lamp holder	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL21 (female) (1) and CNFS2 (5)	Repair wiring harness or replace

1) 20 – 30 V
2) Disconnect CNL21.
3) Turn starting switch ON.
4) Turn lamp switch ON.

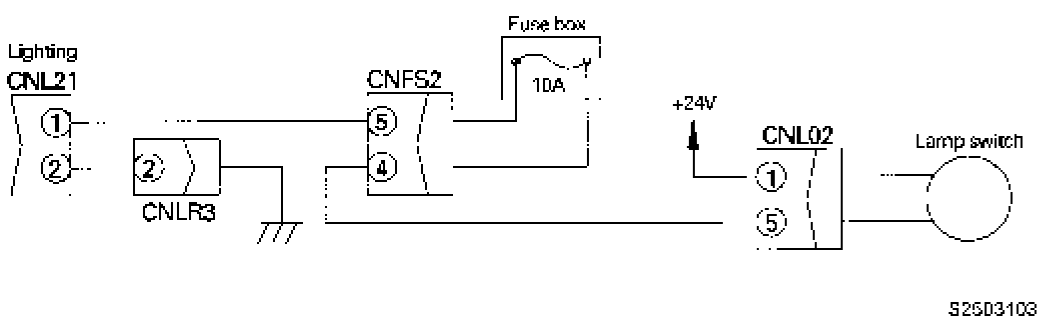


S26031C2

K-11 Night lighting lights up even when lamp switch is OFF, night lighting stays lighted up

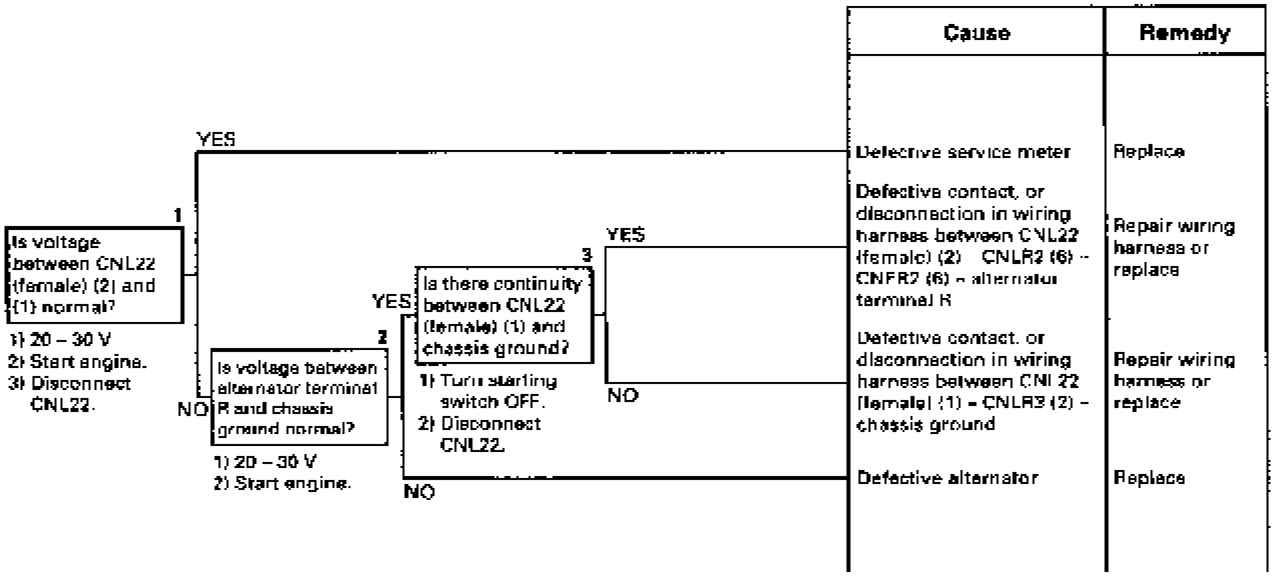


Switch	Continuity
ON	Continuity
OFF	NO continuity



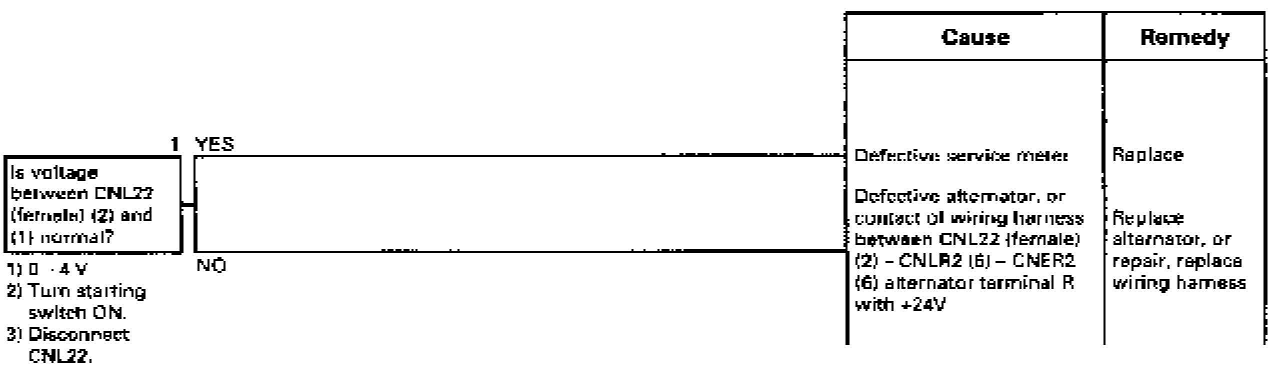
K-12 Service meter does not work

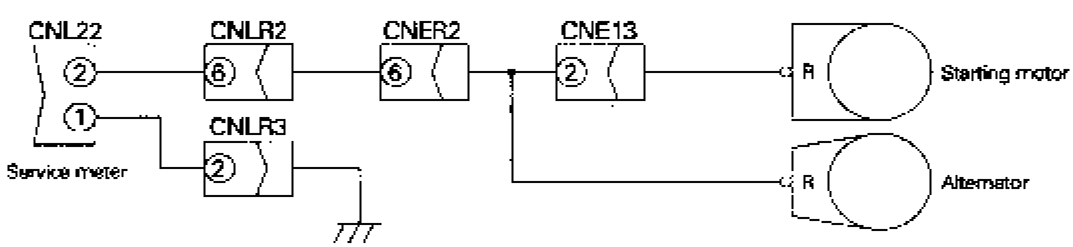
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.



K-13 Service meter is running even when engine is stopped

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

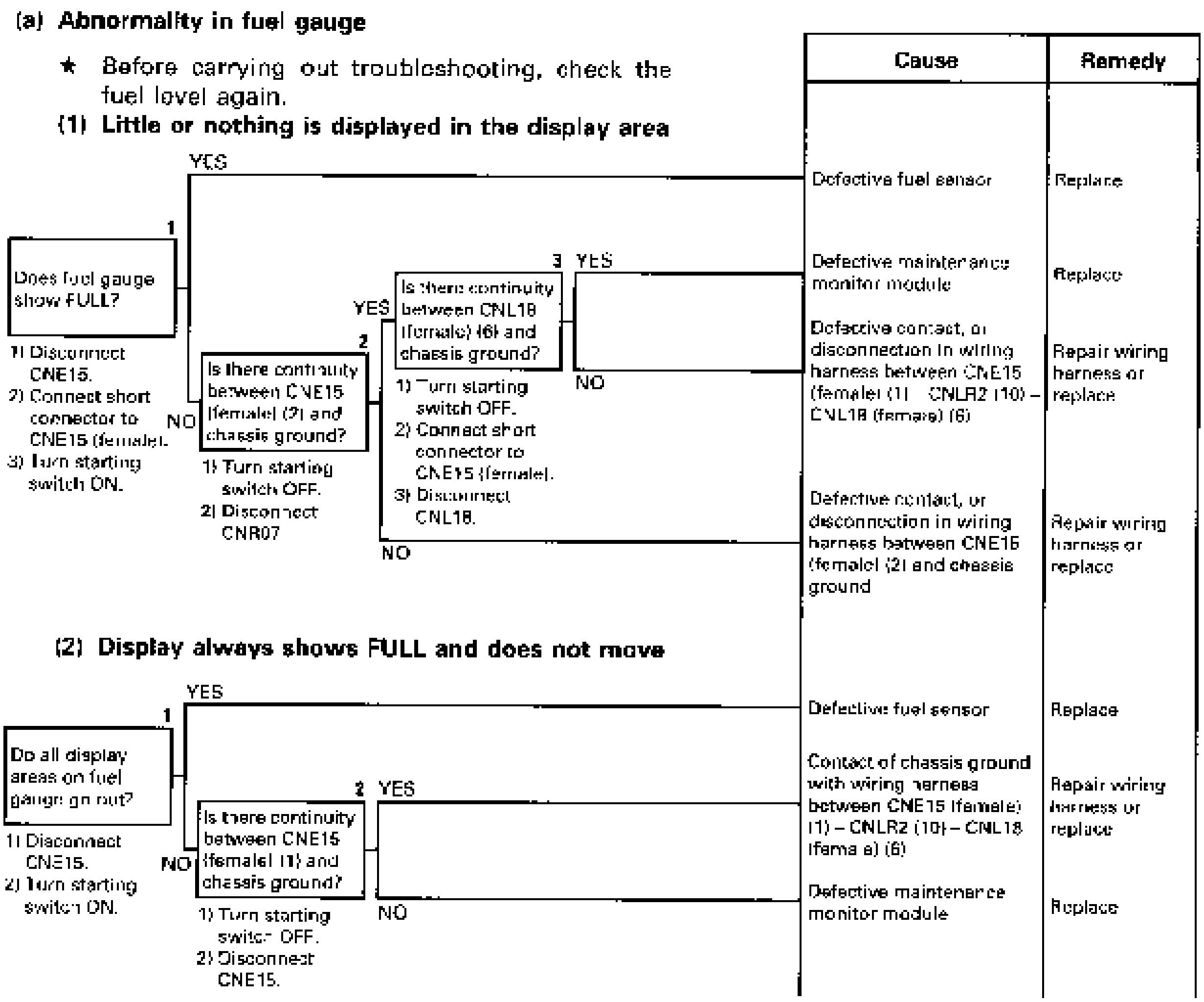


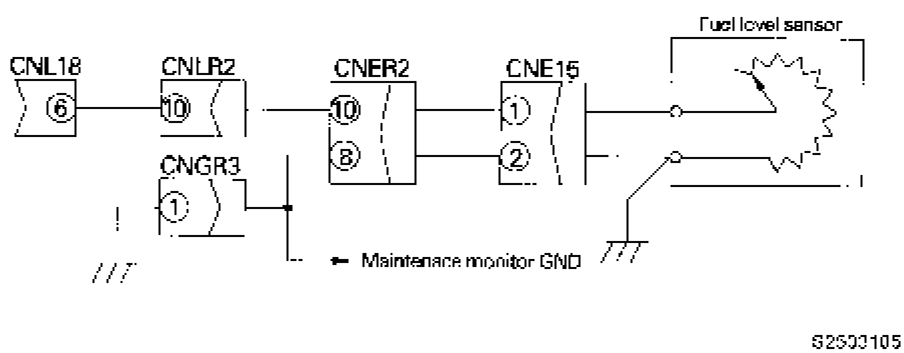


S2503104

K-14 Abnormality in gauge items

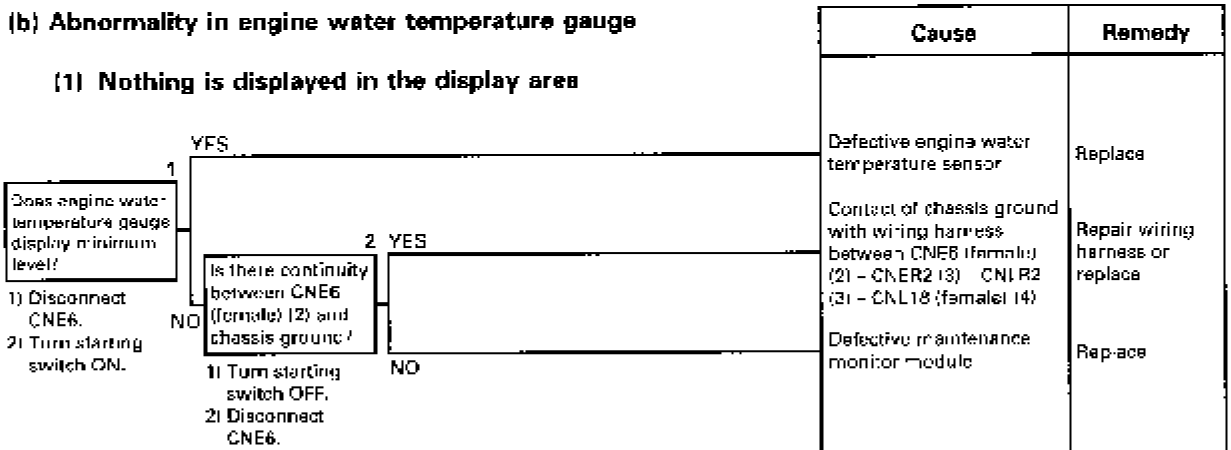
Ú Before carrying out troubleshooting, check that all the related connectors are properly inserted.
Ú Always connect any disconnected connectors before going on to the next step.



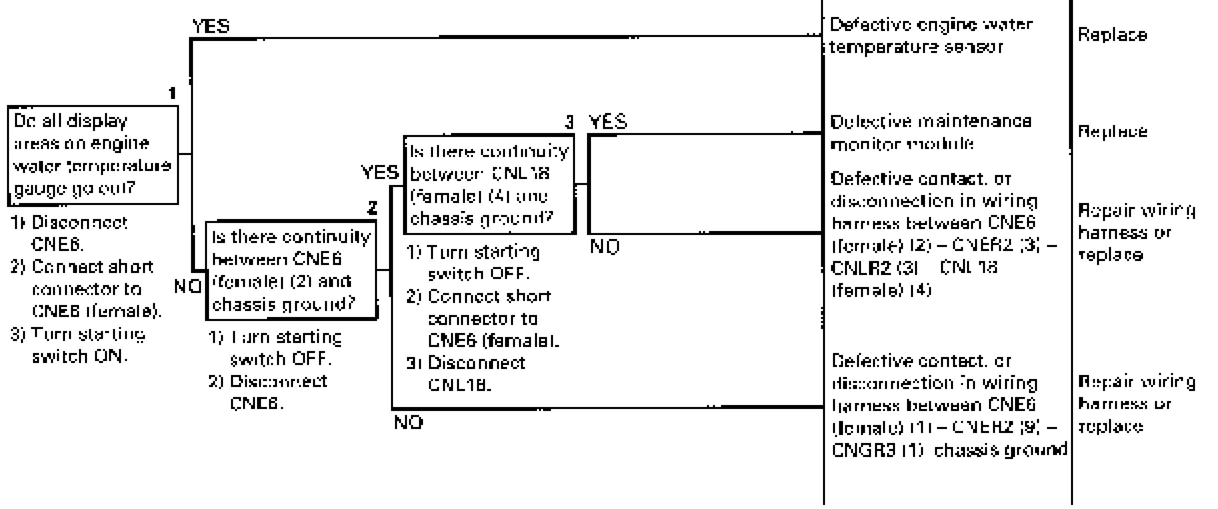


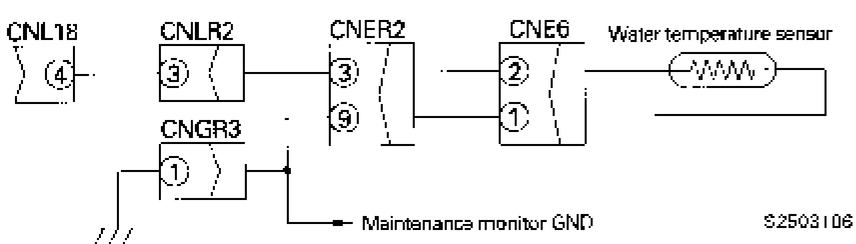
(b) Abnormality in engine water temperature gauge

(1) Nothing is displayed in the display area



(2) Display shows lowest level and does not move





(c) Abnormality in torque converter oil temperature gauge

(1) Nothing is displayed in the display area

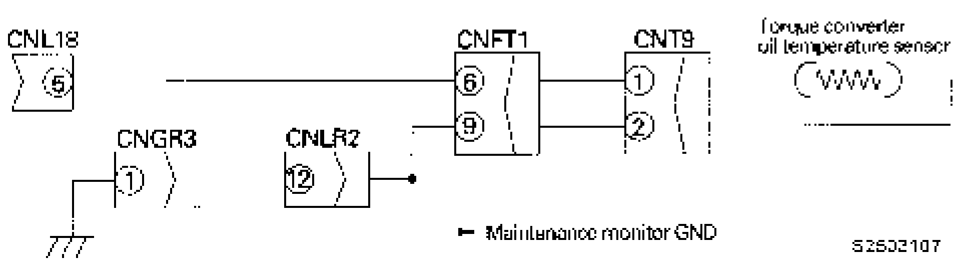
Step	Check	Procedure	YES	NO
1	Does torque converter oil temperature gauge display minimum level?	1) Disconnect CNT9. 2) Turn starting switch ON.	Defective torque converter oil temperature sensor	Go to 2
2	Is there continuity between CNT9 (female) (1) and chassis ground?	1) Turn starting switch OFF. 2) Disconnect CNT9.	Contact of chassis ground with wiring harness between CNT9 (female) (1) – CNFT1 (6) – CNL18 (female) (5)	Defective maintenance monitor module

Cause	Remedy
Defective torque converter oil temperature sensor	Replace
Contact of chassis ground with wiring harness between CNT9 (female) (1) – CNFT1 (6) – CNL18 (female) (5)	Repair wiring harness or replace
Defective maintenance monitor module	Replace

(2) Display shows lowest level and does not move

Step	Check	Procedure	YES	NO
1	Do all display areas on torque converter oil temperature gauge go out?	1) Disconnect CNT9. 2) Connect short connector to CNT9 (female). 3) Turn starting switch ON.	Defective torque converter oil temperature sensor	Go to 2
2	Is there continuity between CNT9 (female) (2) and chassis ground?	1) Turn starting switch OFF. 2) Disconnect CNT9.	Go to 3	Defective contact, or disconnection in wiring harness between CNT9 (female) (2) – CNFT1 (9) – CNLR2 (12) – chassis ground
3	Is there continuity between CNL18 (female) (5) and chassis ground?	1) Turn starting switch OFF. 2) Connect short connector to CNT9 (female). 3) Disconnect CNL18.	Defective maintenance monitor module	Defective contact, or disconnection in wiring harness between CNT9 (female) (1) – CNFT1 (6) – CNL18 (female) (5)

Cause	Remedy
Defective torque converter oil temperature sensor	Replace
Defective maintenance monitor module	Replace
Defective contact, or disconnection in wiring harness between CNT9 (female) (1) – CNFT1 (6) – CNL18 (female) (5)	Repair wiring harness or replace
Defective contact, or disconnection in wiring harness between CNT9 (female) (2) – CNFT1 (9) – CNLR2 (12) – chassis ground	Repair wiring harness or replace



MEMORANDA

TROUBLESHOOTING-EAGLE AIR CONDITIONER

Troubleshooting

Setup:
Controller on Temp. 60E F
Defrost "off", Fan on high

Abbreviations:
EC - Electric Condenser

(A) Problem - **EO** error message display on the controller:

Possible Cause	Inspection	Remedy
1. Open EC power circuit	Check the EC circuit breaker for power, voltage, and continuity	a) Repair the wiring b) Replace open circuit breaker
2. Defective EC relay (circuit)	Check for output voltage on the yellow wire, at the relay coil. Check the voltage and continuity across the relay contacts.	a) Repair the connections / wiring b) Replace the defective relay
3. Open EC voltage detection circuit	Check for input voltage on the brown wire, at the controller.	a) Repair the wiring or connector
4. Improper wiring installation	Applicable to systems without an EC	a) See note #3
5. Defective controller	Check for output voltage on the yellow wire, at the controller.	a) Replace the controller

(B) Problem - **E1** error message display on the controller:

Possible Cause	Inspection	Remedy
1. Abnormal A/C refrigerant pressure(s). * Cool weather operation may cause low pressure short cycling	Check the refrigerant pressures with gauges. High side greater than: 320 psig (R12), or 350 psig (R134a). Low side less than: 3 - 6 psig.*	a) Check the condenser operation for air and refrigerant blockage b) Leak check system, repair the leaks and recharge the system c) Relocate the low pressure switch to the evaporator outlet
2. Opened compressor clutch circuit	Check for output voltage on the green wire at the compressor. Check the wire connections. Check for continuity across the pressure switch(es) and thermostat. Check the continuity of the clutch solenoid to ground.	a) Repair the connections/wiring b) Replace the defective switch(es) or the thermostat c) Replace the defective compressor clutch
3. Opened pressure switch detection circuit	Check for an input voltage on the tan wire, at the controller.	a) Repair the connections/ wiring
4. Defective controller	Check for output voltage on the green wire, at the controller.	a) Replace the controller

(B) Problem continued

False E1 error message / cold weather charging problems:
(Occurs particularly when vapor charging in cold weather)

1. E1 error message may occur during charging when the low pressure switch (LPS) opens at 3 psig. The suction side pressure must rise above 45 psig to reset the E1 error message.

2. When the system is fully charged, the E1 error message should not appear under normal operating conditions.

3. In order to continue charging, by-pass the LPS, turn the controller “off” then “on”, and set the controller to 60E F. This will reset the controller and force into the air conditioning mode.

4. If the LPS can’t be easily reached, disconnect the clutch wire at the compressor, and run a hot wire directly to the compressor clutch solenoid. Take care not to short out the controller clutch circuit.

5. E1 error message may occur while charging, when the compressor is wired hot.

(C) Problem - No Heat

Possible Cause	Inspection	Remedy
1. Opened heat solenoid circuit. Poor connection, loss of voltage.	Check for an output voltage on the white wire, at the heat solenoid valve. Check the solenoid continuity to ground.	a) Repair connections/wiring
2. Defective heat solenoid or improper installation.	Check for coolant blockages in the heat solenoid valve and hoses. Check the direction of coolant flow (feel the hoses).	a) Repair or replace the valve. b) Reverse the coolant hoses to the valve.
3. Defective controller	Check for output voltage on the white wire, at the controller.	a) Replace the controller

(D) Problem - No display, the blower fan will not turn off, when the power is turned on.

Possible Cause	Inspection	Remedy
1. Fan wires shorted to ground or vehicle chassis	Disconnect the controller from the external harness, Individually check the continuity of the orange and black fan wires to ground, in the external harness.	a) Unground and repair the shorted wiring.

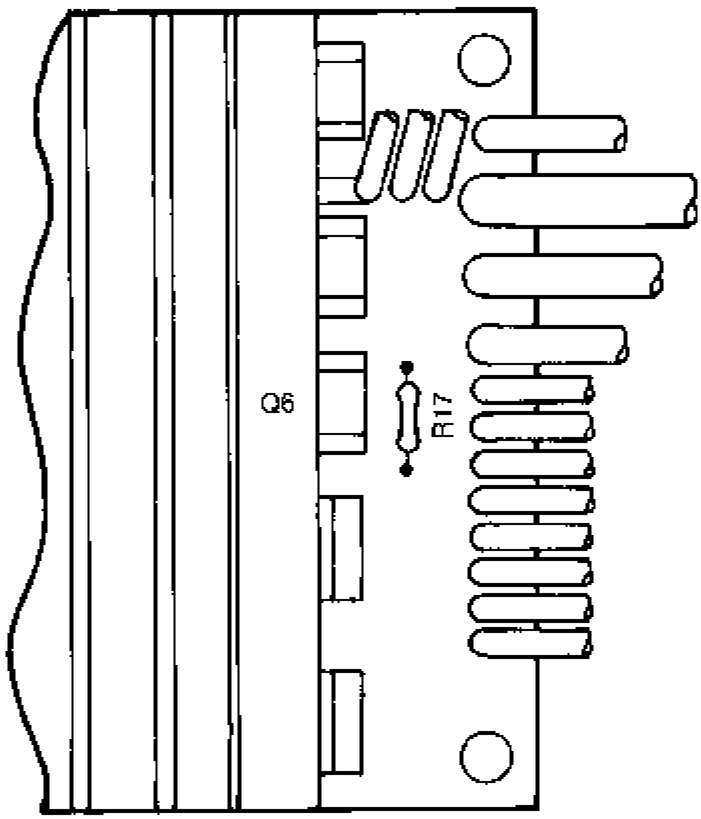
(E) Problem - Compressor clutch will not engage, unless defrost button is pushed.

Possible Cause	Inspection	Remedy
1. Defective preset thermostat inside evaporator. Opened preset thermostat circuit. Broken thermostat wiring. Evaporator coil temperature too cold for a/c operation.	Push, hold defrost / temperature decrease buttons simultaneously. Check display for “OP” or “CL” readout. Disconnect red leads, and check for continuity across thermostat terminals.	a) If “CL”, go to step 2. b) If “OP”, repair connections or wiring to preset thermostat. c) Replace preset thermostat.
2. Ambient cab temperature too cool (below 60E F).	Set controller at 68-70E F, in a/c mode. Warm-up ambient temperature probe with fingers or heat gun.	a) Verify if compressor clutch will pull in or not. b) If not go to step 3.
3. Opened ambient cab temperature probe (thermistor)	Push, hold temp. Decrease/increase buttons simultaneously. Display will read 40F if probe is defective. Disconnect the controller, check for continuity across black probe leads. Check resistance of thermistor.	a) If display reads 49F, at room temperature, replace thermistor. b) Repair connections/wiring. c) If 10K ohms +/- 20%, thermistor is good. If 100K-1M ohms, replace thermistor.

Notes:

1. Wire colors may vary with installation. Refer to the wiring schematic.

2. For 24V controllers, resistor (R17) must be clipped and removed from the circuit board. (Refer to figure below) If the resistor is not clipped on the 24V system, the controller display will light up, but the blower fan will not turn on.



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3. For air conditioning systems that do not use an electric condenser, the blue and brown wires must be connected together, on the external harness. The brown wire must be connected to the battery voltage, or the **EO** error message will result.

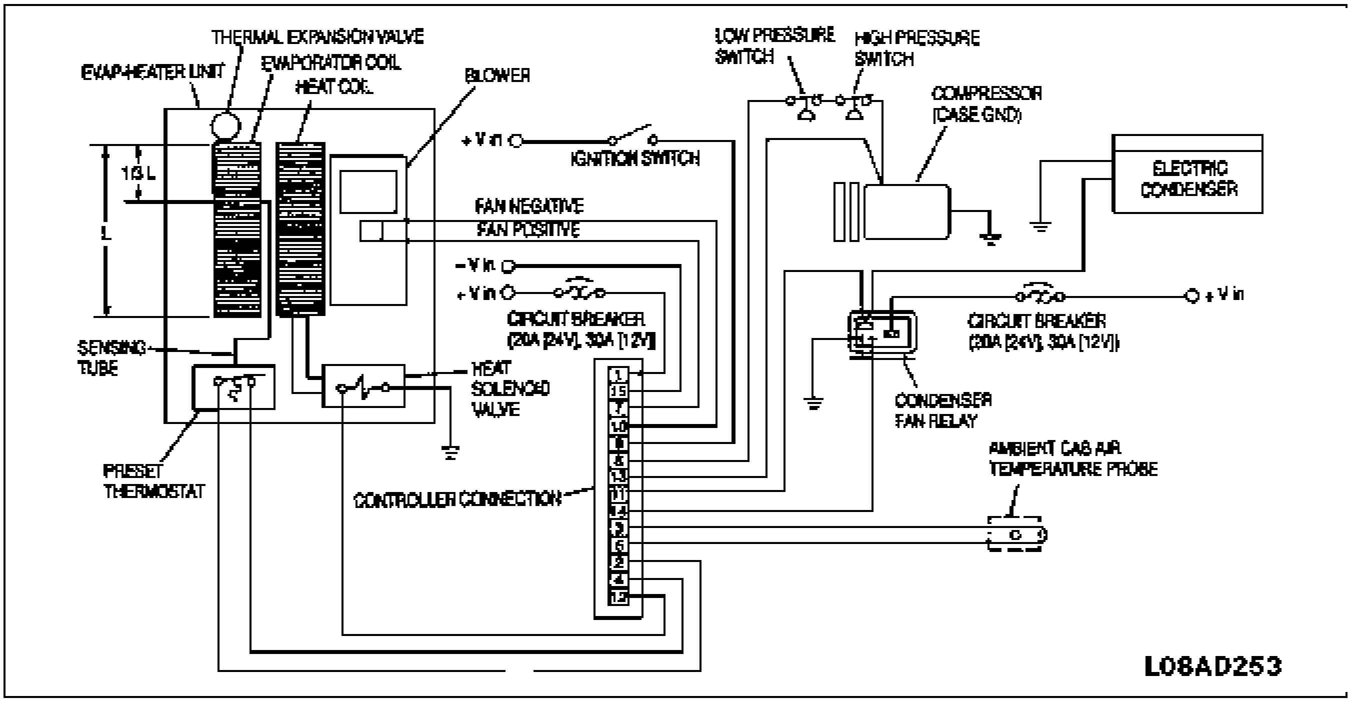
4. Care must be taken during installation, not to pinch or cut wiring from the controller. Shorted wiring may result in damage to the controller.

5. Improper probe location of the evaporator coil thermostat sensor, or ambient cab temperature sensor, may cause short cycling of the compressor.

6. Eagle climate controllers are designed to use normally closed heat solenoid valves.

7. Disconnect the vehicle battery leads, if a machine is to be inactive, or put into storage, for a period of a week or more. The current drain from the controller's memory may result in a dead vehicle battery. An optional ignition relay may be installed to disable the controller's memory function, when the key switch is turned off.

WIRING DIAGRAM



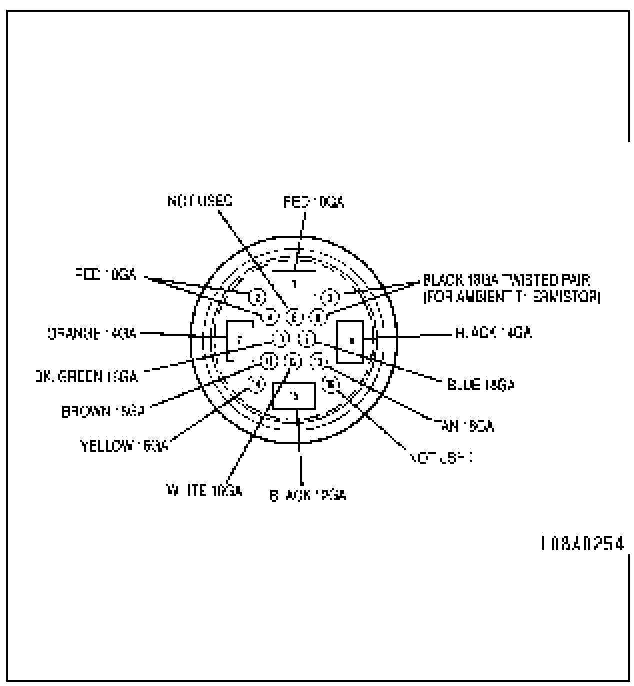
NOTES:

1. Position the ambient temperature probe near waist high level, out of air flow and sun load.
2. Insert the sensing tube from present thermostat down into the evaporator coil, parallel to the coil face, between the 1st and 2nd rows, to a depth of the coil height minus 1 inch.

Wire Chart

Scoket	Size	Color	Wire function
1	10GA	Red	Battery positive in
2	18GA	Red	½ evap coil thermostat in
3	18GA	Black	½ ambient thermistor in
4	18GA	Red	½ evap coil thermostat in
5	N/A	N/A	Not used
6	18GA	Black	½ ambient thermistor in
7	14GA	Orange	Fan positive out
8	16GA	Dk. Green	Clutch out
9	18GA	Dk. Blue	Ignition switch in
10	14GA	Black	Fan negative out
11	18Ga	Brown	Condenser blown fuse in
12	16GA	White	Heat solenoid out
13	18GA	Tan	Pressure switch detect in
14	16GA	Yellow	Condenser fan relay out
15	12GA	Black	Battery negative in
16	N/A	N/A	Not used

CONNECTOR DETAIL



MEMORANDA

30 DISASSEMBLY AND ASSEMBLY

METHOD OF USING MANUAL

1.When removing or installing unit assemblies

1. When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.
2. Any special techniques applying only to the installation procedure are marked ·:· 1 and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

(Example)

REMOVAL OF ± ± ± ± ASSEMBLY . . . . Title of operation

Warning! . . . . Precautions related to safety when carrying out the operation

1. XXXX (1) . . . . Step in operation

i . . . . Technique or important point to remember when removing XXXX (1)

2. **- - - -** (2) . . . . ·:· 1 indicates that a technique is listed for use during installation

3. **9 9 9 9** assembly (3)

. . . . Quantity of oil or water drained

INSTALLATION OF ± ± ± ± ASSEMBLY . . . . Title of operation

! . . . . Carry out installation in the reverse order of removal.

·:· 1 . . . . Technique used during installation

i . . . . Technique or important point to remember when installing **- - - -** (2)

! Adding water, oil . . . . Step in operation

i . . . . Point to remember when adding water or oil

. . . . Quantity when filling with oil and water

2. **General precautions** when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTION WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3.Listing of special tools

(1) For details of the description, part number, and quantity of any tools (A1, etc.) that appear in the operation procedure, see the SPECIAL TOOL LIST given in the manual.

PRECAUTIONS WHEN CARRYING OUT OPERATION

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

! If the coolant contains antifreeze, dispose of it correctly.
! After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
! When draining oil, prepare a container of adequate size to catch the oil.
! Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
! To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
! Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
! Check the number and thickness of the shims, and keep in a safe place.
! When raising components, be sure to use lifting equipment of ample strength.
! When using forcing screws to remove any components, tighten the forcing screws alternately.
! Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

i **Precautions when handling piping during disassembling**
Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1. Hoses and tubes using sleeve nuts

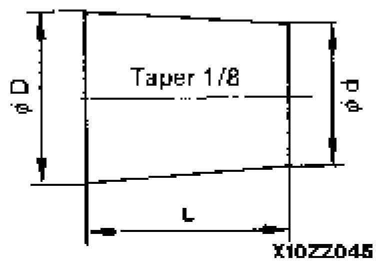
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616 (Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018 (Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219 (Plug)

2. Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3. If the part is not under hydraulic pressure, the following corks can be used.

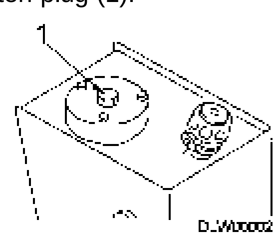
Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



2. Precautions when carrying out installation work

! Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
! Install the hoses without twisting or interference.
! Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
! Bend the cotter pin or lock plate securely.
! When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.
! When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
! Clean all parts, and correct any damage, dents, burrs, or rust.
! Coat rotating parts and sliding parts with engine oil.
! When press fitting parts, coat the surface with anti-friction compound (LM-P).
! After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
! When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
! When using eye bolts, check that there is no deformation or deterioration, screw them fully, and align the direction of the hook.
! When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
i When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:

1. Start the engine and run at low idle.
2. Operate the work equipment control lever to operate the hydraulic cylinder 4 - 5 times, stopping 100 mm from end of its stroke.
3. Next, operate all hydraulic cylinders 3 - 4 times to the end of their stroke, then stop the engine and loosen air bleed plug (1) to bleed the air from the hydraulic tank. After bleeding the air , tighten plug (1).
4. Following this raise the engine speed , repeat the procedure in Step 3) to bleed the air. Repeat this operation until no more air comes out from the plug hole.
   Plug: **11.3 ± 1.5 Nm (1.15 ± 0.15 kgm)**
5. After doing this, run the engine at normal speed.



i When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operations

- ! If the coolant has been drained, tighten the drain valve, and add coolant to the specified level. Run the engine to circulate the coolant through the system. Then check the coolant level again.
- ! If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- ! If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed air from the system after reassembling the parts.
- i For details, see TESTING AND ADJUSTING, Bleeding air.
- ! Add the specified amount of grease (molybdenum disulfide grease) to the work equipment related parts.

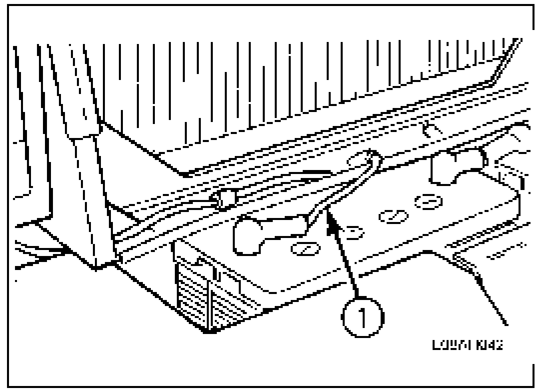
SPECIAL TOOL LIST

Nature of work	Symbol		Part no.	Part Name	Qty.	Remarks	
Disassembly, assembly of transmission assembly	A	1	793-305-1600	Lifting tool	2		
		2	793-310-2100	Lifting tool	1		
		3	793-520-2900	Lifting tool	1		
Disassembly, assembly of transmission clutch pack assembly	B	1	793-310-1300	Stand	1	Removal, installation of end plate	
		2	793-310-1370	Guide pin	5		
		3	793-310-1330	Plate	1		
		4	01541-01260	Nut	2		
		5	793-310-1360	Bar	2		
		6	793-415-1140	Seal holder	1	F - R	piston seal shaping tool
		7	793-415-1130	Seal holder	1	1st - 4th	
Disassembly, assembly of parking brake assembly	C	1	793-310-1300	Stand	1	Removal, installation of separator plate	
		2	793-310-1330	Plate	1		
		3	01541-01260	Nut	2		
		4	793-310-1360	Bar	2		
Disassembly, assembly of differential assembly	D	1	793-520-2150	Mandrel	1	Positioning bearing of differential pinion	
		2	793-520-2110	Plate	5	Insertion of brake piston	
			01010-31640	Bolt	5		
			01010-31680	Bolt	5		
			01643-31645	Washer	5		
		3	793-605-1001	Brake tester	1	Checking for oil leaks	
			799-101-5002	Hydraulic tester kit	1		
			790-101-1102	Pump assembly	1		
Disassembly, assembly of axle housing	E	1	790-101-3110	Puller	1set	Puller assembly 790-101-3100	
		2	790-101-3120	Bolt	2		
		3	790-101-3130	Nut	2		
		4	793-520-1551	Seal support	1		
Disassembly, assembly of parking brake disc	F		793-415-1150	Plate	1	Removal, installation of parking brake	
Removal of main control valve	G		793-463-1110	Stopper	2	Boom holding tool	
			01011-51815	Bolt	4		
			01643-31845	Washer	8		
			01580-11815	Nut	4		
Hydraulic cylinder	H		790-502-1003 or 790-502-2000	Cylinder repair stand	1		
			790-101-1102	Pump	1		

Nature of work	Symbol	Part no.	Part Name	Qty.	Remarks	
Disassembly, assembly of hydraulic cylinder	I	790-102-3802	Wrench assembly	1	Boom, bucket cylinder	Removal, Installation of round head
		790-330-1100	Wrench assembly	1	Steering cylinder	
	J	790-102-1320	Socket (width across flats: 70 mm)	1	Boom cylinder	Removal, installation of piston nylon nut
		790-302-1340	Socket (width across flats: 80 mm)	1	Bucket cylinder	
		Commercially available	Socket (width across flats: 36 mm)	1	Steering cylinder	
	K	790-101-5021	Grip	1	Press fitting of coil bushing Kit part no.: 790-201-1702	
		01010-50816	Bolt	1		
		790-201-1811	Push tool	1	Boom, bucket cylinder	
		790-201-1741	Push tool	1	Steering cylinder	
	L	790-101-5021	Grip	1	Press fitting of dust seal Kit part no.: 790-201-1500	
		01010-50816	Bolt	1		
		790-201-1620	Plate	1	Boom, bucket cylinder	
		790-201-1550	Plate	1	Steering cylinder	
	M 1	790-702-1000	Expander	1	Removal, installation of piston ring	
	M 2	796-720-1670	Ring	1	Boom, bucket cylinder	
		07281-01279	Clamp	1		
		796-720-1740	Ring	1	Steering cylinder	
		07281-00809	Clamp	1		

Note: As for special tool of disassembly and assembly of engine components (engine oil cooler, fuel injection pump, turbocharger, nozzle holder, thermostats, cylinder head etc.) Refer to “ENGINE SHOP MANUAL”

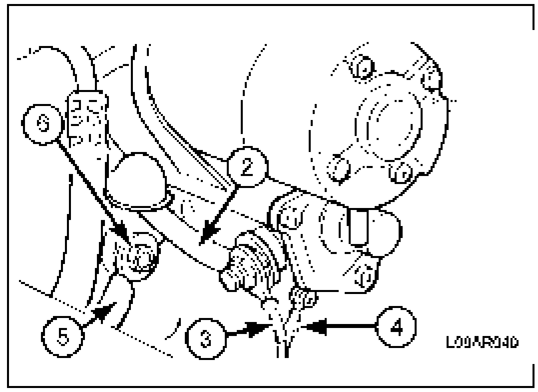
STARTING MOTOR



Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Disconnect the cable from the negative (-) terminal of the battery.

REMOVAL



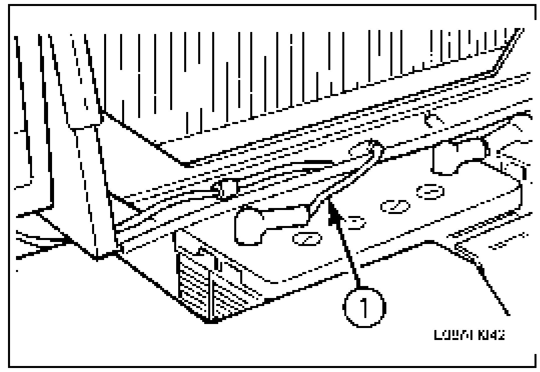
1. Disconnect negative (-) terminal (1) of the battery located behind the radiator grille.
2. Open engine hood side cover and lock into position.
3. Disconnect cable (2) and harness wires (3) and (4).
4. Remove ground connection (5) with two mounting bolts (6), then remove starting motor assembly.

INSTALLATION

Ú Install starting motor assembly in reverse order of removal

Mounting bolt: 32 ±4 lbf.ft
(43 ±6 Nm)
(4.38 ±0.61 kgm)

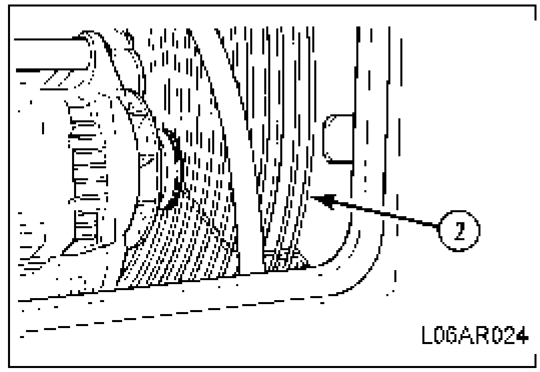
ALTERNATOR



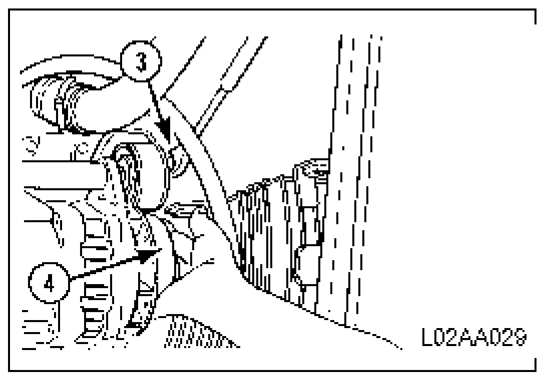
Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Disconnect the cable from the negative (-) terminal of the battery.

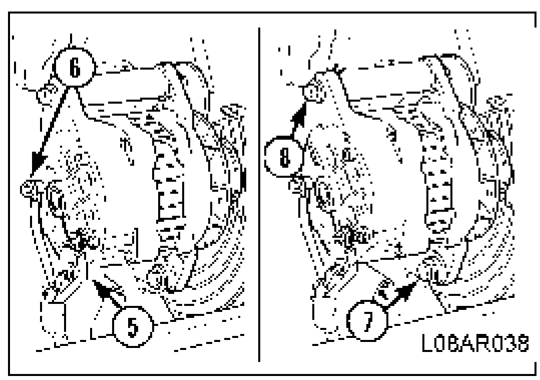
REMOVAL



1. Disconnect negative (-) terminal (1) of the battery located behind the radiator grille.
2. Open engine hood side cover and lock into position.
3. Remove 5 mounting bolts of left fan guard half (2) and rotate down out of way.
4. Install 3/8" drive breaker bar (3) in belt tensioner. Lift up on breaker bar and remove belt (4) from alternator pulley.
5. Remove output (5) and ground (6) leads from back of alternator.
6. Remove bottom mounting bolt (7). Supporting the alternator, remove top mounting bolt (8) and remove the alternator from the machine.



INSTALLATION

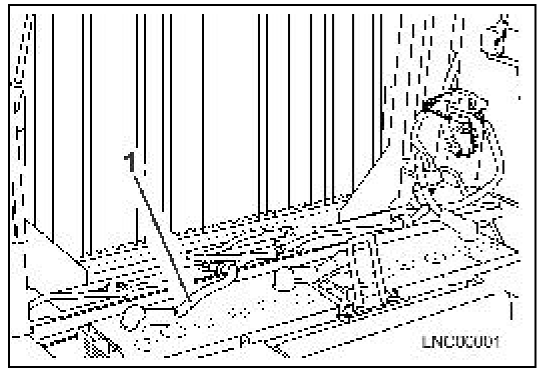


Ú Install starting motor assembly in reverse order of removal

Mounting bolt: 32 ±4 lbf.ft
(43 ±6 Nm)
(4.38 ±0.61 kgm)

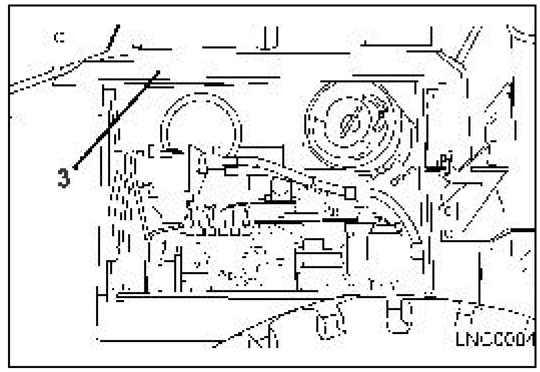
FUEL INJECTION PUMP

Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

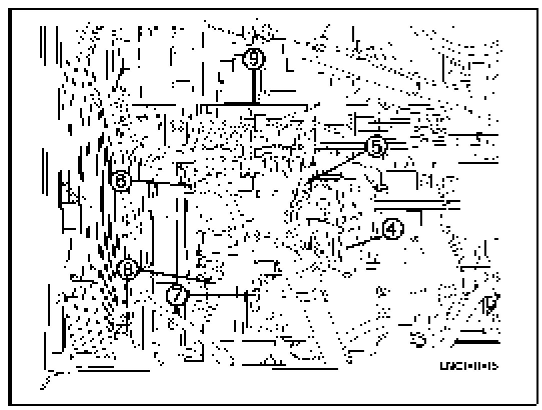


REMOVAL

1. Disconnect negative (-) terminal (1) of the battery located behind the radiator grille.



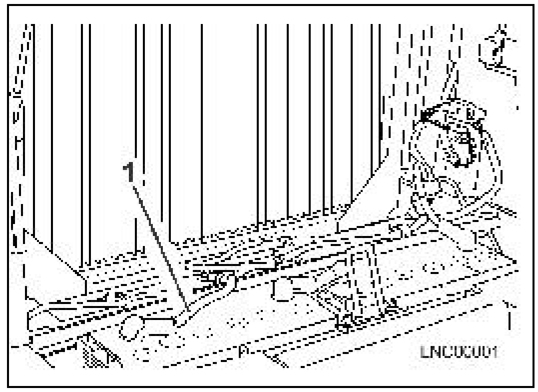
2. Open engine hood right side cover and lock into position (3).
3. Disconnect the throttle linkage (4).
4. Disconnect the fuel inlet line (filter to pump line) (5).
5. Disconnect the return (6) and drain lines (7).
6. Disconnect the electrical wiring (8).
7. Disconnect the six fuel lines (pump to injectors) (9).
8. Remove the Fuel Injection Pump.
   Refer to "ENGINE SHOP MANUAL".



INSTALLATION

Ú Install fuel injection pump assembly in reverse order of removal

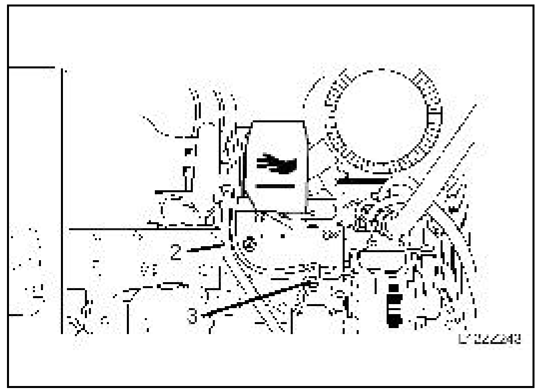
ENGINE OIL COOLER



Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Disconnect the cable from the negative (-) terminal of the battery.

REMOVAL

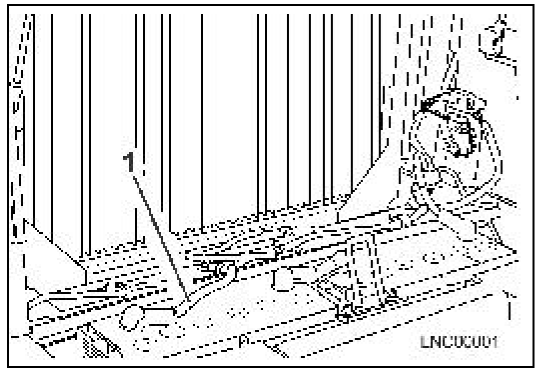


1. Disconnect negative (-) terminal (1) of the battery located behind the radiator grille.
2. Open engine hood left side door and lock into position.
3. Drain the engine oil.
   Refer to “OPERATIONAL & MAINTENANCE MANUAL”.
4. Remove the alternator.
   Refer to “ENGINE SHOP MANUAL”.
5. Remove the turbocharger drain line (2).
6. Remove the Oil Filter.
   Refer to “OPERATIONAL & MAINTENANCE MANUAL”.
7. Remove the Engine Oil Cooler (3).
   Refer to “ENGINE SHOP MANUAL”.

INSTALLATION

Ú Install engine oil cooler in reverse order of removal.

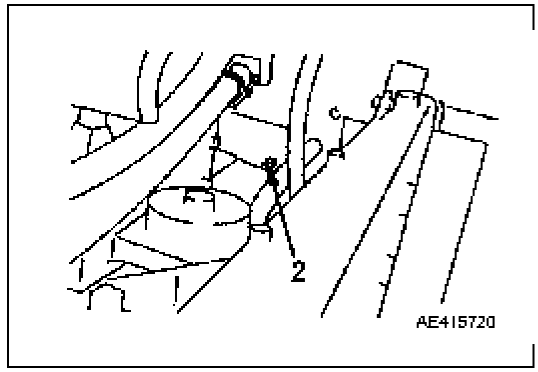
WATER PUMP



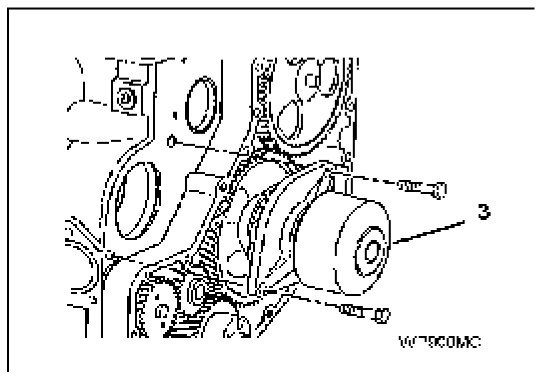
Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Disconnect the cable from the negative (-) terminal (1) of the battery.

REMOVAL



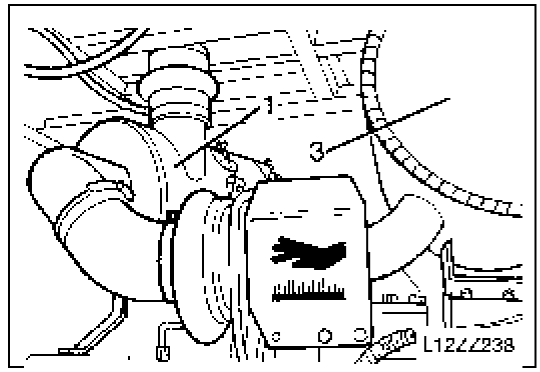
1. Open engine hood left side door and lock into position.
2. Drain water system (coolant) (2).
   Refer to "OPERATION & MAINTENANCE MANUAL".
3. Remove the Fan Belt from the Alternator and Belt Tennsioner.
   Refer to "ALTERNATOR ASSEMBLY".
4. Remove the alternator.
   Refer to "ALTERNATOR ASSEMBLY".
5. Remove the Water Pump (3).
   Refer to "ENGINE SHOP MANUAL".



INSTALLATION

Ú Install the water pump assembly in reverse order of removal. Refer to "ENGINE SHOP MANUAL".

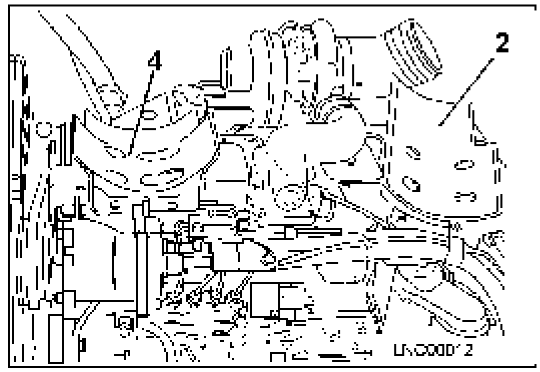
NOZZLE HOLDER



Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

REMOVAL

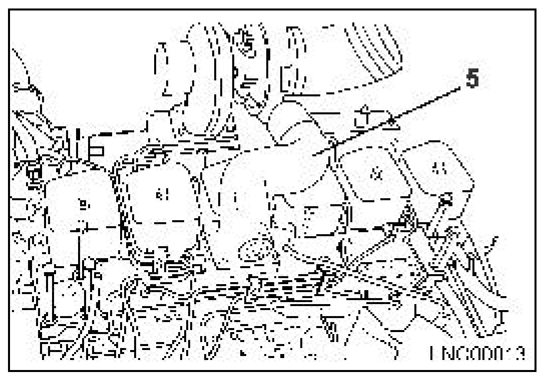
1. Remove hood.
   Refer to "ENGINE HOOD REMOVAL".



2. Remove air cleaner (1) and bracket (2).
   Refer to "MUFFLER AND AIR CLEANER REMOVAL".

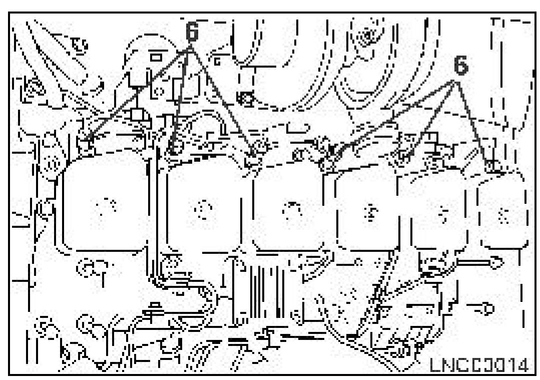
3. Remove muffler (3) and mount bracket (4).
   Refer to "MUFFLER AND AIR CLEANER REMOVAL".

   NOTE: When the muffler bracket is removed, the air conditioner compressor and mount bracket comes off with it.



4. Remove turbocharger crossover tube (5) (air intake).

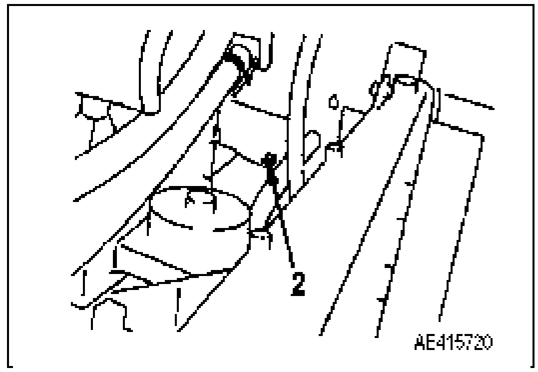
5. Remove nozzel holder (6).
   Refer to "ENGINE SHOP MANUAL".



INSTALLATION

Ú Install nozzel holder in reverse order of removal. Refer to "ENGINE SHOP MANUAL".

THERMOSTAT

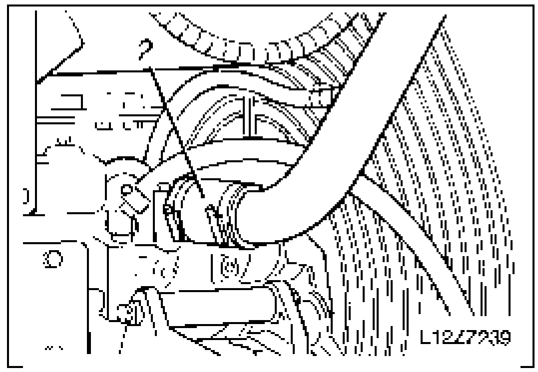


Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

REMOVAL

1. Drain water system of coolant (1).
   Refer to “OPERATION & MAINTENANCE MANUAL”.

2. Open engine hood left side door and lock into position.



3. Disconnect screw clamp on thermostat and remove hose connection (2).

4. Remove thermostat.
   Refer to “ENGINE SHOP MANUAL”.

INSTALLATION

Ú Install thermostat in reverse order of removal. Refer to “ENGINE SHOP MANUAL”.

TURBOCHARGER

Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

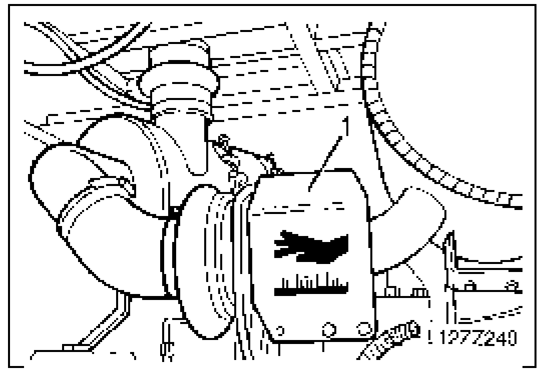
REMOVAL

1. Open engine hood left side door and lock into position.

2. Remove heat shield (1).

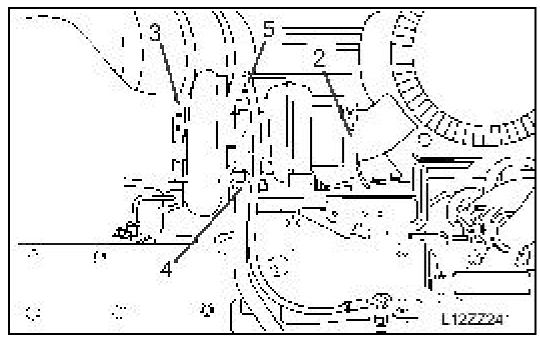
3. Disconnect muffler clamp (2), air intake clamp (3), oil drain line (4) and oil lube line (5).

4. Remove turbocharger.
   Refer to “ENGINE SHOP MANUAL”.

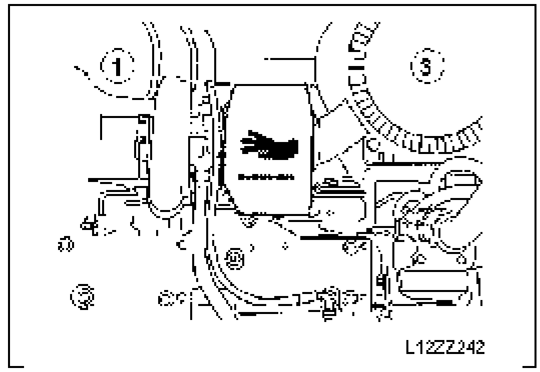


INSTALLATION

Ú Install turbocharger assembly in reverse order of removal. Refer to “ENGINE SHOP MANUAL”.

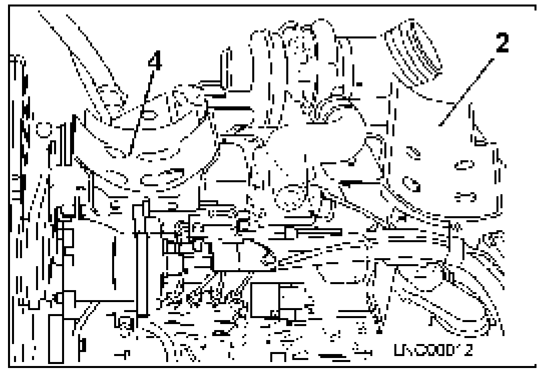


CYLINDER HEAD



Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

REMOVAL



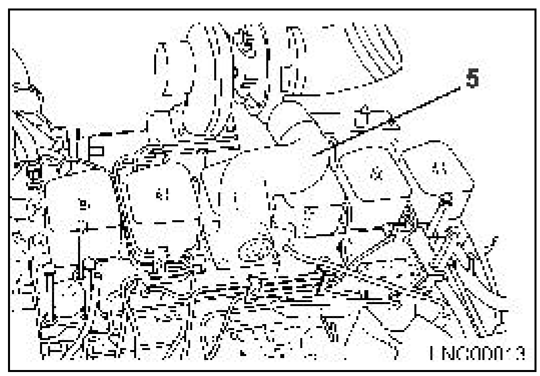
1. Remove hood.
   Refer to "ENGINE HOOD REMOVAL".

2. Remove air cleaner (1) and bracket (2).
   Refer to "MUFFLER AND AIR CLEANER REMOVAL".

3. Remove muffler (3) and mount bracket (4).
   Refer to "MUFFLER AND AIR CLEANER REMOVAL".

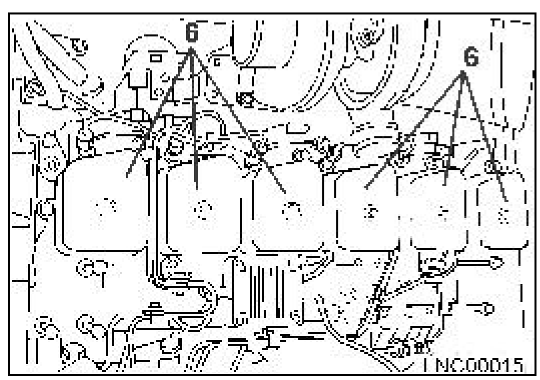
   NOTE: When the muffler bracket is removed, the air conditioner compressor and mount bracket comes off with it.

4. Remove turbocharger crossover tube (air intake).



5. Remove cylinder head.
   Refer to "ENGINE SHOP MANUAL".

INSTALLATION



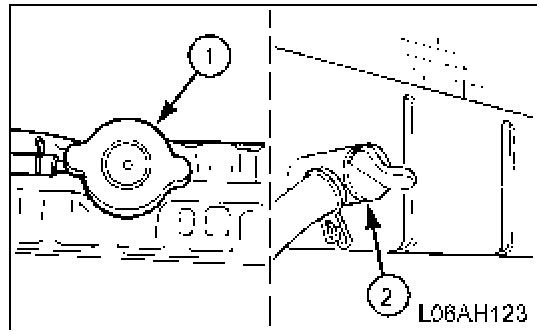
Ú Install cylinder head in reverse order of removal. Refer to "ENGINE SHOP MANUAL".

RADIATOR

Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

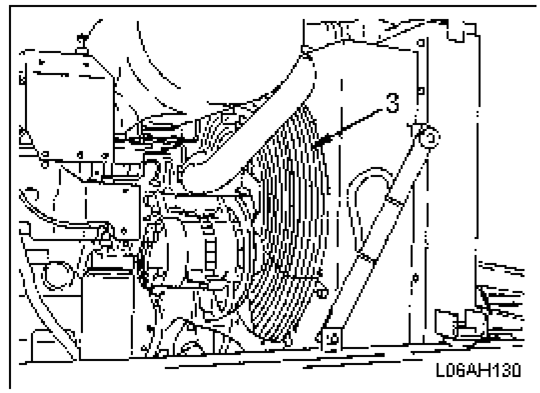
Warning! Disconnect the cable from the negative (-) terminal of the battery.



REMOVAL

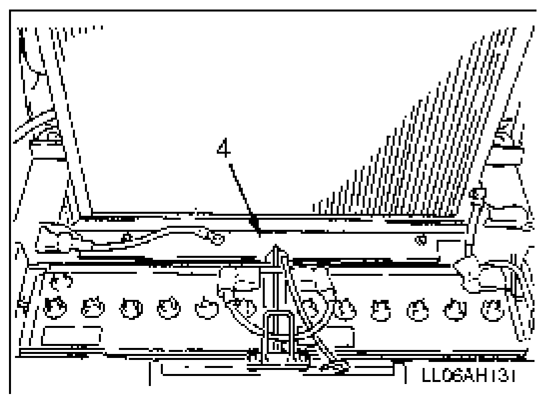
1. **Engine hood and side covers**
   Refer to “REMOVAL OF ENGINE HOOD”.

2. **Draining coolant**
   Loosen radiator cap (1) to release internal pressure, and open drain valve (2) and drain coolant from system.
   Ú When system is drained close the drain valve.
   Ú If the coolant contains antifreeze, dispose of it properly.



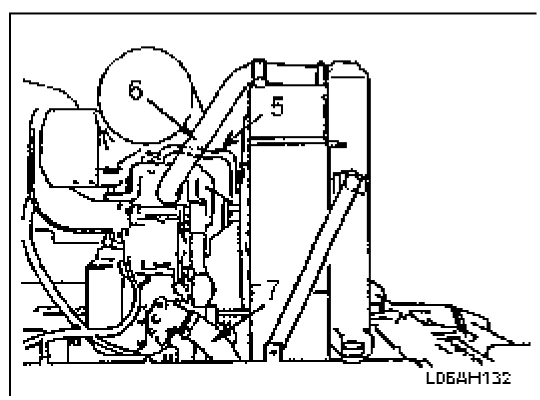
Coolant: 36.5ℓ (9.6 US gals)

3. **Fan guards**
   Remove fan guard (3).
   Ú Be careful not to damage radiator fins.
   Ú Remove the left and right fan guard with them still connected

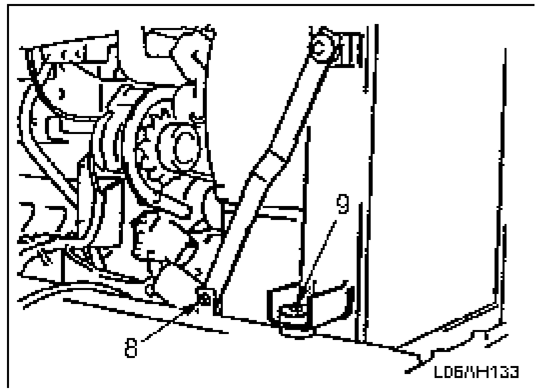


4. **Rear cover** ✲4
   Remove cover (4) at the bottom rear of the radiator.

5. **Radiator hoses** ✲3
   Disconnect radiator hoses (5) (6) and (7) at engine end.

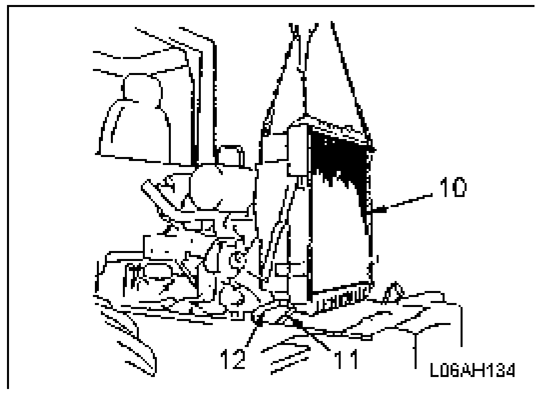


6. **Radiator supports**
   Remove bolts (8) of radiator supports from rear frame end.
   Sling radiator temporarily, then remove bolt (9).



7. **Hang radiator**
   Hang radiator (10) and slide backward, then disconnect cooler hoses (11) and (12).

8. **Remove radiator**



INSTALLATION

Ú Install radiator in reverse order of removal.

※4

Ú Install so that the clearance between fan and fan guard is uniform

※3

Ú Temporarily tighten the mounting bolts and fix the position, then tighten fully.

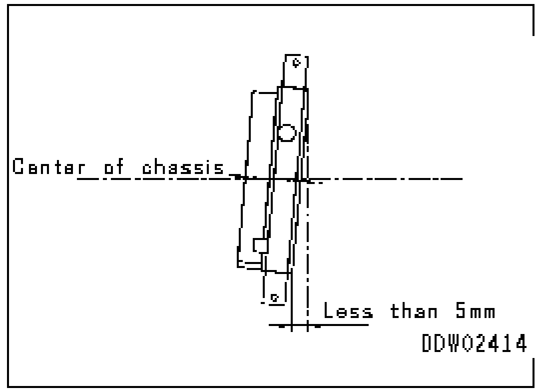
Ú When installing the radiator, the difference in the clearance between the fan and radiator on the left and right must be within 3 mm (0.12 IN).

Ú Install so that the clearance between the radiator fins and the front face of the fan is uniform at the top, bottom, left, and right.

Ú The difference between the left and right in the position of the radiator in the front-to-rear direction must be within 5 mm ((0.197").

Ú Adjust so that the clearance between the shroud and fan is uniform.

Ú Be careful not to damage the fins on the radiator assembly.



Ú Tighten hoses without twisting.

Radiator mounting bolts:
82 ±8 lbf.ft
(112.8 ±9.8 Nm)
(11.5 ±1.0 kgm)

Radiator support mounting bolts:
82 ±8 lbf.ft
(112.8 ±9.8 Nm)
(11.5 ±1.0 kgm)

Torque converter cooler hoses:
130 ±22 lbf.ft
(176.4 ±29.4 Nm)
(18.0 ±3.0 kgm)

! **Refilling with oil and water**

1) Tighten drain valve and add water through water filler to specified level.
2) Add transmission oil through oil filler to the specified level.

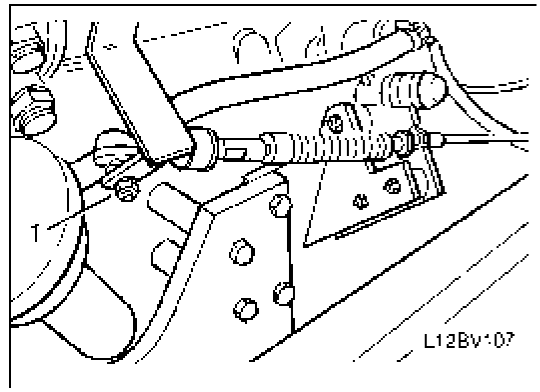
Ú Run the engine to circulate the oil through the system. Then check the oil level again.

ENGINE

Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

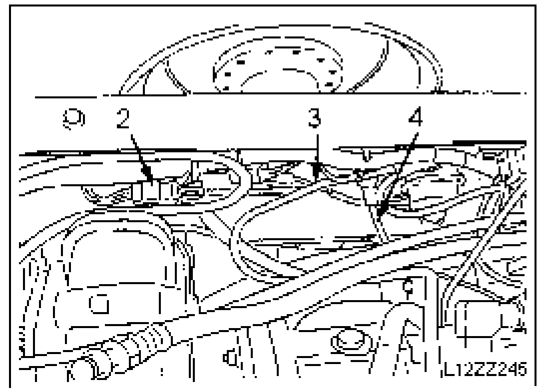
Warning! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

Warning! Disconnect the cable from the negative (-) terminal of the battery.



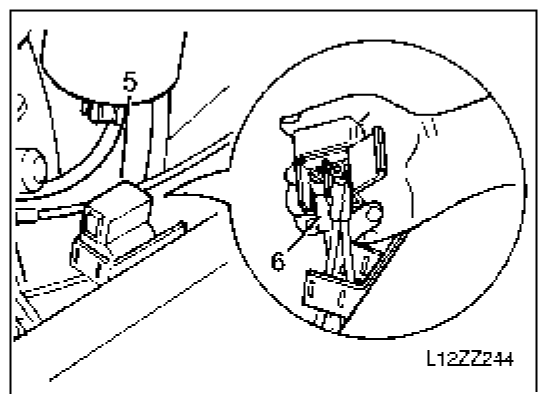
REMOVAL

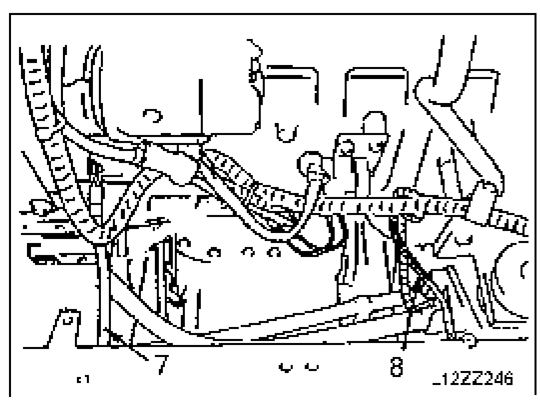
1. Remove engine hood and radiator.
   Refer to " REMOVAL OF RADIATOR" 1
   - **i** For machines equipped with air conditioning:
     Disconnect the heater hose, then remove the compressor together with the bracket, and move to the side.



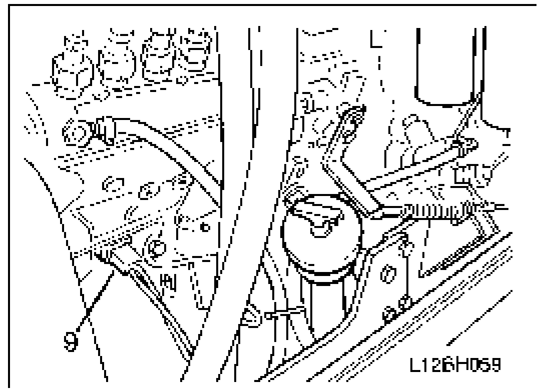
2. Disconnect fuel control cable (1) at engine end.

3. Disconnect the following electric wiring:
   1) Disconnect rear wiring connectors (2) from rear frame connectors.
   2) Disconnect cable (3) between battery relay and starting motor from starting motor.
   3) Disconnect wiring harness (4) for air intake heater at relay side.
   4) Remove slow blow fuse box (5) and open cover, then disconnect wiring connector (6) between engine wiring and slow blow fuse.
   5) Disconnect ground wiring (7) from staring motor.
   6) Disconnect ground wiring (8) from alternator.

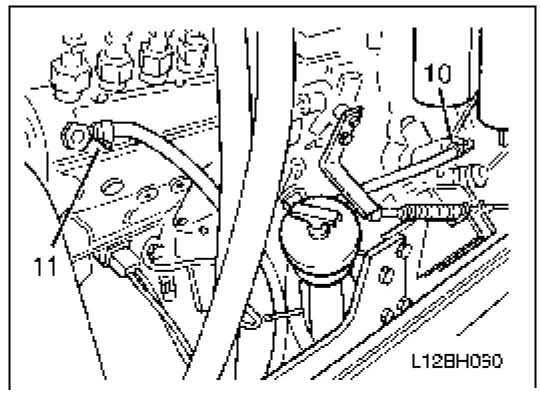




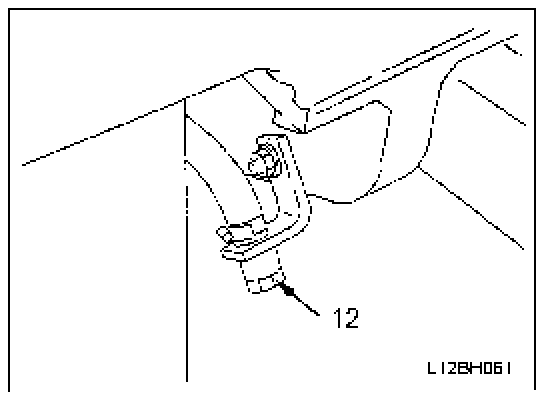
4. Disconnect fuel level sensor connector (9).



5. Disconnect the following fuel lines.
    1) Disconnect hose (10) between fuel tank and feed pump from feed pump.
    2) Disconnect fuel return hose (11) from engine.

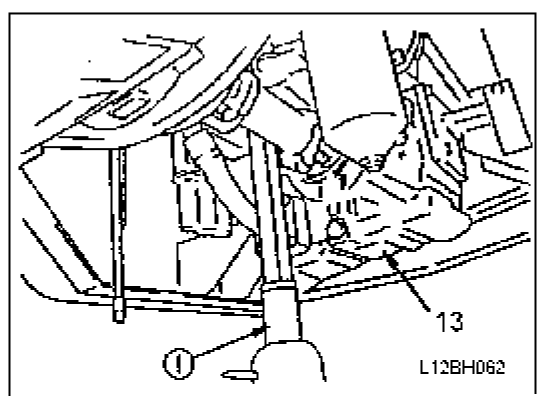


6. Remove engine oil drain valve (12) from rear axle pivot portion.



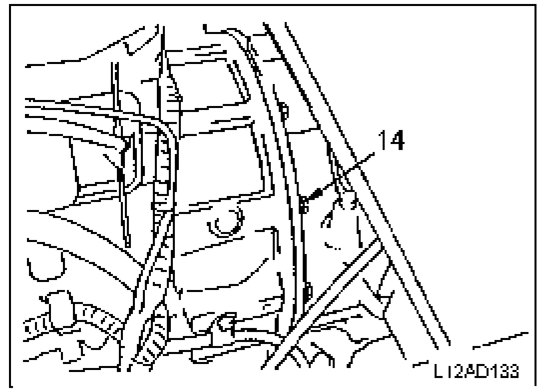
7. Set stand â under transmission (13).

Ú Adjust the height properly and set stand â in posotion.



8. Sling engine and remove bolts connected to transmission (14).

2

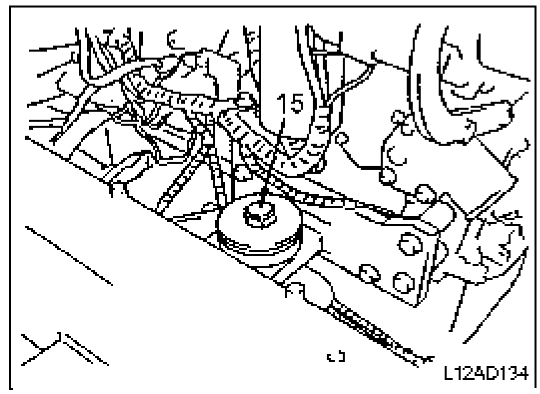


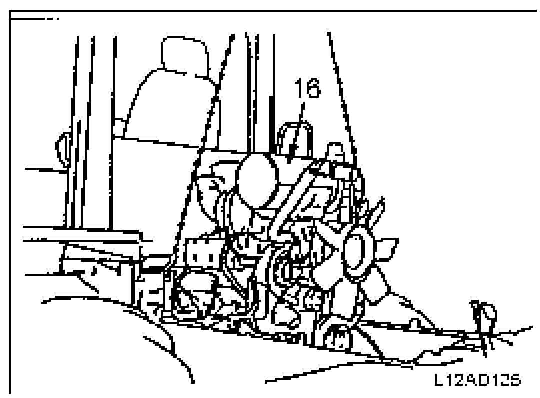
9. Remove mounting bolts and lift off engine (16).

3

   i Be extremely careful not to damage the fuel tank breather tube and engine oil drain hose when removing.

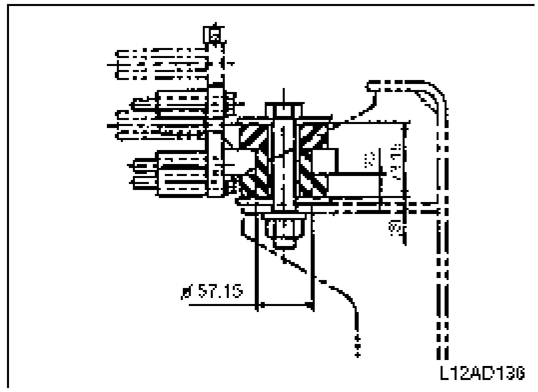
kg Engine: 575 kgm





INSTALLATION

! Carry out installation in reverse order of removal



※1

- Install radiator and hood. For details, see “INSTALLATION OF RADIATOR”.

※2

Mounting bolt:
745 ± 83 Nm (76 ± 8.5 kgm)
(Width across flats: 32 mm)

※3

- Check that there is a O-ring installed to the mating face of the torque converter.

Outside circumference of O-ring:
Soapy water

- When connecting the engine and torque converter, adjust the height so that the torque converter pilot goes in smoothly. Never use force when connecting.
- When assembling the rubber, never use grease, oil, or soapy water.

! **Refilling with oil and water.**

1) Tighten drain valve and add water through water filler to the specified level.
2) Add transmission oil through oil filler to the specified level.
   - Run the engine to circulate the oil through the system. Then check the oil level again.

ENGINE HOOD

Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

REMOVAL

Refer to "TORQUE CONVERTER, TRANSMISSION" REMOVAL step 3.

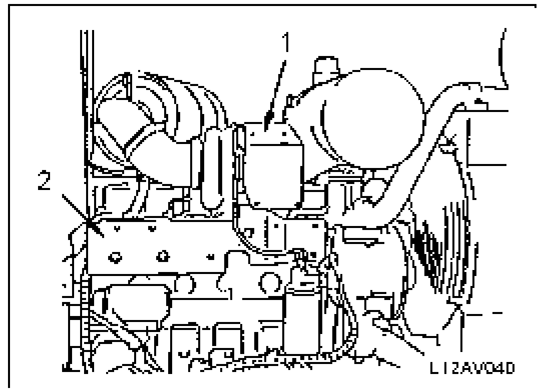
INSTALLATION

Refer to "TORQUE CONVERTER, TRANSMISSION" INSTALLATION

MUFFLER AND AIR CLEANER

Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Disconnect the cable from the negative (-) terminal of the battery.

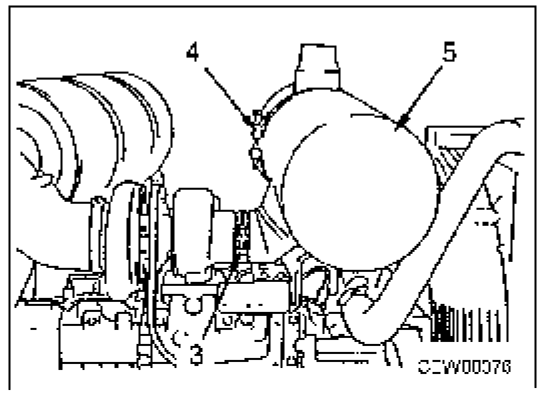


REMOVAL

1. Remove engine hood.
   Refer to “REMOVAL OF ENGINE HOOD”.

2. Remove cover (1), (2).

3. Remove clamps (3) connecting muffler with turbo charger.

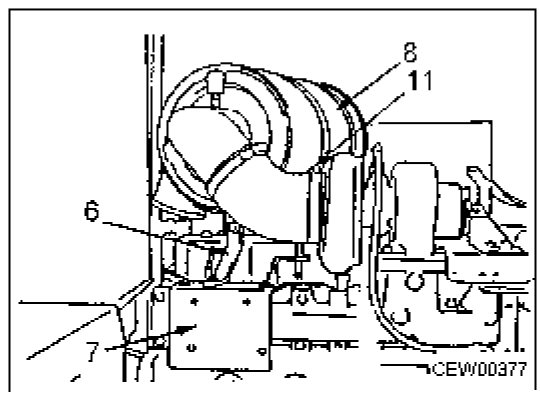


※1

4. Remove band (4) fixing muffler (5) to mounting bracket (9).

5. Remove bracket (6), (7).
   i Be careful not to miss the spacers.

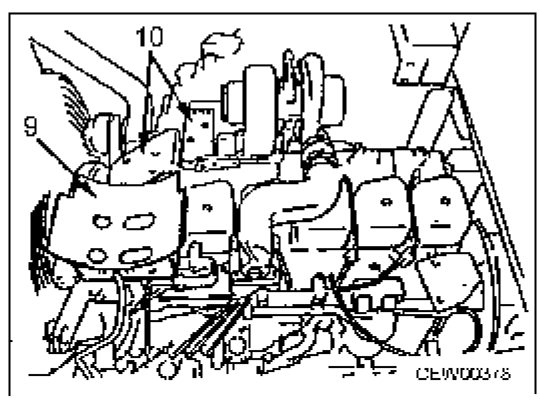
6. Remove clamp (11) for air cleaner hose and 3 bolts mounting air cleaner, then remove air cleaner (8).



7. Remove mounting bracket (9), (10).

INSTALLATION

! Carry out installation in the reverse order of removal.

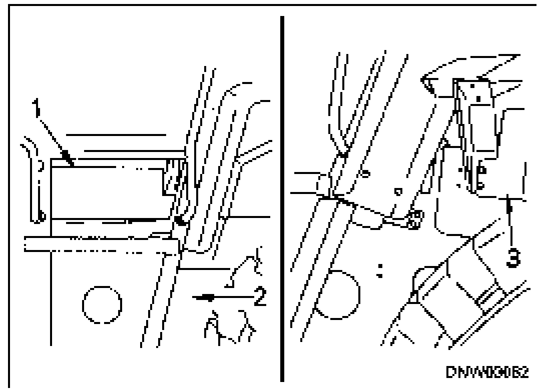


※1

Clamp for Exhaust muffler:
Torque to: 7.8 Nm (0.8 kgm)

TORQUE CONVERTER CHARGING PUMP

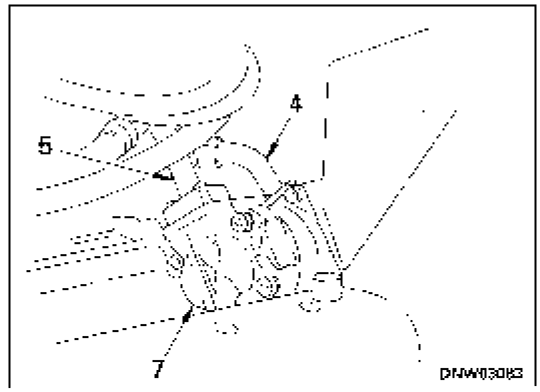
Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.



REMOVAL

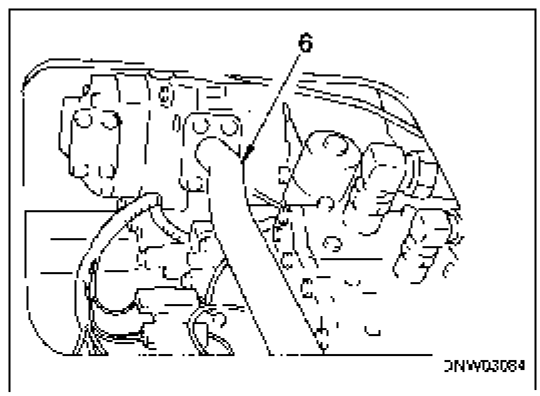
1. **Covers**
   Remove cover (1) at bottom of cab, transmission inspection cover (2), and side inspection cover (3).

2. **Hydraulic piping**
   Disconnect following hydraulic piping.
   Disconnect tube (4) between filter and pump from pump.
   Disconnect tube (5) between pump and power master cylinder from pump.
   Disconnect tube (6) between transmission strainer and pump from pump.

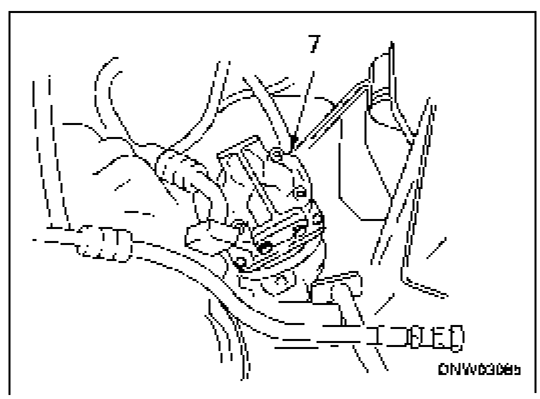


3. **Torque converter charging pump** Sling pump (7), then remove mounting bolts, and remove torque converter charging pump (7). ※1

i Carry out the removal operation with two workers.



kg Torque converter charging pump: **13 kg**



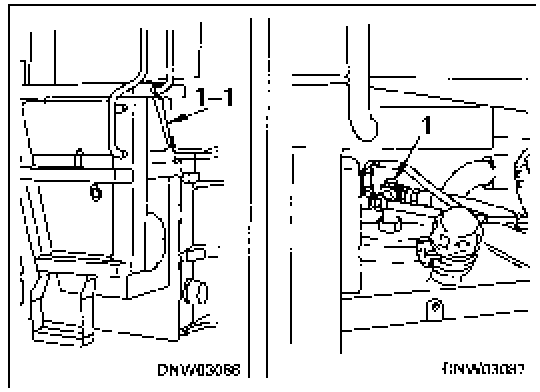
INSTALLATION

! Carry out installation in the reverse order of removal.

※1

Check that there is an O-ring fitted at the mating surface with the housing.

TORQUE CONVERTER, TRANSMISSION



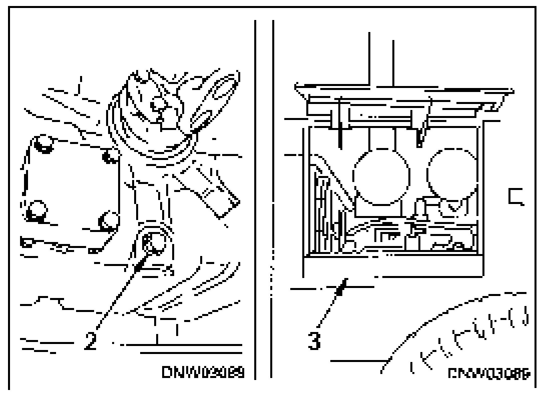
Warning! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

Warning! Remove cover (1-1) at the top of the hydraulic tank, loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen plug (1) at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.

Warning! Disconnect the cable from the negative (-) terminal of the battery.

REMOVAL



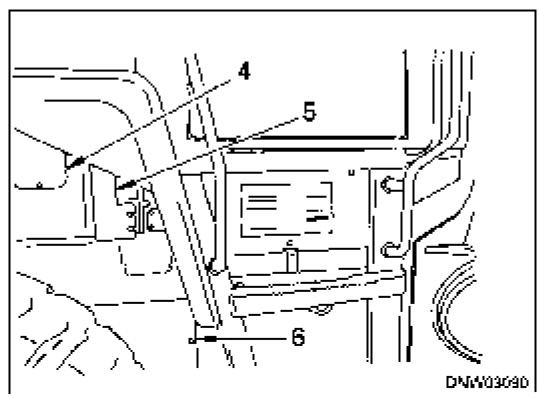
1. Drain oil

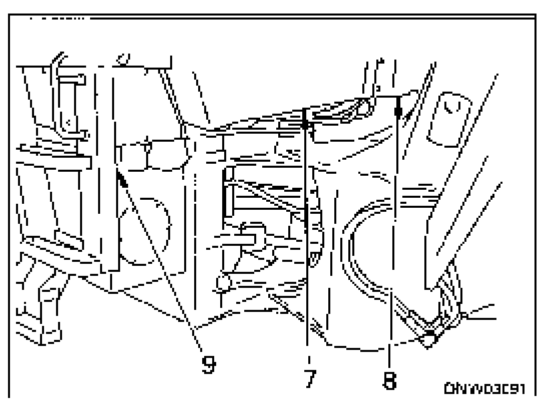
Ú Loosen drain valve (2) and drain transmission oil.

Transmission oil: **35 L**

2. Covers, ladder

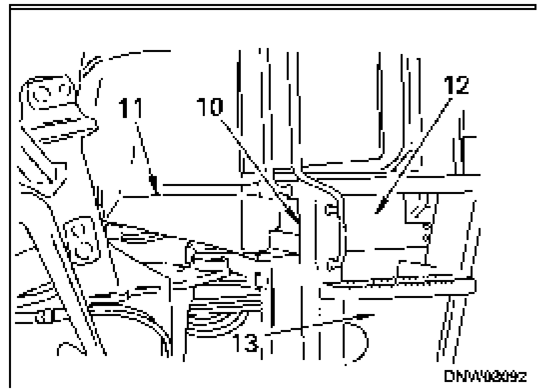
1) Remove hood panel (3).
2) Remove hood covers (4) and (5).
3) Remove rear frame inspection cover (6).



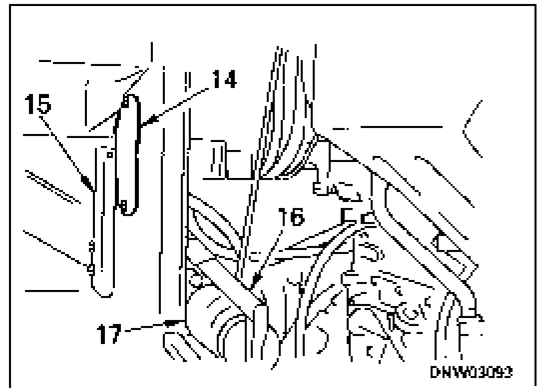


4) Remove covers (7) and (8) under cab.
5) Remove ladder fender assembly (9).

6) Remove ladder fender assembly (10). ※1
7) Remove covers (11) and (12) under cab.
8) Remove rear frame inspection cover (13).

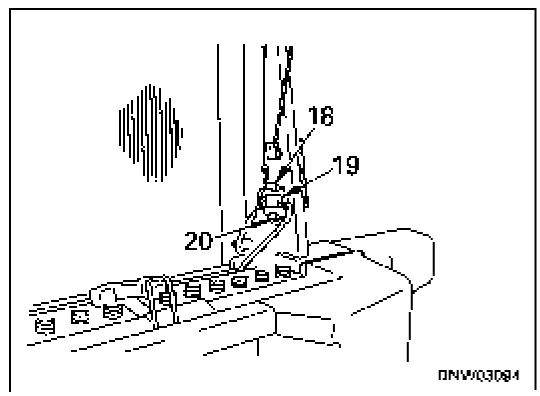


9) Remove hood covers (14) and (15), then remove grease gun (16).
Ú Loosen the mounting bolts of grease gun clamp (17).

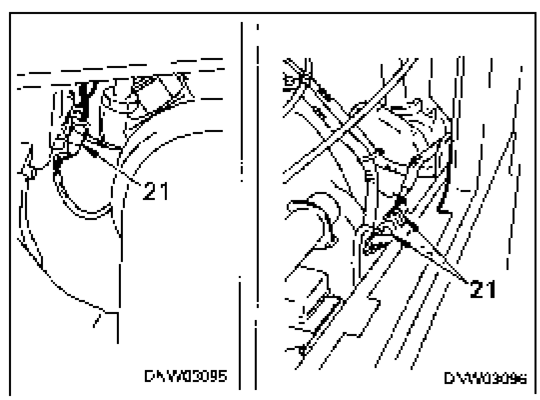


3. Hood

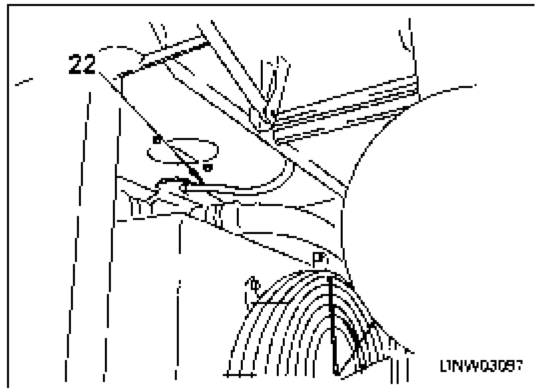
1) Remove rear lamp wiring connectors (18), (19), and (20) from hood, and disconnect connector (18).



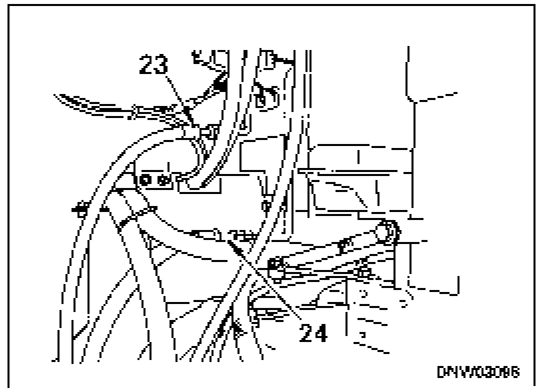
2) Disconnect bulkhead wiring connectors (21) from rear wiring.



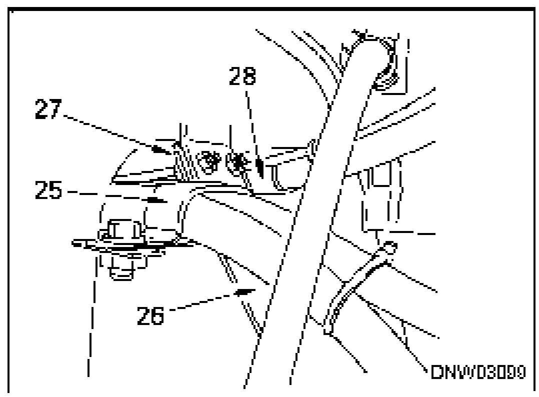
3) Disconnect hose (22) between radiator and radiator subtank at radiator end.



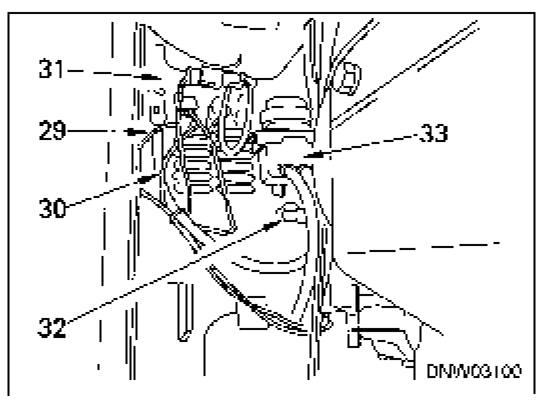
4) Disconnect air conditioner hoses (23) and (24).
Ú Carry out the oil return operation for the compressor, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves. 2



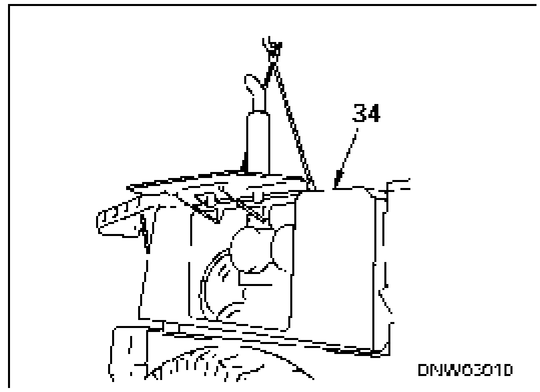
5) Remove heater hose clamp (25) from hood.
6) Remove mounting plate (27) of rubber (26) from hood.
7) Remove brake hose clamp (28).



8) Disconnect window washer hoses (29) and (3) from window washer tank (31).
   Ú Make marks to distinguish the hoses.
9) Disconnect brake oil level sensor connector (32).
10) Remove brake tank (33).
   Ú Open the inspection cover at the top of the hood.
   Ú Tighten the cap of the brake tank and secure it to the mounting clamp on the frame for the grease gun.

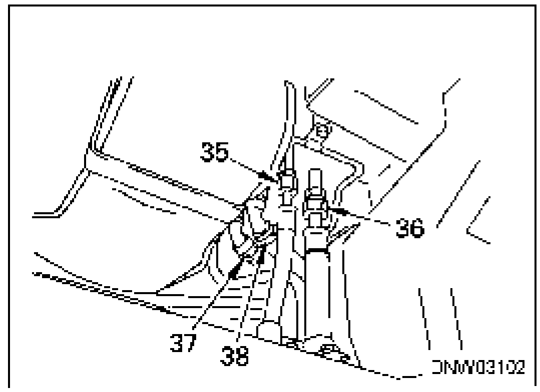


11) Fit eye-bolt to top of hood (34) and sling, then remove mounting bolts and lower hood assembly slowly.
Ú Open the side door of the hood to prevent interference.



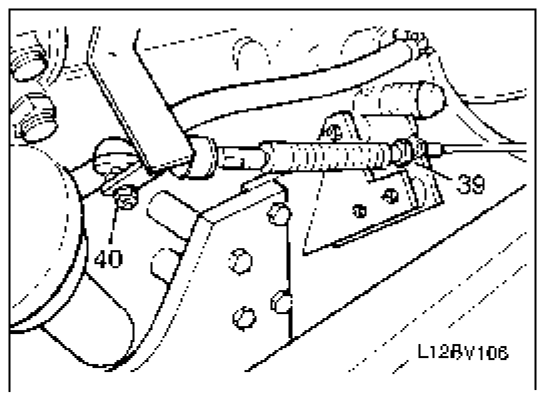
4. Disconnect air conditioner hoses (35) and (36) from under air conditioner unit. ⁝3

i After disconnecting the air conditioner hoses, cover up the openings to prevent any entry of dirt or water.
Loosen the clamp of heater hoses (37), (38), and disconnect the hoses.



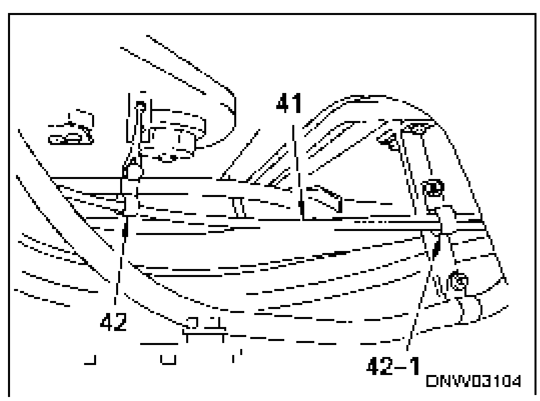
5. Fuel control cable

1) Loosen locknut (39) of fuel control cable.
2) Remove nut of fuel control cable (40) and disconnect from injection pump. 4



6. Work equipment control cable

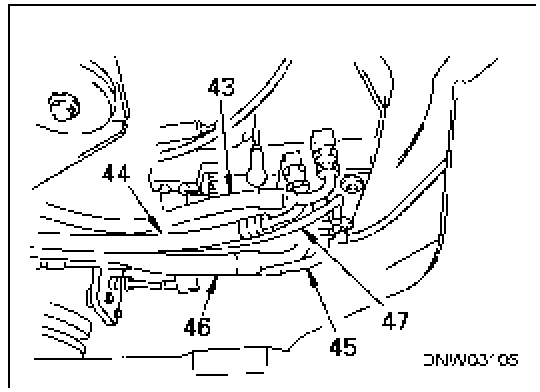
Disconnect work equipment control cable (41) at main control valve end, and remove intermediate clamps (42) and (42-1). 5



7. Steering hoses

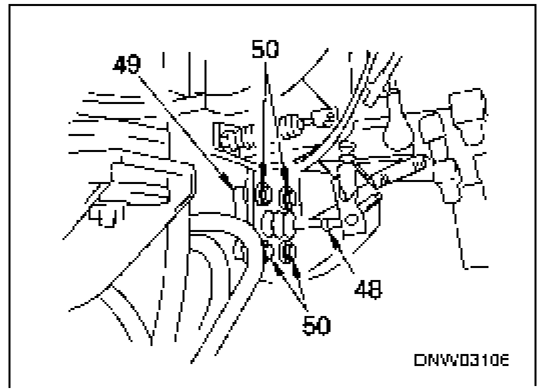
Disconnect steering valve hoses at steering valve end.

- Hose(43) between steering valve and steering cylinder tube
- Hose (44) between steering valve and hydraulic tank
- Hose(45) between steering valve and steering cylinder tube
- Hose (46) between steering valve and priority valve
- Hose (47) between steering valve and priority valve



8. Master cylinder

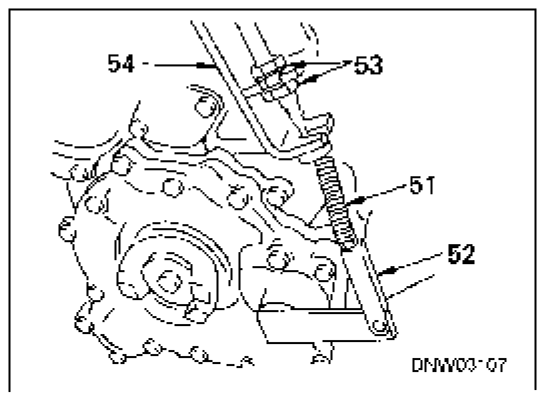
1) Remove push rod (48) of master cylinder.
2) Remove mounting bolts (50) of master cylinder (49), then remove master cylinder.



9. Parking cable

1) Remove clevis pin and disconnect yoke (52) of parking brake cable (51).
2) Loosen adjustment nut (53) of parking brake cable and disconnect parking brake cable (51) from cable bracket (54).
3) Remove parking brake cable bracket (54).

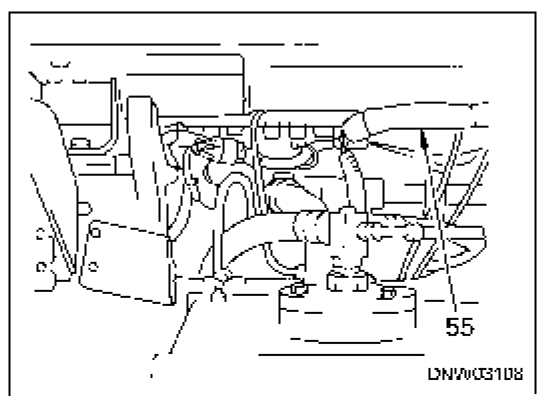
※6



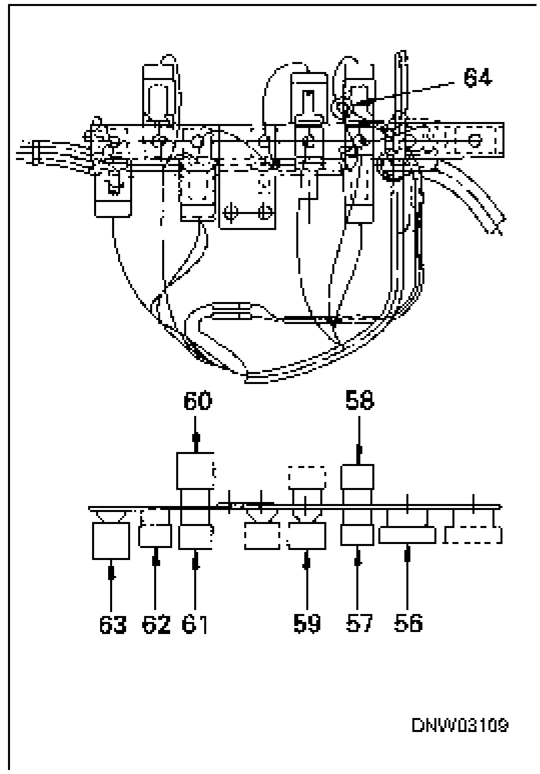
10. Electric wiring

1) Disconnect following wiring harness connector from floor wiring harness (55).

※7

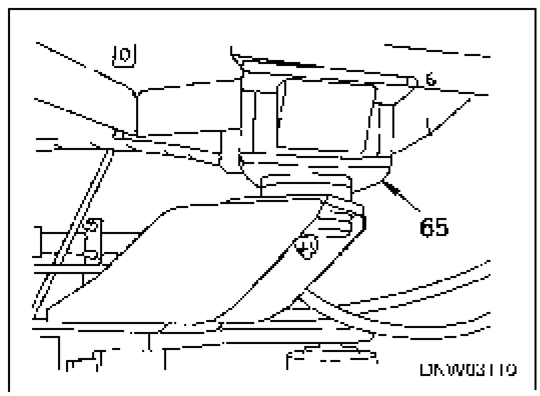


2) Disconnect ground terminal (64) from floor.

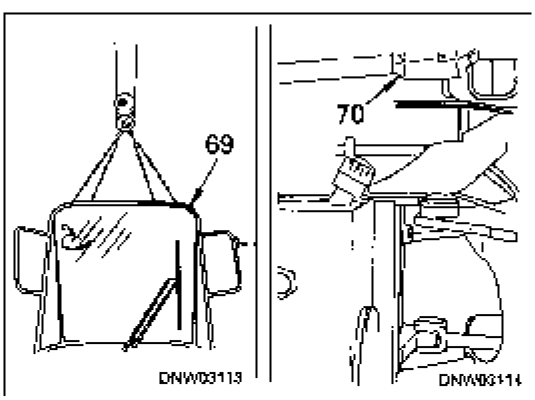


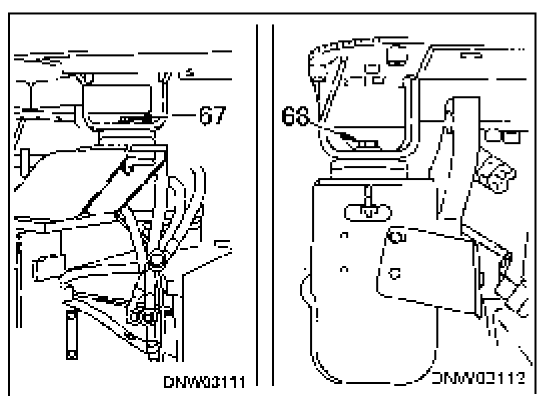
11. Cab, floor support

1) Disconnect left and right covers (65) from floor support mount.
2) Sling cab and remove 4 left and right mounting bolts (67) and (68) of floor support.
3) Raise cab (69), and lift off floor support (70) as an assembly.



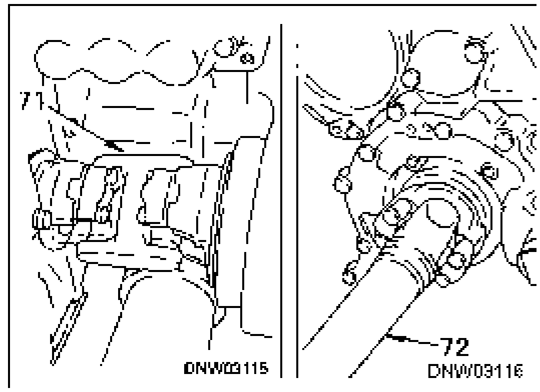
ROPS Cab, floor assembly: **653 kg**





12. Drive shafts

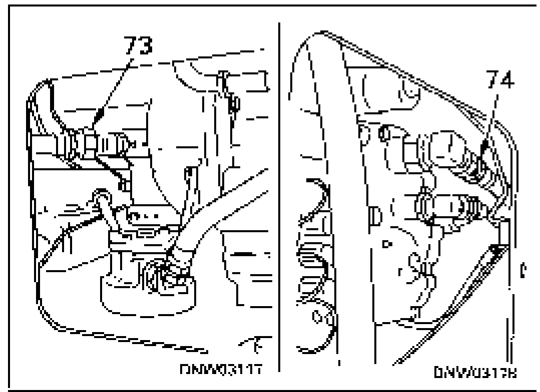
1) Disconnect rear drive shaft (71) at transmission end.
2) Disconnect center drive shaft (72) at transmission end.



13. Cooler hoses

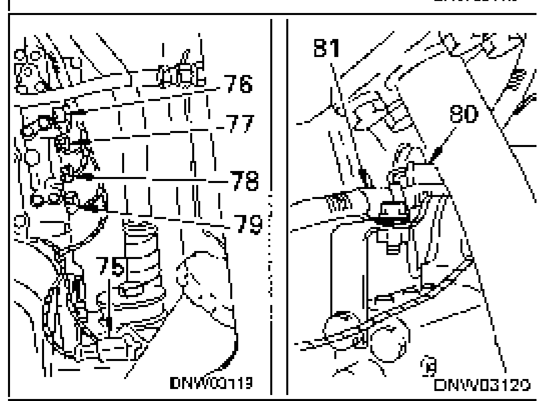
1) Disconnect cooler hose (73) from transmission.
2) Disconnect cooler hose (74) from transmission valve.

10

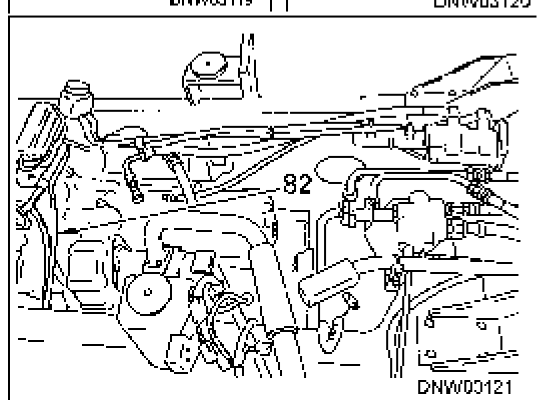


14. Transmission wiring

1) Disconnect transmission wiring harness, speedometer sensor connector (75), and transmission solenoid connectors (76), (77), (78), and (79).
2) Disconnect oil pressure sensor connector(80).
Remove transmission wiring harness clamp (81).

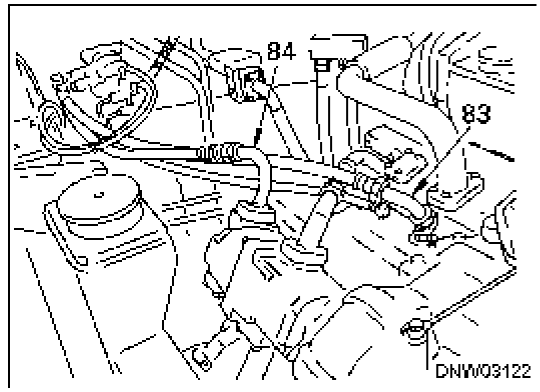


3) Remove mounting band of transmission wiring harness (82) from engine wiring harness.



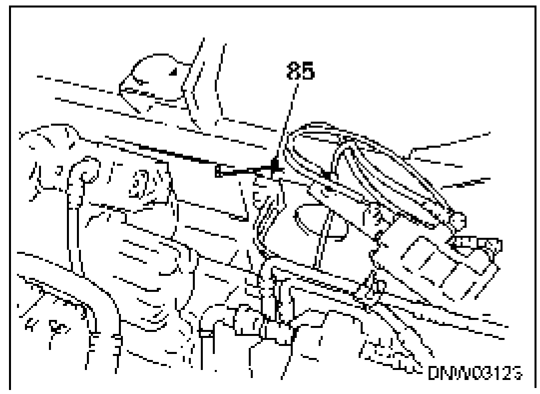
15. Brake hoses

1) Disconnect hose (83) between transmission and power master cylinder at transmission end.
2) Disconnect tube (84) between torque converter charging pump and power master cylinder at torque converter charging pump end.



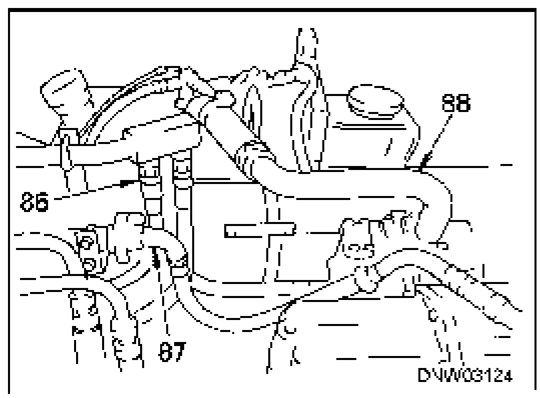
16. Remove mounting bolt of cushion valve (85).

Ú Set the cushion valve on top of the rear frame lower hinge.



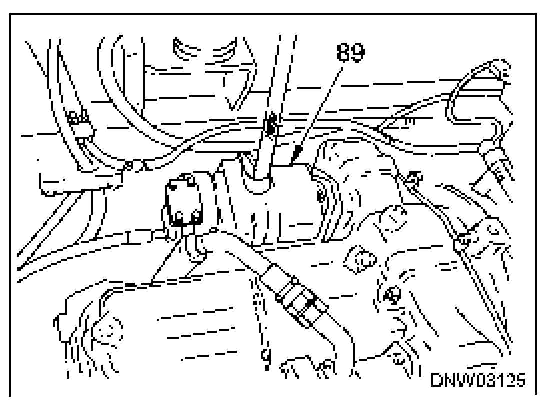
17. Hydraulic, steering pump

1) Disconnect hoses (86) and (87) between hydraulic, steering pump and priority valve at priority valve end.
2) Remove tube (88) between hydraulic, steering pump and hydraulic tank.



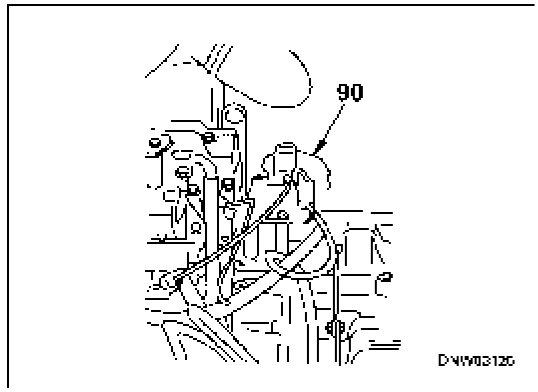
3) Lift off hydraulic and steering pump (89) together with hose.

11

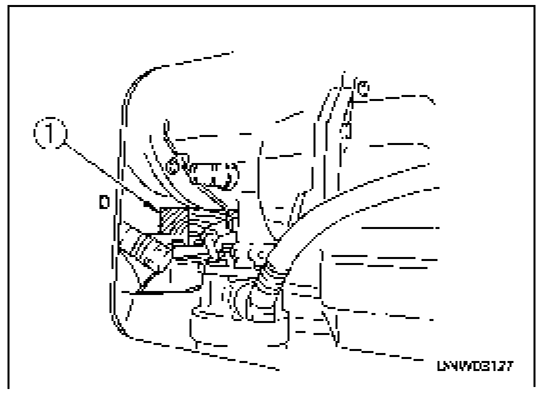


18. Torque converter, transmission

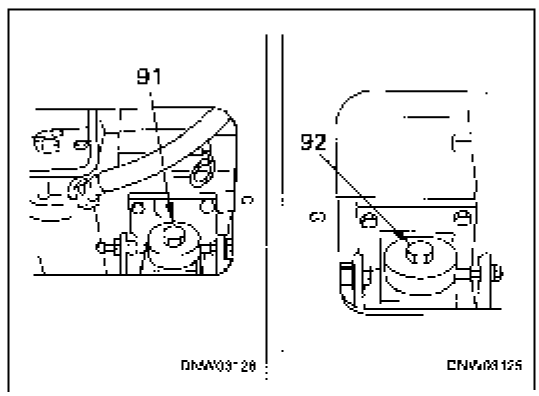
1) Remove mounting bracket of engine stop motor (90) from engine flywheel housing, and move towards engine.



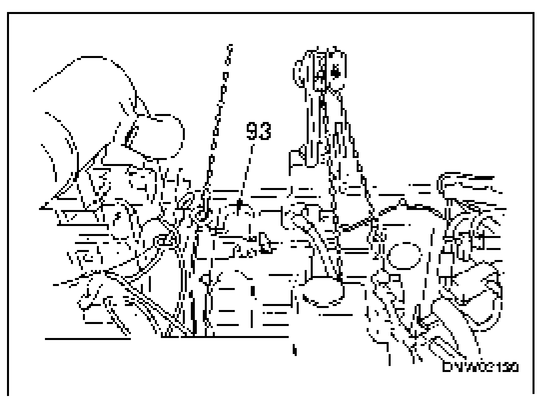
2) Set block Î between engine and axle housing and adjust height.



3) Using eye bolts, sling torque converter and transmission, then remove bracket mounting bolts (91) and (92). ※12



4) Remove mounting bolts connecting to engine, and lift off torque converter and transmission (93). ※13



Ú Be careful of the mating of the pilot cover and lift off slowly.
Ú Check that there is no interference between the piping and any other parts before lifting off.

kg Torque converter, transmission: **557 kg**

INSTALLATION

! Carry out installation in the reverse order of removal.

1

Ú Determine the position, then tighten fully.

2

Hose mouthpiece nut (16 mm):
13.2 ± 1.5 Nm (1.35 ± 0.15 kgm)

Hose mouthpiece nut (22 mm):
22.1 ± 2.6 Nm (2.25 ± 0.25 kgm)

3

Hose mouthpiece nut (16 mm):
13.2 ± 1.5 Nm (1.35 ± 0.15 kgm)

Hose mouthpiece nut (24 mm):
31.9 ± 2.6 Nm (3.25 ± 0.25 kgm)

4

Ú For details of the procedure for adjusting the cable length, see TESTING AND ADJUSTING.

Cable joint nut:
13.7 ± 1 Nm (1.4 ± 0.1 kgm)

5

Ú Adjust the work equipment lever.
For details, see TESTING AND ADJUSTING, Measuring, adjusting work equipment lever.

6

Ú If the operation of the brake is poor, carry out adjustment. For details, see TESTING AND ADJUSTING.

7

Ú Apply the connector lock securely.

8

Floor mount bolt:
279.5 ± 29.4 Nm (28.5 ± 3.0 kgm)

9

Ú Be careful to connect the coupling facing in the correct direction.

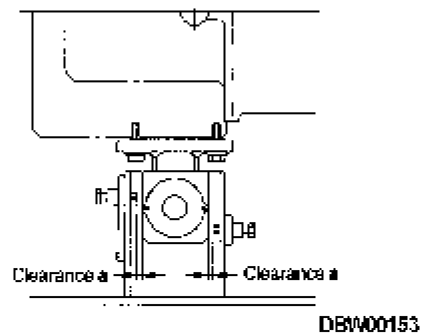
Mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

10

Mouthpiece nut:
196.1 ± 49 Nm (20.0 ± 5.0 kgm) (Width across flats: 41 mm)

11

Ú Check that there is an O-ring fitted in the mating surface of the housing, and be careful not to get it caught.



★12

Bracket mounting bolt:
279.5 ± 94.5 Nm (28.5 ± 30 kgm)

- When installing the rubber, do not use oil or soapy water.
- Clearance **a : 1.0 - 3.0 mm**

Mounting bolt:
652.1 ± 34.3 Nm (66.5 ± 3.5 kgm)
(Width across flats: 32 mm)

- To determine the position of the transmission, adjust with the adjustment screw to set clearance **a** to the specified dimension, then tighten the mounting bolts.

★13

- Check that there is an O-ring fitted in the torque converter housing.

Outside circumference of O-ring: **Soapy water**

- When connecting the torque converter to the engine, adjust the height so that the torque converter pilot goes in smoothly. Do not use force to connect the torque converter and engine.

Refilling with oil

1) Tighten drain plug and add transmission oil through oil filler to the specified level.
   - Run the engine to circulate the oil through the system. Then check the oil level again.

   Transmission oil: **35 L**

2) Tighten the plug at the top of the hydraulic tank filter and the plug in the pump piping, then add hydraulic oil through the oil filler to the specified level.

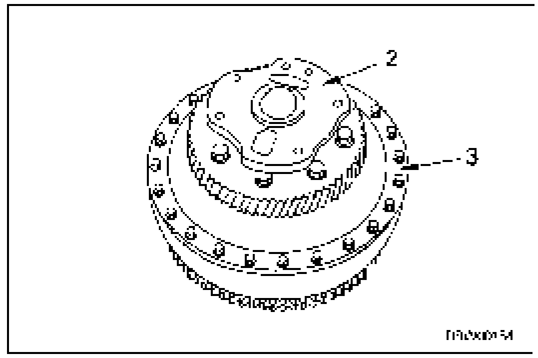
! Filling with gas

- Fill the air conditioner with gas. (Rl34a)
  - Guideline for amount when filling: 1.5 - 1.6 kg
- Before filling with refrigerant, always use the repeat vacuum method to completely evacuate.
- Do not use the can of refrigerant upside down or use any other mistaken method. Be careful not to let liquid Freon get into the refrigerating system.
- Do not operate the compressor before charging with refrigerant.
- Check that the refrigerant level is correct.
- Check the oil level in the compressor.
  (Specified oil level: 150 +14 -0 cc ND-OIL8)

TORQUE CONVERTER
DISASSEMBLY

1. Turbine, case assembly

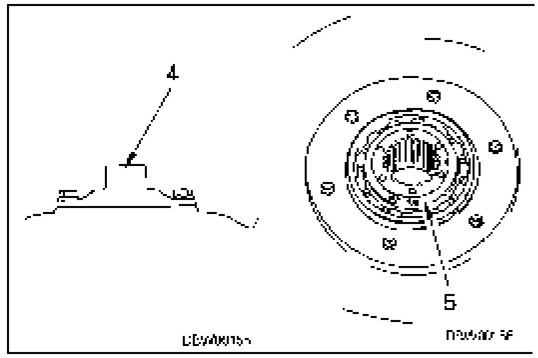
1) Remove stator shaft and pump assembly (2) from turbine and case assembly (3).



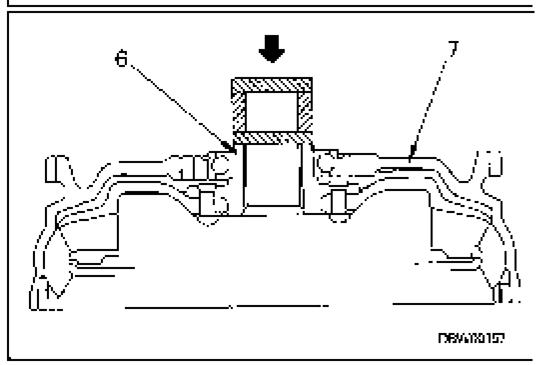
2) Disassemble turbine and case assembly as follows.

I) Remove pilot (4).

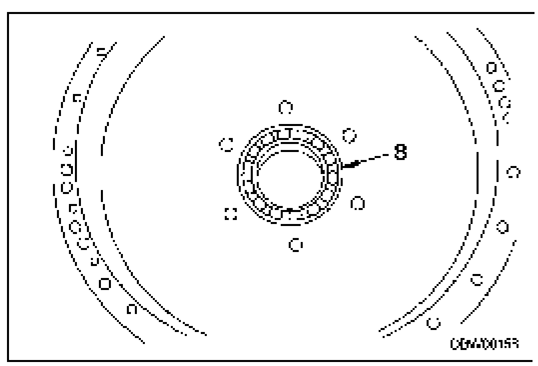
ii) Remove snap ring (5).



iii) Push boss portion of turbine (6) and remove from case (7).



iv) Remove bearing (8) from case.

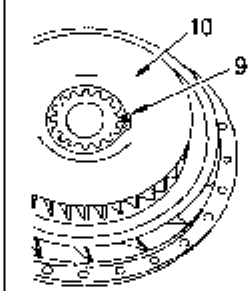


2. Stator

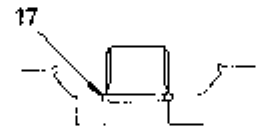
1) Remove snap ring (9).

2) Remove stator (10).

3) Remove ring (17).



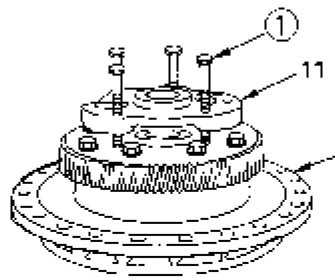
DBW00159



DBW00160

3. Stator shaft

Using forcing screws Î, push in from stator shaft (11) end, and disconnect pump assembly (12).



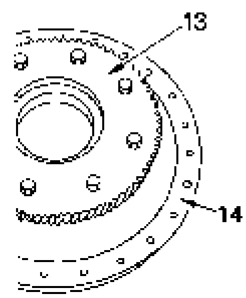
DNW03134

4. Gear

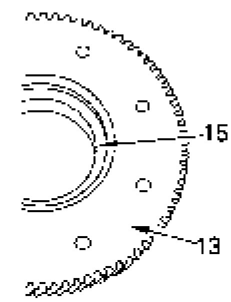
Remove gear (13) from pump (14).

5. Bearing

Remove bearing (15) from gear (13).

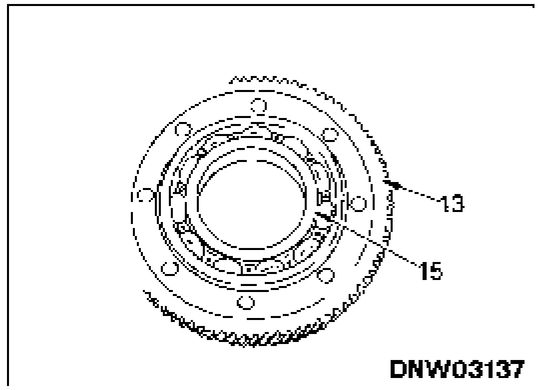


DNW03135

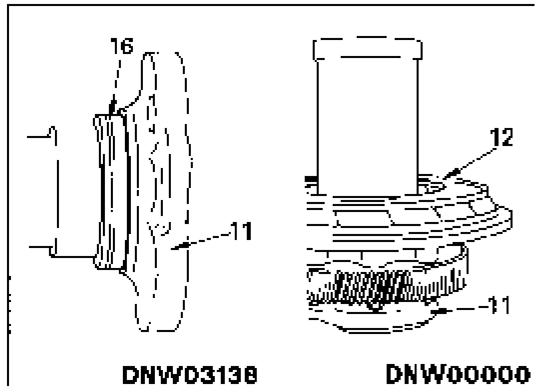


DNW03136

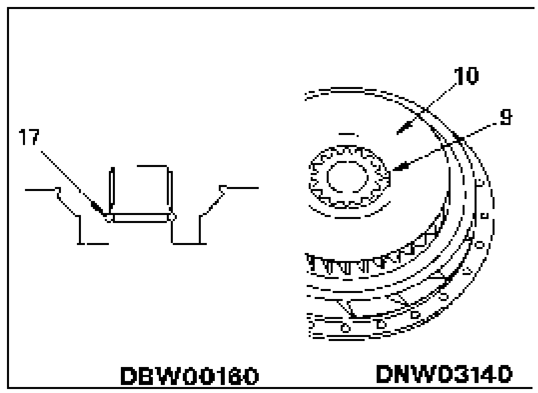
ASSEMBLY



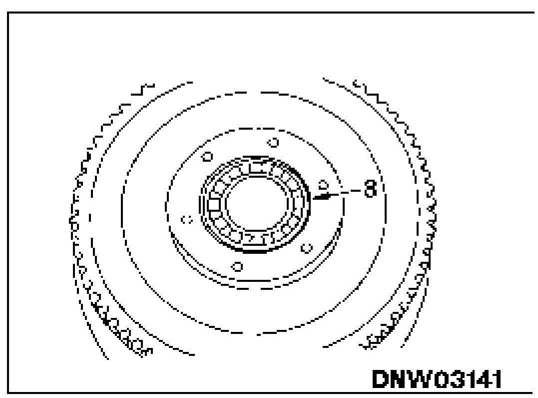
1. **Bearing**
   Install bearing (15) to gear (13).
2. **Gear**
   Install gear (13) to pump (14).
   Mounting bolt:
   66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)



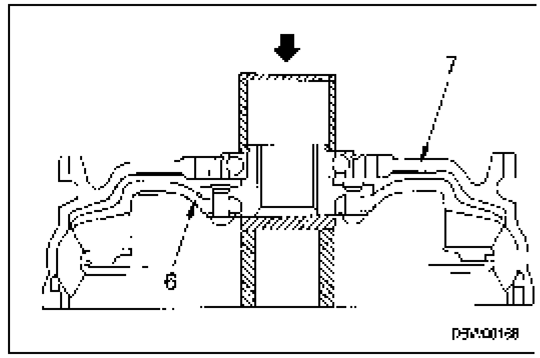
3. **Stator shaft**
   1) Install seal ring (16) to stator shaft (11).
      Seal ring: **Grease (G2-LI)**
      U Spread the seal ring out uniformly.
   2) Push inner race end of bearing, and install pump assembly (12) to stator shaft (11).



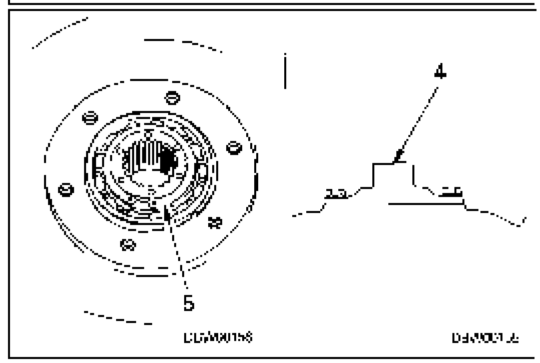
4. **Stator**
   1) Install ring (17).
   2) Install stator (10).
   3) Install snap ring (9).



5. **Turbine, case assembly**
   1) Assemble turbine and case assembly as follows.
      i) Install bearing (8) to case.
         Ú Press fit the ring until it contacts the case.



ii) Push inner race end of bearing and install turbine (6) to case (7).



iii) Install snap ring (5).

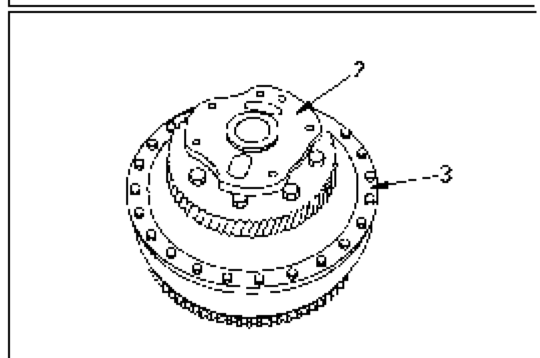
iv) Install pilot (4).

Mounting bolt:

Thread tightener (LT-2)

Mounting bolt:

66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)



DNW03142

2) Install stator shaft and pump assembly (2) to turbine and case assembly (3).

Mounting bolt:

Thread tightener (LT-2)

Mounting bolt:

30.9 ± 3.4 Nm (3.15 ± 0.35 kgm)

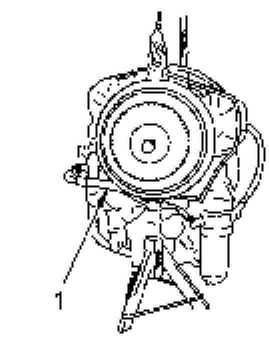
TRANSMISSION
DISASSEMBLY

! Remove the left and right mount brackets from the transmission assembly first.

1. Hydraulic piping

Disconnect following hydraulic piping.

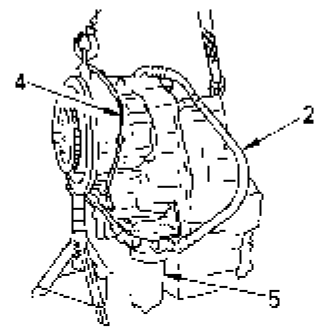
! Hose (1) between torque converter oil filter and transmission valve
! Hose (2) between torque converter charging pump and torque converter oil filter
! Hose and tube (3) between strainer and charging pump
! Remove PTO lubrication tube (4).
Ú Be careful not to crush the tube during the operation.
Ú After removing the tube, fit a cover to protect the thread.
Ú Remove the transmission bracket first.



DNW03143

2. Oil filter

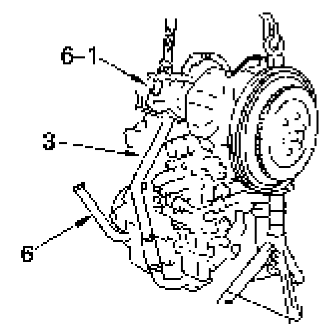
1) After removing each hose, remove filter mounting bracket (5) with filter still installed.
2) Remove oil filler (6).
Ú Remove the rear coupling.



DNW03144

3. Charging pump

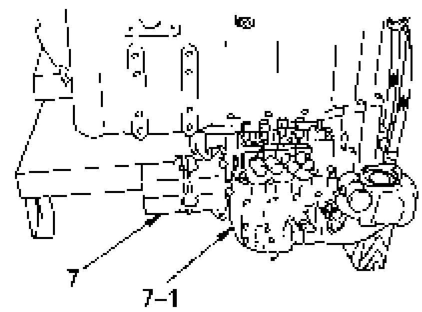
After removing each pipe, remove charging pump (6-1).
Ú Raise the transmission assembly and install it to an assembly stand.



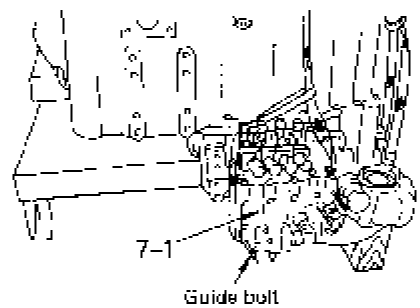
DNW03145

4. **Transmission control valve**
   1) Remove accumulator valve (7).
   2) Sling transmission control valve (7-1), then remove mounting bolts and lift off.
      Ú Assemble guide bolts in the mounting bolt holes.

      kg Transmission control valve: **46 kg**

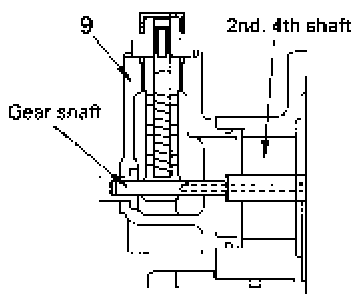


DNW03146

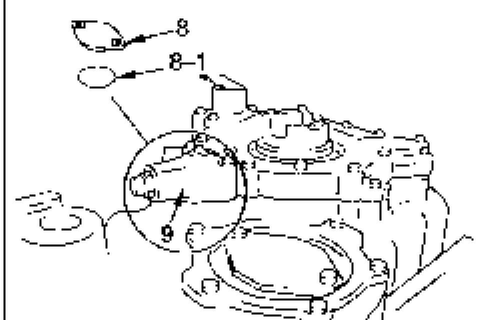


DNW03147

5. **2nd, 4th shaft cover, tachometer pickup outlet port**
   Remove 2nd and 4th shaft cover (8) or tachometer pickup outlet port (9) and O-ring (8-1).
   Ú After removing the tachometer pickup outlet port cover, be careful not to damage the tachometer gear shaft.
   Ú Turn over the torque converter and transmission assembly.

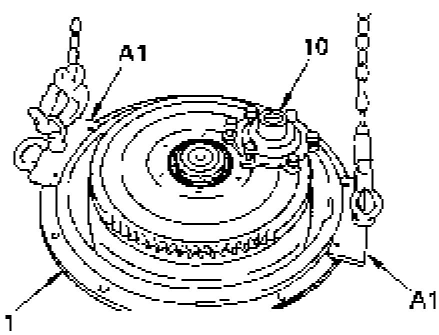


DMW03149



DNW03148

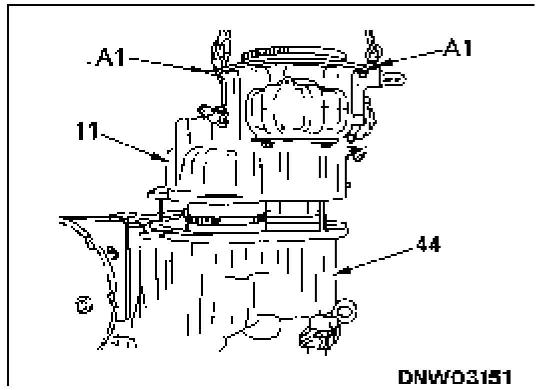
6. **Rear housing**
   1) Remove torque converter pilot cap (10).
   2) Install tool **A1** to rear housing (11), then sling housing.
      Ú Install tool **A1** securely so that it does not come off.



DNW03150

3) Using forcing screws, raise rear housing (11), then use tool **A1** to lift it off.
   Ú Remove slowly and be careful not to damage the seal ring.
   Ú When removing, install guide bolts to front housing (44) and lift off horizontally.

   kg Rear housing, torque converter assembly: **160 kg**

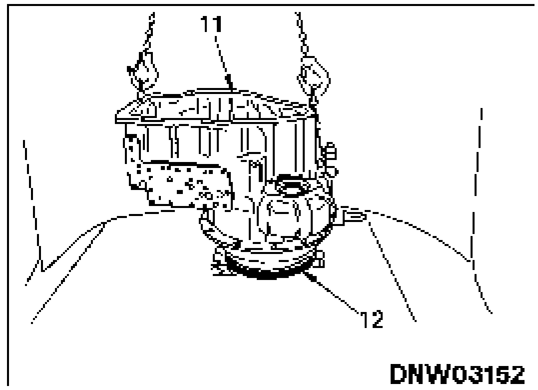


DNW03151

7. Torque converter

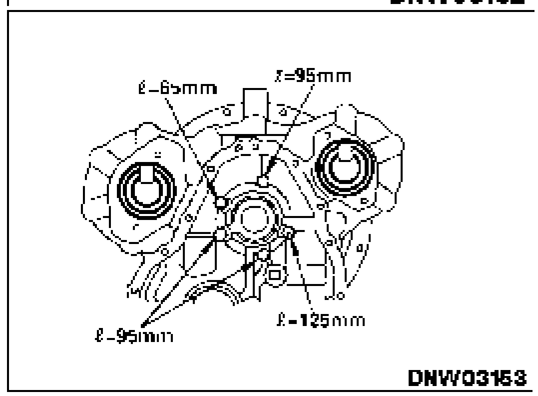
Lift off torque converter (12) from rear housing (11).

Ú Before removing, use a felt pen to make match marks on the mating surface of the housing and torque converter.



DNW03152

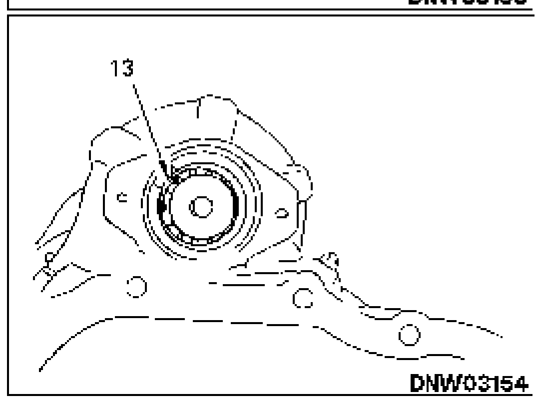
Ú The length of the mounting bolts is different, so make marks.



DNW03153

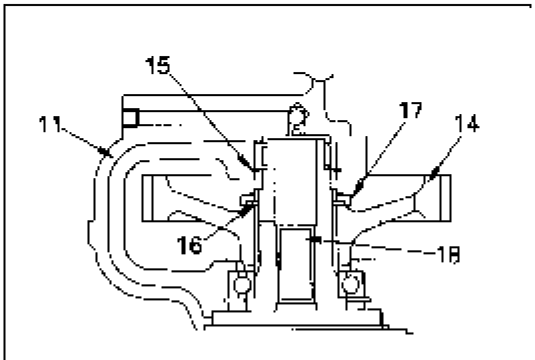
8. Pump (torque converter, loader)

1) Remove snap ring (13) at torque converter pump mount end.



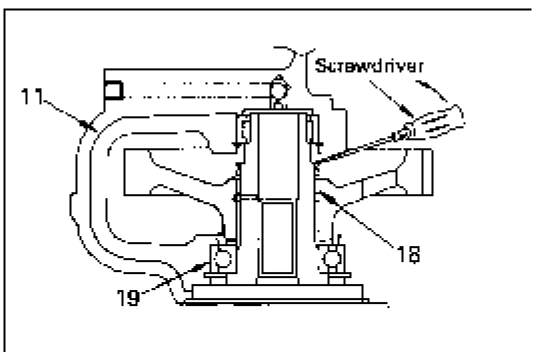
DNW03154

2) Turn over rear housing (11), remove snap ring (15) of pump gear (14), then remove ring washer (16) and split spacer (17).



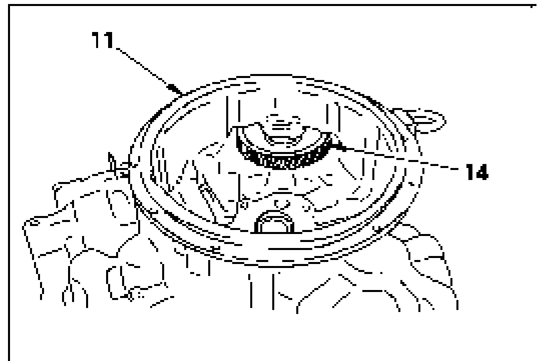
DNW03159

3) Insert screwdriver between rear housing (11) and shaft (18), then lever shaft and push down to remove.
4) Remove bearing (19) from shaft (18).
   Ú Carry out the same procedure at the loader pump end.

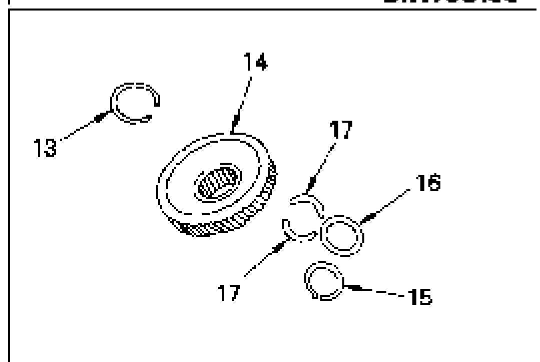


DNW03160

! **Seal rings**
Remove seal rings (20) from each clutch shaft.



DNW03155



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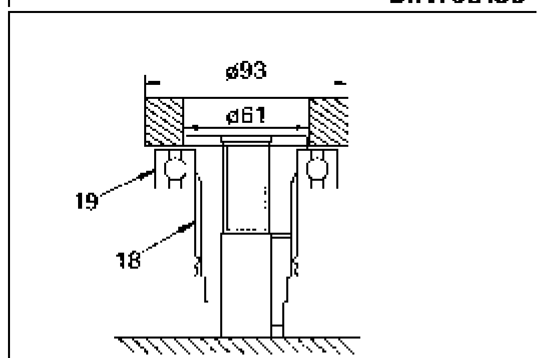
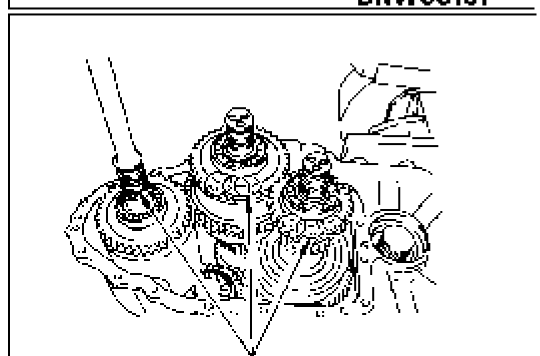


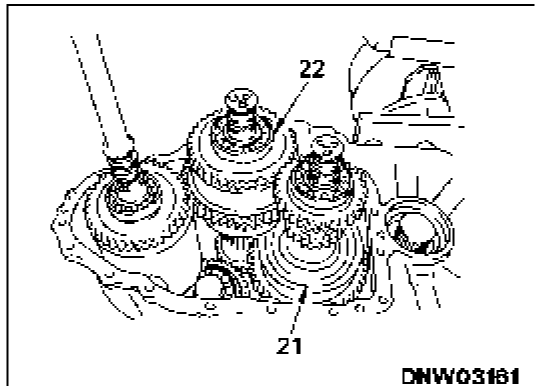
DNW03157



DNW03158

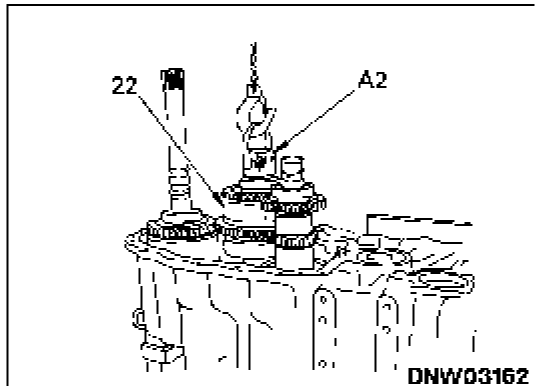
10. 2nd and 4th, 1st and 3rd clutches

1) Pull out 2nd and 4th clutch (21) together with 1st and 3rd clutch (22) from housing bearing, then move towards 2nd and 4th clutch output shaft end.
   Ú Remove the 1st and 3rd clutch from bearing, then move towards the FORWARD, REVERSE end.



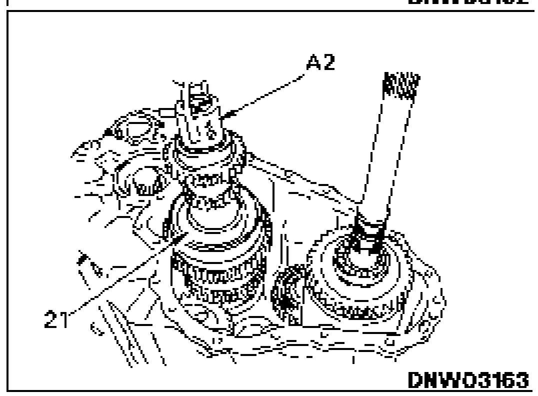
2) Using tool **A2,** lift off 1st and 3rd clutch (22).
   Ú Remove slowly and take care not to hit any other gear.

kg 1st and 3rd clutch: **41 kg**



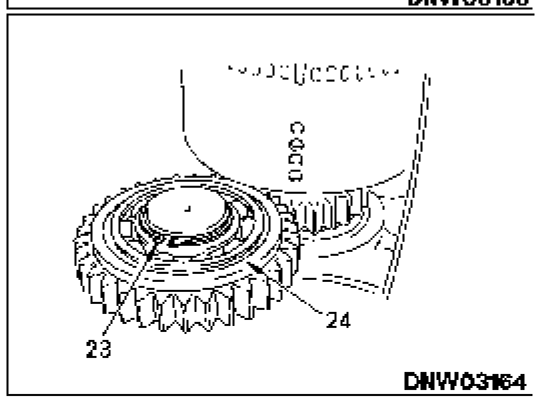
3) Using tool **A2,** lift off 2nd and 4th clutch (21).

kg 2nd and 4th clutch: **50 kg**



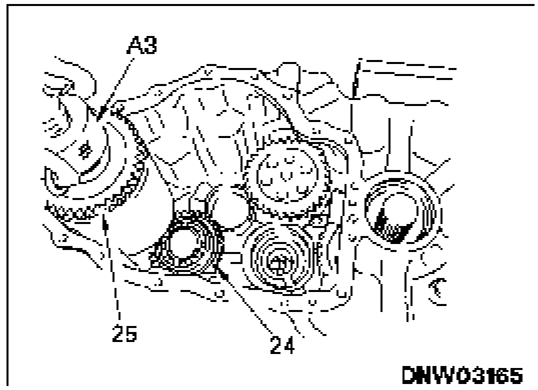
11. FORWARD, REVERSE clutch

1) Remove snap ring (23), and set gear (24) in free condition.
   Ú If the idler shaft is removed from the front housing, cool the shaft to -70EC when assembling.



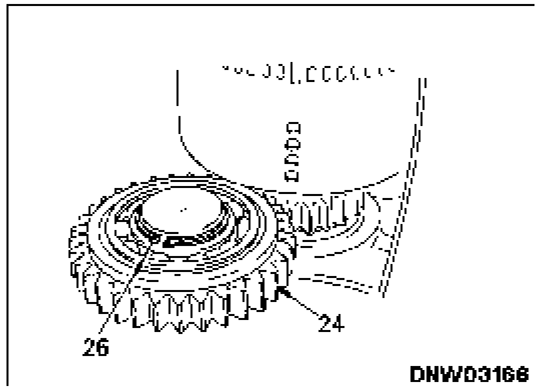
2) Using tool **A3,** pull out FORWARD and REVERSE clutch (25).
   - Ú When removing the FORWARD and REVERSE clutch, gear (24) will hit the REVERSE bearing, so leave the gear half floating.
   - **WARNING!** Be careful not to get your fingers caught between gear (24) and the housing.

kg FORWARD, REVERSE clutch: **40.4 kg**



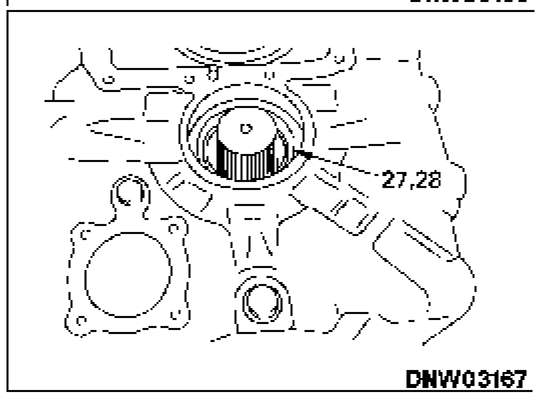
12. Idler gear

1) Remove gear (24) from housing.
2) Remove snap ring from gear (24), then remove bearing (26).



13. Rear dust seal, oil seal

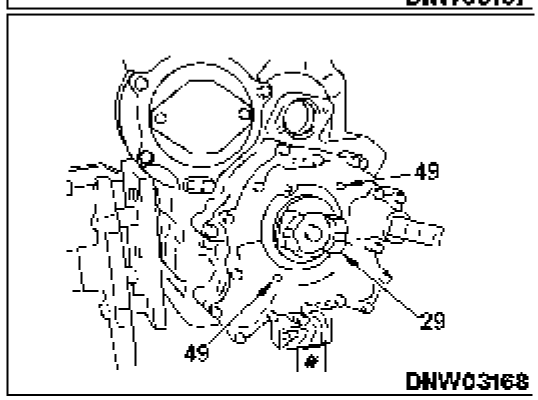
Remove dust seal (27) and oil seal (28).

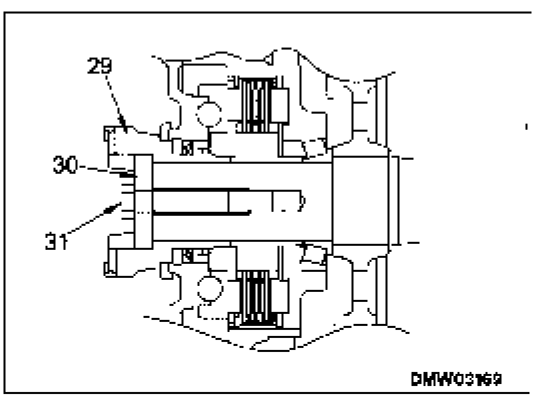


14. Parking brake assembly

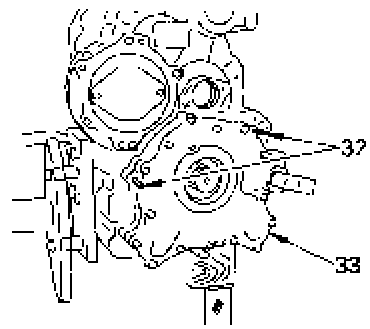
Ú Turn over the front housing, then set stand under the housing.

1) Remove mounting bolts, then remove front coupling (29), holder (30), and O-ring.
   - Ú Always assemble set bolt (49) for holding piston from the parking brake front retainer end.
   - Ú Set bolt: 8 mm, P = 1.25, ℓ = 35 mm



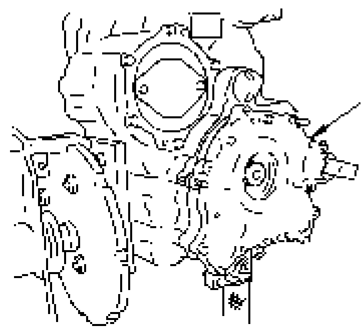


2) Remove mounting bolts (31), and set guide bolts (32) in position.
   Ú To make it easier to remove the parking brake assembly, sling the output shaft gear inside the housing.



DNW03170

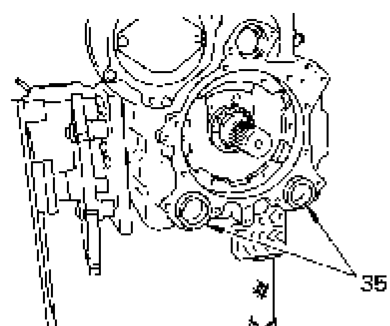
3) Screw forcing screws into parking brake assembly (33), and remove parking brake assembly.
   Ú When removing the parking brake, carry out the removal operation with two workers, give signals to each other and remove the parking brake carefully.



DNW03171

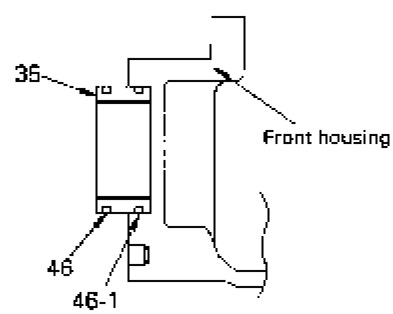
   Ú Pull out slowly and be careful not to cut O-ring (46) of spacer (35) at the bottom of the parking brake assembly.
   Ú Check the number and thickness of the shims and use for reference when assembling.

kg Parking brake assembly: **37 kg**



DNW03172

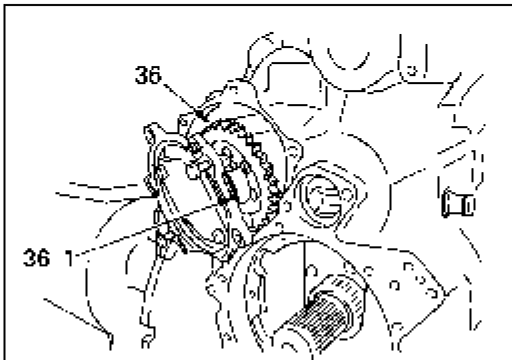
4) Remove spacer (35).
   ! Be careful not to damage O-ring (46-1).



DNW03173

15. Emergency steering pump gear

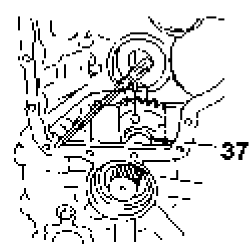
1) Screw forcing screws into emergency steering pump gear (36).
2) Remove mounting bolts of emergency steering pump gear (36).
   Ú Pull out the top part first, then pull up. There are places inside the housing where there is interference, so check the inside and remove slowly.
3) Remove O-ring (36-1) from emergency steering pump gear (36).

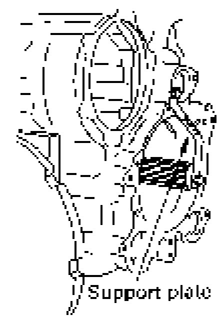


DNW03174

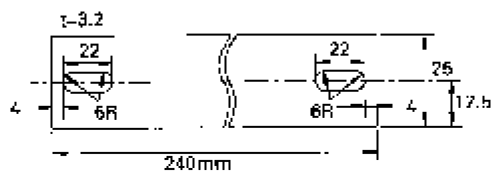
16. Output shaft gear

1) Remove sling from inside, then support output shaft (37) from outside with support plate.



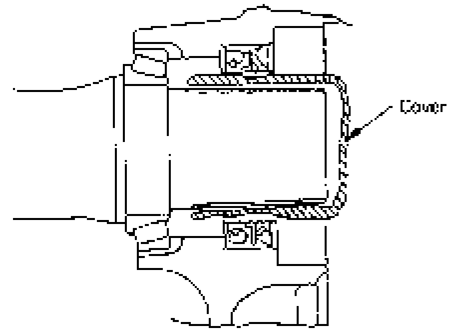


DNW03175 DNW03176



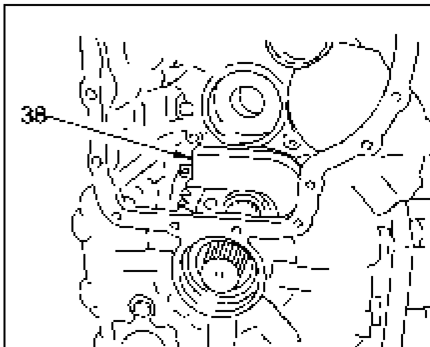
DNW03177

Ú Fit a cover to the shaft spline to prevent damage to the oil seal.



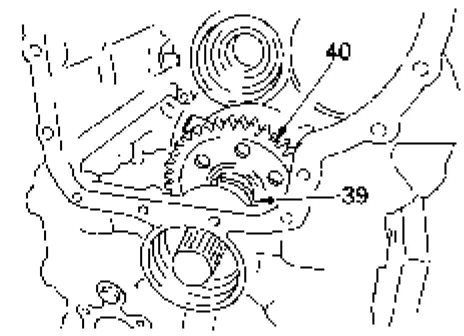
DBW00207

2) Remove shroud (38).
Ú Be careful not to cut your hand on the edge of the shroud.



DNW03178

3) Remove snap ring (39) from groove, move to center, then move gear (40) to same place as snap ring.

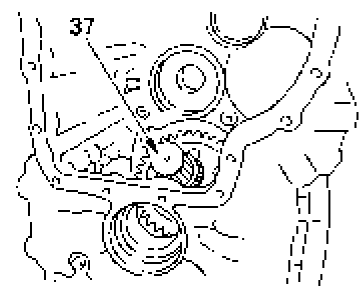


DNW03179

4) Push shaft (37) in towards rear, then pass shaft through front housing and remove.

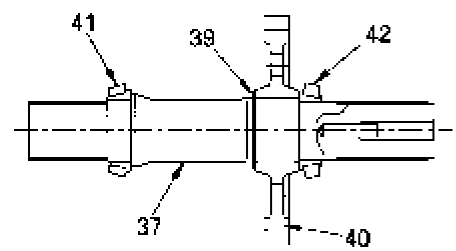
WARNING! Be careful not to get your fingers caught between the gear and the housing.

Ú Becareful not to damage the spline groove of the shaft.



DNW03180

5) Remove bearing cone (41), snap ring (39), gear (40), and bearing cone (42) from shaft (37).

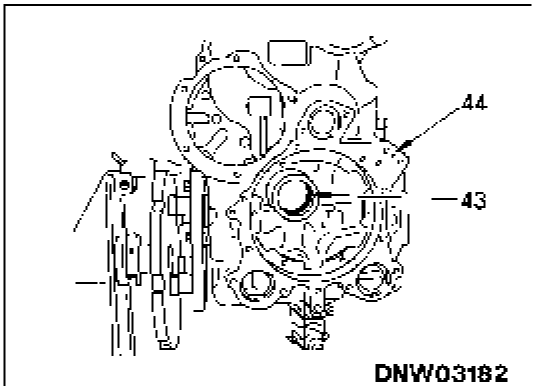


DNW03181

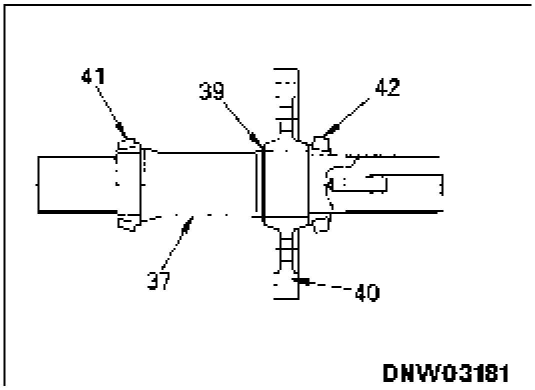
ASSEMBLY

1. Output shaft gear

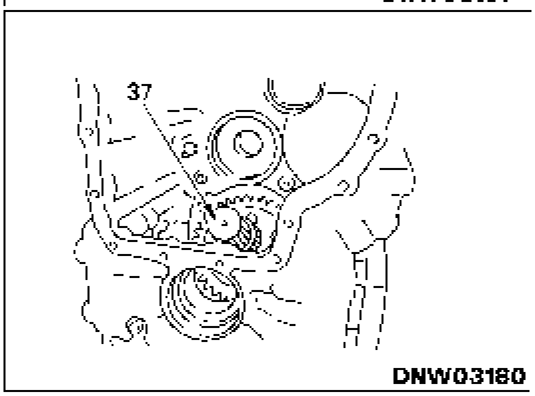
1) Press fit bearing cup (43) to front housing (44).
   - Ú Press fit the oil seal and dust seal before assembling each clutch assembly.
   - Ú Press fit the bearing cup fully to the stepped portion of the housing, and check that there is no clearance.



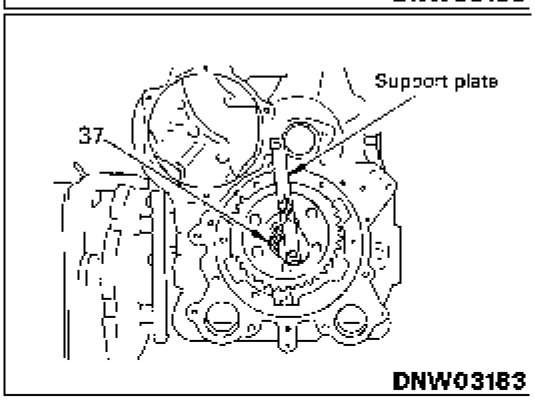
2) Press fit bearing cone (42) to shaft (37), assemble gear (40) and snap ring (39), then press fit bearing cone (41).
   - Ú To prevent defective adjustment of the end play, press fit the cone as far as the shoulder of the shaft.
   - Ú Do not insert the snap ring into the groove. Move it to the center, then remove gear (40) from the spline groove, and put it in the same position as the snap ring.



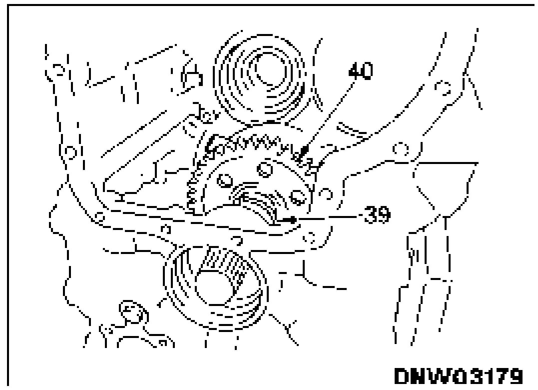
3) Assemble shaft (37) to front housing.
   - Ú Hold the shaft at an angle and insert it.



4) Install support plate to output shaft (37), and support shaft.
   - Ú Use the support shaft used during disassembly.



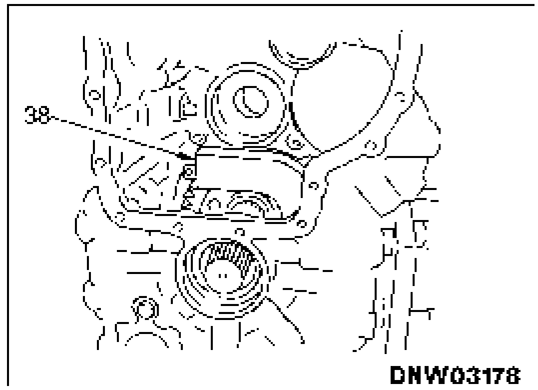
5) Insert gear (40) in shaft spline portion and secure with snap ring (39).



6) Coat mounting bolts with thread tightener, and install shroud (38).
   - Ú Wash and remove all oil and grease from the mounting bolt hole and mounting bolt.
   - Ú Insert the shroud from immediately above the gear, then turn over and assemble.
   - Ú Check that the gear does not interfere with the shroud.

   Mounting bolt:
   Thread tightener (LT-2)

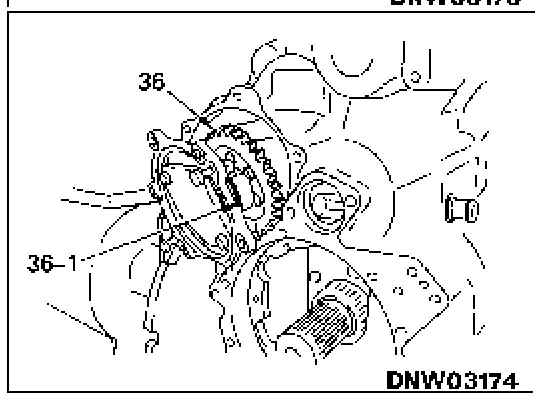
   Mounting bolt:
   110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)
   - Ú After installing the shroud, remove the support plate.



2. Emergency steering pump gear (opt.)

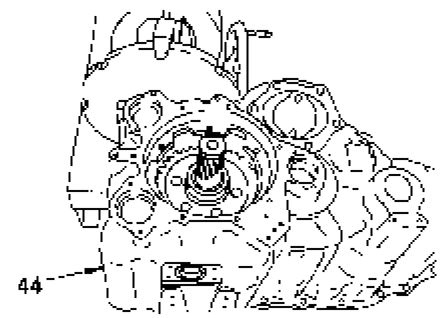
1) Assemble O-ring (36-1) in groove of emergency steering pump gear (36).
2) There are places where there is interference inside, so insert bottom of gear first, then check inside and install emergency steering pump gear (36) slowly.

   Mounting bolt:
   110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)



3. Adjusting rotating torque of bearing

1) Turn over front housing (44).
   - Ú When turning over, be careful that the output shaft does not lean at an angle.
   - Ú Set a stand under the bottom surface of the top of the front housing.
   - Ú After turning over, hold the output shaft bearing cone in the bottom bearing cup.
   - Ú Install guide pin (44-1) (10 mm, P = 1.25, ℓ = 100 mm).



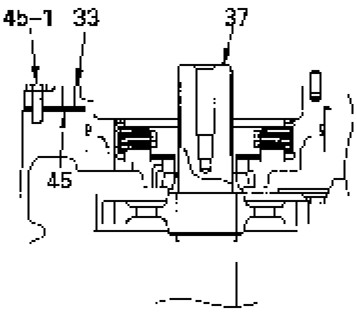
DNW03184

2) Assemble desired shim (45) to parking brake retainer assembly (33), then tighten 3 mounting bolts (45-1) to specified torque. Do not install hub spline and O-ring spacer.

   Mounting bolt:
   110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)
   - Ú To settle the bearing, rotate the shaft while tightening. After tightening, tap the end face of the shaft several times with a plastic hammer to settle the bearing again.
   - Ú Coat the bearing well with oil.
   - Ú Standard shim thickness: 0.95 ± 0.6 mm

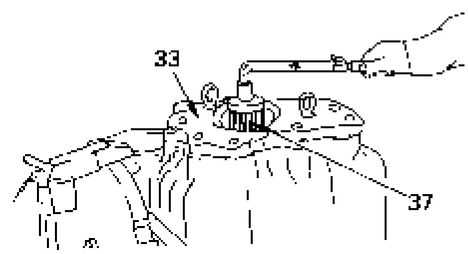
   Bearing: **Transmission oil**

   Mounting bolt:
   110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

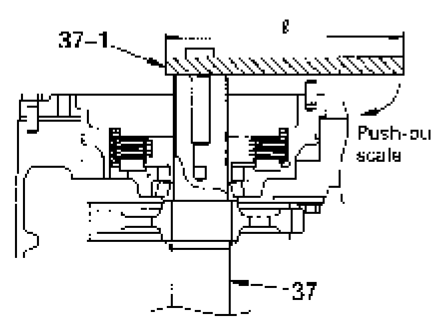


DNW03185

3) Tighten coupling mounting bolts to shaft (37) and measure rotating torque.
   - Ú Rotating torque : 0.1 - 1 Nm (0.01 - 0.1 kgm)
   - Ú If a small torque wrench is not available, it is possible to measure as follows.
   - Ú Install plate (37-1) for measuring and retainer plate to shaft (37), and tighten coupling mounting bolts, then install pushpull scale to tip of plate (37-1) and measure.
     - ! Plate length ℓ: 100 mm
     - ! Reading of push-pull scale : 1.0 - 9.8 Nm (0.1 - 1.0 kgm)
   - Ú When measuring the rotating torque, do not measure at the point where movement begins. Measure while it is rotating.
   - Ú If the rotating torque is not within the standard value, change the shim thickness to adjust again.



DNW03186



DNW03187

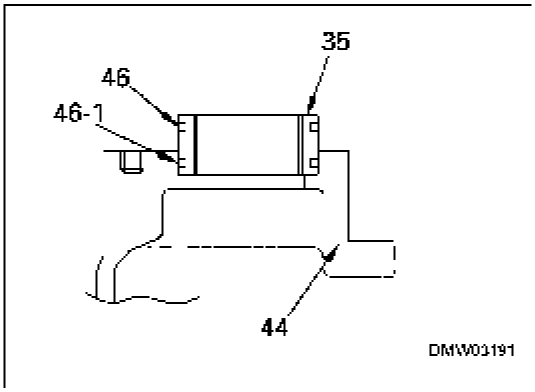
Ú When the rotating torque is within the standard value, check that the end play is “0".

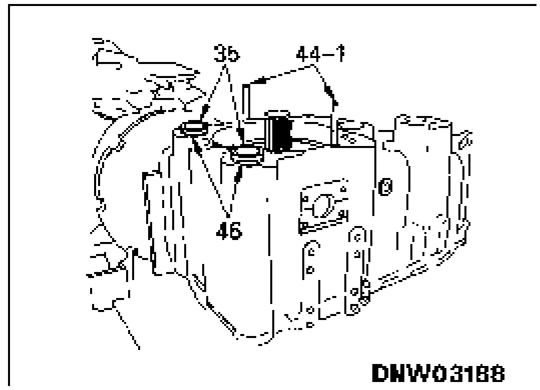
Ú Leave the guide pin as it is.

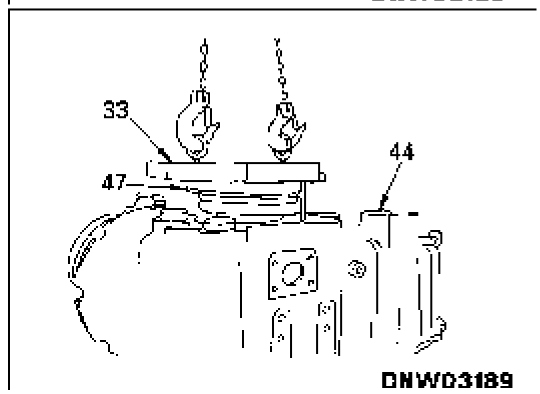
4) Assemble O-rings (46) and (46-1) to space (35), and install to front housing (44).

Ú Coat the outside circumference of O-ring thinly with grease.

Outside circumference of O-ring:







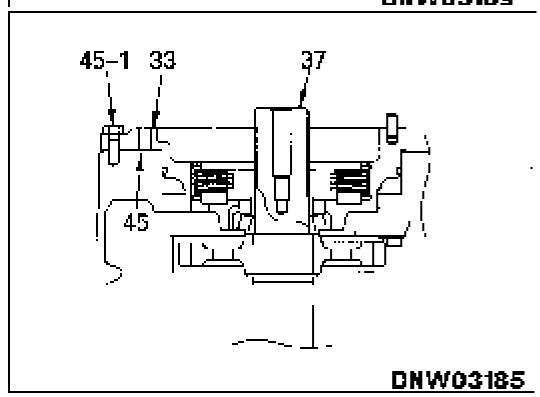
5) Align with guide pin (44-1) of front housing (44), assemble selected shim (45) and O-ring (47), raise parking brake retainer assembly (33), then assemble to housing mount portion.

Ú Assemble the thinnest shim on the inside and the thickest shim on the outside.

Ú Coat the outside circumference of the parking brake retainer assembly with grease.

Outside circumference of O-ring:
Grease (G2-LI)

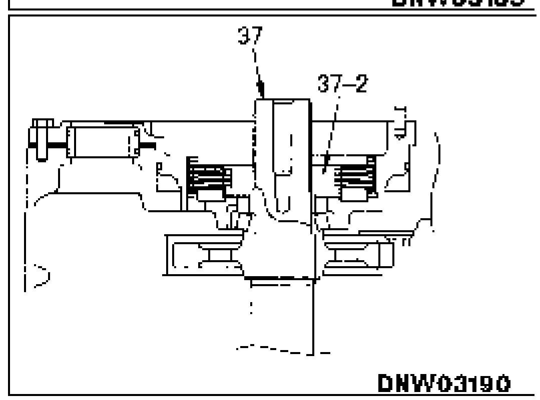
Mounting bolt:
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)



6) Align with parking brake disc spline and assemble hub spline (37-2) to output shaft (37).

Ú Align the spline of the disc with a screw driver.

Ú If the spline cannot be aligned, rotate lightly while assembling. Never use force to push it in.

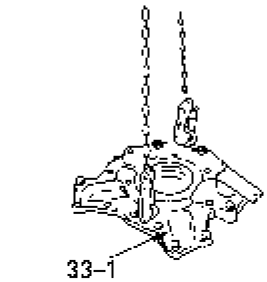


4. Parking brake assembly

1) Assemble gasket to parking brake retainer assembly (33).
2) Raise housing and piston assembly (33-1) and install to parking brake retainer.

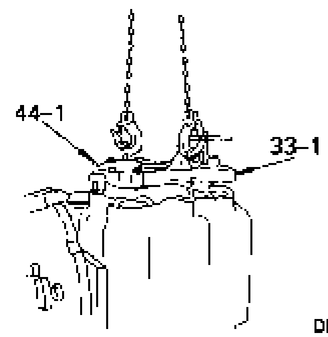
Ú Be careful not to damage the oil seal retainer portion when assembling.

Mounting bolt:
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

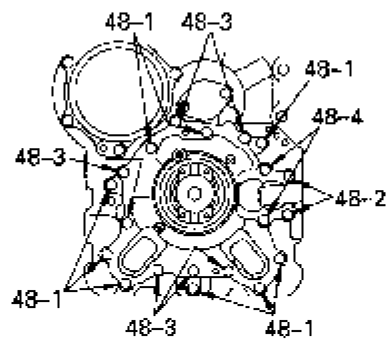


DNW03192

3) Remove guide pin (44-1), then assemble mounting bolts (48) and tighten bolts uniformly.



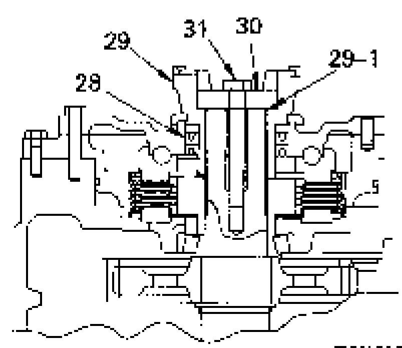
DNW03193



DNW03194

Ú The length of the mounting bolts is different. The lengths are as follows.
(48-1) = 35 mm
(48-2) = 50 mm
(48-3) = 60 mm
(48-4) = 75 mm

4) Remove lock set bolt (49) and assemble plug.



DNW03195

5) Coat lip of oil seal (28) thinly with grease and assemble coupling (29), then tighten O-ring (29-1), holder (30), and mounting bolt (31).

Lip of oil seal: **Grease (G2-LI)**

Mounting bolt:
270 ± 31.9 Nm (28.25 ± 3.25 kgm)

Ú Push O-ring (29-1) into the shaft groove, and be careful not to get it caught.

Ú Remove lock set bolt (49), and check that it has been interchanged with the plug.

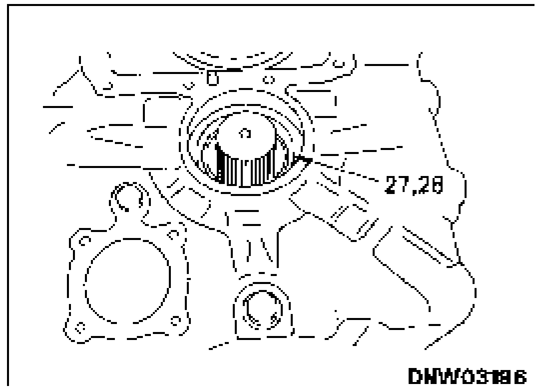
5. Rear oil seal, dust seal

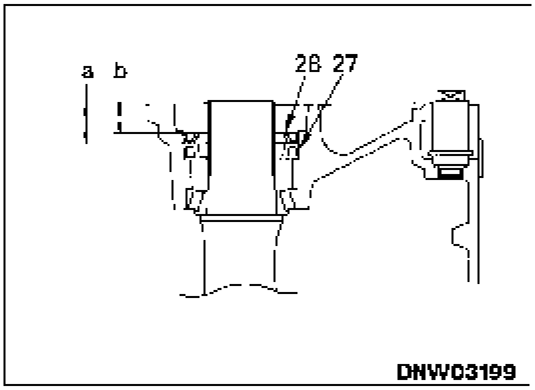
1) Turn over front housing (44), and press fit oil seal (27) and dust seal (28).

Ú Press-fitting dimension **a** 36 ± 1 mm

Ú Press-fitting dimension **b** 28 ± 1 mm

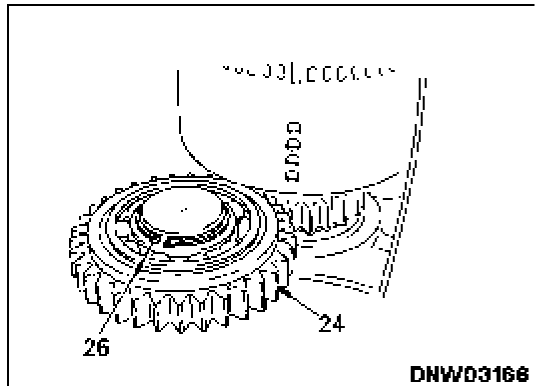
Lip of oil seal: **Grease (G2-LI)**





6. Idler gear

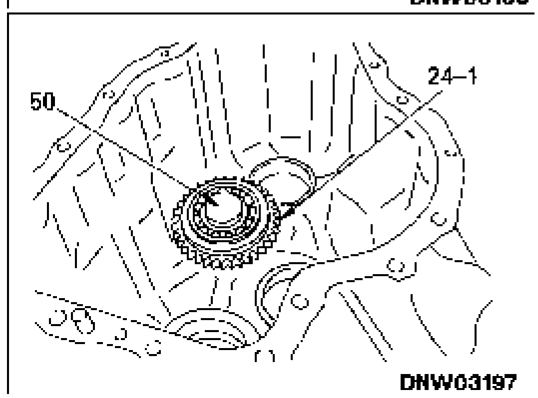
1) Press fit bearing (26) to gear (24), and install snap ring.

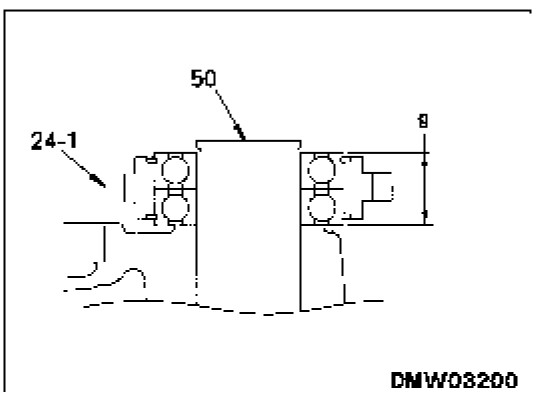


2) Press fit idler gear (24-1) to shaft (50).

Ú If the shaft has been removed, cool the shaft to -70EC, then press fit it to dimension **g.**

Ú Shaft dimension **g** : 46.5 ± 0.5 mm

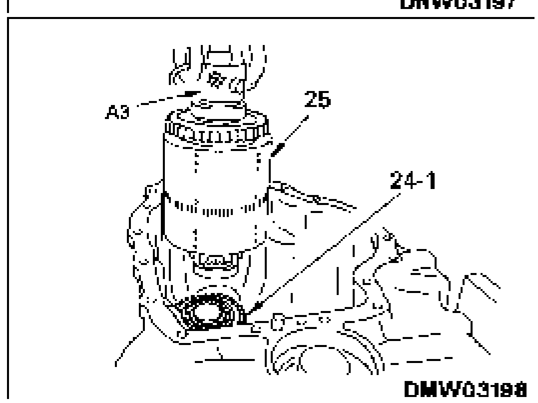




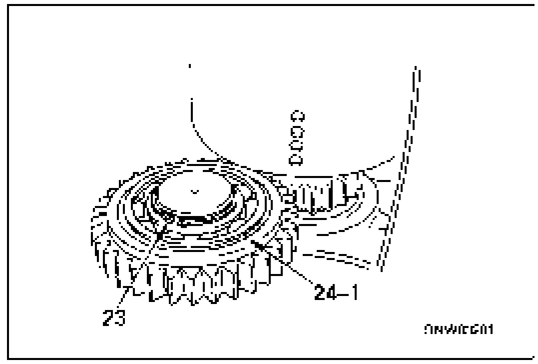
7. FORWARD and REVERSE clutch

1) Using tool **A3,** insert FORWARD and REVERSE clutch (25) in housing, then mesh REVERSE gear and idler gear (24-1) and assemble.

WARNING! Be careful not to get your fingers caught in the gears.

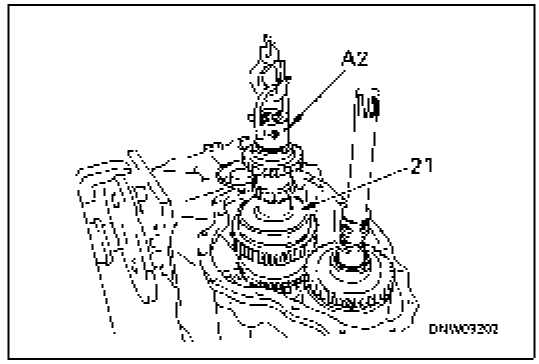


2) Press fit idler gear (24-1) completely, and lock with snap ring (23).

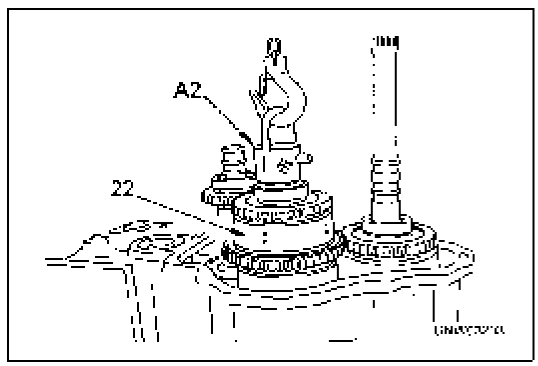


8. 2nd and 4th, 1st and 3rd clutches

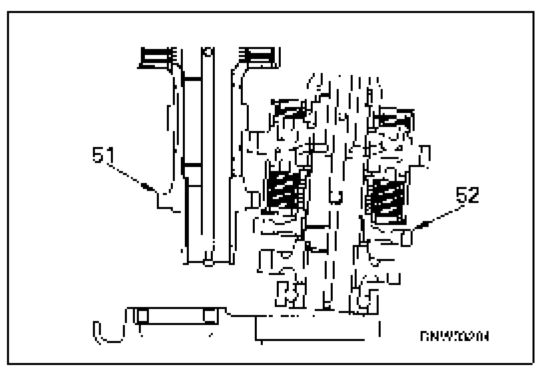
1) Using tool **A2,** insert 2nd and 4th clutch (24) in housing and move towards output shaft end.



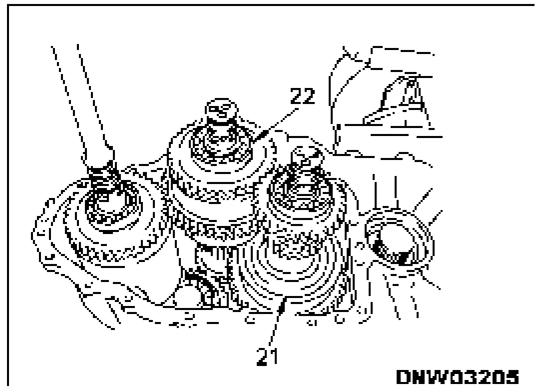
2) Using tool **A2,** assemble 1st and 3rd clutch (22) to housing.
   Ú Do not fit the bearing at the bottom of the clutch completely.



3) When 1st gear (51) passes 2nd and 4th clutch gear (52), insert bearing of 2nd and 4th clutch into housing.



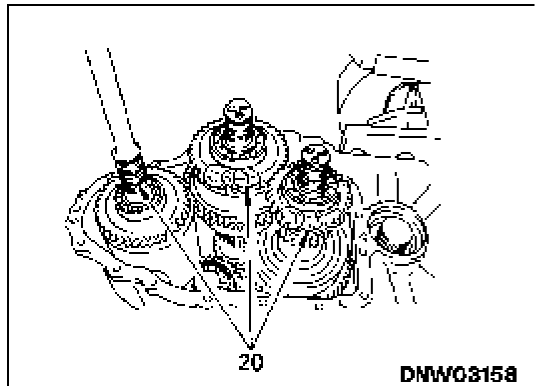
4) Insert 1st and 3rd clutch (22) into bearing assembly portion.
   - Ú Check that each gear is correctly meshed when inserting into the bearing.
   - Ú Be careful about the meshing of 2nd and 4th clutch gear (21) and the emergency drive gear when assembling.
   - Ú If the gears are not properly meshed, rotate slightly to assemble. Do not use force.



9. Seal ring

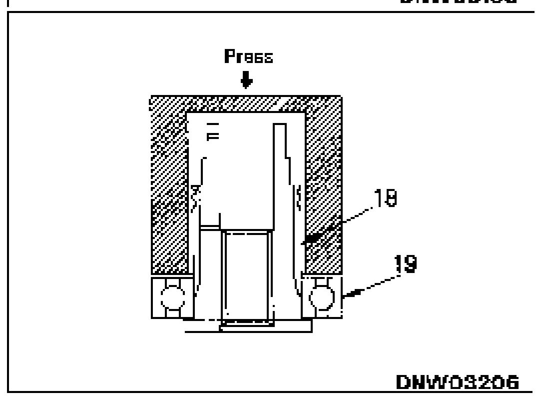
Install seal rings (20) to each shaft.
- Ú Coat the seal rings well with oil, then assemble and check that the shaft rotates smoothly by hand.

Seal ring **Transmission oil**

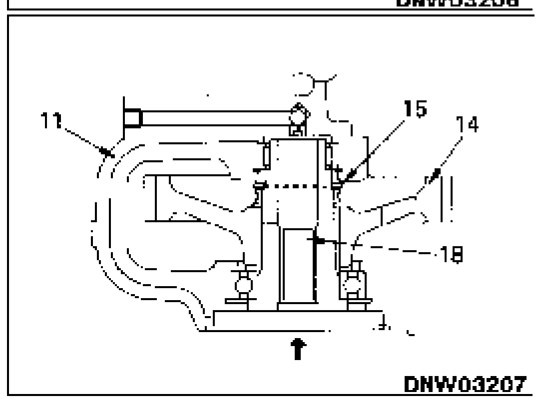


10. Pump (torque converter, loader)

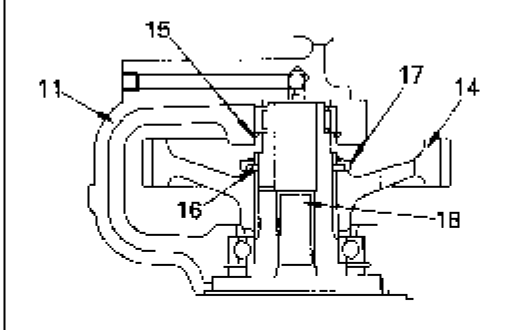
1) Press fit bearing (19) to shaft (18).
   - Ú Press fit so that there is no clearance at the stepped portion of the shaft.



2) Assemble gear (14) and snap ring (15) inside rear housing (11), then insert shaft (18) from pump mount end.

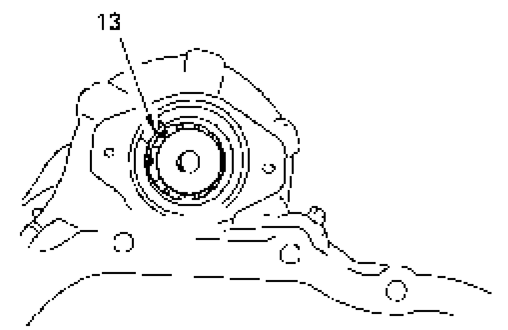


3) Assemble ring washer (16) and split spacer (17) to shaft stepped portion and install snap ring (15).



DNW03159

4) Turn over rear housing and assemble snap ring (13) at pump mount end.
   Ú Carry out the same procedure at the loader pump end.



DNW03154

11. Torque converter

Using eyebolts, raise rear housing (11), then set to torque converter mount and tighten mounting bolts.

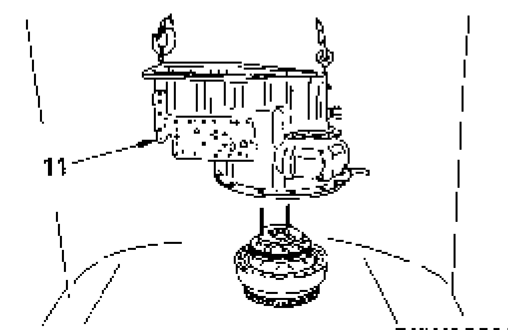
Ú Align the mounting bolt holes properly, and be careful of the meshing with the pump accessory gear when installing.

Ú Blow in air to check if the oil holes are correctly aligned.

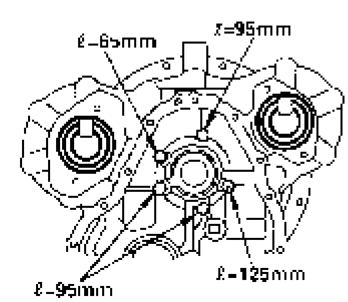
Mounting bolt:

112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

   Ú The length of the mounting bolts is different, so be careful when assembling.



DNW03208



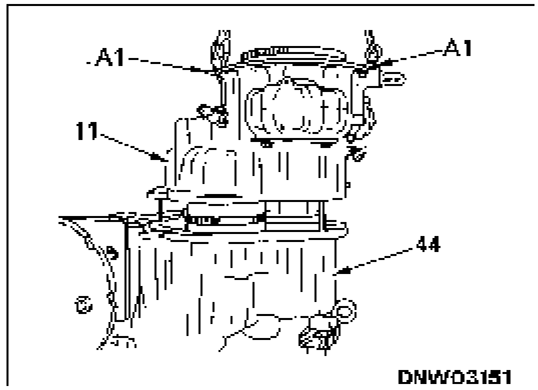
DNW03153

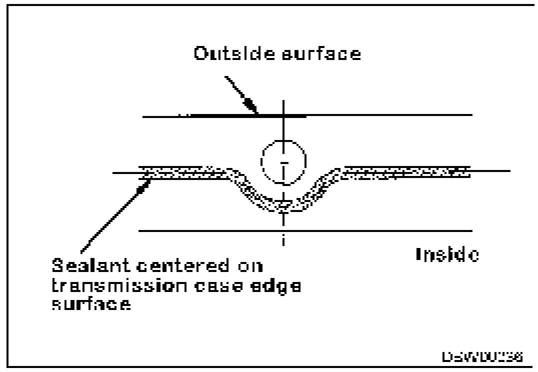
12. Rear housing

1) Using tool **A1,** raise rear housing (11) and assemble to front housing (44).
   - Ú Screw the guide pin into the front housing. (0 = 12 mm, P = 1.75, ℓ = 55 mm)
   - Ú Make sure that the gasket sealant is not squeezed out inside the case. Be careful also not to coat with too much gasket sealant.
   - Ú See the right for details of the procedure for coating with gasket sealant.
   - Ú Mesh the input shaft spline correctly.
   - Ú Be careful not to damage the seal ring of each shaft.

   Mating surface of housing:
   Gasket sealant (Three Bond 1207B)

   Housing mounting bolt:
   112.8 ± 4.9 Nm (11.5 ± 0.5 kgm)

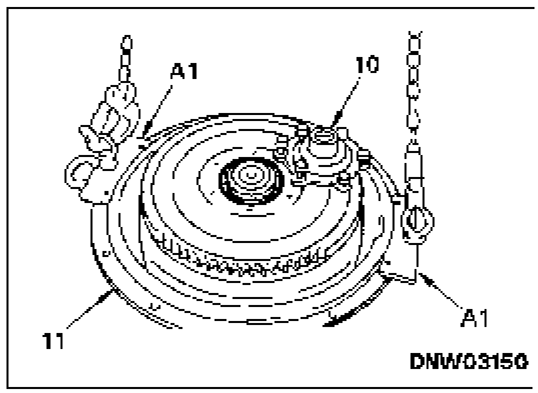




2) Assemble pilot cap (10).
   - Ú Remove all oil and grease from the mounting bolts and bolt holes.

   Cap mounting bolt:
   Thread tightener (LT-2)

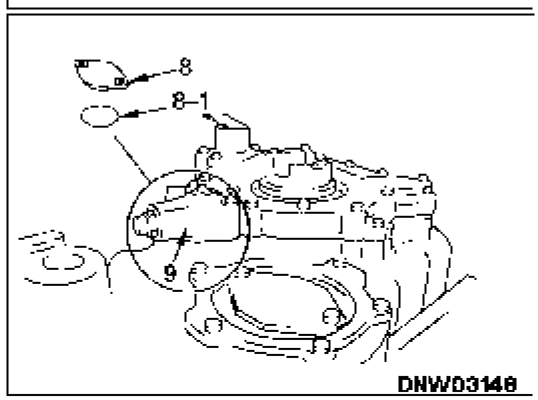
   Pilot cap mounting bolt:
   662.0 ± 7.4 Nm (6.75 ± 0.75 kgm)
   - Ú Remove tool **A1** from rear housing (11).



13. 2nd and 4th shaft, tachometer pickup outlet port cover (opt.)

1) Assemble O-ring (8-1) to 2nd and 4th shaft cover (8) or (9) and install.
   - Ú Be careful not to let the O-ring fall out.

   O-ring: **Transmission oil**



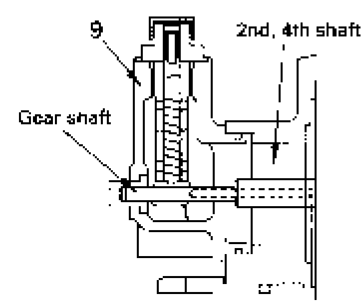
2) If a tachometer pick-up port is installed, mesh gear shaft and gear (9) at cover end to assemble.

Ú Coat the gear shaft with transmission oil.

O-ring: **Transmission oil**

Ú Turn over the torque converter and transmission assembly.

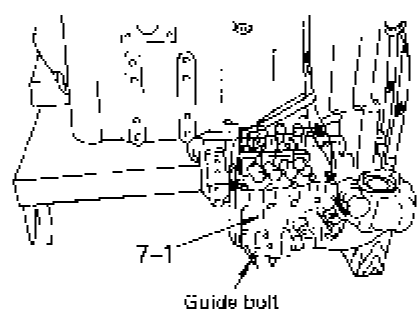
Ú Set stand to the torque converter end.



DMW03149

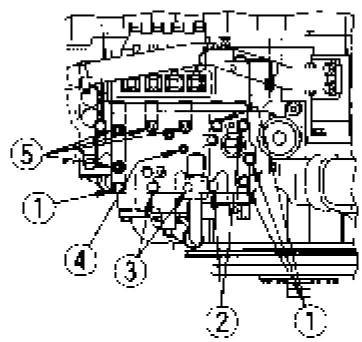
14. Transmission control valve

1) Install guide bolt to mount portion of transmission control valve (7-1).
   Ú Wash and remove all oil and grease from the control valve mounting bolt hole and mounting bolt thread.
2) Align with guide bolt and assemble gasket, then fit control valve (7-1) temporarily.



DNW03147

3) Coat mounting bolts of control valve (7-1) with thread tightener and tighten.
   Ú Tighten the mounting bolts in turn on diametrically opposite sides and be careful not to tighten too far.



DNW03209

Ú The length of the mounting bolts is different, so be careful when using them.

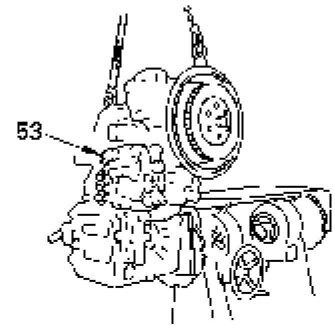
Ú The lengths are as follows.

Î R= 120 mm
Ï R= 130 mm
Ð R= 135 mm
Ñ R= 115 mm
Ò R= 100 mm

Mounting bolt:
Thread tightener (LT-2)

Mounting bolt:
34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)

4) Assemble O-ring to accumulator valve (7), and install to transmission.
   Ú Wash and remove all oil and grease from the mounting bolt holes and mounting bolts.
   Mounting bolt:
   Thread tightener (LT-2)
   Mounting bolt:
   34.3 ± 4.9 Nm (3.5± 0.5 kgm)
5) Sling transmission assembly (53) and lift off from assembly stand.
   Ú When standing the transmission assembly up, be careful of the center of gravity, and lift off slowly.



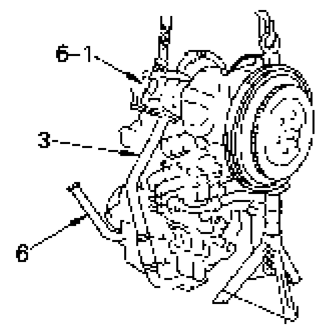
DNW03210

15. Charging pump

Assemble O-ring to charging pump (6-1) and install to transmission.

Ú Be careful not to get the O-ring caught.

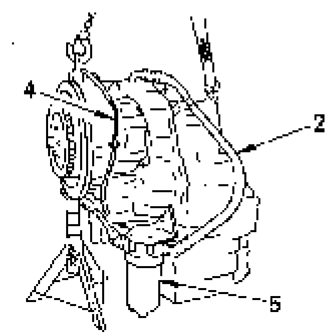
Mounting bolt:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)



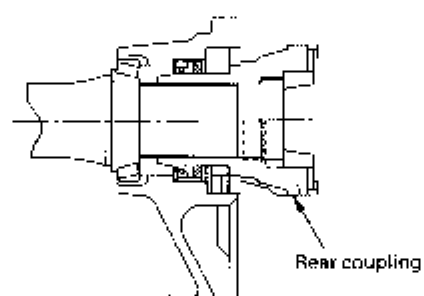
DNW03145

16. Oil filter

1) Install oil filter bracket (5).
   Mounting bolt:
   112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)
2) Assemble O-ring and install oil filler (6).
   Ú Be careful not to get the O-ring caught.
   Ú Assemble so that the front coupling and rear coupling face in same direction.



DNW03211

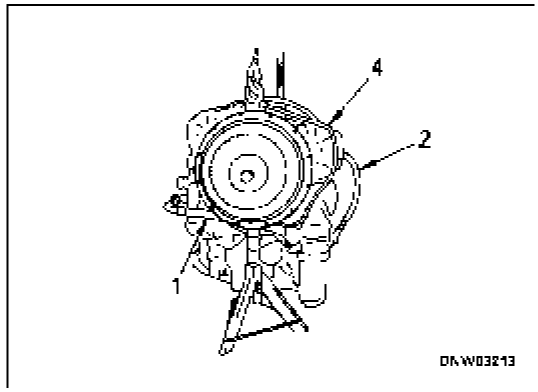


DMW03212

17. Hydraulic piping

Connect following hydraulic piping.

- ! Hose (1) between torque converter oil filter and transmission valve
- ! Hose (2) between torque converter charging pump and torque converter oil filter
- ! Connect hose and tube (3) between strainer and charging pump.
- ! Connect PTO lubrication tube (4).
  - Ú Be careful not to crush the tube during the operation.



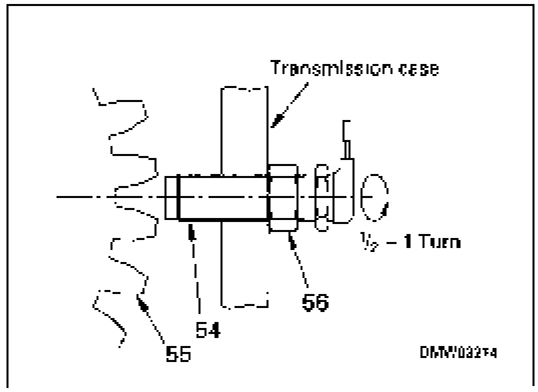
18. Adjusting speedometer sensor

1) Screw in sensor (54) until it contacts outermost surface of gear (55).
   - Ú Before installing the sensor, check that the gear is at the outermost circumference in relation to the mounting surface.
   - Ú When screwing in the sensor with a wrench, stop before it contacts the gear, and finally tighten by hand until it is lightly in contact.
2) After sensor (54) contacts gear (55), turn it back 1/2 - 1 turn, and secure it in position with locknut (56).
   - Ú When securing with the locknut, hold the other nut with a wrench when tightening.

   Sensor thread portion:
   Gasket sealant (LG-5)

   Sensor lock nut:
   58.8 ± 9.8 Nm (6 ± 1 kgm)

   - Ú Install the transmission bracket.



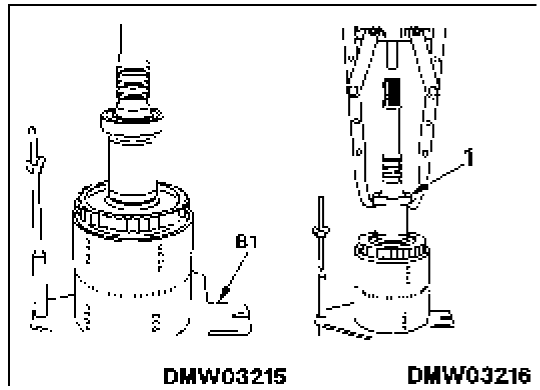
TRANSMISSION CLUTCH PACK
DISASSEMBLY

Disassembly of FR clutch pack

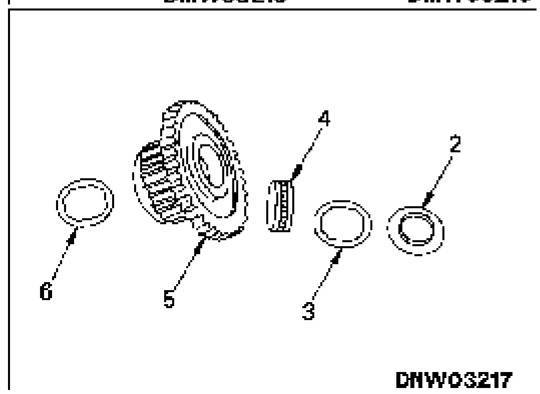
WARNING! The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

Ú Set on tool **B1** with the FORWARD clutch side at the top.

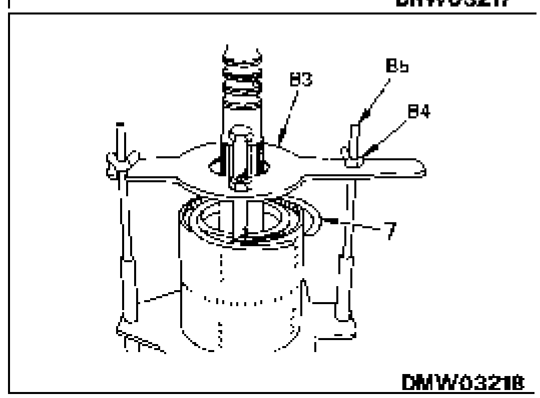
1. Bearing Using puller, remove bearing (1).



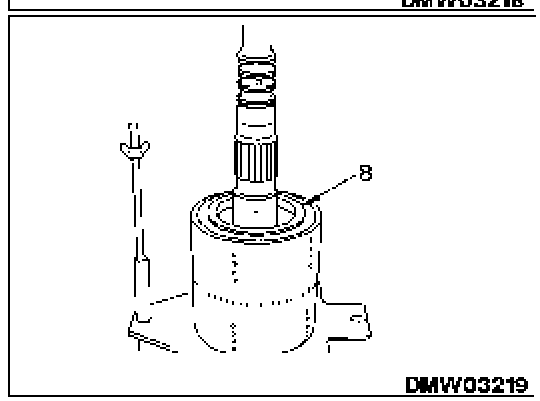
2. Spacer, FORWARD gear
Remove spacer (2), thrust washer (3), needle bearing (4), FORWARD gear (5), and thrust washer (6).



3. End plate
1) Install tools **B3** and **B5,** then tighten tool **B4** and remove ring (7).
   Ú After removing the ring, remove tool **B3.**

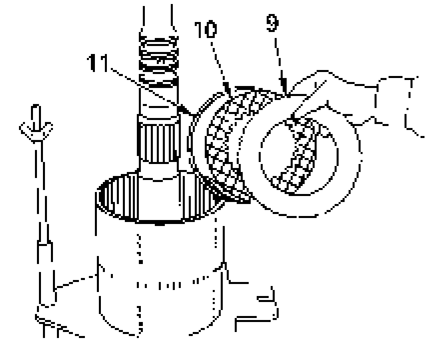


2) Remove end plate (8).



4. Clutch plate

Remove plate (9), disc (10), and spring (11) from housing.



DMW03220

5. Piston

Blow air in FORWARD oil hole of shaft and remove piston (12).

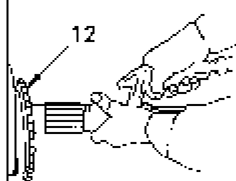
Ú If the piston is at an angle and cannot be removed, push the piston in and try to remove it again.

Ú Do not use force to remove it. The inside circumference of the cylinder will be damaged.

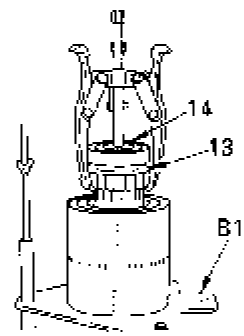
6. Bearing

Ú Set on tool **B1** with the REVERSE clutch side at the top.

Using puller, remove gear (13) and bearing (14).



DMW03221

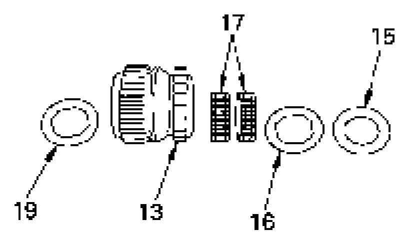


DMW03222

7. REVERSE gear

Remove spacer (15), thrust washer (16), needle bearing (17), REVERSE gear (13), thrust washer(19).

Ú Repeat Steps 3 - 5 for the FORWARD clutch to disassemble the other parts.

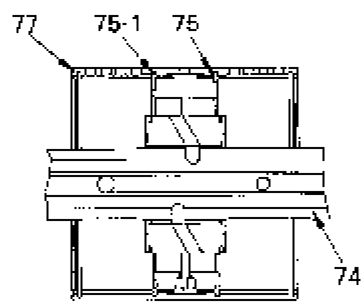


DNW03223

8. Shaft, cylinder

1) Remove snap ring (75) from shaft and housing, then remove housing (77).

2) Remove snap ring (75-1), then remove housing (77).

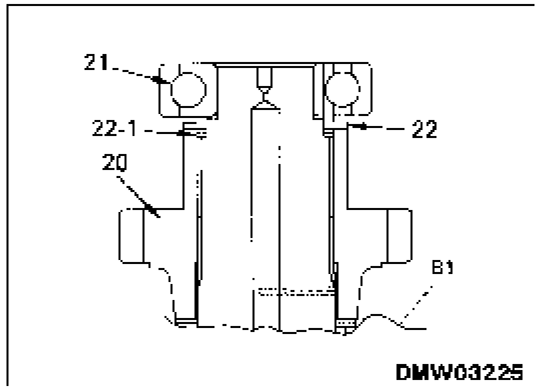


DMW03224

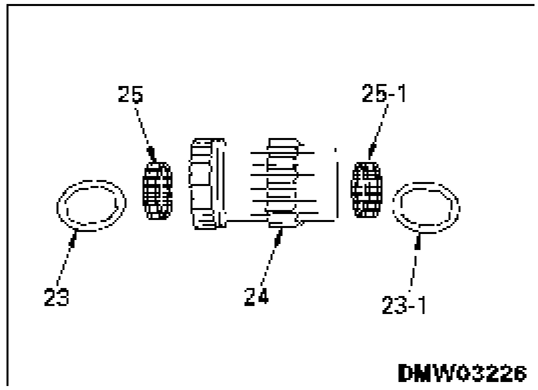
Disassembly of 1st and 3rd clutch pack

Ú Set on tool **B1** with the 1st clutch side at the top.

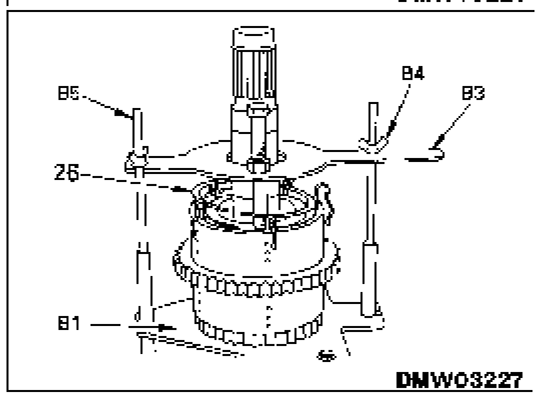
1. **Idler gear**
   1) Using puller, pull out bearing (21) and remove spacer (22).
   2) Remove snap ring (22-1), then remove idler gear (20).



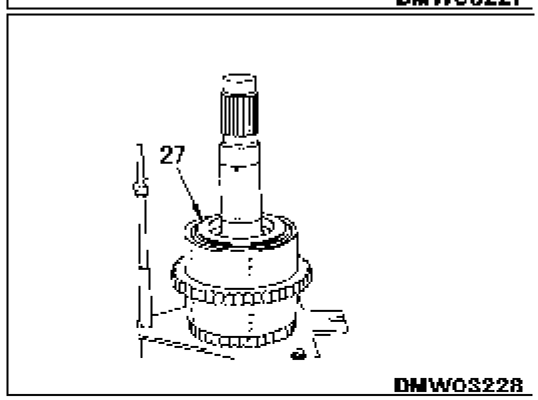
2. **1st gear**
   Remove thrust washer (23), needle bearing (25),1st gear (34), needle bearing (25-1), and thrust washer (23-1).



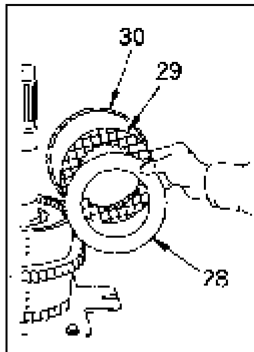
3. **End plate**
   1) Install tools **B3** and **B5** and tighten tool **B4,** then remove ring (26).
   Ú When removing the ring, remove tool **B3.**



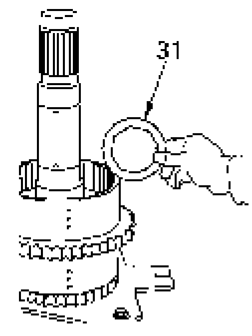
   2) Remove end plate (27).



4. Clutch plate
1) Remove plate (28), disc (29), and spring (30) from housing.
2) Remove thrust washer (31).

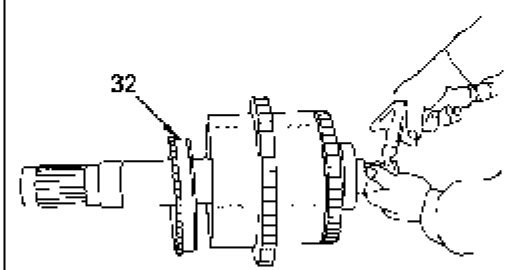


DMW03229



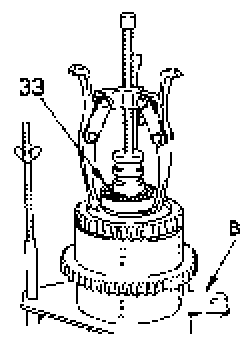
DMW03230

5. Piston
Blow air in REVERSE oil hole of shaft, and remove piston (32).
- Ú If the piston is at an angle and cannot be removed, push the piston in and try to remove it again.
- Ú Do not use force to remove it. The inside circumference of the cylinder will be damaged.



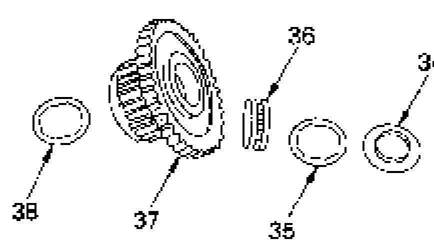
DNW03231

6. Bearing
- **Ú** Set on tool **B1** with the 3rd clutch side at the top. Using puller, remove bearing (33).



DMW03232

7. 3rd gear
Remove spacer (34), thrust washer (35), needle bearing (36), 3rd gear (37), and thrust washer (38).
- Ú Use the same procedure as in Steps 3 - 5 for the 1st gear to continue disassembly.

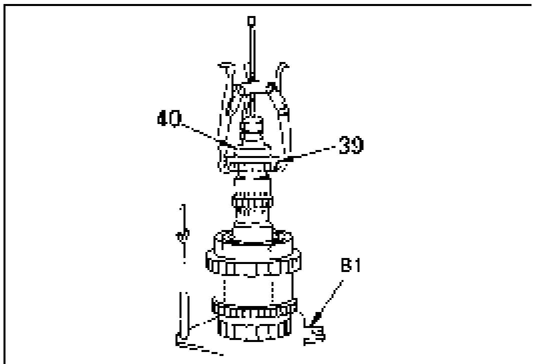


DMW03233

Disassembly of 2nd and 4th clutch pack

Ú Set on tool **B1** with the 4th clutch side at the top.

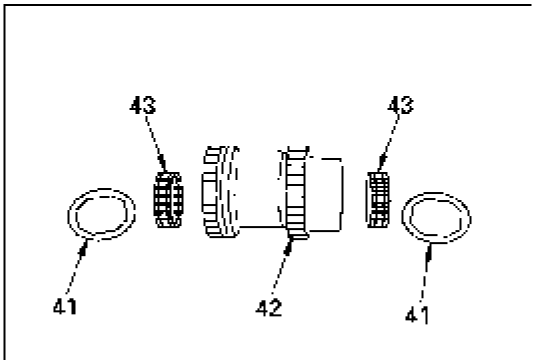
1) Idler Gear
Fit puller to idler gear (39) and remove bearing (40) together with idler gear.



DMW03234

2. 4th gear

Remove thrust washer (41), 4th gear (42), and needle bearing (43)

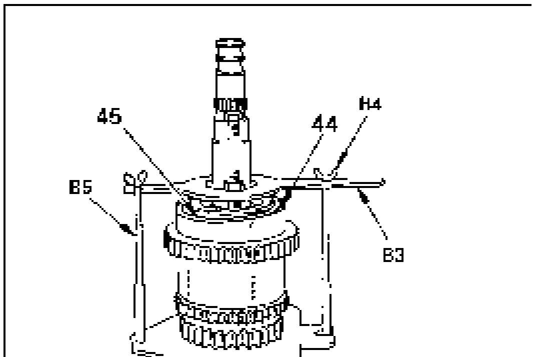


DMW03235

3. End plate

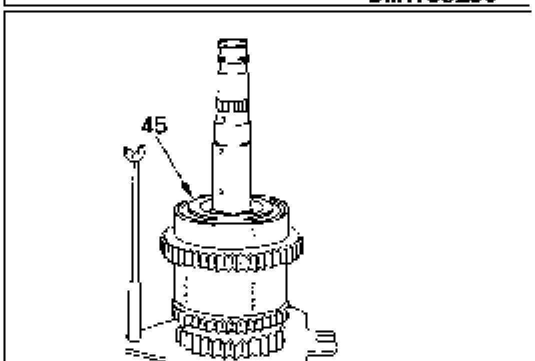
1) Install tools **B3** and **B5** and tighten tool **B4,** then remove ring (44).

Ú After removing the ring, remove tool **B3.**



DMW03236

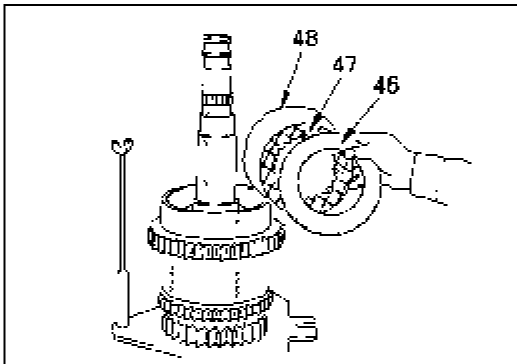
2) Remove end plate (45).



DMW03237

4. Clutch plate

Remove plate (46), disc (47), and spring (48) from housing.

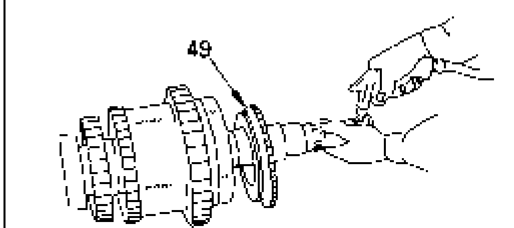


DMW03238

5. Piston

Blow air in 4th oil hole of shaft, and remove piston (49).

- Ú If the piston is at an angle and cannot be removed, push the piston in and try to remove it again.
- Ú Do not use force to remove it. The inside circumference of the cylinder will be damaged.

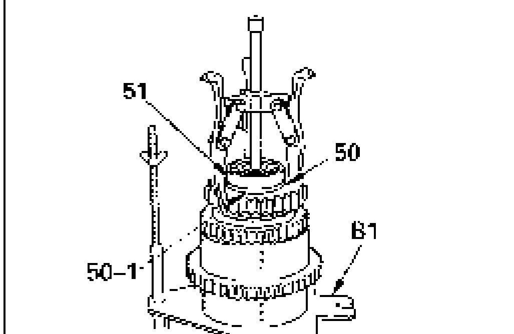


DMW03239

6. Idler gear

Ú Set on tool **B1** with the 2nd clutch side at the top.

1) Using puller, pull out bearing (51) and remove snap ring (50-1).
   - Ú When fitting the puller, put the plate in contact with the center first.
2) After removing the snap ring, remove idler gear (50).

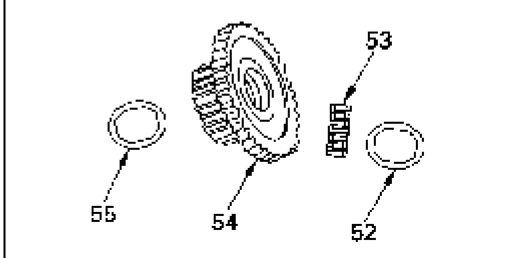


DMW03240

7. 2nd gear

Remove thrust washer (52), needle bearing (53), 2nd gear (54), and thrust washer (55).

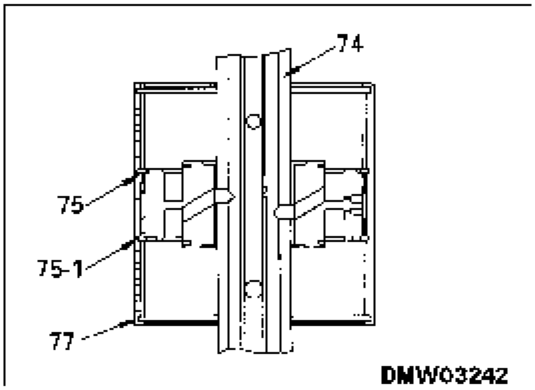
Use the same procedure as in Steps 3 - 5 for the 2nd gear to continue disassembly.



DMW03241

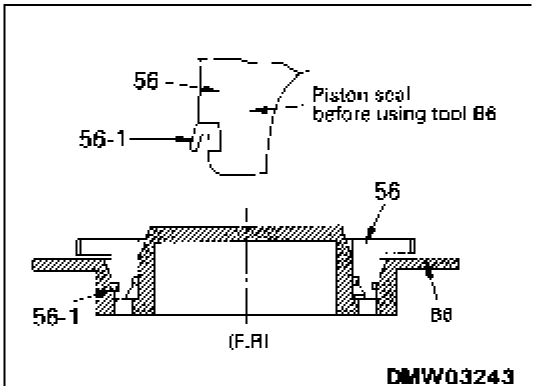
ASSEMBLY

Assembly of FORWARD, REVERSE clutch pack



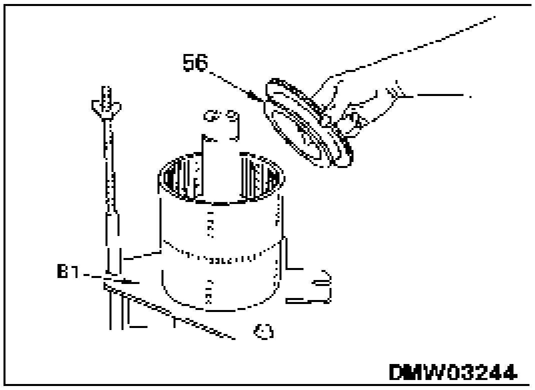
WARNING! The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand.
Be careful also not to get your fingers caught between the stand and the clutch pack.

1. **Housing**
   Assemble snap ring (75-1) to one side of housing (77).
2. **Shaft, housing**
   1) Assemble snap ring (57-1) to housing, then set on tool **B1.**
   2) Assemble shaft and housing to housing (77)and install snap ring (75).
3. **Piston seal**
   Assemble piston seal (56-1) to piston (56).
   Ú When assembling a new piston seal, use tool **B6** to make the seal fit well (time:approx. 2 - 3 minutes), then assemble the seal.
   Ú If the seal is assembled to the cylinder without making it fit first, the seal will be damaged.



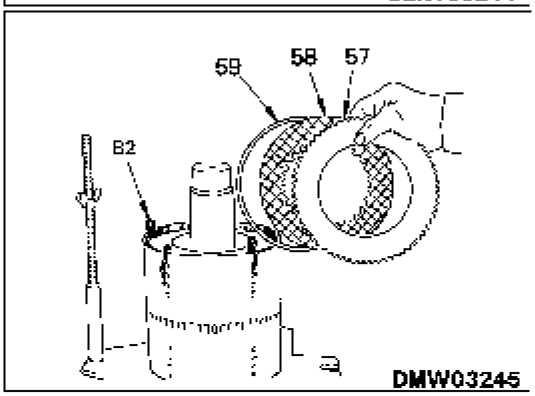
Inside surface of tool **B6:**
Transmission oil

4. **REVERSE piston**
   Install REVERSE piston (56).
   Ú Be careful not to damage the piston seal.
   Ú Check that the spring pin does not extend from the circumference of the shaft.



Sliding surface of piston seal:
Transmission oil

5. **Clutch plate**
   Insert tool **B2** in housing and assemble plate (57) disc (58), and spring (59) in turn.

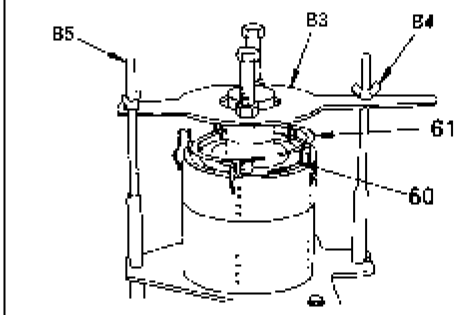


   Ú Soak disc (58) in clean transmission oil for at least 2 minutes before assembling.
   Ú Be careful to assemble so that disc (58) and spring (59) are not resting on each other.
   Ú Be careful that the plate or spring are not caught in the clutch housing ring groove when assembling.

6. End plate

1) Install tools **B3** and **B5,** then tighten tool **B4** to push in end plate (60).
2) Assemble ring (61) and remove tool **B3.**

Ú Check that the disc rotates smoothly by hand.



DMW03246

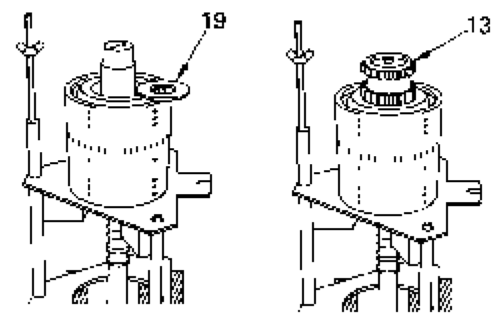
7. Thrust washer

Install thrust washer (19).

8. REVERSE gear

Align spline groove on inside of plate with a screwdriver to assemble gear (13).

Ú If the gear spline does not match, turn lightly when assembling. Never use force to push it in.

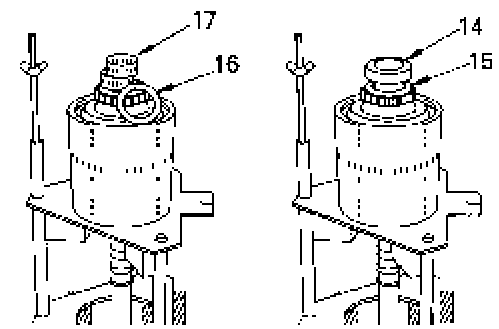


DNW03247 DNW03248

9. Needle bearing

Assemble needle bearing (17) and thrust washer (16).

Ú Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.



DNW03249 DNW03250

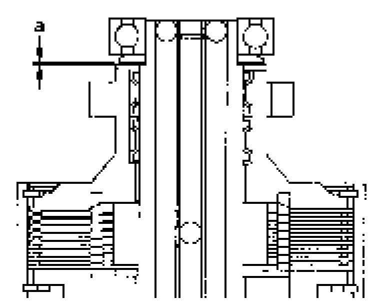
10 Bearing

Assemble spacer (15) and press fit bearing (14).

Ú Press fit completely so that spacer (15) is in tight contact with bearing (14) at the stepped portion of the shaft.

Ú After press fitting the bearing, check that the clearance **"a"** between the thrust washer and spacer is within the specified range.

a = 0.1 = 0.9 mm



DMW03251

11. REVERSE piston

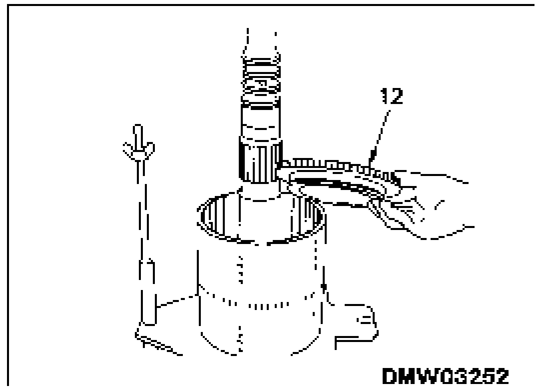
1) Turn over clutch pack.

⚠ **WARNING!** When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

2) In the same way as with REVERSE piston, make sure that piston seal fits well before assembling it to piston (12).
3) Assemble piston (12) in the same way as REVERSE piston.

Sliding surface of piston seal:

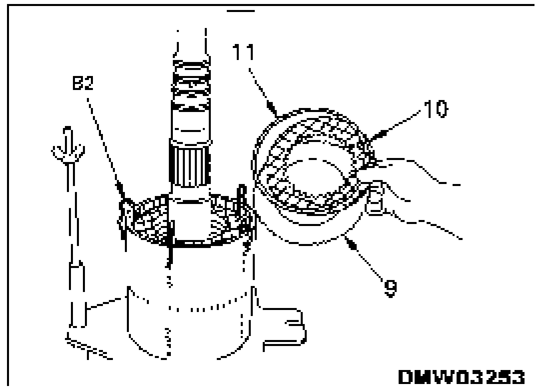
Transmission oil



12. Clutch plate

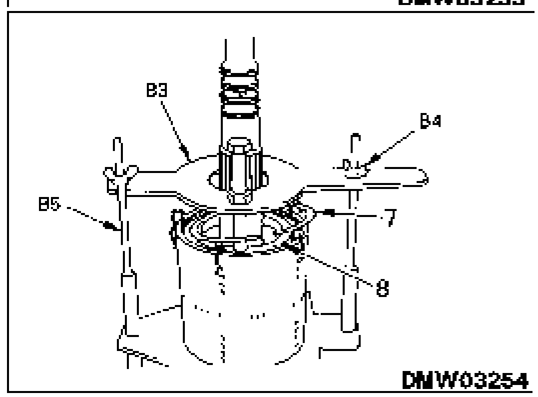
Insert tool **B2** in housing and assemble plate (9),disc (10), and spring (11) in turn.

Ú Assemble in the same way as for the REVERSE clutch plate.



13. End plate

1) Install tools **B3** and **B5,** then tighten tool B4 to push in end plate (8)
2) Assemble ring (7) and remove tool **B3.**
   Ú Assemble in the same way as for the REVERSE end plate.



14. Thrust washer

Install thrust washer (6).

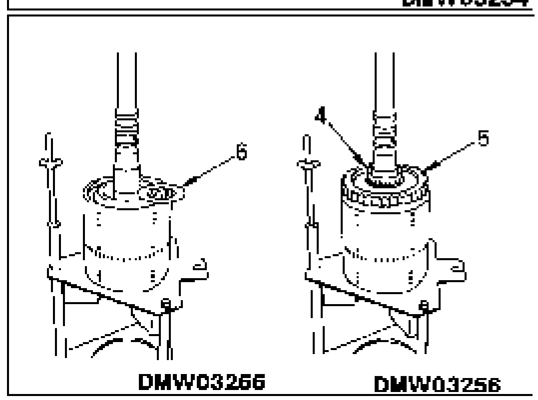
15. FORWARD gear

Assemble FORWARD gear (5)

Ú Assemble in the same way as for the REVERSE gear.

16. Needle bearing

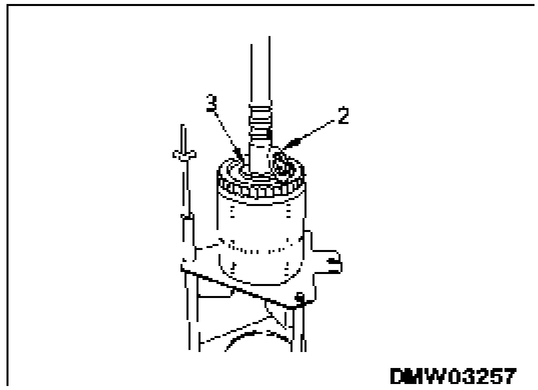
Assemble needle bearing (4).



17. Spacer

Assemble thrust washer (3), then assemble spacer (2).

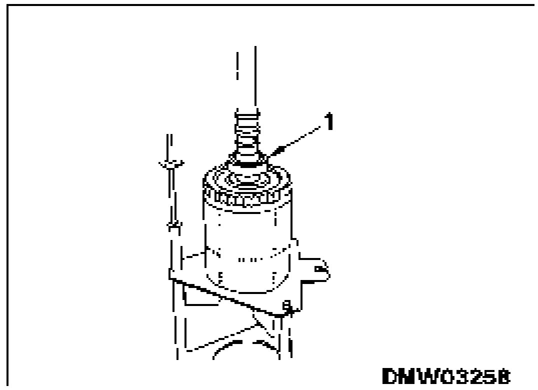
Ú Check that the end face of the thrust race of the thrust washer is below the surface of the stepped portion of the shaft.



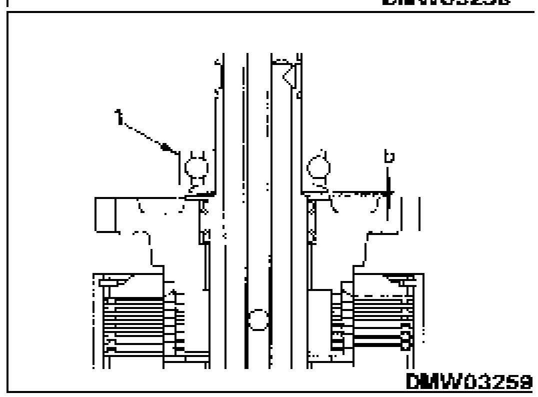
18. Bearing

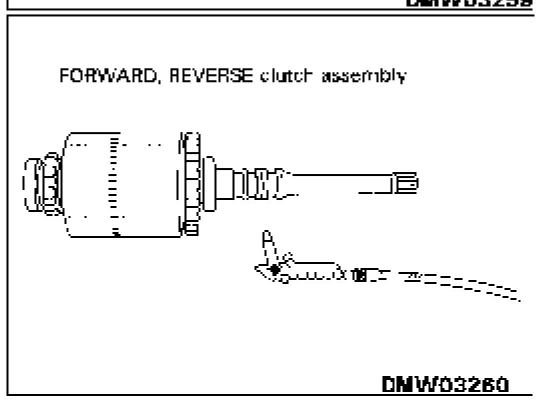
Press fit bearing (1).

Ú Press fit completely so that the spacer is in tight contact with bearing (1) at the stepped portion of the shaft.



Ú After press fitting the bearing, check that the clearance **"b'** between the thrust bearing and spacer is within the specified range.
b = 0.07 - 1.33 mm





19. Clutch pack operation test

Blow in compressed air through oil hole in shaft and check that each clutch works properly.

Ú If the gear where the air is blown in is held in position, the clutch is working properly.

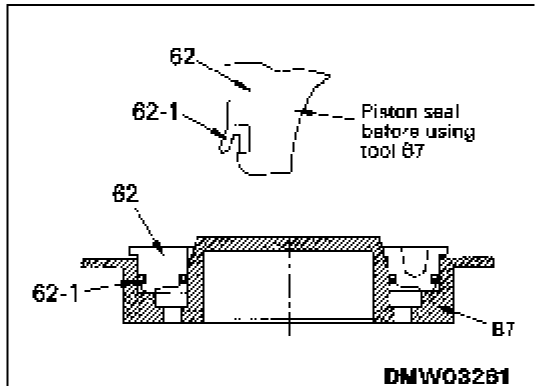
Assembly of 1st and 3rd clutch pack

WARNING! The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

- Set the shaft housing on the assembly stand with the 3rd clutch side at the top.

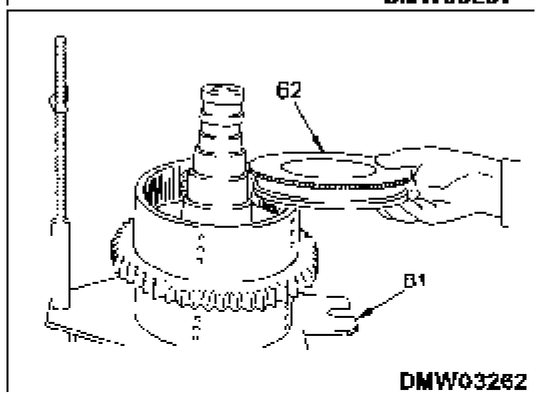
1. **Piston seal**
   Assemble piston seal (62-1) to piston (62).
   - When assembling a new piston seal, use tool **B7** to make the seal fit well (time:approx. 2 - 3 minutes), then assemble the seal.
   - If the seal is assembled to the cylinder without making it fit first, the seal will be damaged.

   Inside surface of tool **B7:**
   Transmission oil

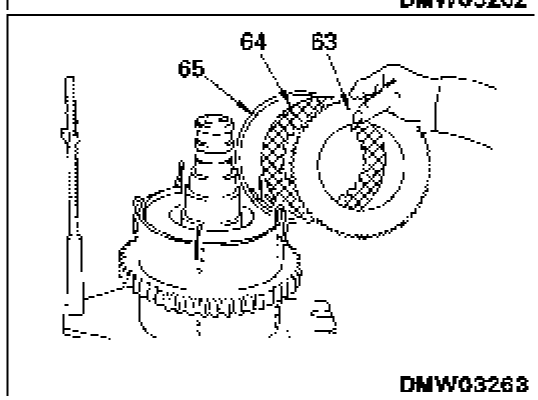


2. **3rd piston**
   Install 3rd piston (62).
   - Be careful not to damage the piston seal.
   - Check that the spring pin does not extend from the circumference of the shaft.

   Sliding surface of piston seal:
   Transmission oil

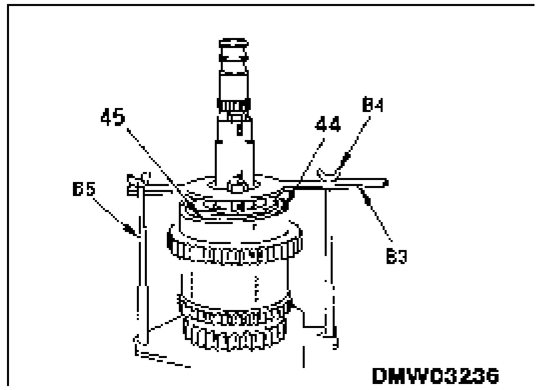


3. **Clutch plate**
   Assemble plate (63), disc (64), and spring (65) in turn to housing.
   - Soak disc (64) in clean transmission oil for at least 2 minutes before assembling.
   - Be careful to assemble so that disc (64) and spring (65) are not resting on each other.
   - Be careful that plate (63) or spring (65) are not caught in the clutch housing ring groove when assembling.



4. End plate

1) Install tools **B3** and **B5,** then tighten tool **B4** to push in end plate (66).
2) Assemble ring (67) and remove tool **B3.**
   Ú Check that ring (67) is fitted securely in the groove.
   Ú Check that the disc rotates smoothly by hand.

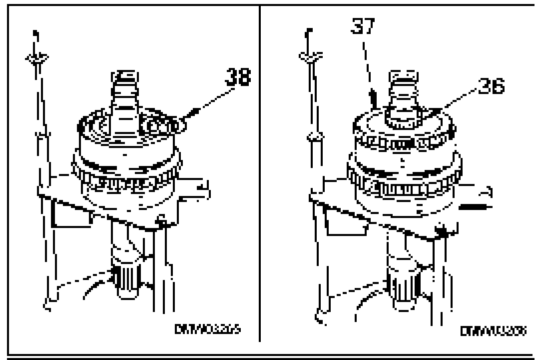


3) Assemble thrust washer (38).

5. 3rd gear

Assemble 3rd gear, then assemble needle bearing (36).

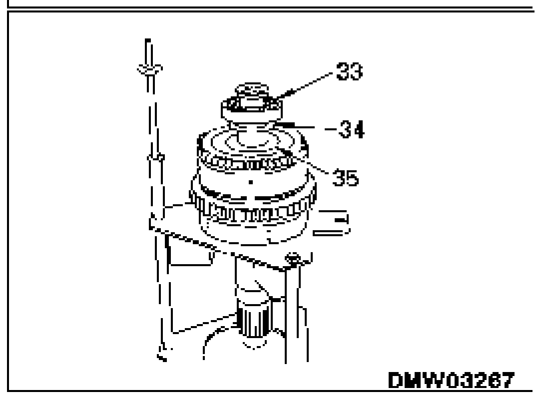
Ú If the gear spline does not match, turn lightly when assembling. Never use force to push it in.
Ú Assemble the needle bearing at the bottom first.



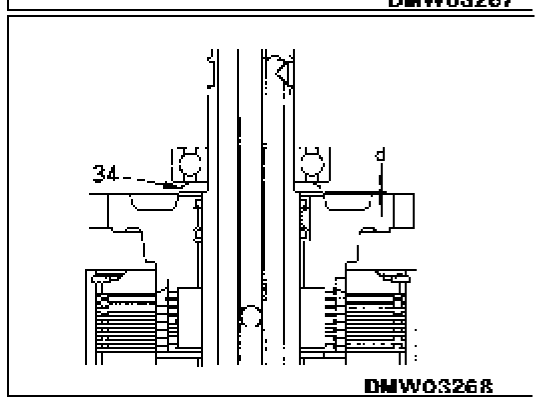
6. Bearing

Assemble thrust washer (35) and spacer (34), and press fit bearing (33).

Ú Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.
Ú Press fit completely so that the spacer is in tight contact with bearing (33) at the stepped portion of the shaft.



Ú After press fitting the bearing, check that clearance **"d"** between the thrust washer and spacer is within the specified range.
d = 0.1 - 0.9 mm



7. 1st piston

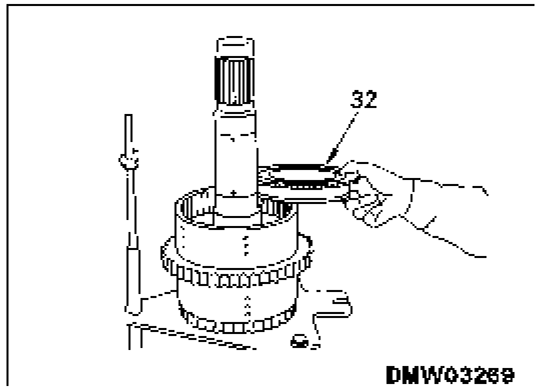
1) Turn over clutch pack.

WARNING! When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

2) In the same way as with 3rd piston, make sure that piston seal fits well before assembling it to piston (32).
3) Assemble piston (32) in the same way as 3rd piston.

Sliding surface of piston seal:

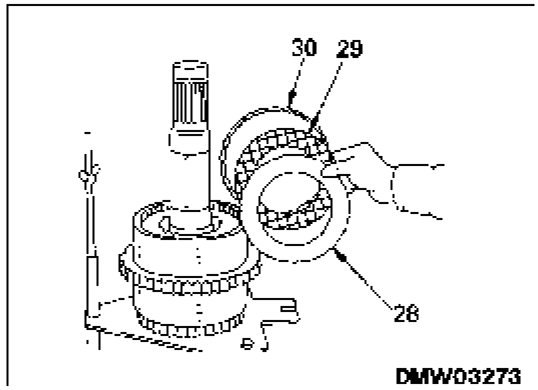
Transmission oil



8. Clutch plate

Assemble plate (28), disc (29), and spring (30) in turn to housing.

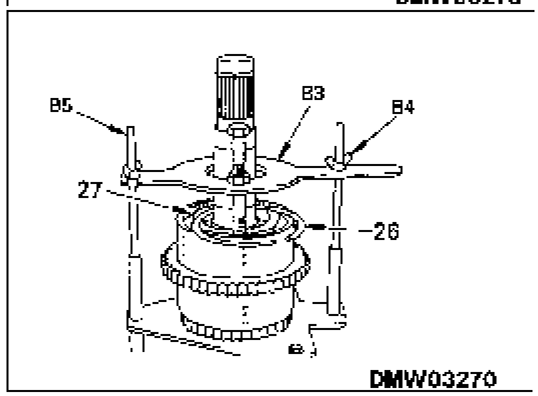
Ú Assemble in the same way as for the 3rd clutch plate.



9. End plate

1) Install tools **B3** and **B5,** then tighten tool **B4** to push in end plate (27).
2) Assemble ring (26) and remove tools **B3** and **B4.**

Ú Assemble in the same way as for the 3rd end plate.

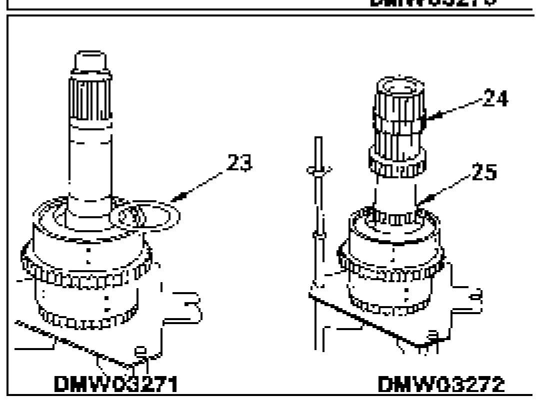


3) Assemble thrust washer (23).

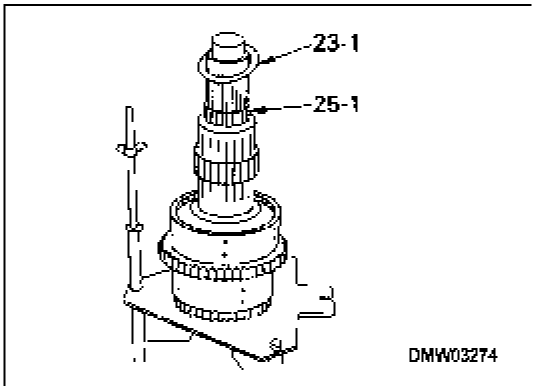
10. 1st gear

1) Assemble 1st gear (24) and needle bearing (25).

Ú Assemble in the same way as for the 3rd gear.



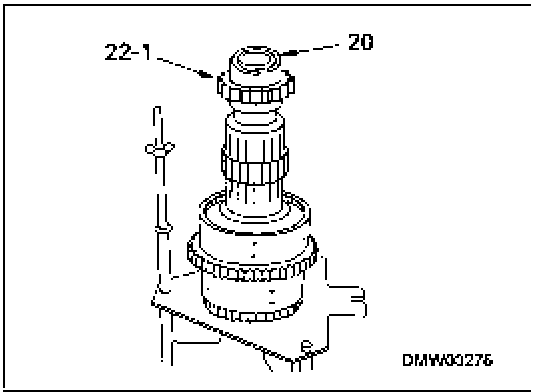
2) Assemble needle bearing (25-1) and thrust washer (23-1).



11. Idler gear

1) Assemble idler gear (20) and install snap ring (22-1).

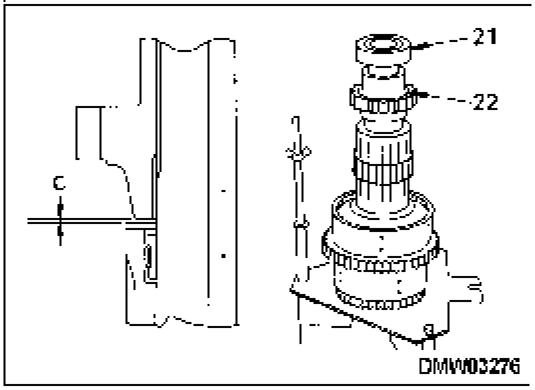
Ú Fit the snap ring securely in the shaft groove.



12. Bearing

Assemble spacer (22) and assemble bearing (21)

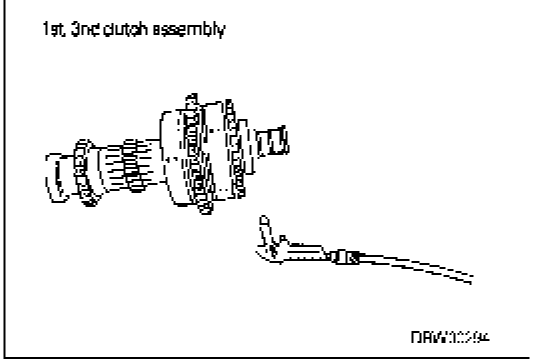
Ú After press fitting the bearing, check that clearance **'c"** between the washer and gear is within the specified range.
c = 1.0 - 1.59 mm



13. Clutch pack operation test

Blow in compressed air through oil hole in shaft and check that each clutch works properly.

Ú If the gear where the air is blown in is held in position, the clutch is working properly.



Assembly of 2nd and 4th clutch pack

WARNING! The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

Ú Set the shaft housing on tool **B1** with the 2nd clutch side at the top.

1. Piston seal

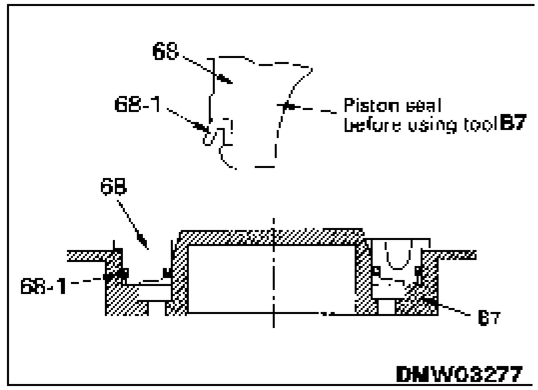
Assemble piston seal (68-1) to piston (68).

Ú When assembling a new piston seal, use tool **B7** to make the seal fit well (time: approx. 2 - 3 minutes), then assemble the seal.

Ú If the seal is assembled to the cylinder without making it fit first, the seal will be damaged.

Inside surface of tool **B7**:

Transmission oil

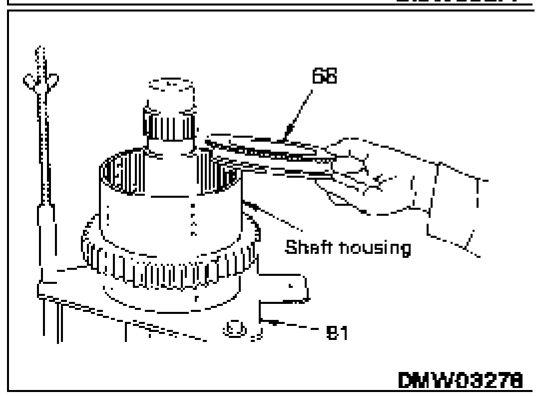


2. 2nd piston

Install 2nd piston (68).

Ú Be careful not to damage the piston seal.

Ú Check that the spring pin does not extend from the circumference of the shaft.



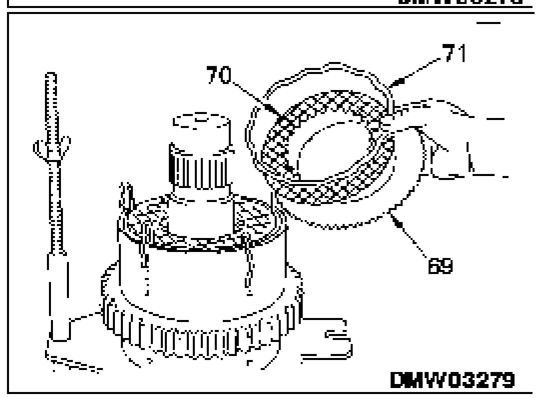
3. Clutch plate

Assemble plate (69), disc (70), and spring (71) in turn to housing.

Ú Soak disc (70) in clean transmission oil for at least 2 minutes before assembling.

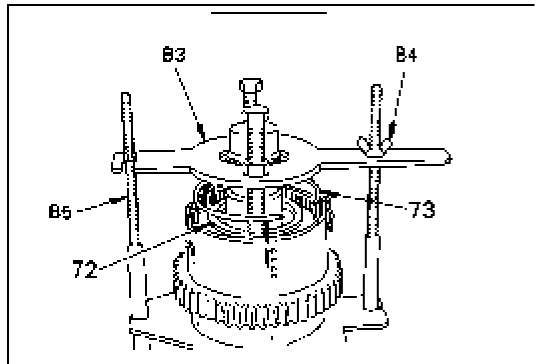
Ú Be careful to assemble so that disc (69) and spring (71) are not resting on each other.

Ú Be careful that the plate or spring are not caught in the clutch housing ring groove when assembling.

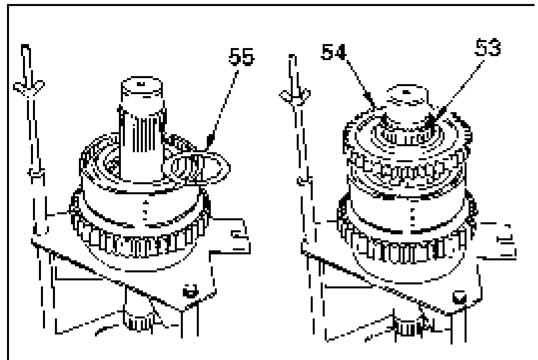


4. End plate

1) Install tools **B3** and **B5,** then tighten tool **B4** to push in end plate (72).
2) Assemble ring (73) and remove tool **B3.**
   Ú Check that the disc rotates smoothly by hand.



DMW03280



DMW03281 DMW03282

5. Thrust washer

Assemble thrust washer (55).

6. 2nd gear

Assemble 2nd gear (54), then assemble needle bearing (53).

Ú If the gear spline does not match, turn lightly when assembling. Never use force to push it in.

7. Idler gear

Assemble thrust washer (35), then assemble idler gear (50).

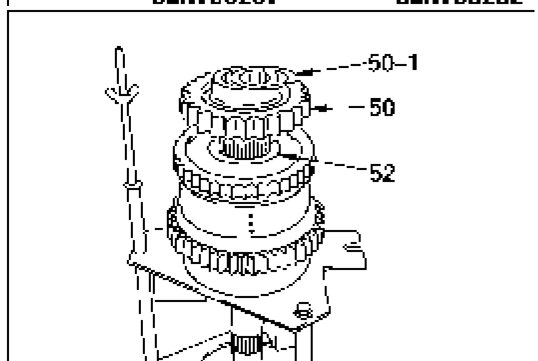
Ú Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.

8. Bearing

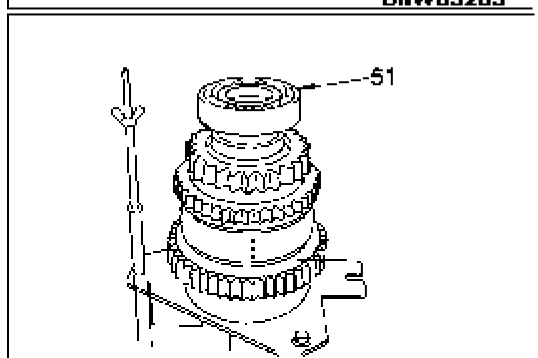
After assembling the idler gear, install snap ring (50-1), and press fit bearing (51).

Ú Fit the snap ring securely in the groove.

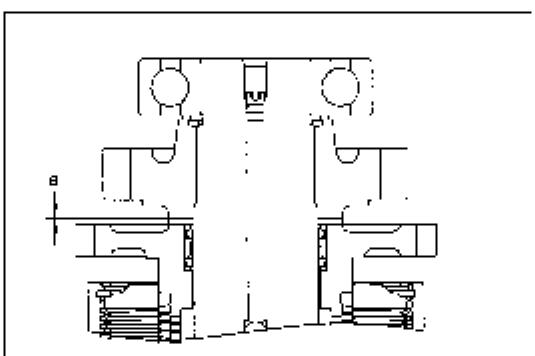
Ú After press fitting the bearing, check that clearance **"e"** between the thrust washer and idler gear is within the specified range. **e** = 0.04 - 1.16 mm



DNW03283



DNW03284



DNW03285

9. 4th piston

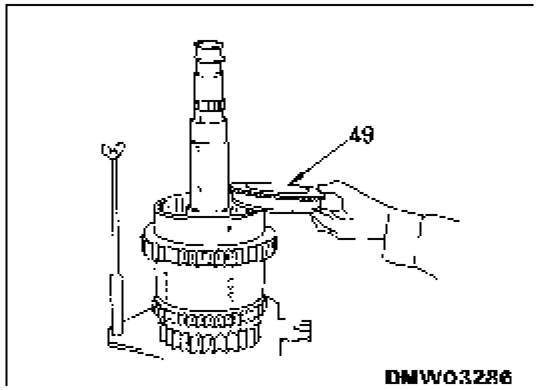
1) Turn over clutch pack.

WARNING! When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

2) In the same way as with 1st piston, make sure that piston seal fits well before assembling it to piston (49).

3) Assemble piston (49) in the same way as 2nd piston.

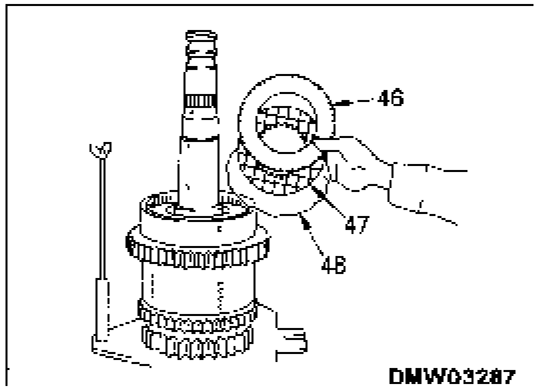
Sliding surface of piston seal: **Transmission oil**



10. Clutch plate

Assemble plate (46), disc (47), and spring (48) in turn to housing.

Ú Assemble in the same way as for the 2nd clutch plate.

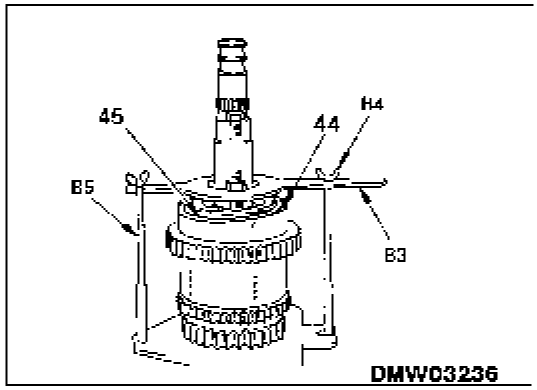


11. End plate

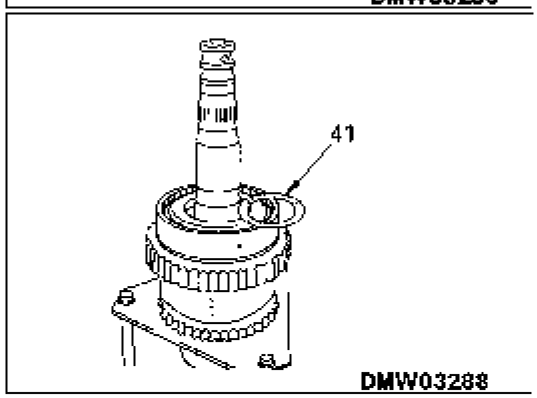
1) Install tools **B3** and **B5,** then tighten tool **B4** to push in end plate (45).

2) Assemble ring (44) and remove tool **B3.**

Ú Assemble in the same way as for the 2nd end plate.

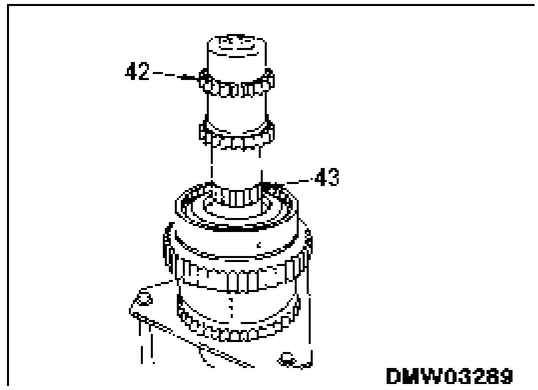


3) Assemble thrust washer (41).

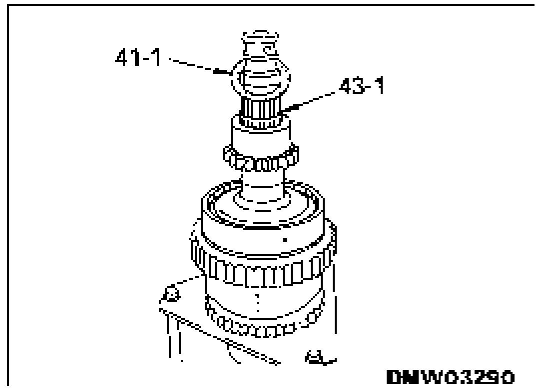


12. 4th gear

1) Assemble 4th gear (42) and needle bearing (43).
   - Ú Assemble in the same way as for the 2nd gear.
   - Ú Assemble the bottom needle bearing first.



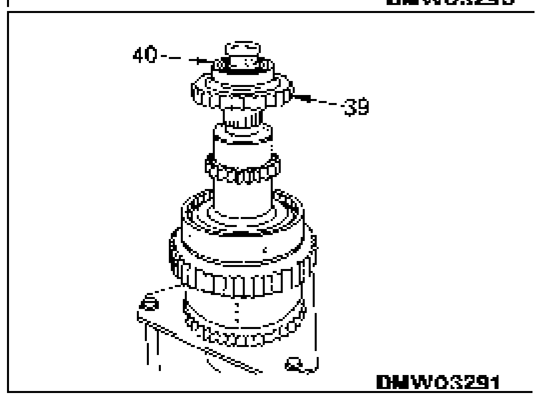
2) Assemble top needle bearing (43-1).
3) Assemble thrust washer (41-1).
   - Ú Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.

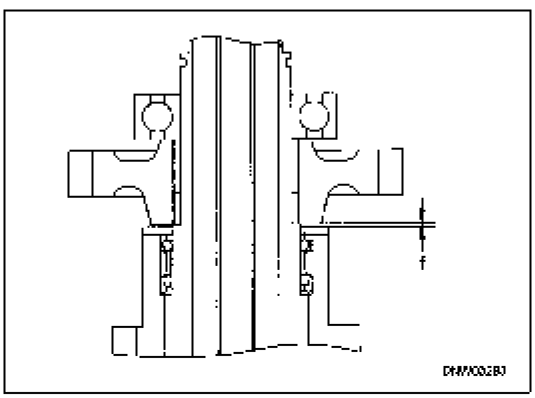


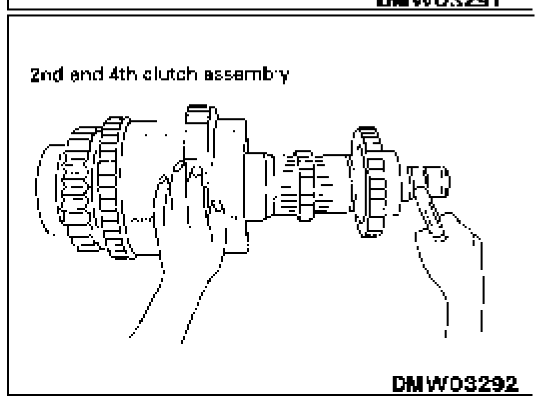
13. Bearing

Assemble idler gear (39) and press fit bearing (40).

- Ú Press fit completely so that the spacer is in tight contact with bearing (40) at the stepped portion of the shaft.
- Ú After press fitting the bearing, check that the clearance **"f"** between the thrust bearing and spacer is within the specified range.
  - Ú **f** = 0.07 - 1.33 mm







14. Clutch pack operation test

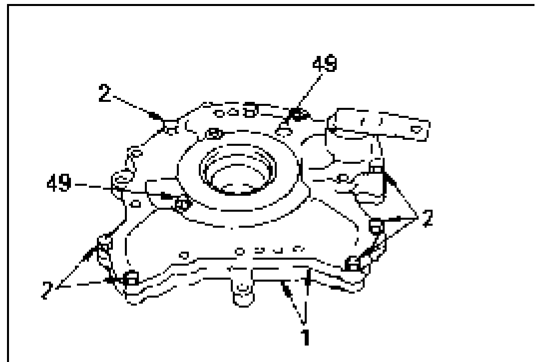
Blow in compressed air through oil hole in shaft and check that each clutch works properly.

- Ú If the gear where the air is blown in is held in position, the clutch is working properly.

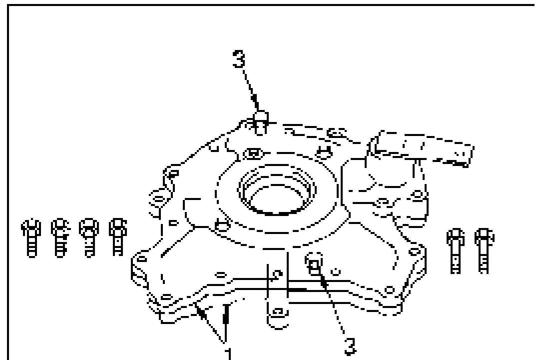
PARKING BRAKE ASSEMBLY
DISASSEMBLY

1. Brake housing and

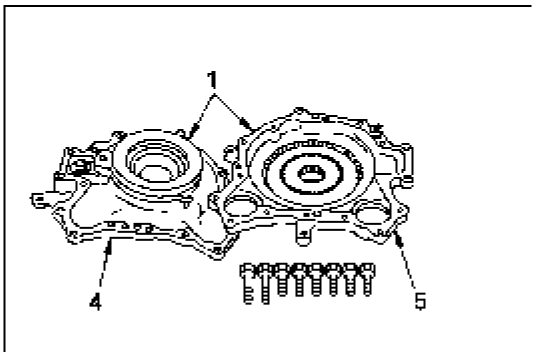
1) Remove mounting bolts (2) from brake assembly (1).
Ú Do not remove the 2 lock set bolts (49) installed when removing the parking assembly.
2) Using forcing screws (3), divide into housing (4) and retainer (5).



DNW03294

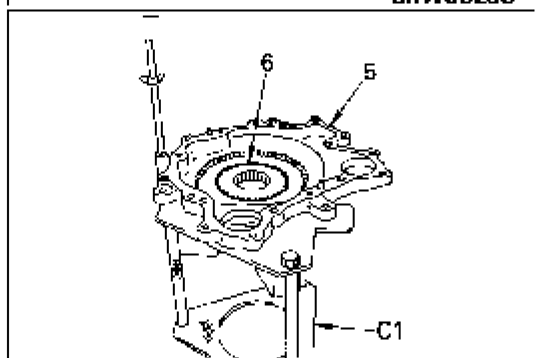


DNW03295



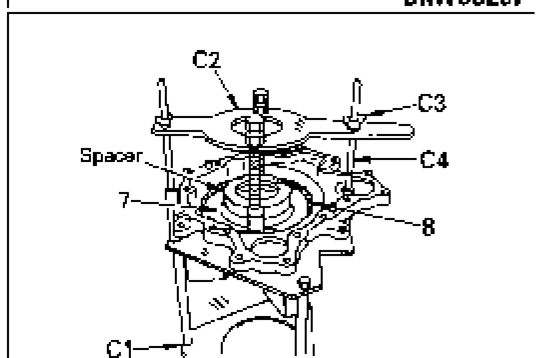
DNW03296

2. Hub spline
Set retainer (5) to tool **C1,** then pull out hub spline (6) and remove.
Ú Pull the hub spline straight up to remove.

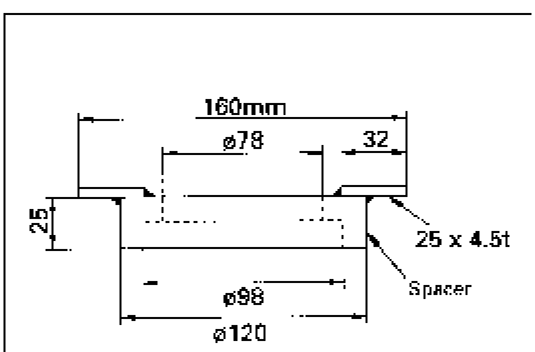


DNW03297

3. Separator plate
1) Set spacer on top surface of separator plate (7), install tools **C2, C3** and **C4,** then tighten **C3,** and remove ring (8).
Ú After removing the ring, remove tools **C2, C3, C4,** and spacer.

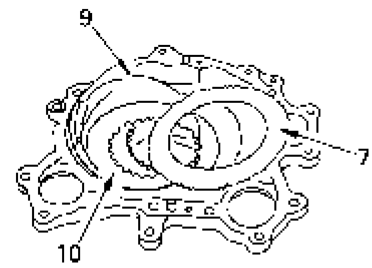


DNW03298



DMW03299

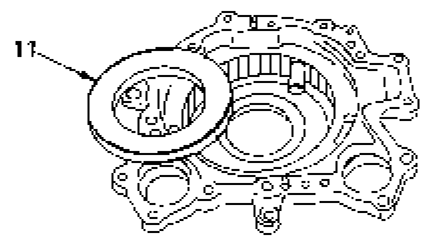
2) Remove separator plate (7), wave spring (9),and disc (10).



DNW03300

4. End plate

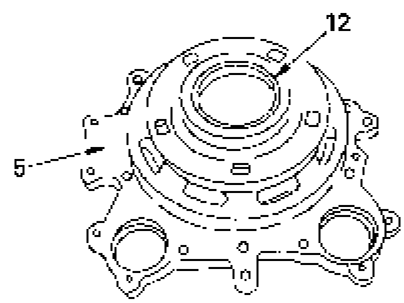
Remove end plate (11).



DNW03301

5. Retainer

Turn over retainer (5), and remove bearing cup (12) with puller.

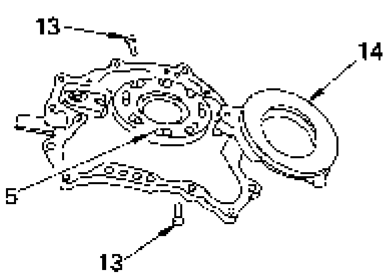


DNW03302

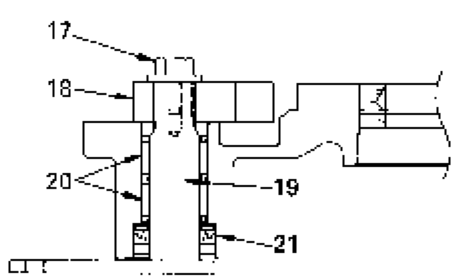
6. Housing

Remove 2 lock set bolts (13), then remove piston (14) and ball (15).

Ú If it is necessary to disassemble the lever portion, remove lock bolt (17), check the match marks on inner lever (18) and outer lever (19), then pull out the inner lever, and remove bearing (20) and oil seal (21).



DNW03303



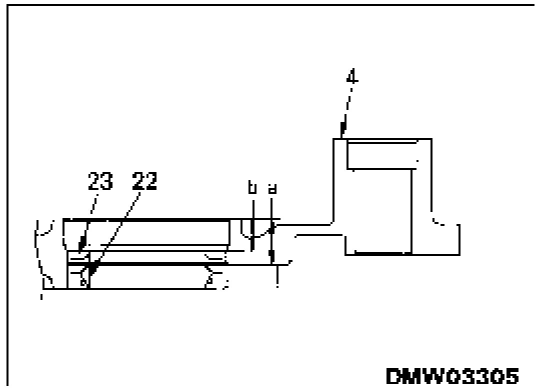
DNW03304

ASSEMBLY

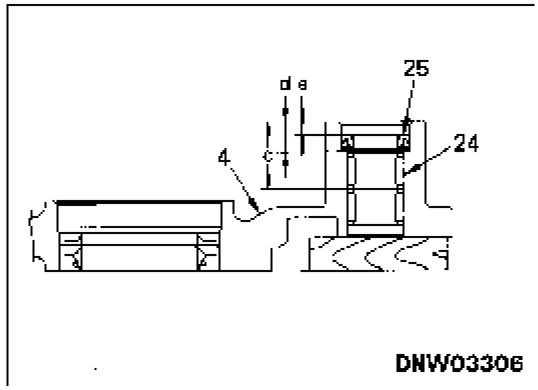
1. Housing

1) Press fit oil seal (22) and dust seal (23) to housing (4).
   - Ú Be careful not to let the seal lean at an angle when press fitting.
   - Ú Oil seal press-fitting dimension **(a):** 19 ± 1 mm
   - Ú Dust seal press-fitting dimension **(b):** 11 ± 1 mm

   Lip of seal: **Grease (G2-L1)**
   - Ú Coat with grease when assembling the housing.

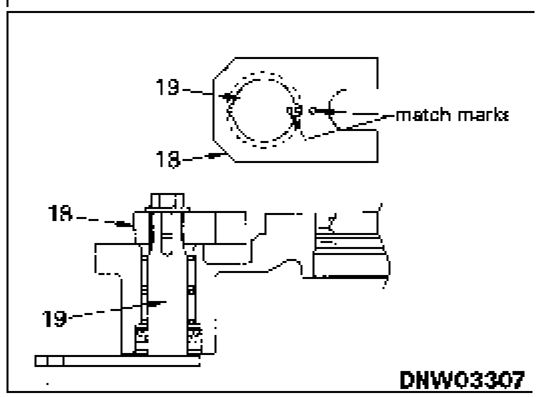


2) Press fit needle bearing (24) and oil seal (25) to housing (4) to specified dimension.
   - Ú Needle bearing press-fitting dimension **(c)**: 39.0 ± 0.1 mm (1st)
   - Ú Needle bearing press-fitting dimension **(d):** 17.0 ± 0.5 mm (2nd)
   - Ú Oil seal press-fitting dimension **(e):** 8.0 ± 0.3 mm



Lip of seal: **Grease (G2-L1)**
- Ú Set a stand under the housing to prevent the bearing and seal from leaning at an angle when press fitting.

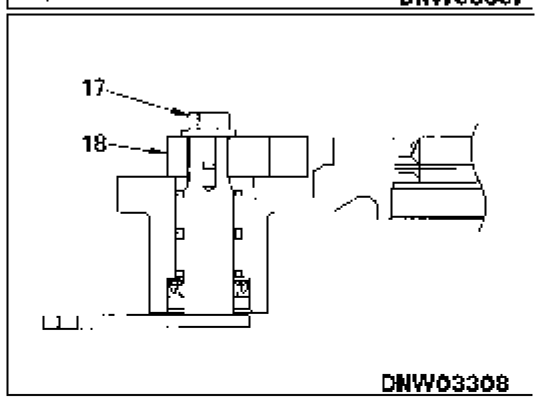
3) Insert outside lever (19) from oil seal end.
   - Ú Clean and remove all oil and grease from the bolt hole of the outside lever.
4) Align match marks and assemble inside lever (18)



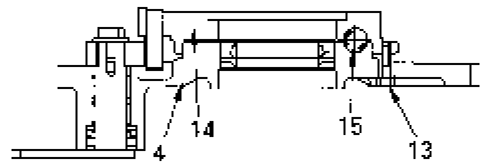
5) Coat thread of lock bolt (17) with thread tightener, then tighten.

   Lock bolt: **Thread tightener (LT-2)**

   Lock bolt: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**
   - Ú Do not forget to assemble the washer.
   - Ú Clean and remove all oil and grease from the lock bolt and bolt hole.



6) Assemble ball (15) in groove of housing (4), install piston (14) from above, then tighten lock set bolt (13) temporarily.
   - Ú Temporarily assemble the two set bolts to prevent the piston from falling out during assembly.
   - Ú Set bolt length: 8 mm, ℓ = 30 mm

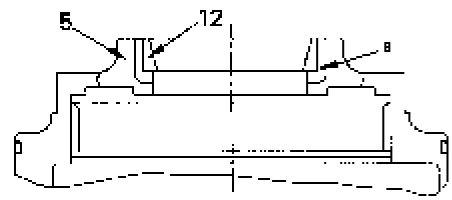


DNW03309

2. Retainer

Press fit bearing cup (12) to retainer (5).

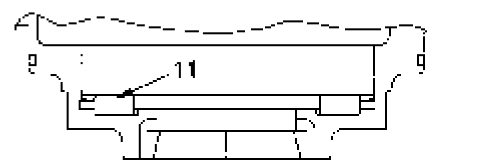
- Ú After press fitting the cup, check that there is no clearance at portion **"a".**



DNW03310

3. End plate

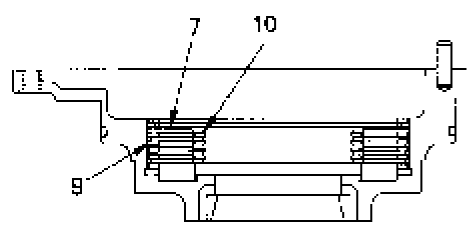
Assemble end plate (11).



DNW03311

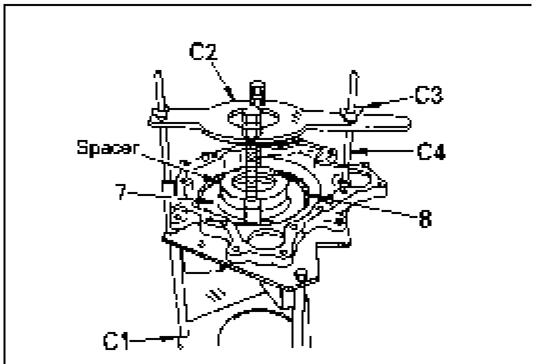
4. Separator plate

1) Assemble separator plate (7), wave spring (9), and disc (10) in turn.
   - Ú Soak disc (10) in clean transmission oil for at least 2 minutes before assembling.
   - Ú Use one spring.



DNW03312

2) Set retainer assembly on tool **C1** then set spacer on top of separator plate (7), install tools **C2, C3,** and **C4** and tighten **C3,** and assemble ring (8).
   Ú Use the same spacer that was used during disassembly.
   Ú After assembling the ring, remove tools **C2, C3, C4,** and the spacer.
   Ú Check that the disc rotates smoothly by hand.

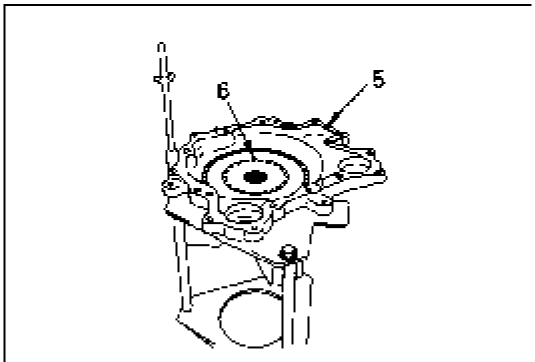


DNW03295

5. Hub spline

Align with spline and assemble hub spline (6).

Ú If the hub spline cannot be aligned, rotate it lightly when assembling. Do not use force to push it in.

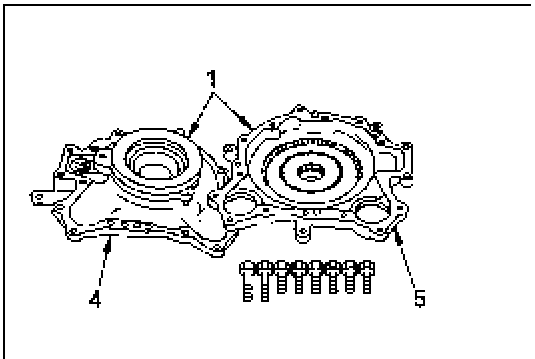


DNW03313

6. Brake housing and retainer

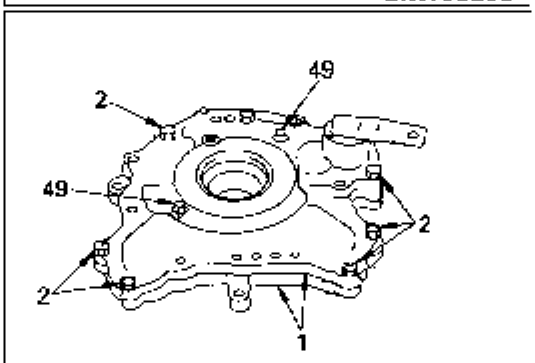
1) Assemble gasket seat to join of retainer (1), then install housing (4).
   Ú Wipe the mating surface of the retainer and housing clean before assembling.

Ú Do not remove the two set bolts (49) for holding the piston which were installed when removing parking brake assembly (1). Replace them with a plug after assembly.



DNW03296

2) Tighten mounting bolts (2) uniformly on diagonally opposite sides.
   Mounting bolt:
   110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)



DNW03294

TRANSMISSION CONTROL VALVE

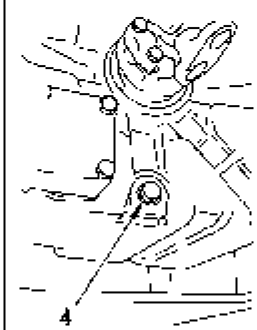
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving. Remove the cover under the cab, the transmission inspection cover, and the side cover.

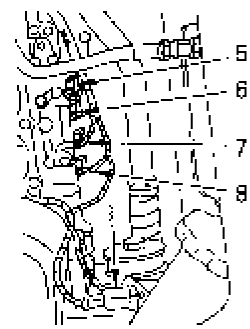
For details, see REMOVAL OF TORQUE CONVERTER CHARGING PUMP ASSEMBLY.

1. Draining oil

Loosen drain valve (4) and drain transmission oil.



DNW03314

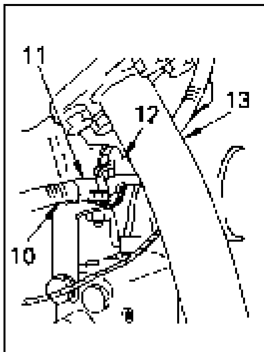


DNW03315

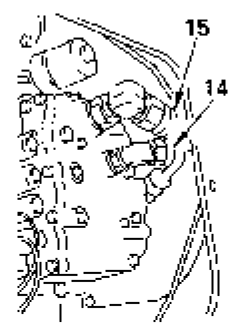
Transmission oil: **35ℓ**

1) Disconnect transmission solenoid connectors (5), (6), (7), and (8), and speedometer sensor connector (9) from transmission wiring. ※1

Ú If the connectors are removed, fit tags to distinguish the wiring.



DNW03316

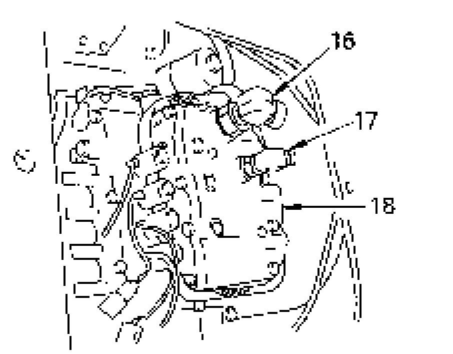


DNW03317

2) Remove clamp (11) of transmission wiring (10), and disconnect torque converter oil temperature sensor connector (12). ※2

2. Tube hose

1) Remove tube (13) between transmission and torque converter charging pump.
2) Disconnect hose (14) between torque converter oil filter and transmission valve, and hose (15) between oil cooler and transmission valve at transmission valve end.



DNW03318

3) Remove elbows (16) and (17).

3. Transmission valve

Sling transmission valve (18), then remove mounting bolts and lower under chassis. ※3

WARNING! The working space is confined, so be extremely careful.

Ú When fitting the lifting tool, avoid the connectors and fit the tool securely to the valve body.

Transmission valve: **46 kg**

INSTALLATION

! Carry but installation in the reverse order of removal.

1

Ú Connect the wiring connector securely.

2

Mouthpiece nut:
196.1 ± 2:49.0 Nm (20.0 ± 5.0 kgm)
(Width across flats: 41 mm)

Mouthpiece nut:
176.5 ± 29.4 Nm (18.0 ± 3.0 kgm)
(Width across flats: 36 mm)

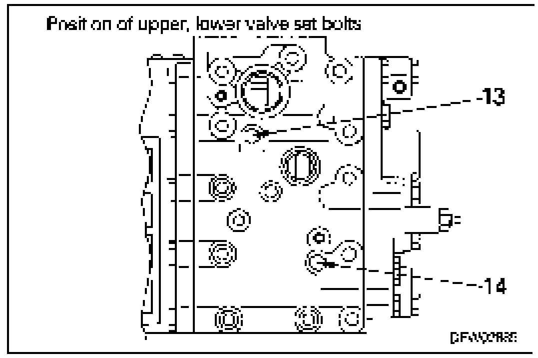
3

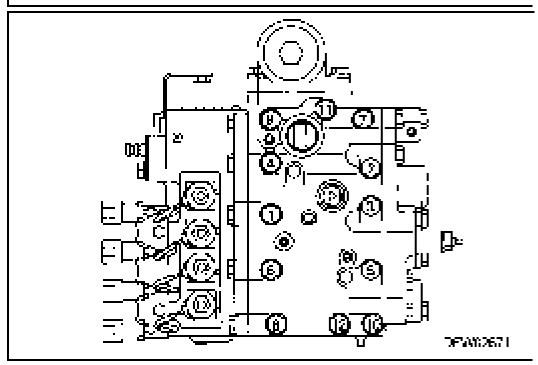
WARNING! The working space is confined, so be extremely careful.

Ú When installing the transmission valve, replace the gasket with a new part.
Ú When installing the transmission valve, use guide bolts to prevent it from falling.
Ú Secure with upper and lower valve set bolts (13) and (14).
Ú Remove all oil and grease from the valve mounting bolts and mounting bolt holes.

Mounting bolt:: **Thread tightener (LT-2)**

Mounting bolt:: **34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)**





Ú To prevent distortion of the valve, tighten the transmission valve mounting bolts in the order shown in the diagram.

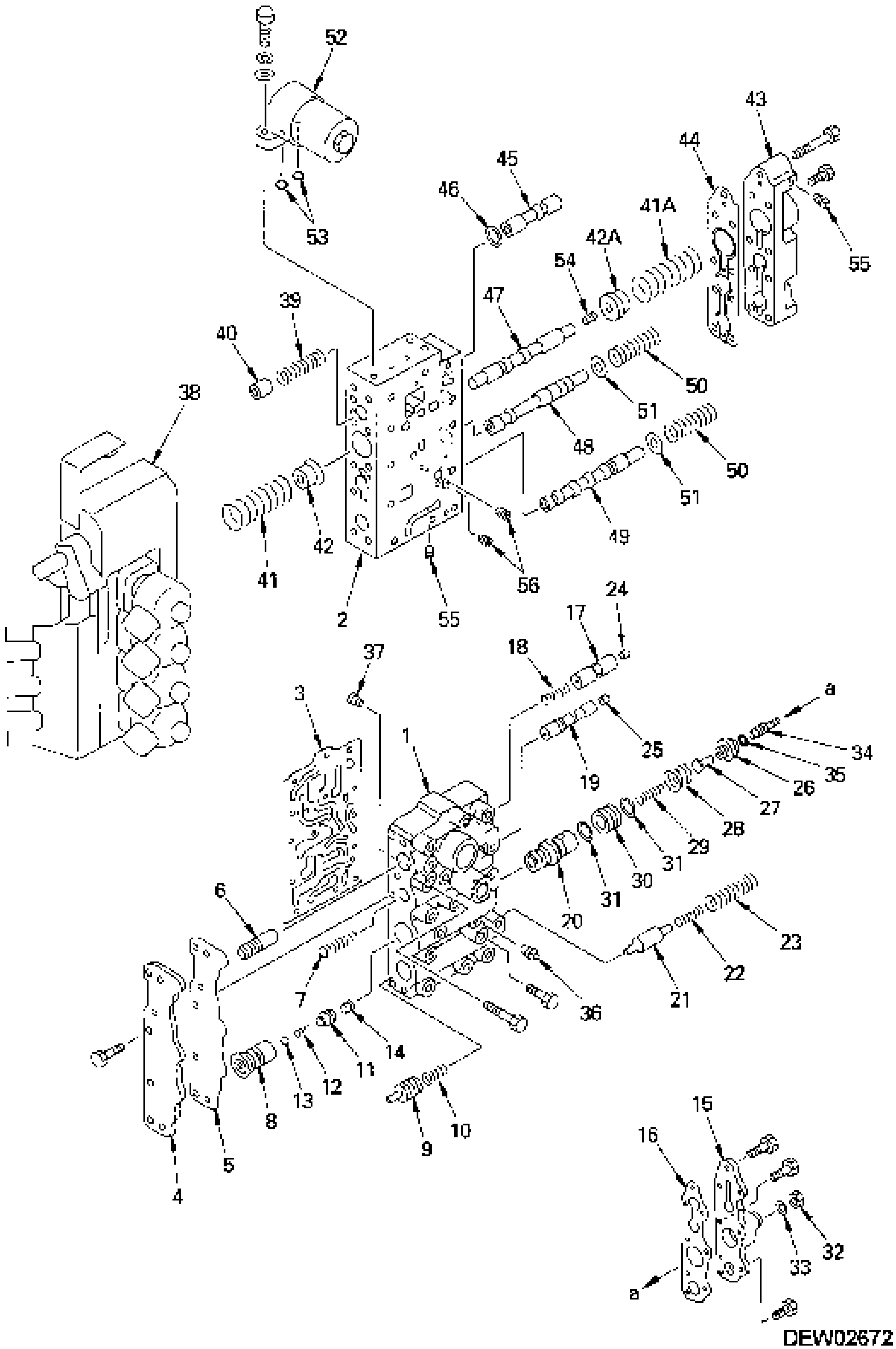
Mounting bolt length (R): R = 100 mm (1, 6, 8, 12)
R = 120 mm (4, 7, 1 0, 11)
R = 130 mm (2, 9)
R = 135 mm (3, 5)

Refilling with oil

! Tighten drain plug and add transmission oil through oil filler to the specified level.

! Transmission oil: **35 R**

TRANSMISSION CONTROL VALVE
DISASSEMBLY



1. Disconnection

Remove mounting bolts, disconnect upper valve (1) and lower valve (2), then remove gasket (3).

2. Disassembly of upper valve

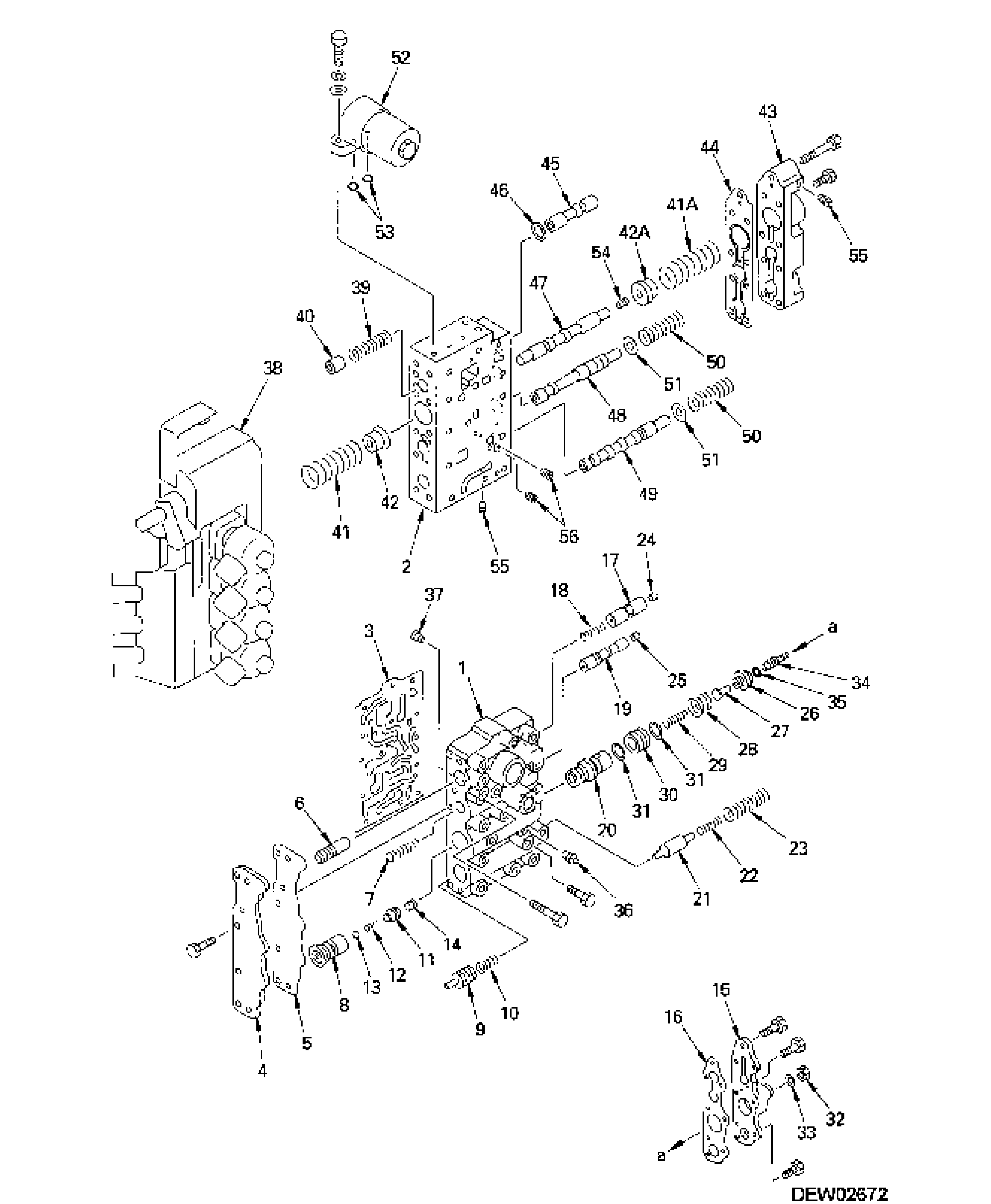
1) Remove mounting bolts, remove cover (4), then remove gasket (5), pilot valve (6), priority spring (7), quick return valve assembly (8), accumulator piston (9), and spring (10).
2) Remove sleeve (11) from quick return valve assembly, then remove spring (12) and ball (13).
3) Remove plug (14) from sleeve (11).
4) Remove mounting bolts, remove cover (15), then remove gasket (16), main regulator valve (17), spring (18), priority valve (19), modulating valve assembly (20), accumulator shaft (21), and springs (22) and (23).
5) Remove load pistons (24) and (25) from main regulator valve (17) and priority valve (19).
6) Remove plug (26) from modulating valve assembly (20), then remove retainer (27), springs (28) and (29), sleeve (30), and O-ring (31).
7) Remove nut (32) and washer (33) from cover (15), then remove adjustment screw (34) and O-ring (35).
8) Remove plug (36) and main orifice (37) from upper valve (1).

3. Disassembly of lower valve

1) Remove mounting bolts, remove solenoid valve assembly (38), then remove spring (39), retainer (40), spring (41), and sleeve (42).
2) Remove mounting bolts, remove cover (43), then remove gasket (44), torque converter regulator valve (45), shim (46), spring (41A), sleeve (42A), F-R selector valve (47), H-L selector valve (48), range selector valve (49), spring (50), and spacer (51).
3) Remove mounting bolts, then remove pilot filter (52) and O-ring (53).
4) Remove plug (54) from F-R selector valve (47).
5) Remove plug (55) from lower valve (2) and cover(43).
6) Remove orifice (56) from lower valve (2).

TRANSMISSION CONTROL VALVE

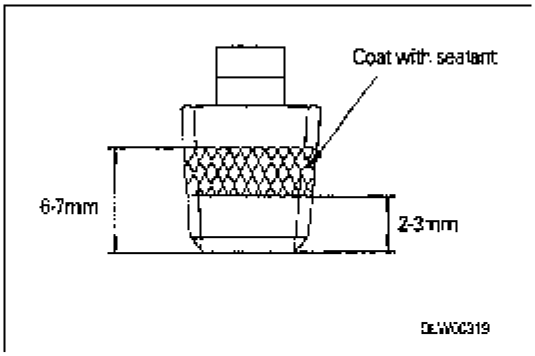
ASSEMBLY



1. Assembly of lower valve

1) Fit orifice (56) to lower valve (2).
   Ú Turn in the orifice until it clears the body by 2 mm or longer.

2) Fit plug (55) to lower valve (2) and cover (43).
   Plug: **Selector (LG-1 or LG-5)**



3) Fit plug (54) to forward-reverse selector valve (47).

4) Fit O-ring (53) to pilot filter (52) and mount the pilot filter in position by tightening its mounting bolt.
   Mounting bolt:
   68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)

5) Fit H-L selector valve (48), range selector valve (49), spacer (51), spring (50), forward-reverse selector valve (47), sleeve (42A), spring (41A), shim (46) and torque converter regulator valve (45), and then mount cover (43) with gasket (44) suitably fitted in position.
   Mounting bolt:
   68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)

6) Fit sleeve (42), spring (41), retainer (40and spring (39), and mount solenoid valve ass'y (38) to lower valve (2) with gasket suitably fitted in position.
   Mounting bolt:
   68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)

2. Assembly of upper valve

1) Fit plug (36) and main orifice (37) to upper valve (1).
   Ú Turnin the orifice until it clears the body by 2mm or longer.
   Plug: **Selector (LG-1 or LG-5)**

2) Fit adjusting screw (34) together with O-ring (35) to cover (15) and also fit washer (33) and nut (32) to cover (15).
   Ú See "Testing and adjusting Volume" for the adjusting procedure.

3) Fit plug (26) to modulating valve ass'y (20); fit O-ring (31) to sleeve (30) and then fit springs (28), (29) and retainer (27).

4) Fit load pistons (24), (25) to main regulator valve (17) and priority valve (19).

5) Fit springs (22), (23), accumulator shaft (21), modulating valve ass'y (20), priority valve (19), spring (18) and main regulator valve (17) to cover (15); and then mount cover (15) with gasket (16) suitably fitted in position.
   Mounting bolts:
   68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)

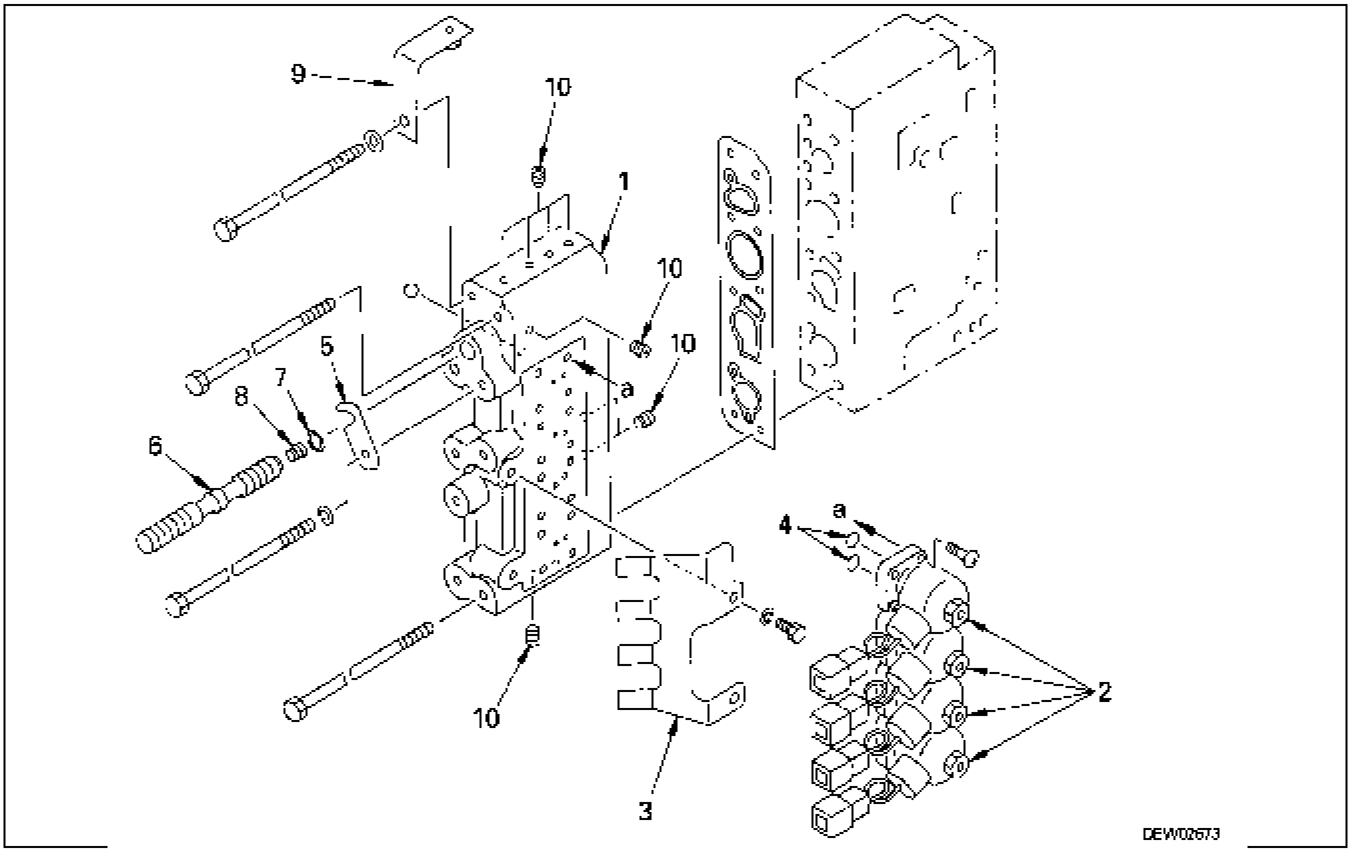
6) Fit plug (14) to sleeve (11), set ball (13) and spring (12) to quick return valve (8) and then mount sleeve (11).

7) Fit spring (10), accumulator piston (9), quick return valve ass'y (8), priority spring (7) and pilot valve (6) to cover (4). Then mount cover (4) with gasket (5) suitably fitted in piston.
   Mounting bolts:
   68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)

3. Connecting

Connect lower valve (2) and upper valve (1) together with gasket (3) suitably fitted in position.
   Mounting bolts:
   31.4 ± 4.9 Nm (3.2 ± 0.5 kgm)

TRANSMISSION SOLENOID VALVE



DISASSEMBLY

1. Remove mounting bolts from solenoid valve body (1), then remove solenoid (2) and O-ring (4).
   Ú Remove the connector from plate.

2. Remove plate (3) from valve body (1).

3. Remove lock plate (5), then remove emergency manual spool (6) and O-ring (7).
   1) Remove orifice (8) from emergency spool (6).
   2) Remove plate (9).

4. Remove plug (10) from solenoid valve body (1).

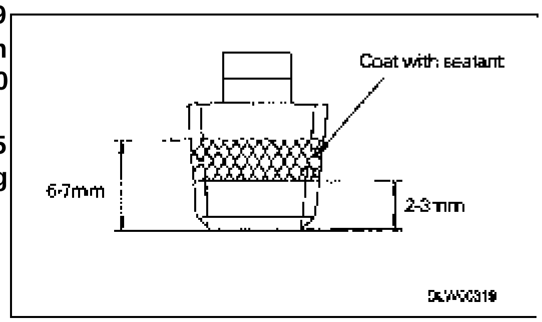
ASSEMBLY

1. Install plug (10) to solenoid valve body (1).
   Plug: **Sealant (LG-1 or LG-5)**

2. Install orifice (8) and O-ring (7) to emergency manual spool (6), secure with lock plate (5), then install plate (9).

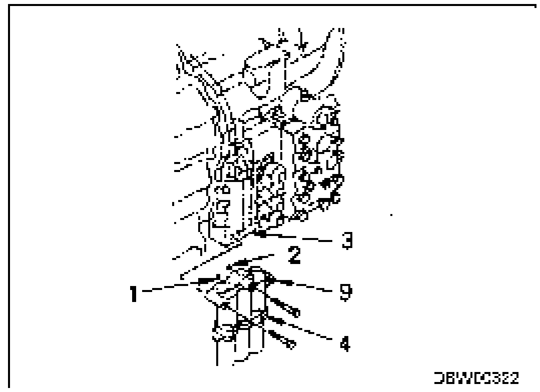
3. Install plate (3) to valve body (1).

4. Assemble O-ring (4) to solenoid valve (2) and tighten bolts.
   Ú Be careful not to get the O-ring caught.
   Mounting bolt:
   68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)



ACCUMULATOR VALVE
DISASSEMBLY

1. Remove accumulator valve (4) from transmission assembly (3).



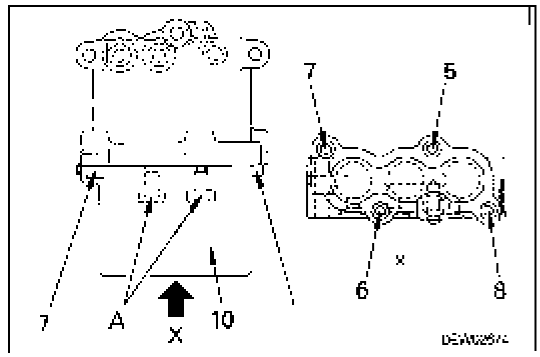
2. Remove O-rings (1) and (2) from accumulator valve (4).

3. Set pads in vice, then set accumulator valve body (9) in vice.

4. Remove mounting bolts (5) and (6), and assemble guide bolts (10mm, P=1.5, R approx. 40mm).

5. Remove bolts (7) and (8), then remove cover(10) together with guide bolt **a.**

Ú The internal parts will come out together with the cover, so be extremely careful not to damage them when removing.

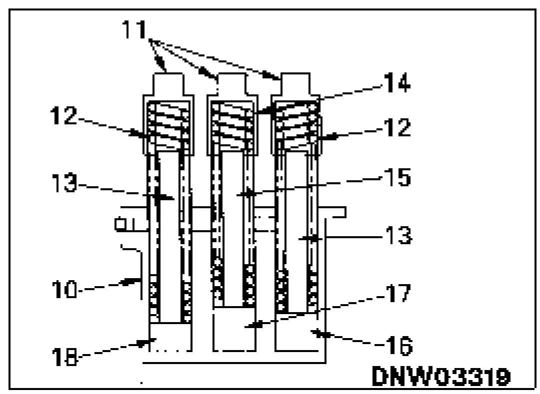


6. Pull out valve (11), springs (12) and (14), stoppers (13) and (15), and spacers (16), (17), and (18) from cover (10).

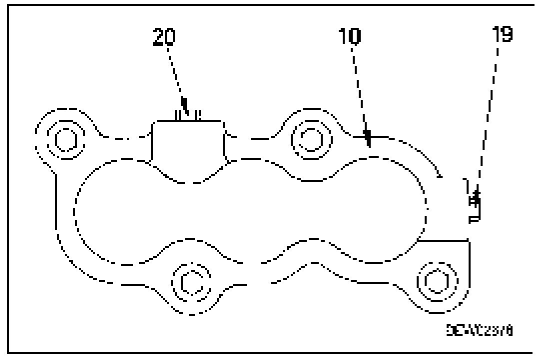
Ú Fit tags to distinguish the springs, stoppers, and spacers, and use as reference when assembling.

Ú Reference

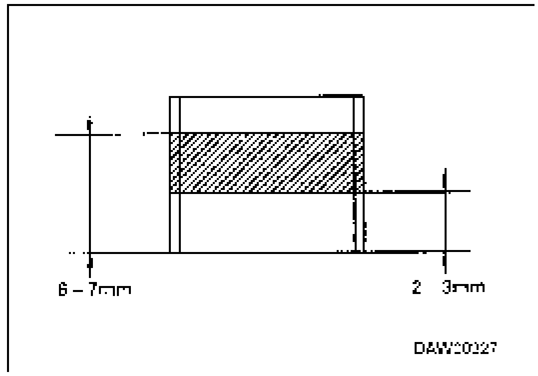
	Spring	Stopper	Spacer
Forward	R = 185	R = 147.6	R = 10
1st	R = 158	R = 110.1	R = 41.1
2nd	R = 158	R = 125	R = 21.1



7. Remove plugs (19) and (20) from cover (10).
 Ú Plug: 5 mm (Width across flats)
  Ú Do not remove the plug unless necessary.
  Ú If plugs (19) and (20) have been removed, coat the thread with thread tightener as shown in the diagram, then tighten the plugs.



 Ú Be careful not to get thread tightener on the hatched area when coating with thread tightener.
 Plug: **Thread tightener (LG-1)**



ASSEMBLY

1. Set pads in vice, then set accumulator valve cover (10) in vice.
 Ú Becareful not to tighten the cover with any excessive force.

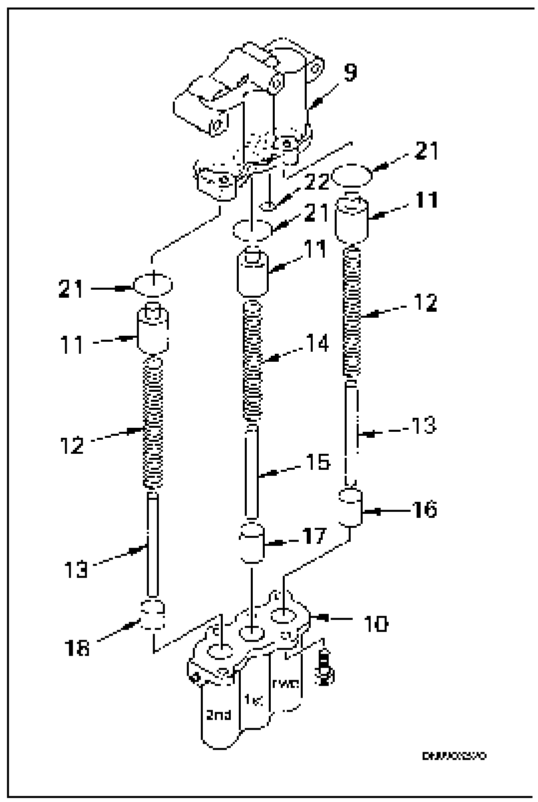
2. Insert spacers (18), (17), and (16), stoppers (15) and (13), and springs (14) and (12) in accumulator valve cover (10), then insert valves (11) from above each spring.

3. Insert O-rings (21) and (22) in each groove of accumulator valve body (9).
 Ú Assemble O-rings in the groove of the body securely.

4. Place accumulator valve body (9) perpendicular to cover (10), and temporarily assemble with guide bolts.
 Ú Assemble the body slowly and be careful not to let the O-ring fall out.

5. Pushin accumulator valve body (9),then remove guide bolts and secure with specified bolt.
 Mounting bolt:

53.9 ± 19.6 Nm (5.5 ± 2.9 kgm)
(Width across flats: 8 mm)

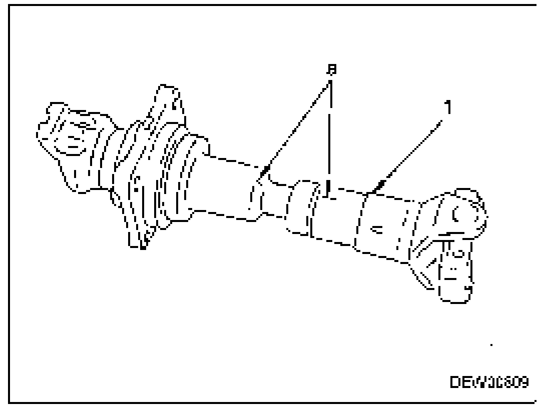


DRIVE SHAFT
DISASSEMBLY

1. Front drive shaft

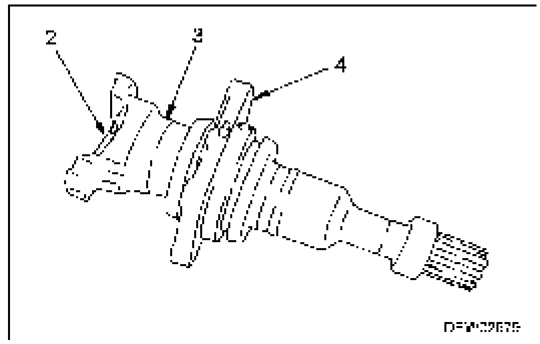
1) Remove coupling and tube (1)

Ú Make match marks **"a"** before removing so that the direction of the coupling does not change.

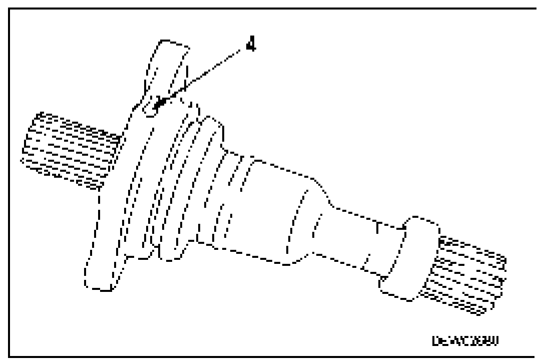


2) Loosen bolt (2), then remove coupling (3) and retainer.

Ú Make match marks before removing so that the direction of the coupling does not change.



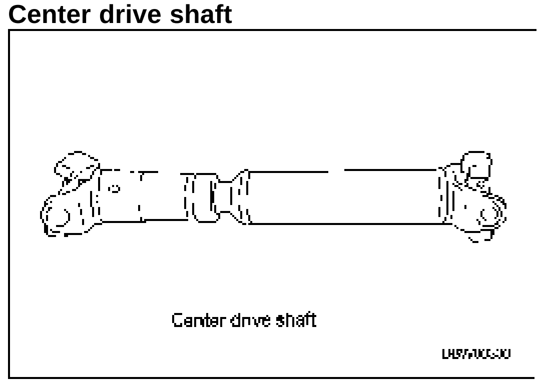
3) Using a press, removing flange bearing (4).



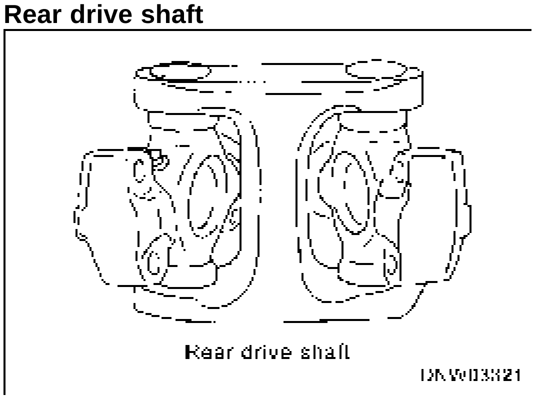
2. Center drive shaft, rear drive shaft

Ú Follow the procedure in **1. Front drive shaft** step 1).

Center drive shaft

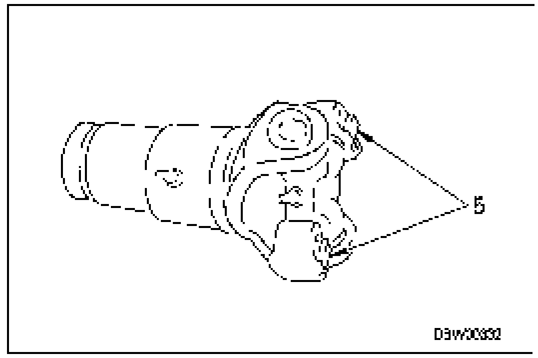


Rear drive shaft

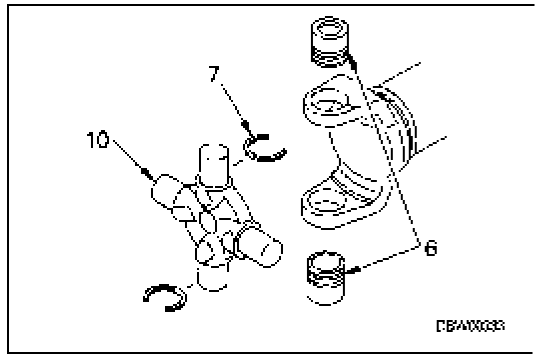


3. Spider, bearing

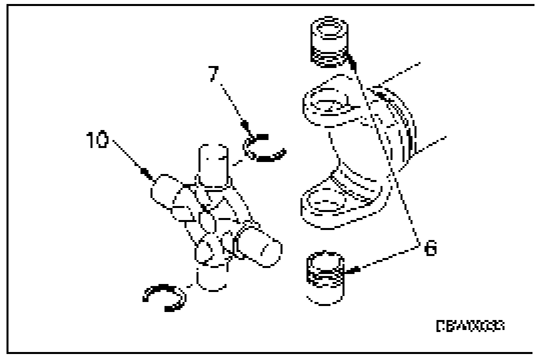
1) Remove seal and bearing caps (5).



2) Remove ring (7) of spider (10) and bearing (6), then tap with plastic hammer to remove spider and bearing.
   Ú Repeat the same procedure for the front, center and rear drive shafts.

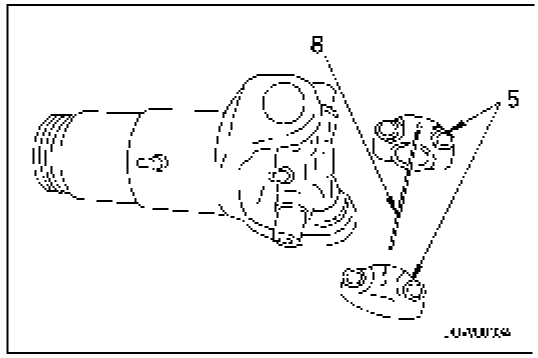


DRIVE SHAFT
ASSEMBLY



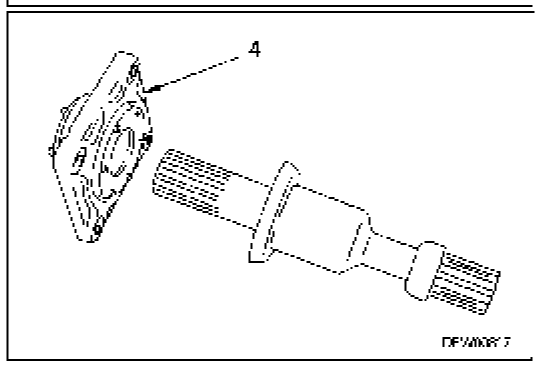
1. Spider, bearing

1) Set spider (10) and bearing (6) in mounting position, assemble ring (7), then install.
   - Ú Assemble so that the grease nipples face in the same direction.
   - Ú Repeat thesame procedure for the front, center and rear drive shafts.



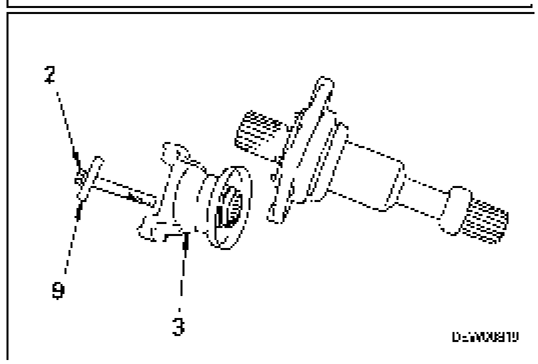
2) Install bearing cap (5).
   - Ú Check that the there is a bearing and Derling washer inside the bearing cap.

   Bearing cap: **Grease (G2-L1)**
   - Ú If the spider and bearing caps are worn, replace the spider and bearing.
   - Ú Heat will damage the bearing, so do not weld strap (8) of the cap.



2. Front drive shaft

1) Press fit flange bearing (4).
   - Ú Do not hit the flange bearing directly with a hammer.



2) Align match marks, install coupling (3) and retainer (9), then tighten mounting bolt (2).
   - Ú Tighten the bolts to the specified tightening torque after installing on the machine.

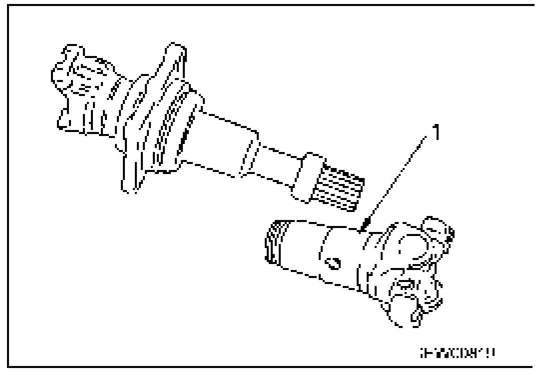
   Spline: **Grease (G2-L1)**

   Mounting bolt:

   279.5 ± 29.4 Nm (28.5 -± 3.0 kgm)

3) Align match marks and install coupling and tube (1).
   - Ú Check that the couplings are facing in the same direction.
   - Ú If the spline is worn, replace the whole drive shaft assembly.

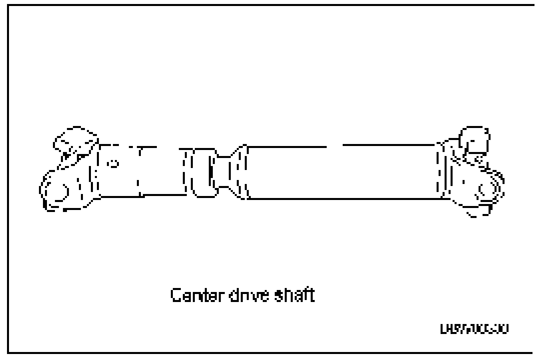
   Spline: **Grease (G2-L1)**



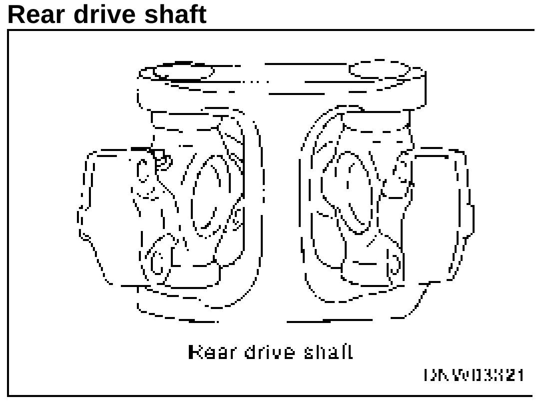
3. Center drive shaft, rear drive shaft

Ú Follow the procedure in **2. Front drive shaft** step 3).

Center drive shaft



Rear drive shaft



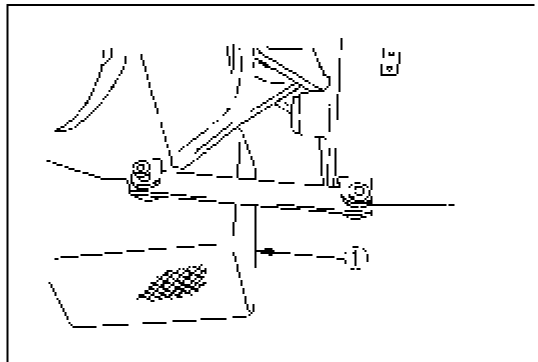
FRONT AXLE
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the work equipment to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Jack up machine, and put blocks **â** under front frame.

1

Ú Use the bucket to raise the front frame, and insert the block when the tires are slightly off the ground.

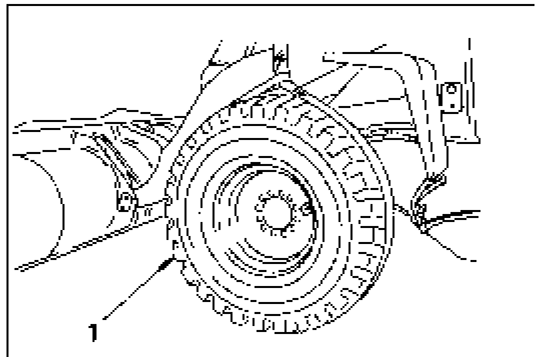


DNW03322

2. Tire, wheel
Sling tire and wheel (1), remove mounting bolts, then lift off.

2

Tire, wheel: **210 kg**

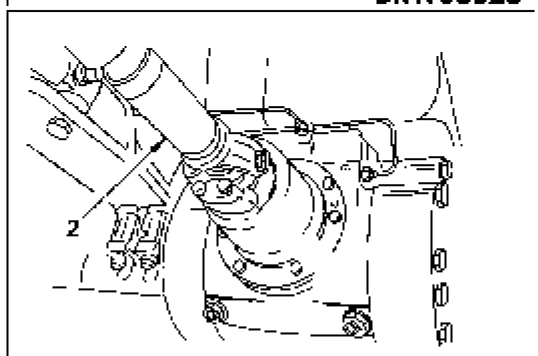


DNW03323

3. Front drive shaft

3

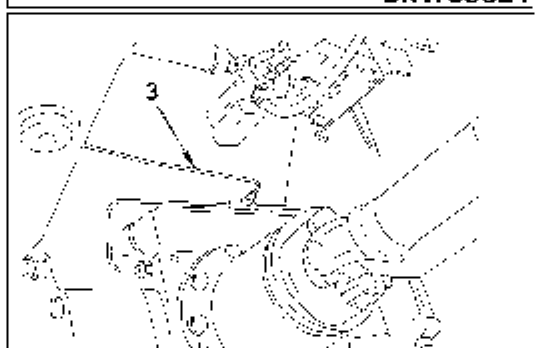
1) Disconnect front drive shaft (2).



DNW03324

4. Axle
1) Disconnect brake tube (3).

4

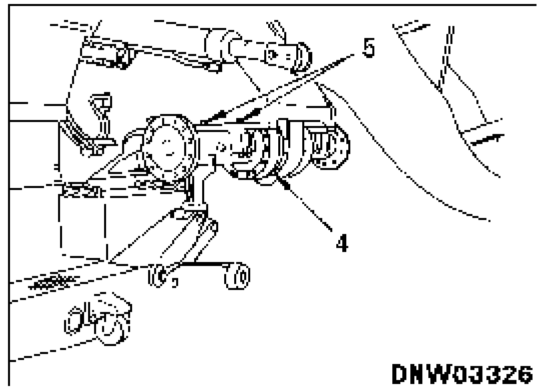


DNW03325

2) Using jack and hoist, sling axle (4), then remove mounting bolts and lower axle.
   Ú Use the jack to adjust the height when removing the mounting bolts.

★5

kg Axle: **493kg**



3) Pull out axle assembly from machine.
   Ú Use the jack and hoist.

★6

INSTALLATION

! Carry out installation in the reverse order of removal.

1
- Ú Raise the front frame slightly with the bucket, and remove block â.

2
- Ú Raise tire and wheel (1) and set to the mounting position, then tighten mounting bolts.

  Mounting bolt:
  926.7 ± 103.0 Nm (94.5 ± 10.5 kgm)
  (Width across flats: 36 mm)

3
- Ú Connect front drive shaft (2).

  Drive shaft:
  66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

4
- Ú Be careful not to tighten the tube nut too far.

  Tube nut: **11.8 ± 2.9 Nm (1.2 ± 0.3 kgm)**

5
- Ú Use the bolts as a guide and align the mounting position.

  Mounting bolt:
  676.7 ± 68.6 Nm (69.0 ± 7.0 kgm) (Width across flats: 36 mm)

6
- Ú Use a hoist and jack for the operation.

! **Bleeding air from brake system**
- Ú Bleed the air from the brake system. For details, see TESTING AND ADJUSTING, Bleeding air from brake system.

REAR AXLE

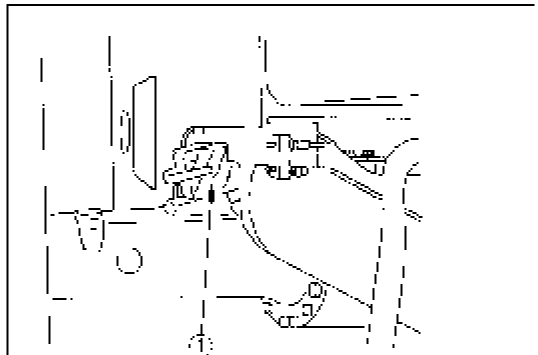
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Remove fuel tank.
For details, see REMOVAL OF FUEL TANK.

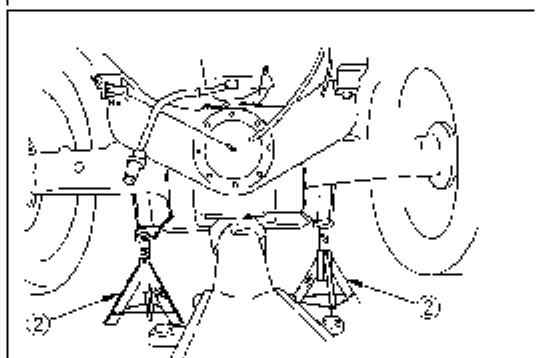
2. Jacking up chassis

1) Set block â between left and right rear axles and rear frame.



DNW03327

2) Jack up chassis and insert block ã under rear frame.
Ú Jack up the rear frame with a garage jack, and set block ã in position when the tires are slightly off the ground.

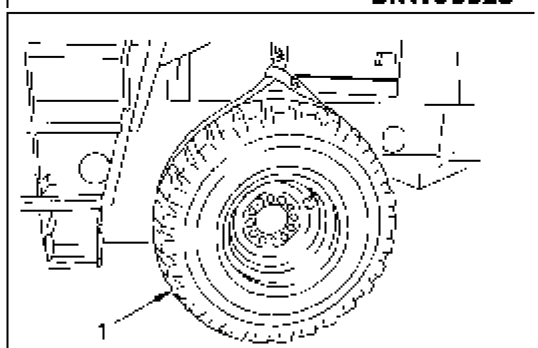


DNW03328

3. Tire, wheel
Fit sling to tire and wheel (1), remove mounting bolts, then lift off

1

kg Tire, wheel: **210 kg**

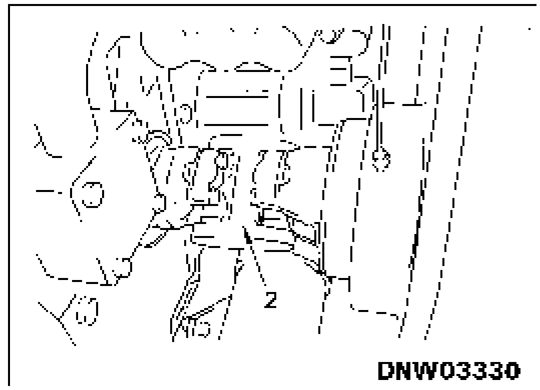


DNW03329

4. Drive shaft

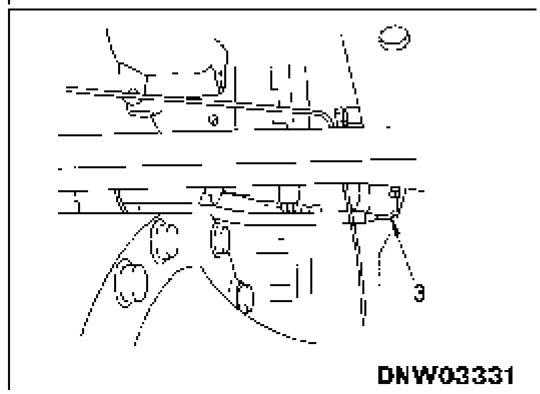
Remove rear drive shaft (2). ※2

Ú Make match marks to show the mounting position.

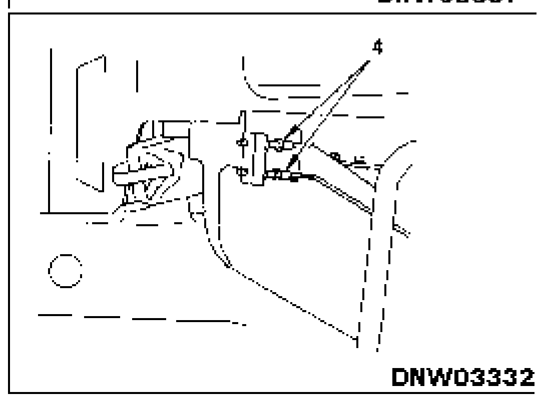


5. Brake hose, grease tube

1) Disconnect brake hose (3). ※3



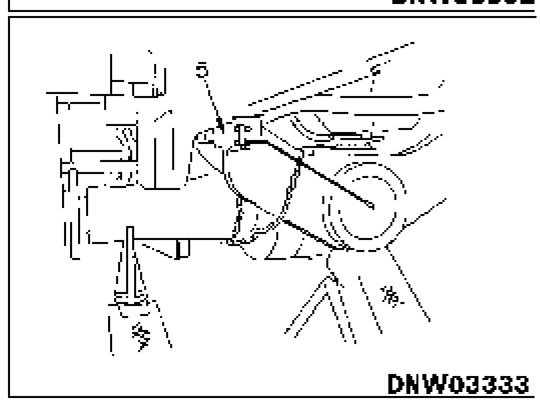
2) Disconnect grease tube (4).



6. Axle

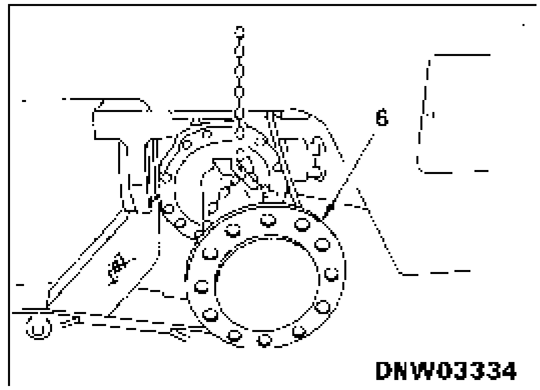
1) Secure pivot (5) to axle with wire.

Ú Fix securely so that the pivot does not move.

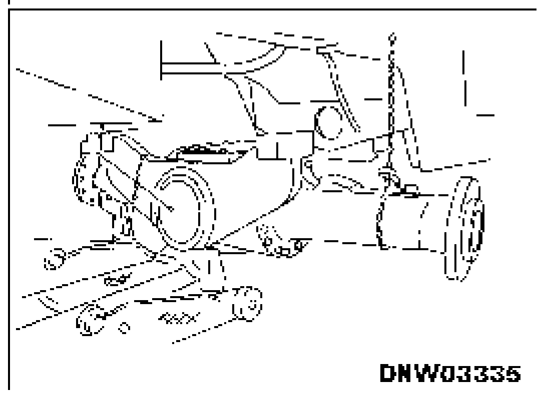


2) Sling one side of axle (6) and set garage jack under axle housing on other side, then remove mounting bolts. 4
   - Ú Adjust the height of the garage jack when removing.
   - Ú The pivot end will go down, so be extremely careful when removing the axle.

kg Rear axle, pivot: **573 kg**

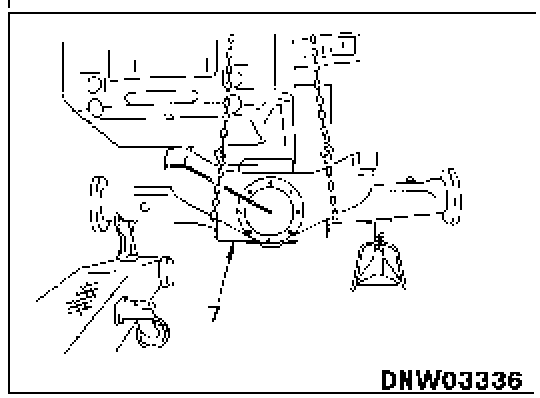


3) Pull out axle assembly from chassis.
   - Ú Use a hoist and jack for the operation.
   - Ú After pulling the axle assembly out from the chassis, remove the wire.
   - Ú The clearance from the engine oil drain tube is small, so be careful when removing.

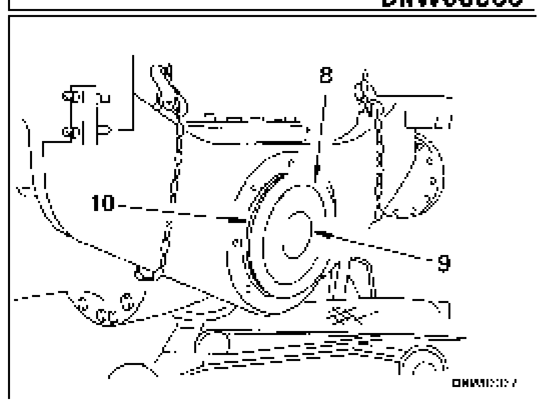


7. Rear pivot

1) Remove trunnion cap (7) 5
   - Ú If there are shims installed, check the number and thickness of the shims and use for reference when assembling.
   - Ú Remove the grease tube.



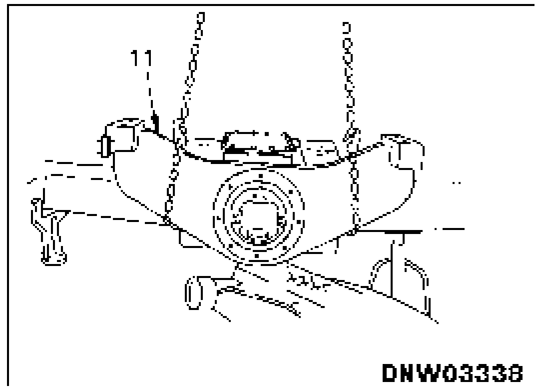
2) Remove thrust washer (8), thrust plate (9), and thrust washer (10) 6



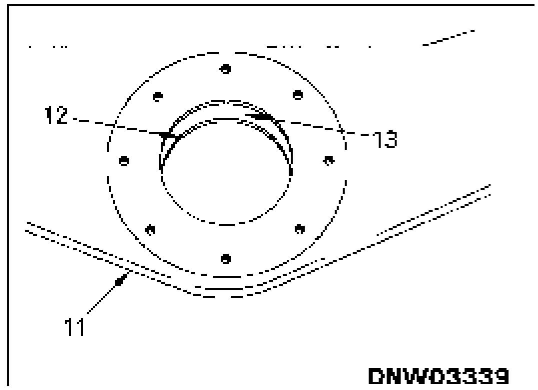
3) Lift off rear pivot (11). ※7

Ú Fit the sling securely and be careful not to let it slip off when removing.

kg Rear pivot: **85 kg**

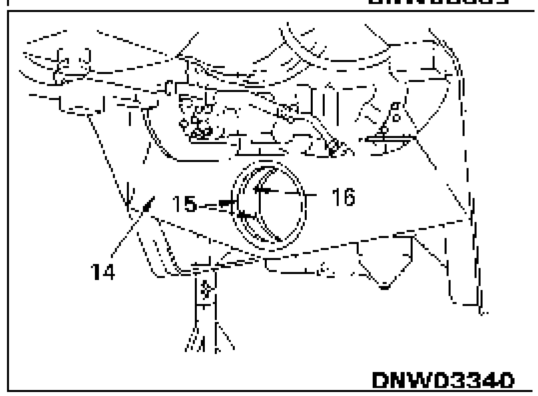


4) Remove packing (12) and packing (13) from pivot (11). ※8



8. Front pivot

Remove packing (15) and packing (16) from pivot (14). ※9



INSTALLATION

! Carry out installation in the reverse order of removal.

※1

Mounting bolt:
926.7 ± 103.0 Nm (94.5 ± 10.5 kgm)
(Width across flats: 36 mm)

※2

Ú Align the pilot portion securely and take care to assemble with the yoke facing in the correct direction.

Mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

※3

Ú Be careful not to tighten the brake hoses too far.

Mounting hose:
11.3 ± 3.4 Nm (1.15 ± 0.35 kgm

※4

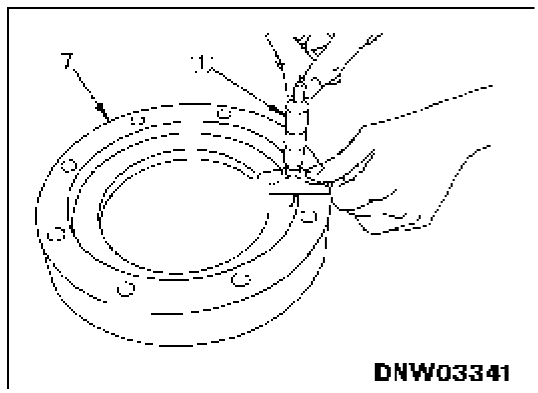
Ú Use the bolt as a guide and set to the mounting position.
Ú When tightening the mounting bolts, do not tighten in one step. Divide the torque and tighten in three steps.
Ú After installing the axle assembly, remove the wire.

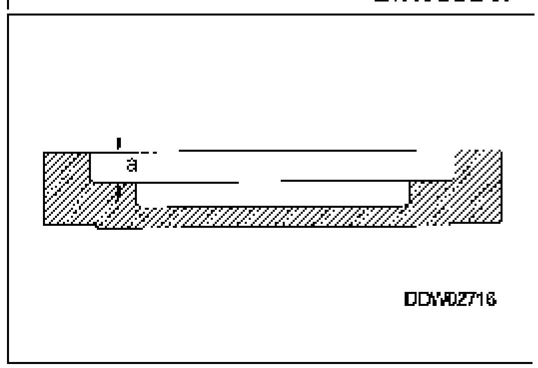
Mounting bolt:
676.7 ± 68.6 Nm (69.0 ± 7.0 kgm)
(Width across flats: 36 mm)

※5

Adjusting rear pivot shim

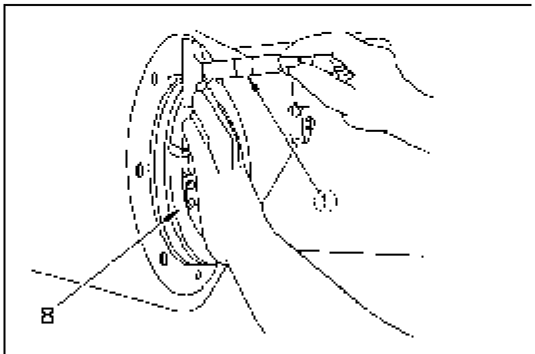
1) Measure dimension **a** of trunnion cap (7) at 4 places on diagonally opposite sides with depth micrometer **â** and take the average.
Ú Wipe the measurement surface clean before measuring.
! Standard value **a:** 19.85 - 20.0 mm



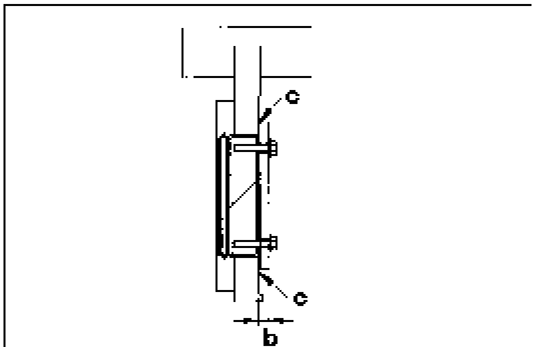


2) Assemble thrust washer (8) to rear pivot, then measure dimension **b** at 4 places on diagonally opposite sides with depth micrometer **â** and take the average.
   Ú Wipe the mating surface of the thrust washer and thrust plate clean before measuring.
   Ú Wipe the contact surface of the probe clean before measuring.
   ! Reference value for **b:** 19.65 - 20.0 mm
   Ú Insert **a** feeler gauge between circumference **c** and the joint of the thrust washer and the thrust plate, and check that there is no clearance.
   Ú Measure **a - b = t** at the joint of the rear pivot and trunnion cap, and determine the number and thickness of the shim.
   Ú Select the number and thickness of shims within the range below.
   Ú Thickness of 1 shim = 0.2 mm
      Ú **t** mm

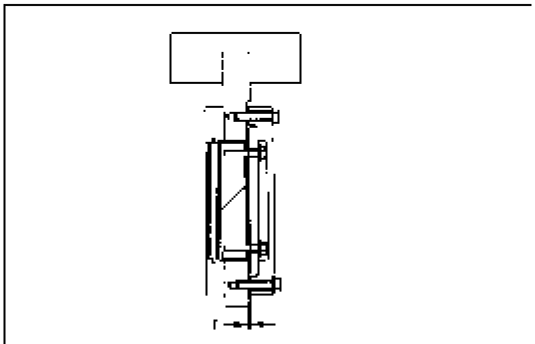
(shim thickness)	Number of shims
0 - 0.07	1
0.08 - 0.27	2
0.28 - 0.47	3



DNW03314



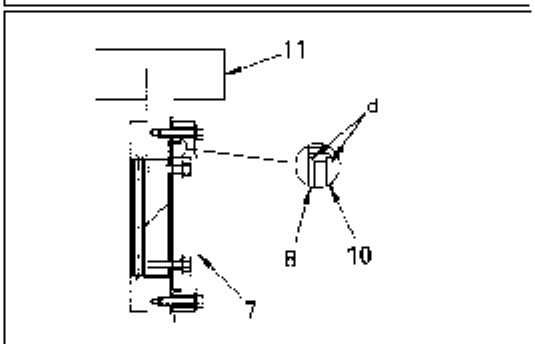
DNW03343



DNW03344

3) Assemble selected shim between rear pivot (11) and trunnion cap (7), and install mounting bolts.
   Ú Fill the trunnion cap with grease, then install.
   Trunnion cap: **Grease (G2-L1)**

   Mounting bolt:
   12.8 ± 9.8 Nm (11.5 ± 1.0 kgm)
   Ú Assemble so that the chamfered portion d of thrust washers (8) and (10) is on thrust cap (7) side.



DNW03345

6

Ú Clean the mating surface of the thrust washer and thrust plate.
Ú Assemble so that the chamfered portion of the thrust washer is on the thrust plate side.
Outside circumference of pivot mount:
Grease (G2-L1)
Mounting bolt: **Thread tightener (LT-2)**

Mounting bolt:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

7

1) Be careful not to get the packing caught.
2) To make the axle and support parallel, turn the trunnion cap over and tighten uniformly with the 8 bolts.

Mounting bolt:
68.6 ± 9.8 Nm (7.0 ± 1.0 kgm)

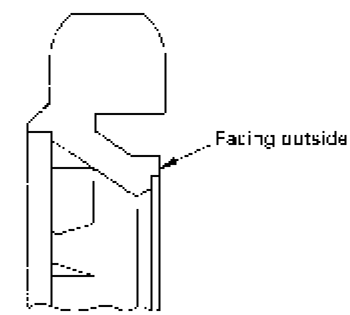
- Remove the grease tube elbow first.
- Check that the clearance between the pivot and trunnion cap is uniform.
- Set on the chassis mount with the cap still reversed.

8 9

- Assemble so that the chamfered side of the packing is on the axle housing side.
- Set the packing with the join at the side.

Packing: **Grease (G2-L1)**

- Assemble with the lip of the packing facing the outside.



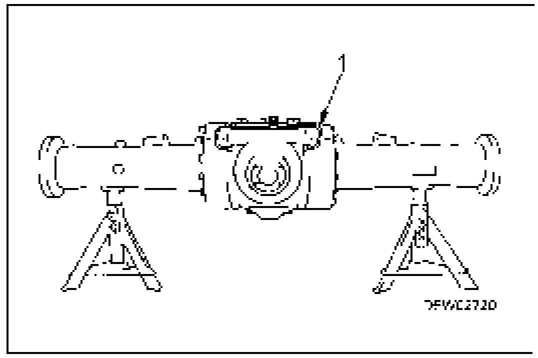
DNW03346

! Bleeding air from brake system

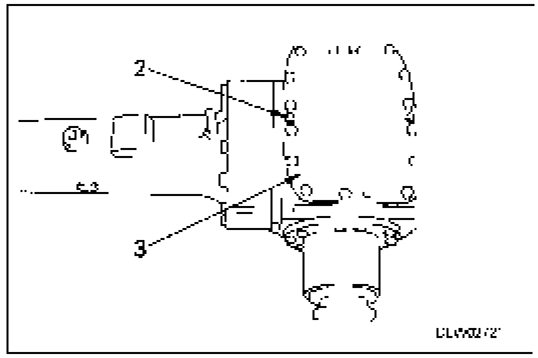
- Bleed the air from the brake system.
  For details, see TESTING AND ADJUSTING, Bleeding air from brake

DIFFERENTIAL
DISASSEMBLY

1. Brake tube
Remove brake tube (1).



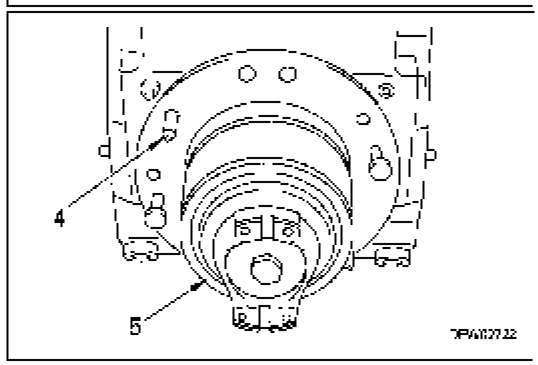
2. Differential cover
Remove bleeder screw (2), then remove differential cover (3).
Ú Install the differential assembly in a stand.
Ú Remove the axle housing.



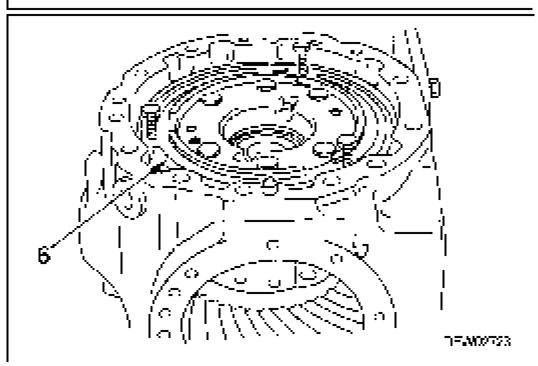
3. Cage
1) Screw in a forcing screw, then using guide bolt (4), remove cage (5).
 Ú Check the number and thickness of the shims, and keep them in a safe place.
 Ú Loosen mounting bolts of coupling, and temporarily install the cage.

kg Cage: **17 kg**

2) Remove O-ring from cage.



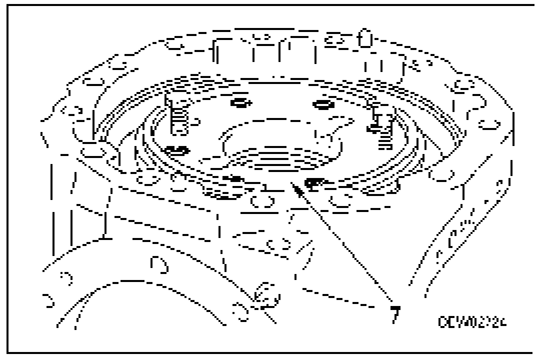
4. Brake piston
Screw in forcing screws (3 places) to raise evenly, then remove piston (6).
Ú If the O-ring of the piston is not damaged, it is possible to install the bleeder screw and blow in air to remove the piston.



5. Bearing carrier

Screw in forcing screws to raise bearing carrier evenly, and remove bearing carrier (7). Remove angle ring.

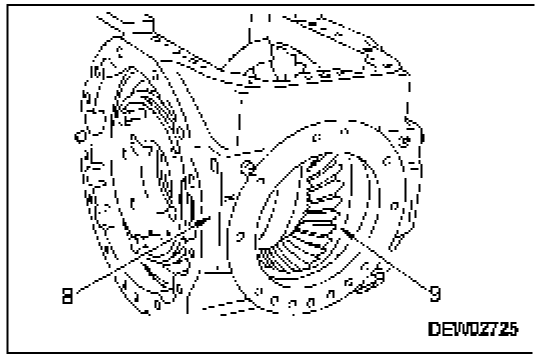
- Ú Check the number and thickness of the shims, and keep them in a safe place.
- Ú Mark the left and right bearing carriers to avoid confusing them.



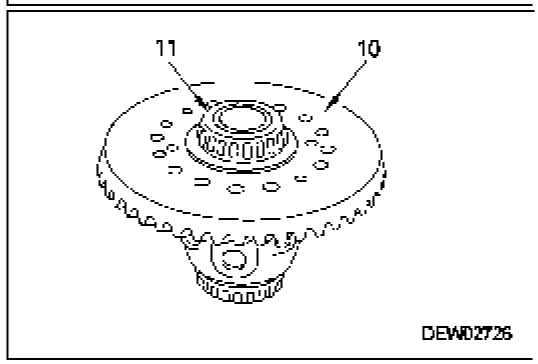
6. Differential carrier

1) Lift off differential carrier assembly (9) from differential housing (8).
   - Ú When removing the assembly, be careful that the lifting tool does not slip.

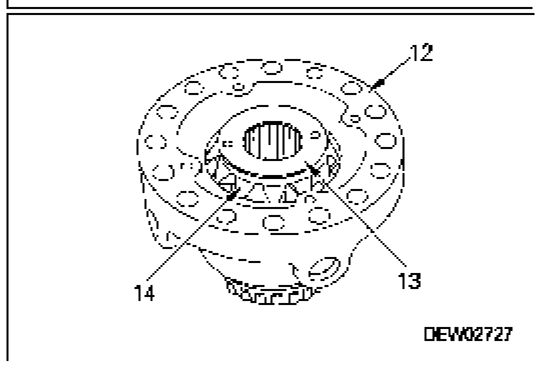
   kg Differential carrier assembly: **30 kg**



2) Remove bevel gear (10), then remove bearing (11) from bevel gear.

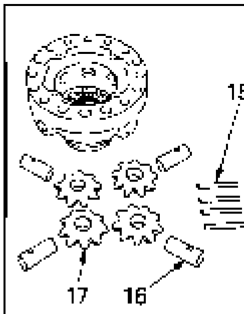


3) Remove thrust washer (13) from differential carrier (12), then remove side gear (14).

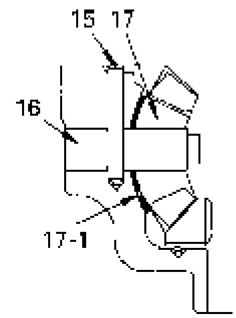


4) Remove lock pin (15) and pull out shaft (16), then remove pinion gear (17).
   Ú Remove together with spherical surface washer (17-1) at the pinion gear portion.

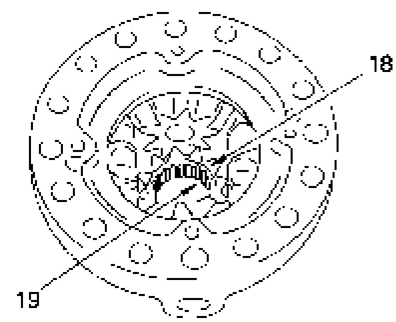
5) Remove side gear (18) and thrust washer (19).



DEW02728



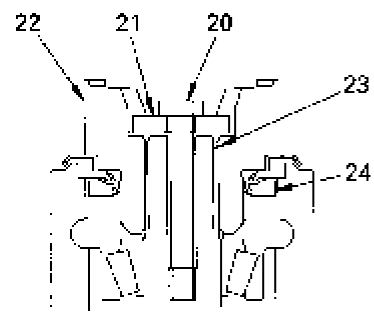
DNW03347



DNW03348

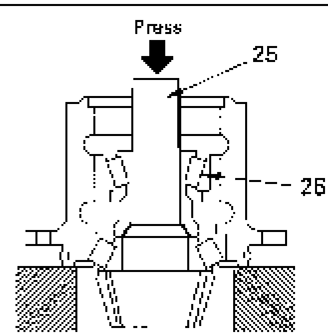
7. Coupling

1) Remove mounting bolts (20), then remove coupling (22) and O-ring (23).
   Ú Do not remove the protector press fitted 23 to the coupling unless necessary.
2) Remove oil seal (24).



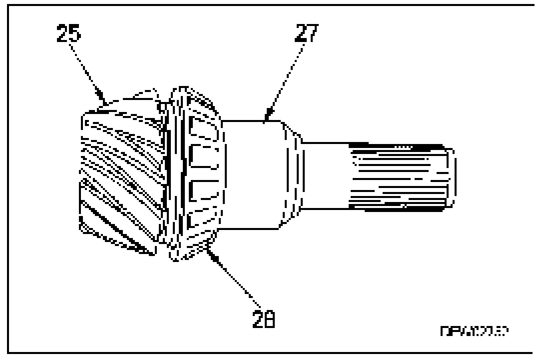
DNW03349

3) Using press, remove pinion gear (25) from cage and remove bearing (26).

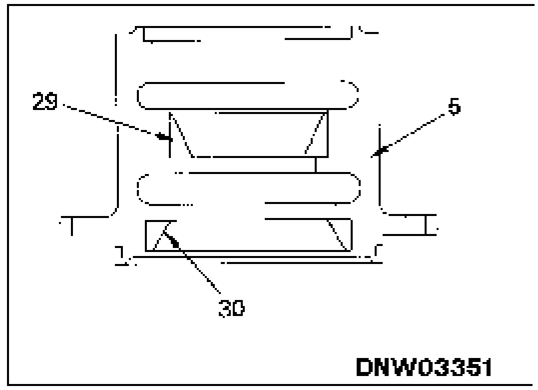


DNW03350

4) Remove spacer (27) and bearing (28) from pinion gear (25).

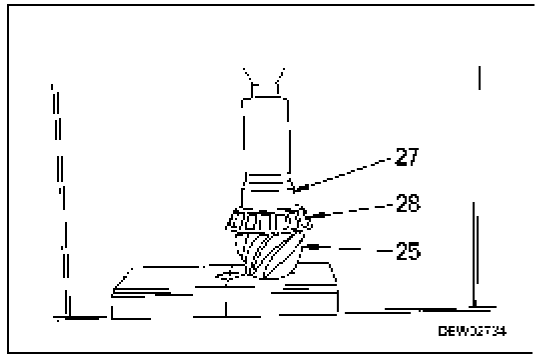


5) Remove bearing cups (29) and (30) from cage

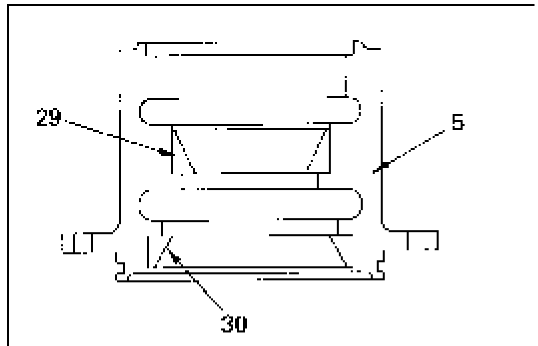


ASSEMBLY

1. Pinion gear

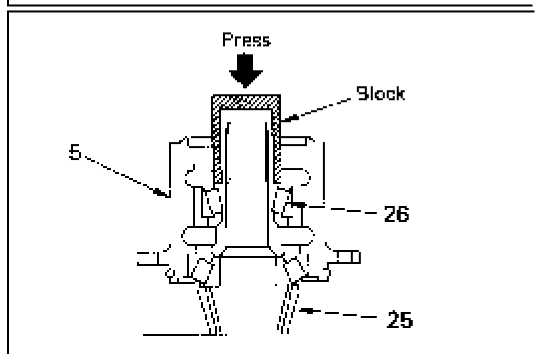


1) Press fit bearing cone (28) in pinion gear (25), then assemble spacer (27).
   Ú There must be no clearance at the contact surface of any parts.



DNW03352

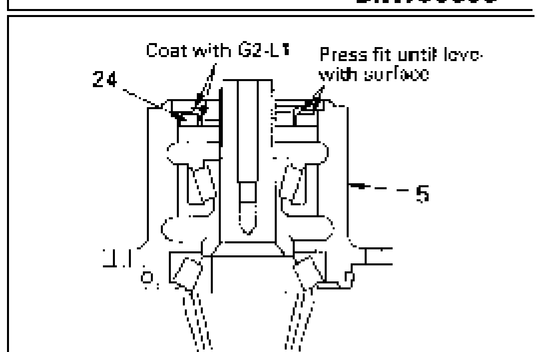
2) Press fit bearing cups (29) and (30) in cage (5).



DNW03353

3) Assemble pinion gear (25) in cage (5), then press fit bearing cone (26).
   Ú The front pinion gear and rear pinion gear are different, so be careful not to mistake them when installing.
   Ú Apply pressure to the bearing at the specified load, and rotate the cage to settle the
   Press load: 5 ton
   Bearing: **Oil (axle oil)**

   Ú When rotating the cage at the specified Load, rotate lightly by hand. If the rotation is not smooth, replace the bearing and spacer, and check that rotate lightly by hand again.



DNW03354

4) Press fit oil seal (24) to cage (5).
   Ú Press fit oil seal (24) until it is level with the surface.
   Lip of oil seal: **Grease (G2-L1)**

   Pinion gear shaft: **Grease (G2-L1)**

2. Coupling

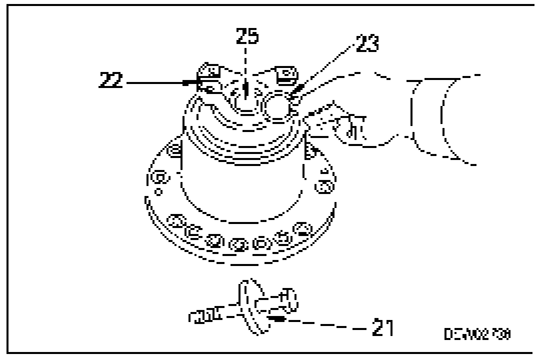
Install coupling (22), O-ring (23) and holder (21) to pinion gear (25), then tighten mounting bolts.

Ú Tighten the mounting bolts temporarily.
Tighten them fully after the completion of assembly.

Ú When inserting the coupling, be careful not to damage the seal.

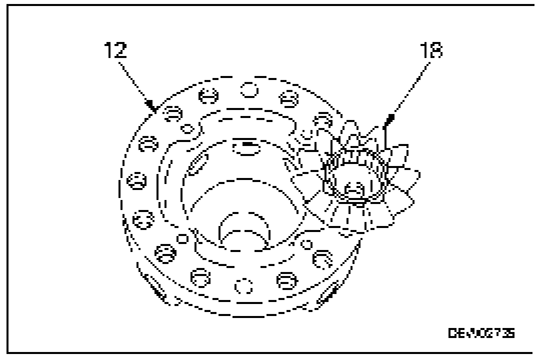
Mounting bolt:: **Adhesive (LT-2)**

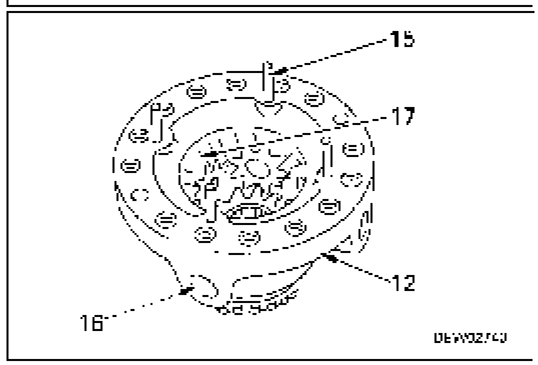
Mounting bolt: **279.5 ± 29.4 Nm (28.5 ± 3.0 kgm)**



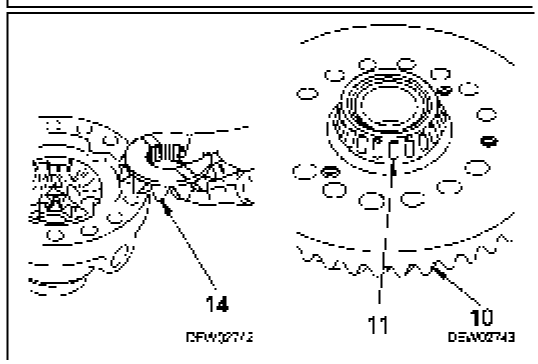
3. Differential carrier assembly

1) Install side gear (18) and thrust washer (19) to differential carrier (12).
   Ú Install thrust washer (19) correctly with the groove in the carrier (12).





2) Install pinion gear (17) and shaft (16) to differential carrier (12), then insert lock pin (15)
   Ú Install a spherical washer at the pinion gear.
   Gears, shafts: **Oil (axle oil)**



3) Assemble side gear (14) and thrust washer (13).
   Sliding surface of thrust washer: **Oil (axle oil)**

4) Press fit bearing (11) on bevel gear (10).

5) Assemble bevel gear (10) in differential carrier (12), then tighten mounting bolts.

Mounting bolts: **Adhesive (LT-2)**

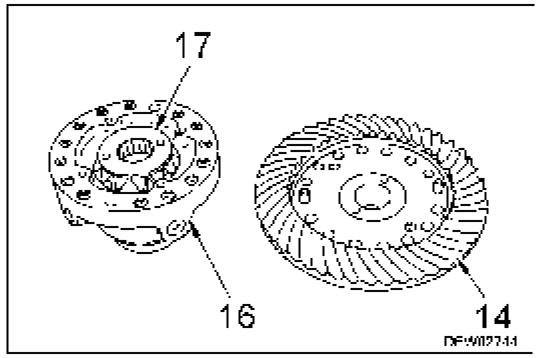
Mounting bolts:

279.5 ± 29.4 Nm (28.5 ± 3.O kgm)

Ú The bevel gears for the front axle and rear axle are different, so be careful not to mistake them when assembling.

Ú Coat the thrust washer with grease and stick it to the bevel gear to prevent it from failing off during installation.

Ú Align the lock of the washer correctly with the groove in the bevel gear.

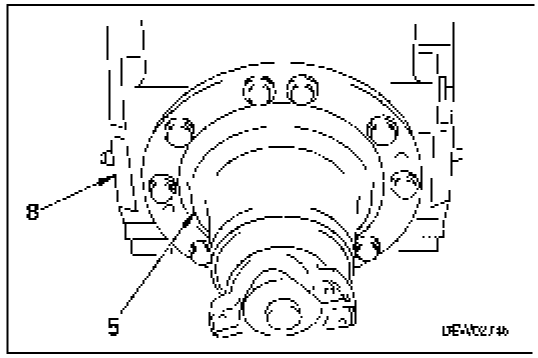


4. Adjusting shim of cage

1) Assemble cage (5) without shims in differential housing (8).

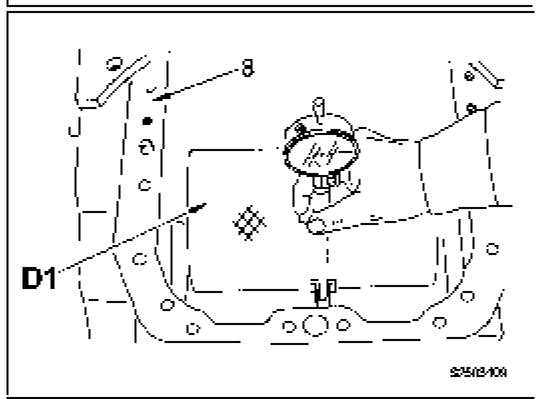
Mounting bolts:

112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)



2) Insert measuring tool **D1** in differential housing (8), and measuring distance between end face of bevel pinion gear and tool **D1** with an inside micrometer or a cylinder gauge.

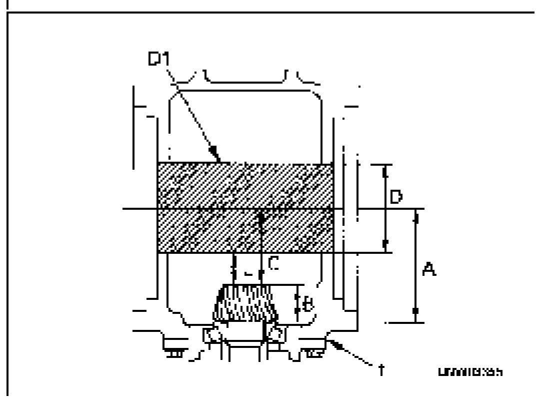
Ú When inserting tool **D1** in the differential housing, coat thinly with oil and insert straight without twisting.



3) Selecting shim

t = C - (L + D/2)

t : Shim thickness
C: (A + a) - (B + b)
L: Measured value
D: Diameter of tool **D1**
A: 167.8
B: 50.5
a: Deviation for dimension **A**
b: Deviation for dimension **B**



Ú Use the measured value for distance **D**

Ú Shim thickness **"t"** must be within 0.5 - 1.9 mm
The end of the pinion gear is marked with an electric pen as follows.

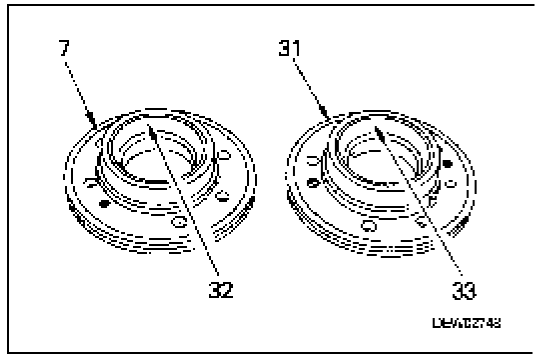
Example:
MD combination No. for bevel pinion gear and bevel gear
+0.10 Distance **"a"** (mm)
(-0.01) Distance **"b"** (mm)

4) Remove cage.

5. Bearing carrier

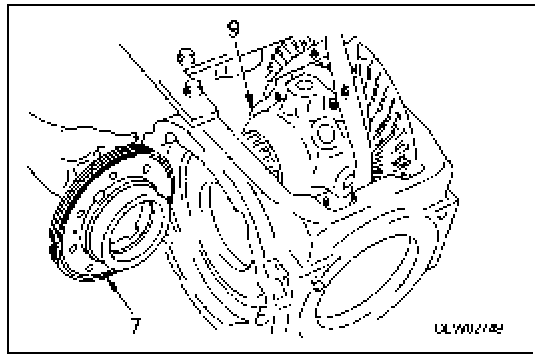
Press fit bearing cups (32) and (33) in bearing carriers (7) and (31).

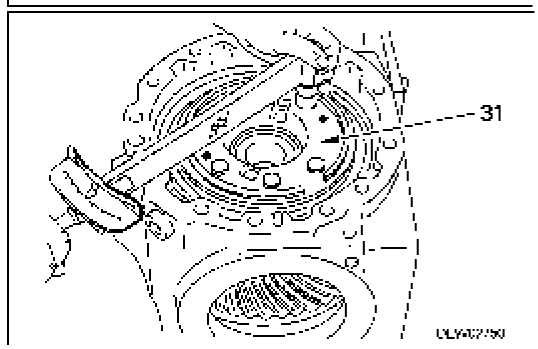
Press-fitting portion of bearing cup: **Oil (axle oil)**



6. Adjusting bearing carrier shims

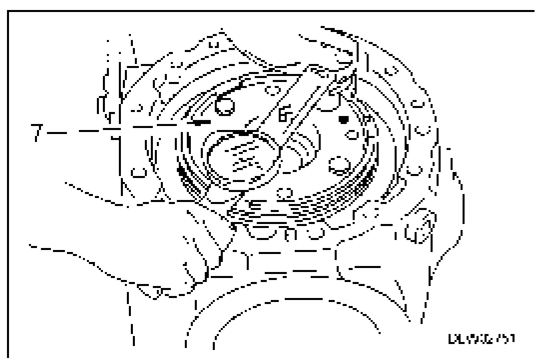
1) Raise differential carrier assembly (9), set in mounting position, then install left and right bearing carriers (7) temporarily.
   - Ú Assemble the differential carrier assembly with the bevel gear on the right as seen from the cage mount.
   - Ú Assemble the bearing carrier and adjust without the angle ring and shim.





2) Tighten carrier (31) at differential carrier end to specified tightening torque.

   Mounting bolts:
   112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)



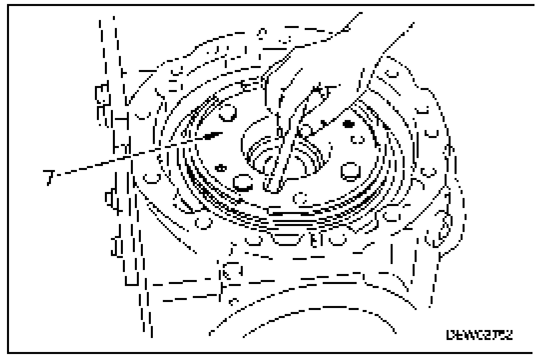
3) Tighten 4 mounting bolts of carrier (7) at bevel gear end.
   - Ú Rotate the bevel gear and coat the bearing with oil.

     Bearing: **Oil (axle oil)**
   - Ú To settle all the parts, rotate the bevel gear when tightening.

   Mounting bolts: **11.8 Nm (1.2 kgm)**

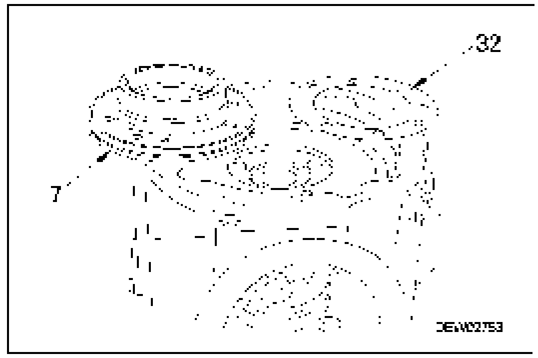
4) Loosen 4 mounting bolts at bevel gear end until there is axial play at bearing.
5) Tighten 4 mounting bolts uniformly again.
   Mounting bolts: **3.9 Nm (0.4 kgm)**

   Ú When doing this, check that there is axial play at the bearing, and rotate the bevel gear when tightening.

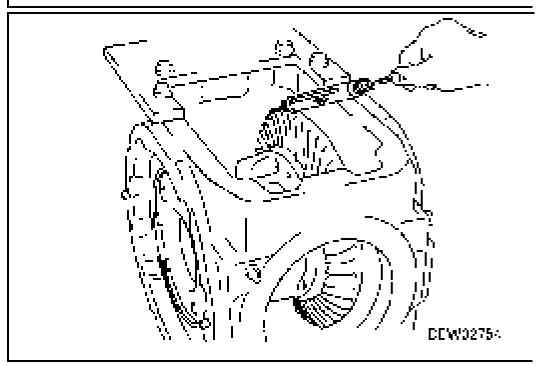


6) Using a feeler gauge at 2 places in groove of bearing carrier (7) at bevel gear end, measure clearances $\mathbf{T_1}$ and T_2.

7) Selecting shims
   Shim thickness = $\mathbf{(T_1 + T_2)/2 \pm}$ 0.035mm
   Ú Combine the following shims to give the necessary shim thickness.
   0.07 mm, 0.20 mm, 0.30 mm, 0.80 mm)

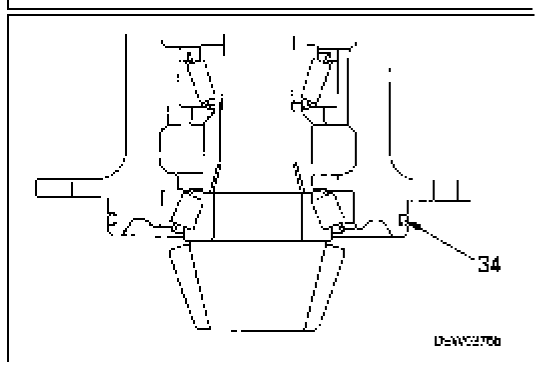


8) Remove left and right bearing carriers (7), and assemble selected shims (32).
   Ú Rotate the bevel gear and tighten the mounting bolts of the bearing carrier uniformly.
   Mounting bolts:
   112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)
9) Using a spring balance, measure preload of bevel gear and check that it is within specified range.
   ! Preload: 7.4 - 23.5 N (0.75 - 2.4 kg)
   ! If the preload is not within the specified range, change the shim thickness to adjust.

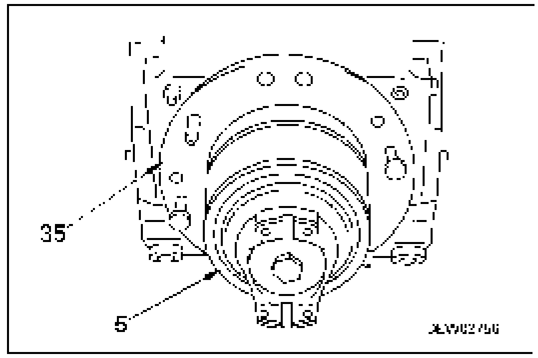


7. Cage

1) Assemble O-ring (34) in bearing cage.
   O-ring: **Oil (axle oil)**

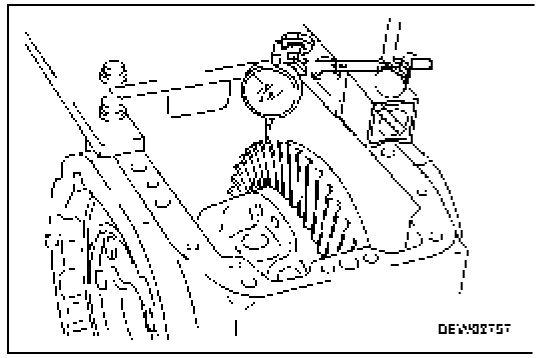


2) Install guide bolt, assemble shims (35) selected in Step 4, and install cage (5).
Mounting bolts: **112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)**

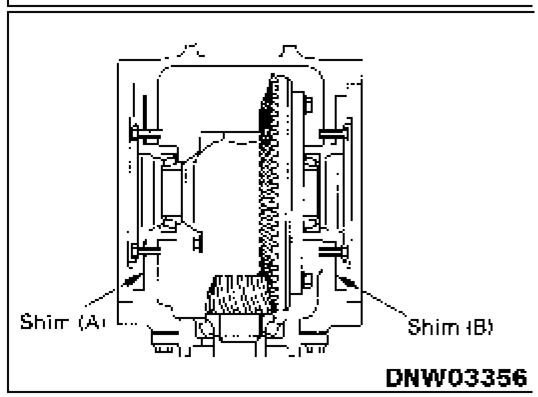


8. Adjusting backlash

1) Measure backlash of bevel gear with a dial gauge.
   - Ú First, measure with all the shims inserted at the bevel gear end.
   - Ú Measure the backlash at 3 places around the circumference of the bevel gear. The variation between the measurements must be within 0.1 mm.

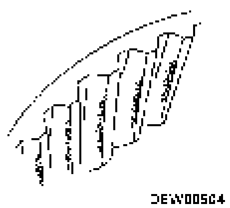
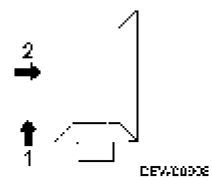
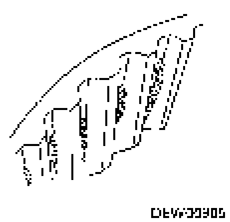
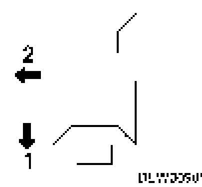
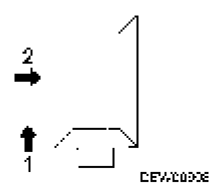
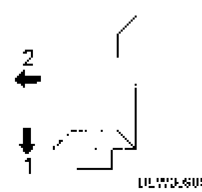


2) To obtain backlash within specified range,move some of shims from bevel gear side to opposite side.
   - Ú When moving the shims, do not change the total shim thickness. The total shim thickness on the left and right must remain the same.
   - Ú Adjust the backlash as follows.
     If backlash is too LARGE, move shims from **B** to **A**
     If backlash is too SMALL, move shims from **A** to **B.**



9. Adjusting tooth contact

Coat face of 7 or 8 teeth of bevel gear lightly with red lead (minimum). Hold the bevel gear by hand to act as a brake, rotate the pinion gear forward and backward and inspect the pattern left on the teeth.

Tooth contact	Cause	Procedure for adjustment
	The tooth contact pattern should start from about 5 mm from the toe of the bevel gear and cover about 50% of the length of the tooth. It should be in the center of the tooth height.	Adjust the pinion gear by adjusting the shims at the cage. Adjust the bevel gear in the same way as when adjusting backlash.
	Bevel pinion gear is too far from bevel gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly. 
	Bevel pinion gear is too close to bevel gear.	1. Increase shims at pinion gear to move away from bevel ear.. 2. Move bevel gear closer to pinion gear and adjust backlash correctly. 
	Bevel gear is too close to pinion gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly. 
	Bevel gear is too far from pinion gear.	1. Increase shims at pinion gear to move away from bevel gear. 2. Move bevel gear closer to pinion gear and adjust backlash correctly 

Ú When adjusting the bevel gear, do not change the preload of the bearing. Adjust by moving shims between the left and right. Always keep the same total thickness of shims.

10. Bearing carrier

Remove bearing carrier (7), assemble Square-ring (36), then install together with adjusted shims (36).

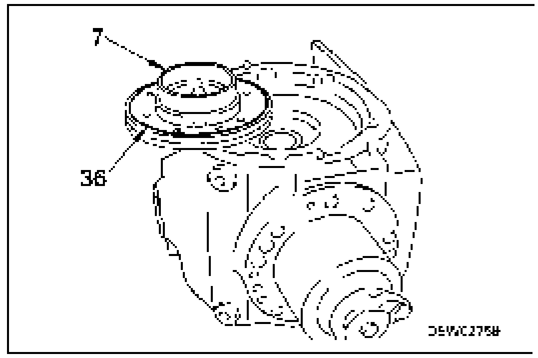
Ú Coat the Square-ring with grease, and be careful not to let it fall when assembling.

Ú When installing bearing carrier (7), the Square-ring may fall out, so do not use a hammer to install.

Square-ring: **Grease (G2-L1)**

Mounting bolt:

112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

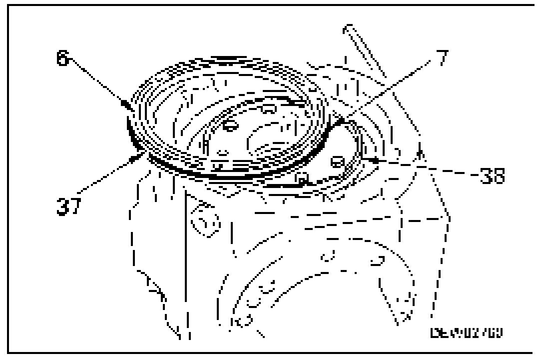


11. Brake piston

1) Fit O-ring (37) and (38) securely in grooves of brake piston (6) and bearing carrier (7)

Ú Coat the brake piston and piston mount lightly with grease to prevent the O-ring from twisting or breaking.

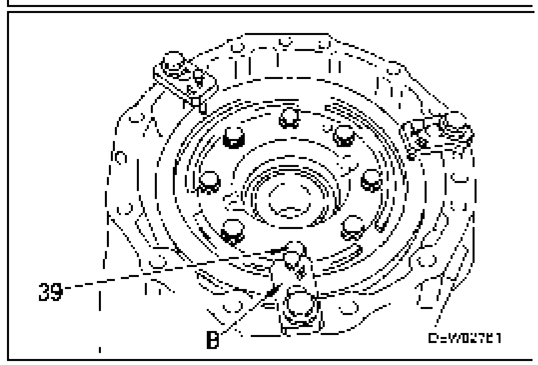
Piston and piston mount surface: **Oil (axle oil)**

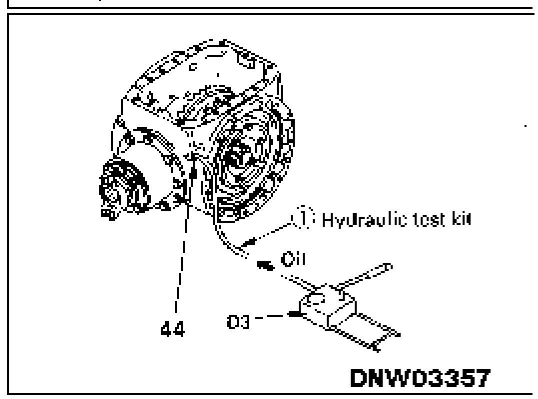


2) Install piston press-fitting tool **D2** to differential housing , then tighten screws (39) uniformly to press fit.

Ú Press fit the piston until it contacts the housing.

Ú If using a plastic hammer to tap in, be careful not to damage the O-ring and piston.





12. Checking for leakage of break oil

1) Install bleeder screw.

2) Tighten all screws (39) of piston press-fitting tool **D2** completely, then turn back one turn.

3) Install tool **D3** to brake tube mount (44), then bleed air from inside cylinder.

4) Operate pump and raise pressure to **1.4 MPa (14 kg/c M^2)**

Ú After raising the pressure to **1.4 MPa (14 kg/cm^2)** leave for 5 minutes and check that the drop in pressure is less than **0.33 MPa (3.5 kg/cm^2)**

5) If the test shows that there is no leakage of oil, raise pressure to **1.4 MPa (42 kg/cm²)**
   - Ú After raising the pressure to **1.4 MPa (42 kg/cm²)**, leave for 5 minutes and check that the drop in pressure is less than **0.33 MPa (3.5 kg/cm²)**.
   - Ú If there is any leakage of oil, remove the brake piston and check the O-ring for damage, then reassemble.
   - Ú After checking for leakage of break oil, insert piston fully.

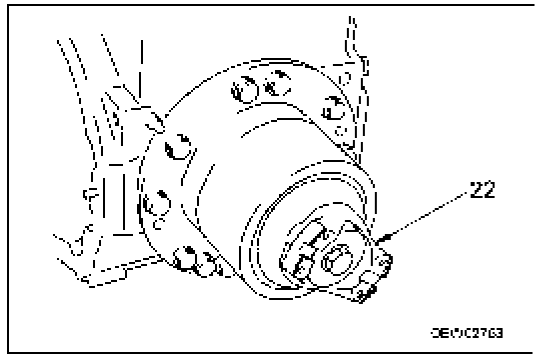
13. Coupling

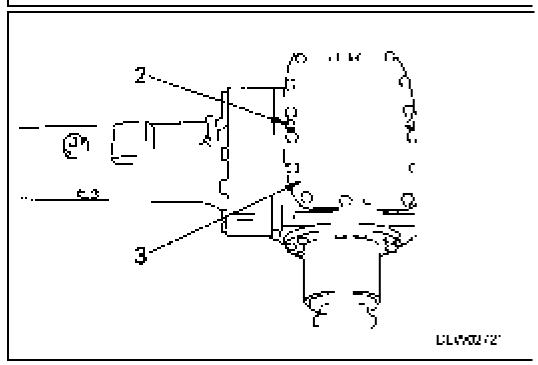
Tighten mounting bolts of coupling (22).

Mounting bolt: **Adhesive (LT-2)**

Mounting bolt:

279.5 ± 29.4 Nm (28.5 ± 3.0 kgm)





14. Differential cover

1) Install differential cover (3) on differential, housing.
   - Ú Install a guide bolt in the mount hole of the bleeder screw to prevent gasket sealant from entering the hole.

   Cover contact surface:

   Gasket sealant (Loctite 515)

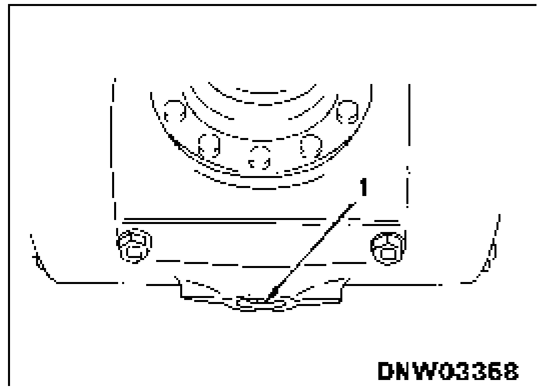
   Mounting bolt:

   112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)
2) Remove guide bolt and install bleeder screw (2).
   - Ú Check that there is no gasket sealant in the screw hole when installing.
   - Ú The front and rear axle housings are different, so be careful not to mistake them when installing the housing assemblies.

AXLE HOUSING
DISASSEMBLY

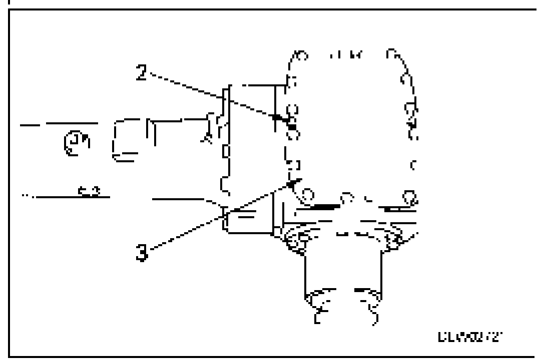
Ú The final drives for the front axle and rear axle are different, so be careful not to mistake them when assembling again.

1. Draining oil
Loosen drain plug (1) and drain oil from axle.

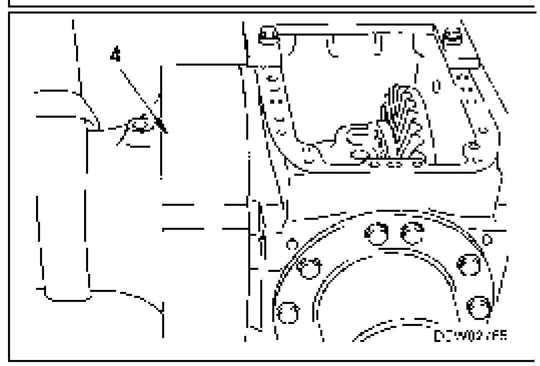


Axle: **17.5R**

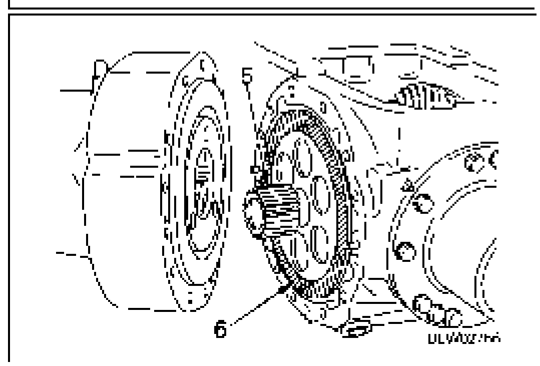
2. Differential cover
1) Remove bleeder screw (2), then remove differential cover (3).
2) Install axle on stand.



3. Axle housing
1) Sling axle housing (4), remove mounting bolts, then lift off.
Ú Marks the housings,to distinguish the left and right axle housings.



2) Disconnect axle housing, then remove sun gear shaft (5), brake disc (6) and brake inner ring (7).
Ú Be careful not to damage the face of the brake disc.



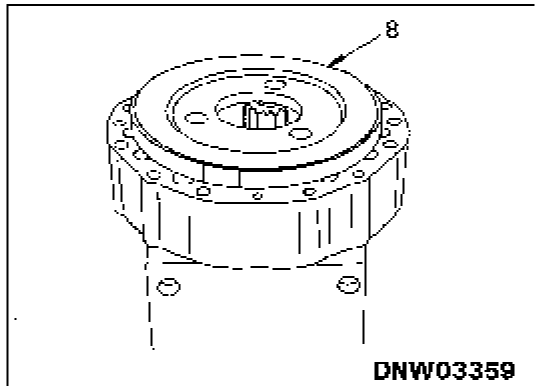
kg Axle housing: **130kg**

4. Brake outer ring

Remove brake outer ring (8).

Ú Be careful not to damage the contact surface of the brake disc.

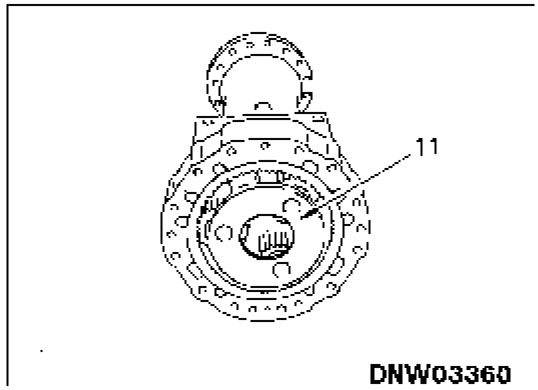
Ú Pull out pin.



5. Planetary carrier

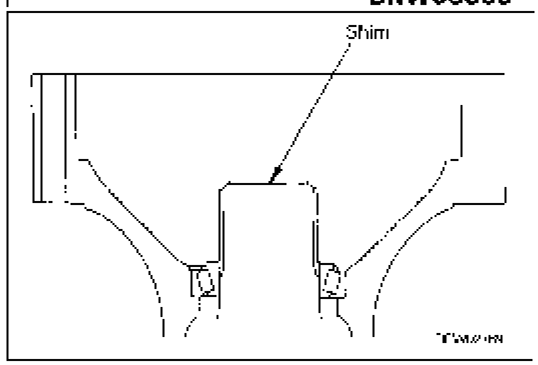
1) Remove axle shaft mounting bolts, then remove planetary carrier (11).

Ú When removing the planetary carrier, be careful not to get your fingers caught between the pinion gears.



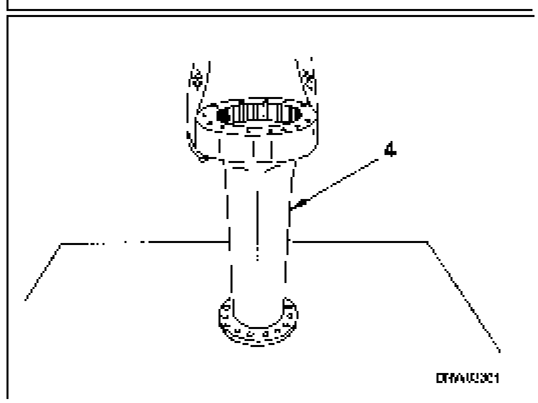
2) Remove shims.

Ú Check the number and thickness of the shims, and use as reference when assembling.

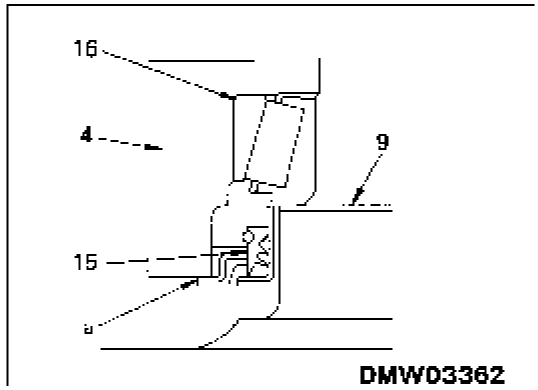


6. Axle shaft

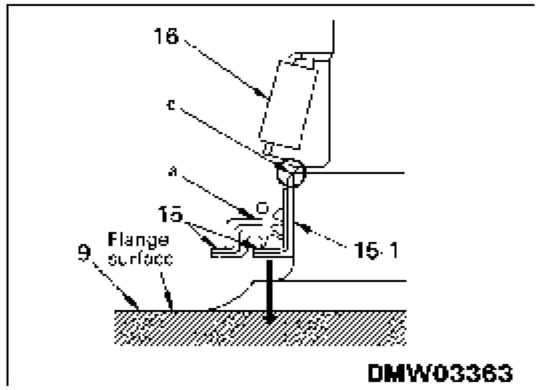
1) Stand housing (4) and raise approx. 20 mm.



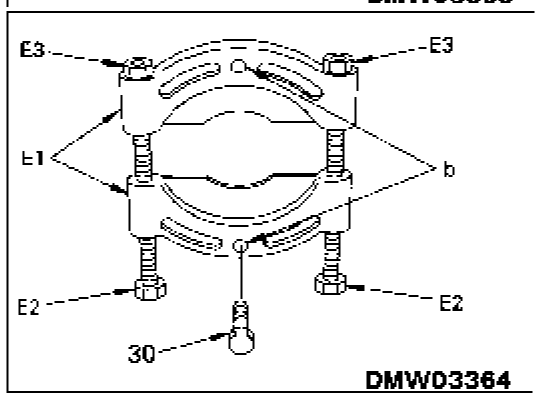
2) Put a copper hammer in contact with end face of axle shaft (9), knock in shaft and remove it, then remove bearing.
   Ú Push out the axle shaft a short distance and use a screw driver to remove portion **a** of oil seal (15) to prevent bearing (16) from damaging the oil seal.

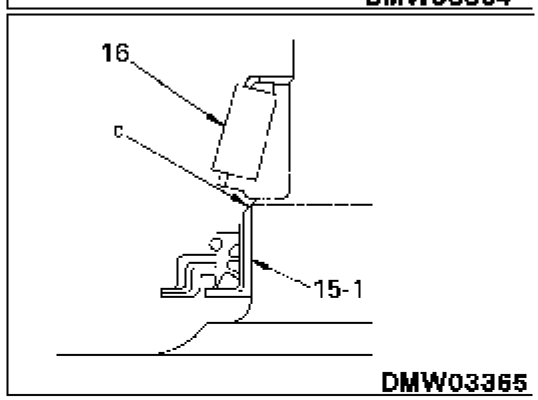


3) Remove bearing (16) and seal (15) from axle shaft (9).
   Ú Remove the bearing as follows.
4) When removing bearing (16) of shaft (9), use a screw driver to push in circumference of portion **a** of oil seal and sleeve (15) uniformly towards flange.
5) Make clearance **c** to allow claws of puller to be fitted to contact portion of sleeve (15-1) and bearing (16).

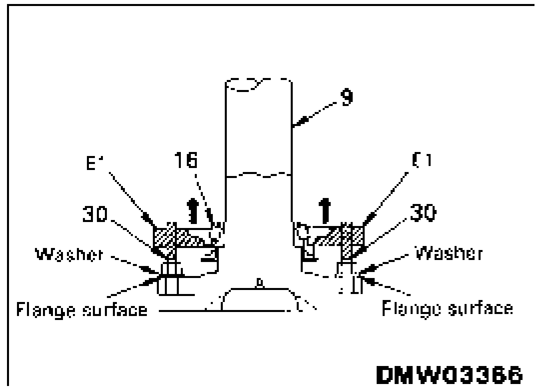


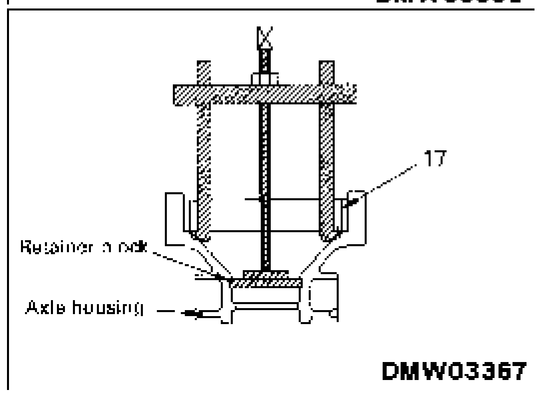
6) Install bolt (30)(5/8-18UNFR= Approx. 60 mm) to portion **b** of bearing puller **E1**
   Ú Screw the bolt fully into the thread.
7) Set bearing puller **E1** to clearance portion **c** of sleeve (15-1) and bearing (16), then assemble bolts **E2** and nuts **E3.**
   Ú When doing this, fix securely to prevent any play in the bearing.





8) Insert washer between bolt (30) and flange surface, turn bolt (30) to loosen it, and remove bearing (16).
   - Ú The puller has little grip on the bearing, so be extremely careful that the puller does not come off from the bearing.
   - Ú If the thread of bolt (30) is too short, add a washer to the flange surface to adjust the height of bolt (30) when removing bearing (16).
   - Ú Replace the oil seal and sleeve assembly with a new part.



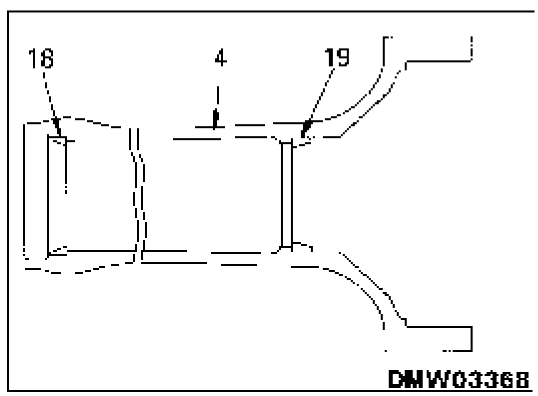


7. Ring gear

Using puller, raise horizontally and remove ring gear (17).

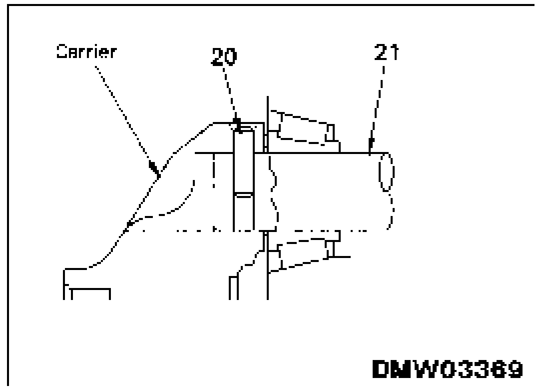
8. Axle housing

Remove bearing cups (18) and (19) from axle housing (4).

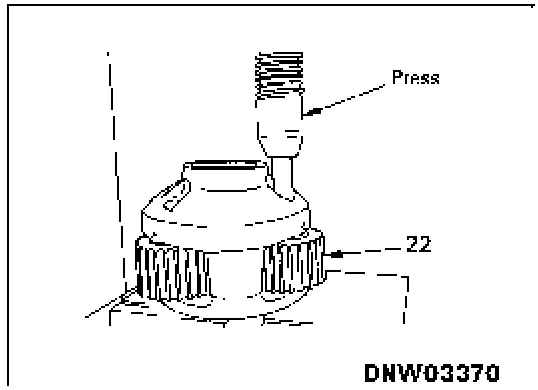


8. Planetary carrier

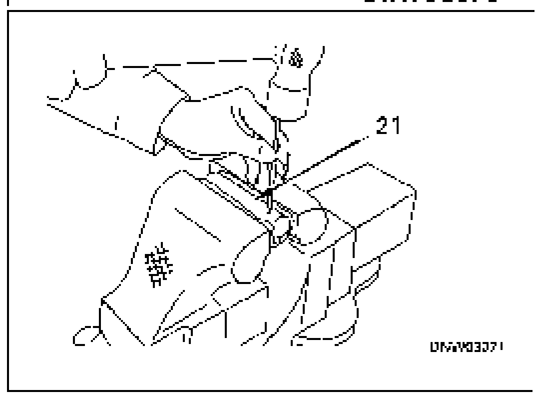
1) Knock in spring pin (20).
   Ú Be careful not to knock in the spring pin too far.



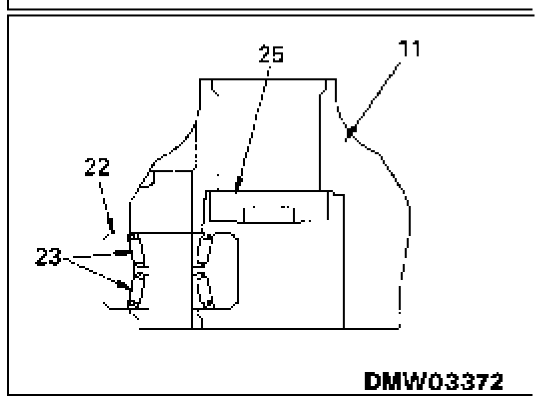
2) Using press, remove shaft (21).



3) Remove spring pin (20) from shaft (21).



4) Remove pinion gear (22) from planetary carrier (11), then remove bearing cone (23) and spacer (25).
   Ú Repeat the procedure above to remove each pinion.



ASSEMBLY

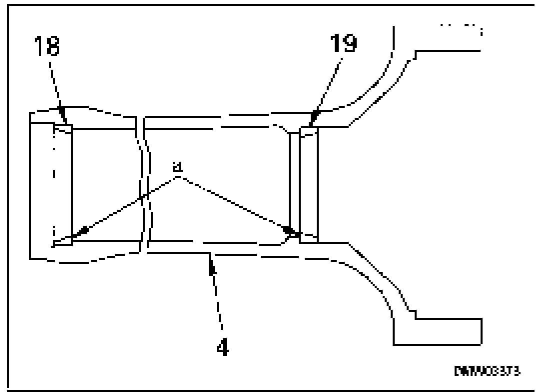
Ú When assembling the final drive of the front axle and rear axle, check the marks made when disassembling.

1. Axle housing

Press fit bearing cups (18) and (19) to axle housing (4).

Ú Afterpress fitting the cups, check that there is no clearance at portion **a.**

Cup press-fitting portion, rolling surface :**Axle oil**

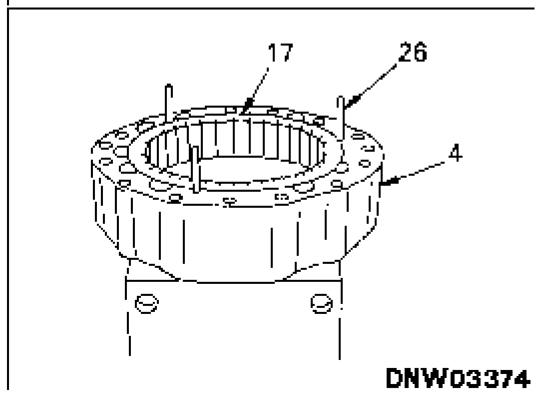


2. Ring gear

Press fit ring gear (17) to axle housing (4), and insert pin (26).

Ú Align the pin hole of the ring gear and the housing, then assemble the ring gear.

Ú Coolring gear (17) with dry ice at approx.-30EC before press fitting.



3. Axle shaft

1) Assemble outer oil seal (28) to inner oil seal (27).

Ú Check that the lip of the oil seal is coated with grease.

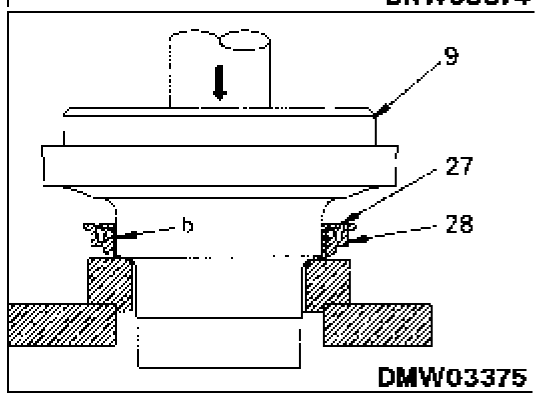
Grease (G2-L1)

2) Using press, press fit oil seal to axle shaft (9).

Ú In order not to deform the oil seal, do not tap with a hammer.

Ú Sleeve press-fitting surface **b** of oil seal: Axle oil

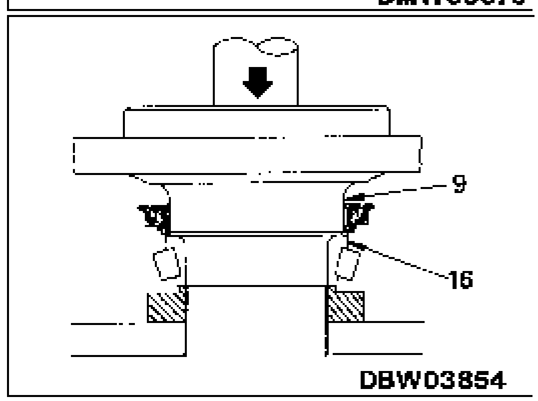
Contact surface **b** of sleeve: **Axle oil**



3) Set bearing (16) on press stand, then press fit axle shaft (9).

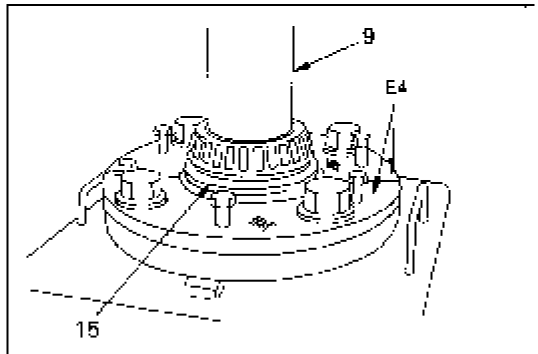
Ú Be careful not to install the bearing at an angle.

Bearing press-fitting portion: **Axle oil**



4. Housing, shaft

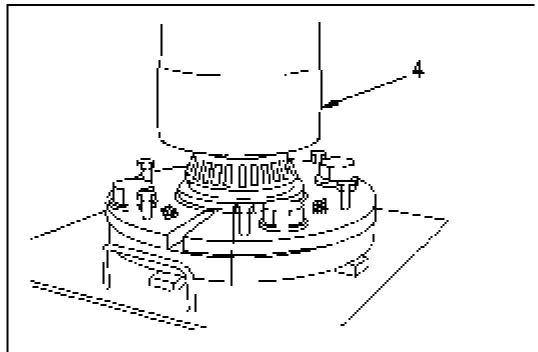
1) Stand shaft (9) vertically and install tool **E4.**
   - Ú Adjust the height of the seal support with the adjustment bolts, put the top surface of tool **E4** in light contact with seal (15), then set so that the clearance is uniform.
   - Ú Set tool **E4** securely so that it does not come off.



DNW03376

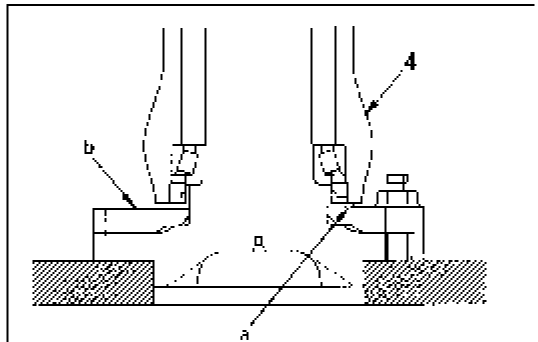
2) Raise housing (4) horizontally and insert to shaft slowly.
   - Ú Stop housing (4) at a point before the oil seal is press fitted.

   Oil seal press-fitting portion: **Axle oil**



DNW03377

3) Align housing (4) with oil seal press-fitting portion, then lower housing slowly.
   - Ú Use the weight of the axle housing to insert it.
   - Ú After assembling the housing, check that seal surface **a** and jig surface **b** are level with the surface. If there is a clearance at portion **a,** check that the clearance is uniform.



DMW03378

4) Remove tool **E4.**

5) Use a press to press fit bearing (29) to shaft (9), then rotate housing by hand to settle bearing.
   - Ú Press-fitting force: Approx. 19.6 KN (2 ton)

   Bearing cone press-fitting portion: **Axle oil**

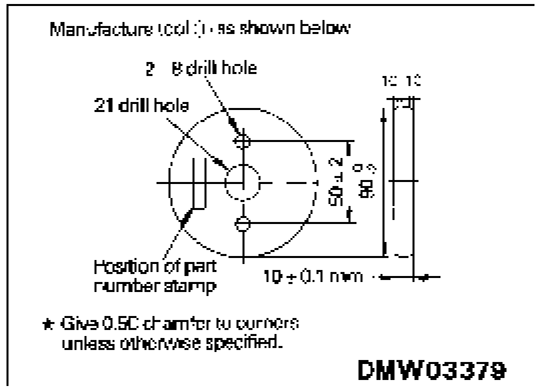
5. Adjusting end play

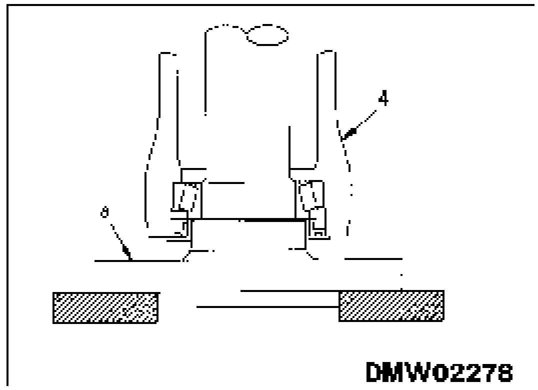
1) Stand axle shaft and housing assembly (4) upright, and secure flange portion **a.**

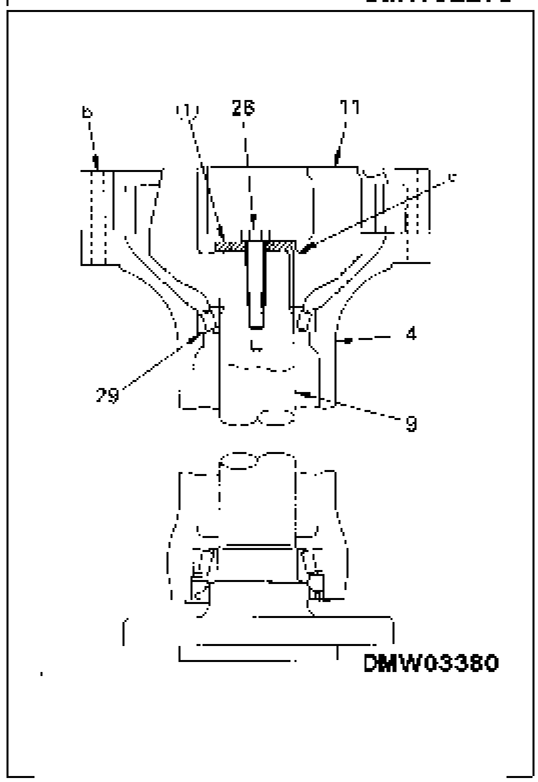
2) Install planetary carrier (11) to spline of axle shaft (9), then assemble shim adjustment tool **â** to portion **c** of planetary carrier, and install mounting bolts.
   Ú Install planetary carrier (11) without the gears.
   Ú Remove all adhesive from the mounting bolts and mounting bolt holes of the axle shaft before using.

3) Rotate axle housing (4) and tighten retainer mounting bolts (26).
   Bolt: **44.1 Nm (4.5 kgm)**

4) Make sure that bearing (29) is fully settled, then measure starting torque **"X"** at drill hole **b** of axle housing (4).
   Ú Starting torque **"X":**
   18.6 - 60.8 N (1.9 - 6.2 kg)
   ! If starting turning force is not within the standard value, adjust again as follows.
   Ú If starting turning force is less than 18.6 N (1.9 kg) Press fit bearing (29) again and repeat the operation from Step 3).
   Ú If starting turning force is more than 60.8 N (6.2 kg)
   i) Use method in Step 5) to measure dimension **H** and dimension **t.**
   ii) Remove mounting bolt (26) and tool (1), and insert shim.
      Ú Shim thickness: **(H - t) + 0.1** mm
   iii) Tighten tool **â** again with mounting bolt (26).
      Ú Tightening torque:
      44.1 Nm (4.5 kgm)
   iv) Secure axle housing (4) in position shown in diagram on right, then tap flange of axle shaft (9) with a copper hammer several times in a downward direction to remove axle shaft.

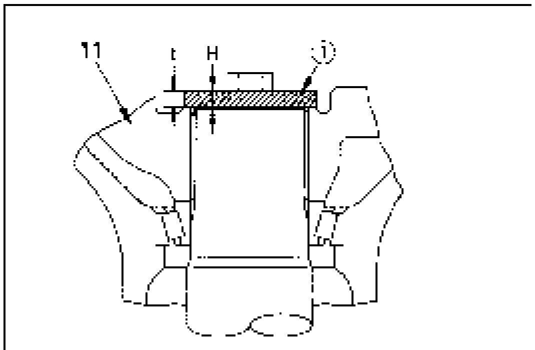






v) Rotate axle housing again to settle bearing, then measure starting turning force at drill hole **b** again.
   ! Repeat this operation until the starting turning force is 18.6 - 60.8 N (1.9 - 6.2 kg).

vi) Remove bolt (26) and tool **â** remove shim, then assemble tool **â** again and tighten bolt.
   ! Tightening torque: 44.1 Nm (4.5 kgm)



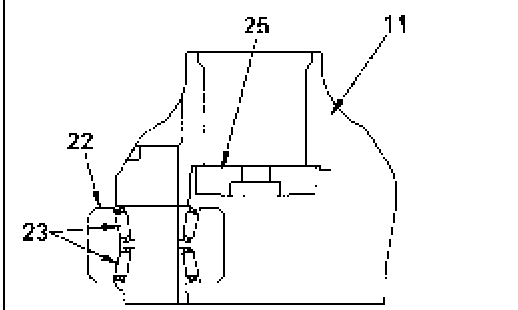
DMW03381

5) Using depth micrometer, measure distance **H** from shim adjustment tool **â** to end face of axle shaft.
   Subtract thickness **t** of the jig from **H** to give the value **(H - t).**
   Ú Shim thickness **$X = (H - t)^{+0.10}_{-0}$**
      Ú Select a shim to give the value closest to **(H - t) + 0.05 mm**.

6) After deciding shim, loosen bolt and remove planetary carrier (11).

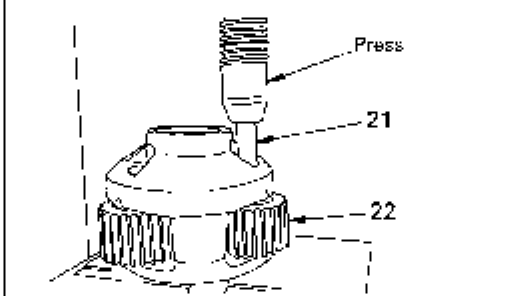
6. Planetary carrier

1) Assemble bearing cone (23) to gear (22), and set in carrier (11).
   Ú Insert spacer (25) inside the planetary carrier before starting.



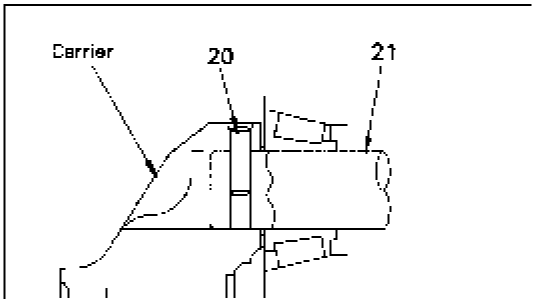
DMW03382

2) Press fit shaft (21).
   Ú Align the holes of shaft (21) and spring pin (20), and knock in the spring pin so that it is level with the surface of the carrier.
   Ú Pressing force : 49.0 KN (5 ton)
   Shaft: **Oil (axle oil)**

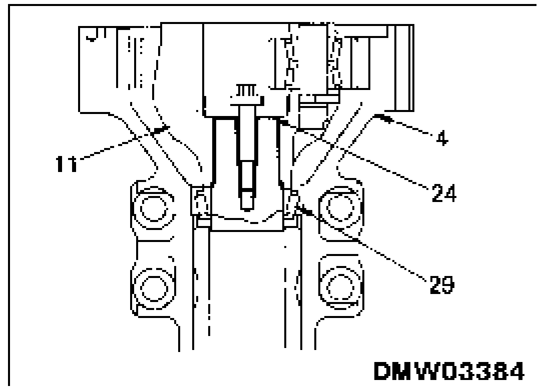


DNW03383

3) Tap differential end of gear (28) and end face of shaft (27), and push back bearing (29) so that the gear can rotate smoothly.
   Ú Check that the gear rotates smoothly.



DMW03369



7. Planetary carrier

1) Assemble shim (24) selected in Step 5) to end face of axle shaft, then install planetary carrier assembly (11) and install mounting bolts.

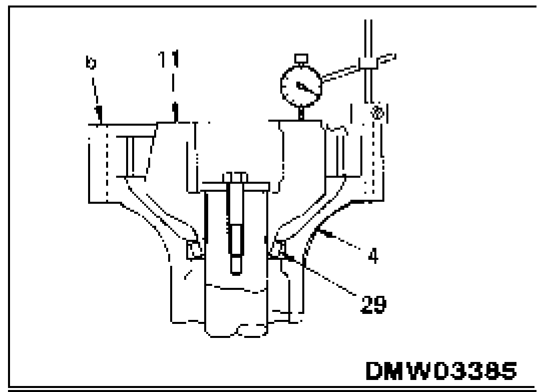
Ú Wash and remove all oil and grease from mounting bolts and mounting bolt holes of axle shaft.

Mounting bolt:
Thread tightener (LT-2)

Mounting bolt:
549.2 ± 58.8 Nm (56.0 ± 6.0 kgm)

Ú Clean the end face of the shaft and the planetary carrier spline before assembling.

WARNING! When assembling the planetary carrier, be extremely careful not to get your fingers caught in the gear.

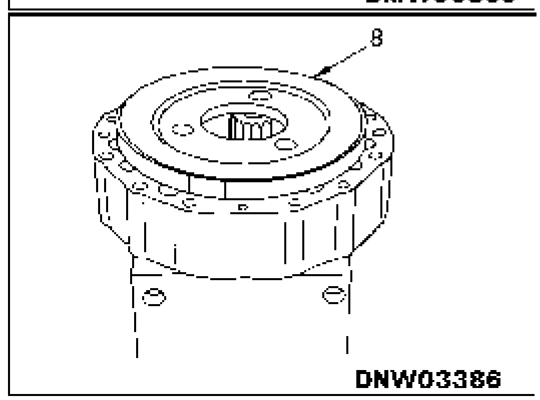


2) Make sure that bearing (29) is fully settled, then check starting turning force **"X"** at drill hole b of axle housing assembly (4).Starting turning force **X:**
18 .6 - 70.6 N (1.9 - 7.2 kg)

3) Install stand of dial gauge to axle housing (4), then measure end play of planetary carrier at end face of planetary carrier.

Ú End play of planetary carrier: 0 - 0.1 mm

Ú If the starting turning torque and end play are not within the standard range, carry out the adjustment in Step 5 again.



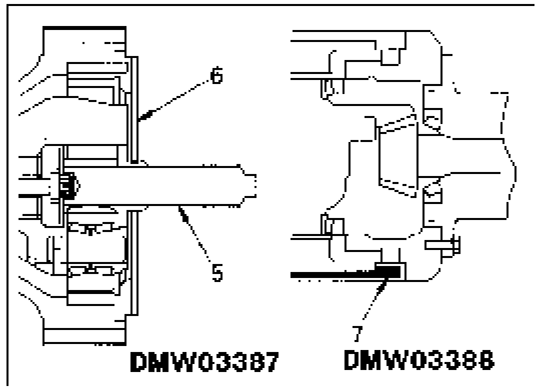
8. Brake outer ring

1) Assemble brake outer ring (8) to axle housing.

Ú Align outer ring pin hole and pin, then assemble.

Ú Be careful not to damage the surface of the brake outer ring.

2) Assemble brake disc (6) and sun gear shaft (5) inside axle housing.

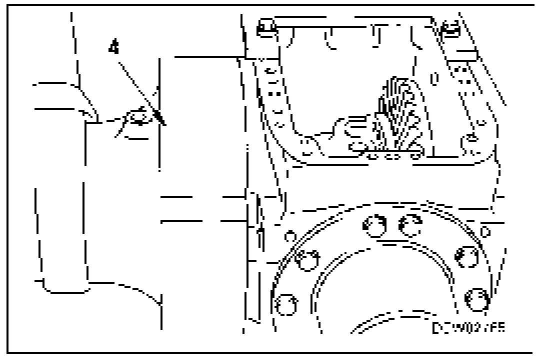


9. Axle housing

1) Assemble brake ring (7) to differential housing.
   - Ú Check that there is no damage to the surface of the brake ring when assembling.
2) Raise axle housing (4) horizontally, then align spline groove and pin hole, and assemble slowly.
   - Ú When assembling, be careful not to let the brake ring and disk come out of place.
   - Ú Wash and remove all oil and grease from the axle housing and differential housing mounting surface, then coat with a continuous line of gasket sealant so that there is no break.

Mating surface of housing:
Gasket sealant (Loctite 515)

Housing mounting bolt:
279.5 ± 29.4 Nm (28.5 ± 3.0 kgm)



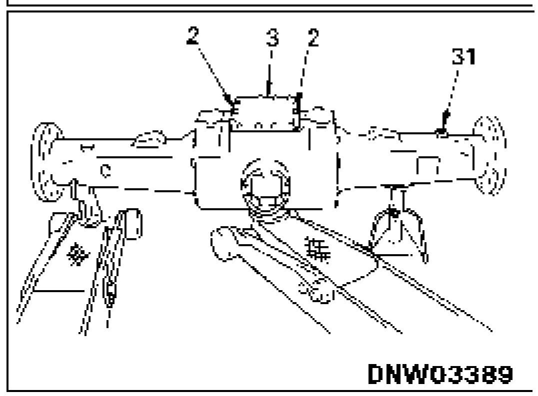
10. Differential cover

1) Knock pin in differential housing and install differential cover (3).
   - Ú Coat with a continuous line of Loctite so that there is no break.
   - Ú Be careful not to get any gasket sealant in the bleeder screw mounting hole when assembling.

Cover mating surface:
Gasket sealant (Loctite 515)

Cover mating surface:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

2) Install bleeder screw (2).



11. Refilling with oil

Tighten drain plug and add axle oil through oil filler (31) to the specified level.

Axle oil: **17.5R**

CENTER HINGE PIN

REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

WARNING! Remove the cover at the top of the hydraulic tank, and loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen the plug at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.
For details, see REMOVAL OF TRANSMISSION, TORQUE CONVERTER ASSEMBLY.

WARNING! Disconnect the cable from the negative (-) terminal of the battery.

Ú Set a pallet under the bucket.

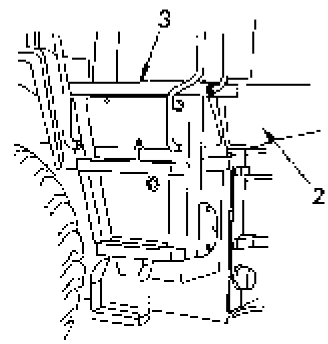
1. Bodywork

1) Remove cover (2) under cab.

Ú Remove the cover at the front on the opposite side also.

2) Remove ladder assembly (3).

Ú Remove the ladder on the opposite side also.



DNW03390

2. Drive shaft

Disconnect center drive shaft (4).

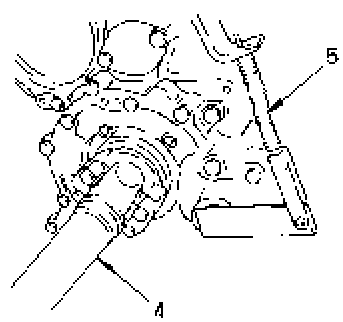
Ú Set a block under the drive shaft and disconnect.

※1

kg Center drive shaft: **20 kg**

3. Disconnect parking cable (5) from transmission.

※2



DNW03391

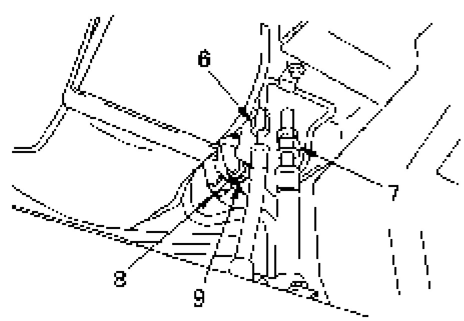
4. Air conditioner, heater hoses

1) Disconnect air conditioner hoses (6) and (7).
2) Loosen clamps of heater hoses (8) and (9) and disconnect from hose.

Ú After disconnecting the hoses, fit covers to prevent dirt, dust, or water from entering the mouthpiece.

Ú Carry out the air return operation for the compressor, then use a gauge manifold band release the refrigerant slowly from the high-pressure valve.

※3

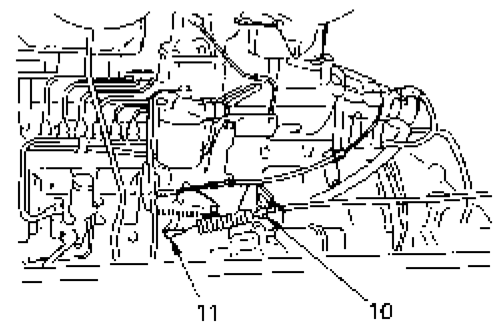


DNW03392

5. Fuel control cable

Loosen locknut (10) of fuel control cable, remove nut of fuel control cable (11), then disconnect from injection pump.

※4

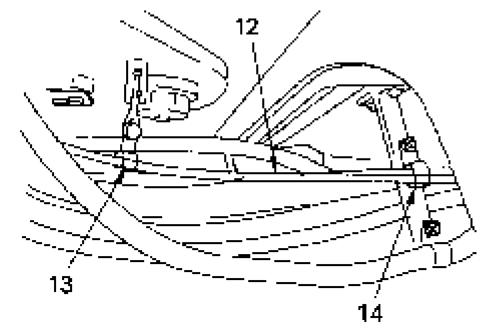


DNW03393

6. Work equipment control cable

Disconnect work equipment control cable (12) at main control valve end, and remove intermediate clamps (13) and (14).

※5

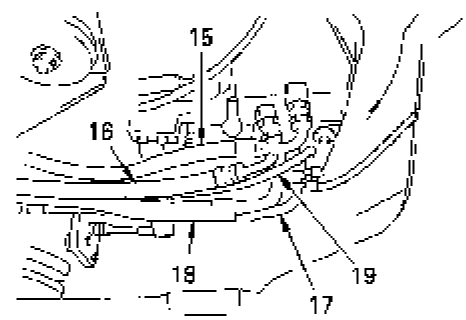


DNW03394

7. Steering cylinder hoses

Disconnect following steering valve hoses at steering valve end.

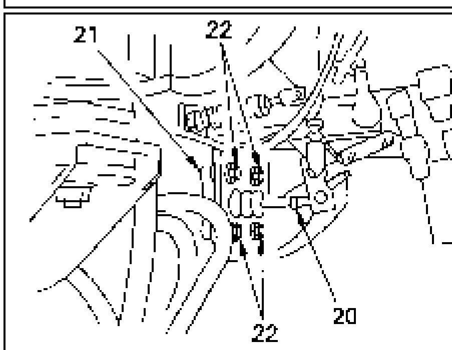
! Hose(15) between steering valve and steering cylinder tube
! Hose (16) between steering valve and hydraulic tank
! Hose(17) between steering valve and steering cylinder tube
! Hose (18) between steering valve and priority valves
! Hose (19) between steering valve and priority valve



DNW03395

8. Master cylinder

1) Remove push rod (20) of master cylinder.
2) Remove mounting bolts (22) of master cylinder (21), then remove master cylinder (21).



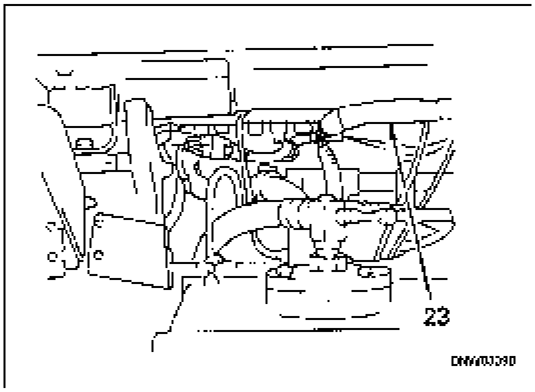
DNW03396

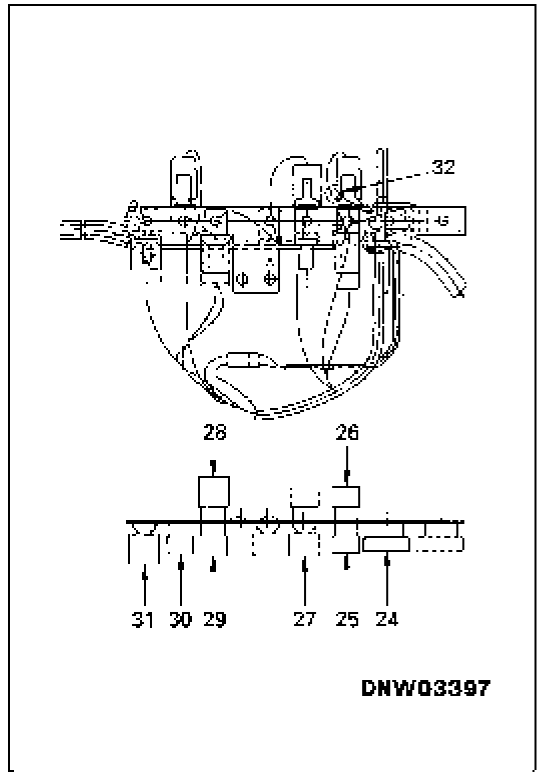
9. Floor wiring

Disconnect following wiring connectors from floor wiring (23).

! Front wiring connector (24)
! Rear wiring connectors (25), (26), (27), (28),(29), and (30)
! Transmission wiring connector (31)
! Disconnect ground terminal (32) from floor.

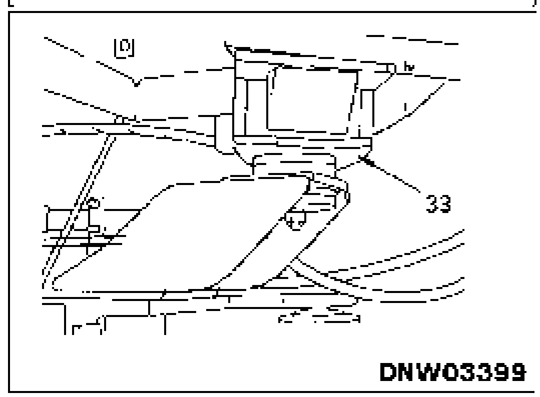
6





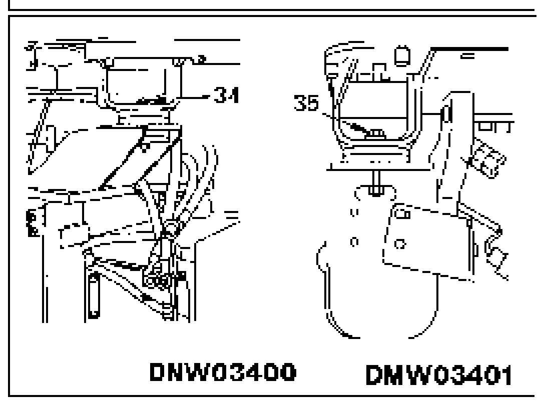
10. Cab, floor

1) Remove cover (33) from floor support
Ú Remove the opposite side also.



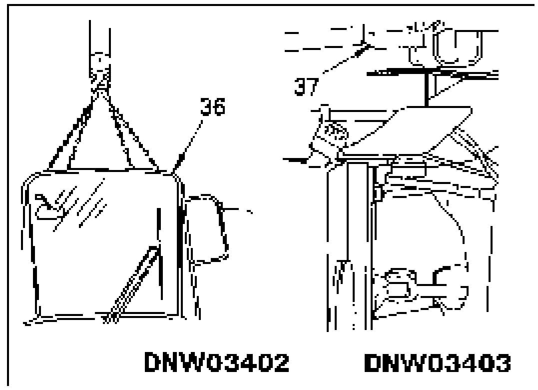
2) Sling cab and remove floor support mount bolts (34) and (35).
Ú Remove the bolts on the opposite side in the same way.

7



3) Raise cab (36) and lift off floor support (37) as assembly.

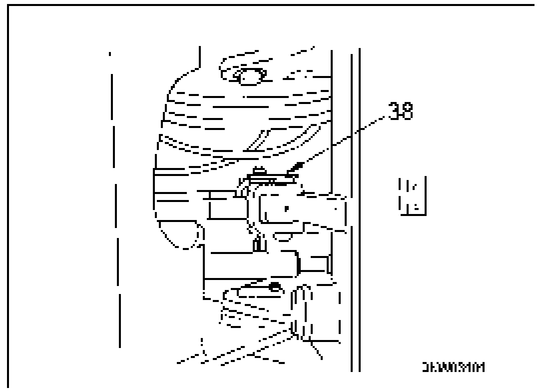
kg ROPS Cab floor assembly: **653 kg**



11. Steering cylinder

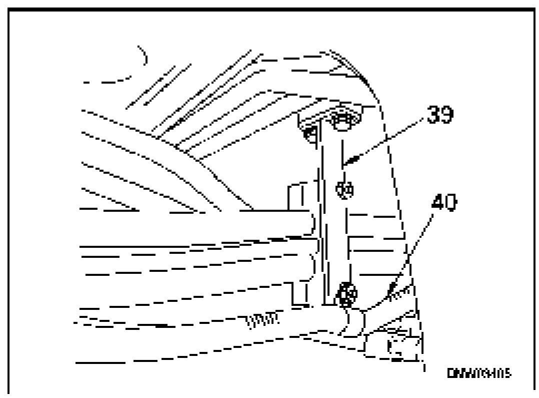
Remove left and right steering cylinder rod pins (38).

Ú If there are shims, check the number and thickness of the shims, and keep in a safe place. 8

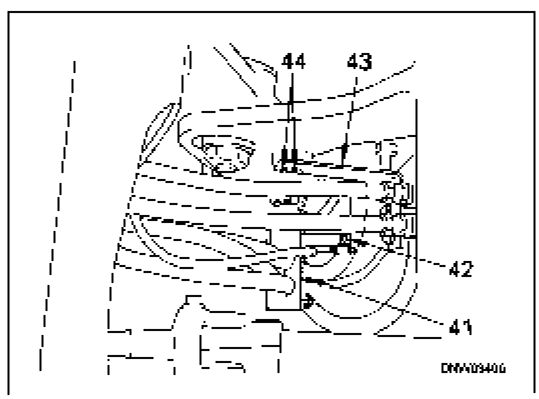


12. Hydraulic piping

1) Remove hose bracket (39) for work equipment piping from front frame.
   Ú Remove the clamp of front frame wiring (40).

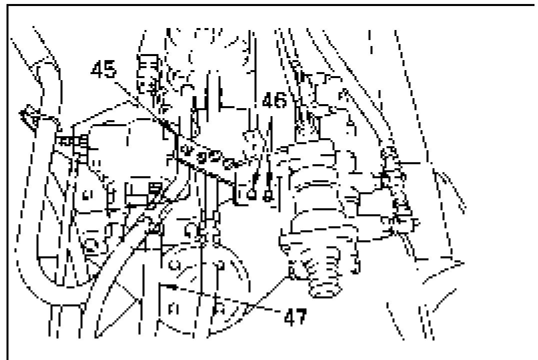


2) Remove hose bracket (41) for work equipment piping from rear frame.
   Ú Remove brake tube T-clamp (42) from the bracket.
3) Remove mounting bolts (44) of steering tube bracket (43) from frame.



4) Remove mounting bolts (46) of steering tube bracket (45) from frame.
5) Disconnect priority valve hose (47) at priority valve end.

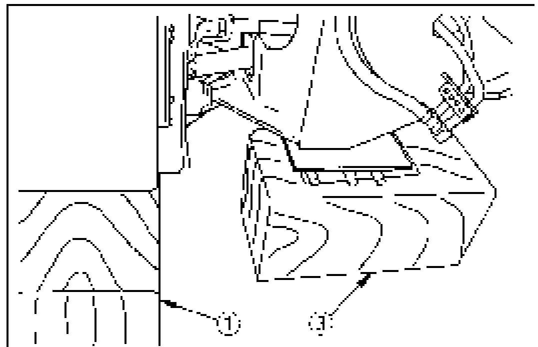
※9



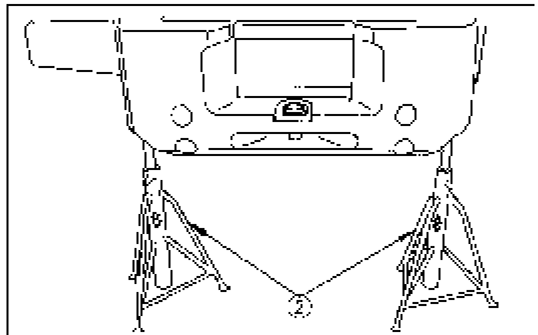
DNW03407

13. Supporting frame

1) Adjust height of rear frame and set block â in position.
2) Set stands ã under counterweight.
3) Adjust height of front frame on left and right, and set block ä in position.
   Ú Be extremely careful when adjusting the height of the frame.



DNW03408

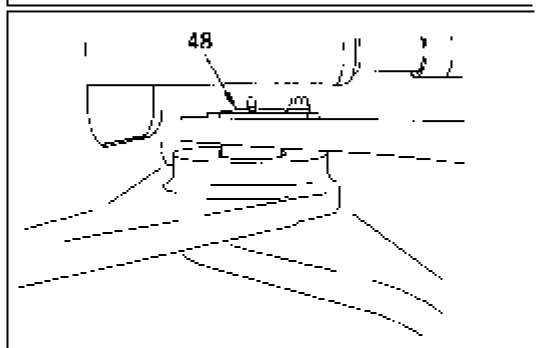


DNW03409

14. Lower hinge pin

Remove lock bolt, and pull out lower hinge pin (48).
Ú Beextremely careful when adjusting the height, and set so that the pin can be removed easily by hand.

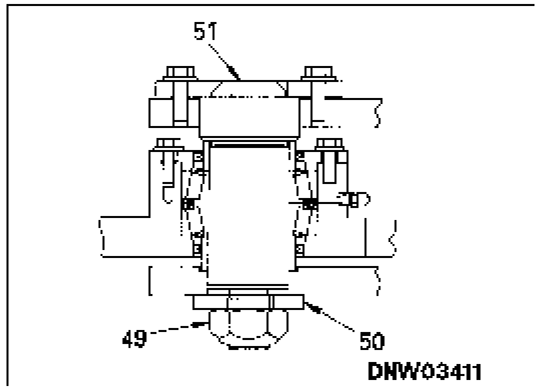
※10



DNW03410

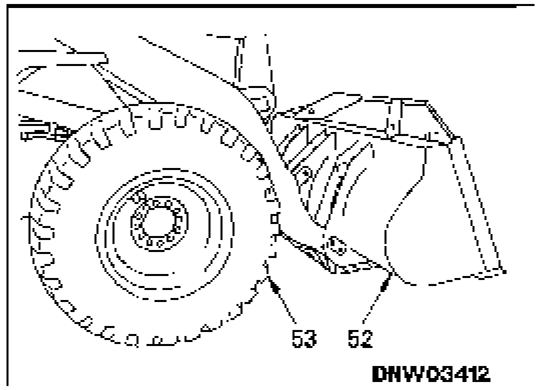
15. Upper hinge pin

1) Remove locknut (49) and washer (50).
2) Remove pin mounting bolts, then pull out upper hinge pin (51).
   Ú There are shims between the retainer and frame, so check the number and thickness of the shims, and keep in a safe place. ※11

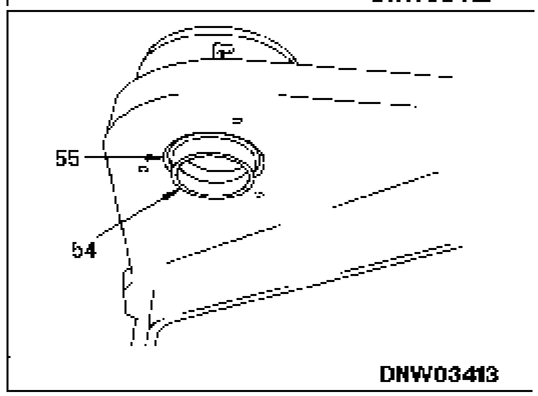


16. Disconnection of frame

1) Jack up pallet under bucket (52) with palleter, remove safety bar, rotate tire (53) by hand, and pull out front frame to front.
   Ú Be extremely careful to maintain the balance when carrying out this operation.
   Ú Be careful not to let the spacer at the bottom of the upper hinge get caught in the rear frame, and insert a bar between the rear frame and front frame to raise the front frame while disconnecting.
   ※12

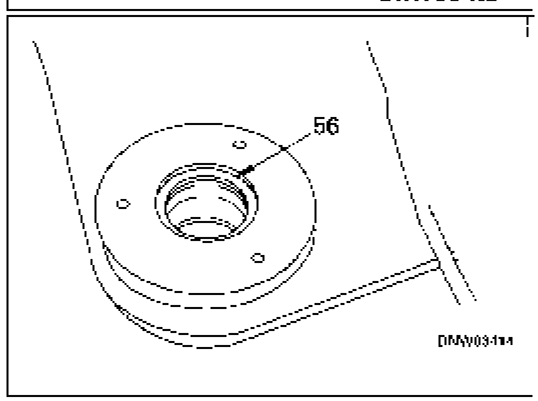


2) After disconnecting frame, remove spacer (54) and dust seal (55) under upper hinge.
   ※13

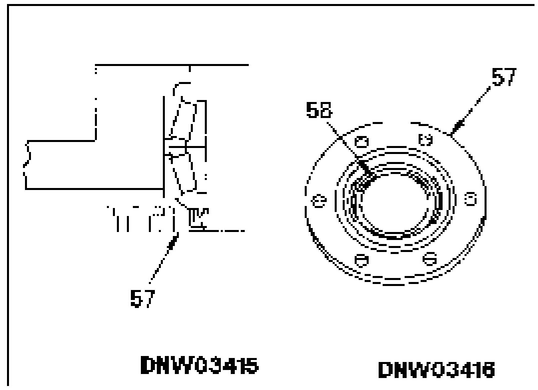


17 Lower hinge

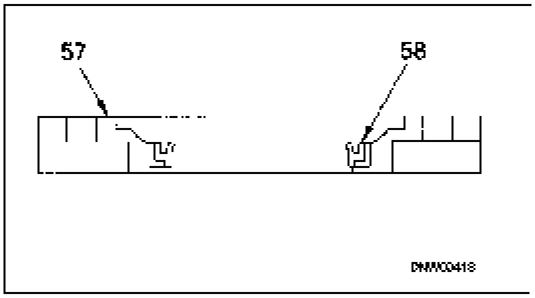
1) Remove dust seal (56) from front frame.
   ※14

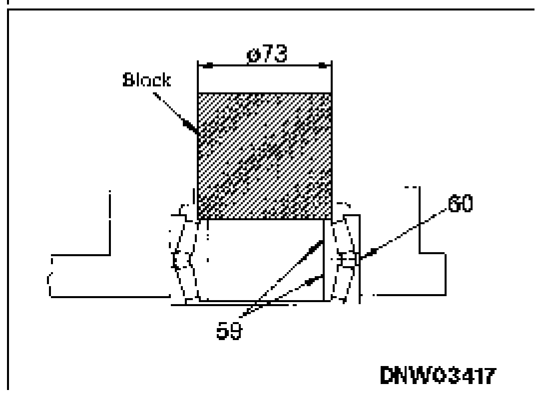


2) Remove mounting bolts, then remove retainer (57).
   Ú If there are shims between the retainer and frame, check the number and thickness of the shims, and keep in a safe place 15



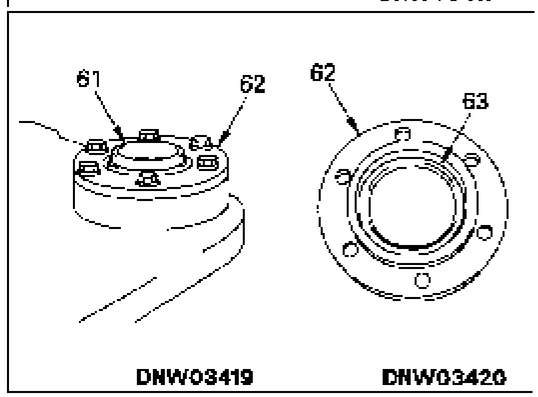
3) Remove dust seal (58) from retainer. 16



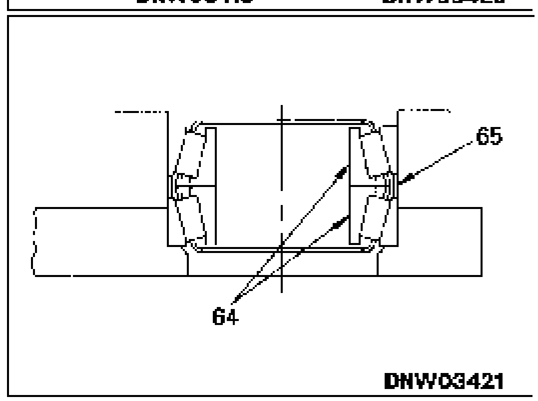


4) Remove bearing (59) and spacer (60) from front frame. 17

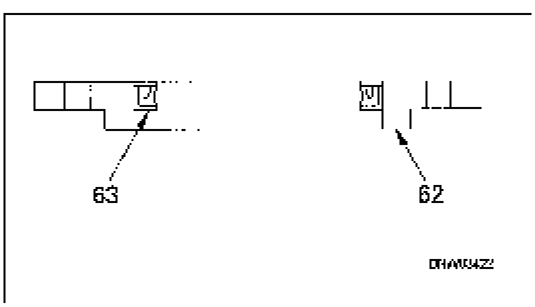
18. Upper hinge



1) Remove spacer (61).
2) Remove mounting bolts, then remove retainer (62).
   Ú There are shims between the retainer and frame, so check the number and thickness of the shims, and keep in a safe place. 18



3) Remove dust seal (63) from retainer (62). 19



4) Remove bearing (64) and spacer (65) from front frame. 20

CENTER HINGE PIN

INSTALLATION

Carry out installation in the reverse order of removal.

1

- Align the pilot portion securely and take care to assemble with the coupling facing in the correct direction.

Mounting bolt **66.2 ± 7.4 nM (6.75 ± 0.75 KGM)**

- After connecting the drive shaft, remove the block.

2

- If the operation of the brake is poor, carry out adjustment. For details, see TESTING AND ADJUSTING.

3

Hose mouthpiece nut (16 mm): **13.2 ± 1.5 Nm (1.35 ± 0.15 kgm)**

Hose mouthpiece nut (24 mm): **31.9 ± 2.5 Nm (3.25 ± 0.25 kgm)**

4

- For details of the adjustment of the cable length, see TESTING AND ADJUSTING.

Cable joint nut: **13.7 ± 1 Nm (1.4 ± 0.1 kgm)**

5

- For details of adjusting the work equipment lever, see TESTING AND ADJUSTING.

6

- Fit the lock of the connector securely.

7

Mounting bolt: **279.5 ± 29.4 Nm (28.5 ± 3.0 kgm)**

8 9

- Adjust shims so that the total clearance is within the standard value.
- Clearance: Max. 0.5 mm

10

Outside circumference of hinge pin: **Grease (G2-LI)**

WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

- Be extremely careful when adjusting the height, and set so that the pin can be inserted easily by hand.

※11

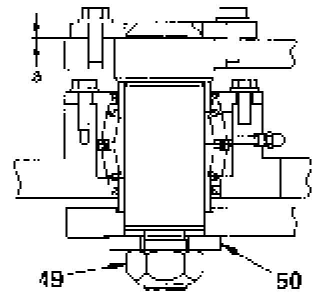
- Ú Tighten washer (49) and lockout (50) to the specified torque, then select shim so that the clearance **a** between the rear frame and pin is the specified value.
- Ú When tightening the lockout, tighten the mounting bolt temporarily to prevent turning.
  Clearance **a:** Max. 0.1 mm
- Ú Standard shim thickness: 1.45 mm

Lockout: **568.8 ± 58.8 Nm (58.0 ± 6.0 kg)**
(width across flats: 55 mm)

- Ú Assemble the selected shim, and tighten the pin mounting bolts.
- Ú Before tightening the mounting bolts, tighten the lockout to the specified torque again.

Lockout: **568.8 ± 58.8 Nm (58.0 ± 6.0 kgm)**

Mounting bolt:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)



DNW03423

※12

WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

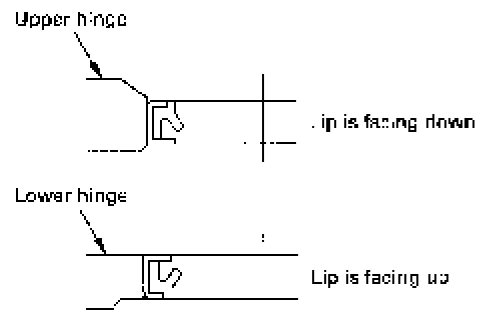
- Ú When joining, be careful not to get the spacer at the bottom of the upper hinge caught.
- Ú Align the pin holes securely.
- Ú Install the safety bar.

※13※14

- Ú Be careful not to damage the seal lip, and assemble with the lip on the outside.

Lip of seal: **Grease (G2-L1)**

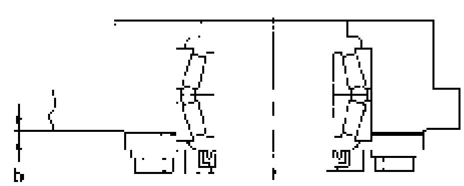
Inside circumference of spacer: **Grease (G2-L1)**



DNW03424

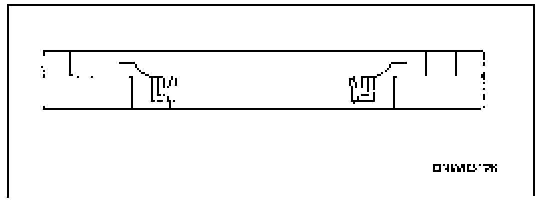
※15

1) Tighten the retainer with 3 bolts.
   Mounting bolt:
   14.7 ± 1.5 Nm (1.5 ± 0.15 kgm)
   (when adjusting shim)
2) Measure the clearance between the retainer and hinge, then select shims and assemble so that the maximum clearance is less than 0.1 mm.
   - Ú Clearance **b:** Max. 0.1 mm
   - Ú Standard shim thickness: 0.85 mm
3) After assembling the shim, tighten 6 bolts.
   Mounting bolt:
   66.2 ± 7.3 Nm (6.75 ± 0.75 kgm)



DNW03425

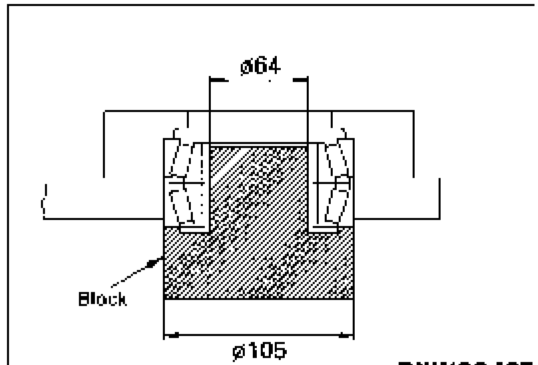
※16



Ú When press fitting the dust seal, be careful that the lip is on the outside.

Lip of seal: **Grease (G2-L1)**

※17



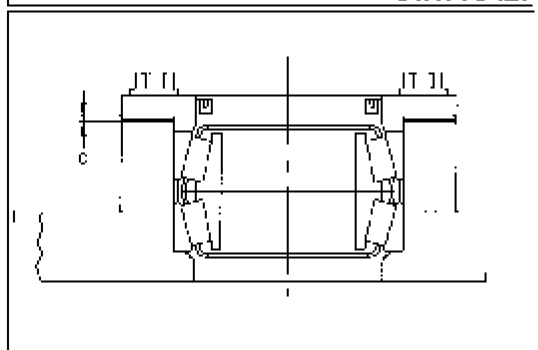
DNW03427

Ú The clearance between the bearing and spacer is adjusted, so do not change the combination.
When replacing, always replace the parts as a set.

Ú When press fitting the bearing, press fit securely so that there is no clearance from the contact surface of the frame.

Bearing: **Grease (G2-L1)**

※18



DNW03428

1) Tighten the retainer with 3 bolts.

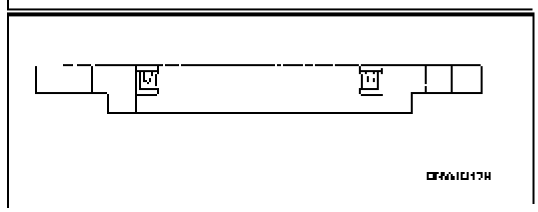
Mounting bolt:
14.7 ± 1.5 Nm (1.5± 0.15 kg)
(when adjusting shim)

2) Measure the clearance between the retainer and hinge, then select shims and assemble so that the maximum clearance is less than 0.1 mm.
   Ú Clearance **c:** Max. 0.1 mm
   Ú Standard shim thickness: 0.92 mm

3) After assembling the shim, tighten 6 bolts.

Mounting bolt:
66.2 ± 7.3 Nm (6.75 ± 0.75 kgm)

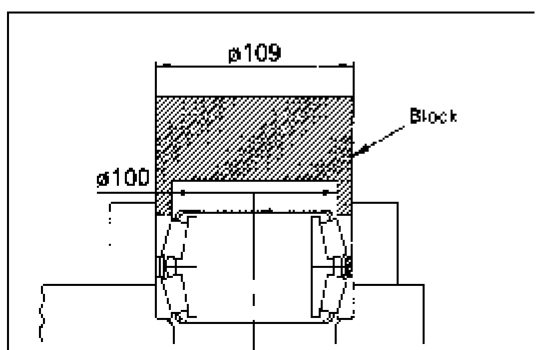
※19



Ú When press fitting the dust seal, be careful that the lip is on the outside.

Lip of seal: **Grease (G2-L1)**

※20



DNW03430

Ú The clearance between the bearing and spacer is adjusted, so do not change the combination.

Ú When press fitting the bearing, press fit securely so that there is no clearance from the contact surface of the frame.

Bearing: **Grease (G2-L1)**

! **Refilling with oil**

Tighten drain plug at the top of the hydraulic tank filter and add hydraulic oil through oil filler to the specified level.

- Run the engine to circulate the hydraulic oil through the system. Then check the oil level again.

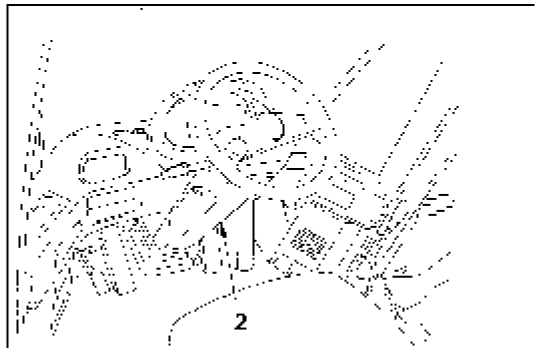
! **Filling with gas**

- Fill the air conditioner with gas. (R134a)
  - Guideline for amount when filling: 1.5 - 1.6 kg

- Before filling with refrigerant, always use the repeat vacuum method to completely evacuate.
- Do not use the can of refrigerant upside down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
- Do not operate the compressor before charging with refrigerant.
- Check that the refrigerant level is correct.
- Check the oil level in the compressor.
  (Specified oil level: **150^{+14}_{-0} cc** ND-OIL8)

STEERING VALVE

REMOVAL



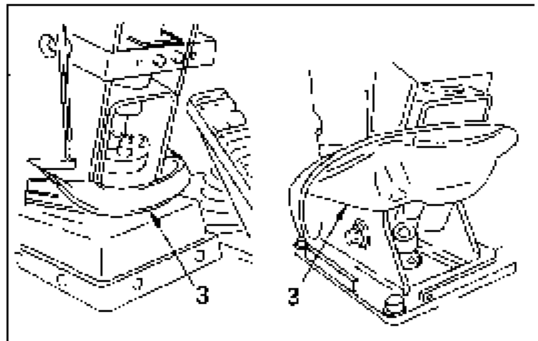
DNW03431

WARNING!, Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

WARNING! Remove the cover at the top of the hydraulic tank, and loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen the plug at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.
For details, see REMOVAL OF TRANSMISSION, TORQUE CONVERTER ASSEMBLY.

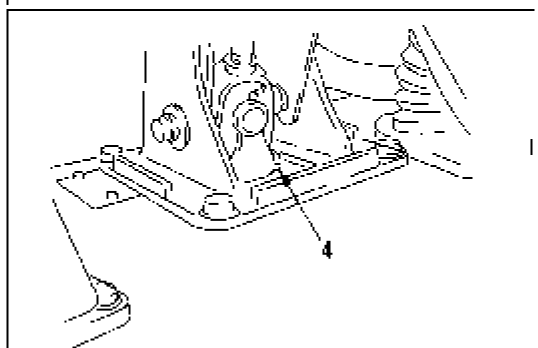
1. Remove steering post cover (2).



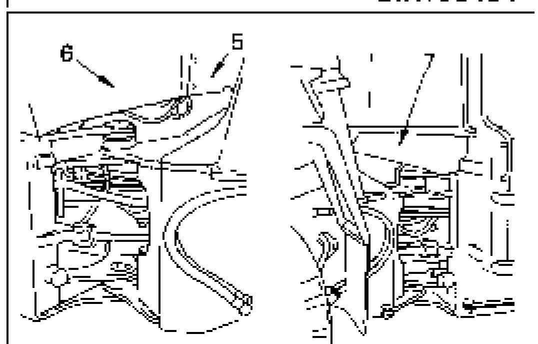
DNW03432 DNW03433

2. Remove 6 plugs and lift boot (3) up.

3. Remove column connecting bolt (4). 1



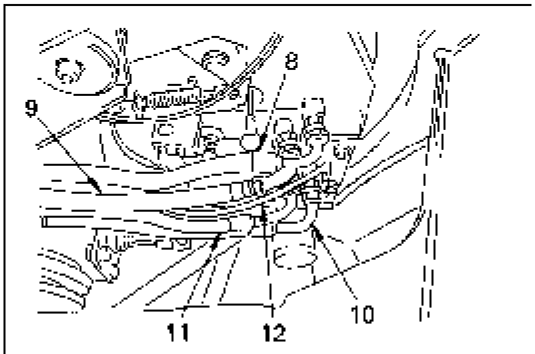
DNW03434



DNW03435 DNW03436

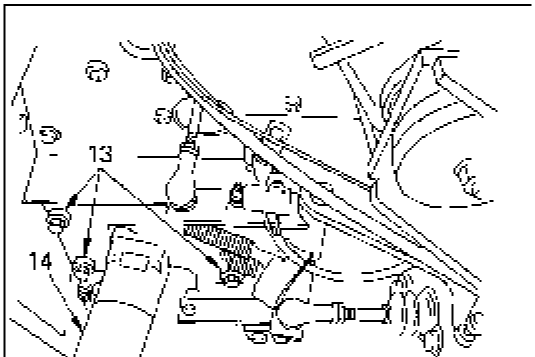
4. Remove covers (5), (6), and (7) under floor.

5. Disconnect following steering valve hoses at steering valve end.
   - ! Hose (8) between steering valve and steering cylinder tube
   - ! Hose (9) between steering valve and hydraulic tank
   - ! Hose(10) between steering valve and steering cylinder tube
   - ! Hose (11) between steering valve and priority valve
   - ! Hose (12) between steering valve and priority valve



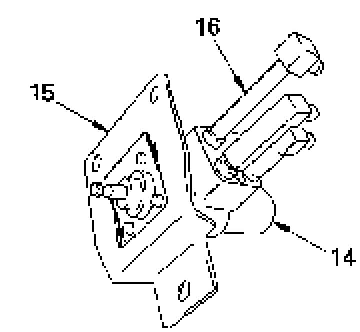
DNW03437

6. Remove steering valve and bracket assembly mounting bolts (13), then remove from floor as steering valve and bracket elbow assembly.



DNW03438

7. Remove bracket (15) and elbow (16) from steering valve (14).
※2



DNW03439

INSTALLATION

! Carry out installation in the reverse order of removal.

※1

Ú Align the spline at the steering column end and the spline at the steering valve end.

Column connecting bolt:
54.9 ± 6.9 Nm (5.6 ± 0.7 kgm)

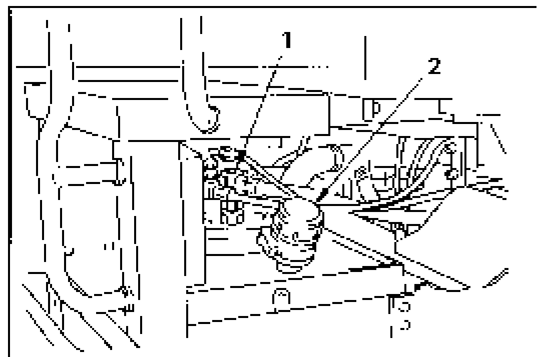
※2

Bracket mounting bolt, steering valve:
51.5 ± 7.6 Nm (5.25 ± 0.75 kgm)

! **Refilling with oil**

Tighten plug (1), remove oil filler cap (2), then add hydraulic oil through oil filler to the specified level.

Ú Run the engine to circulate the oil through the system. Then check the oil level again.

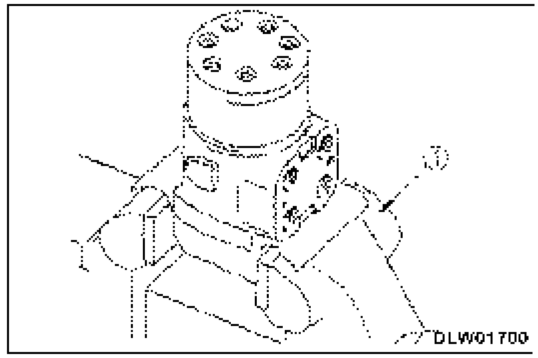


DNW03440

STEERING VALVE

DISASSEMBLY

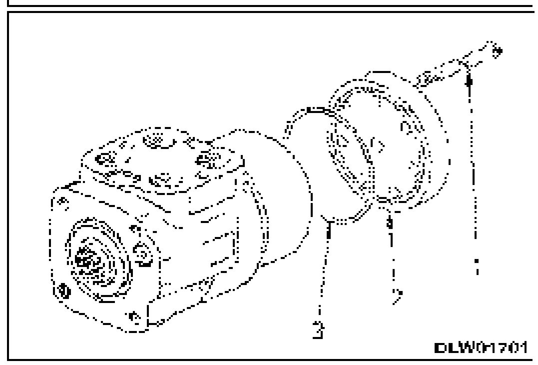
Ú Use a wire brush to remove all the dirt and dust stuck to the joint around the outside circumference of the unit.
Ú Carry out the operation in a clean place to prevent dirt or dust from sticking to the valve.
Ú As long as possible, hold the valve in a vice when disassembling.



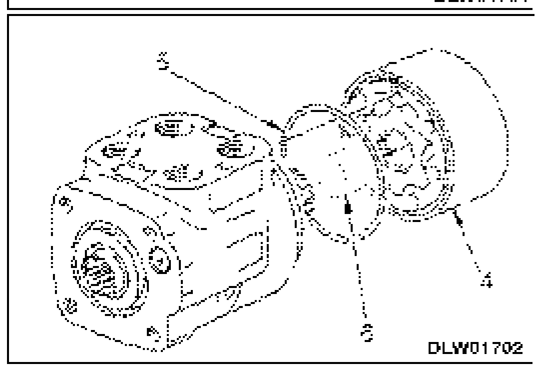
DISASSEMBLY OF ROTOR

1. Set rotor side facing up, and hold mounting flange lightly in vice â.

Ú Put a copper plate in contact with the vice and be careful not to tighten the vice too hard.



2. Remove screw (1), then remove end cap (2).
3. Remove O-ring (3) from end cap (2).



4. Pull out rotor set (4), then remove O-ring (5).

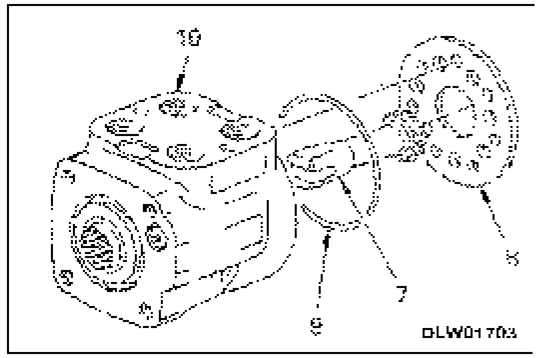
   Ú Be careful not to drop the star inside the rotor set.

5. Remove spacer (6).

6. Remove drive shaft (7).

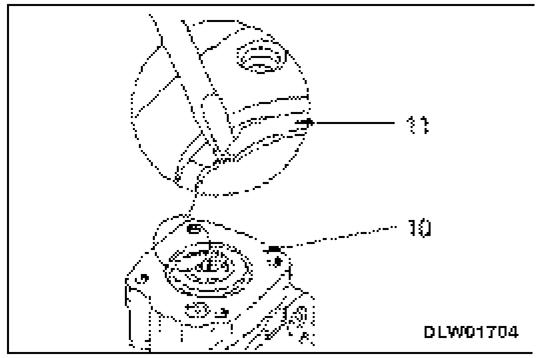
7. Remove spacer plate (8).

8. Remove O-ring (9) from housing (10).

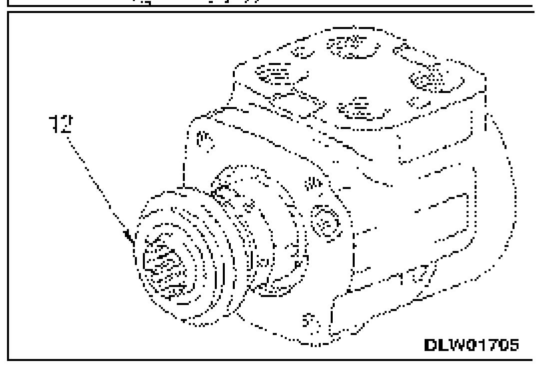


9. Remove housing (10) from vice, and place on a clean cloth. Be careful not to damage the finished surface.

10. Raise tip of snap ring (11) with screwdriver, and remove from housing.

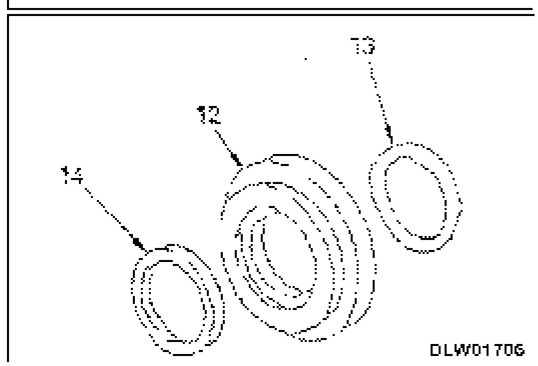


11. Turn spool and sleeve to place pin in a horizontal position, then push in spool and sleeve with your thumb, and remove bushing (12) from housing.



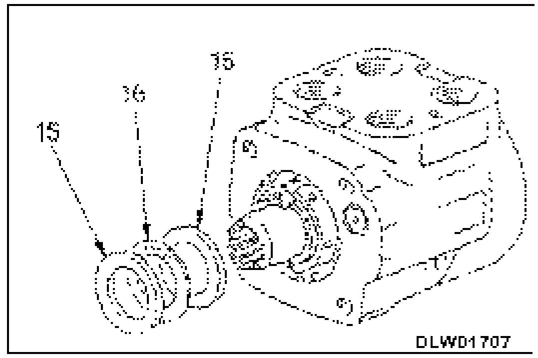
12. Remove X-ring seal (13) from bushing (12).

13. Remove dust seal (14) from bushing (12) with screwdriver.



Ú Be careful not to damage the bushing.

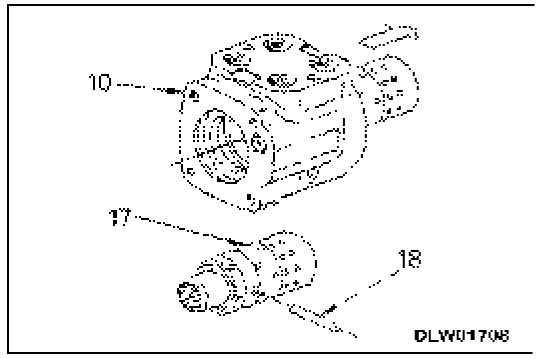
14. Remove 2 bearing races (15) and thrust needle (16) from spool and sleeve.



15. Pull out spool and sleeve assembly (17) from housing (10) in the direction of the arrow.

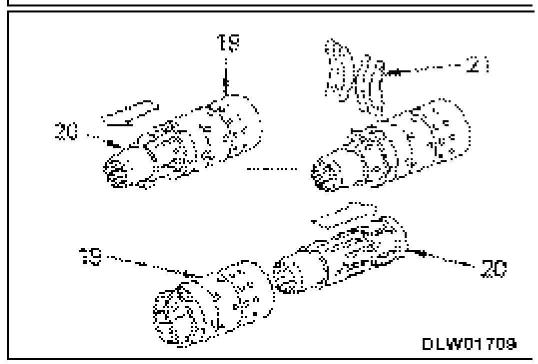
    Ú To prevent the spool and sleeve assembly from catching in the housing, rotate the spool and sleeve assembly slowly to the left and right when pulling out from the housing.

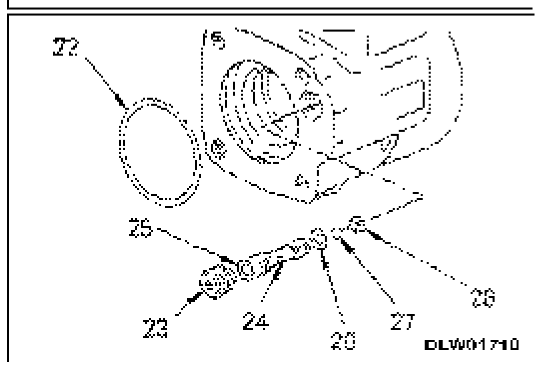
16. Pull out pin (18) from spool and sleeve assembly (17)



17. Push spool (20) inside sleeve (19) slightly to front, and remove 6 centering springs (21) from spool (20) carefully by hand.

18. Turn spool (20) slowly and pull out from rear of sleeve (19) (in the direction of the arrow).





19. Remove O-ring (22) from housing.

20. Remove set screw (23) from housing.

21. Screw a threaded bar into check sheet (24), and pull out check sheet (24).

22. Remove O-rings (25) and (26) from check sheet 24.

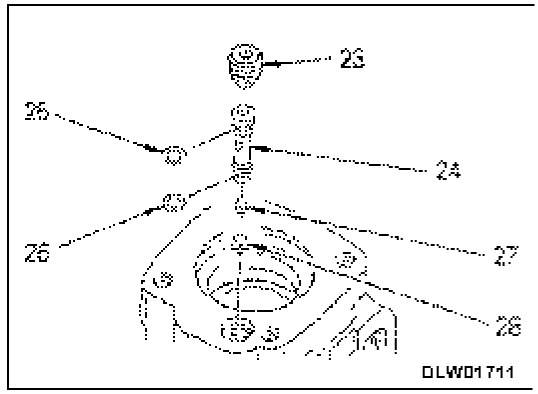
23. Tap housing, and remove ball (27) and retainer (28).

STEERING VALVE

ASSEMBLY

Ú Check all parts for damage or burrs.
Ú Wash all metal parts in clean solvent and blow dry with air.
Ú Do not use a file or polish any part with rough sandpaper.
Ú Coat the O-rings with clean grease. (No need to put grease on new X-ring seals)
Ú Coat the O-ring for the rotor set with a small amount of grease.

ASSEMBLY OF CONTROL SIDE



1. Insert retainer (28) in housing with tweezers.

   Ú Check that the retainer is not inserted at an angle.

2. Insert ball (27).

3. Fit O-rings (26) and (25) in check sheet (24), and push check sheet (24) into housing.

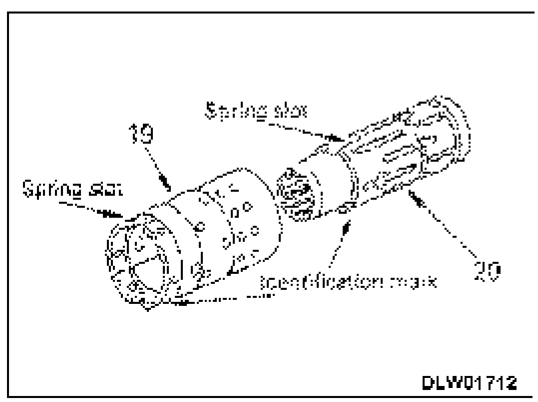
   Ú Be careful to set the top and bottom of the check sheet facing in the correct direction.

4. Install set screw (23).

   Ú Check that the set screw is set in slightly from the end face of the housing.

   Set screw: **11.8 Nm (1.2 kgm)**

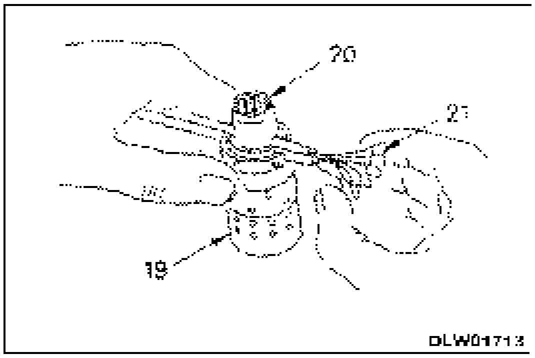
   Set screw : **Adhesive (LT-2)**



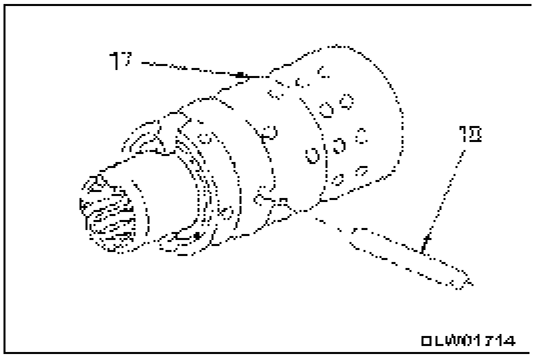
5. Assemble spool (20) and sleeve (19) so that spring groove is on same side.
   Ú Rotate the spool and slide it in.
   Ú Grip the splined portion of the spool lightly and check that the spool rotates smoothly inside the sleeve.
   Ú If there are match marks, check that the match marks are aligned.

6. Align spring groove positions of spool (20) and sleeve (19), and set on flat plate, then insert spring (21) in spring groove.

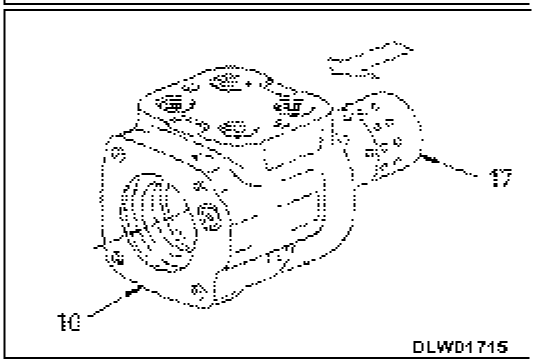
   Ú Set so that the notches at both ends are at the bottom.



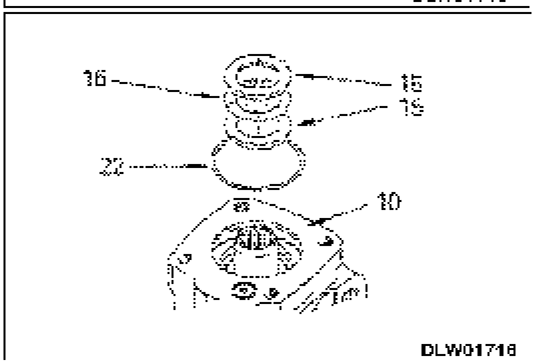
7. Insert pin (18) in spool and sleeve assembly (17).



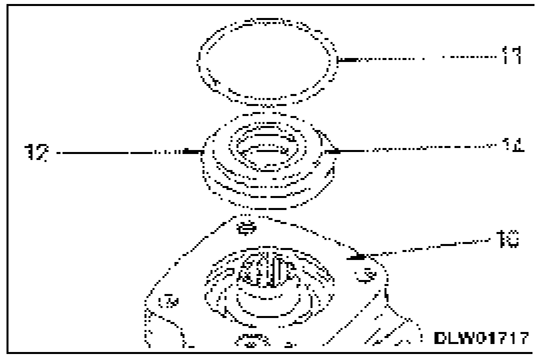
8. Insert spool and sleeve assembly (17) in housing (10) in the direction of the arrow.
   1) Keep pin horizontal and rotate to left and right a little at a time to insert.
      Ú Be extremely careful not to get it caught.
   2) Make the spool and sleeve assembly flush with the rear end face of the housing.
   Ú If it is inserted beyond the end face, the pin will fall out.
   3) Check that spool and sleeve rotate smoothly inside housing.



9. Install O-ring (22) to housing (10).



10. Fit 2 bearing races (15) and thrust needle (16) in case (10).

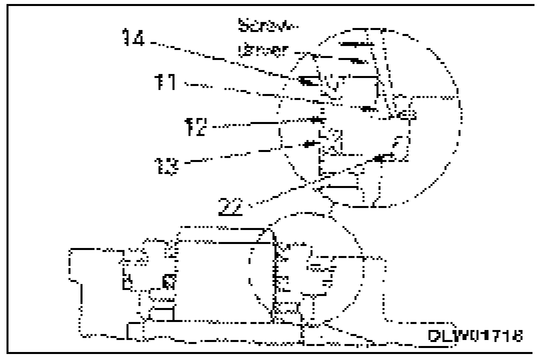


11. Insert dust seal (14) in bushing (12).

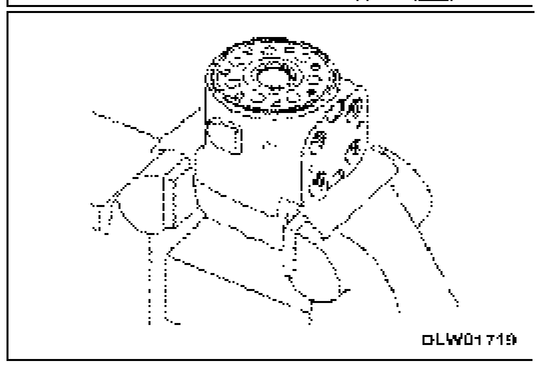
12. Insert X-ring seal (13) in bushing (12).

13. Insert bushing (12) in spool, and rotate to install.

   ! Tap with a plastic hammer to assemble to the specified position.
   ! It must be in contact horizontally with the bearing race.



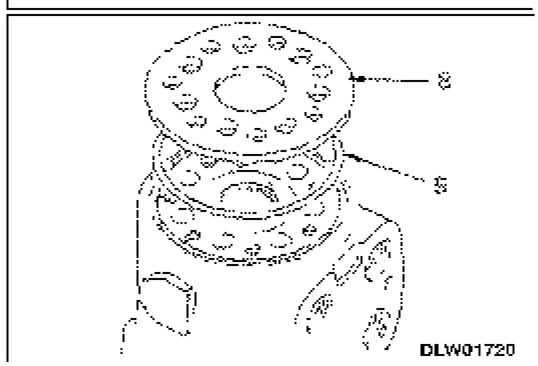
14. Fit snap ring (11) in housing.



ASSEMBLY OF ROTOR

15. Hold flange of housing lightly in vice.

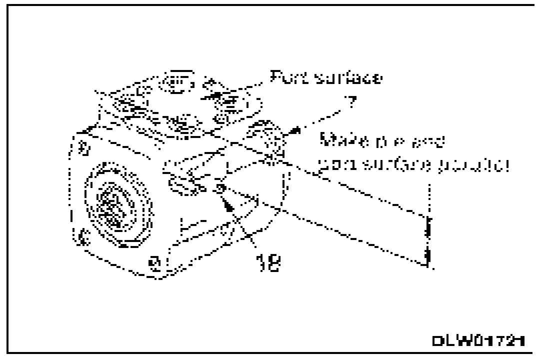
   Ú Be careful not to tighten the vice too hard.
   Ú Check that the spool and sleeve are set in slightly from the housing surface with fourteen holes.



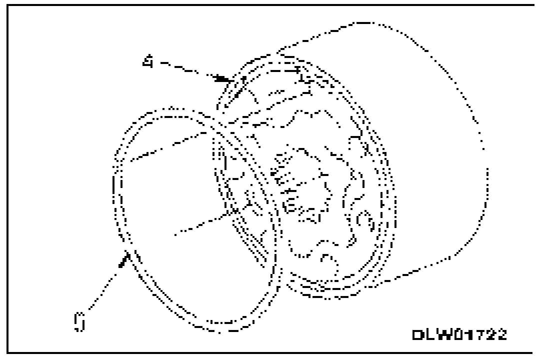
16. Insert O-ring (9) in housing.

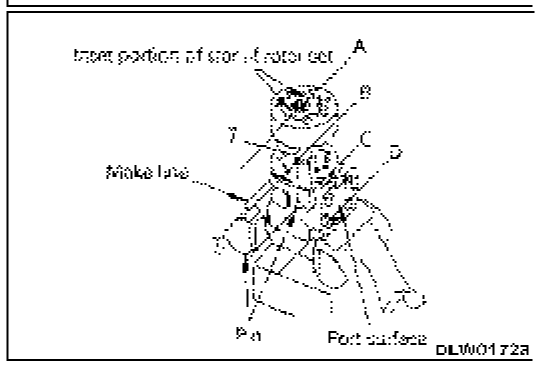
17. Put on spacer plate (8), and align positions of bolt hole and tap hole of housing.

18. Turn spool and sleeve assembly to make pin (18) and port surface of housing parallel, then mesh pin and yoke of drive shaft (7).
    Ú To position accurately, draw a line on the end face of the drive shaft spline.

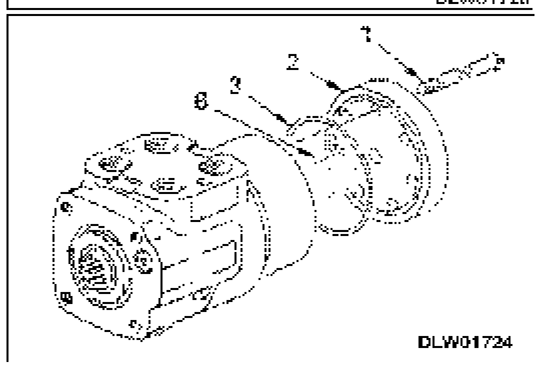


19. Insert O-ring (5) in rotor set (4).





20. Make O-ring (5) end of rotor set to spacer plate end, then align insert portion of star of rotor (4) with drive.
    1) Check that lines **A,B,C,** and **D** are all parallel.
    2) Without removing joint of drive (7), position bolt holes of rotor set.
    Ú This procedure is very important for determining the valve timing of unit.



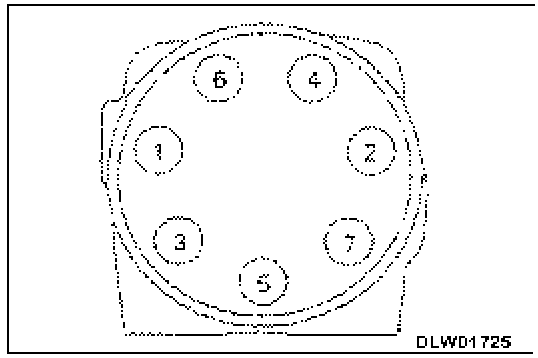
21. Insert spacer (6) inside rotor set.

22. Set end cap (2) on rotor set, and align bolt hole.

23. Coat thread of screw with grease, and tighten end cap.

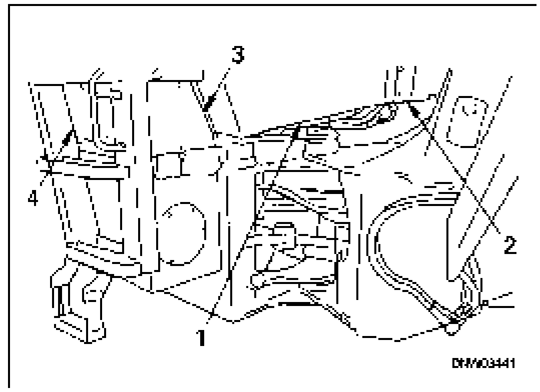
Ú Install the handle to the spool, and check that the spool rotates.

End cap mounting screw
First step: **14.7 Nm (1.5 kgm)**
Second step :
27.0 ± 1.5 Nm (2.75 ± 0.15 kgm)



PRIORITY VALVE

REMOVAL

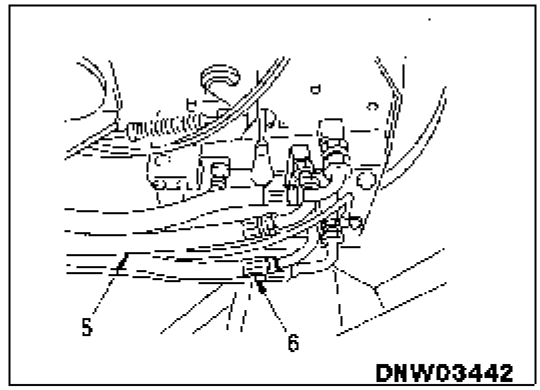


WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

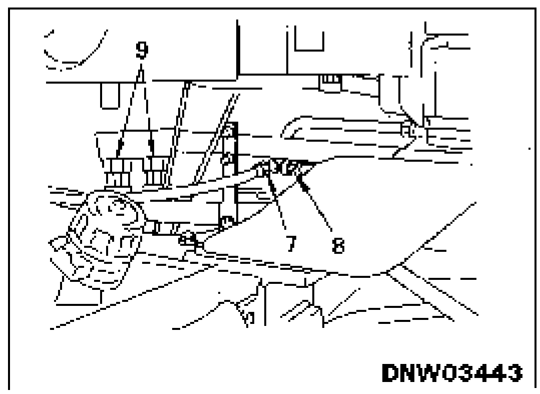
WARNING!, Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen the plug at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.
For details, see REMOVAL OF TRANSMISSION, TORQUE CONVERTER.

1. Remove covers (1) and (2) under cab, and covers (3) and (4) at top of hydraulic tank.

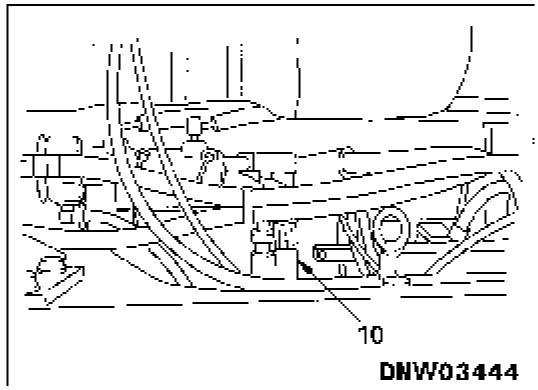


2. **Hydraulic piping**
   1) Disconnect hose (5) between steering valve and hydraulic tank at steering valve end.
   2) Disconnect hose (6) between steering valve and priority valve at steering valve end.

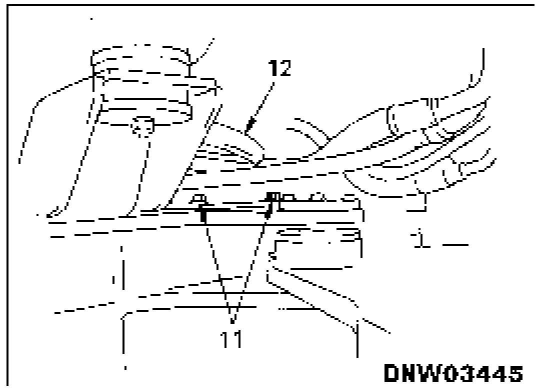


   3) Disconnect hose (7) between priority valve and hydraulic tank at hydraulic tank end.
   4) Disconnect hose (8) between priority valve and steering valve at steering valve end.
   5) Disconnect 2 hoses (9) between tube and main control valve at tube end.

6) Disconnect hose (10) between hydraulic, steering pump and priority valve from tube at priority valve end.
 Ú Remove the cover under the cab.



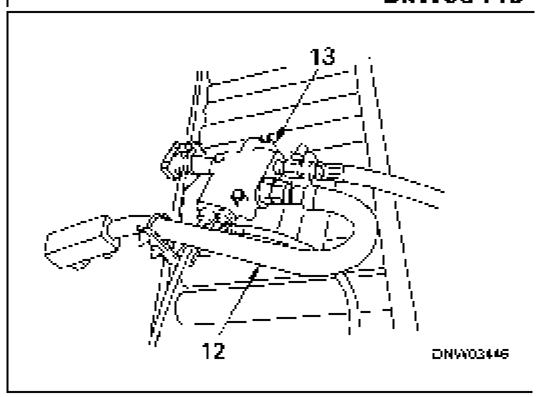
3. Remove bracket mounting bolts (11) from frame, remove priority valve, tube, hose, and bracket assembly (12), then remove priority valve (13).
 Ú Pull the tube towards the front of the chassis and remove.



INSTALLATION

! Carry out installation in the reverse order of removal.

! **Refilling with oil**
Tighten plug at top of hydraulic tank filter and add hydraulic oil through oil filler to the specified level.

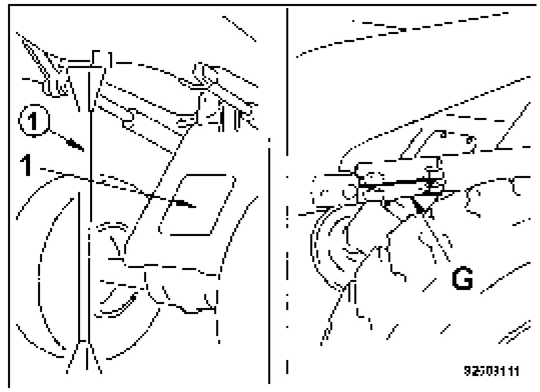


MAIN CONTROL VALVE

REMOVAL

WARNING! Apply the parking brake and put blocks under the wheels to prevent the machine from moving.

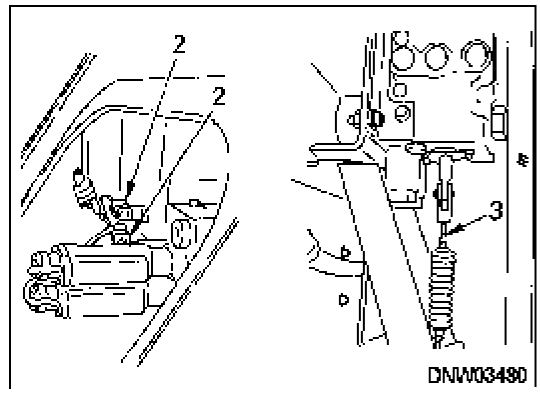
1. Raise boom and set support **â** or tool **G** in position, then remove front cover (1).



WARNING! Remove the cover at the top of the hydraulic tank, and loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

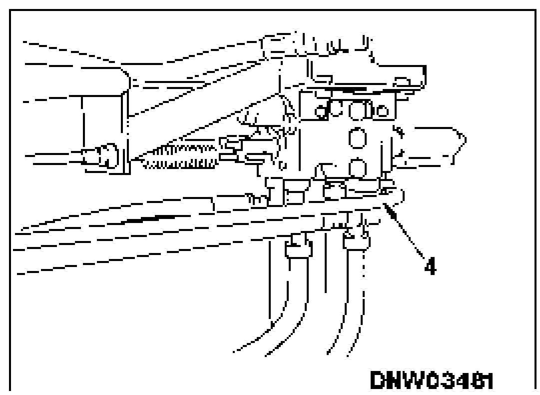
! Loosen the plug at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.

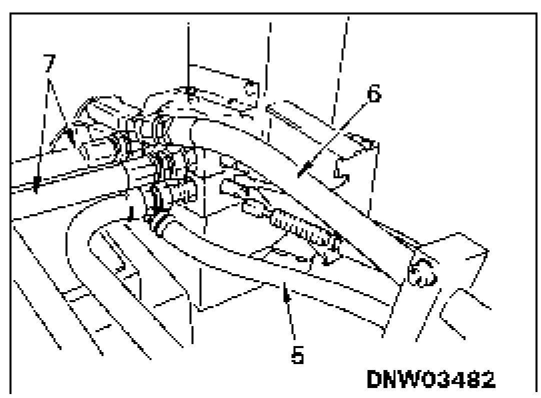
2. Disconnect wiring connector (2) of main control valve.



3. Disconnect work equipment control cable (3) at main control valve end.

4. Disconnect hydraulic piping at main control valve end.
   1) Hose (4) between hydraulic tank and main control valve





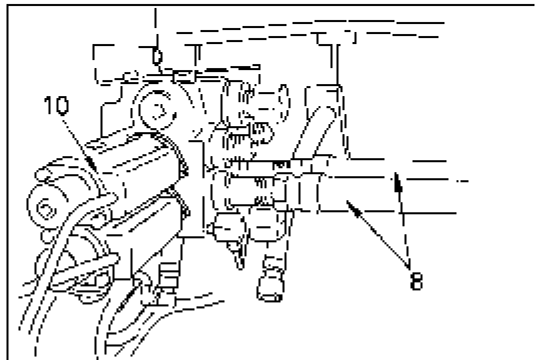
   2) Hose (5) between hydraulic tank and main control valve
   3) Hose (6) between priority valve and main control valve
   4) Hose (7) for bucket cylinder

5) Tube (8) for boom cylinder
   Ú Loosen U-bolt (9) for securing the boom cylinder tube.
   1

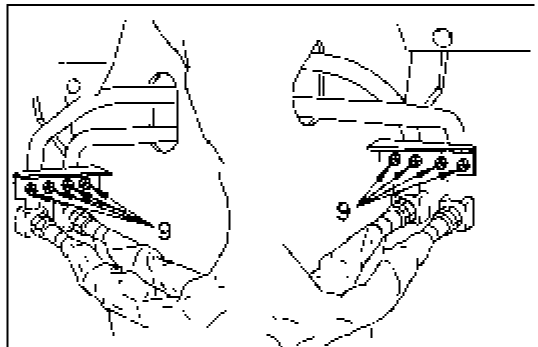
5. Install eye bolts to frame at top of main control valve, sling main control valve (10), then remove mounting bolts (11), and lift off.

   Main control valve: **21 kg**

   Ú When raising the main control valve, be careful to fit the lifting equipment securely.



DNW03483



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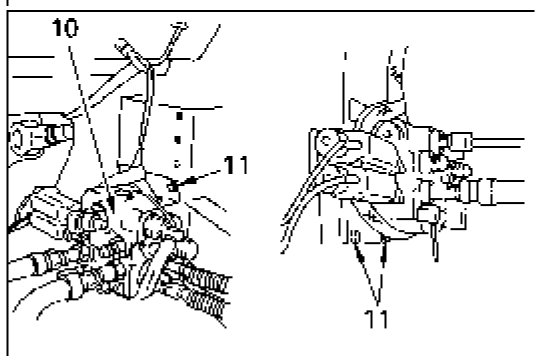


DNW03486 DNW03487

INSTALLATION

! Carry out installation in the reverse order of removal.

1

Boom tube:
176.5 ± 38.3 Nm (18.0 ± 3.9 kgm)
(width across flats: 36 mm)

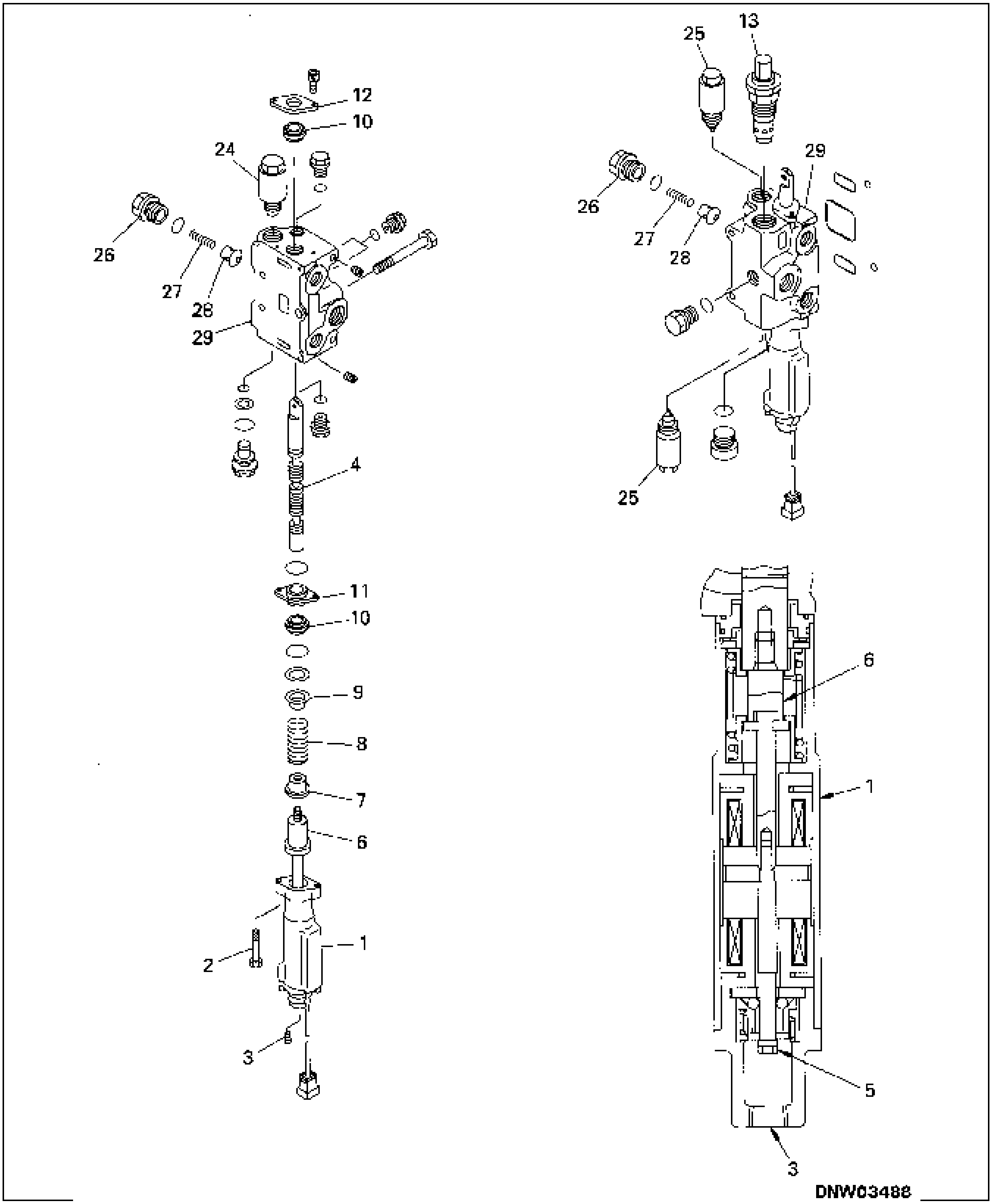
Bucket hose:
176.5 ± 38.3 Nm (18.0 ± 3.9 kgm)
(width across flats: 36 mm)

Hydraulic hose:
196.1 ± 49.0 Nm (20.0 ± 5.0 kgm)
(width across flats: 41 mm)

U-bolt: **18.6 ± 7.9 Nm (1.9 ± 0.8 kgm)**

! **Refilling with oil**
Add hydraulic oil through oil filler to the specified level.
Ú Run the engine to circulate the hydraulic oil through the system. Then check the oil level again.

MAIN CONTROL VALVE



DISASSEMBLY

1. Spool assembly

1) Remove mounting bolt (2) and plug (3) of detent assembly (1).
2) Holding spool (4) from moving, loosen bolt (5) inside detent assembly (1), then remove detent assembly (1).
   Ú Remove joint (6) from spool (4).
3) Remove retainer (7), spring (8), retainer (9), oil seal (10) and plate (11).
4) Remove plate (12), then remove oil seal (10) and spool (4).

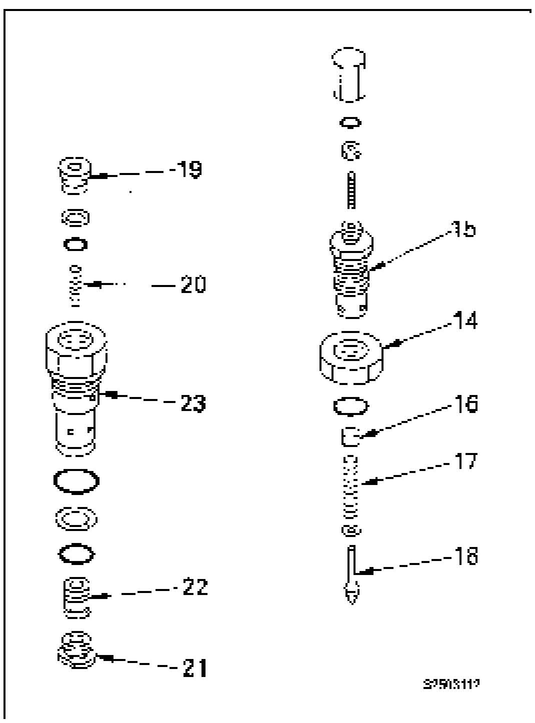
2. Main relief valve assembly

1) Remove main relief valve assembly (13).
2) Loosen nut (14), and screw out holder (15), then remove retainer (16), spring (17), poppet (18), seat (19) and spring (20).
3) Remove plug (21), then remove valve (22) from sleeve (23).

Ú Valve (22) and sleeve (23) are not available as individual parts, so replace them as a set.

3. Remove safety valve assembly (25) with suction valve and suction valve assembly (24).

4. Remove plug (26), then remove spring (27) and valve (28).



ASSEMBLY

1. Assemble valve (28) and spring (27) in body (29), and fit O-ring and tighten plug (26).

Plug: **107.8 ± 14.7 Nm (11 ± 1.5 kgm)**

2. Fit O-rings and install suction valve assembly (24) and safety valve assembly (25) with suction valve.

Safety valve (with suction):
142.2 ± 19.6 Nm (14.5 ± 2 kgm)

Suction valve: **142.2 ± 19.6 Nm (14.5 ± 2 kgm)**

3. Main relief valve assembly

1) Assemble valve (22) in sleeve (23), then tighten plug (21).
2) Assemble spring (20), seat (19), poppet (18), spring (17) and retainer (16) in sleeve.
3) Screw nut (14) into holder (15), fit O-ring on holder, then install the holder into sleeve (23) and tighten nut (14).
4) Fit O-ring and backup ring and install main relief valve assembly (13).

Main relief valve: **83.4 ± 14.7 Nm (8.5 ± 1.5 kgm)**

4. Spool assembly

1) Assemble spool (4) in body, then install oil seal (10) and plate (12).
2) Pull out spool slightly, then assemble retainer (11), oil seal (10), retainer (9), spring (8), and retainer (7).
3) Hold spool from moving, turn bolt inside detent assembly (1), and install joint (6) to spool (4).

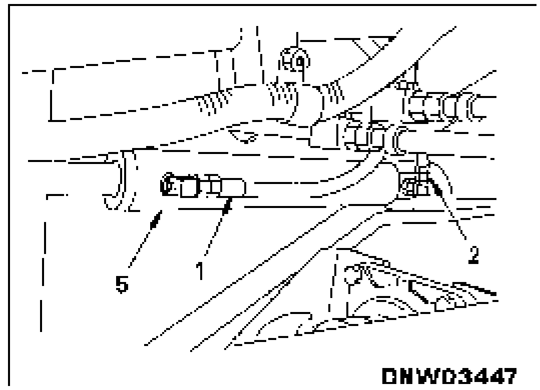
   Joint: **14.7 ± 4.9 Nm (1.5 ± 0.5 kgm)**

4) Tighten bolt (5), then install detent assembly (1).
5) Tighten plug (3).

   Plug: **13.7 ± 3.9 Nm (1.4 ± 0.4 kgm)**

STEERING CYLINDER

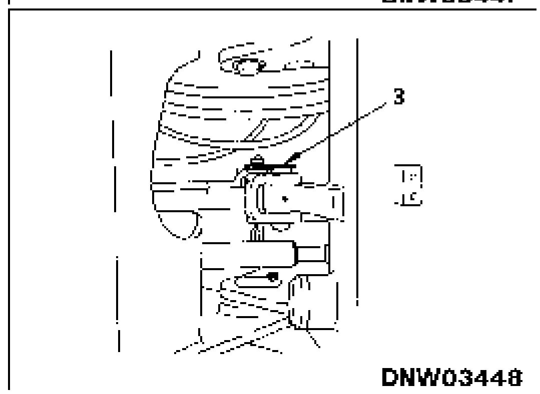
REMOVAL



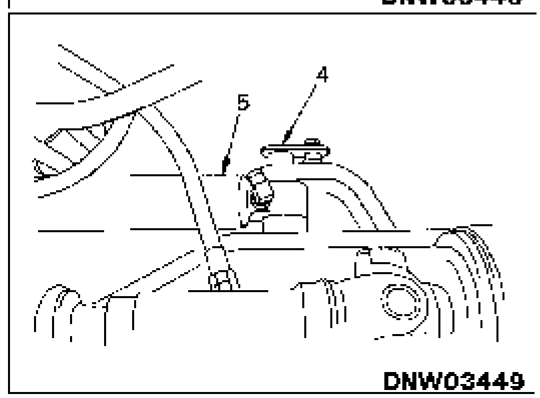
WARNING!, Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving

WARNING!. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel several times to the left and right to release the remaining pressure in the

1. **Hydraulic piping**
   Disconnect hoses (1) and (2) from cylinder.

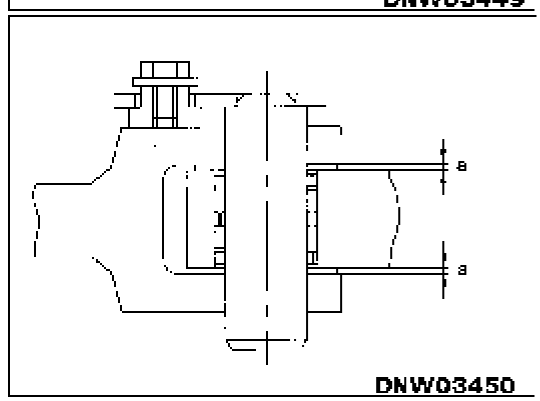


2. **Steering Cylinder**
   1) Remove rod bolt, and pull out pin (3).
   Ú Check the number and thickness of the shims and use for reference when assembling. 1



   2) Remove bottom bolt, and pull out pin (4).
   3) Remove steering cylinder (5)
      Ú When removing the cylinder, carry out the operation with two workers. Be careful not to damage the cylinder rod.
      kg Steering cylinder: 20 kg

INSTALLATION



! Carry out installation in the reverse order of removal.

WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

1

1. Adjust the shim so that the total of clearance **a** is the specified value.
   Ú Clearance **a:** 0 **-** 0.5 mm

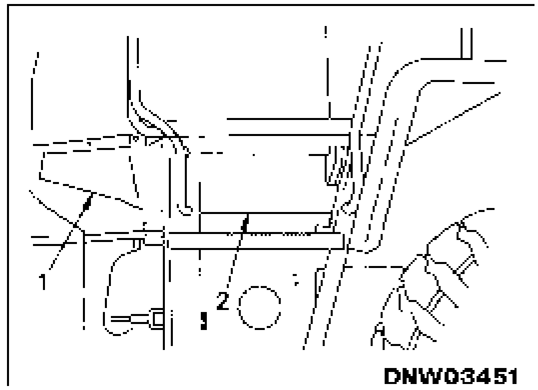
2. Grease the cylinder pin thoroughly.
   Ú Wipe off any grease that is squeezed out.

POWER MASTER CYLINDER

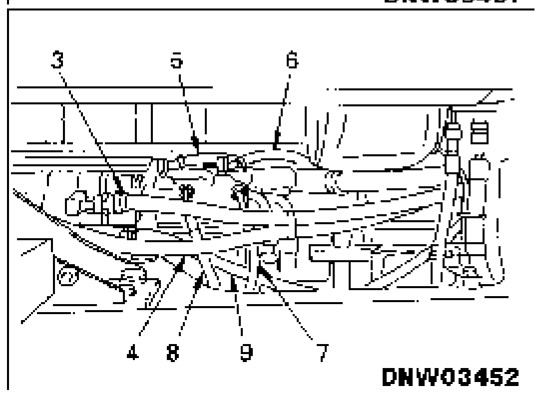
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

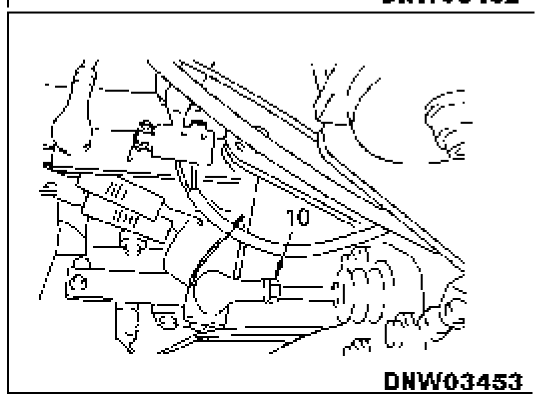
1. **Cover**
   Remove side covers (1) and (2).

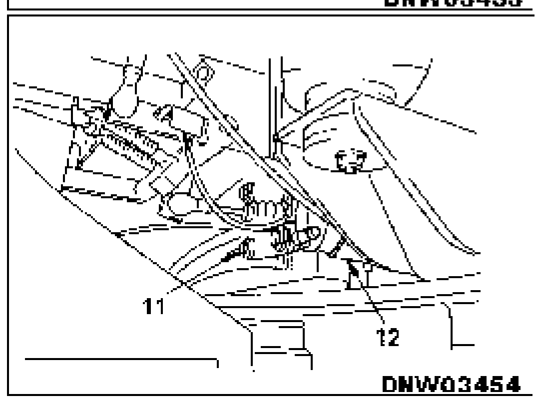


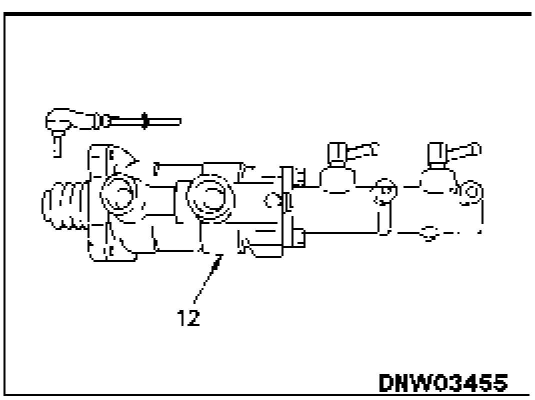
2. **Brake piping**
   1) Disconnect hose (3) between power master cylinder and transmission from power master cylinder.
   2) Disconnect hose (4) between power master cylinder and torque converter charging pump from power master cylinder.
   3) Disconnect hoses (5) and (6) between brake oil tank and power master cylinder from power master cylinder.
   4) Disconnect tubes (7) and (8) between power master cylinder and front and rear brakes from power master cylinder.
   5) Disconnect hose (9) between power master cylinder and transmission from power master cylinder.



3. **Power master cylinder**
   1) Remove brake lever connecting nut of brake rod assembly (10).
   2) Remove 4 mounting bolts (11), then remove power master cylinder (12). ※2







INSTALLATION

! Carry out installation in the reverse order of removal.

1

Tube between power master cylinder and front and rear brakes:
11.8 ± 2.9 Nm (1.2 ± 0.3 kgm)

Hose between power master cylinder and brake oil tank:
3.3 ± 0.5 Nm (0.34 ± 0.05 kgm)

Power master cylinder mounting bolt:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

! **Bleeding air**
Bleed the air from the brake system.
For details, see TESTING AND ADJUSTING, Bleeding air from brake system.

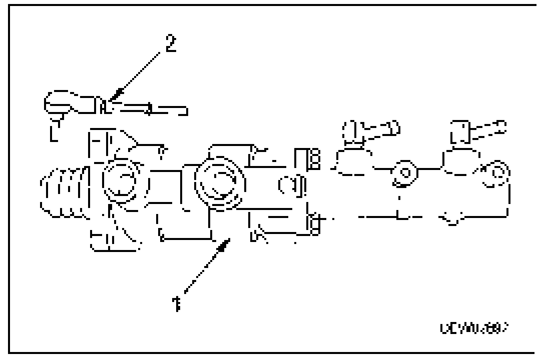
! **Adjusting rod**
Adjust the rod.
For details, see TESTING AND ADJUSTING, adjusting brake pedal, linkage.

POWER MASTER CYLINDER

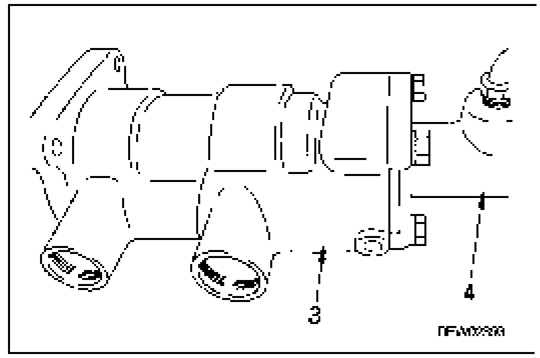
DISASSEMBLY

1. Power master cylinder

1) Remove linkage rod (2) from power master cylinder (1).
   Ú Protect and store insertion end of piston of linkage rod from damage with masking tape.

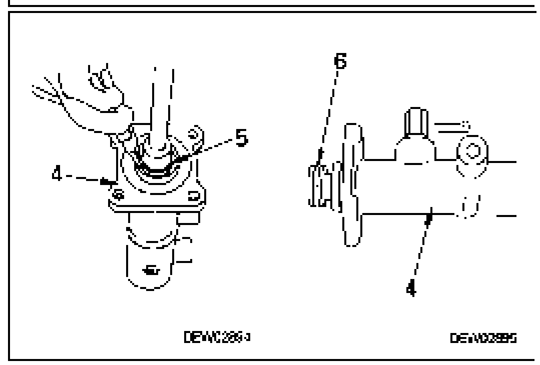


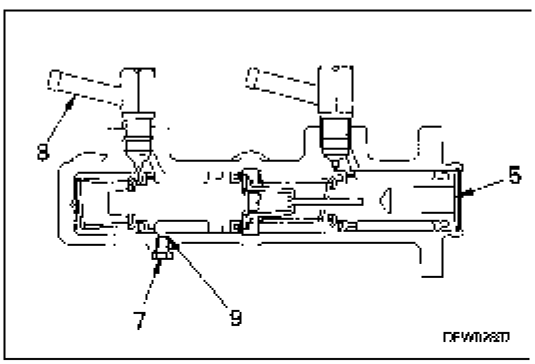
2) Disconnect power cylinder (3) and master cylinder (4).



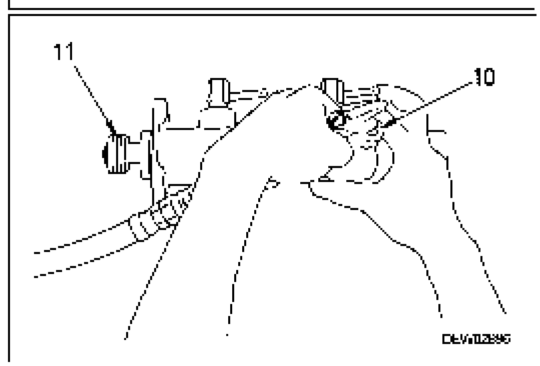
2. Disassembly of master cylinder

1) Remove C-ring (5) from body (4) and take out secondary piston (6).

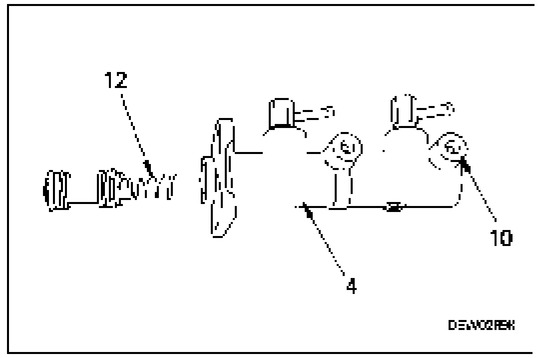




2) Remove stopper bolt (7). Hold brake oil hole (8) and stopper bolt hole (9) with finger, then blow air from brake oil hole (10) to take out primary piston (11).
   Ú Do not blow air in suddenly as the piston will fly out.

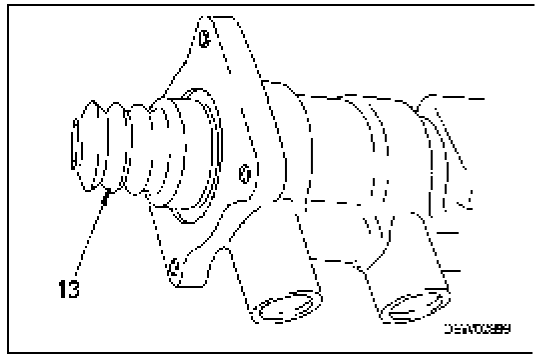


3) Remove spring (12) from inside body (4).
   - Ú When removing the piston, be careful not to damage the inside of the body or the sliding surface of the piston.
   - Ú If there is any problem with the primary or secondary pistons, replace the master cylinder assembly.

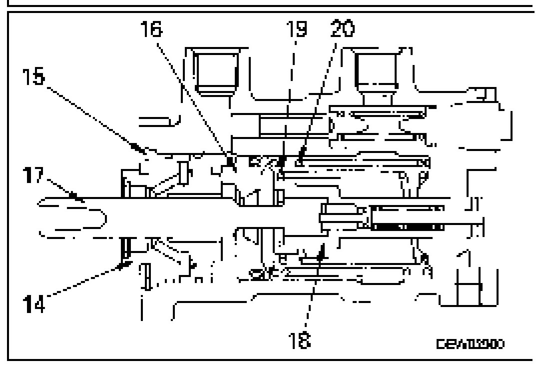


3. Disassembly of power cylinder

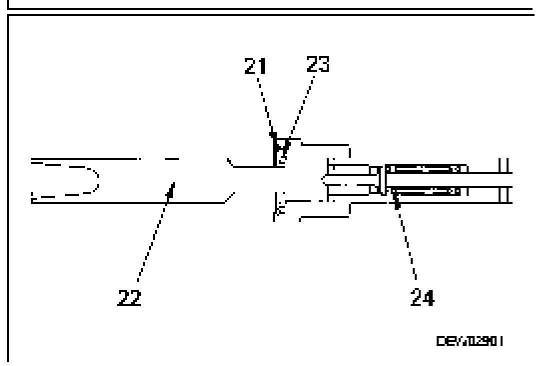
1) Remove dust cover (13).
   - Ú Remove the elbow first.



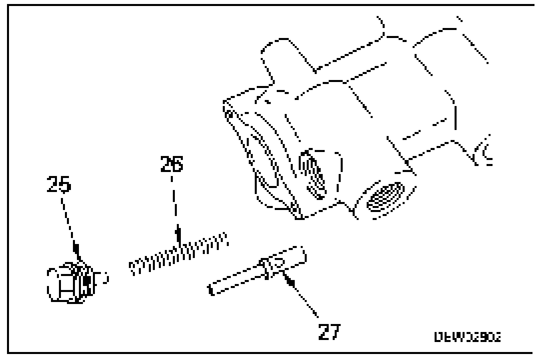
2) Push in cylinder cover (14), remove snap ring (15), then remove power piston (16), connector assembly (17), spring seat (18), and springs (19) and (20).
   WARNING! When removing the snap ring, the cylinder cover is pushed out by the spring, 17 so remove carefully.
3) Remove power piston (16) from connector assembly (17).



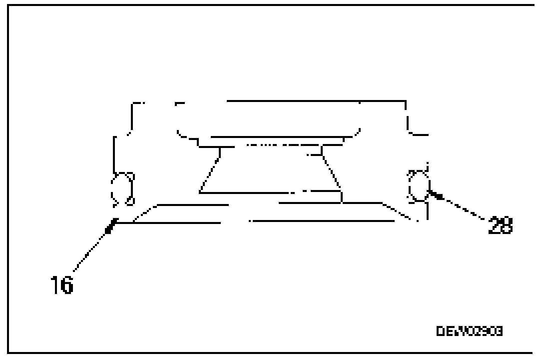
4) Remove snap ring (21), disconnect spool (22 and connector, then remove thrust washer (23) and spring (24).



4. Relief valve
Remove plug (25), then remove spring (26) and spool(27).

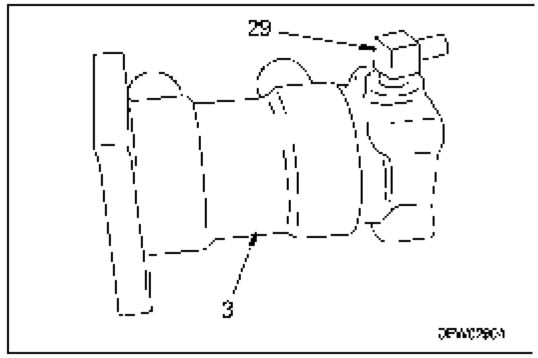


5. Power piston
Remove seal ring (28) from piston (16).

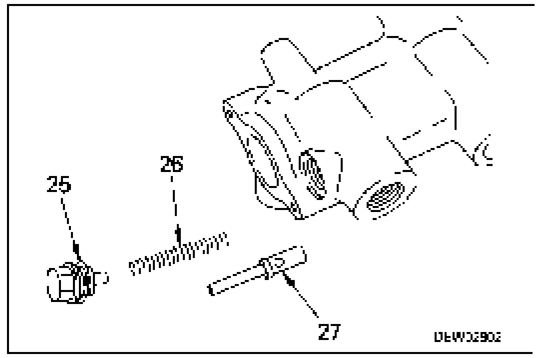


ASSEMBLY

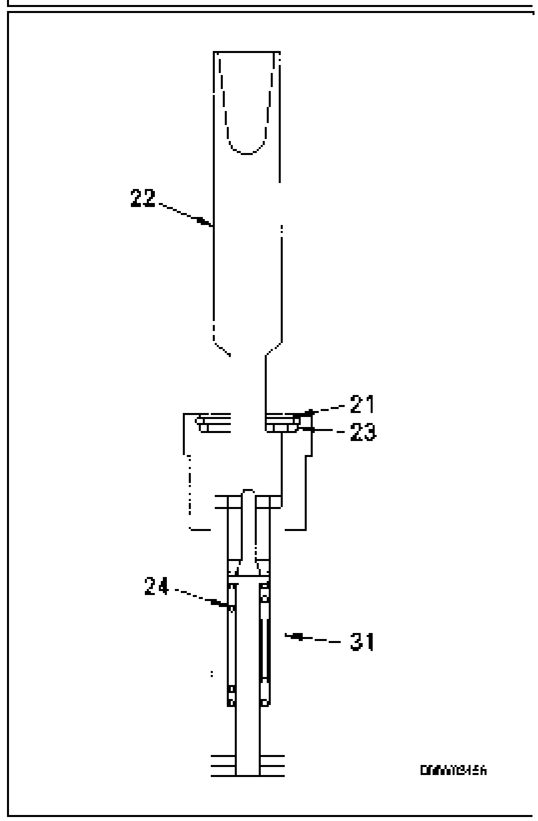
1. Elbow
Install elbow (29) to power cylinder body (3).



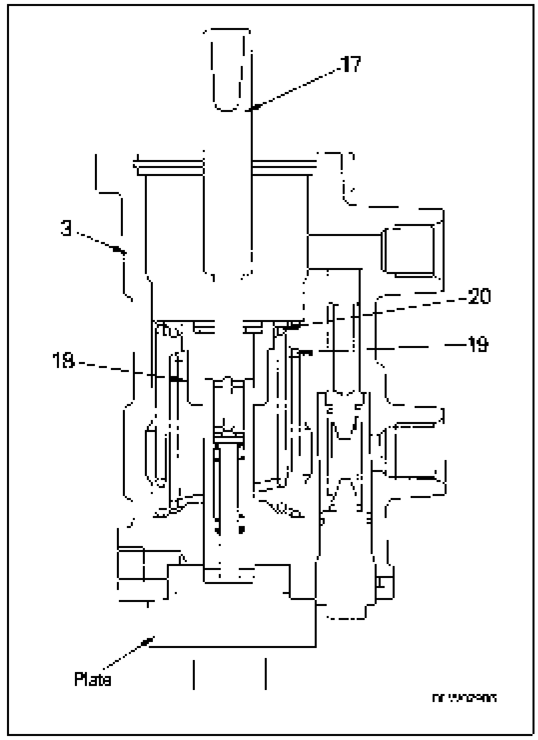
2. Relief valve
Insert spring (26) in spool (27), assembly in power cylinder body, then install plug (25).



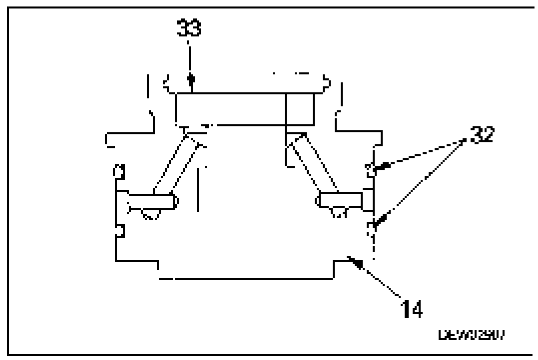
3. Assembly of power cylinder
1) Assemble spring (24) in connector (31).
2) Insert spool (22) in connector (31), assemble thrust washer (23), then secure with snap ring (21).



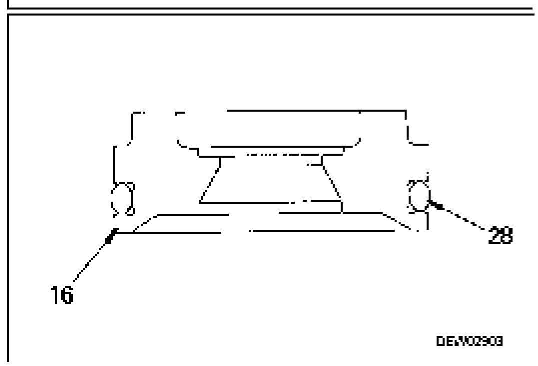
3) Set body (3) on block.
4) Insert springs (19) and (20), and spring seat (18) inside body (3).
5) Assemble connector assembly (17).



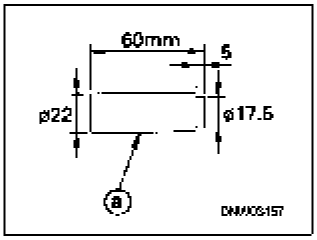
6) Assemble O-ring (32) and seal (33) in cylinder cover (14).
Seal:

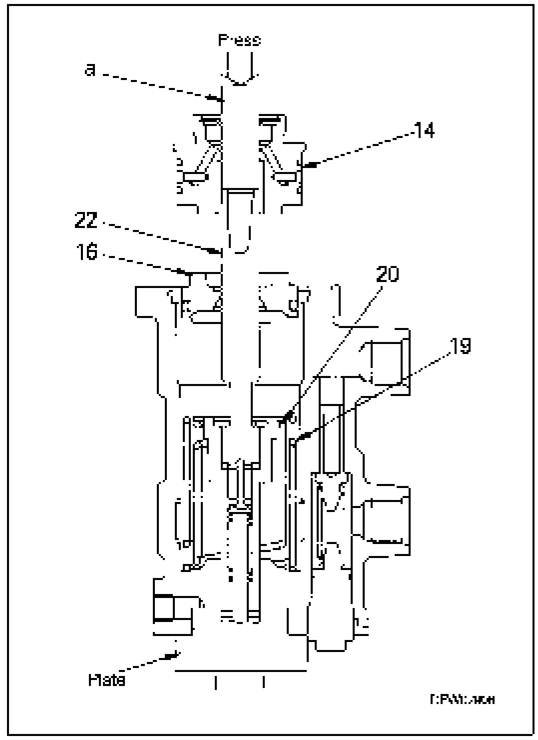


7) Assemble sealing (28) in power piston (16).
Sealing: **Oil (brake oil)**

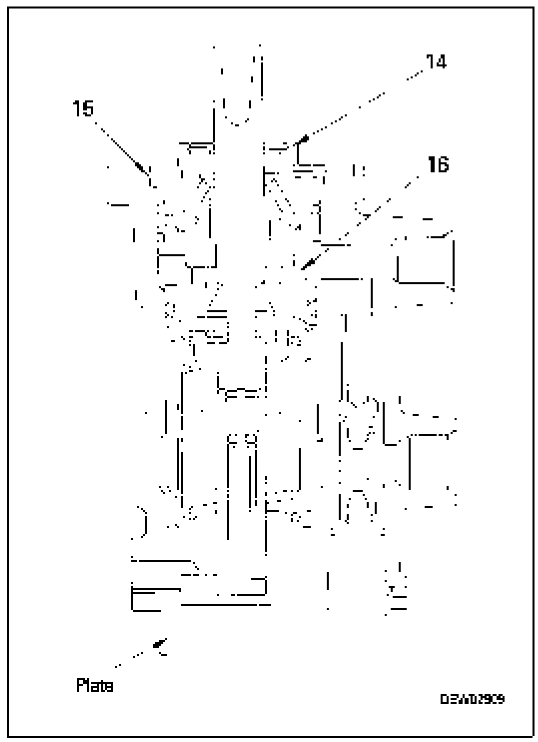


8) Assemble power piston (16) and cylinder cover (14) to spool (22), then set guide shaft (a) in position.
   Ú To prevent power piston (16) and cylinder cover (14) from dropping inside the body, stop them at the top of the body.





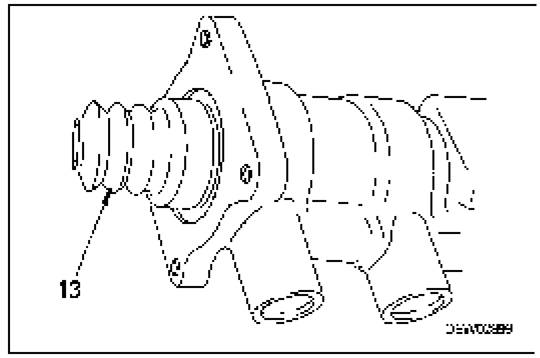
9) Push in guide shaft (a) with a press, bend springs (19) and (20), and keep in position.
Ú Keep snap ring (15) until the completion of assembly.



10) Lower power piston (16) only, and push in evenly on the left and right with both thumbs.
   Ú When assembling the power piston, do not hit it in with a hammer.
   Ú When assembling power piston (16), apply the force evenly. Never use excessive force.

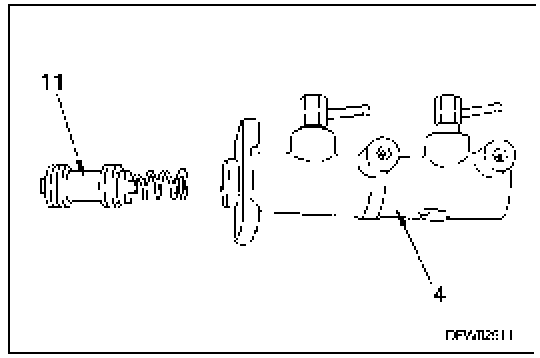
11) Check that there is no damage to O-ring of power piston (16), then assemble cylinder cover (14).
12) Secure cylinder cover (14) with snap ring (15).

13) Install dust cover (13).

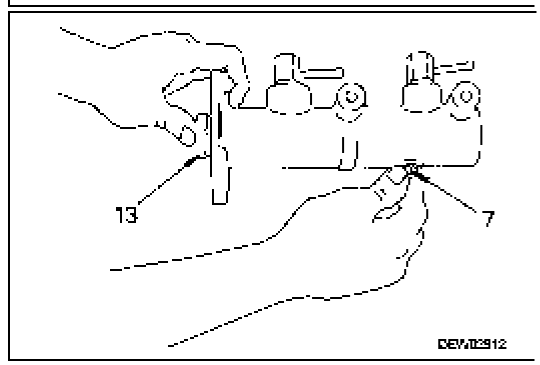


4. Assembly of master cylinder

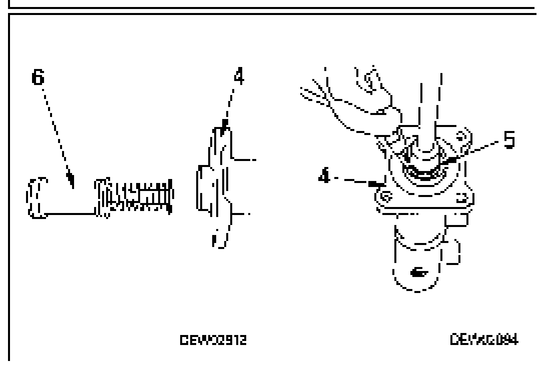
1) Insert the primary piston (11) in body (4).
   Ú Insert the piston carefully to prevent damage to the seal cup. Never force it into position.
   Body and piston: **Oil (brake oil)**



2) Push piston (13) and tighten stopper bolt (7) by hand.
   Ú After tightening as far as possible by hand, tighten fully.
   Stopper bolt:
   10.8 ± 2 Nm (1.1 ± 0.2 kgm)



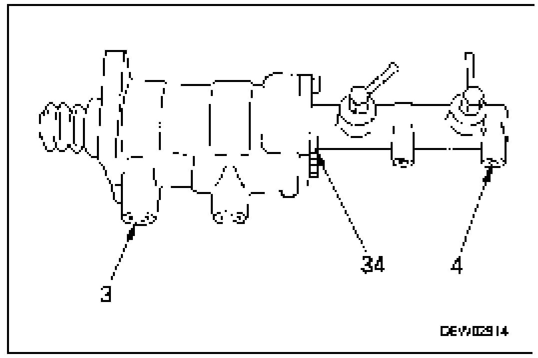
3) Insert secondary piston (6) in body (4).
   Body and piston: **Oil (brake oil)**
   Ú When assembling the piston, be careful not to damage the inside of the body and the outside of the piston.
   Ú Be careful not to get the O-ring caught.



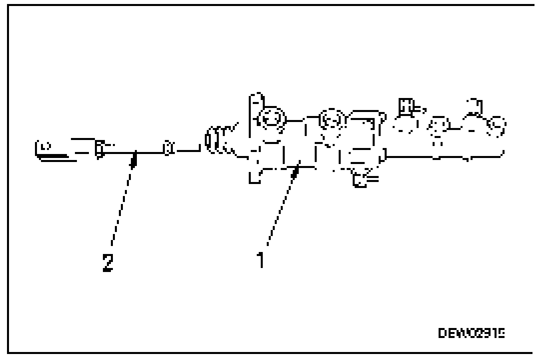
4) Push in secondary piston (6), then install C-ring (5).
   Ú Fit the C-ring properly in the groove.

5. Power master cylinder

1) Connect power master cylinder (3) and master cylinder (4).
   Ú Use new O-ring at connecting portion of master cylinder.
   Connecting bolt (30):
   31.9 ± 2.5 Nm (3.25 ± 0.25 kgm)



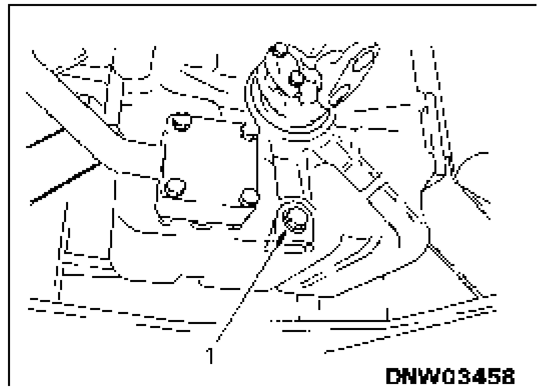
2) Install linkage rod (2) in power master cylinder.
   Ú For details of adjustment of brake linkage, see TESTING AND ADJUSTING.



PARKING BRAKE DISC

REMOVAL

WARNING!, Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

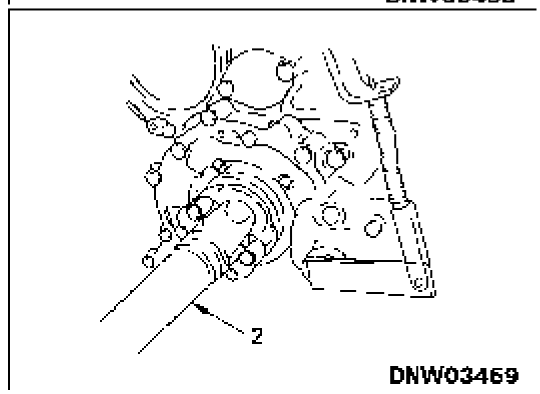


1. Draining oil
Loosen drain plug (2) and drain transmission oil.

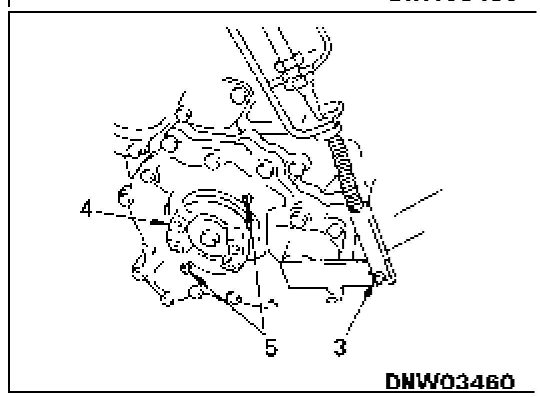
Transmission oil: **35 R**

Ú After loosening the drain plug, pull it out gradually and drain the oil.

2. Center drive shaft
Disconnect center drive shaft (2) from transmission.

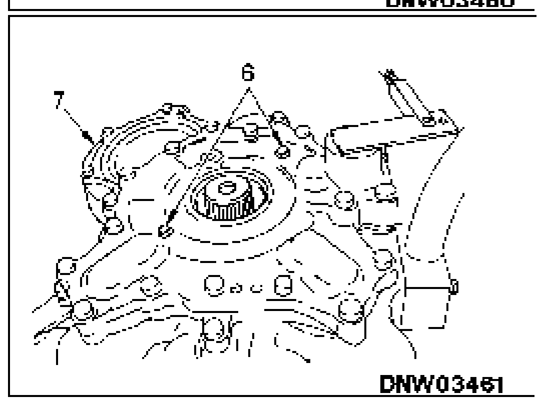


3. Linkage
Remove lever pin (3).
Ú Check that the parking brake is released.

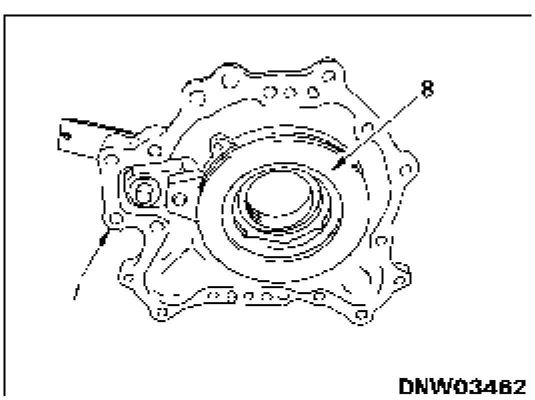


4. Yoke
Remove yoke (4). 1

5. Cover
Remove plug (5), install temporary stopper bolts M8x35 (6), then remove cover (7) and piston (8) as assembly.
Ú Be careful not to damage the oil seal.
Ú Install forcing screws and guide bolts.



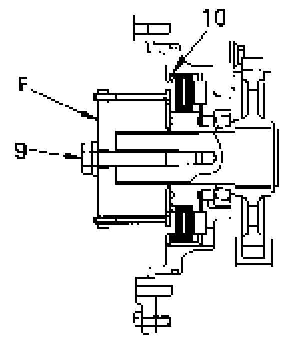
kg Cover assembly: **15.5 kg**



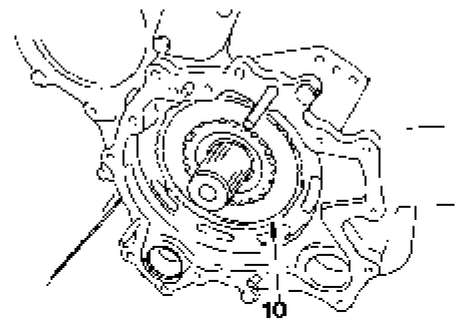
6. Disc

Install tool **F**, tighten with yoke mounting bolt (9) so that tool **F** pushes in plate, then remove snap ring (10) and remove separator plate (11), wave spring (12), and disc (13).

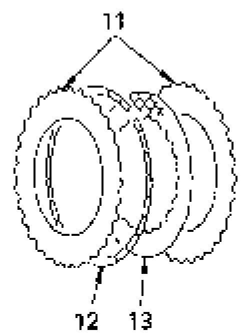
Ú Before installing the tool, install M10 bolts-to the jig.



DMW03463



DNW03464



DNW03465

INSTALLATION

! Carry out installation in the reverse order of removal.

1

Mounting bolt:

274.6 ± 29.4 Nm (28.0 ± 3.0 kgm)

! **Adjusting linkage**

For details, see TESTING AND ADJUSTING.

! **Refilling with oil**

Tighten drain plug and add transmission oil through oil filler to the specified level.

Ú Run the engine to circulate the oil through the system. Then check the oil level again.

Transmission oil: **35 ℓ**

HYDRAULIC TANK

REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Remove cover (1-1) at the top of the hydraulic tank.

WARNING! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen plug (1) at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.

1. Remove R.H. ladder, fender, and cover assembly (2).

2. Disconnect hydraulic piping at hydraulic tank end.
  1) Hose (3) between main control valve and hydraulic tank
  2) Hose (4) between steering valve and hydraulic tank
  3) Hose (5) between priority valve and hydraulic tank
  4) Hose (6) between main control valve and hydraulic tank
  5) Hose (7) between hydraulic pump and hydraulic tank

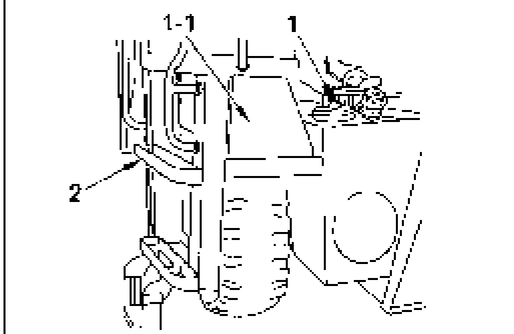
Ú Disconnect hose (7) when removing the hydraulic tank.

3. Sling hydraulic tank assembly (8) and remove mounting bolts (9).

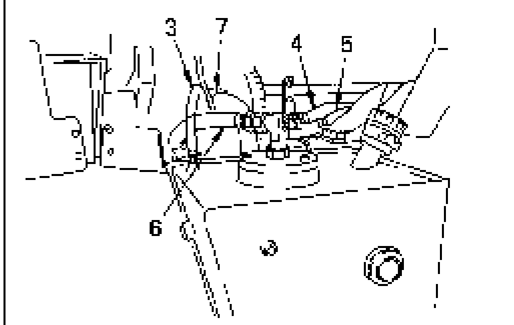
WARNING! Be careful to maintain the balance when slinging, and remove the bottom bolts first.

4. Disconnect hydraulic tank assembly from hose (7) while lifting off.

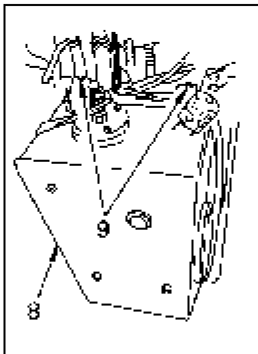
kg Hydraulic tank : **71 kg (dry)**



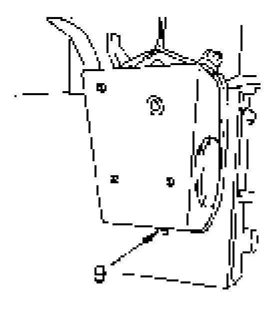
DNW03466



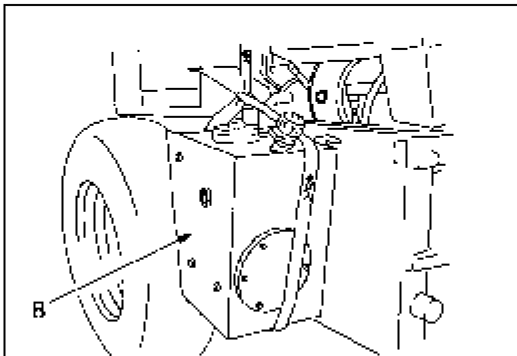
DNW03467



DNW03468



DNW03469



DNW03470

INSTALLATION

! Carry out installation in the reverse order of removal.

1

Clamp of hose (3):
3.3 ± 0.5 Nm (0.34 ± 0.05 kgm)
Clamp of hose (7):
5.9 ± 0.5 Nm (0.60 ± 0.05 kgm)
Hose (5): **24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)**
(width across flats: 19 mm)
Hose (4):
137.3 ± 29.4 Nm (14.0 ± 3.0 kgm)
(width across flats: 32 mm)
Hose (6):
196.1 ± 49.0 Nm (20.0 ± 5.0 kgm)
(width across flats: 41 mm)

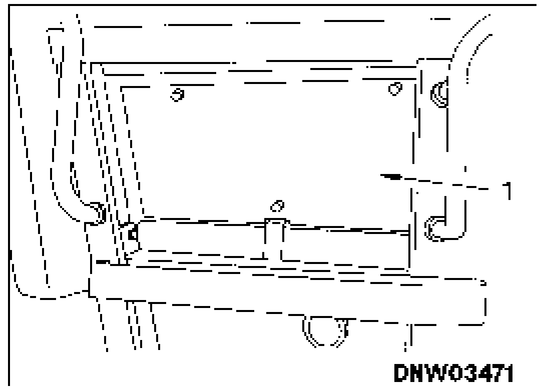
Ú Add hydraulic oil to the specified level.

Ú Run the engine to circulate the hydraulic oil through the system. Then check the oil level again.

HYDRAULIC FILTER

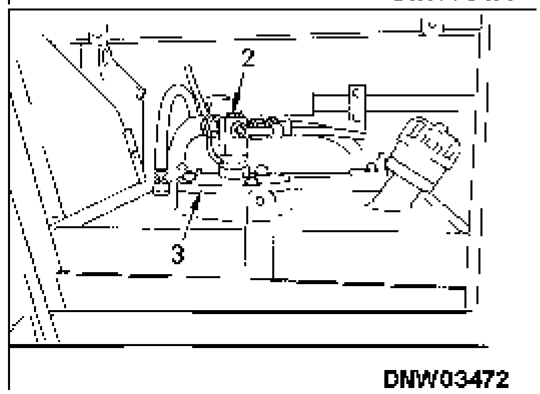
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.



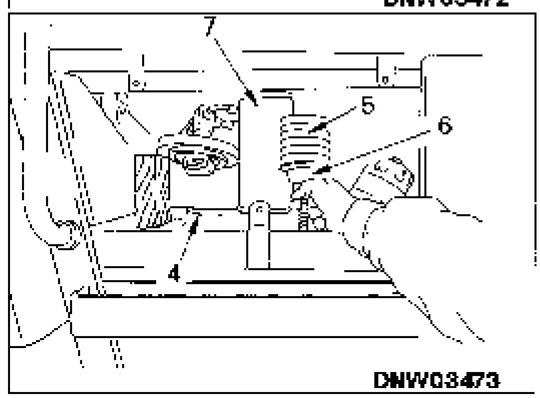
1. Remove cover (1) at top of hydraulic tank.
   WARNING! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen plug (2) at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.



2. Remove cover mounting bolts, then remove cover (3).
   WARNING! The cover is under the force of a spring, so be careful when removing it.
   Be careful not to damage the mating surface of the cover and tank and O-ring (4). ⁘1

3. Remove filter, spring (5), and bypass valve (6), then remove filter (7).



INSTALLATION

! Carry out installation in the reverse order of removal.

⁘1

Ú Fit the O-ring securely in the groove and be careful not to get it caught.

WORK EQUIPMENT, STEERING PUMP

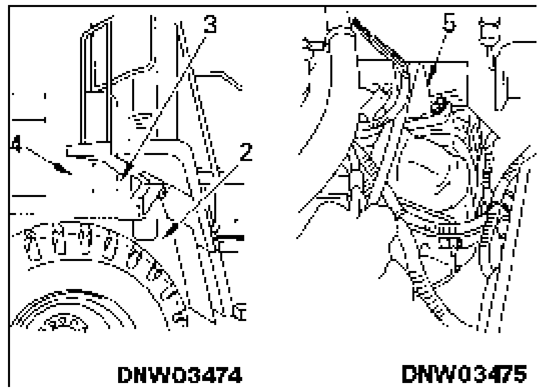
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

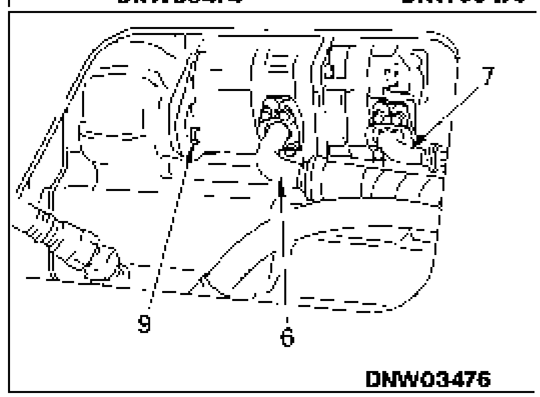
WARNING! !Remove the cover at the top of the hydraulic tank, and loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

! Loosen the plug at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.
For details, see REMOVAL OF TRANSMISSION, TORQUE CONVERTER.

1. **Covers**
   Remove transmission side cover (2), hood front cover (3), and hood side cover (4).

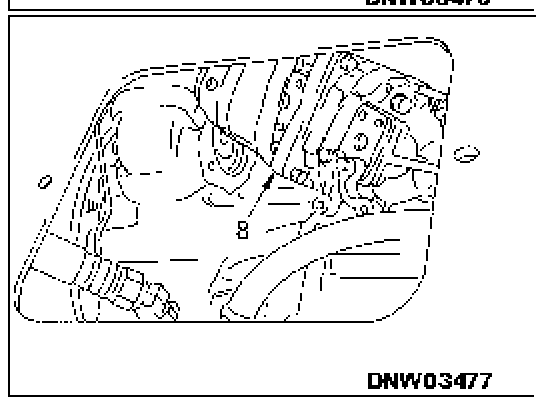


2. **Hydraulic piping**
   1) Disconnect tube (5) between hydraulic tank and hydraulic, steering pump from pump.
   2) Disconnect hoses (6) and (7) between hydraulic, steering pump and priority valve from pump.



3. **Hydraulic, steering pump.** ※1
   Sling hydraulic and steering pump (8), and remove mounting bolts (9), then remove pump (8) ※2
   Ú When removing the pump, carry out the operation with two workers, and remove from the bottom inspection port.
   Ú The working space is confined, so be extremely careful.

   kg Hydraulic, steering pump: **13 kg**



INSTALLATION

! Carry out installation in the reverse order of removal.

※1

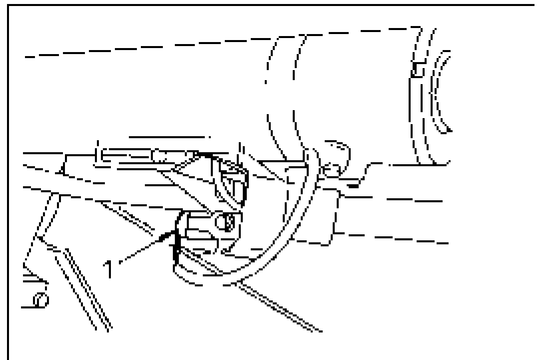
Ú Add hydraulic oil to the specified level.
Ú Run the engine to circulate the hydraulic oil through the system. Then check the oil level again.

※2

Ú Check that there is an O-ring between the pump and housing.

BUCKET CYLINDER

REMOVAL

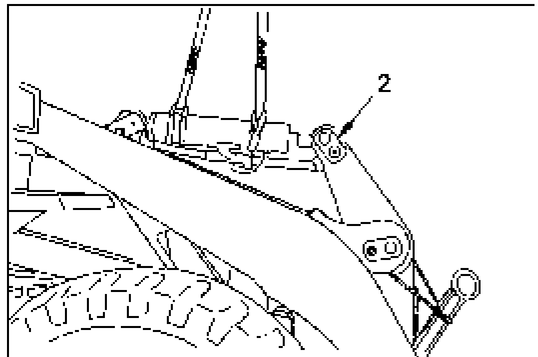


DNW03489

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

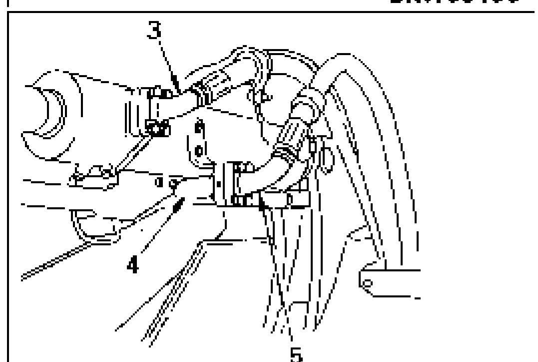
WARNING! !Remove the cover at the top of the hydraulic tank, and loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

1. **Bucket positioner**
   Disconnect connector (1).
   Ú Remove the wiring clamp and bracket. ※1



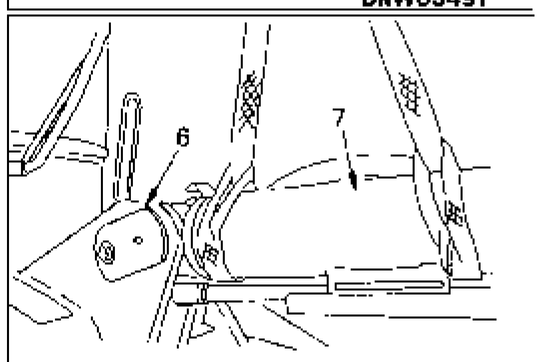
DNW03490

2. **Rod pin**
   Sling cylinder, remove lock bolt, then remove pin (2).
   Ú Be careful of the center of gravity when slinging, and lift at two places. ※2



DNW03491

3. **Hydraulic piping**
   1) Disconnect rod hose (3) from cylinder.
   2) Disconnect tube (4) and hose (5) at bottom end from connecting portion. ※3



DNW03492

4. **Bucket cylinder**
   1) Remove lock bolt, then remove bottom pin (6).
      Ú If there are shims, check the number and thickness of the shims, and keep in a safe place. ※4
   2) Lift off bucket cylinder (7).
      Ú Be careful not to damage the cylinder rod.

kg Bucket cylinder: **80 kg**

INSTALLATION

! Carry out installation in the reverse order of removal.

1

! Bucket positioner

Ú For details of adjusting the bucket positioner, see TESTING AND ADJUSTING.

2

! Rod pin

WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

3

! Hydraulic piping

! Fit the O-ring securely in the groove.

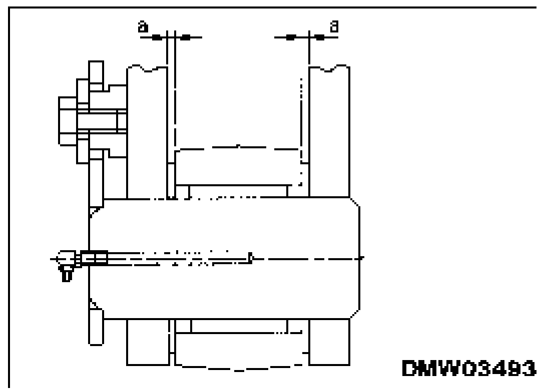
! Install the hoses without twisting or interference.

4

! Bucket cylinder

Ú Align the pin hole at the bottom end and assemble shims so that the total for clearance **a** between the cylinder and frame is within the standard value.

Ú Clearance: Max. 1.5 mm



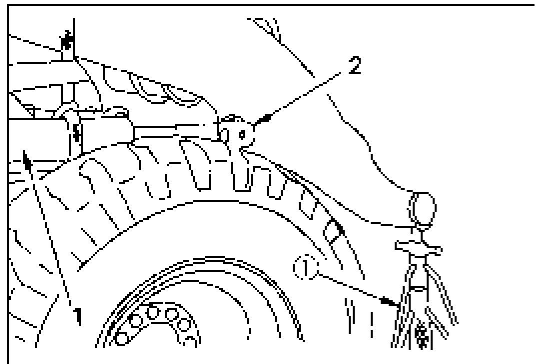
DMW03493

BOOM CYLINDER

REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

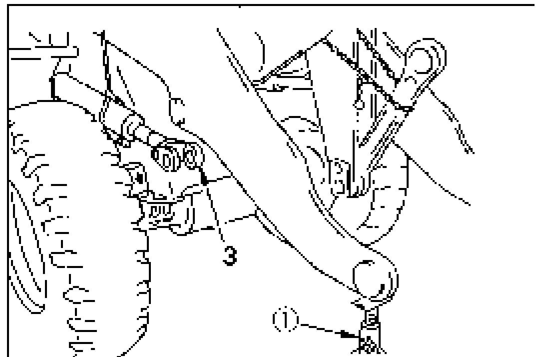
WARNING! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.



DNW03494

1. Rod pin

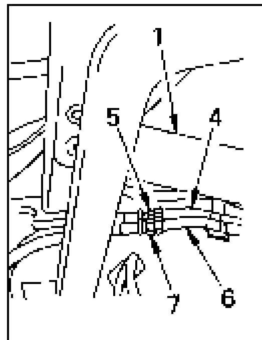
1) Sling boom cylinder (1), then remove lock bolt, and remove pin (2).
   Ú After removing the boom, set stand **â** under the tip of the boom.
2) Start engine, and operate control [ever to retract cylinder rod (3) of cylinder which has been removed.
   Ú When retracting the rod, do not operate it to the end of the stroke. Leave approx. 20 mm.



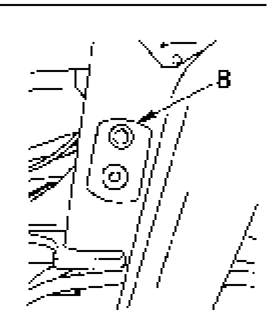
DNW03495

2. Hydraulic piping

1) Disconnect rod tube (4) from connecting portion of hose (5). 1
2) Disconnect bottom tube (6) from connecting portion of hose (7).
   Ú After disconnecting, fit covers to prevent dirt, dust, or water from entering.



DNW03496



DNW03497

3. Boom cylinder

1) Remove lock bolt, then remove bottom pin (8).
   Ú If there are shims, check the number and thickness of the shims, and keep in a safe place. 2
2) Lift off boom cylinder (1).
   Ú Be careful of the center of gravity, and remove slowly.
   Ú Be careful not to damage the cylinder rod.

kg Boom cylinder: **87 kg**

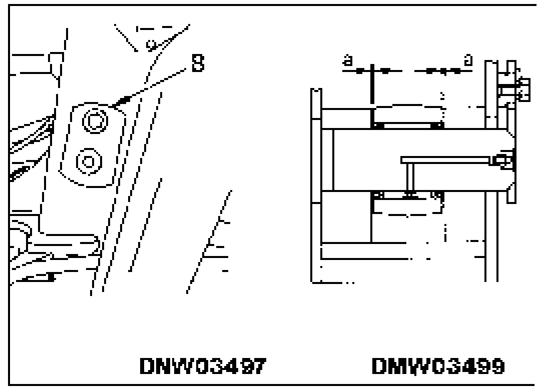
INSTALLATION

! Carry out installation in the reverse order of removal.

1

Ú Install the hoses without twisting or interference.

2



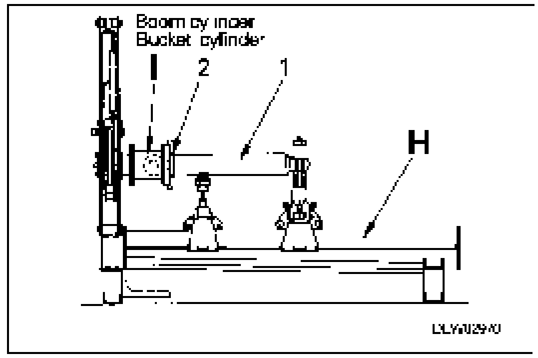
Ú Align the pin hole at the bottom end and assemble shims so that the total for clearance **a** between the cylinder and frame is within the standard value. Then assemble (8) and lock with the bolt.

WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

Ú Clearance **a:** Max. 1.5 mm

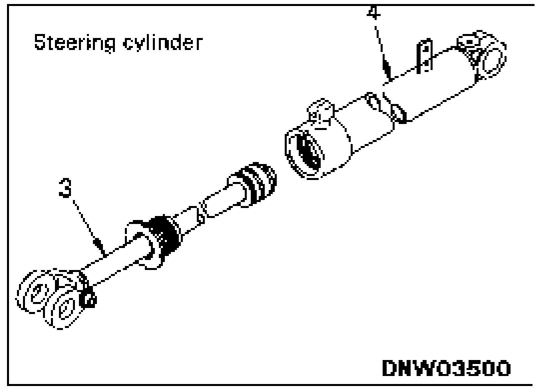
HYDRAULIC CYLINDER

DISASSEMBLY



1. Set cylinder assembly (1) to tool **H.**

2. Raise lock of cylinder head (2), and using tool **I**, remove cylinder head (2) from cylinder.

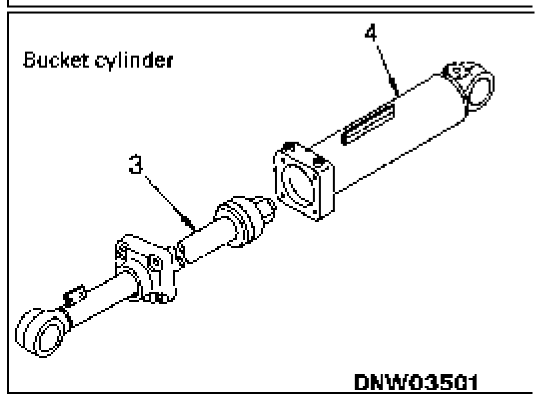


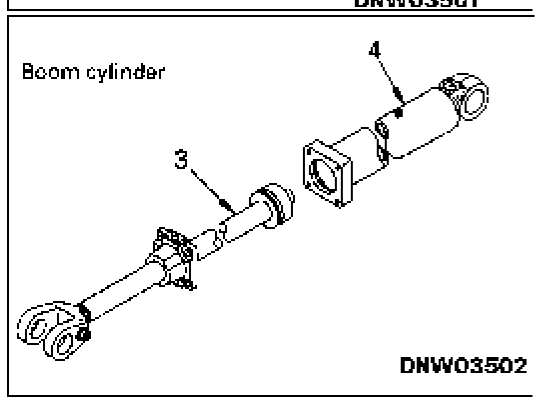
3. Pull out cylinder head and piston rod assembly (3) from cylinder (4), then lift off.
   Ú Oil will come out when the piston rod assembly is removed from the cylinder, so prepare a container to catch the oil.

4. Remove cylinder (4) from tool **H.**

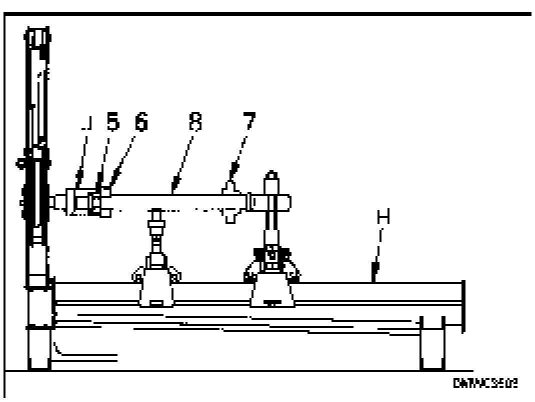
5. Set cylinder head and piston rod assembly to tool **H,** and using tool **J,** remove nut (5).
   Ú Tool **J:**

Cylinder	Width across flat (mm)
Boom Cylinder	70
Buckey Cylinder	80
Steering Cylinder	36



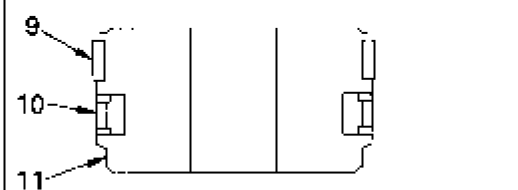


6. Remove piston assembly (6) and cylinder head assembly (7) from rod (8).



7. Disassembly of piston assembly

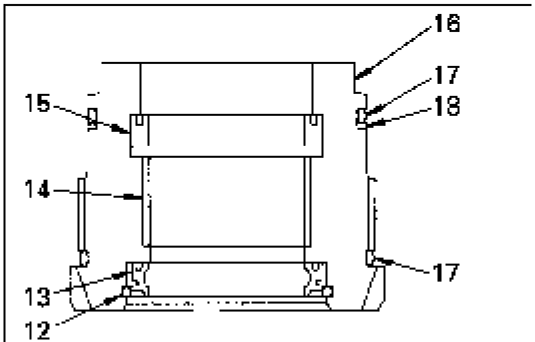
1) Remove wear ring (9).
2) Remove piston ring (10) from piston (11).



DMW03504

8. Disassembly of cylinder head assembly

1) Remove snap ring (12), then remove dust seal (13).
2) Remove rod packing (15).
3) Remove bushing (14) from cylinder head (16).
4) Remove O-ring (17) and backup ring (18).



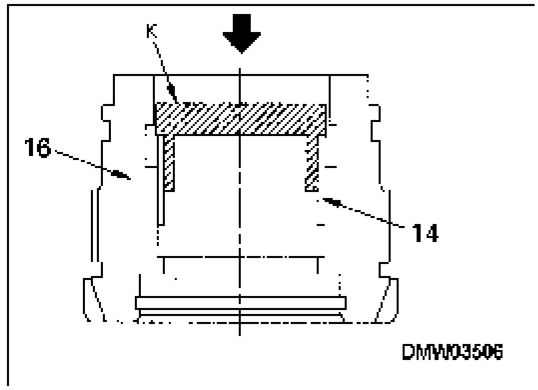
DMW03505

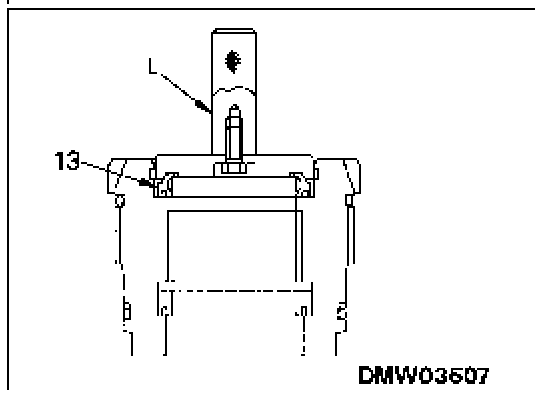
ASSEMBLY

Ú Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing, and be careful not to damage the rod packings, dust seals, or O-rings when assembling.

1. Assembly of cylinder head assembly

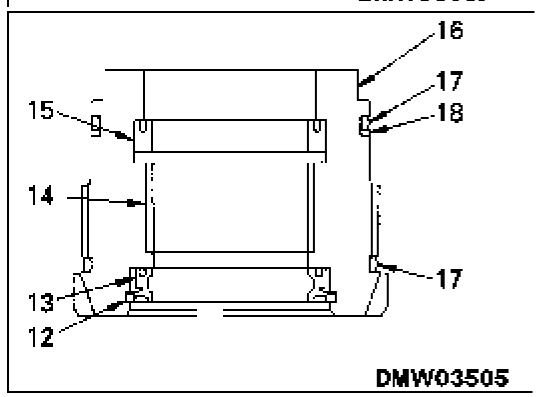
1) Using tool **K**, press fit bushing (14) to cylinder head (16).
   Ú Be careful not to deform the bushing when press fitting.
2) Assemble rod packing (15).
   Ú Be careful to assemble the rod packing facing in the correct direction.
3) Using tool **L,** install dust seal (13) to head (16).
4) Install snap ring (12).
5) Install backup ring (18) and O-ring (17).
   Ú Do not try to force the backup ring into position. Warm it in warm water (50 - 60'C) before fitting it.

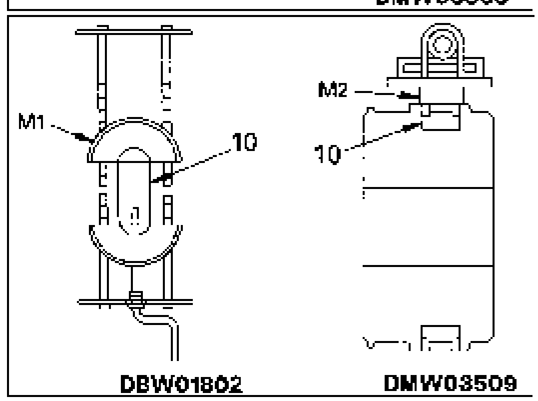


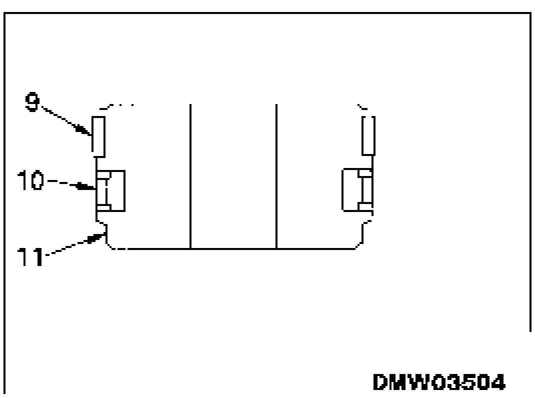


2. Assembly of piston assembly

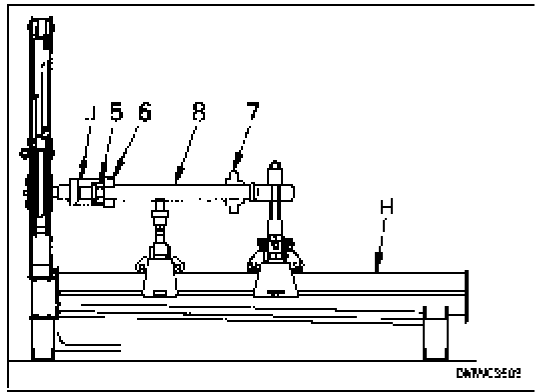
1) Using tool **M1,** expand piston ring (10).
   Ú Set the piston ring on the tool and turn the handle 8 - 10 times to expand the ring.
2) Remove piston ring (10) from tool **M1,** then assemble to piston (11).
3) Fit piston ring, then using tool **M2,** compress piston ring.
4) Assemble wear ring (9).







3. Set piston rod (8) to tool **H.**



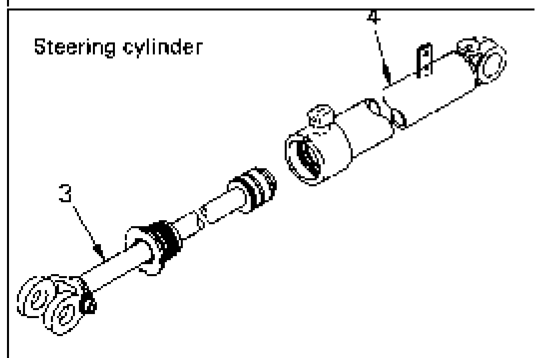
4. Assemble cylinder head assembly (7) and piston assembly (6) to rod, then fit nut (5).

5. Using tool **J,** tighten nut (5).

Rod thread: **Thread tightener (LT-2)**

Piston nut:

Cylinder	Width across flats (mm)	Tightening torque Nm (kgm)
Boom cylinder	70	2598.8±259.9 (265±26.5)
Bucket cylinder	80	3971.7±397.2 (405±40.5)
Steering cylinder	36	411.9±41.2 (42±4.2)

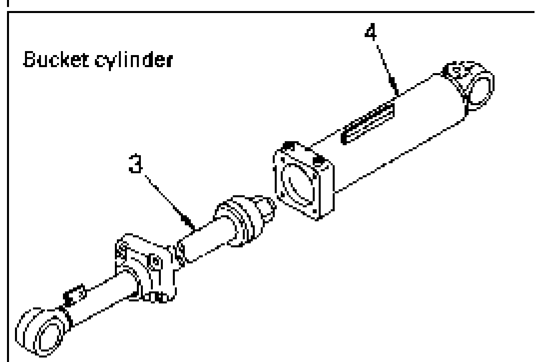


DNW03500

6. Remove piston rod and head assembly from tool **H**.

7. Set cylinder (4) to tool **H.**

8. Raise piston rod and head assembly (3), and assemble to cylinder (4).

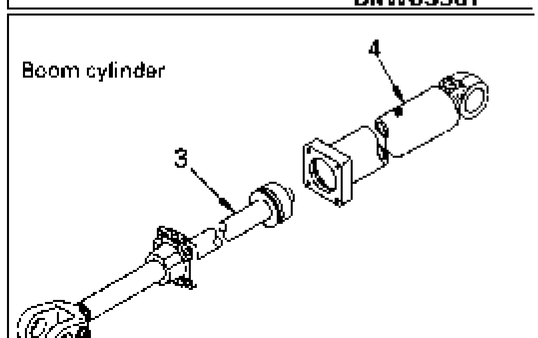


DNW03501

9. Using tool **I**, tighten cylinder head nut (2).

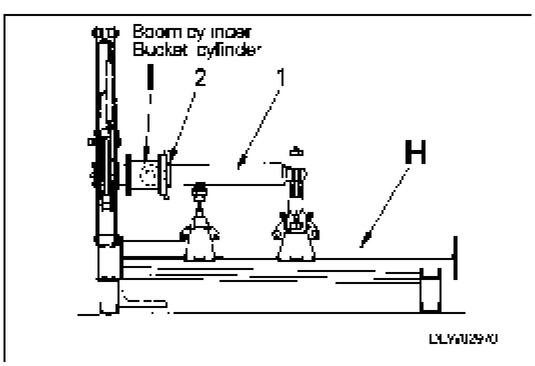
Cylinder head nut:

Cylinder	Tightening Torque Nm (kgm)
Boom cylinder	980.7±98 (100±10)
Bucket cylinder	1029.7±103.0 (105±10.5)
Steering cylinder	539.4±53.9 (55±5.5)



DNW03502

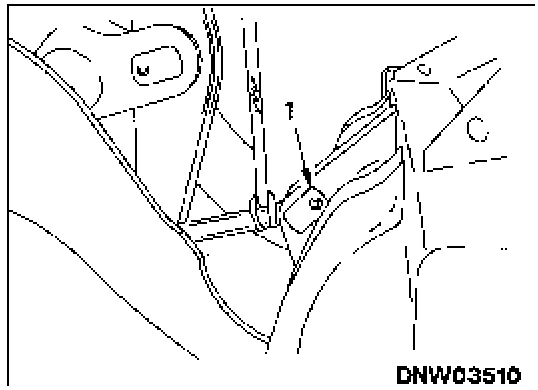
10. Remove cylinder assembly (1) from tool **H.**



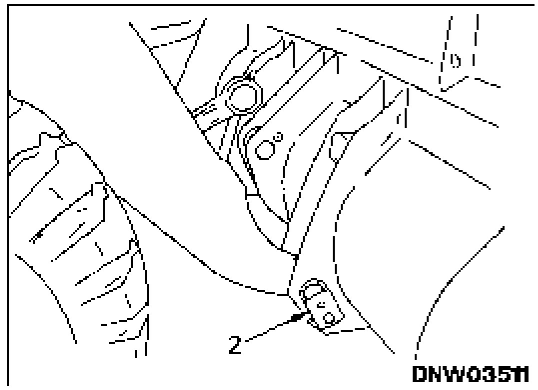
WORK EQUIPMENT

REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.



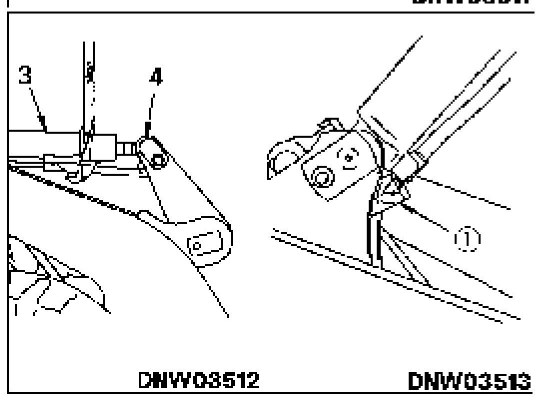
1. **Bucket link**
   1) Remove bucket link mounting pin (1). 1
      Ú Secure the bucket link to the bellcrank with wire.



   2) Remove bucket hinge mounting pin (2). 2

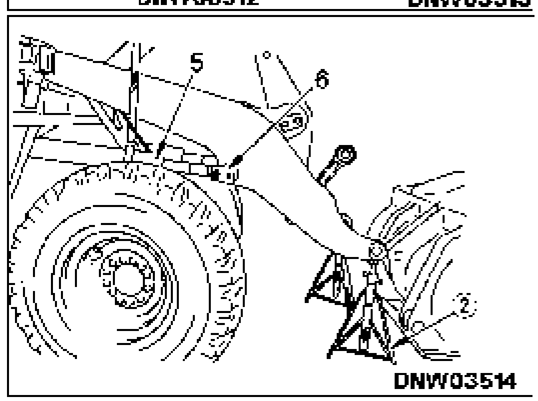
   WARNING! Never insert your fingers in the pin hole.

   3) Move machine towards rear and disconnect bucket.



2. **Bucket cylinder mounting pin**
   Sling bucket cylinder (3), then pull out pin (4) and disconnect cylinder rod and belicrank.
   Ú Set block â between the cylinder bottom and frame.

   kg Bucket cylinder: **80 kg** 3

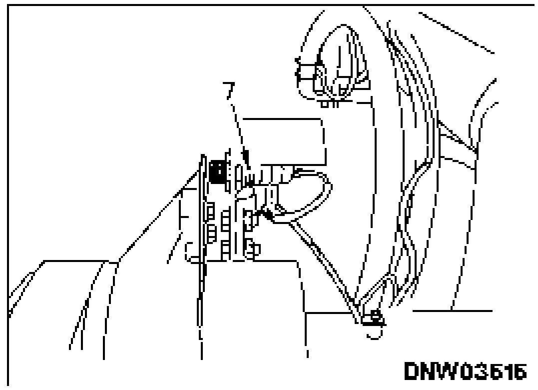


3. **Boom cylinder pin**
   Sling boom cylinder (5), and remove mounting pin (6).
   Ú Set stand ã under the tip of the boom.
   Ú Release the pressure in the hydraulic piping.
   Ú Set a block on the top of the axle, then lower the cylinder.

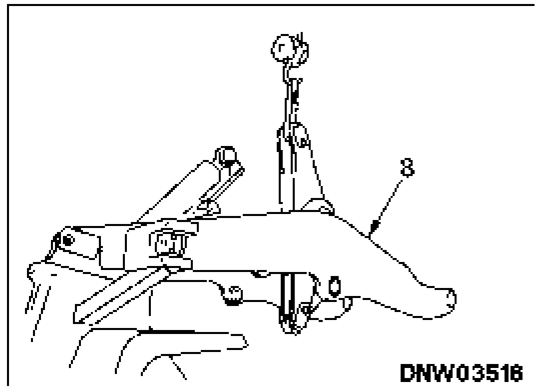
   kg Boom cylinder: **87 kg** 4

4. Boom arm, tilt lever, bucket link

1) Remove boom kickout switch (7).



2) Sling lift arm, tilt lever and bucket link (8),remove mounting pin of lift arm, then lift off lift arm. 5

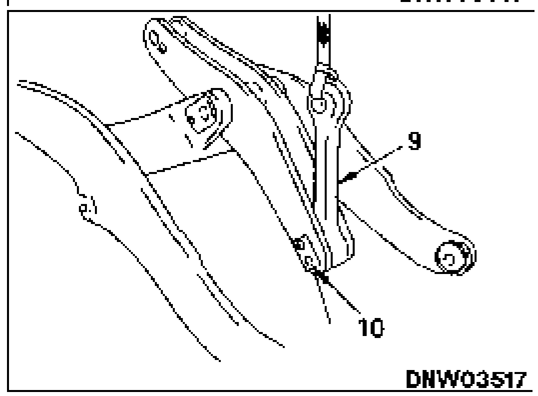


kg Lift arm, tilt lever, bucket link assembly: **830kg**

Ú If there are any shims, check the number and thickness of the shims, and keep in a safe place.

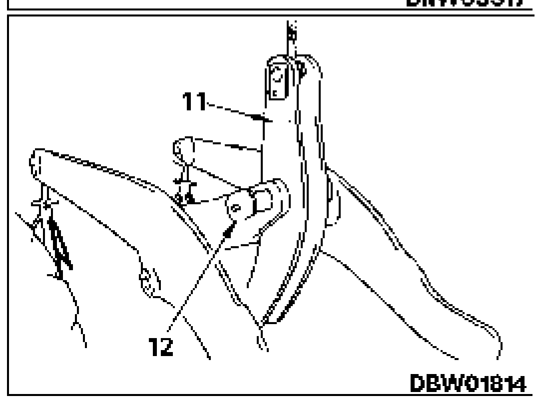
5. Tilt lever, bucket link

1) Sling bucket link (9), remove mounting pin (10), then remove bucket link from tilt lever.



kg Bucket link: **25kg**

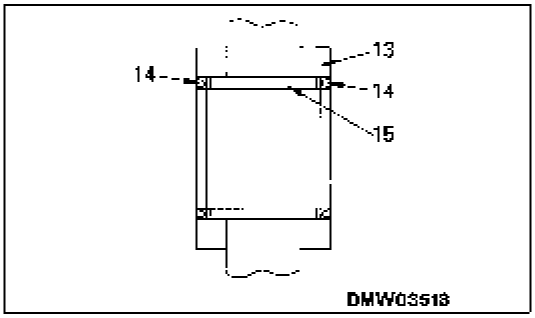
2) Sling tilt lever (11), remove mounting pin (12), then lift off from lift arm.

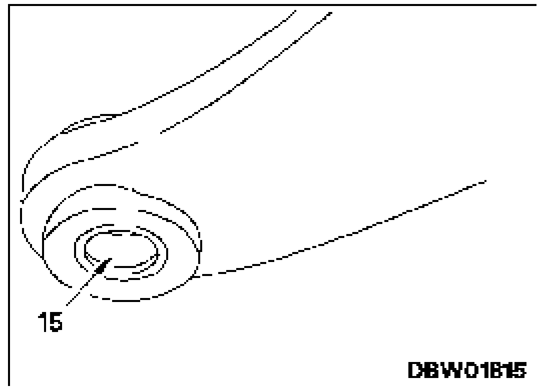


kg Tilt lever: **145kg**

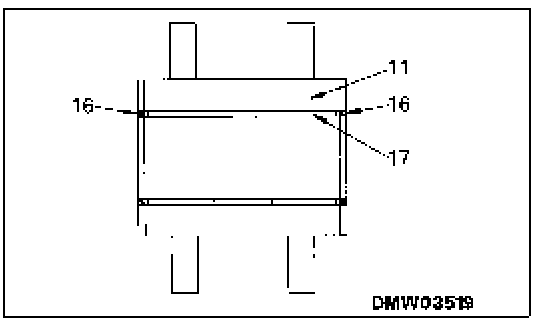
6. Dust seal, bushing

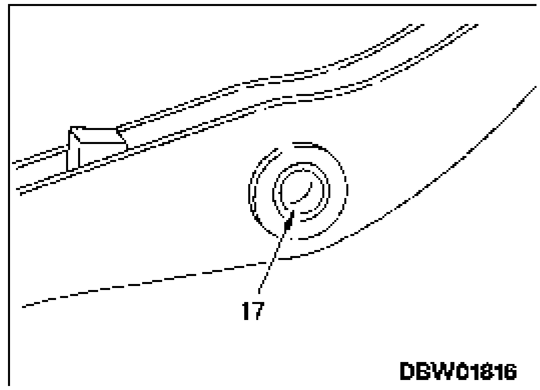
1) Remove dust seal (14) and bushing (15) from boom arm (13). ※6



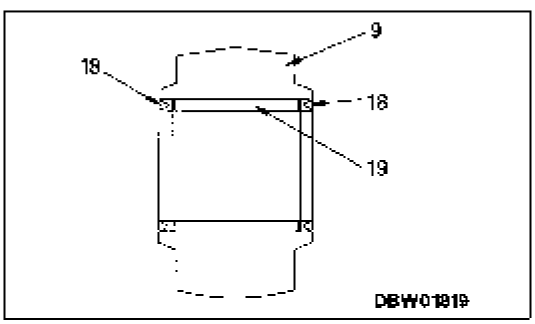


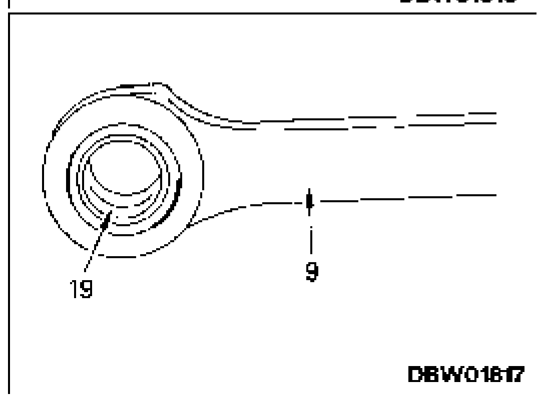
2) Remove dust seal (16) and bushing (17) from tilt lever (11).





3) Remove dust seal (18) and bushing (19) from bucket link (9).





WORK EQUIPMENT

INSTALLATION

! Carry out installation in the reverse order of removal.

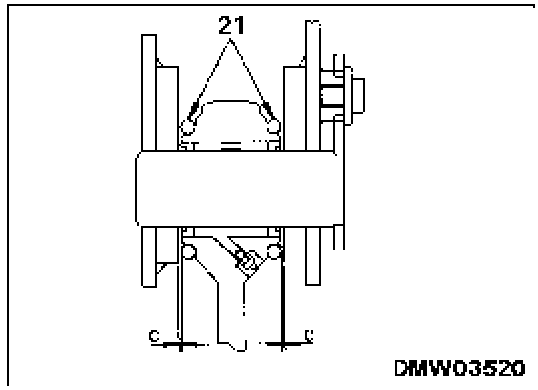
WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

1

Ú Align the mounting pin holes for the bucket link, install cord ring (21), insert shims so that clearance **c** on the left and right is uniform, then assemble the mounting pin and lock with the bolt.

Ú Be careful not to get the cord ring caught.

Ú Clearance **c:** Max. 1.5 mm

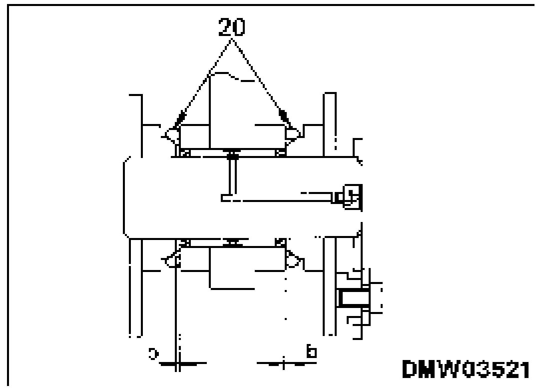


2

Ú Operate the control levers, align the mounting pin holes for the bucket, install cord ring (21), insert shims so that clearance **b** on the left and right is uniform, then assemble the mounting pin and lock with the bolt.

Ú Be careful not to get the cord ring caught.

Ú Clearance **b:** Max. 1.5 mm



3

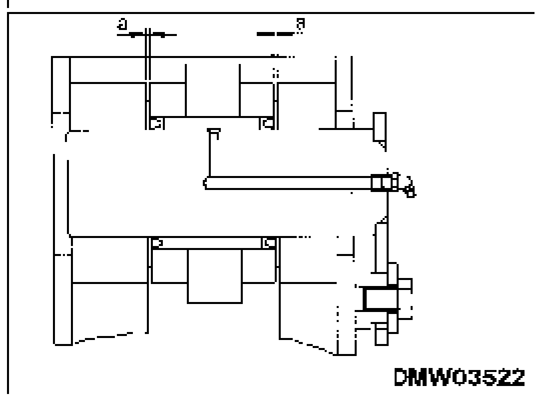
Ú To install the bucket cylinder, start the engine and align the cylinder rod with the bellcrank mounting hole.

4

Ú To install the boom cylinder, start the engine and align the cylinder rod with the boom mounting hole.

5

Ú Raise the boom, bellcrank, and bucket link, set in the mounting position, insert shims so that clearance **a** between the front frame and boom mount hole on the left and right is uniform, then assemble the mounting pin and lock with the bolt.



Ú Clearance **a:** Max. 1.5 mm

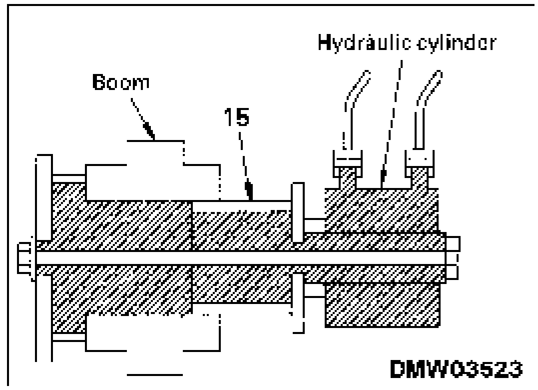
Ú After assembling the pin, set a stand under the tip of the boom.

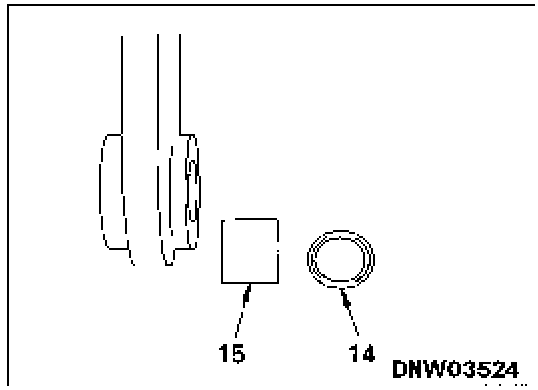
WARNING! When starting the engine, check first that the directional lever is at neutral and that the parking brake is applied.

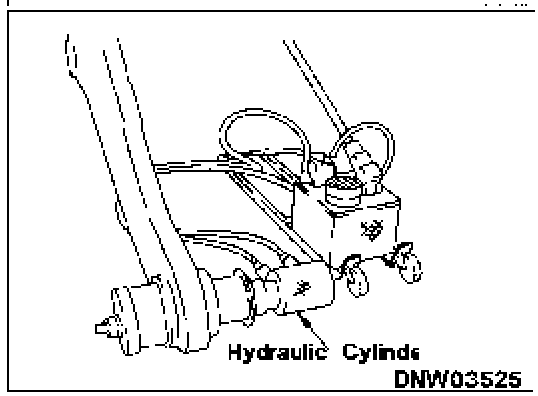
※6

Ú Press fit bushing (15) to each of bucket link, bellcrank, and boom with press, then assemble dust seal (14).

Bushing: **Grease (G2-L1)**







COUNTERWEIGHT

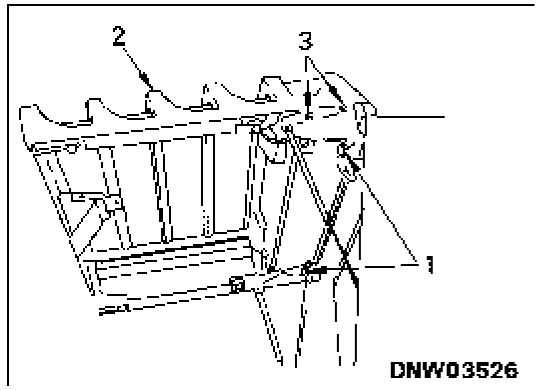
REMOVAL

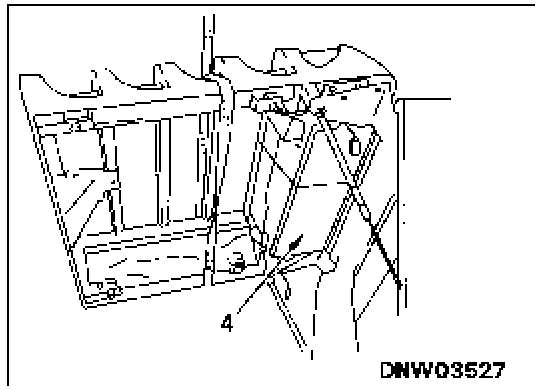
WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Open grill and disconnect connector (1).

2. Sling grill (2) and remove left and right mounting bolts (3).

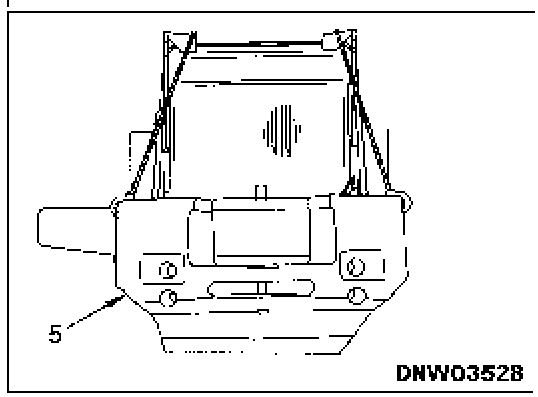
3. Lift off grill together with plate (4).





4. Sling counterweight (5), then remove mounting bolts and lift off.
Ú Be careful to maintain the balance when lifting the counterweight off. 1

kg Counterweight: **1,390 kg**



INSTALLATION

! Carry out installation in the reverse order of removal.

1

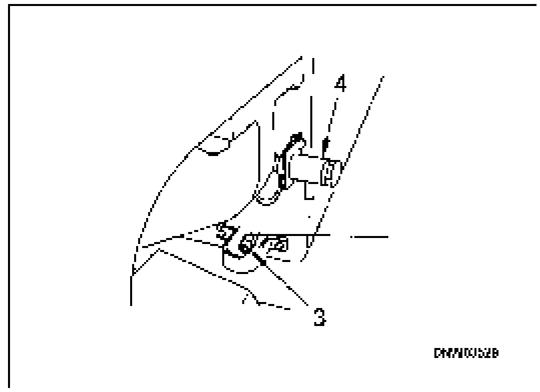
Ú When installing the counterweight into the mounting position, be careful not to bump any of the lamps.

Mounting bolt:
539.4 ± 58.8 Nm (56.0 ± 6.0 kgm) (width across flats: 30 mm)

FUEL TANK

REMOVAL

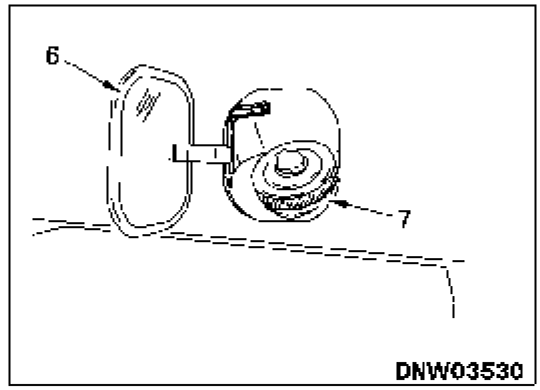
WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stopp at the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.



1. Open grill and hood side door.

2. Loosen fuel drain valve (3) and drain fuel.

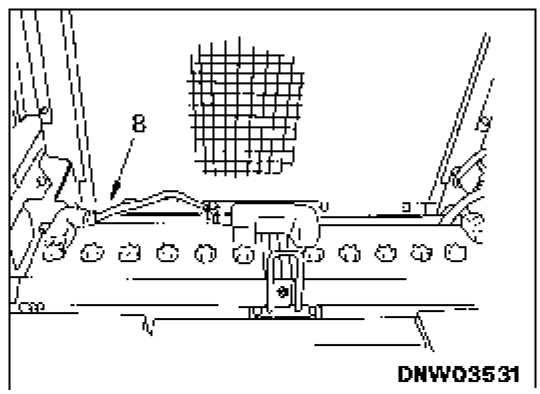
Fuel: **184 ℓ**



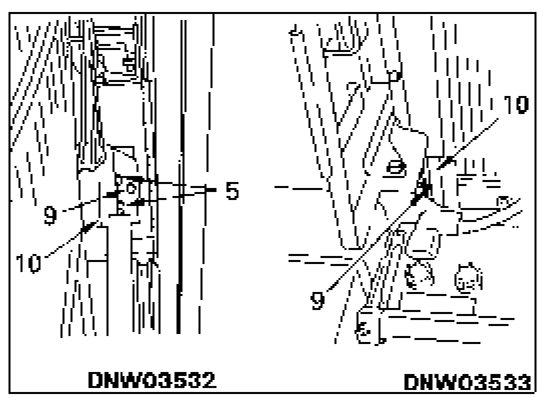
3. Remove engine oil drain valve (4) from fuel tank.

4. Remove cover mounting bolts (5), then remove cover (6).
Ú Remove the spring at the same time.

5. Remove baffle (7).



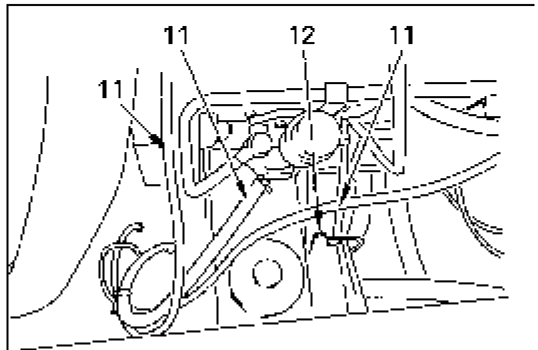
6. Remove baffle mounting bolts, then remove baffle (8).



7. Remove cover mounting bolts (9), then remove cover (10).

8. Disconnect 3 fuel hoses (11) from fuel tank end.

9. Remove breather tube from clamp bolt (12).

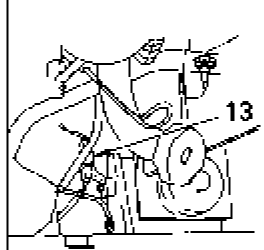


DNW03534

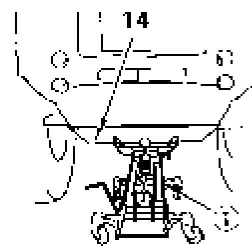
10. Disconnect fuel unit wiring (13) from connector.

11. Support fuel tank (14) with transmission jack **â**.

12. Remove 4 fuel tank mounting bolts (15), then move fuel tank to right and lower carefully. **1**



DNW03535



DNW03536

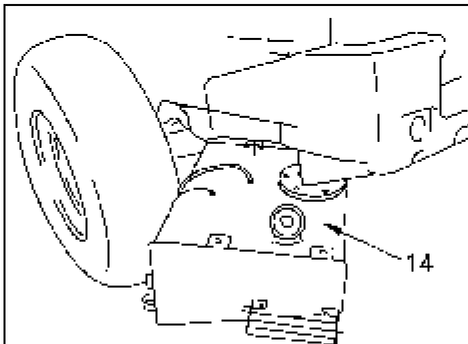
Fuel tank: **104 kg**

INSTALLATION

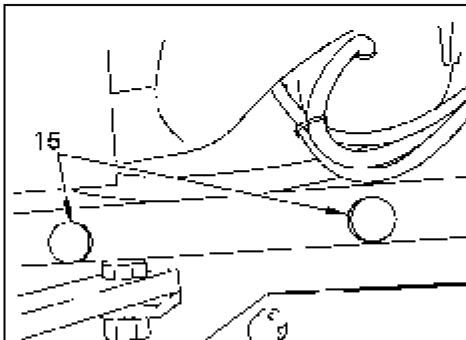
! Carry out installation in the reverse order of removal.

1

Mounting bolt:
274.6 ± 29.4 Nm (28.0±3.0 kgm)



DNW03537

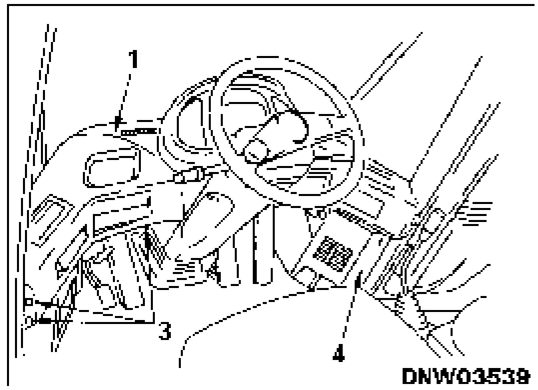


DNW03538

CAB (ROPS)

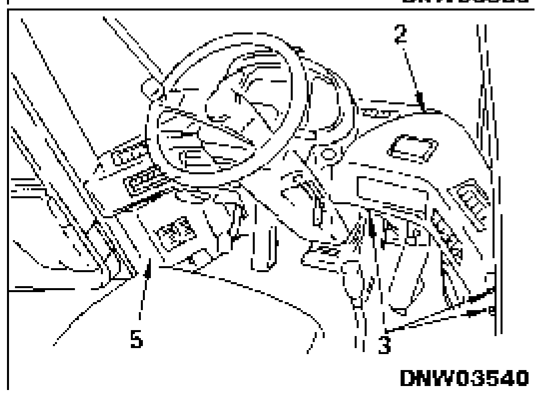
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

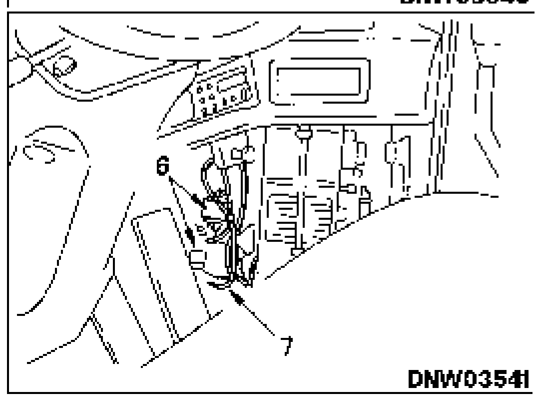


1. Remove mounting bolts (3) of left and right dashboards (1) and (2).

2. Remove right cover (4).

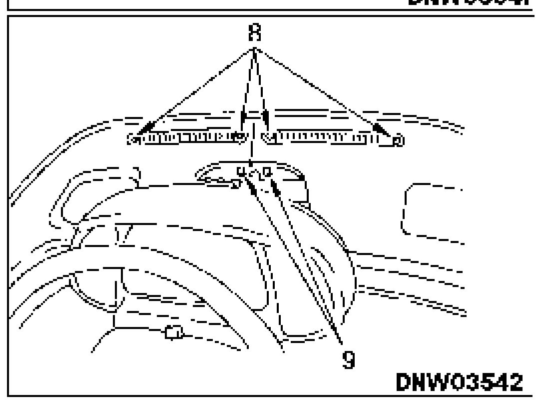


3. Remove left cover (5).



4. Disconnect electric wiring at connectors (6).

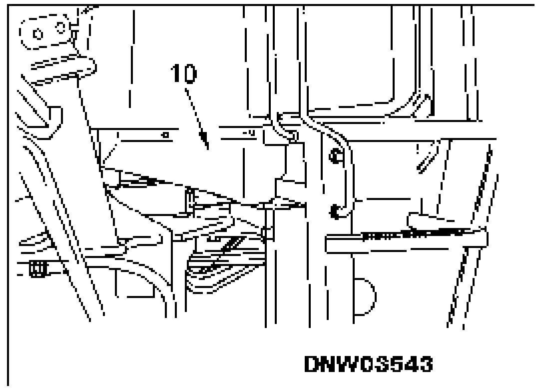
5. Disconnect window washer hose (7).
ÚMake marks to distinguish the parts.



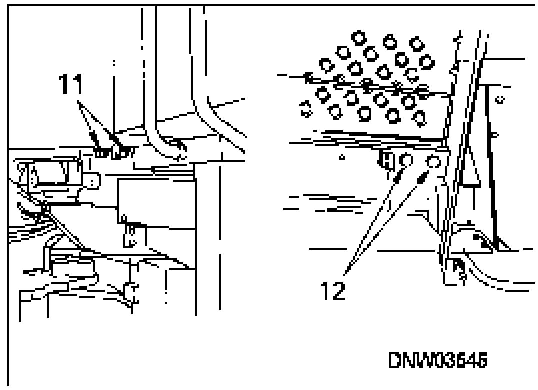
6. Remove mounting bolts (8) of left and right dashboards, then remove left and right dashboards (1) and (2).

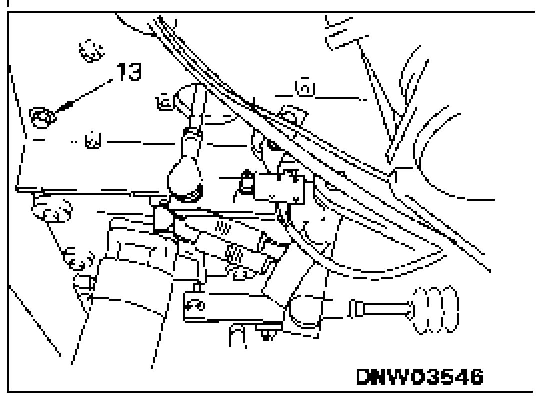
7. Remove steering post and cab mounting bolts (9).

8. Remove left and right covers (10) under cab.



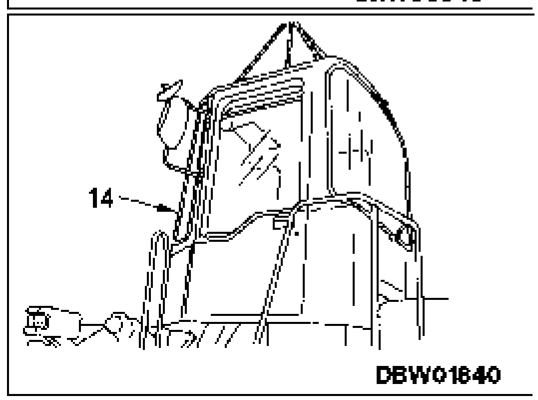
9. Remove left and right cab mounting bolts (11), (12), and (13).





10. Lift off cab (14).
- Ú Raise horizontally and lift off slowly.
- Ú Remove the plugs on top of the cab and install I-bolts.

kg Cab (ROPS): **520 kg**



INSTALLATION

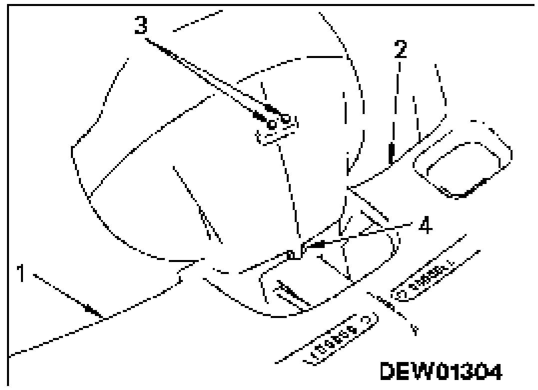
! Carry out installation in the reverse order of removal,

MAIN MONITOR

REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

WARNING! Disconnect the cable from the negative (-) terminal of the battery.

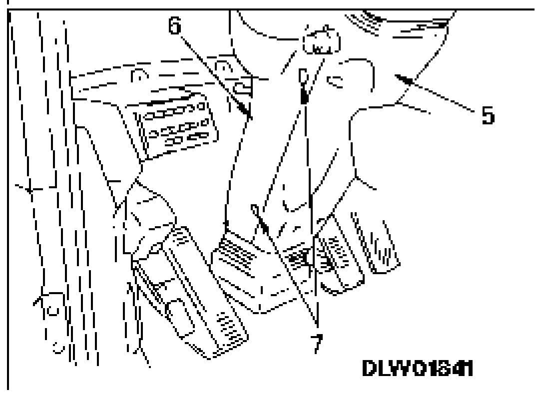


1. Remove dashboards (1) and (2).

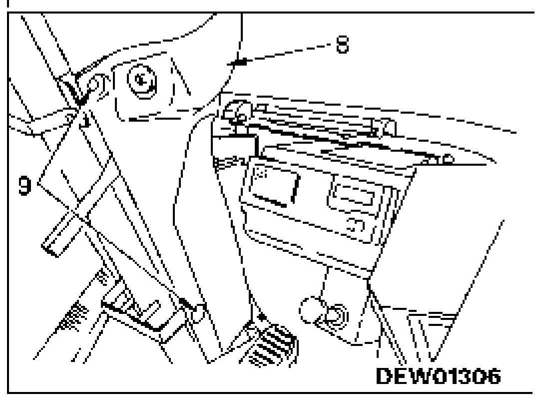
2. Remove steering post cover mounting bolts (3) an d (4).

3. Remove steering post cover (5).

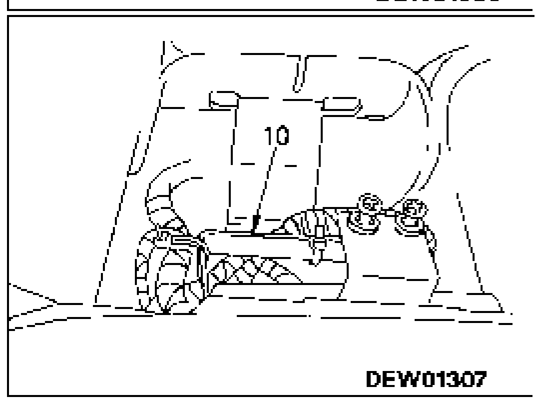
4. Remove mounting bolt caps (7) of steering post cover (6), then remove bolts.



5. Remove mounting bolt caps from steering post cover (8), then remove mounting bolts (9).
Ú Tip the steering post cover to the front.

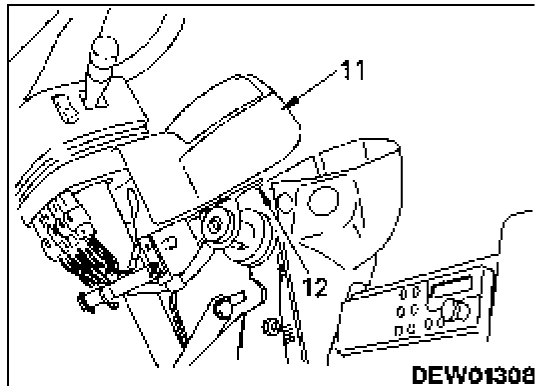


6. Remove bracket (10) at back of main monitor.

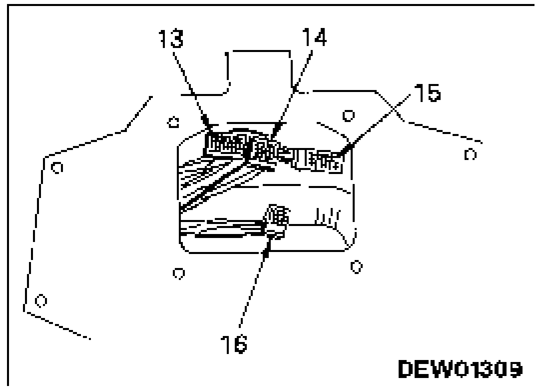


7. Remove 8 mounting bolts (12) of main monitor (11).

Ú When removing the main monitor, be careful not to subject it to any strong shock.



8. Disconnect wiring connectors (13), (14), (15), and (16) from main monitor, and remove main monitor (11).

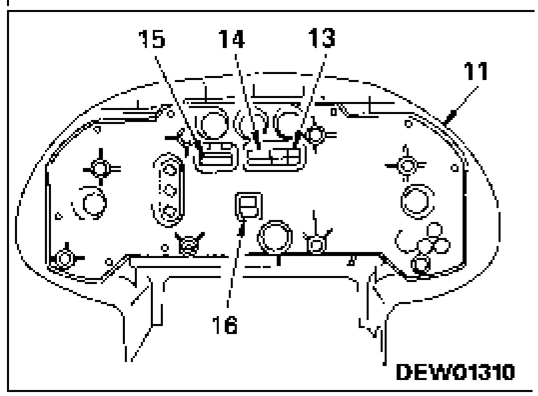


INSTALLATION

! Carry out installation in the reverse order of removal.

※1

Ú Fit the connector lock securely.



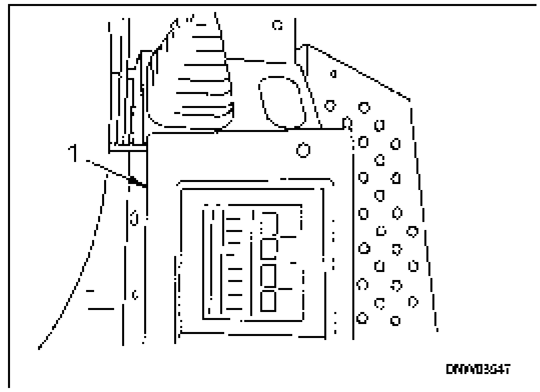
MAINTENANCE MONITOR ASSEMBLY

REMOVAL

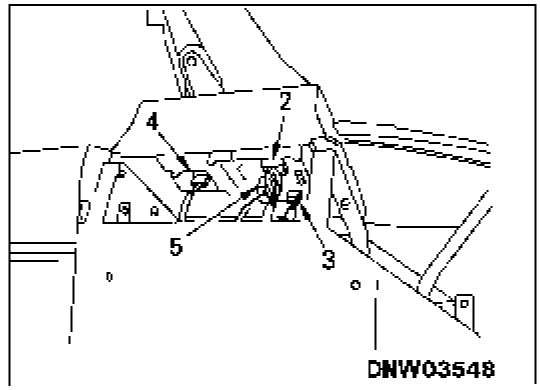
WARNING! Stop the machine on level ground and install the safety bar,on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

WARNING! Disconnect the cable from the negative (-) terminal of the battery.

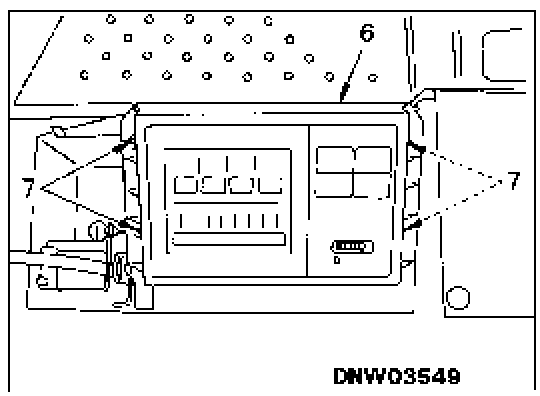
1. Remove cover (1) of right console box.



2. Disconnect connectors (2), (3), (4) of maintenance monitor wiring and valve wiring (5) from maintenance monitor.



3. Remove mounting bolts (7) of maintenance monitor (6), then remove maintenance monitor (6).

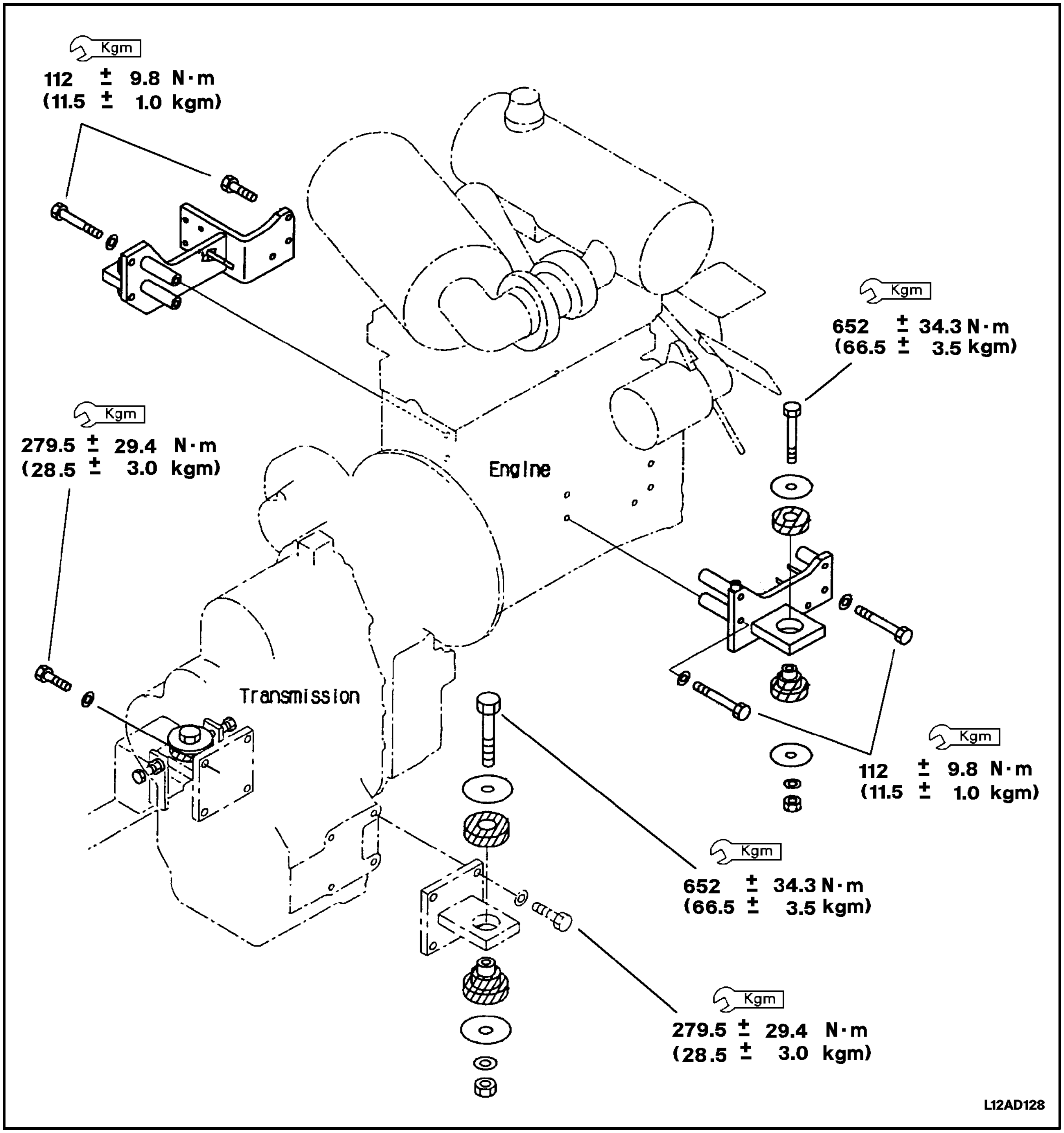


INSTALLATION

! Carry out installation in the reverse order of removal.

40 MAINTENANCE STANDARD

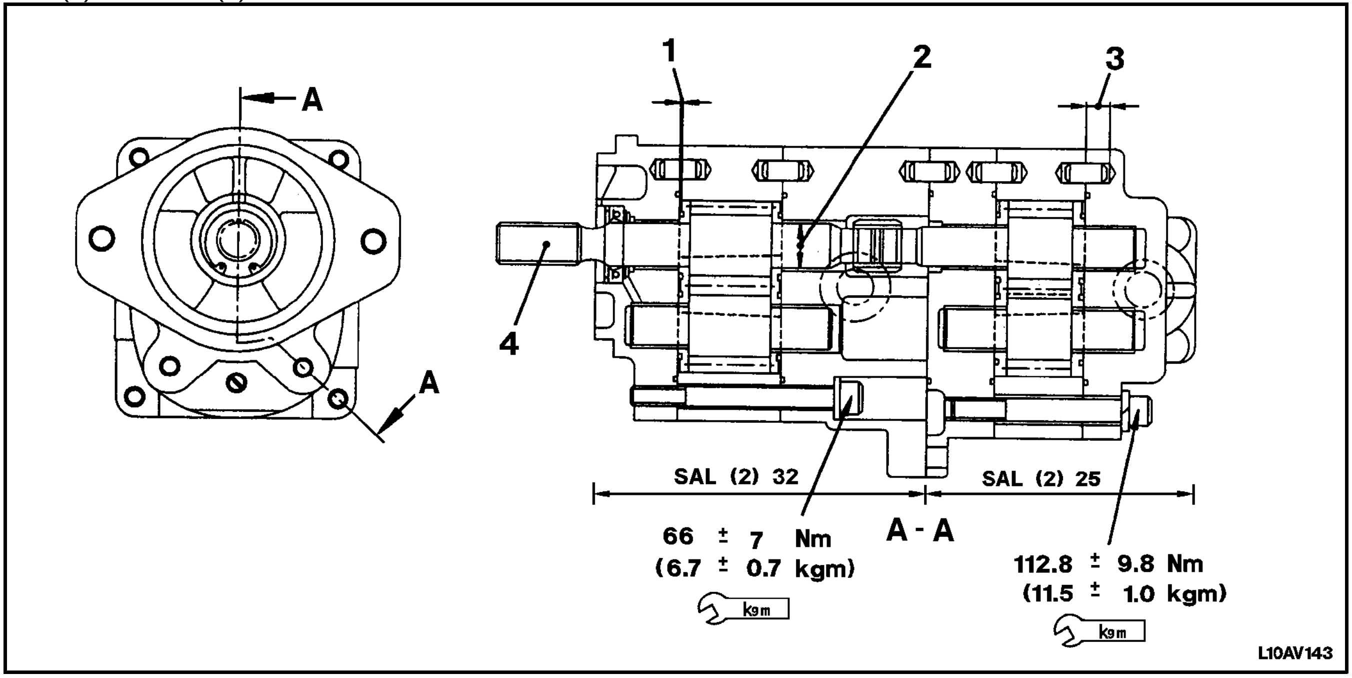
TRANSMISSION, ENGINE MOUNT



No.	Check item	Criteria	Remedy
1	Clearance between transmission bracket and adjustment bolt	1-3 mm	Adjust

TORQUE CONVERTER CHARGING PUMP

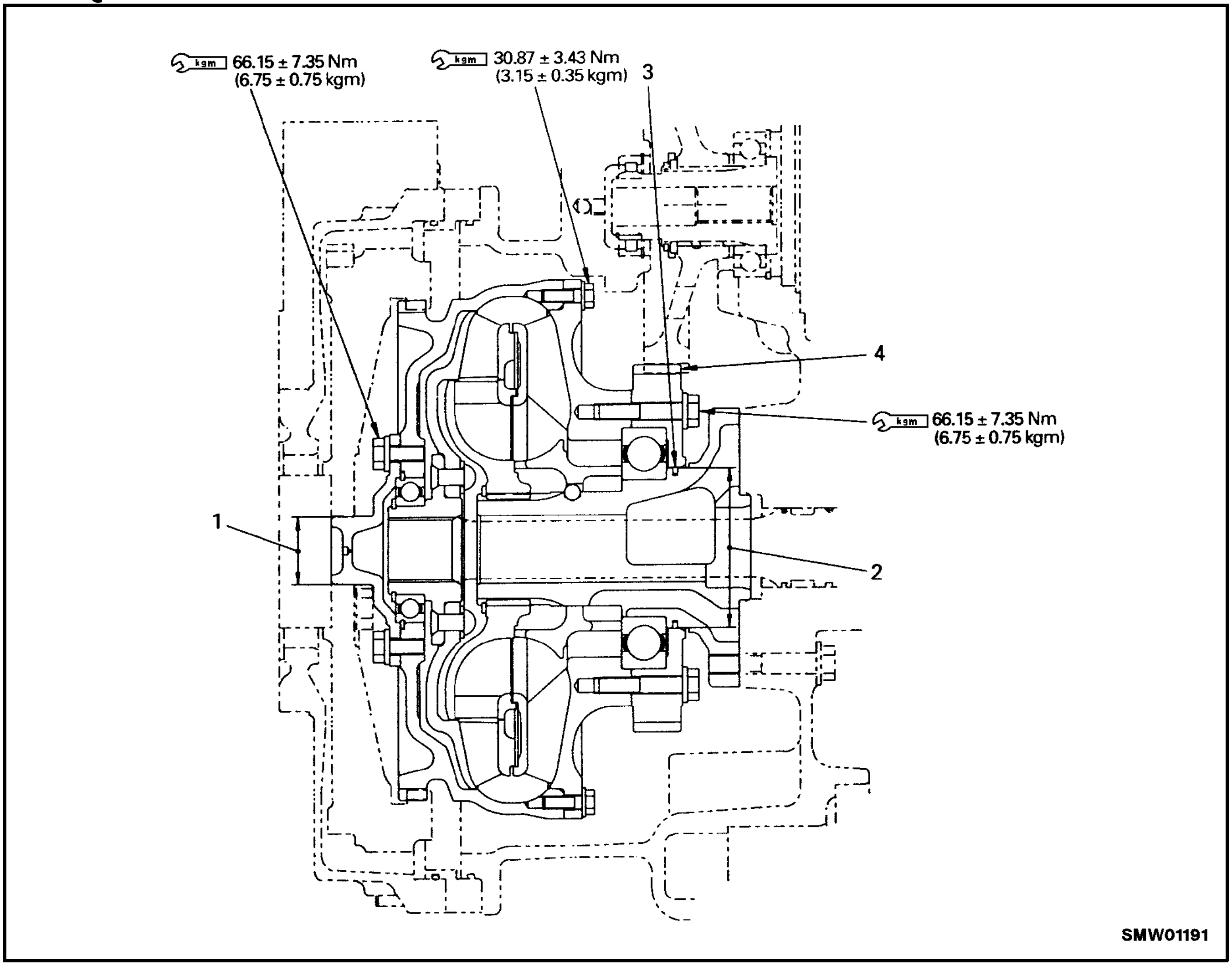
SAL (2) 32 + SAL (2) 25



unit: mm

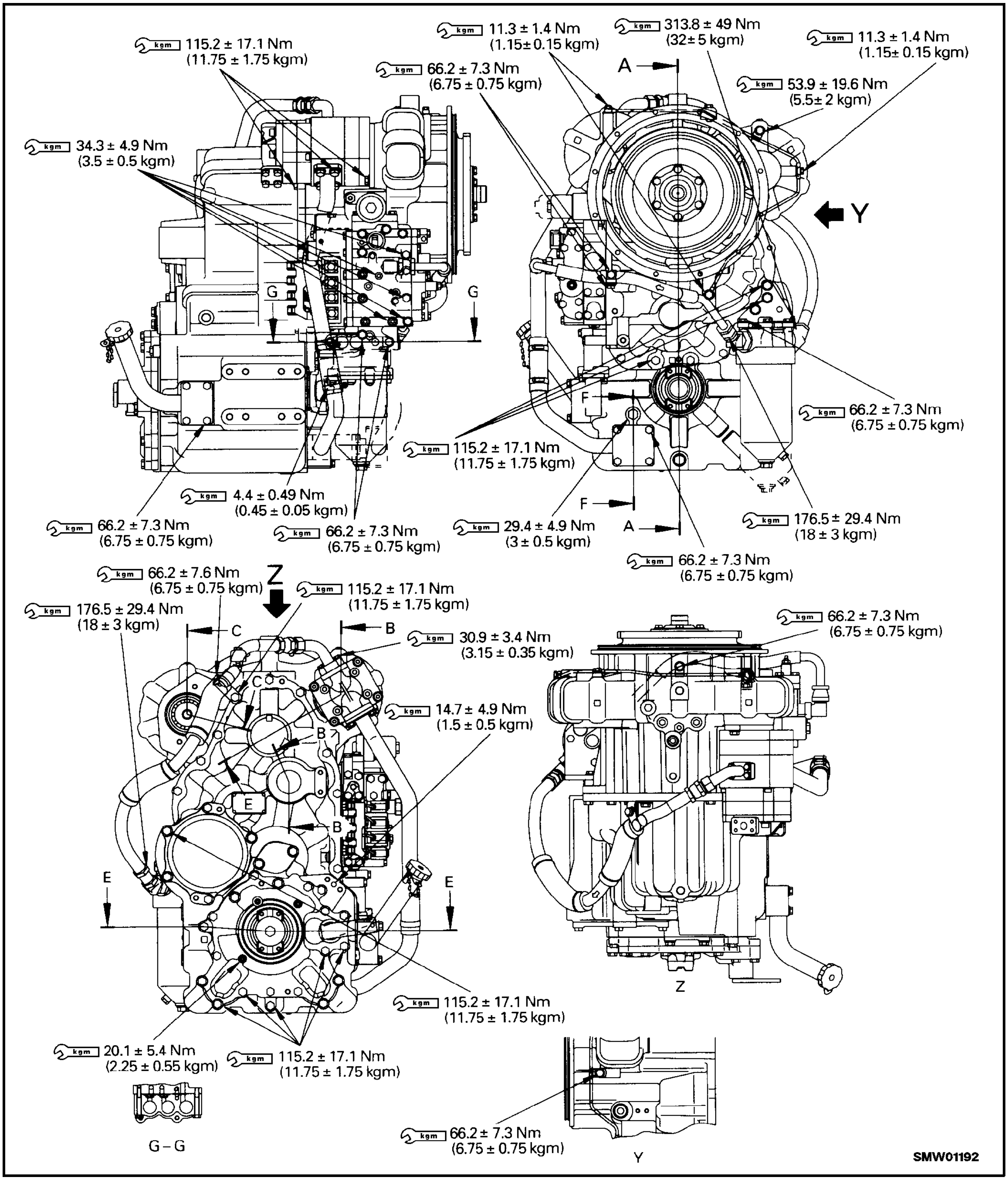
<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td colspan="2" rowspan="2">Side clearance</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="7">Replace</td></tr>
<tr><td colspan="2">0.01 - 0.15</td><td colspan="2">0.19</td></tr>
<tr><td>2</td><td colspan="2">Clearance between inside diameter of plain bearing and outside diameter of gear shaft</td><td colspan="2">0.060 -0.125</td><td colspan="2">0.200</td></tr>
<tr><td rowspan="2">3</td><td colspan="2" rowspan="2">Depth for knocking in pin</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td></tr>
<tr><td colspan="2">12</td><td colspan="2">0
-0.5</td></tr>
<tr><td>4</td><td colspan="2">Rotating torque of spline shaft</td><td colspan="4">4.9 -14.7 Nm (0.5 - 1.5 kgm)</td></tr>
<tr><td rowspan="3">-</td><td rowspan="3">Discharge amount
oil: EO10-CD
oil temperature:
45-55° C</td><td></td><td>Rotating speed</td><td>Delivery pressure</td><td>Standard delivery amount</td><td>Delivery amount limit</td><td rowspan="3">-</td></tr>
<tr><td>Sal(2)32</td><td>3000 rpm</td><td>2.1-2.6 MPa
(21-27 kg/cm²)</td><td>88 ℓ/min</td><td>82 ℓ/min</td></tr>
<tr><td>Sal(2)25</td><td>3000 rpm</td><td>Max 2.5 MPa
Max 25 kg/cm²)</td><td>72 ℓ/min</td><td>66 ℓ/min</td></tr>
</table>

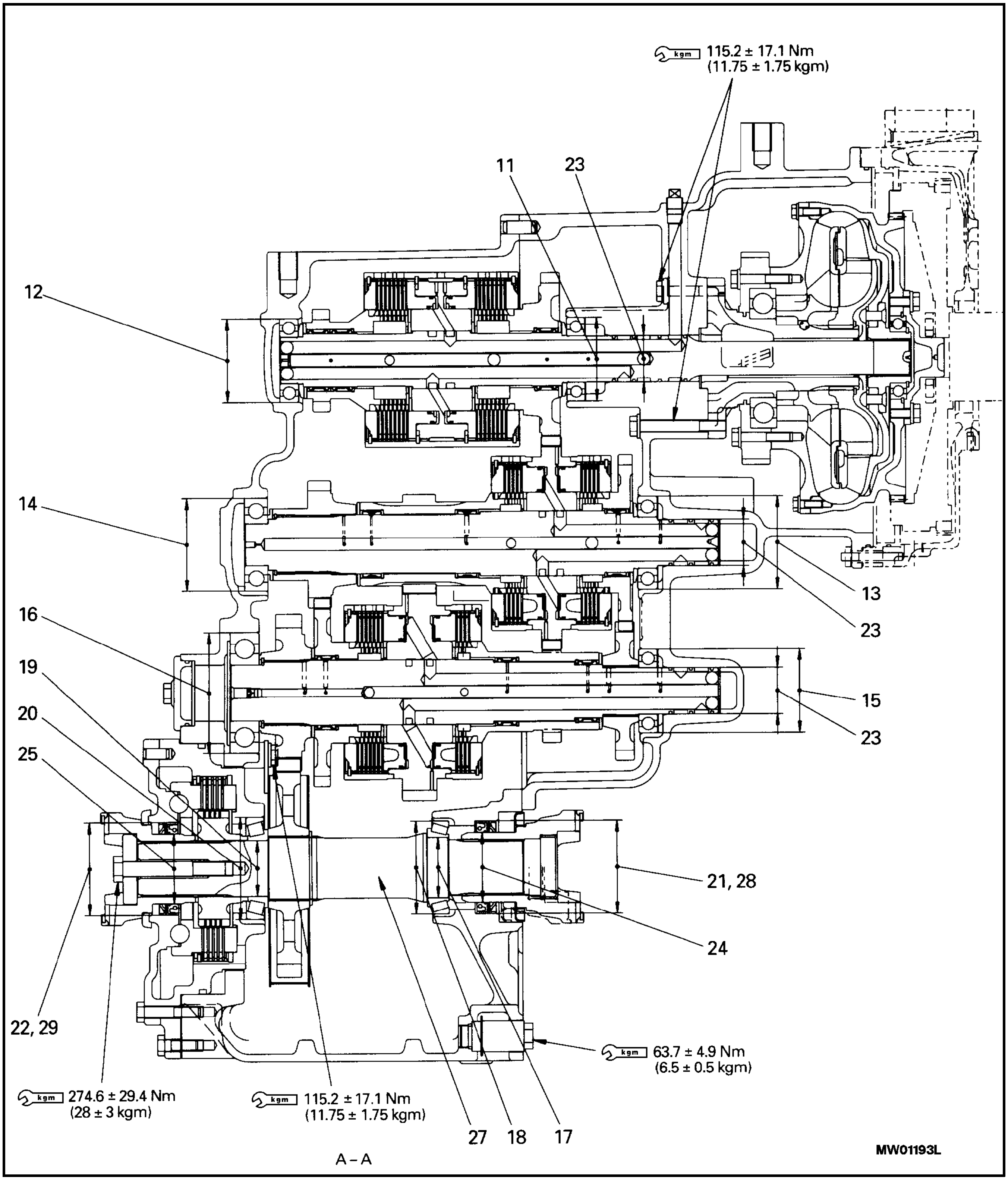
TORQUE CONVERTER

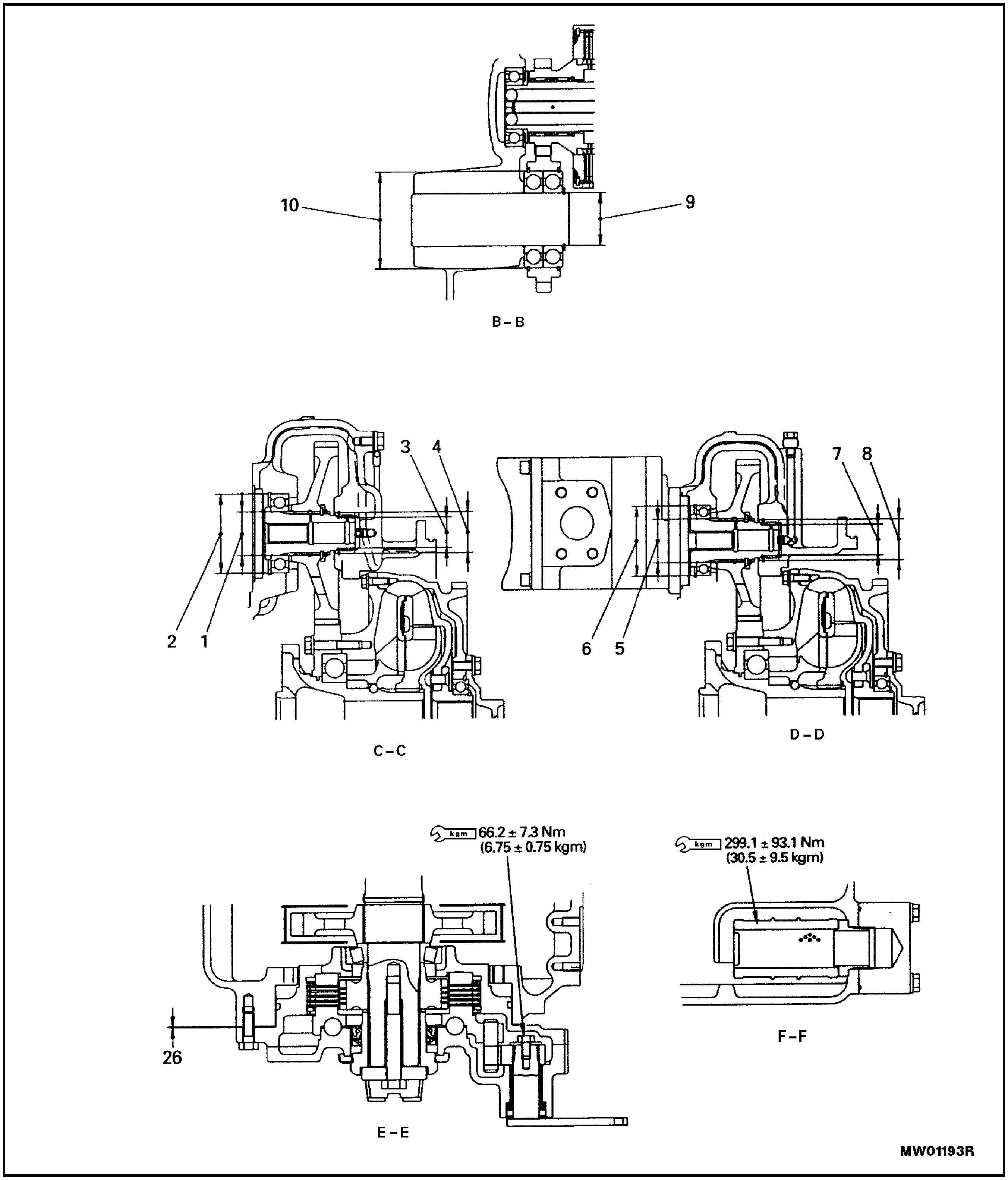


No.	Check item		Criteria			Remedy
1	Outside diameter of pilot		Standard size	Tolerance	Repair limit	Replace
			42	-0.009 -0.034	41.75	
2	Inside diameter of retainer seal ring contact surface		100	+0.035 0	100.5	
3	Wear stator shaft seal ring	Width	3	-	2.7	
		Thickness	4	-	3.6	

TRANSMISSION




115.2 ± 17.1 Nm
(11.75 ± 1.75 kgm)
11
23
12
14
13
23
16
19
15
20
23
25
21, 28
24
22, 29
63.7 ± 4.9 Nm
(6.5 ± 0.5 kgm)
274.6 ± 29.4 Nm
(28 ± 3 kgm)
115.2 ± 17.1 Nm
(11.75 ± 1.75 kgm)
27
18
17
A – A
MW01193L

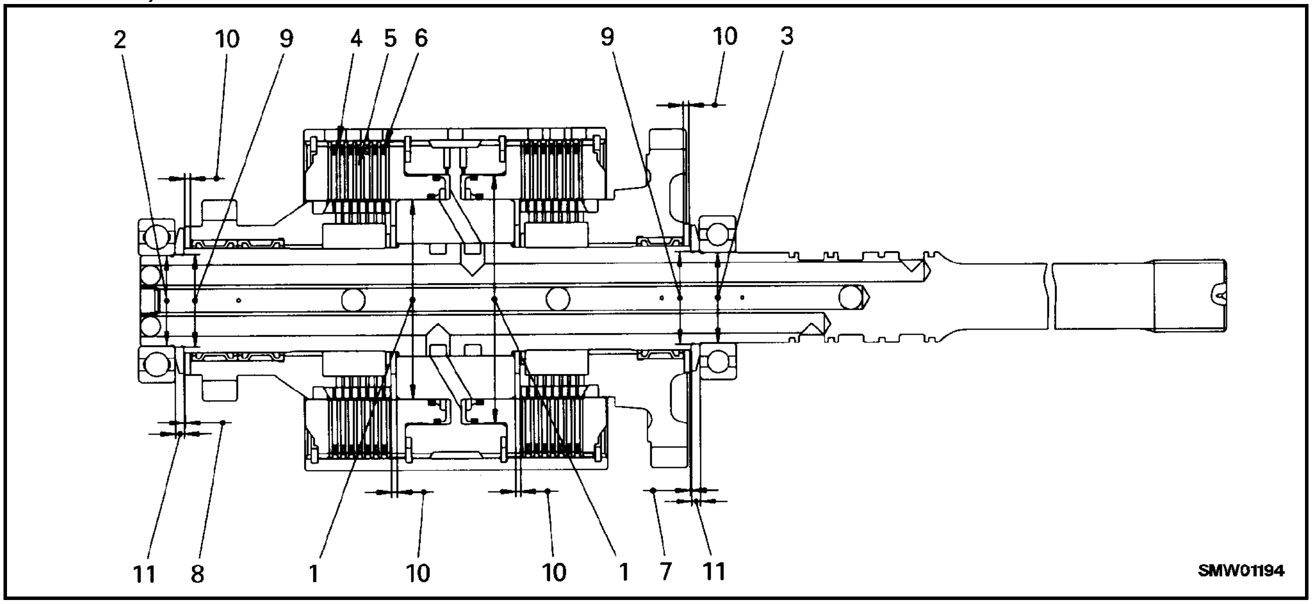

10
9
B – B
3
4
2
1
C – C
7
8
6
5
D – D
66.2 ± 7.3 Nm
(6.75 ± 0.75 kgm)
299.1 ± 93.1 Nm
(30.5 ± 9.5 kgm)
26
E – E
F – F
MW01193R

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pump drive shaft and bearing	50	+0.025 -0.009	0 -0.012	-0.009 - -0.037		Replace
2	Clearance between pump drive shaft bearing and housing	90	0 -0.015	+0.022 -0.013	-0.013 - 0.037		
3	Clearance between pump drive shaft and bearing	35	-0.009 -0.025	+0.041 +0.025	0.034 - 0.066		
4	Clearance between pump drive shaft bearing and housing	47	0 -0.011	+0.014 -0.011	-0.011 - 0.025		
5	Clearance between pump drive shaft and bearing	50	+0.025 +0.009	0 -0.012	-0.009 - -0.037	-	
6	Clearance between pump drive shaft bearing and housing	80	0 -0.013	+0.018 -0.012	-0.012 - 0.031	-	
7	Clearance between pump drive shaft and bearing	35	-0.009 -0.025	+0.041 +0.025	0.034 - 0.066	-	
8	Clearance between pump drive shaft bearing and housing	47	0 -0.011	+0.014 -0.011	-0.011 - 0.025	-	
9	Clearance between idler shaft and bearing	60	+0.023 +0.011	0 -0.022	-0.011 - -0.045	-	
10	Clearance between idler gear and bearing	110	0 -0.015	-0.020 -0.042	-0.005 - -0.042	-	
11	Clearance (R) between FORWARD/REVERSE clutch bearing and housing	90	0 -0.015	+0.022 -0.013	-0.013 - 0.037	-	
12	Clearance (F) between FORWARD/REVERSE clutch bearing and housing	90	0 -0.015	+0.035 0	0 - 0.050	-	
13	Clearance (R) between 1st, 3rd clutch bearing housing	100	0 -0.015	+0.022 -0.013	-0.013 - 0.037	-	
14	Clearance (F) between 1st, 3rd clutch bearing housing	100	0 -0.015	+0.035 0	0 - 0.050	-	
15	Clearance (R) between 2nd, 4th clutch bearing housing	90	0 -0.015	+0.022 -0.013	-0.013 - 0.37	-	
16	Clearance (F) between 2nd, 4th clutch bearing housing	130	0 -0.018	+0.040 0	0 - 0.058	-	
17	Clearance (R) between output shaft and bearing	65	+0.030 +0.011	0 -0.015	-0.011 - -0.045	-	
18	Clearance (R) between output shaft bearing and housing	100	0 -0.015	-0.015 -0.040	0 - 0.040	-	
19	Clearance (F) between output shaft and bearing	60	+0.030 +0.011	0 -0.015	-0.011 - -0.045	-	
20	Clearance (F) between output shaft bearing and housing	110	0 -0.015	-0.015 -0.040	0 - 0.040	-	
21	Clearance (R) between output shaft oil seal bearing and housing	100	+0.4 +0.2	+0.054 0	-0.146 - -0.4	-	

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">22</td><td rowspan="3">Clearance (F) between output shaft oil seal and housing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="12">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>100</td><td>+0.4
+0.2</td><td>+0.054
0</td><td>-0.146-
-0.4</td><td>-</td></tr>
<tr><td rowspan="5">23</td><td rowspan="2">Inside diameter of housing seal ring contact surface</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td></tr>
<tr><td colspan="2">50</td><td colspan="2">+0.05
0</td><td>0.05 (wear)</td></tr>
<tr><td>Width of shaft seal ring groove</td><td colspan="2">3.2</td><td colspan="2">+0.076
0</td><td>3.5</td></tr>
<tr><td>Width of seal ring</td><td colspan="2">3.0</td><td colspan="2">0
-0.13</td><td>2.6</td></tr>
<tr><td>Thickness of seal ring</td><td colspan="2">2.29</td><td colspan="2">0
-0.1</td><td>2.1</td></tr>
<tr><td>24</td><td>Outside diameter (R) of sliding portion of coupling oil seal</td><td colspan="2">75</td><td colspan="2">0
-0.074</td><td>0.05 (wear)</td></tr>
<tr><td>25</td><td>Outside diameter (F) of sliding portion of coupling oil seal</td><td colspan="2">75</td><td colspan="2">0
-0.074</td><td>0.05 (wear)</td></tr>
<tr><td rowspan="2">26</td><td rowspan="2">Clearance between parking brake housing and case</td><td colspan="2">Standard size</td><td colspan="2">Standard clearance</td><td>Clearance limit</td></tr>
<tr><td colspan="2">0.95</td><td colspan="2">0.35 - 1.55</td><td>-</td></tr>
<tr><td>27</td><td>Free rotation torque of output shaft</td><td colspan="4">0.1 - 1 Nm (0.01 - 0.10 kgm)</td><td colspan="2">Adjust shim</td></tr>
<tr><td rowspan="3">28</td><td rowspan="3">Clearance (R) between output shaft dust seal and housing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="4"></td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>100</td><td>+0.3
+0.1</td><td>+0.054
0</td><td>-0.046-
-0.3</td><td>-</td></tr>
<tr><td>29</td><td>Clearance (F) between output shaft dust seal and housing</td><td>100</td><td>+0.3
+0.1</td><td>+0.054
0</td><td>-0.046-
-0.3</td><td>-</td></tr>
</table>

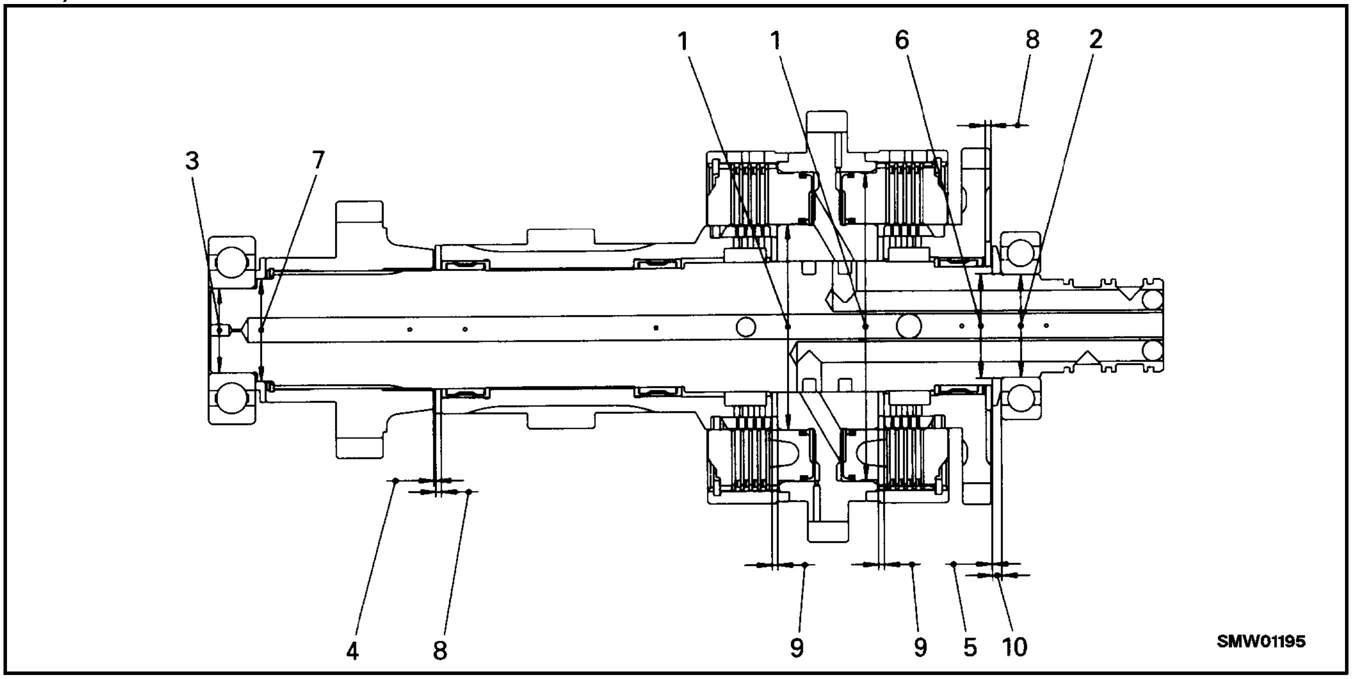
FORWARD, REVERSE CLUTCH



Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Clearance limit	
1	Clearance between piston and cylinder (FORWARD, REVERSE)	Inside	110	-0.27 -0.32	+0.06 -0.07	0.20 - 0.38	0.43	Replace
		Outside	137.5	-0.2 -0.25	+0.13 0	0.20 - 0.38	0.43	
2	Clearance (R) at bearing press-fitting portion of FORWARD, REVERSE clutch shaft		50	+0.025 +0.009	0 -0.012	-0.009 - -0.037	-	
3	Clearance (F) at bearing press-fitting portion of FORWARD, REVERSE clutch shaft		50	+0.025 +0.009	0 -0.012	-0.009 - -0.037	-	
			Standard size	Tolerance	Repair limit			
4	Thickness of separator plate		1.7	± 0.05	1.6			
	Distortion of separator plate		-	0.1	0.15			
5	Thickness of friction plate		2.2	± 0.08	1.9			
	Distortion of friction plate		-	0.1	0.25			
6	Load of wave spring (at height: 2.2 mm)		100.1 N (103 kg)	± 10.1 N (± 10.3 kg)	804 N (82 kg)			
7	End play of FORWARD gear		0.07 - 1.33					
8	End play of REVERSE gear		0.1 - 0.9					
			Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Clearance limit	
9	Clearance (R) at spacer press-fitting portion of FORWARD, REVERSE clutch shaft		51	+0.025 +0.009	0 -0.03	-0.009 - -0.055	-	
	Clearance (F) at spacer press-fitting portion of FORWARD, REVERSE clutch shaft		51	+0.025 +0.009	0 -0.03	-0.009 - -0.055	-	
10	Thickness of FORWARD, REVERSE clutch thrust washer		Standard size	Tolerance	Repair limit			
11	Thickness of FORWARD, REVERSE clutch spacer		3.0	± 0.1	2.7			
			5.0	± 0.05	-			

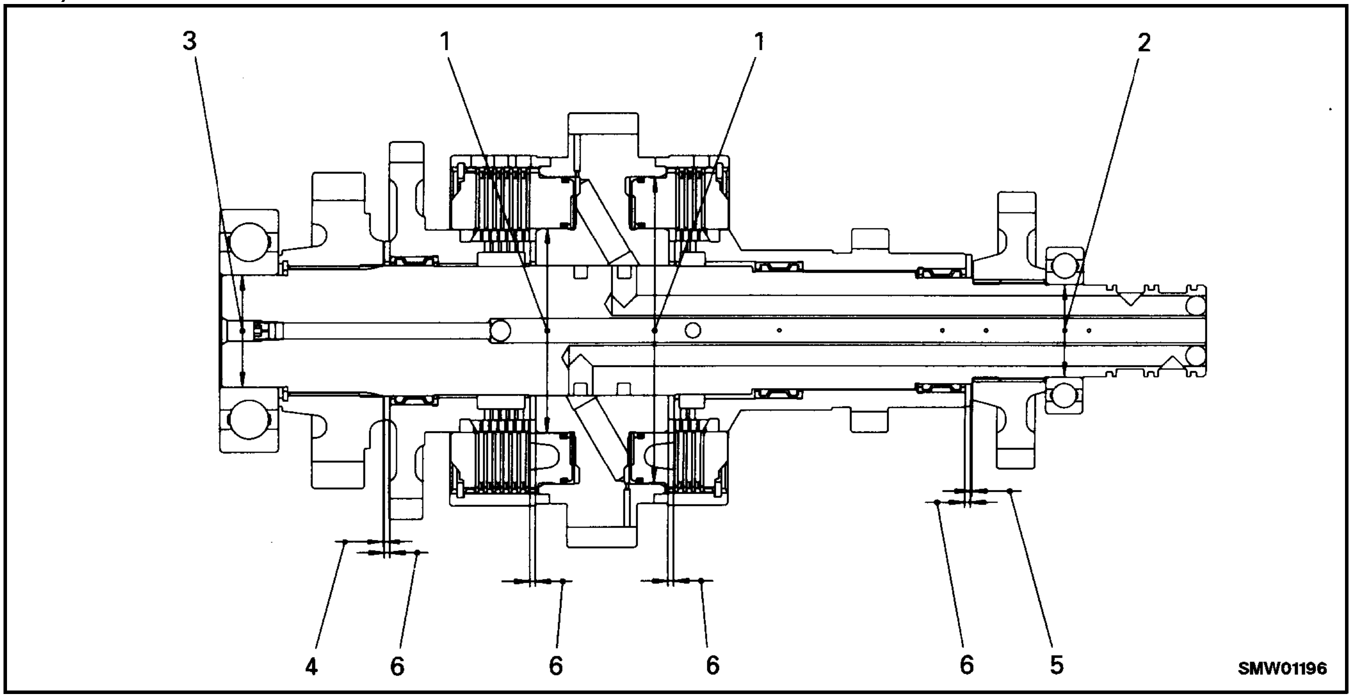
1ST, 3RD CLUTCH



Unit: mm

<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Clearance between piston and cylinder</td><td rowspan="2"></td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="15">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>Inside</td><td>110</td><td>-0.27
-0.32</td><td>+0.06
-0.07</td><td>0.20 -
0.38</td><td>0.43</td></tr>
<tr><td>Outside</td><td>165</td><td>-0.27
-0.32</td><td>+0.06
-0.07</td><td>0.20 -
0.38</td><td>0.43</td></tr>
<tr><td>2</td><td colspan="2">Clearance (R) at bearing press-fitting portion of 1st, 3rd clutch shaft</td><td>55</td><td>+0.030
+0.011</td><td>0
-0.015</td><td>-0.011 -
-0.045</td><td>-</td></tr>
<tr><td>3</td><td colspan="2">Clearance (F) at bearing press-fitting portion of 1st, 3rd clutch shaft</td><td>45</td><td>+0.025
+0.009</td><td>0
-0.012</td><td>-0.009 -
-0.037</td><td>-</td></tr>
<tr><td>4</td><td colspan="2">End play of 1st gear</td><td colspan="5">1.00 - 1.59</td></tr>
<tr><td>5</td><td colspan="2">End play of 3rd gear</td><td colspan="5">0.1 - 0.9</td></tr>
<tr><td rowspan="3">6</td><td colspan="2" rowspan="3">Clearance (R) at spacer press-fitting portion of 1st, 3rd clutch shaft</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>56</td><td>+0.030
+0.011</td><td>0
-0.030</td><td>-0.011 -
-0.060</td><td>-</td></tr>
<tr><td>7</td><td colspan="2">Clearance (F) at spacer press-fitting portion of 1st, 3rd clutch shaft</td><td>55</td><td>+0.025
-0.015</td><td>+0.090 -
+0.015</td><td>-0.010 -
+0.105</td><td>-</td></tr>
<tr><td rowspan="2">8</td><td colspan="2" rowspan="2">Thickness of gear end face clutch thrust washer</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td></tr>
<tr><td colspan="2">3.0</td><td colspan="2">± 0.1</td><td>2.7</td></tr>
<tr><td>9</td><td colspan="2">Thickness of clutch thrust washer</td><td colspan="2">3.0</td><td colspan="2">± 0.1</td><td>2.7</td></tr>
<tr><td>10</td><td colspan="2">Thickness of 3rd clutch spacer</td><td colspan="2">5.0</td><td colspan="2">± 0.05</td><td>-</td><td></td></tr>
</table>

2nd, 4th CLUTCH

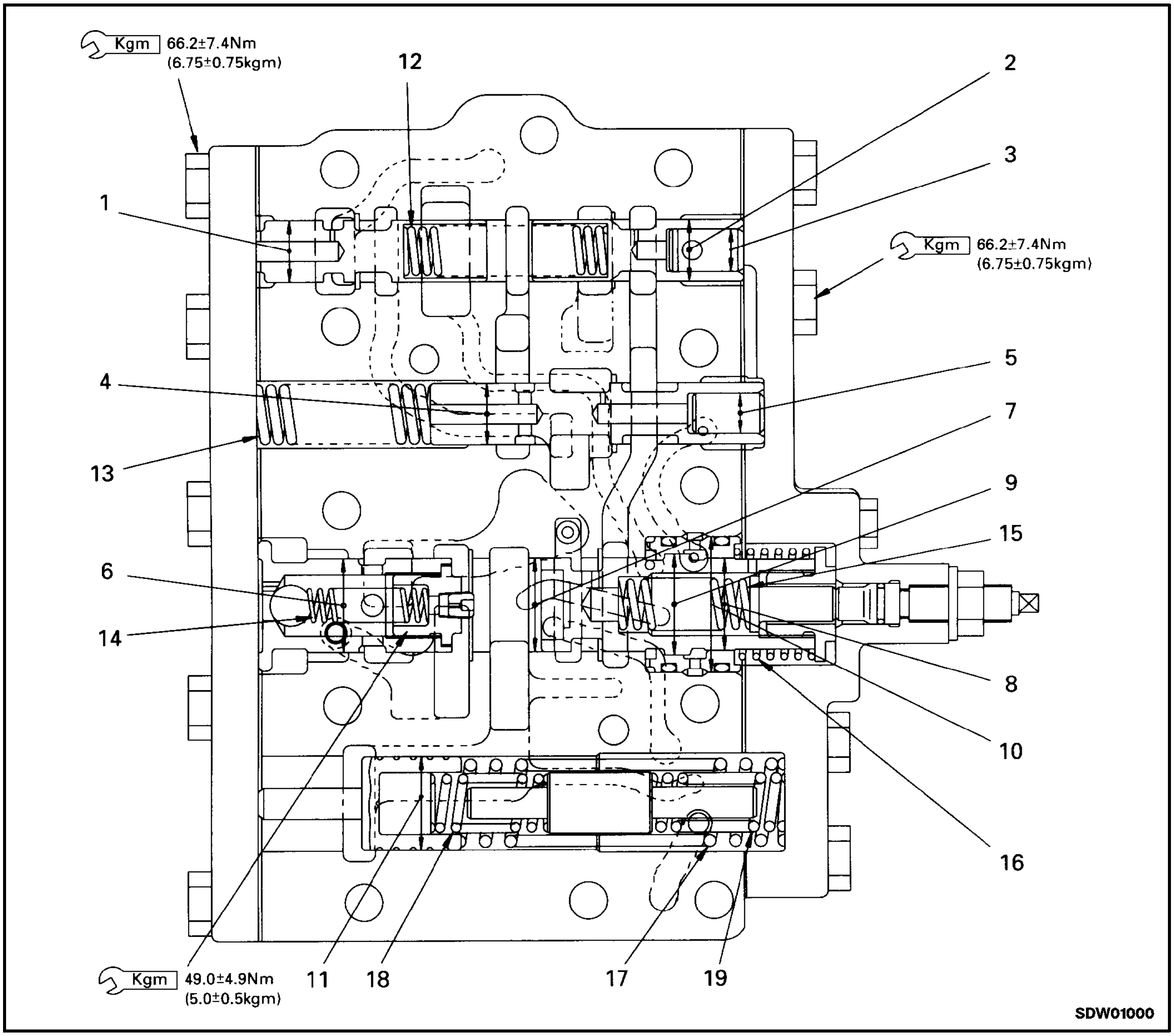


Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Clearance limit	
1	Clearance between piston and cylinder	Inside	110	-0.27 -0.32	+0.06 -0.07	0.20 - 0.38	0.43	Replace
		Outside	165	-0.27 -0.32	+0.06 -0.07	0.20 - 0.38	0.43	
2	Clearance (R) at bearing press-fitting portion of 2nd, 4th clutch shaft		50	+0.025 +0.009	0 -0.012	-0.009 - -0.037	-	
3	Clearance (F) at bearing press-fitting portion of 2nd, 4th clutch shaft		60	+0.030 +0.011	0 -0.015	-0.011 - -0.037	-	
4	End play of 2nd gear		0.04 - 1.16					
5	End play of 4th gear		0.07 - 1.33					
6	Thickness of 4th gear end face thrust washer		Standard size		Tolerance		Repair limit	
			3.0		± 0.1		2.7	
7	Thickness of 2nd gear, clutch thrust washer		3.0		± 0.1		2.7	

TRANSMISSION CONTROL VALVE

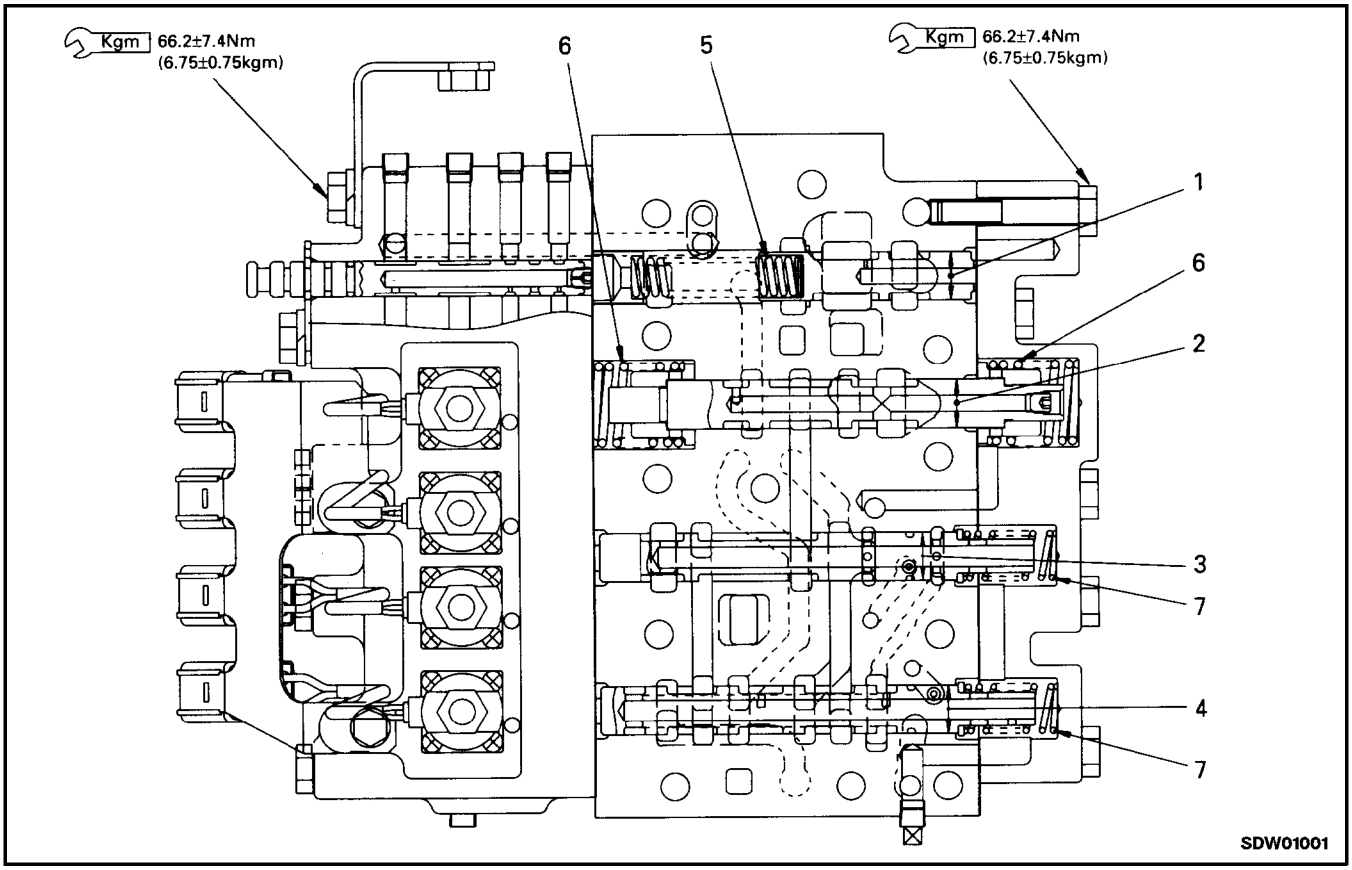
UPPER VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pilot valve and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	Replace
2	Clearance between main regulator valve and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
3	Clearance between main regulator valve and load piston	13.5	-0.02 -0.03	+0.018 0	0.020 - 0.048	0.055	
4	Clearance between priority valve and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
5	Clearance between priority valve and load piston	12.5	-0.02 -0.03	+0.018 0	0.020 - 0.048	0.055	
6	Clearance between quick return valve and body	28	-0.020 -0.028	+0.013 0	0.020 - 0.041	0.044	
7	Clearance between modulation fill valve and body	28	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
8	Clearance between modulation fill valve and sleeve	28	-0.02 -0.03	+0.033 +0.020	0.040 - 0.066	0.070	
9	Clearance between modulation fill valve and sleeve	30	-0.04 -0.05	+0.041 +0.025	0.065 - 0.091	0.100	
10	Clearance between sleeve and body	41	-0.050 -0.075	+0.025 0	0.050 - 0.100	0.110	
11	Clearance between accumulator valve and body	28	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
		Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
12	Main regulator valve spring	82.55	62.6	230 ± 11.5 N (23.46 ± 1.17 kg)	79.3	207 N (21.1 kg)	
13	Priority valve spring	69.5	52.6	254 ± 12.7 N (25.92 ± 1.30 kg)	66.7	228 N (23.3 kg)	
14	Quick return valve spring	48.0	41.0	0.8 ± 0.04 N (0.08 ± 0.004 kg)	46.1	0.7 N (0.072 kg)	
15	Modulation fill valve spring (inner)	41.8	40.0	24.1 ± 1.2 N (2.46 ± 0.12 kg)	40.1	21.7 N (2.21 kg)	
16	Modulation fill valve spring (outer)	43.6	24.3	138 ± 7 N (14.07 ± 0.07 kg)	41.9	125 N (12.7 kg)	
17	Accumulator spring (outer)	99.6	99.6	0	95.6	-	
18	Accumulator spring (inner 1)	35.6	35.6	0	34.2	-	
19	Accumulator spring (inner 2)	40.8	40.8	0	39.2	-	

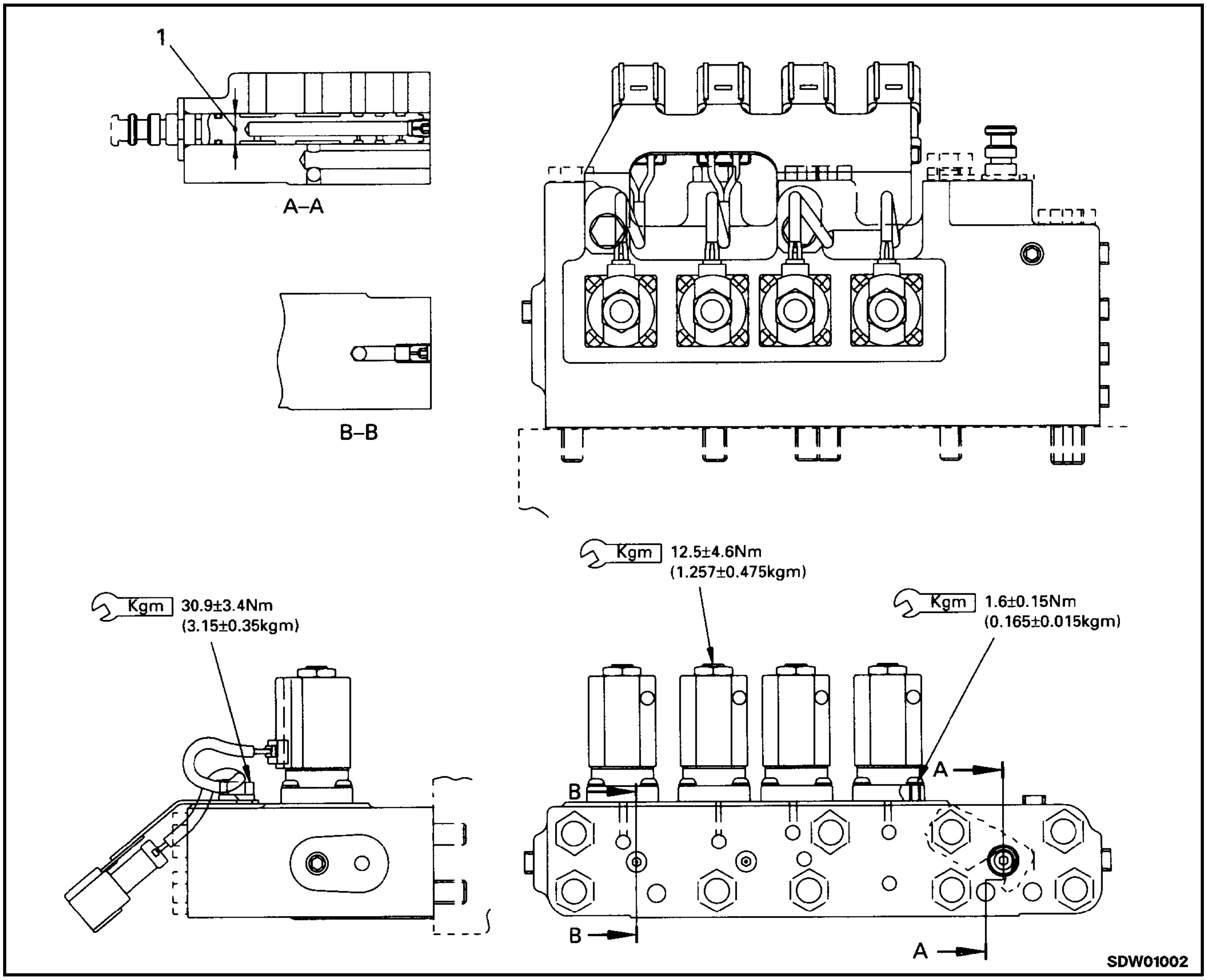
LOWER VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Clearance limit	
1	Clearance between torque converter regulator valve and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	Replace
2	Clearance between F-R selector spool and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
3	Clearance between H-L selector spool and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
4	Clearance between range selector spool and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
		Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
5	Torque converter regulator valve spring	70.3	66.1	55.7 ± 2.7 N (23.46 ± 1.17 kg)	67.5	50 N (5.1 kg)	
6	F-R selector spool spring	48.8	36	83.4 ± 4.2 N (8.5 ±0.43 kg)	46.8	75.5 N (7.7 kg)	
7	H-L range selector spool return spring	48.0	36.7	69.8 ± 3.5 N (7.12 ± 0.036 kg)	46.1	62.8 N (6.4 kg)	

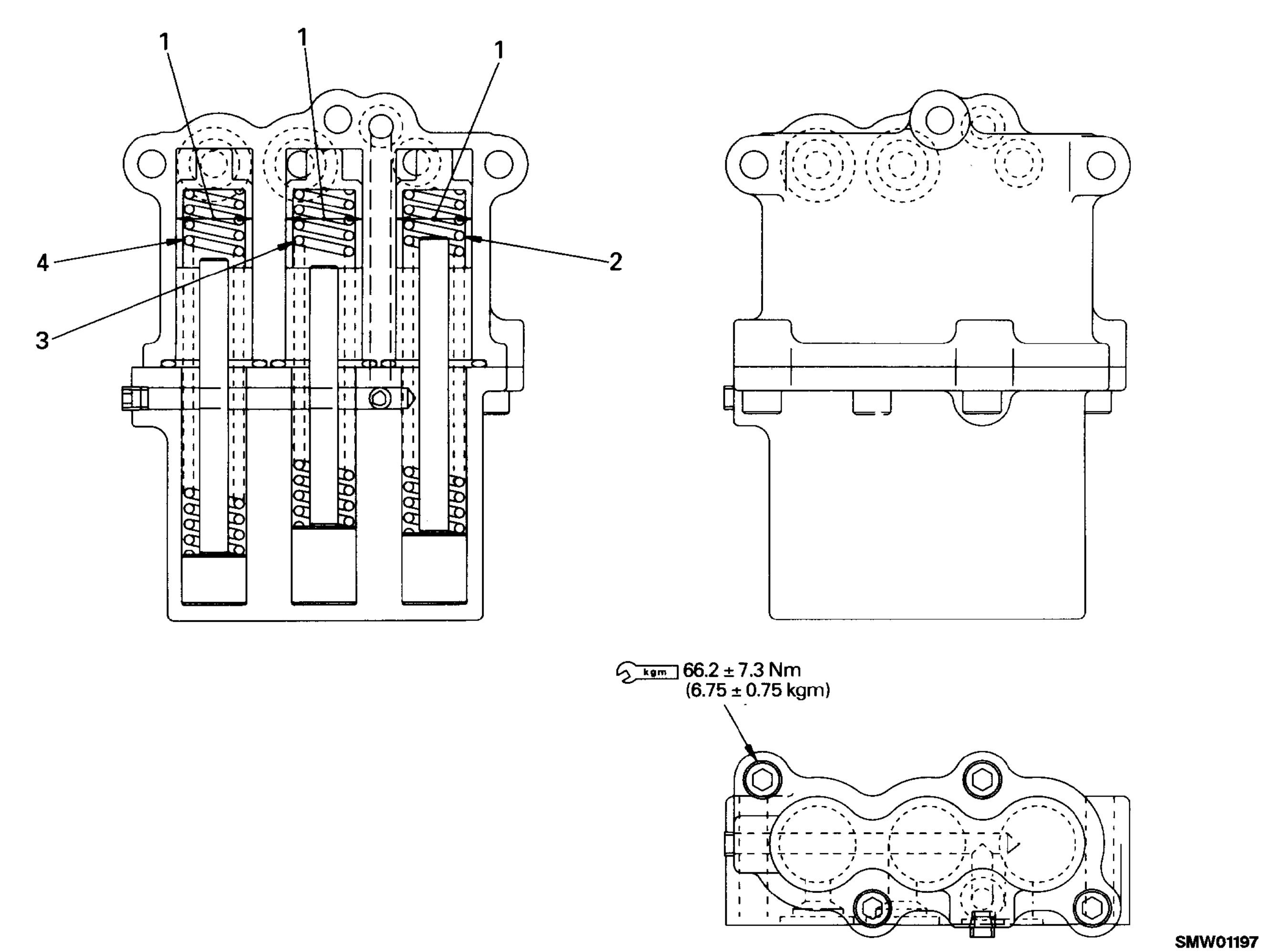
SOLENOID VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between emergency manual spool and body	14	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	Replace

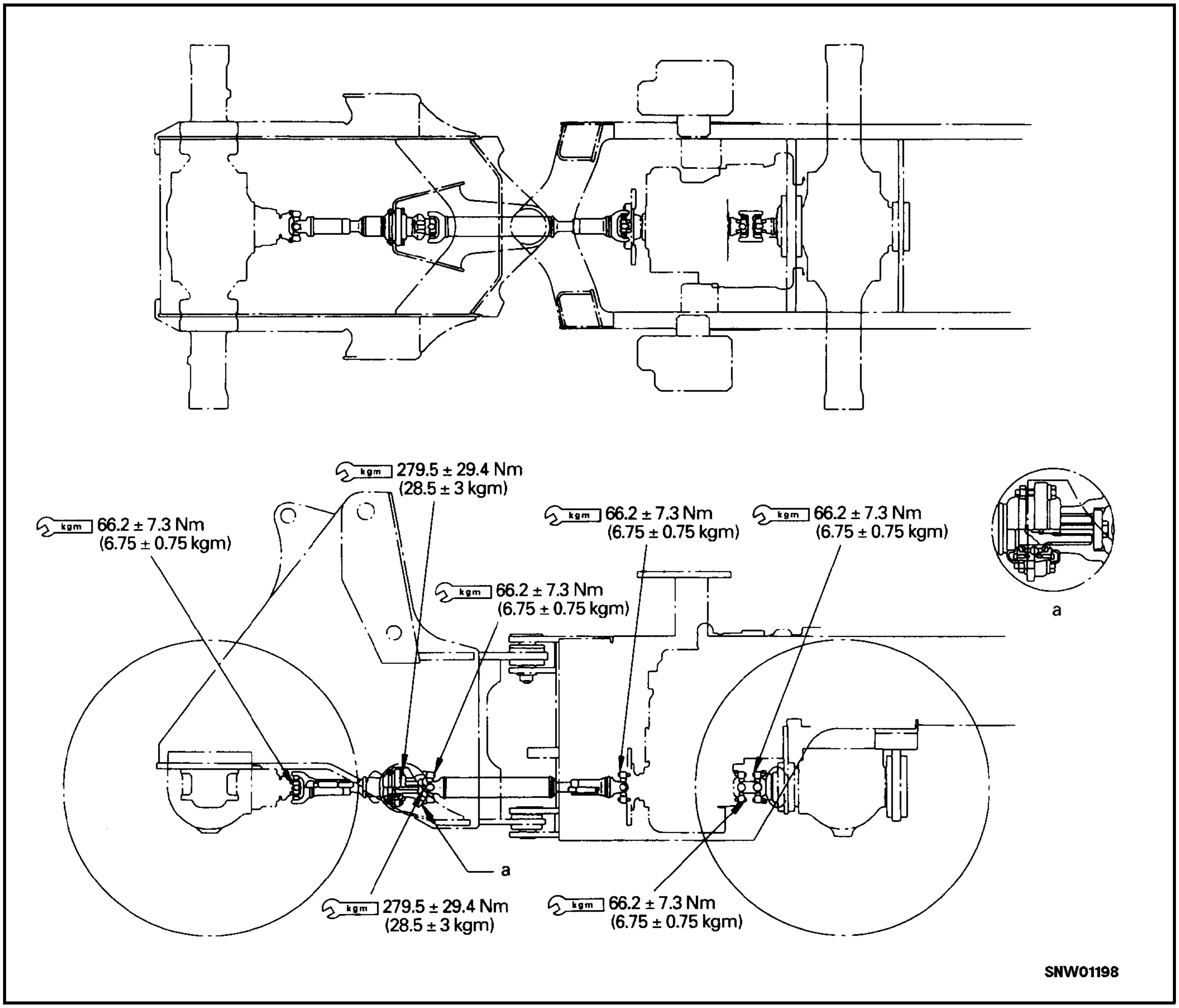
ACCUMULATOR VALVE



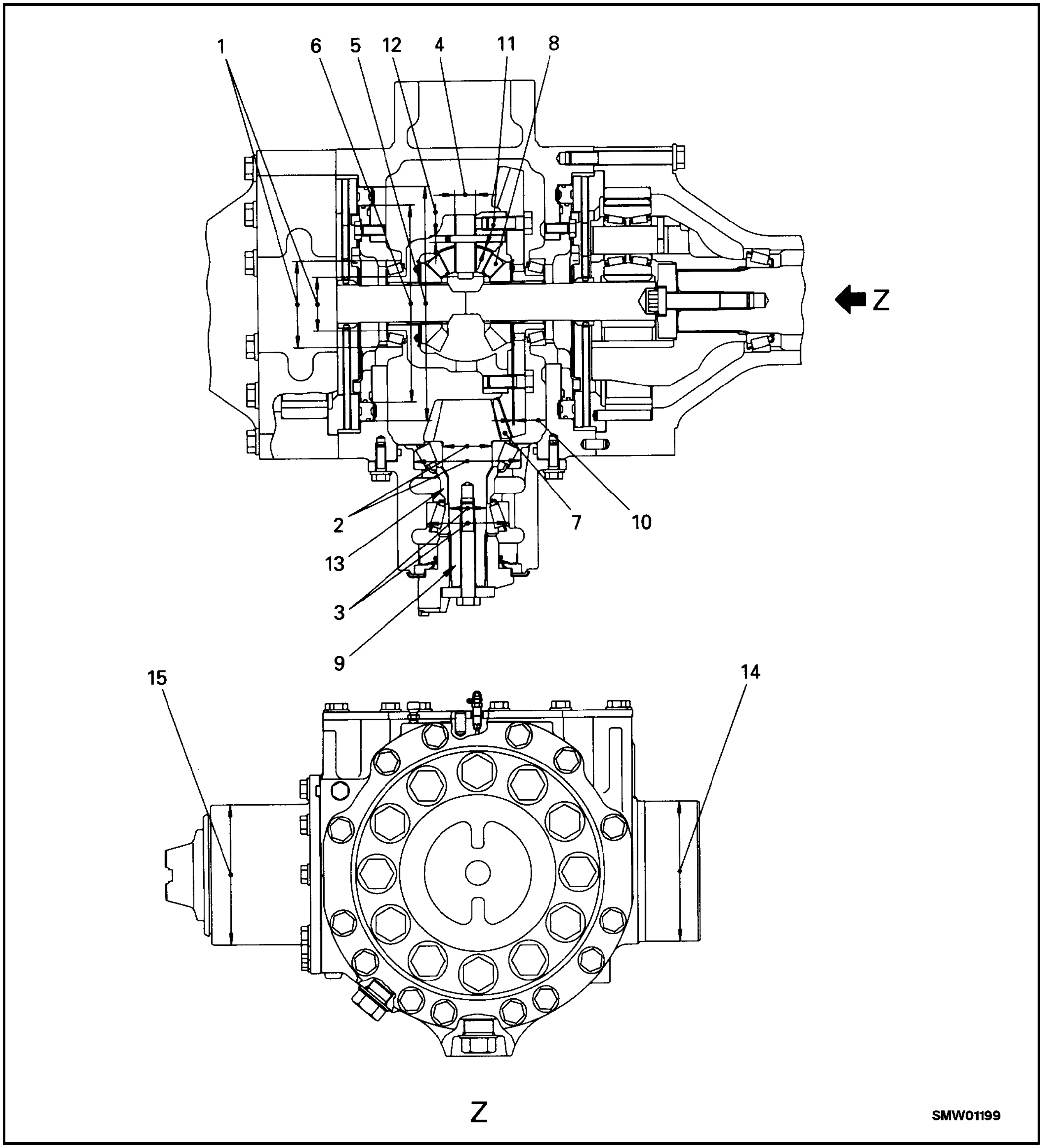
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between piston and body	32	-0.035 -0.045	+0.025 0	0.035 - 0.045	0.08	Replace
		Standard size			Repair limit		
		Free length	Installed height	Installed load	Free length	Installed load	
2	FORWARD clutch accumulator spring	184.8	165	318.7 N (32.5 kg)	177.4	-	
3	1st clutch accumulator spring	157.7	133.9	293.2 N (29.9 kg)	151.4	-	
4	2nd clutch accumulator spring	157.7	153.9	47.1 N (4.8 kg)	151.4	-	

DRIVE SHAFT


279.5 ± 29.4 Nm
(28.5 ± 3 kgm)
66.2 ± 7.3 Nm
(6.75 ± 0.75 kgm)
66.2 ± 7.3 Nm
(6.75 ± 0.75 kgm)
66.2 ± 7.3 Nm
(6.75 ± 0.75 kgm)
66.2 ± 7.3 Nm
(6.75 ± 0.75 kgm)
a
a
279.5 ± 29.4 Nm
(28.5 ± 3 kgm)
66.2 ± 7.3 Nm
(6.75 ± 0.75 kgm)
SNW01198

DIFFERENTIAL

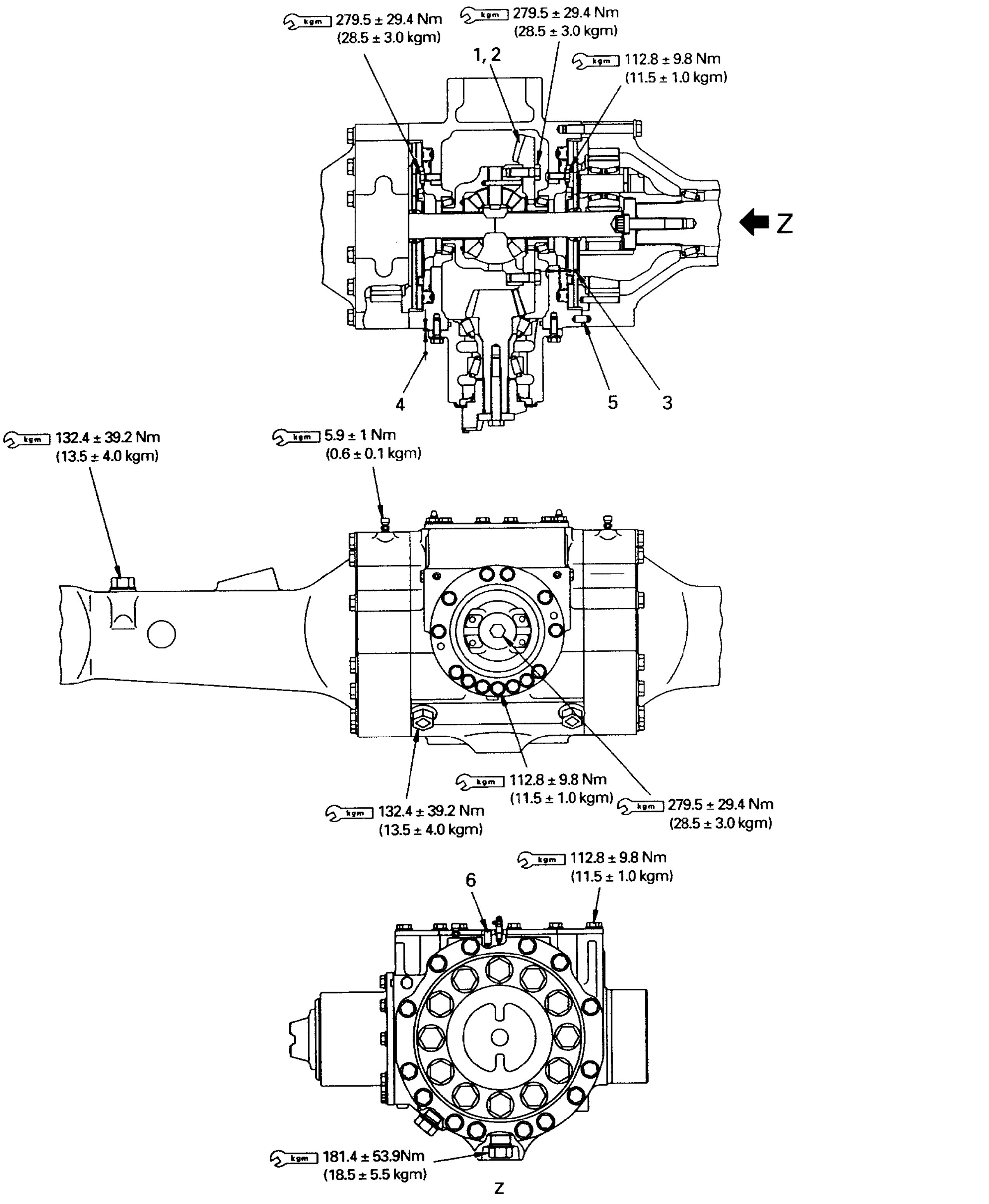


Unit: mm

No.	Check item		Criteria: Standard size	Criteria: Tolerance – Shaft	Criteria: Tolerance – Hole	Criteria: Standard clearance	Criteria: Clearance limit	Remedy
1	Clearance at differential side bearing	Outer race	105	0 -0.020	-0.024 -0.059	0.059 - -0.004	-	Replace
		Inner race	65	+0.051 +0.032	0 -0.015	-0.066 - -0.032	-	
2	Clearance of bearing and pinion shaft gear	Outer race	130	0 -0.018	-0.048 -0.088	-0.088 - -0.030	-	
		Inner race	60	+0.039 +0.020	0 -0.015	-0.054 - -0.020	-	
3	Clearance of bearing and pinion shaft coupling	Outer race	100	0 -0.015	-0.038 -0.073	-0.73 - 0.023	-	
		Inner race	45	+0.033 -0.017	0 -0.012	-0.045 - -0.017	-	
4	Clearance between pinion gear and spider		25.4	-0.105 -0.118	+0.100 +0.050	0.155 - 0.218	-	
5	Assembly portion of piston of differential housing (housing and piston)		283.4	-0.250 -0.450	+0.050 -0.050	0.200 - 0.500	-	
6	Assembly portion of piston of bearing carrier (piston, carrier)		238.95	-0.250 -0.450	+0.050 -0.050	0.200 - 0.500	-	
7	Backlash of bevel gear		0.20 - 0.033					Adjust
8	Backlash of differential gear		0.10 - 0.25					Replace
9	End play of pinion gear		Max. 0.145					

No.	Check item	Standard size	Tolerance	Repair limit	Remedy
10	Thickness of side gear washer	1.50	± 0.05	1.30	Replace
11	Thickness of pinion gear washer	2.0	± 0.06	1.80	
12	Wear of outside diameter of lock pin	8	0 - 0.09	-	
13	Height of spacer between pinion shaft bearings	45.315	± 0.025	-	
14	Outside diameter of axle mount (rear differential)	170	- 0.043 - 0.106	169.6	
15	Axle mount (rear differential)	170	- 0.043 - 0.106	169.6	

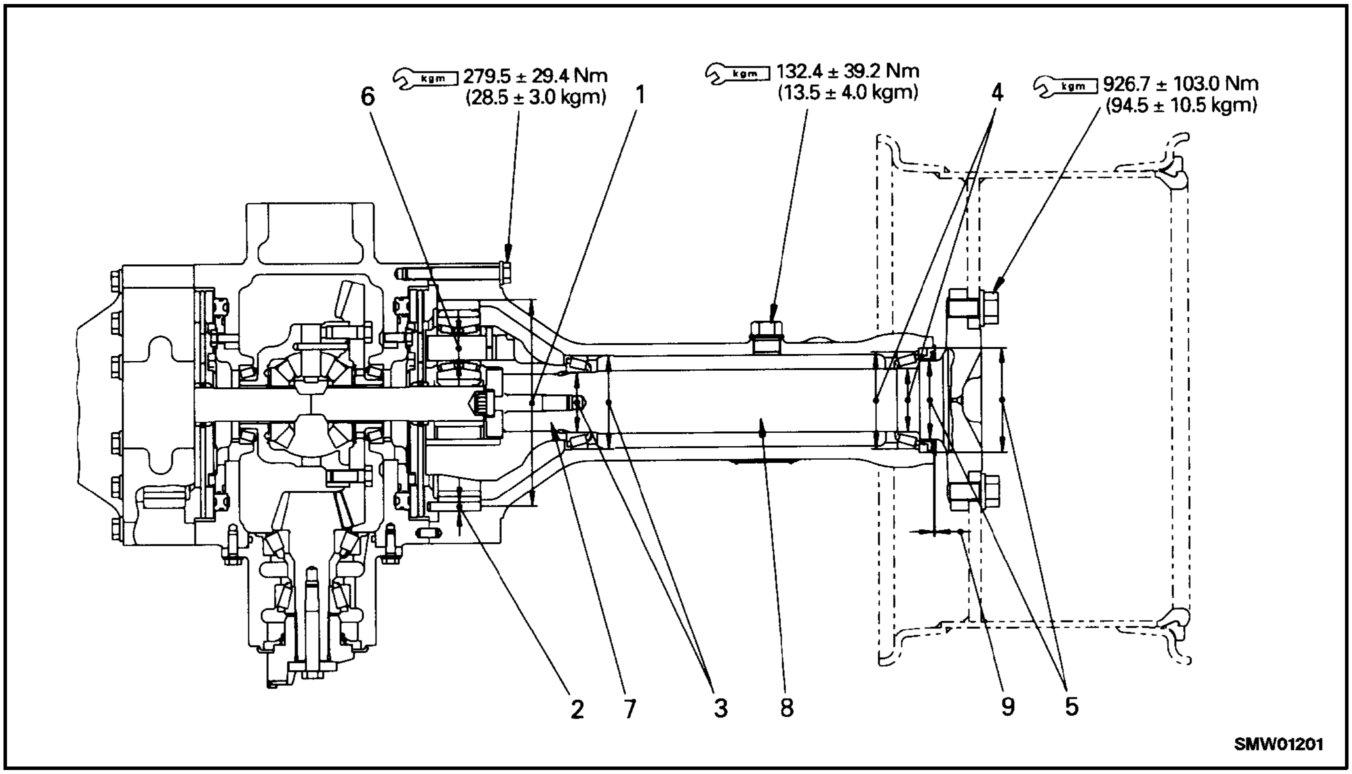
DIFFERENTIAL



Unit: mm

No.	Check item	Criteria	Remedy
1	Bevel gear free rotation torque	7.4 - 23.5 Nm (0.75 - 2..4 kgm)	Replace
2	Preload of differential side bearing	2255.5 - 7551.1 N (230 - 770 kg)	
3	Thickness of shim at differential side bearing carrier (one side)	0.50 - 1.30	
4	Thickness of shim for differential housing and gauge assembly	0.175 - 1.550	
5	Protrusion of pin	13	
6	Protrusion of pin	8	

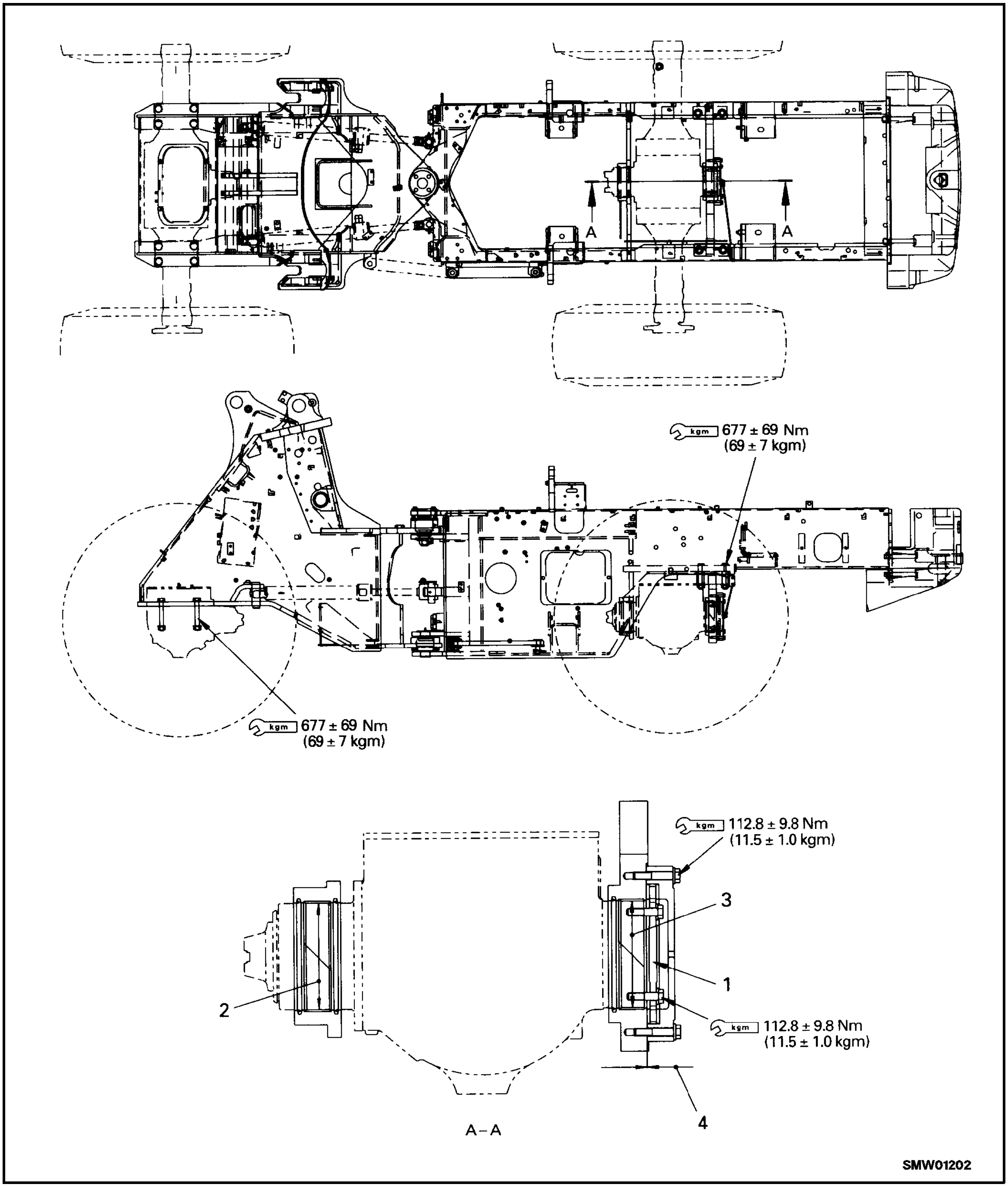
FINAL DRIVE



Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between axle housing and ring gear	Front axle	316	+0.100 +0.030	+0.1 0	-0.100 - 0.070	-	Replace
		Rear axle	276	+0.100 +0.030	+0.100 +0.030	-0.100 - 0.070	-	
2	Clearance of guide pin		12	+0.025 +0.007	+0.207 +0.145	+0.120 - +0.200	-	
3	Clearance at press-fitting portion of axle housing bearing	Inner race	125	0 -0.018	-0.028 -0.068	-0.068 - -0.010	-	
		Outer race	80	+0.030 +0.011	0 -0.015	-0.045 - -0.011	-	
4	Clearance at press-fitting portion of axle housing bearing	Inner race	130	0 -0.025	-0.028 -0.068	-0.068 - -0.003	-	
		Outer race	85	+0.045 +0.023	0 -0.020	-0.065 - -0.023	-	
5	Axle shaft press-fitting portion	Housing	140	-	+0.063 0	-	-	
		Shaft	105	0 -0.054	-	-	--	
6	Clearance between pinion gear bearing and shaft		33.338	+0.025 +0.013	+0.013 0	-0.025 - 0	-	
7	End play of axle shaft		Max. 0.1					-
8	Free rotation torque of axle shaft		Max. 12.3 Nm (1.25 kgm) (including rotating resistance of seal carrier)					
9	Clearance between oil seal and housing		0.1 - 0.09					

AXLE MOUNT

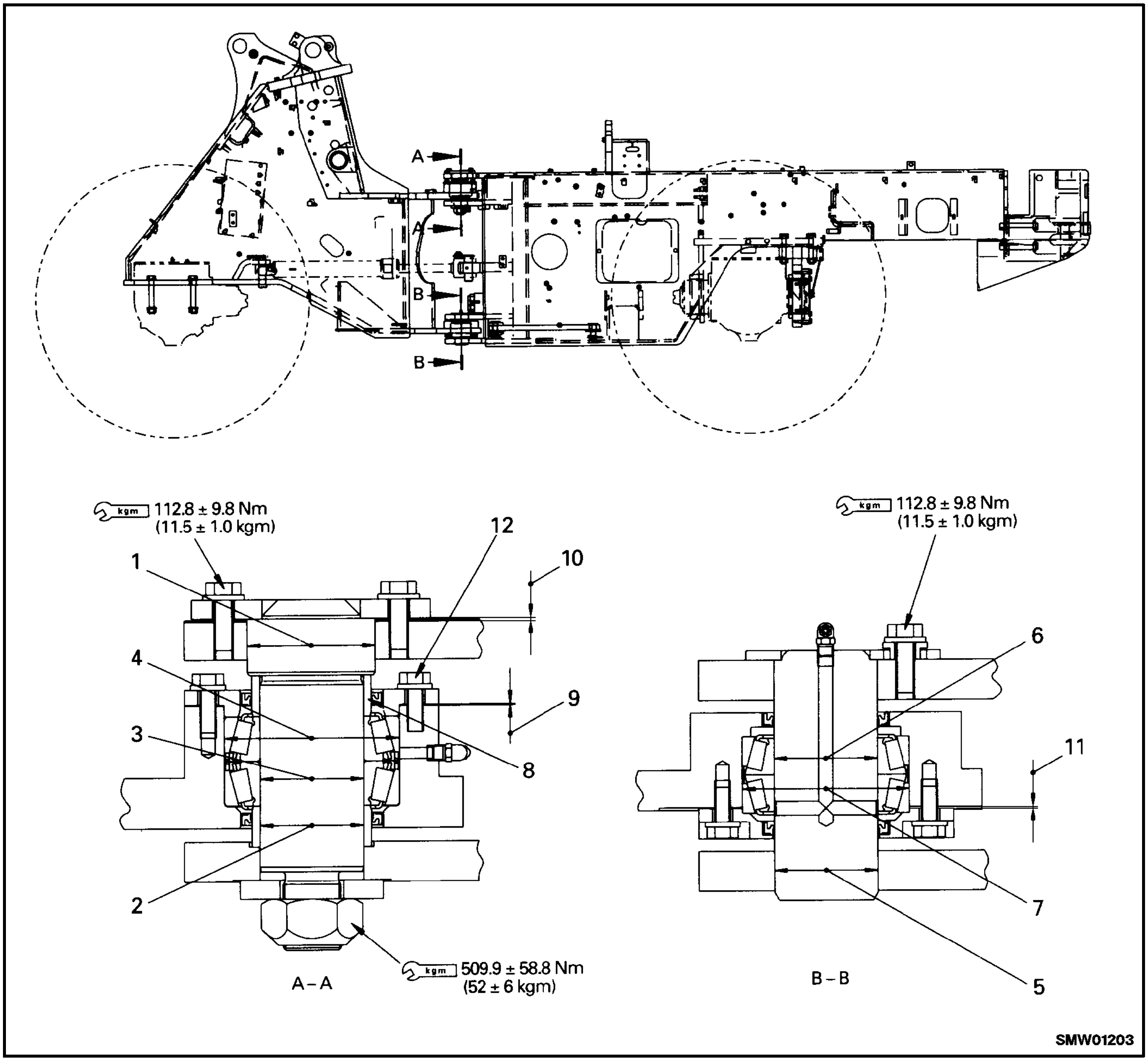

A
A
677 ± 69 Nm
(69 ± 7 kgm)
677 ± 69 Nm
(69 ± 7 kgm)
112.8 ± 9.8 Nm
(11.5 ± 1.0 kgm)
3
1
2
112.8 ± 9.8 Nm
(11.5 ± 1.0 kgm)
4
A – A
SMW01202

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Thickness of thrust plate</td><th colspan="2">Standard size</th><th colspan="2">Tolerance</th><th colspan="2">Repair limit</th><td rowspan="6">Replace</td></tr>
<tr><td colspan="2">10</td><td colspan="2">0
-0.15</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Clearance between hole and shaft at front support end</td><th rowspan="2">Standard size</th><th colspan="2">Tolerance</th><th rowspan="2">Standard clearance</th><th rowspan="2" colspan="2">Clearance limit</th></tr>
<tr><th>Shaft</th><th>Hole</th></tr>
<tr><td>170</td><td>-0.043
-0.106</td><td>+0.550
+0.050</td><td>0.093 -
0.656</td><td colspan="2">※</td></tr>
<tr><td>3</td><td>Clearance between hole and shaft at front support end</td><td>170</td><td>-0.043
-0.106</td><td>+0.550
+0.050</td><td>0.093 -
0.656</td><td colspan="2">※</td></tr>
<tr><td>4</td><td>Thickness of axle mount shim</td><td colspan="6">0.2 (standard shim thickness)</td><td>-</td></tr>
</table>

※ When contact directly shaft of axle to hole of axle support.

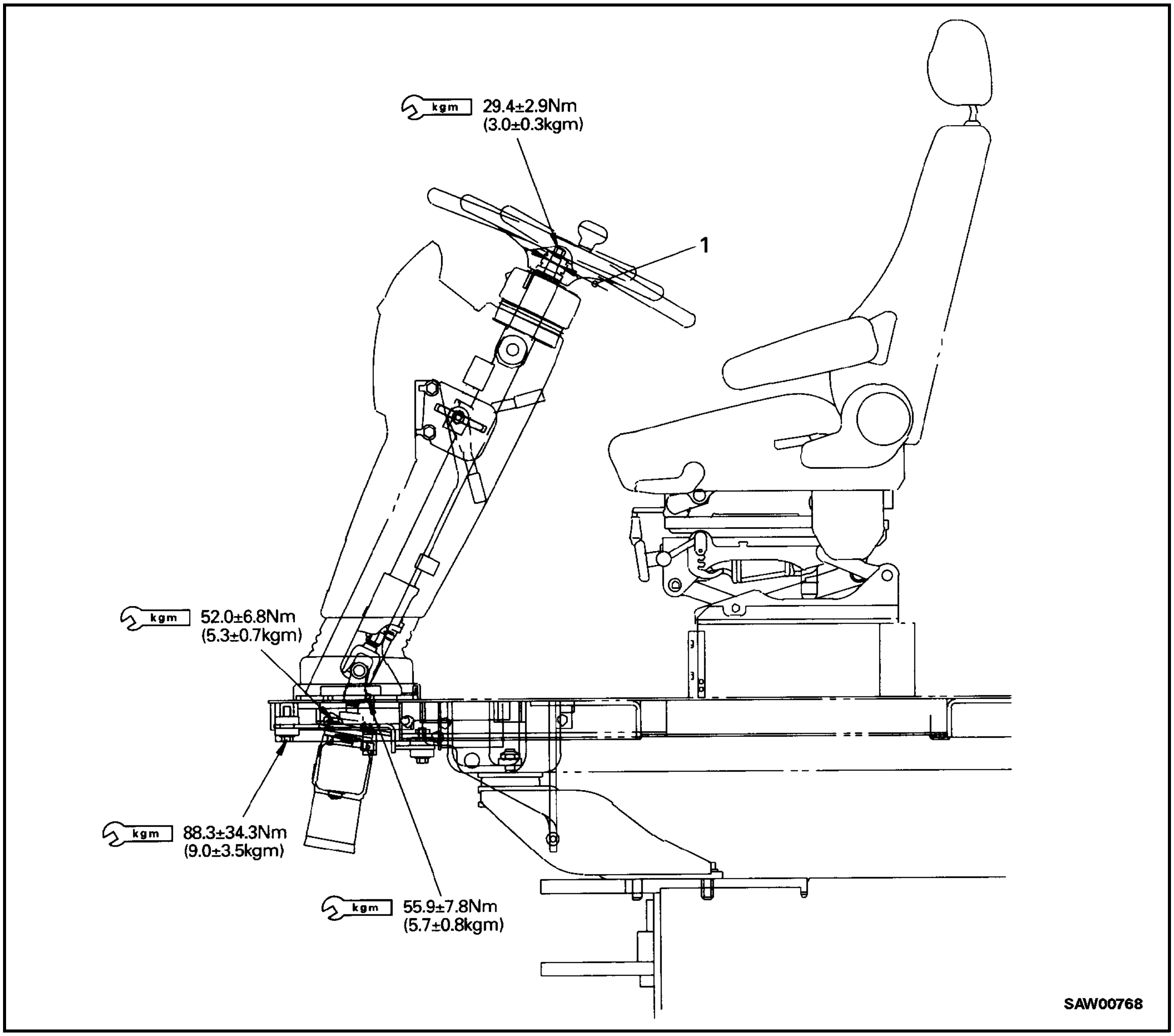
CENTER HINGE PIN



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between upper hinge pin and rear frame</td><td>Standard size</td><td>Tolerance
Shaft</td><td>Tolerance
Hole</td><td>Standard clearance</td><td>Clearance limit</td><td rowspan="8">Replace</td></tr>
<tr><td>80.5</td><td>-0.08
-0.18</td><td>± 0.05</td><td>0.03 -
0.23</td><td>-</td></tr>
<tr><td>2</td><td>Clearance between upper hinge pin and spacer</td><td>65</td><td>-0.030
-0.049</td><td>+0.24
0</td><td>0.030 -
0.073</td><td>-</td></tr>
<tr><td>3</td><td>Clearance between upper hinge and bearing</td><td>65</td><td>-0.030
-0.049</td><td>0
-0.015</td><td>0.015 -
0.049</td><td>-</td></tr>
<tr><td>4</td><td>Clearance between front frame and upper hinge bearing</td><td>110</td><td>0
-0.020</td><td>-0.041
-0.076</td><td>-0.076 -
-0.021</td><td>-</td></tr>
<tr><td>5</td><td>Clearance between lower hinge pin and rear frame</td><td>65</td><td>-0.030
-0.076</td><td>+0.046
0</td><td>0.030 -
0.122-</td><td>-</td></tr>
<tr><td>6</td><td>Clearance between lower hinge and bearing</td><td>65</td><td>-0.030
-0.076</td><td>0
-0.050</td><td>0.020 -
0.076</td><td>-</td></tr>
<tr><td>7</td><td>Clearance between front frame and lower hinge bearing</td><td>105</td><td>0
-0.020</td><td>-0.041
-0.076</td><td>-0.076
-0.021</td><td>-</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Height of upper hinge spacer</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td><td rowspan="6">Adjust</td></tr>
<tr><td colspan="2">26</td><td colspan="2">0
-0.25</td><td>-</td></tr>
<tr><td>9</td><td>Thickness of standard shim between upper hinge and retainer</td><td colspan="5">0.92</td></tr>
<tr><td>10</td><td>Thickness of standard shim between upper hinge and retainer</td><td colspan="5">1.45</td></tr>
<tr><td>11</td><td>Thickness of standard shim between upper hinge and retainer</td><td colspan="5">0.85</td></tr>
<tr><td>12</td><td>Tighten torque for mounting bolt of upper and lower hinge retainer</td><td colspan="5">14.7 ± 1.44 Nm
(1.5 ± 0.75 kgm) (final value)</td></tr>
</table>

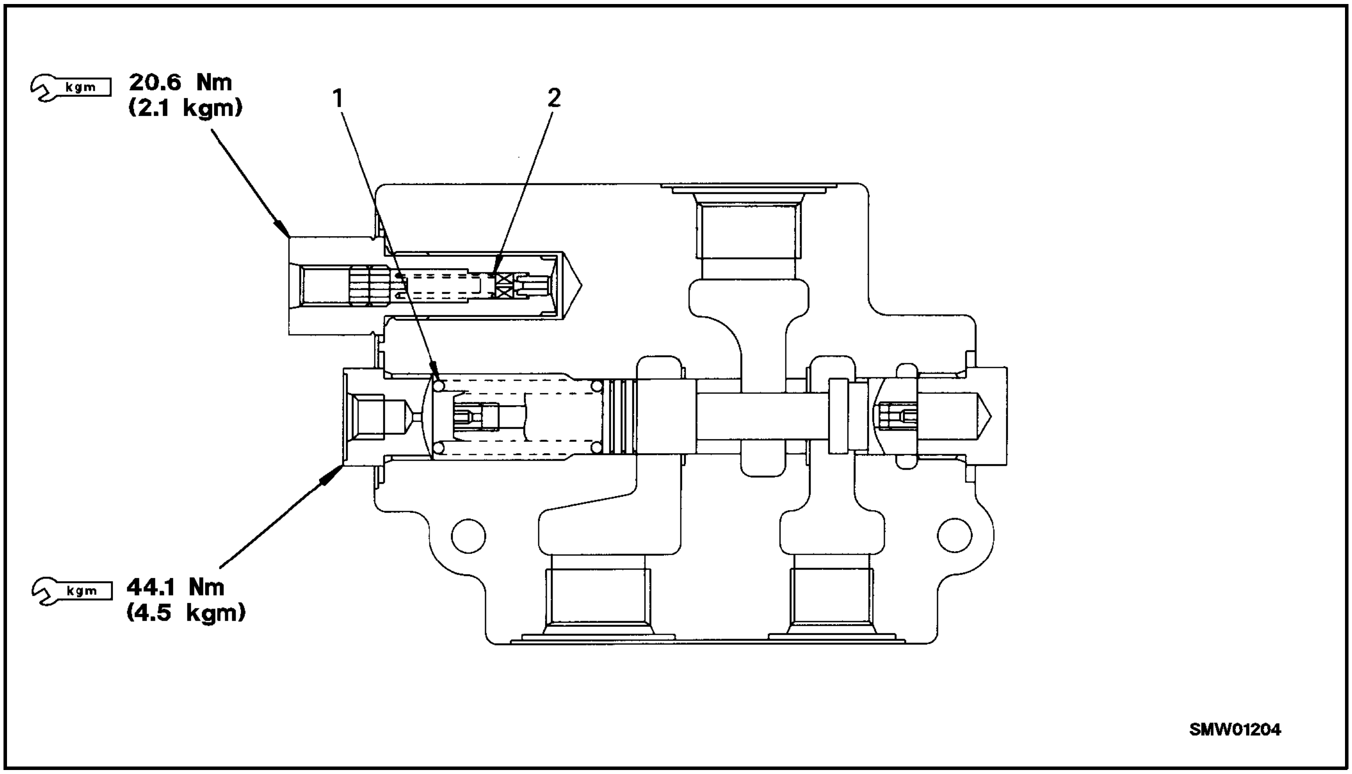
STEERING COLUMN



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between steering shaft and column bearing	19	0 -0.08	+0.15 -0.05	0.05 - 0.23	0.4	Replace

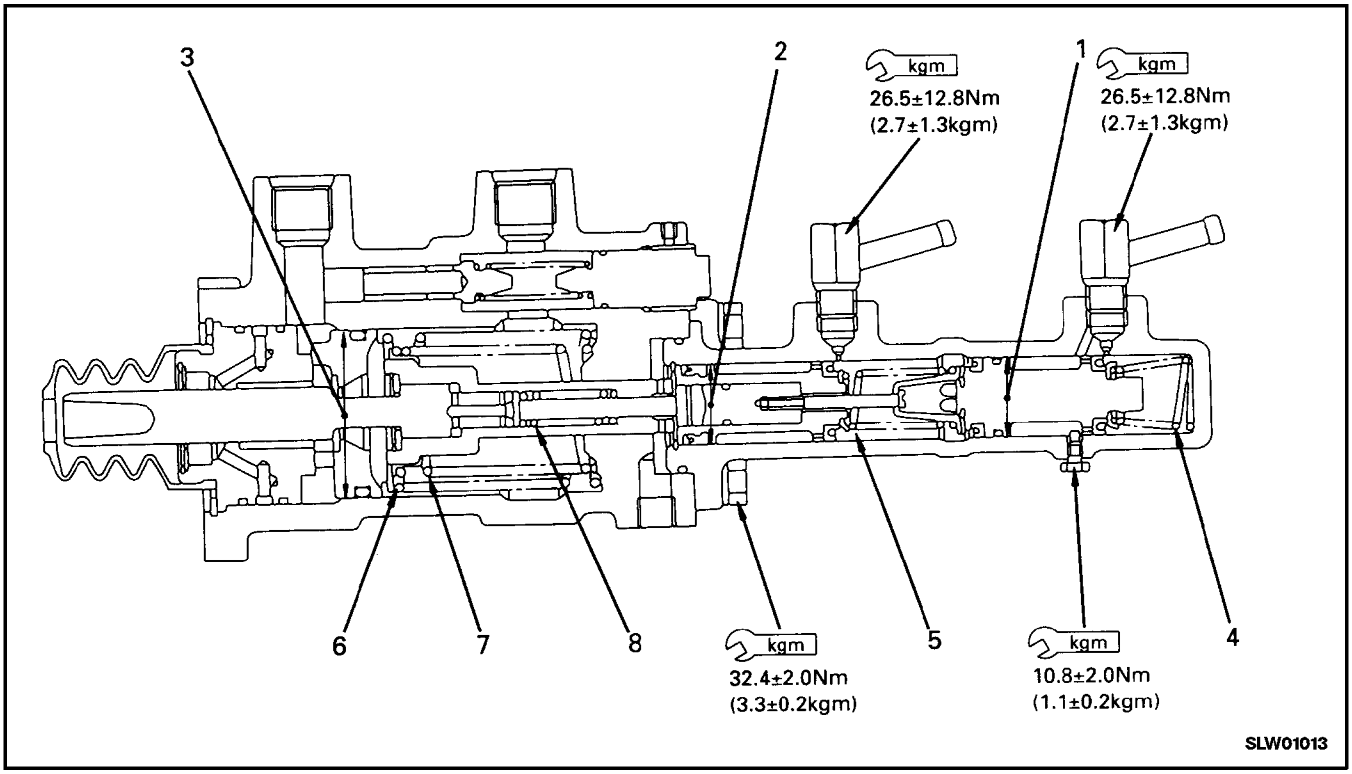
PRIORITY VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		Replace
		Free length	Installed height	Installed load	Free length	Installed load	
1	Control spring	63.4	47.6	187.3 Nm (19.1 kg)	63.4 ±	187.3 ± 14.71 N (19.1 ± 1.5 kg)	
2	Relief spring	31	27.3	132.4 N (13.5 kg)	-	132.4 ± 14.71 N (13.5 ± 1.5	

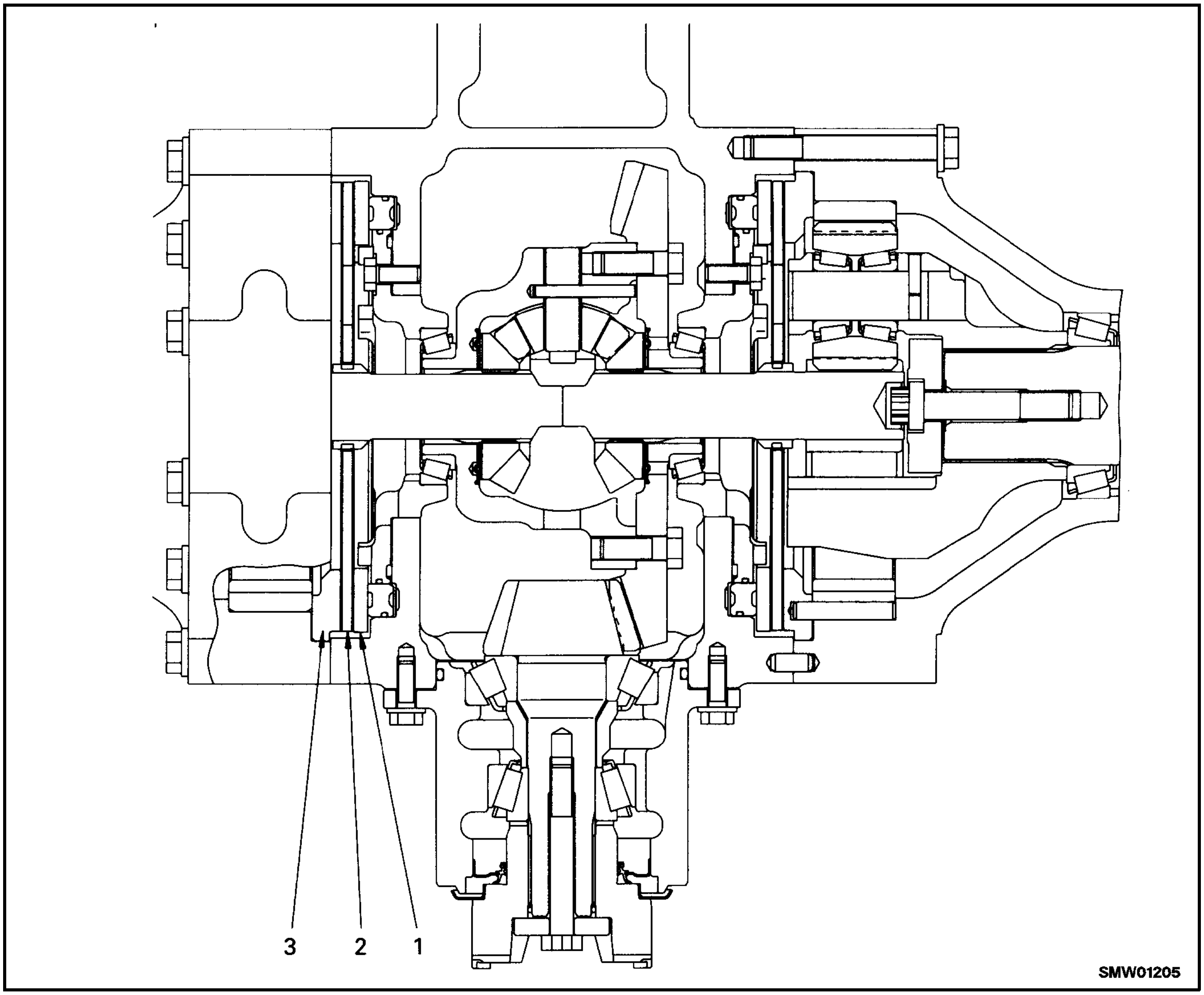
MASTER CYLINDER



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between primary piston and body	33.34	-0.025 -0.064	+0.062 0	0.025 - 0.126	0.15	Replace
2	Clearance between secondary piston and body	33.34	0.025 0.064	+0.062 0	0.025 - 0.126	0.15	
3	Clearance between power piston and body	70	-0.060 -0.106	+0.074 0	0.060 - 0.180	0.20	
		Standard size			Repair limit		
		Free length	Installed height	Installed load	Free length	Installed load	
4	Primary piston spring	57.1	35.1	85.3 N (8.7 kg)	-	85.3 ± 12.75 N (8.7 ± 1.3 kg)	
5	Secondary piston spring	72.8	48.3	129.4 N (13.2 kg)	-	129.5 ± 18.63 (13.2 ± 1.9 kg)	
6	Spring	199.2	86	294.2 N (30 kg)	-	294.2 ± 44.13 N (30 ± 4.5 kg)	
7	Spring	143.75	80.25	196.1 N (20 kg)	-	196.1 ± 29.42 N (20 ± 3.0 kg)	
8	Reaction spring	48	40	127.5 N (13 kg)	-	127.5 ± 18.63 N (13 ± 1.9 kg)	

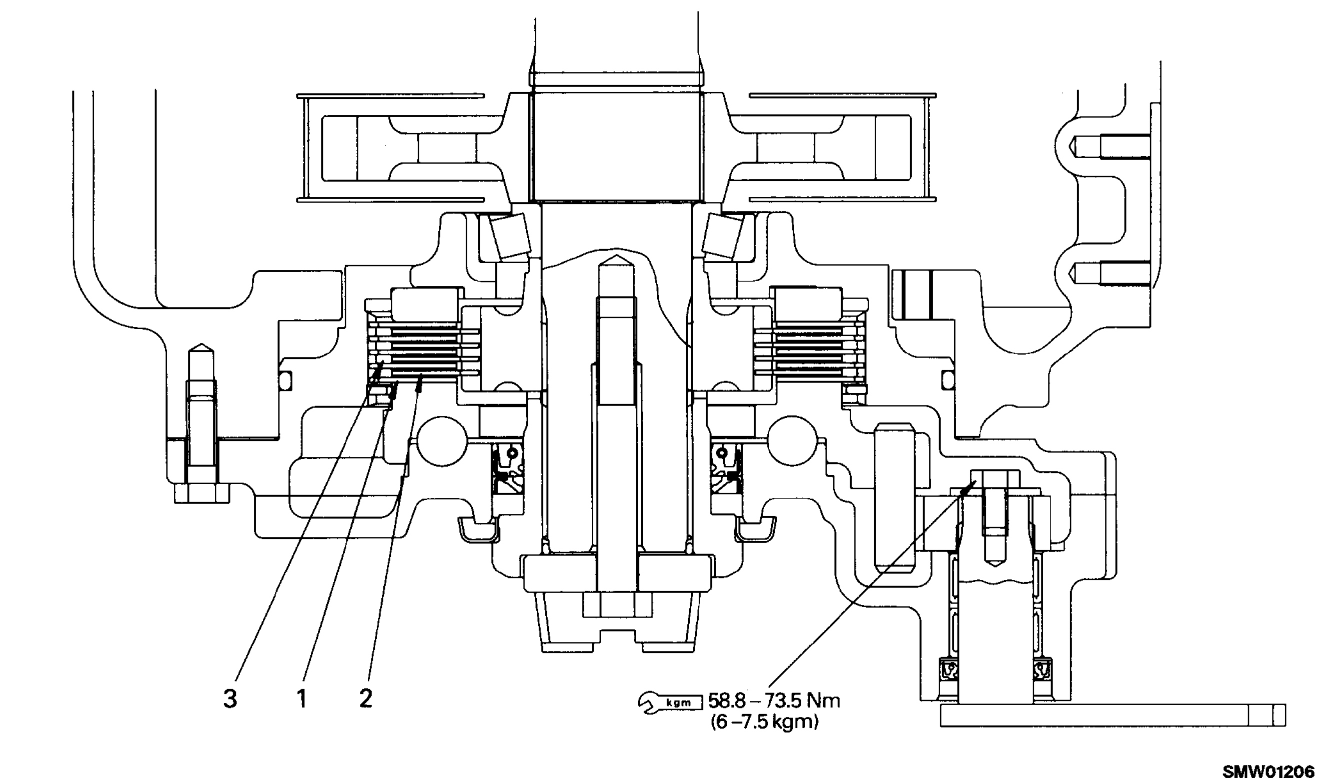
BRAKE



Unit: mm

No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
1	Thickness of inner ring		9.6	$^{0}_{-0.05}$	8.8	Replace
2	Thickness of brake disc		8.7	± 0.15	7.9	
	Depth of lining groove		0.8	± 0.2	0.4	
	Thickness of lining		1.0	0.8 (min.)	-	
3	Thickness of brake outer ring	Front axle	22.3	± 0.1	21.9	
		Rear axle	19.3	± 0.1	18.9	

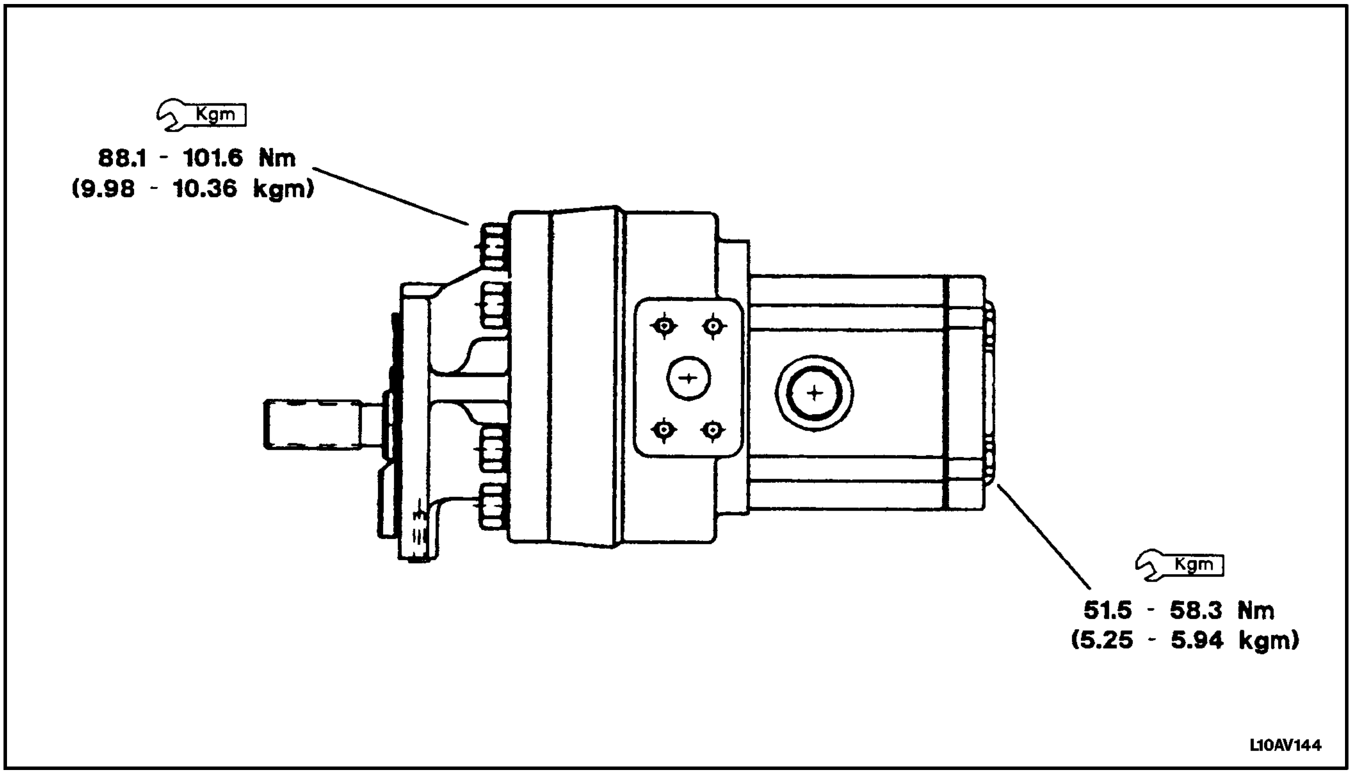
PARKING BRAKE



Unit: mm

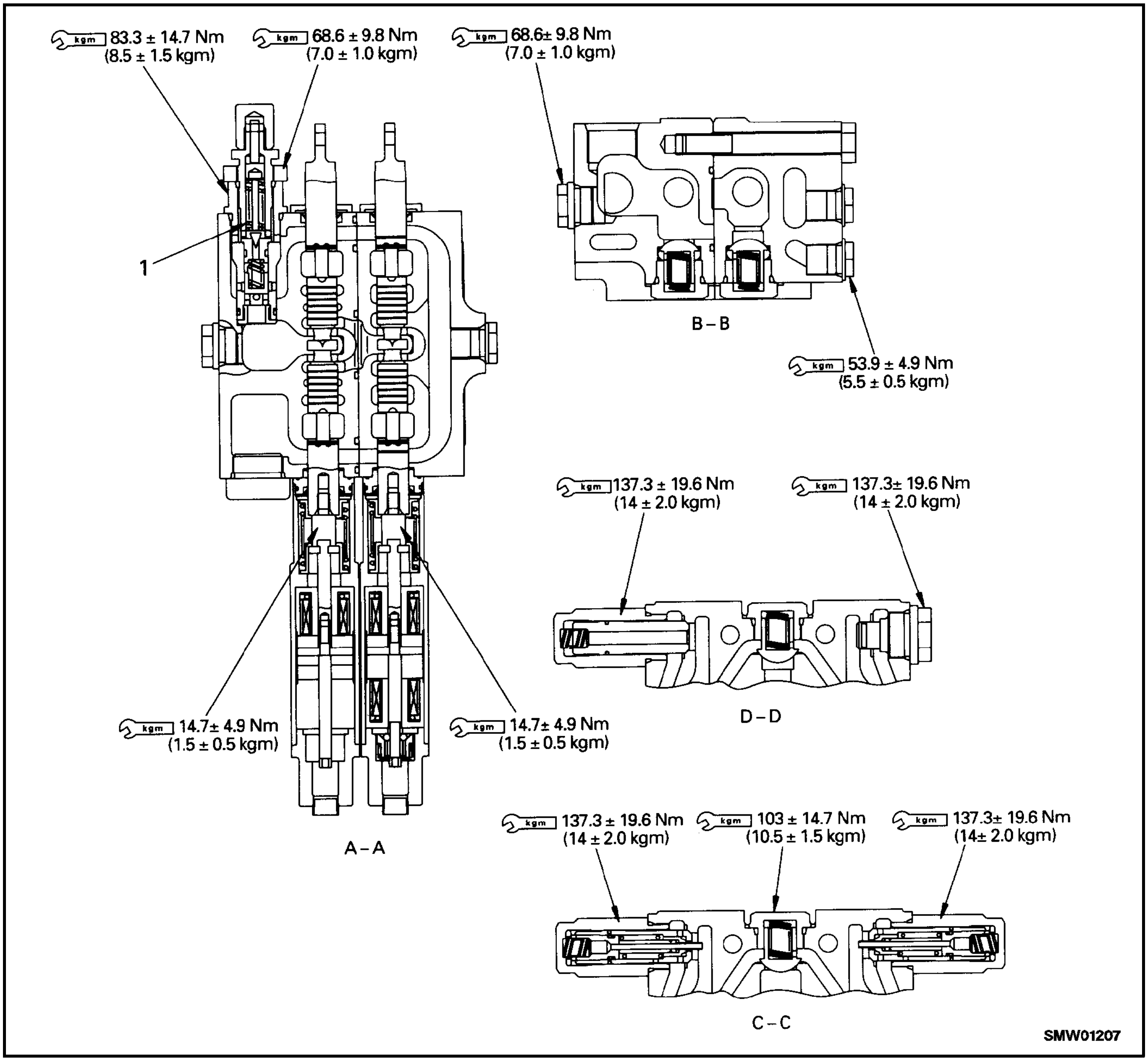
No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
1	Thickness of plate		2.0	± 0.05	1.9	Replace
		Distortion	-	0.05	0.1	
2	Brake disk	Thickness	3.2	± 0.08	2.97	
		Depth of lining groove	0.45	+0.175 0	0.3	
		Lining thickness	0.7	± 0.075		
3	Load of wave spring		1106.2 N (112.8 kg) (Height: 3.2 mm)	± 56.9 N (± 5.8 kg)	892.4 N (91 kg)	

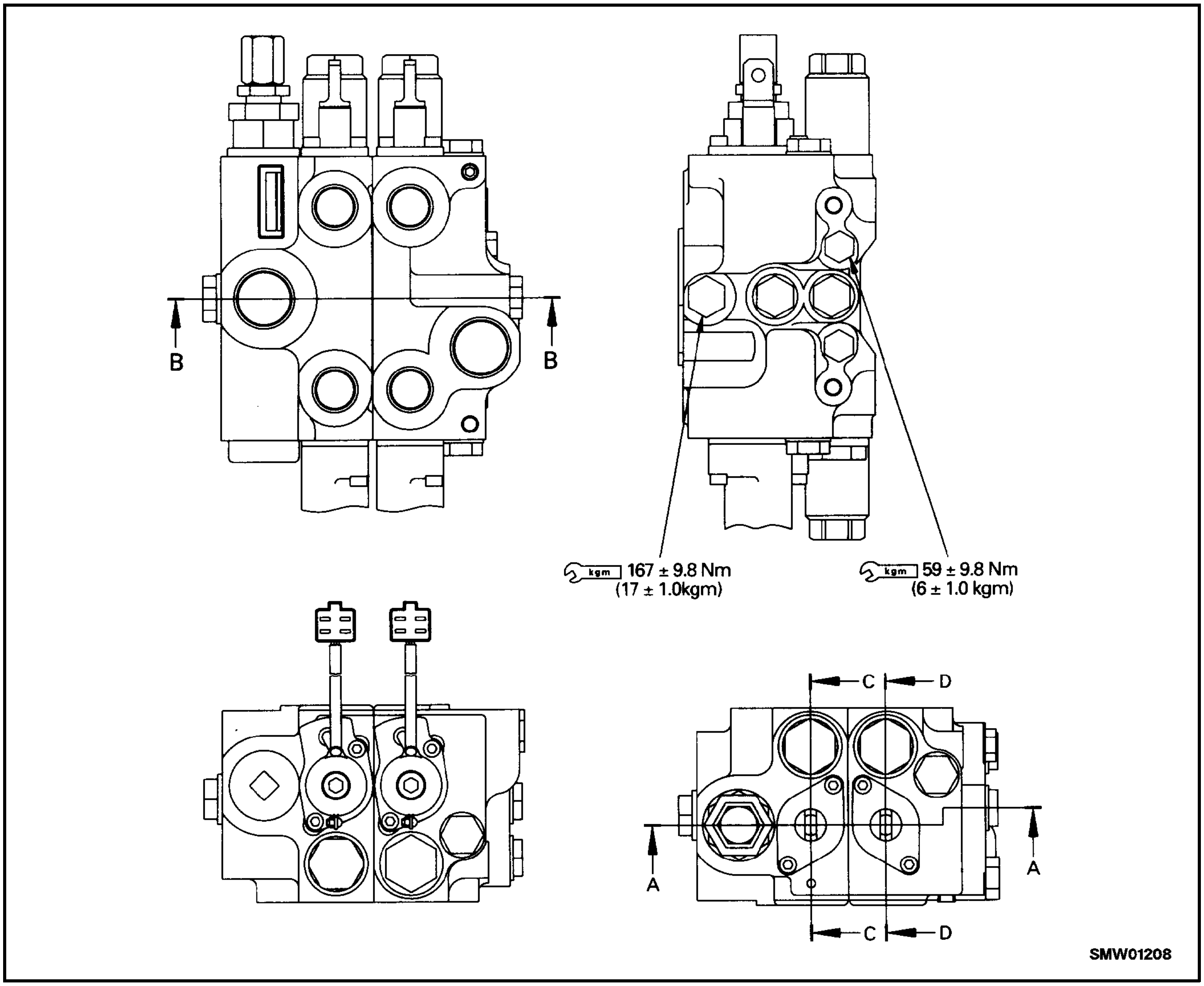
HYDRAULIC PUMP



MAIN CONTROL VALVE

2-SPOOL VALVE

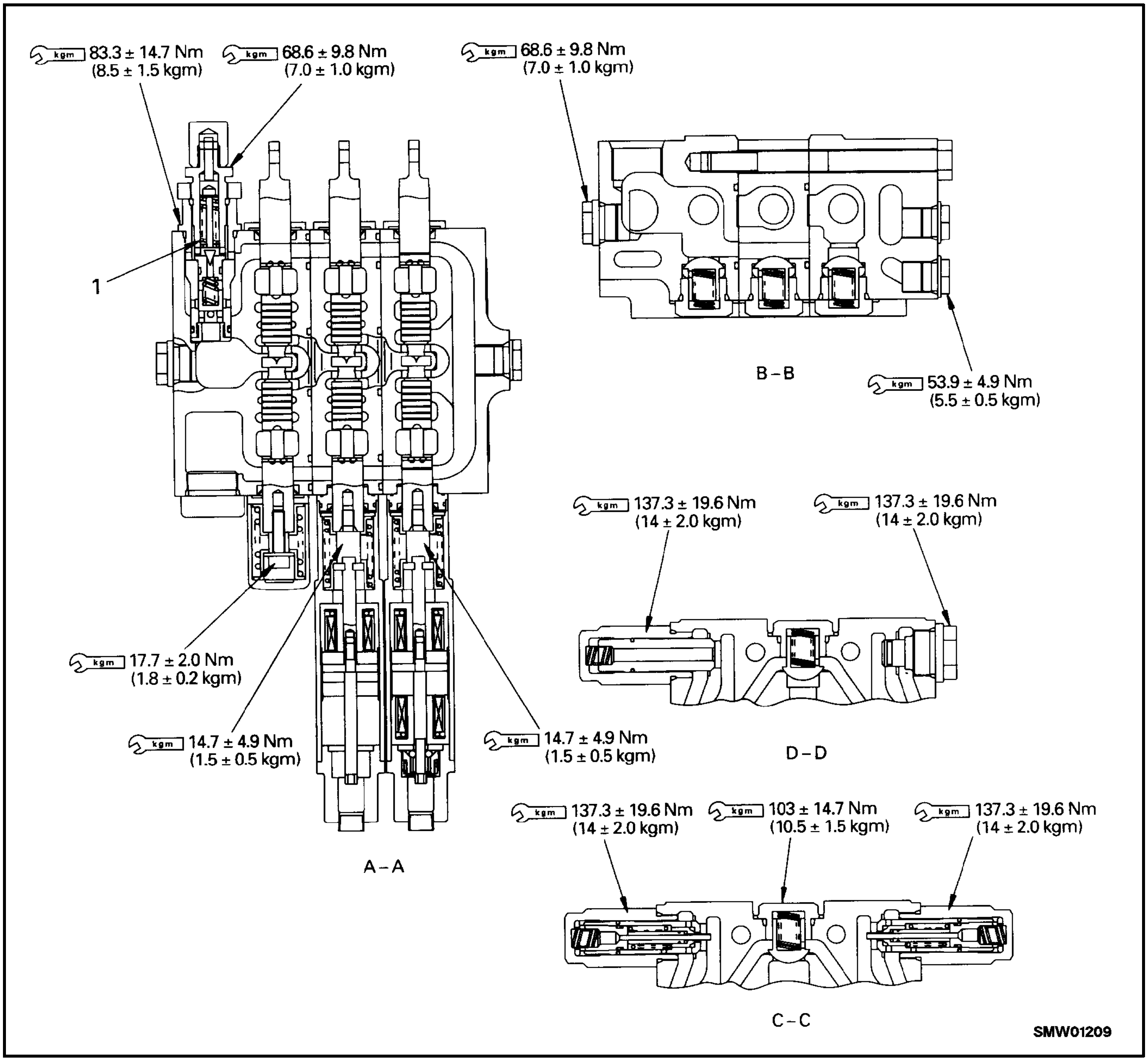


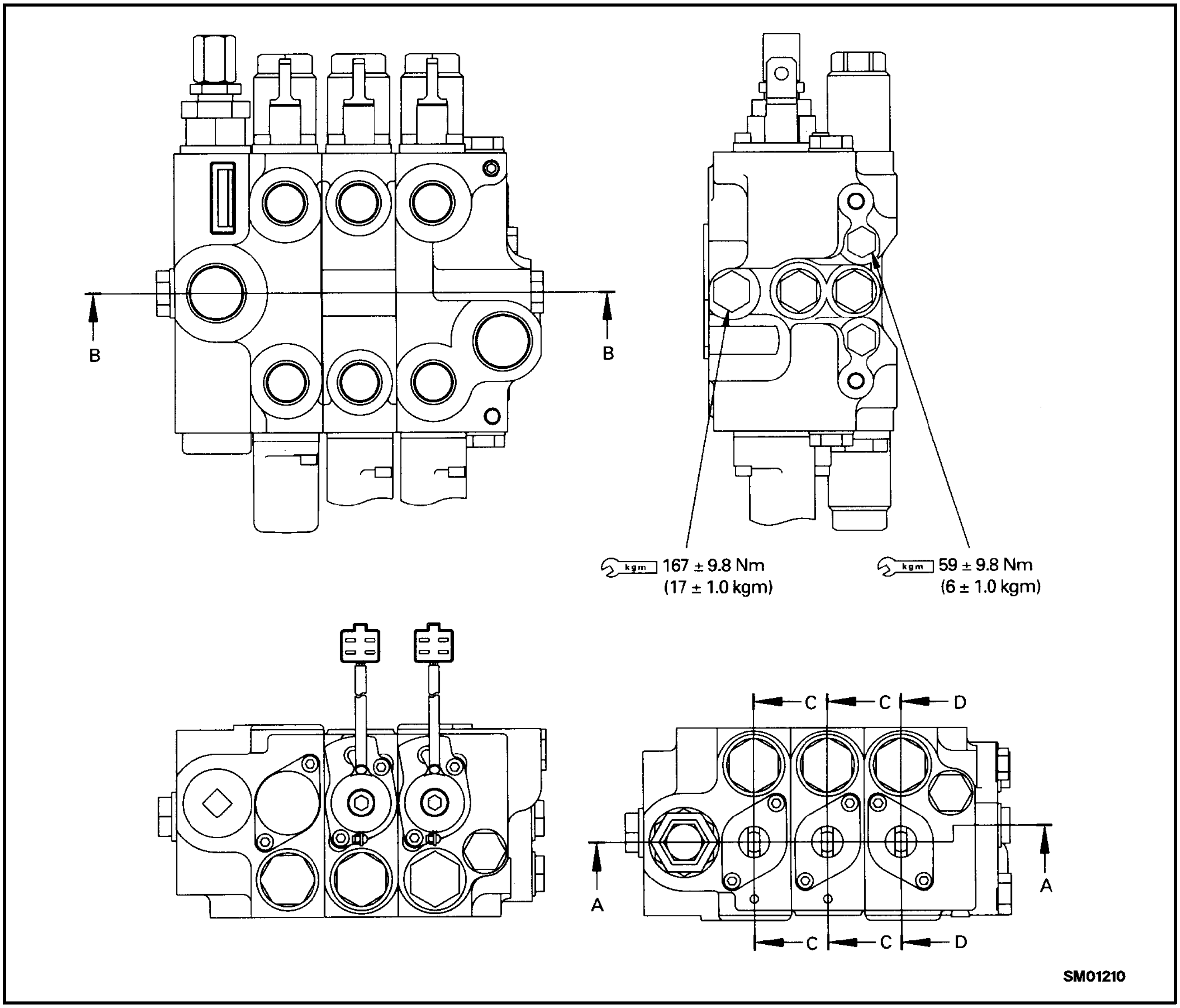


Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length	Installed height	Installed load	Free length	Installed load	
1	Relief valve spring	41.1	32.6	258.9 N (26.4 kg)	39.4	206.9 N (21.1 kg)	

3-spool valve

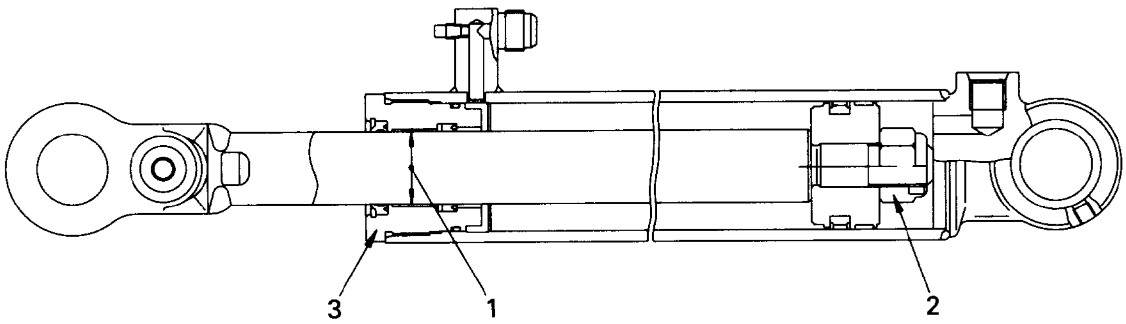




Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length	Installed height	Installed load	Free length	Installed load	
1	Relief valve spring	41.1	32.6	258.9 N (26.4 kg)	39.4	206.9 N (21.1 kg)	

HYDRAULIC CYLINDER

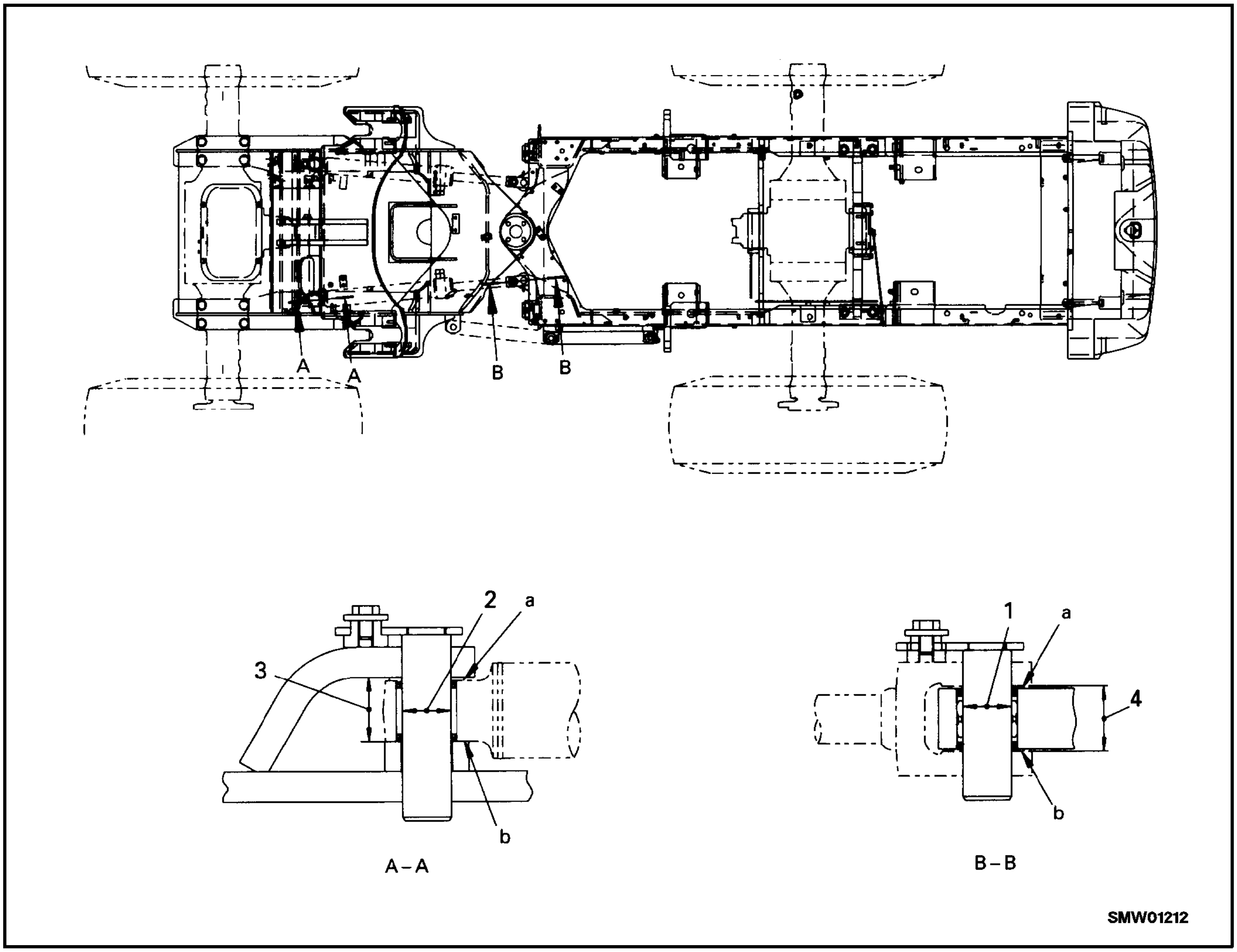


★ The diagram shows the steering cylinder

Unit: mm

No.	Check item		Criteria					Remedy
		Name of cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	70	-0.030 -0.104	+0.271 +0.075	0.105 - 0.375	0.675	Replace bushing
		Bucket	70	-0.030 -0.104	+0.271 +0.075	0.105 - 0.375	0.675	
		Steering	40	-0.025 -0.087	+0.132 +0.006	0.031 - 0.219	0.519	
2	Assembling torque of piston mounting nut	Boom	2598.8 ± 259.9 Nm (265 ± 26.5 kgm)					Tighten
		Bucket	3971.7 ± 397.1 Nm (405 ± 40.5 kgm)					
		Steering	411.9 ± 41.2 Nm (42 ± 4.2 kgm)					
3	Assembling torque of cylinder head	Boom	98.7 ± 9.9 Nm (100 ± 10 kgm)					
		Bucket	1029.7 ± 103 Nm (105 ± 10.5 kgm)					
		Steering	593.4 ± 59.3 Nm (55 ± 5.5 kgm)					

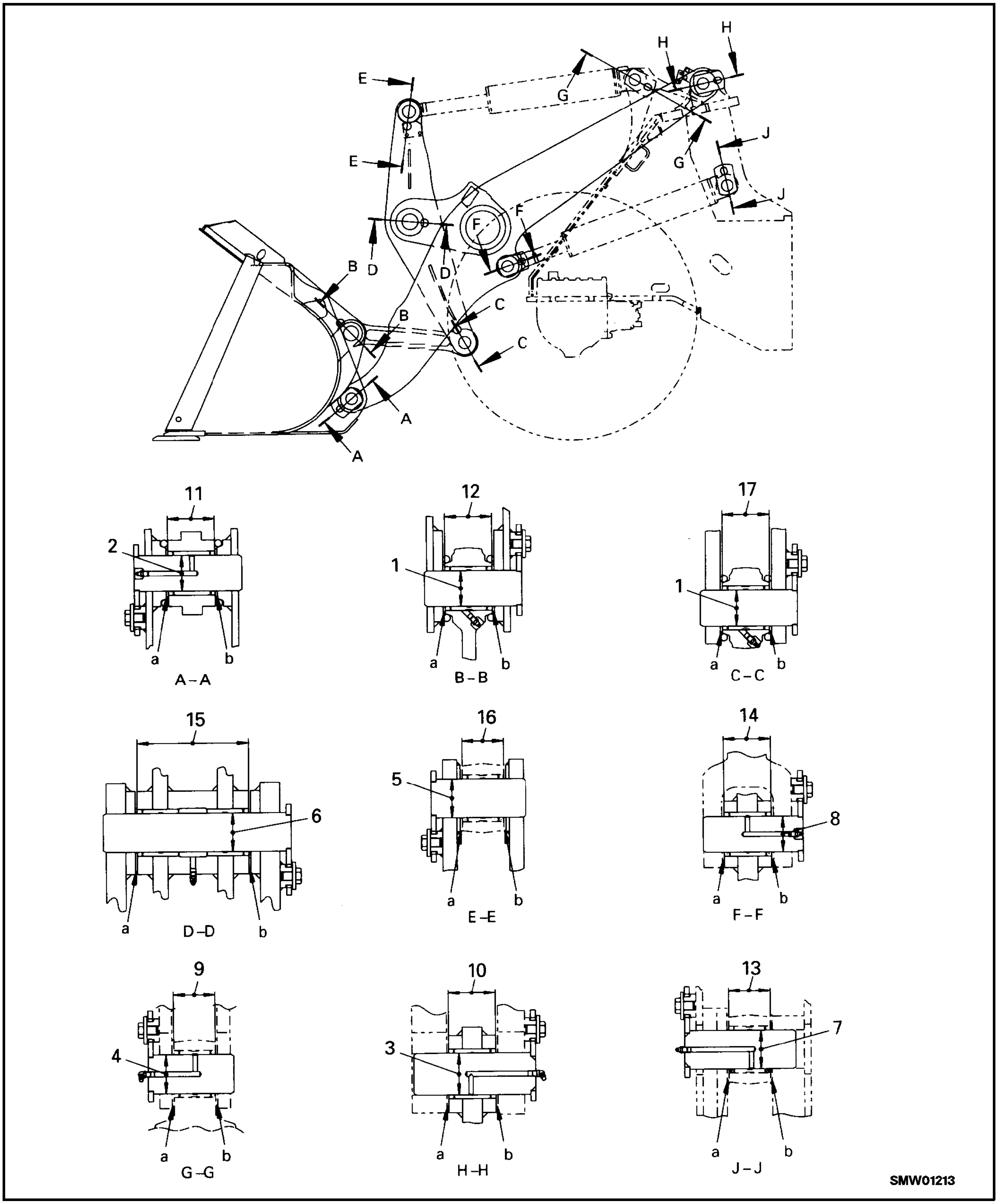
STEERING CYLINDER MOUNT



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between mounting pin and bushing at connection of steering cylinder rod and frame	40	0 -0.025	+0.180 +0.042	0.205 - 0.042	1.0	Replace
2	Clearance between mounting pin and bushing at connection of steering cylinder bottom and frame	40	0 -0.025	+0.173 +0.124	0.198 - 0.124	1.0	
		Width of boss		Width of hinge		Standard clearance (clearance a + b)	
3	Connection of steering cylinder and front frame	50+0.8 0		53		Max. 0.5 (after adjusting shim)	
4	Connection of steering cylinder and rear frame	50		54 ± 0.8		Max. 0.5 (after adjusting shim)	

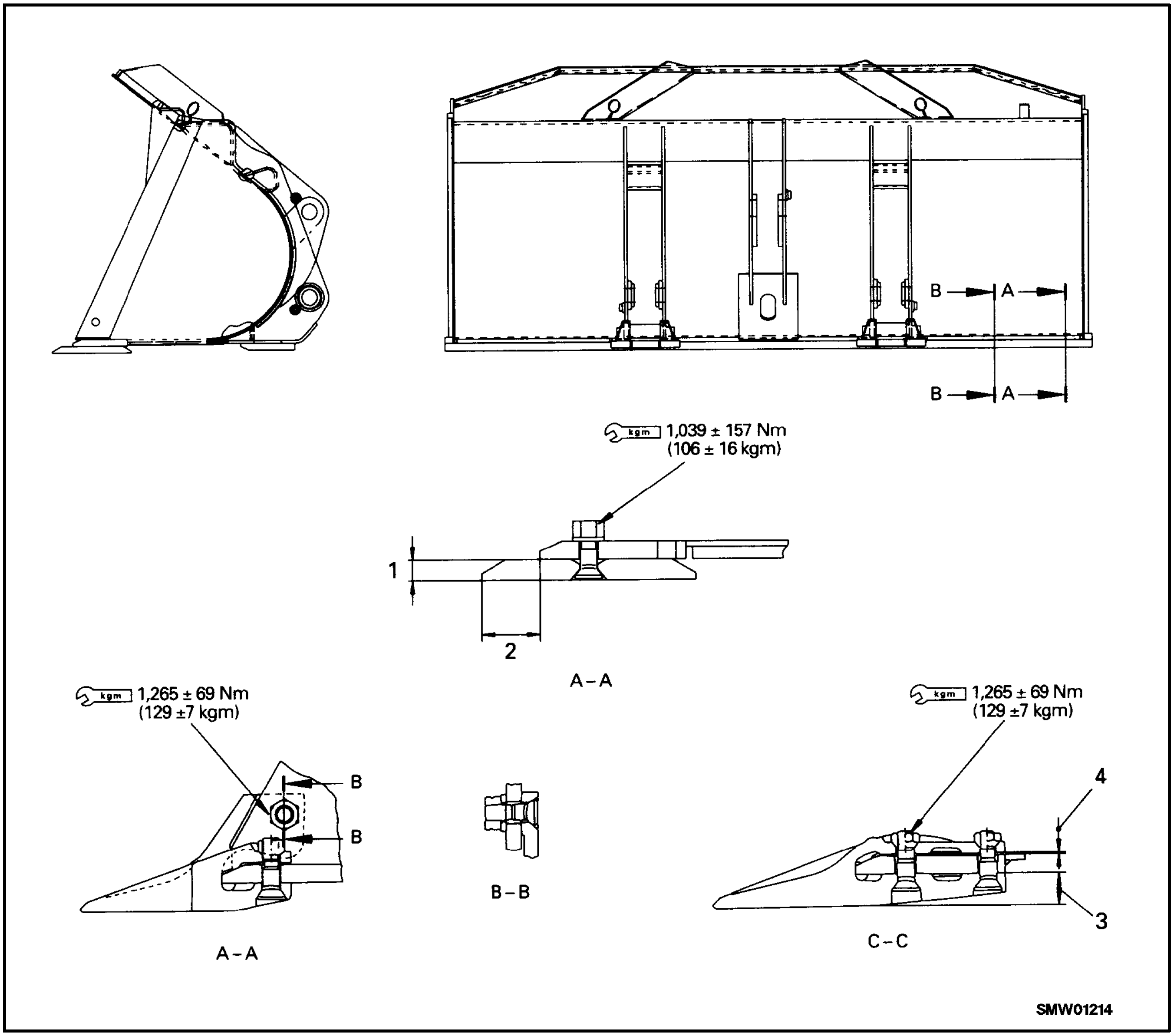
WORK EQUIPMENT LINKAGE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pin and bushing at both ends of bucket link	65	-0.030 -0.076	+0.174 +0.100	0.130 - 0.250	1.0	Replace (Replace also if there is scuffing of pin)
2	Clearance between pin and bushing at connection of boom and bucket	65	-0.030 -0.076	+0.174 +0.100	0.130 - 0.250	1.0	
3	Clearance between pin and bushing at connection of boom and frame	75	-0.030 -0.076	+0.174 +0.100	0.130 - 0.250	1.0	
4	Clearance between pin and bushing at connection of frame and bucket cylinder bottom	70	-0.030 -0.076	+0.290 +0.120	0.156 - 0.366	1.0	
5	Clearance between pin and bushing at connection of lever and bucket cylinder rod	70	-0.030 -0.076	+0.290 +0.120	0.156 - 0.366	1.0	
6	Clearance between pin and bushing at connection of lift arm and bellcrank	70	-0.030 -0.076	+0.174 +0.100	0.130 - 0.250	1.0	
7	Clearance between pin and bushing at connection of frame and boom cylinder bottom	70	-0.030 -0.076	+0.290 +0.100	0.130 - 0.366	1.0	
8	Clearance between pin and bushing at connection of boom and boom cylinder rod	65	-0.030 -0.076	+0.174 +0.100	0.130 - 0.250	1.0	
		Width of boss		Width of hinge		Standard clearance (clearance a + b)	
9	Connection bucket cylinder bottom and frame	75		78 ± 1.5		0.7 - 4.5	Replace (Insert shims at both sides so that clearance is less than 1.5 mm on both left and right)
10	Connection of boom and frame	85 ± 1.8		88 +1.5 0		1.2 - 6.3	
11	Connection of boom and bucket	85 ± 1.8		88 +3 0		1.2 - 7.8	
12	Connection of bucket link and bucket	85 +2.8 -0.8		88 +3 0		0.2 - 6.8	
13	Connection of boom cylinder and frame	75 +0.8 -0.8		77.5 ± 1.5		0.2 - 4.0	
14	Connection of boom and boom cylinder	85 +1.8		89 ± 0.8		1.4 - 6.6	
15	Connection of bellcrank and boom	201 ± 0.5		204 ± 1.5		1 - 5	Replace
16	Connection of bucket cylinder and bellcrank	75 +0.8 -0.8		77.5 ± 1.5		0.2 - 4.0	
17	Connection of bellcrank and bucket link	85 +2.8 -0.8		89.5 ± 1.5		0.2 - 6.8	

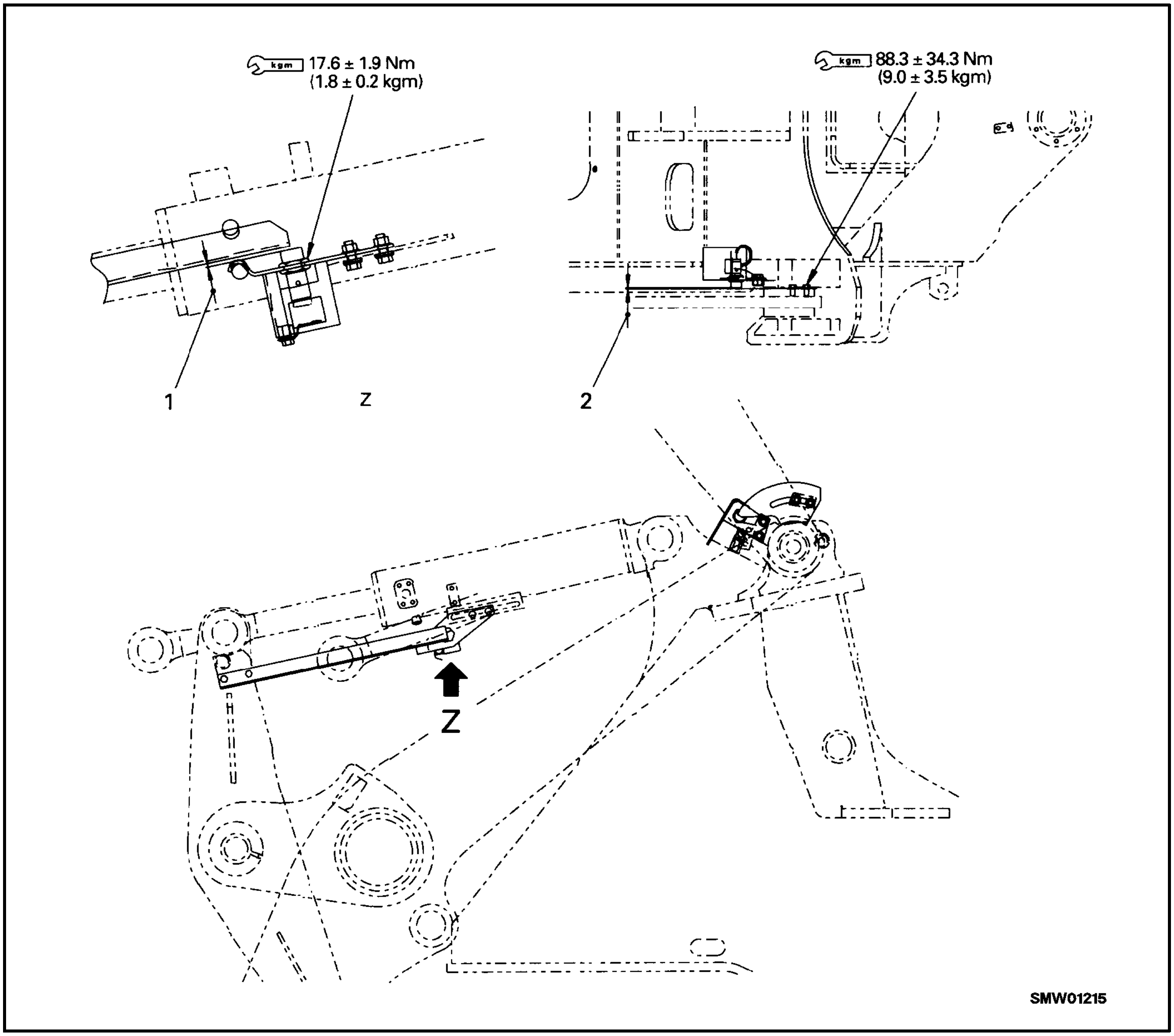
BUCKET



Unit: mm

No.	Check item	Criteria			Remedy
1	Wear of cutting edge (thickness)	Standard size		Repair limit	Replace
		31.8		19	
2	Wear of cutting edge (length)	90		5	
3	Wear of bucket tooth	Standard size	Tolerance	Repair limit	
		37	-	21	
4	Clearance at bucket tooth mount	0.54 (Max.)			

BUCKET POSITIONER AND KICK-OUT



Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance of bucket positioner switch	3 - 5	Adjust
2	Clearance of boom kick-out switch	3 - 5	

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