Shop Manual

VENBM03000

FIRST DRAFT

WA80M-7

WA100M-7

WHEEL LOADER

Model:	Serial number:
WA80M-7	H62051 AND UP
WA100M-7	H62051 AND UP

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local KOMATSU distributor for those items you may require.
- Materials and specifications are subject to change without notice.
- The Wheel Loader WA80M-7 is equipped with the engine SAA4D95LE-6.
  The Wheel Loader WA100M-7 is equipped with the engine SAA4D95LE-6.
- For details of this engine see Engine Manual: WA80M-7, WA100M-7 in attachment

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KOMATSU

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00 SAFETY

Safety notice

Important Safety Notice
Proper service and repair is extremely important for safe machine operation. Some of the described service and repair techniques require the use of tools specially designed by Komatsu for the specific purpose.
To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols must 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 AND MAINTENANCE MANUAL carefully before operating the machine! Always follow the safety rules valid in your country carefully!

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. Never smoke while working. Smoke only in the areas provided for smoking.

Preparations for work

1. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.

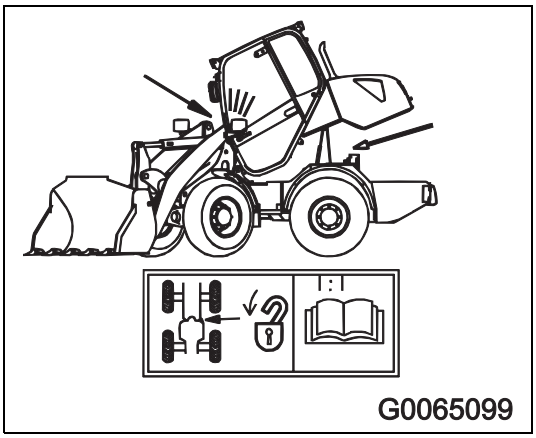
2. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground and install the safety bar on the frame. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.

3. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.

4. 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.

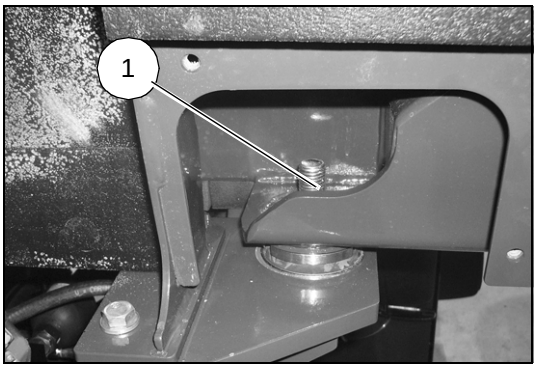
Tipping up the driver's cab

1. Park the machine on solid, level ground.
2. Lower the work unit to the ground and switch off the engine.
3. Close the cab door.
4. Use the locking bolt to secure the articulated steering.

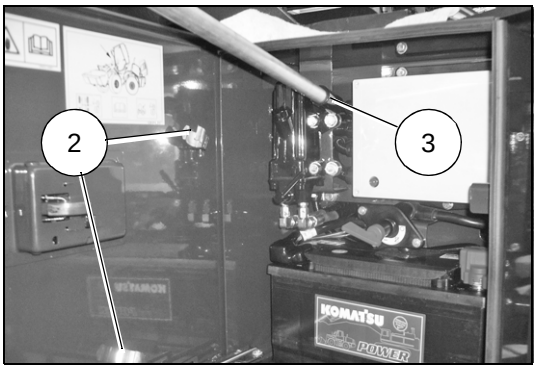


NOTE
The machine has to be positioned straight and the articulated steering has to be secured with the locking bolt! If the driver's cab is tipped up while the machine is bent, the front frame can cause damage to the windscreen!

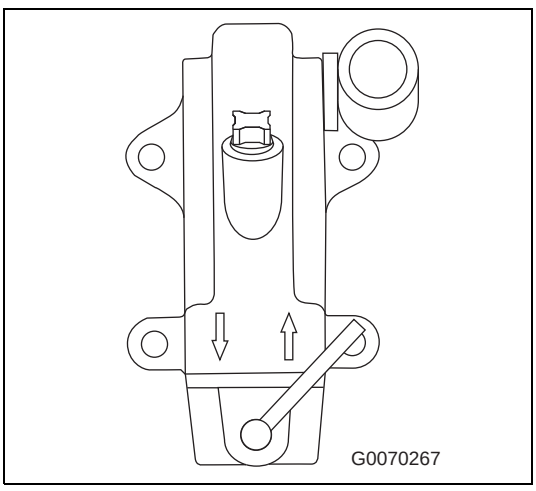
5. Open the bonnet.
6. Remove the fastening nuts (1) for the cabin on both sides.



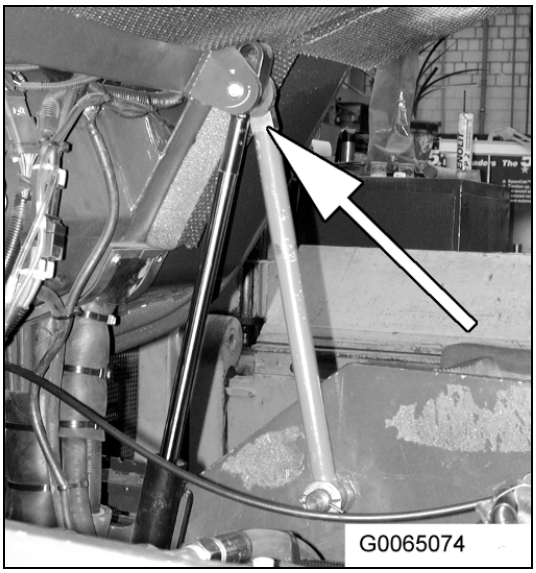
7. Take the hand pump lever from its holder (2) and insert it into the receptacle of the pump (3).



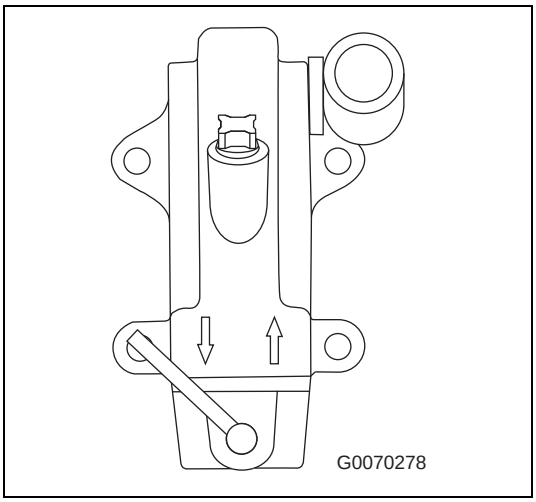
8. Set the lever at the pump to "pump up" and pump the cab upward until it reaches the limit stop.



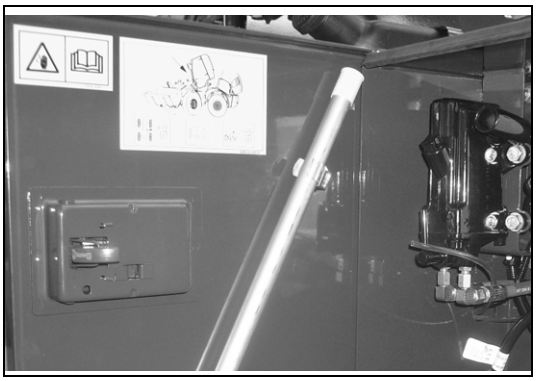
9. Fold out the safety rod on the right side over the retaining pin.



10. Set the lever at the pump to "pump down" and pump the cab downward until the safety rod is secure against the right side of the cab floor.

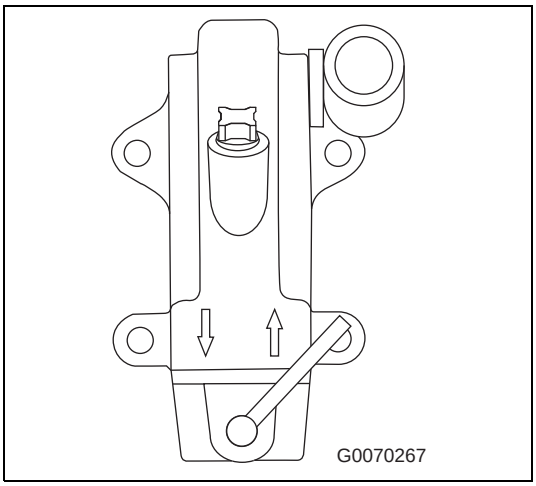


11. Remove the lever from the pump and fasten it in the door.

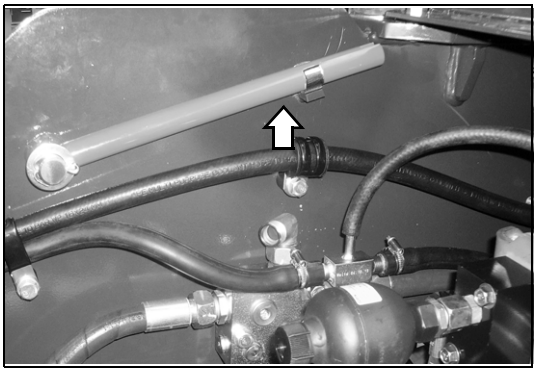


Tipping down the driver's cab

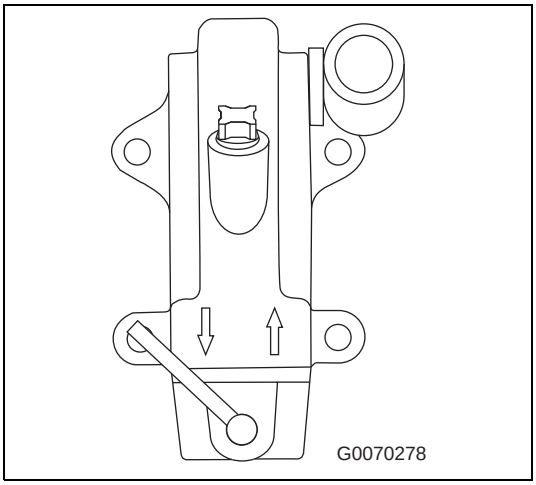
1. Insert the lever into the pump. Set the lever at the pump to "pump up" and pump the cab upward until it reaches the limit stop.



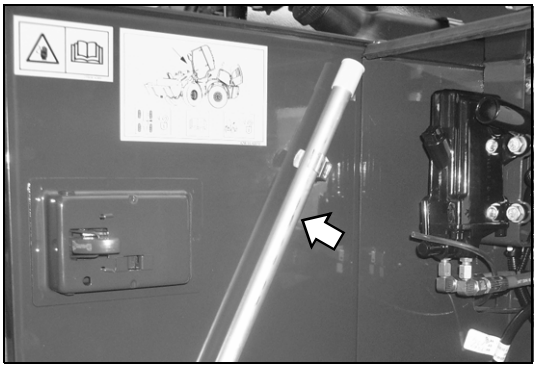
2. Fold down the safety rod on the right side and fasten it in this position (arrow).



3. Set the lever to "pump down" and pump the cab downward until the cylinder is entirely retracted (the resistance at the lever increases markedly).



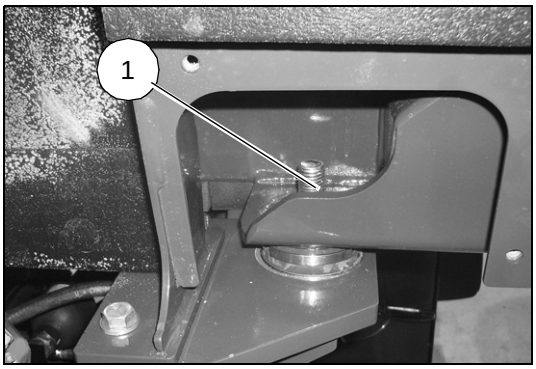
4. Remove the lever from the pump and fasten it in the door.



5. Screw the cabin on firmly at both sides using new locking nuts (1).

   Torque = 500 Nm

6. Close the bonnet.



Precautions during work

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

2. 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.

3. 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.

4. Before starting work, remove the leads from the battery. Always remove the lead from the negative (-) terminal first.

5. 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.

6. 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.

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

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

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

10. Be sure to assemble all parts again in their original places.

    Replace any damaged parts 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 oper ated.

11. 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.

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

13. 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.

Hydraulic system

Only qualified personnel with experience in the handling of highly pressurized fluids is allowed to maintain and repair the hydraulic system.

- **Hydraulic oil is hot and under high pressure!**
  Danger of injury to unprotected parts of the body! Always wear special safety equipment, especially safety googles and gloves.
- **Hydraulic oil is a hazardous substance!**
  Danger of injury. Seek medical help immediately if you are exposed to hydraulic oil.

Foreword

General

This shop manual has been prepared as an aid to improve the quality of repairs by giving the service personnel an accurate understanding of the product and by showing them 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 chapters; these chapters are further divided into the each main group of components:

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.

NOTE
The specifications contained in this shop manual are subject to change at any time and without any advance notice. Use the specifications given in the book with the latest date.

How to read the shop manual

Volumes

Shop manuals are issued as a guide to carrying out repairs.

Distribution and updating

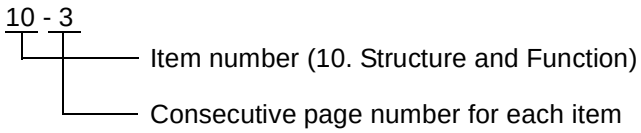
Any additions, amendments or other changes will be sent to Komatsu distributors.

Get the most up-to-date information before you start any work.

Filing method

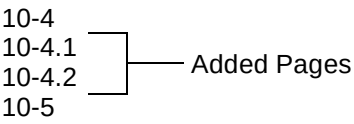
1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.

   Example 1 (Chassis volume):

3. Additional pages: Additional pages are indicated by a point (.) and number after the page number. File as in the example.

   Example:

Symbols

So that the shop manual can be of ample practical use, important safety and quality portions 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 of systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and libricants, 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

Heavy parts (25kg or more) must be lifted with a hoist, etc. In the DISASSEMBLY AND ASSEMBLY section, every part weigthing 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 interference with the part to be removed.

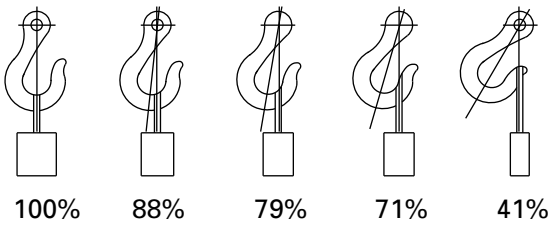
Wire ropes

1. Use adequate ropes depending on the weight of parts to be hoisted, refering to the table below:
   - The allowable load in tons, is given by vertical tensible force.
   - The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

Wire ropes: (Standard "Z" or "S" twist ropes without galvanizing)	
Rope diameter (mm)	**Allowable load (tons)**
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

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.



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

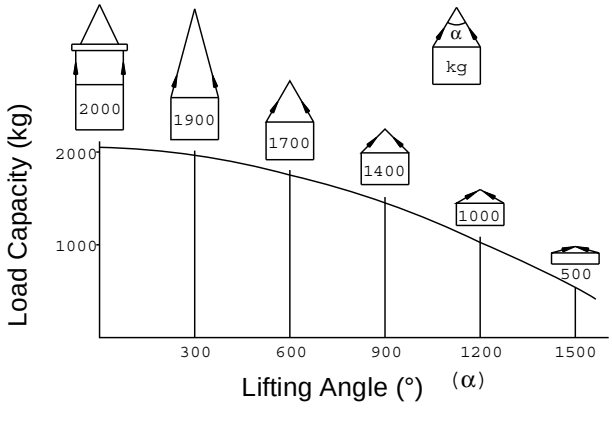
Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

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.

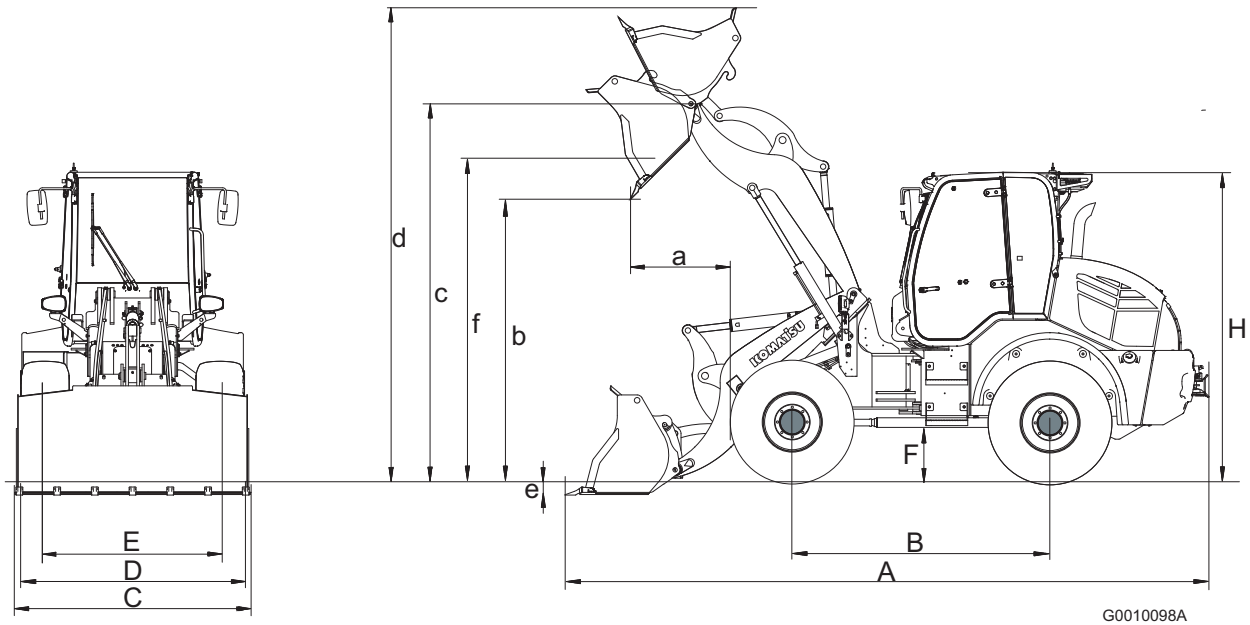
   The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.

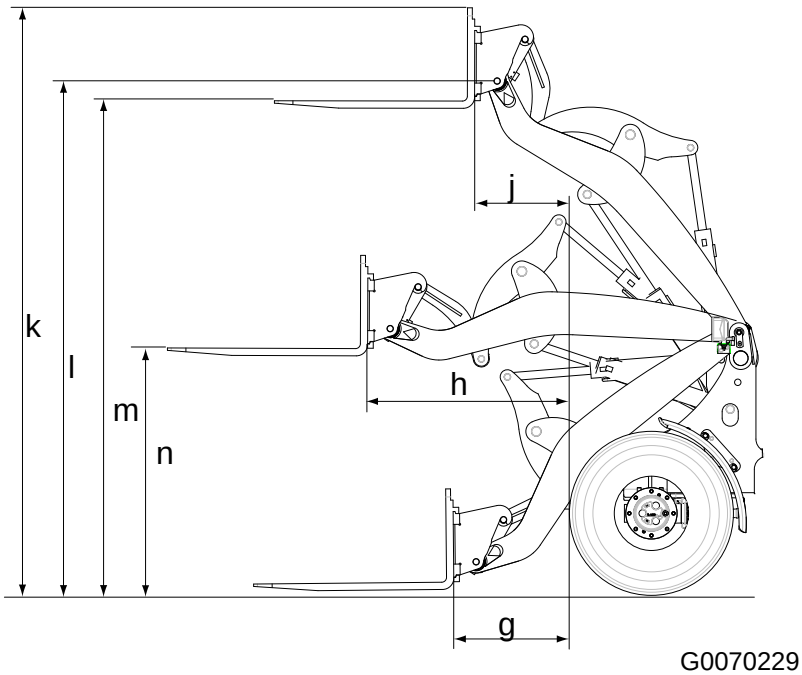
   When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



01 GENERAL

Dimensions, weights and operating data





Dimensions, operating data with bucket			WA80M-7	WA100M-7
	Tyres		405/70R18	455/70R20
	Bucket		42U-70-32250	42W-70-32100
	Bucket capacity according to ISO 7546	m^3	1.0	1.25
	Material density	t/m^3	1.8	1.8
	Bucket weight without teeth	kg	401	415
	Stat. tipping load, straight	kg	4595	6020
	Stat. tipping load at 40° angle	kg	3899	5140
	Breakout force, hydraulic	kN	37	74,2
	Lifting force, hydraulic, on the ground	kN	51	69,8
	Operating weight (w/o counterweight)	kg	5690	6925
	Turning radius, outer edge of tyre	mm	3875	4210
	Turning radius, bucket corner	mm	4290	4730
a	Reach at 45°	mm	995	845
b	Dumping height at 45°	mm	2425	2730
c	Height, bucket pivot point	mm	3225	3540
d	Height, top edge of bucket	mm	4190	4515
e	Digging depth	mm	90	130
f	Max. loading height at 45°	mm	2910	3185
A	Overall length, bucket on the ground	mm	5640	5865
B	Wheelbase	mm	2260	2400
C	Bucket width	mm	1915	2200
D	Width over tyres front / rear	mm	1880	2080
E	Track width (front)	mm	1470	1635
	Track width (rear)	mm	1435	1635
F	Ground clearance (axle / transfer case)	mm	340	385
	Ground clearance (propeller shaft)	mm	446	390
H	Overall height	mm	2721	2885
Dimensions, operating data with fork				
	Fork length	mm	1200	1200
g	Max. reach on the ground	mm	845	850
h	Max. reach	mm	1400	1380
j	Max. reach at max. stacking height	mm	700	565
k	Max. height, fork carriage	mm	3670	4000
l	Height, fork pivot	mm	3230	3525
m	Max. stacking height	mm	3065	3320
n	Tine height at max. reach	mm	1470	1540
	Max. tipping load, straight	kg	3523	4440
	Max. tipping load, articulated	kg	3000	3785
	rated load acc. to EN474-3, firm and level ground (80%)	kg	2400	3030
	rated load acc. to EN474-3, rough terrain (60%)	kg	1800	2270
	Operating weight with tines	kg	5483	6840

Specifications

WA80M-7 – Specifications

Machine model		WA80M-7
Serial No.		H62051 and up
Engine	Model	SAA4D95LE-6
	Type	4-cycle Diesel, turbo charged, aftercooled
	No. of cylinders - bore/stroke [mm]	4 - 95 / 115
	Piston displacement [cm³]	3261
	Flywheel horsepower [kW {hp} (PS) / rpm]	52.0 {69.7} (70.7) / 2200 rpm
	Maximum torque [Nm / rpm]	266/ 1600
	Starting motor	12V - 2.2 kw
	Alternator	12V - 120A
	Battery	12V - 100 Ah
Power train	Reduction gear	1-stage
	Differential	Limited slip differential, locking value 25% or optional locking value 100%
	Drive type	Front-, rear-wheel drive
Axle, wheel	Tire	405/70 R18 SPT9
	Turning radius over bucket	4290
Brakes	Operating brakes	Combined inch brake pedal actuates maintenance free wet-disc type brakes in the front axle. Self-braking via the hydrostatic drive.
	Parking brake	Dry disc.

WA100M-7 – Specifications

Machine model		WA100M-7
Serial No.		H62051 and up
Engine	Model	SAA4D95LE-6
	Type	4-cycle Diesel, turbo charged, aftercooled
	No. of cylinders - bore/stroke [mm]	4 - 95 / 115
	Piston displacement [cm³]	3261
	Flywheel horsepower [kW {hp} (PS) / rpm]	66.0 {88.5} (90) / 2350
	Maximum torque [Nm / rpm]	320 / 1600
	Starting motor	12V - 2.2 kW
	Alternator	12V - 120 A
	Battery	12V - 100 Ah
Power train	Reduction gear	1-stage
	Differential	Limited slip differential, locking value 25% or optional locking value 100%
	Drive type	Front-, rear-wheel drive
Axle, wheel	Tire	455/70 R20 SPT9
	Turning radius over bucket [mm]	4730
Brakes	Service brake	Combined inch brake pedal actuates maintenance free wet-disc type brakes in the front axle. Self-braking via the hydrostatic drive.
	Parking brake	Dry disc.

Weight tables

WA80M-7 – Weight table

This weight table is a guide for use when transporting or handling components.

Components	Weight [kg]
Engine	380
Radiator	32
Drive shaft	21
Front axle	239
Rear axle with transfer box	302
Wheel	
Variable-displacement motor 20 km/h Variable-displacement motor 30 km/h	34 64
Variable-displacement pump 20 km/h Variable-displacement pump 30 km/h	31 50
Steering cylinder	17
Lift cylinder, each	33.6

Components	Weight [kg]
Bucket cylinder	40.6
Engine hood	53
Front frame	472
Rear frame	670
Quick-coupler	102
Bellcrank	75
Boom (including bushing)	308
Counterweight	615
Cabine	560
Operator seat	32

WA100M-7 – Weight table

This weight table is a guide for use when transporting or handling components.

Components	Weight [kg]
Engine	380
Radiator	32
Drive shaft	22
Front axle	345
Rear axle with transfer box	345
Wheel	120
Variable-displacement motor 20 km/h Variable-displacement motor 30 km/h	47 64
Variable-displacement pump 20 km/h Variable-displacement pump 30 km/h	39 51
Steering cylinder	12.4
Lift cylinder, each	32.9

Components	Weight [kg]
Bucket cylinder	54
Engine hood	54
Front frame	556
Rear frame	743
Quick-coupler	135
Bellcrank	84
Boom (including bushing)	396
Counterweight	1067
Cabine	560
Operator seat	32

Lubricants and operating mediums

WA80M-7 – Lubricants and operating mediums

The specified filling volumes represent approximate values; the testing devices are binding. The selection of a viscosity class depends on the ambient temperature prevailing over a longer period of time. The temperature limits are to be regarded as guiding values; for a brief period, the actual temperature may be higher or lower than these guiding values.

Components	Lubricants, fuel etc.	BI code	Quality grades	Temperature ranges	Viscosity ranges	Approx. filling capacity in litres
Engine	Engine oil EO (KOMATSU genuine parts)	EO15W40-DH EO10W30-DH	API CH-4 or API CI-4	-15 °C to 45 °C -20 °C to 30 °C	SAE 15W-40 [1]) SAE 10W-30	11.5 (11) *
Transfer Gear Box	AGIP ROTRA MULTI THT ESSO TORQUE FLUID 56 MOBILFLUID 424 MOBILLUBE D LS 80W-90 SHELL SPIRAX LS SHELL SPIRAX S4 TXM ESSO TORQUE FLUID 62	GO 80	API-GL4 API-GL4 API-GL4 API GL-5 API-GL4 API-GL4 API-GL4	–	SAE 80 SAE 80 SAE 80 SAE 80W-90 SAE 80W-90 SAE 10W-30 [1]) SAE 10W-30	1,3
Front Axle	AGIP ROTRA MULTI THT ESSO TORQUE FLUID 56 MOBILFLUID 424 MOBILLUBE D LS 80W-90 SHELL SPIRAX LS SHELL SPIRAX S4 TXM ESSO TORQUE FLUID 62	GO 80	API-GL4 API-GL4 API-GL4 API GL-5 API-GL4 API-GL4 API-GL4	–	SAE 80 SAE 80 SAE 80 SAE 80W-90 SAE 80W-90 SAE 10W-30 [1]) SAE 10W-30	Planet Gear: 2 x 0.7 Differential: 8.0
Rear Axle	AGIP ROTRA MULTI THT ESSO TORQUE FLUID 56 MOBILFLUID 424 MOBILLUBE D LS 80W-90 SHELL SPIRAX LS SHELL SPIRAX S4 TXM ESSO TORQUE FLUID 62	GO 80	API-GL4 API-GL4 API-GL4 API GL-5 API-GL4 API-GL4 API-GL4	–	SAE 80 SAE 80 SAE 80 SAE 80W-90 SAE 80W-90 SAE 10W-30 [1]) SAE 10W-30	Planet Gear: 2 x 0.7 Differential: 8.0
Hydraulic system, steering	Hydraulic oil HYD	KOMATSU HO46-HM	–	-20 °C to 50 °C	ISO VG 46	50
	Engine oil EO (KOMATSU genuine parts)	EO15W40-DH EO10W30-DH	API CH-4 or API CI-4	-15 °C to 45 °C -20 °C to 30 °C	SAE 15W-40 SAE 10W-30 [1])	
	or BIO-E-HYD hydraulic oil	BIO-E-HYD 0530	HEES (acc. to VDMA fluid technology)	-15 °C to 20 °C	ISO VG 46	
Service Brake	AGIP LHM Super	HYD	–	–	–	1.2
Cooling system	Antifreeze and anti-corrosive	AF-NAC	KOMATSU Supercoolant [1])			14.5
Fuel tank	Diesel fuel [2])	CFPP Class B CFPP Class D CFPP Class E CFPP Class F	DIN-EN 590	up to 0°C up to -10°C up to -15°C up to -20°C	–	130
Grease nipples	Lithium-Based Multi-Purpose Grease	MPG-A	KP 2N-20	–	NLGI 2	–
Air conditioning	Coolant Refrigerant oil	NRS NRS	R134a (CFC-free) PAG (polyalkylglycol)	–	–	1200 g 180 cm³
The specified filling capacities are approximate guidelines; test specifications are binding. The selection of the viscosity class depends on the predominantly existing outside temperature. The temperature limits are to be regarded as guidelines which can be exceeded up or down for a brief period.						
*)Top-up quantity [1]) Factory filling [2]) If using fuels with a sulphur content between 0.5 to 1.0 %, reduce the engine-oil change intervals by half.						

WA100M-7 – Lubricants and operating mediums

Components	Lubricants, fuel etc.	BI code	Quality grades	Temperature ranges	Viscosity ranges	Approx. filling capacity in litres
Engine	Engine oil EO (KOMATSU genuine parts)	EO15W40-DH EO10W30-DH	API CH-4 or API CI-4	-15 °C to 45 °C -20 °C to 30 °C	SAE 15W-40 [1]) SAE 10W-30	11.5 (11) *
Transfer Gear Box	AGIP ROTRA MULTI THT ESSO TORQUE FLUID 56 MOBILFLUID 424 MOBILLUBE D LS 80W-90 SHELL SPIRAX LS SHELL SPIRAX S4 TXM ESSO TORQUE FLUID 62	GO 80	API-GL4 API-GL4 API-GL4 API GL-5 API-GL4 API-GL4 API-GL4	–	SAE 80 SAE 80 SAE 80 SAE 80W-90 SAE 80W-90 SAE 10W-30 [1]) SAE 10W-30	1,3
Front Axle	AGIP ROTRA MULTI THT ESSO TORQUE FLUID 56 MOBILFLUID 424 MOBILLUBE D LS 80W-90 SHELL SPIRAX LS SHELL SPIRAX S4 TXM ESSO TORQUE FLUID 62	GO 80	API-GL4 API-GL4 API-GL4 API GL-5 API-GL4 API-GL4 API-GL4	–	SAE 80 SAE 80 SAE 80 SAE 80W-90 SAE 80W-90 SAE 10W-30 [1]) SAE 10W-30	Planet Gear: 2 x 1.3 Differential: 8.0
Rear Axle	AGIP ROTRA MULTI THT ESSO TORQUE FLUID 56 MOBILFLUID 424 MOBILLUBE D LS 80W-90 SHELL SPIRAX LS SHELL SPIRAX S4 TXM ESSO TORQUE FLUID 62	GO 80	API-GL4 API-GL4 API-GL4 API GL-5 API-GL4 API-GL4 API-GL4	–	SAE 80 SAE 80 SAE 80 SAE 80W-90 SAE 80W-90 SAE 10W-30 [1]) SAE 10W-30	Planet Gear: 2 x 1.3 Differential: 8.0
Hydraulic system, steering	Hydraulic oil HYD	KOMATSU HO46-HM	–	-20 °C to 50 °C	ISO VG 46	80
	Engine oil EO (KOMATSU genuine parts)	EO15W40-DH EO10W30-DH	API CH-4 or API CI-4	-15 °C to 45 °C -20 °C to 30 °C	SAE 15W-40 SAE 10W-30 [1])	
	or BIO-E-HYD hydraulic oil	BIO-E-HYD 0530	HEES (acc. to VDMA fluid technology)	-15 °C to 20 °C	ISO VG 46	
Service Brake	AGIP LHM Super	HYD	–	–	–	1.2
Cooling system	Antifreeze and anti-corrosive	AF-NAC	KOMATSU Supercoolant [1])			14.5
Fuel tank	Diesel fuel [2])	CFPP Class B CFPP Class D CFPP Class E CFPP Class F	DIN-EN 590	up to 0°C up to -10°C up to -15°C up to -20°C	–	130
Grease nipples	Lithium-Based Multi-Purpose Grease	MPG-A	KP 2N-20	–	NLGI 2	–
Air conditioning	Coolant Refrigerant oil	NRS NRS	R134a (CFC-free) PAG (polyalkylglycol)	–	–	1200 g 180 cm³
The specified filling capacities are approximate guidelines; test specifications are binding. The selection of the viscosity class depends on the predominantly existing outside temperature. The temperature limits are to be regarded as guidelines which can be exceeded up or down for a brief period.						
*)Top-up quantity [1]) Factory filling [2]) If using fuels with a sulphur content between 0.5 to 1.0 %, reduce the engine-oil change intervals by half.						

Basic procedures of maintenance

Oil

- The oil in the engine and in the hydraulic system is subject to extreme conditions (high temperatures, high pressures). Therefore, the oil quality will decrease with extended operation.

  Always use oils prescribed for the works and temperatures indicated in the operating and maintenance manual. Always observe the prescribed oil change intervals.

- Always handle oils with extreme care so that they are not contaminated.When storing or refilling oil, make sure that it is not contaminated. The majority of all malfunctions is caused by the penetration of dirt and other contaminations.

- Never mix oil of different brands or types.

- Always refill the prescribed oil quantity. Too little or excessive oil may cause malfunctions.

- If the oil in the hydraulic system is not clear (milky), water or air is propably introduced into the circuit. In such cases, call your Komatsu dealer.

- Upon each oil change, the related filter must be replaced as well.

- We recommend to have an oil analysis carried out in regular intervals in order to check the machine condition. Customers who desire such an oil analysis should contact their Komatsu dealer.

Fuel

- The fuel pump is a precision instrument; if fuel containing water or dirt is used, it cannot work properly.

- Be extremely careful not to let impurities penetrate when storing or adding fuel.

- Always use the fuel specified in the Operation and Maintenance Manual. Fuel may congeal depending on the temperature (particularly at low temperatures below -15°C), so change to a fue matching this temperature.

- To prevent the moisture in the air from condensing and forming water inside the fuel tank, always fill the fuel tank after completing the day's work.

- Before starting the engine, or when 10 minutes have passed after adding fuel, drain the sediment and water from the fuel tank.

- If the engine runs out of fuel, or if the filters have been replaced, it is necessary to bleed the air from the circuit.

- If the fuel sulphur content is between 0.5 and 1.0%, the oil change interval must be 1/2 normal. If the fuel sulphur content is more 1.0%, the oil change interval must be 1/4 normal.

Coolant

- River water contains large amounts of calcium and other impurities, so if it is used, scale will stick to the engine and radiator causing a defective heat exchange and overheating.
- Do not use water that is not suitable for drinking.
- When using anti-freeze, always observe the precautions given in the Operation and Maintenance Manual.
- Komatsu machines are supplied with Komatsu original anti-freeze in the coolant when the machine is shipped. This anti-freeze prevents corrosion in the cooling system. The anti-freeze can be used continuously for two years or 4000 hours. Therefore, it can be used as it is even in hot areas.
- Anti- freeze is flammable, so be extremely careful not to expose it to open flame or fire.
- The proportion of anti-freeze to water differs according to the ambient temperature. For details of the mixing ratios, see Operation Manual: CLEANING THE INSIDE OF THE COOLING SYSTEM".
- If the engine overheats, wait for the engine to cool before adding coolant.
- If the coolant level is low, it will cause overheating and corrosion due to the air in the coolant.

Grease

- Grease is used to prevent twisting and noise at the joints.
- The nipples not included in the maintenance section are nipples for overhaul, so they need not be lubricated. If any part becomes stiff after being used for a long time, add grease.
- Always wipe off all of the old grease that is pushed out when greasing. Be particularly careful to wipe off the old grease in places where sand or dirt in the grease would cause the rotating parts to wear.

Storing oil and fuel

- Keep oil and fuel indoors to prevent any water, dirt or other impurities from penetrating.
- When keeping barrels for a long period, lay down the barrel on its side so that the filler port is at the side (to prevent moisture from being sucked in).
  If barrels have to be stored outside, cover them with a waterproof sheet or take other measures to protect them.
- To prevent any change in quality during long term storage, be sure to use in the order of 'first in - first out' (use the oldest oil or fuel first).

Filters

- Filters are extremely important safety parts. They prevent impurities in the fuel and air circuits from entering important equipment and causing problems.
  Replace all filters periodically. For details, see the Operation and Maintenance Manual.
  However, when working under severe conditions, it is necessary to consider replacing the filters at shorter intervals according to the oil and fuel (sulfur content) being used.
- Never try to clean the filters (cartridge type) and use them again. Always replace with new filters.
- When replacing oil filters, check if any metal particles are stuck to the old filter. If any metal particles are found, please contact your Komatsu distributor.
- Do not open packs of spare filters until just before they are to be used.
- Always use original Komatsu filters.

Biodegradable hydraulic oils and lubricants

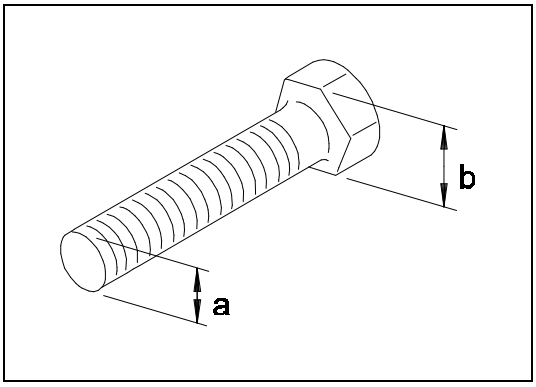
- The use of biodegradable hydraulic oils and lubricants – on the basis of synthetic esters – for Komatsu machines is permitted. For information on the products cleared for use and best suited for your application contact our authorized service workshops.

Outline of electric system

- If the wiring gets wet or the insulation is damaged, the electric system leaks resulting in hazardous malfunctions of the machine.
- Maintenance work at the electric system includes:
  1. Check fan belt tension,
  2. Check damage or wear to the fan belt,
  3. Check battery fluid level.
- Never remove or disassemble any electric components installed in the machine.
- Never install any electric components other than those specified by Komatsu.
- Be careful to keep the electric system free of water when washing the machine or when it is raining.
- When working on the seashore, carefully clean the electric system to prevent corrosion.
- The optional power source must never be connected to the fuse, starter switch, or battery relay.

Torque list – Screws and nuts

- Unless otherwise specified, tighten the metric bolts and nuts to the torque shown in the table.
- The tightening torque is determined by the width across flats of the nut and bolt.
- If it is necessary to replace any nut or bolt, always use a Komatsu genuine part of the same size as the part that was replaced.



NOTE
When tightening panels or other parts having tightening fixtures made of plastic, be careful not to use excessive tightening torque: doing so will damage the plastic parts.

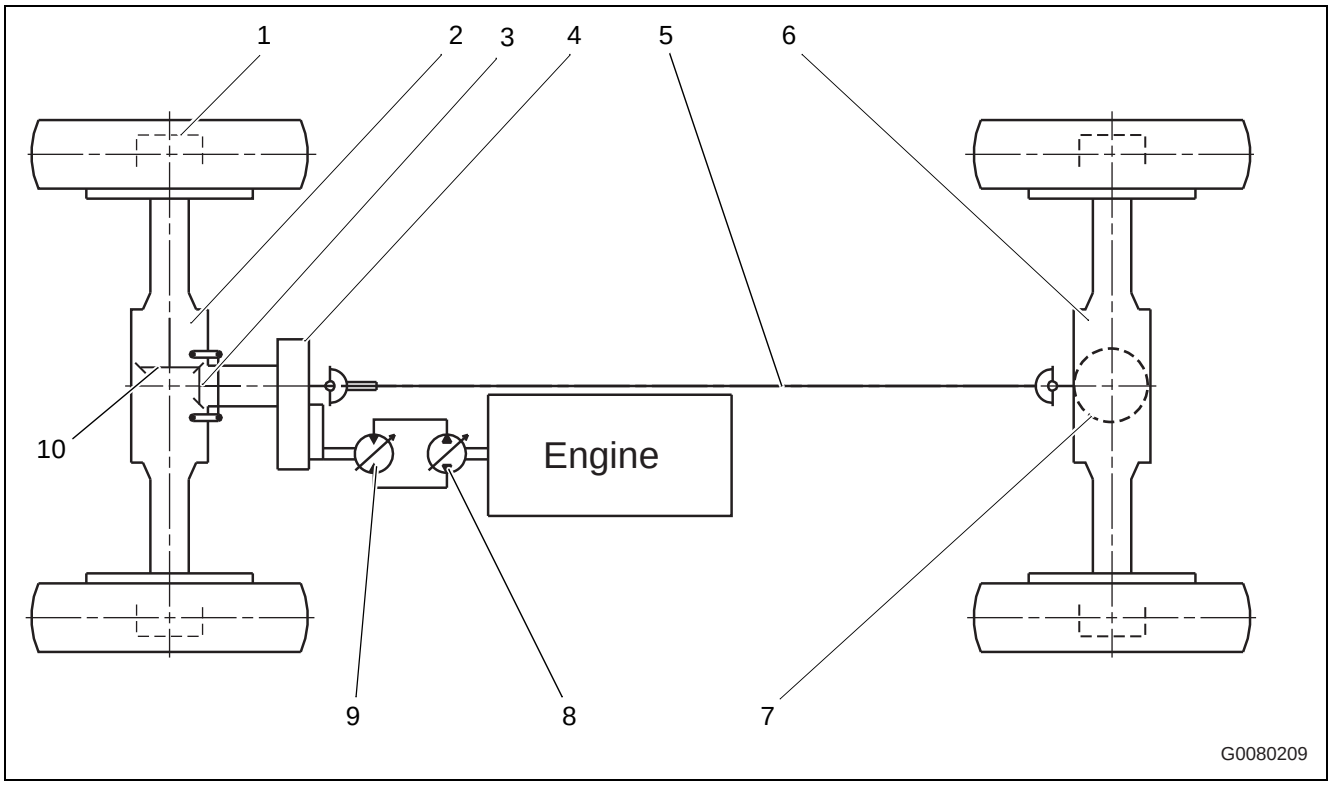
Metric Thread – 10.9					
Thread diameter [mm] (a)	Width across flat [mm] (b)	Steel		Aluminium-Cast	
		Nm	kpm	Nm	kpm
M 6	10	14	1.4	7.7	0.77
M 8	13	35	3.5	19	1.9
M 10	17 (15)	70	7	37	3.7
M 12	19	115	11.5	64	6.4
M 14	22	185	18.5	101.5	10.15
M 16	24	280	28	158	15.8
M 18	27	390	39	218	21.8
M 20	30	560	56	306.5	30.65
M 22	32	750	75	416	41.6
M 24	36	960	96	528.5	52.85
M 27	41	1400	140	774	77.4
M 30	46	1900	190	1053	105.3
M 33	50	2600	260	–	–
M 36	55	3300	330	–	–
M 39	60	4300	430	–	–

Metric Fine Thread – 10.9					
Thread Diameter [mm] (a)	Width across Flat[mm] (b)	Steel		Aluminium-Cast	
		Nm	kpm	Nm	kpm
M 8 × 1	13	35	3.5	20	2
M 10 × 1	17 (15)	75	7.5	42	4.2
M 10 × 1,25	17 (15)	70	7	39	3.9
M 12 × 1,25	19	125	12.5	70	7
M 12 × 1,5	19	120	12	67	6.7
M 14 × 1,5	22	200	20	110	11
M 16 × 1,5	24	300	30	167.5	16.75
M 18 × 1,5	27	440	44	243	24.3
M 18 × 2	27	420	42	230	23
M 20 × 1,5	30	620	62	338.5	33.85
M 20 × 2	30	–	–	322.5	32.25
M 22 × 1,5	32	820	82	454.5	45.45
M 22 × 2	32	–	–	436	43.6
M 24 × 1,5	36	1090	109	596	59.6
M 24 × 2	36	1040	104	573	57.3
M 27 × 2	41	1500	150	832	83.2
M 30 × 2	46	2120	212	1158	115.8
M 33 × 2	50	2800	280	–	–
M 36 × 3	55	3500	350	–	–
M 39 × 3	60	4600	460	–	–

10 STRUCTURE AND FUNCTION

Blank for technical reason

Powertrain



1	Planet carrier	6	Front alxe
2	Rear axle	7	Differential
3	Pinion	8	Variable displacement pump (HST-pump)
4	Hydrostatic transmission	9	Variable displacement motor (HST-motor)
5	Prop shaft	10	Crown gear

Outline

- The engine power is transmitted to the drive axles through a hydrostatic system. The system consists of a variable displacement pump mounted on the engine and a variable displacement motor mounted on the rear axle transmission distribution box. Power is transmitted from the variable displacement motor through the distribution box to the front and rear axles. The front axle is driven through a prop shaft from the distribution box.

- Change in the direction driven is achieved by changing the oil flow direction from the variable displacement pump. Changing from forward to reverse is done electrically and can be carried out under power. The force reaction takes place in the variable displacement drive motor.

- The power transmitted to the front and rear axles passes through the pinion and crown gear, through the limited slip differential to the half shafts.

- The half shafts drive in turn the hub planetary reduction gears and through the planet carriers the wheels.

Closed circuit

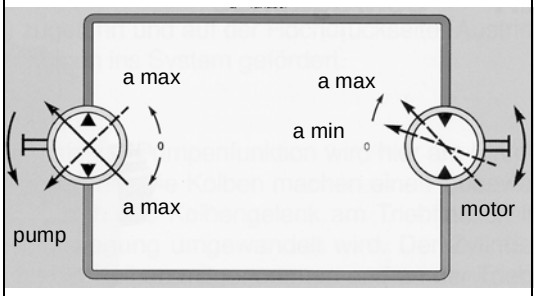
Outline

- A hydraulic system is described as closed when the hydraulic fluid is returned from the user direct to the pump.
- There is a high pressure and a low pressure side, depending on the direction of load (take-off torque at the user).
- The high pressure side is protected by pressure relief valves, which unload to the low pressure side. The hydraulic fluid remains in the circuit. Only the continuous leakage from pump and motor (dependent on operating data) must be replaced.
- This fluid is replenished by an integrated auxiliary pump (normally), which delivers a continuous, adequate supply of fluid (boost fluid) via a check valve into the low pressure side of the closed circuit. Any surplus flow of the boost pump which operates in open circuit, is returned via a boost pressure relief valve to the tank. The boosting of the low pressure side enhances the pump operating characteristics.

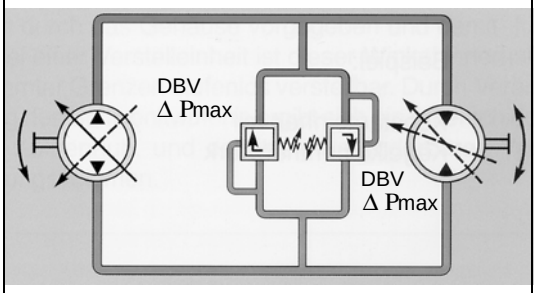
  Typical features of the closed circuit for axial piston units are:

  - directional control valves - small sizes for pilot operation
  - filter/cooler - small sizes
  - tank size - small, dimensioned to suit boost pump flow and volume of system
  - arrangement/mounting position - flixible/optional
  - load maintained via the drive motor
  - feedback of braking power

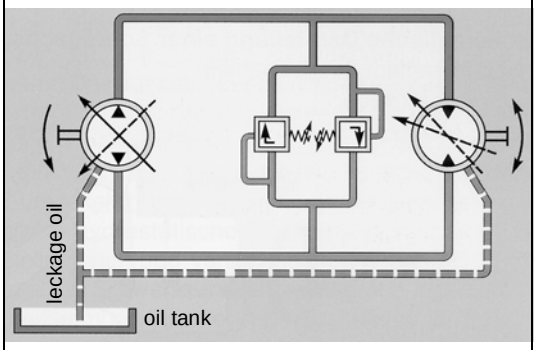
Installation step by step



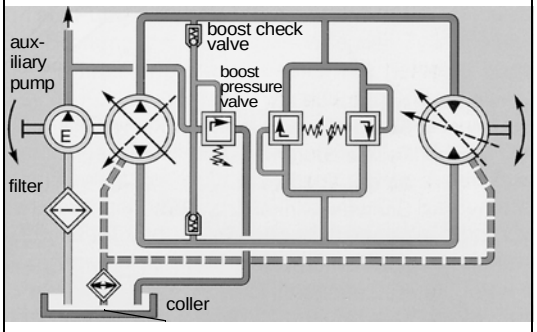
Basic system with variable pump and variable motor. Single pump input drive direction. Motor power take-off in both directions. The pump can be swivelled smoothly over centre, i.e. the direction of flow is reversible.



Pressure relief valves - one each for the high and low pressure sides - prevent the maximum permissible pressure form being exeeded.



The leakage from pump and motor is led back to a small tank and must be replenished.

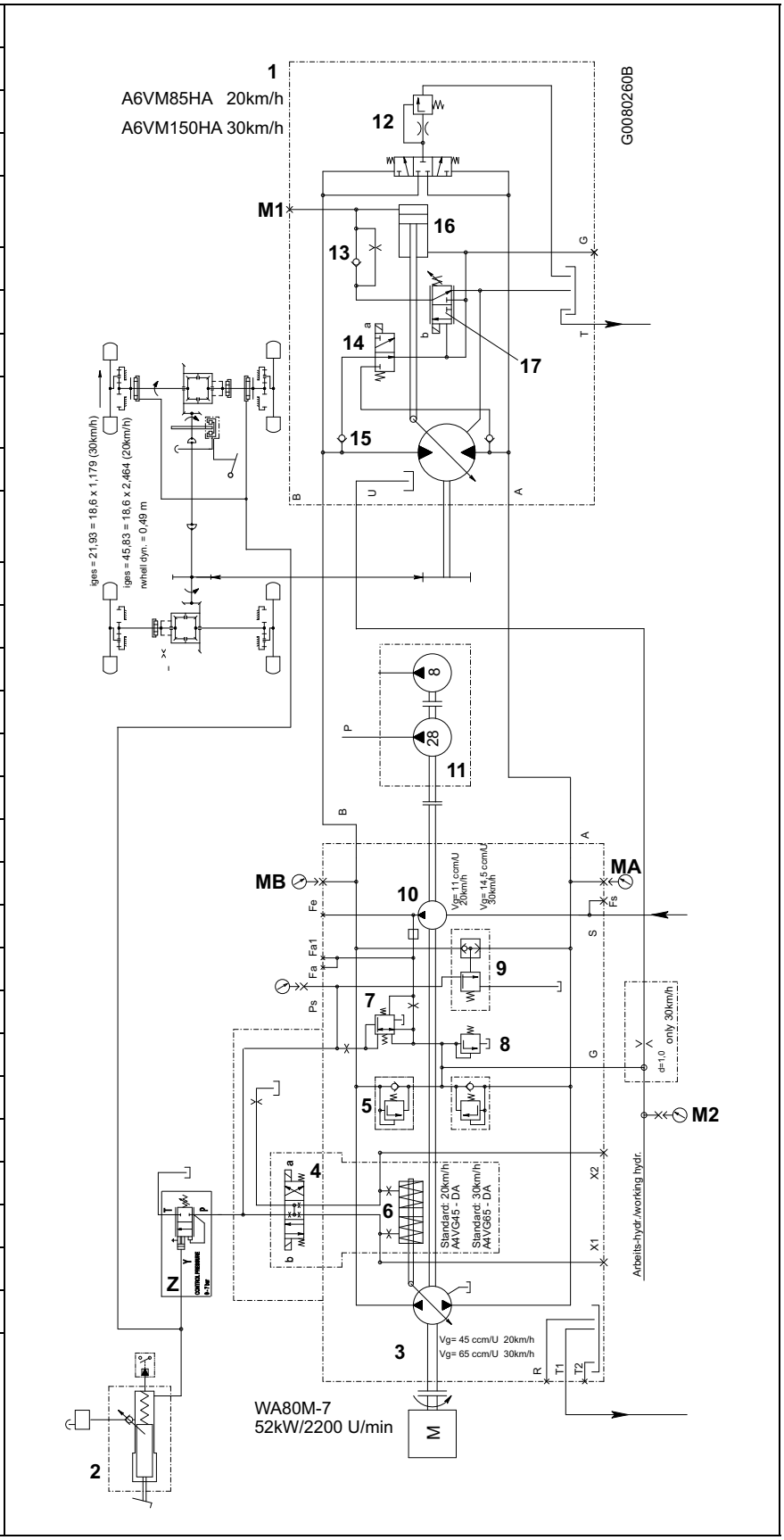


An auxiliary pump for replenishment of leakage oil and control of the pump. Boost check valve RV. Boost pressure relief valve DBV. Fitted filter, cooler and accessories.

Hydraulic drive system

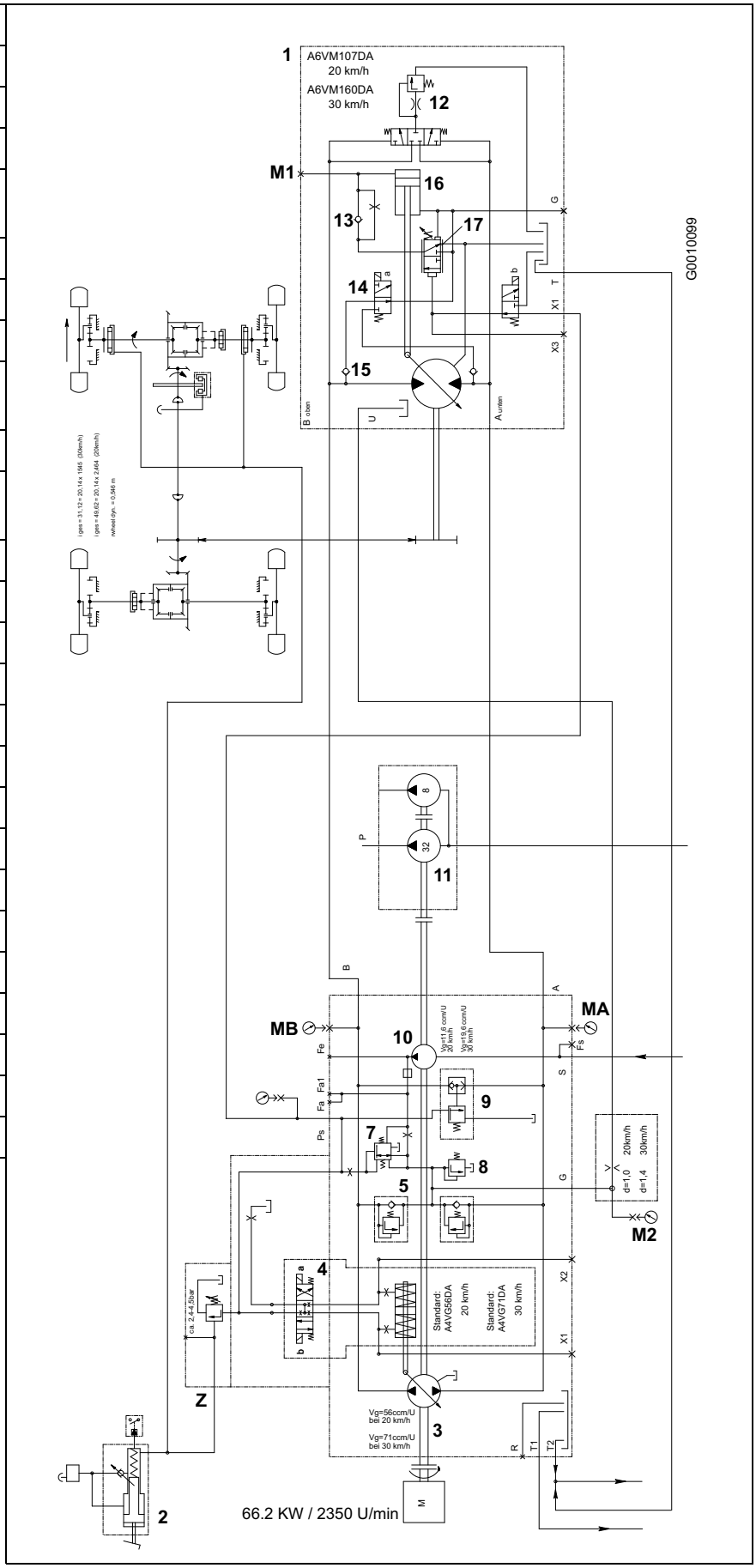
WA80M-7 – Hydraulic drive system – 20 km/h and 30 km/h

1.	HST motor
2.	Main brake cylinder
3.	Variable HST pump
4.	4/3 way valve (control valve)
5.	Safety valve with charge valve
6.	Control cylinder
7.	Regulating valve
8.	Charge pressure relief valve
9.	Hydraulic travel pressure cut-off valve
10.	Charge pump
11.	Steering and working hydraulic pump
12.	Shuttle flushing valve
13.	Throttle check valve
14.	Drive range valve
15.	Check valve
16.	Control piston
17.	Control valve
	1. Range: Energized
	2. Range: De-energized
Z	Inch valve
M1	Control pressure check point
M2	Charge pressure check point
MA	Travel pressure check point
MB	Travel pressure check point



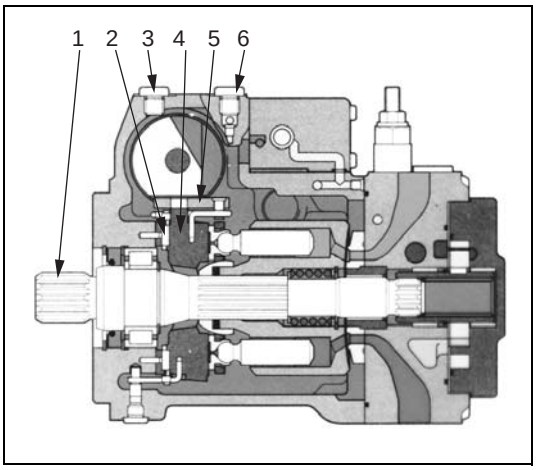
WA100M-7 – Hydraulic drive system – 20 km/h and 30 km/h

1.	Variable HST motor
2.	Main brake cylinder
3.	Variable HST pump
4.	4/3 way valve (control valve)
5.	Safety valve with charge valve
6.	Control cylinder
7.	Regulating valve
8.	Charge pressure relief valve
9.	Hydraulic travel pressure cut-off valve
10.	Charge pump
11.	Steering and working hydraulic pump
12.	Shuttle flushing valve
13.	Throttle check valve
14.	Drive range valve
15.	Check valve
16.	Control piston
17.	Control valve
	1. Range: Energized
	2. Range: De-energized
Z	Inch valve
M1	Control pressure check point
M2	Charge pressure check point
MA	Travel pressure check point
MB	Travel pressure check point

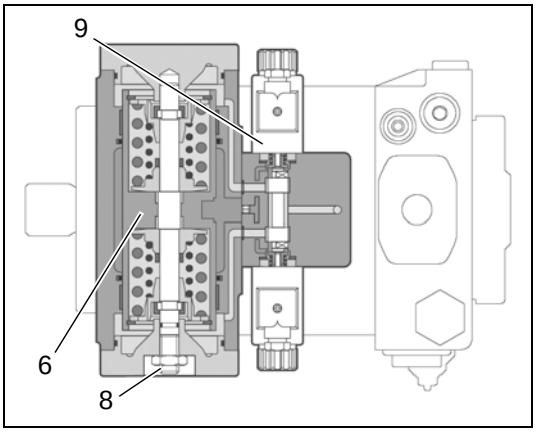


Variable displacement pump (HST pump)

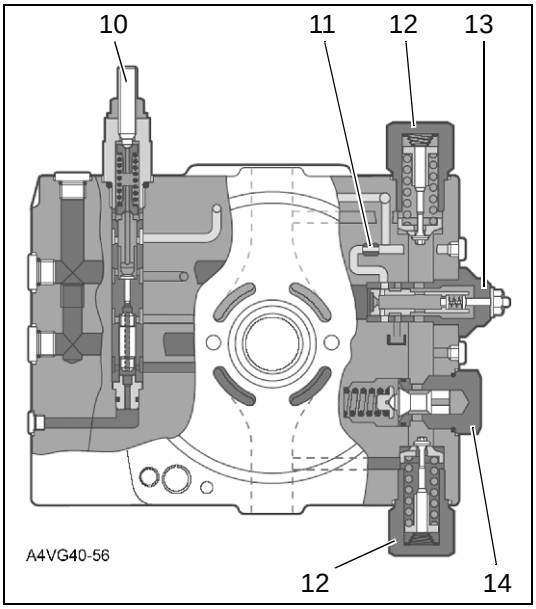
1. Drive shaft
2. Swivel bearing
3. Screw plug
4. Swash plate
5. Adjusting lever, adjusting cylinder-swash plate
6. Screw plug

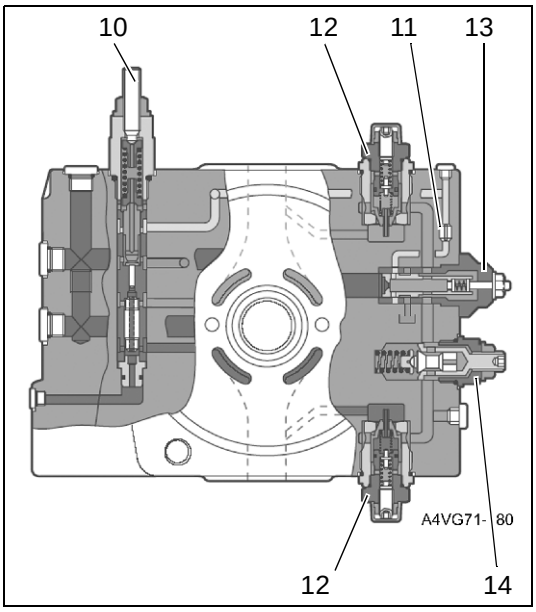


7. Adjusting cylinder
8. Adjusting screw for mechanical 0-position of wash plate
9. 4/3 way valve with electric forward reverse direction preselection

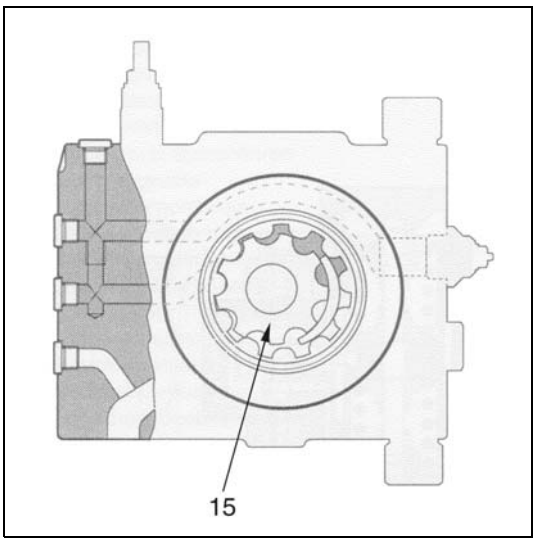


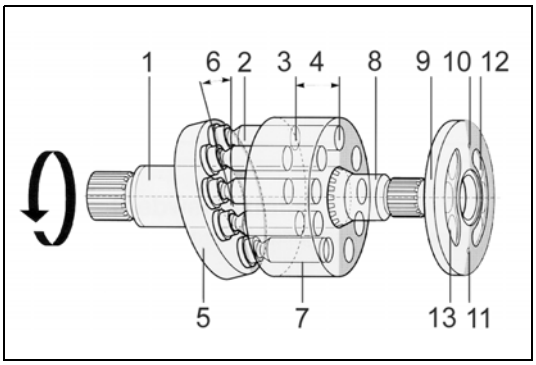
10. Hydraulic travel pressure cut-off valve
11. Orifice
12. Safety-/charge valve
13. Regulating valve
14. Charge pressure relief valve





15. Charge pump





1. Drive shaft
2. Pistons
3. Piston area
4. Piston displacement
5. Swash plate
6. Operating angle
7. Cylinder head
8. Drive shaft
9. Control plate
10. Top dead centre
11. Bottom dead centre
12. Inlet port (rotation as shown)
13. Outlet port (rotation as shown)

Function

- The swash plate drive unit is a displacement pump, where the displacement pistons are mounted axialy parallel to the drive shaft. They react against the swash plate.

- The drive shaft is rotated by the engine. The drive shaft is splined to the cylinder head.

  The cylinder head rotates with the drive shaft. The pistons (2) are mounted in the cylinder head. The pistons are mounted in guide shoes; these glide over the swash plate and cause an axial displacement in the cylinder head. The guide shoes are held with oil pressure against the swash plate.

  During rotation the pistons move between bottom dead centre and top dead centre and back to the start position. In moving between the dead centres (here the piston changes its linear direction) the piston completes a stroke. Because of this oil is sucked in over the inlet port and displaced through the outlet port. The oil volume displaced depends on the piston area an length of stroke.

  Suction takes place when the oil fills the increasing displacement (cylinder). The oil is forced into the cylinder by charge pump pressure.

  The returning piston then forces the oil out of the cylinder head through the outlet port.

  When the swash plate angle changes over the neutral position, the pumped direction also changes. Inlet becomes outlet, outlet becomes inlet.

Regulating valve (DA valve)

The DA valve regulates the control pressure (Pst) from which engine speed on the machine starts to travel.

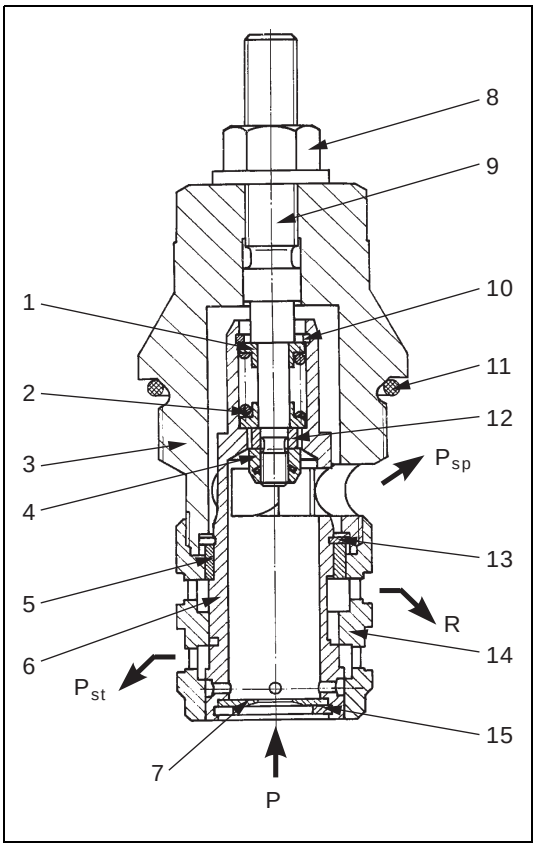
HST charge pump oil (P) flows against orifice (7). The pump flow increases as soon as the engine speed is raised and increases the force against orifice (7).

At a certain engine speed piston (6) lifts up from the seat and control pressure (Pst) is generated.

The (Pst) pressure moves the servo piston, which moves the swash plate to the selected travel direction (forward or reverse).

The higher the engine speed, the greater the HST charge pump oil flow and the bigger the force to orifice (7). As a result the control pressure increases in accordance with the engine speed and so the travel speed increases.

The remaining oil flows to charge pressure port (Psp) to charge the HST circuit and to PPC.



1. Spring cup
2. Pressure spring
3. Housing
4. Nut
5. Ring
6. Piston
7. Throttle
8. Seal nut
9. Screw
10. Circlip
11. O-ring
12. Ring
13. Circlip
14. Regulating cylinder
15. Circlip

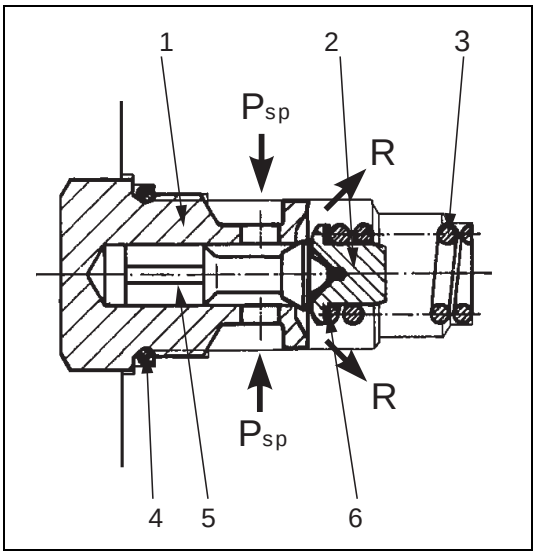
P = from pump
Pst = Control pressure
Psp = Charge pressure
R = Return to tank

WA80M-7 - Charge pump pressure relief valve - 20km/h

The high pressure circuit is fed by the HST charge pump.

The HST charge pressure in neutral between HST pump and motor is adjusted by the HST charge pressure relief valve.

The HST charge pressure on these models is also used for PPC.



1. Valve housing
2. Retainer
3. Pressure spring
4. O-ring
5. Valve piston
6. Pressure adjusting shims

Psp = Charge pump pressure

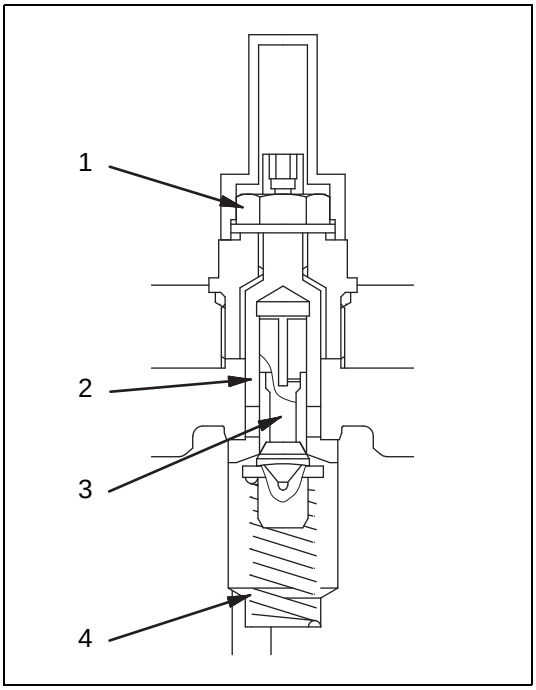
R = Return to tank

WA80M-7, WA100M-7 - Charge pump pressure relief valve - 30km/h

The high pressure circuit is fed by the HST charge pump.

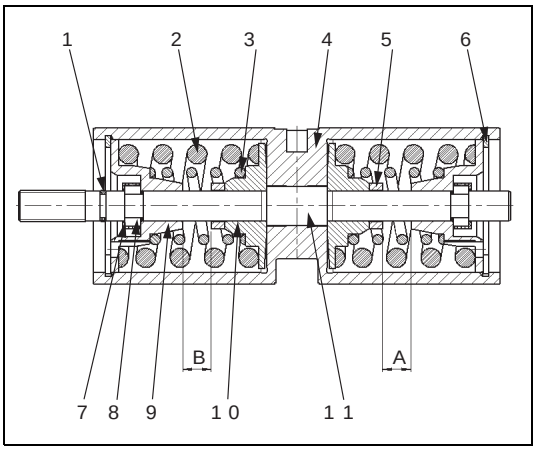
The HST charge pressure in neutral between HST pump and motor is adjusted by the HST charge pressure relief valve.

The HST charge pressure on these models is also used for PPC.



1. Lock nut
2. Adjusting screw
3. Piston
4. Spring

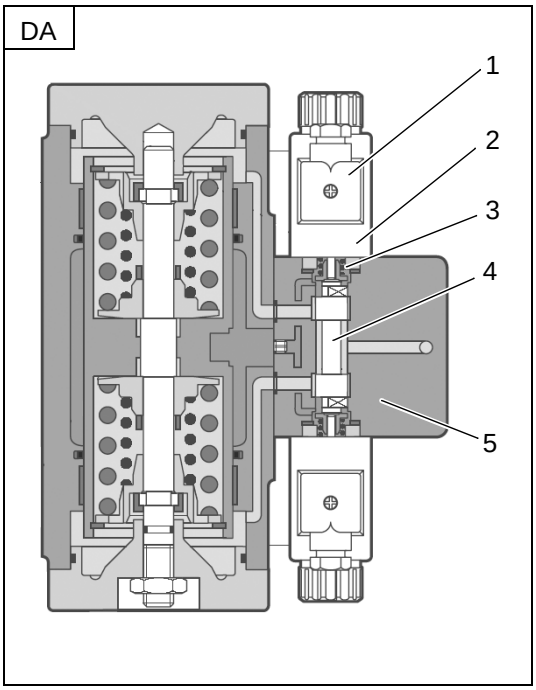
Control cylinder

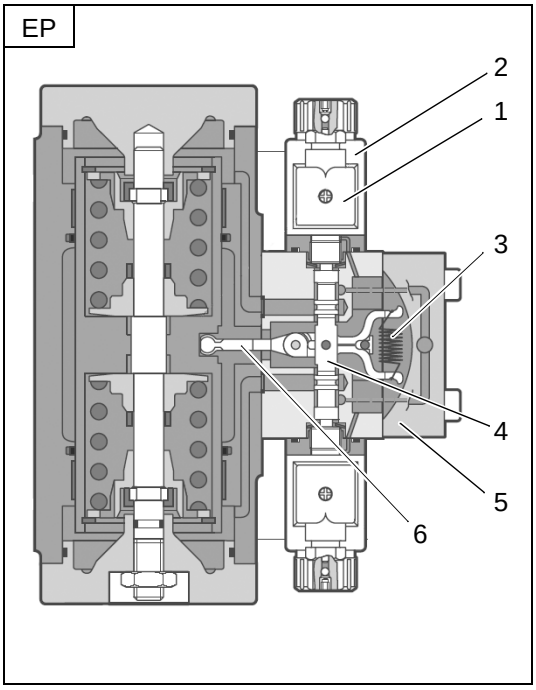


1. O-ring
2. Pressure spring
3. Pressure spring
4. Control cylinder
5. Distance ring
6. Circlip
7. Collet
8. Ring, variable
9. Spring cup
10. Spring cup
11. Rod

4/3 Way valve with direction control solenoids

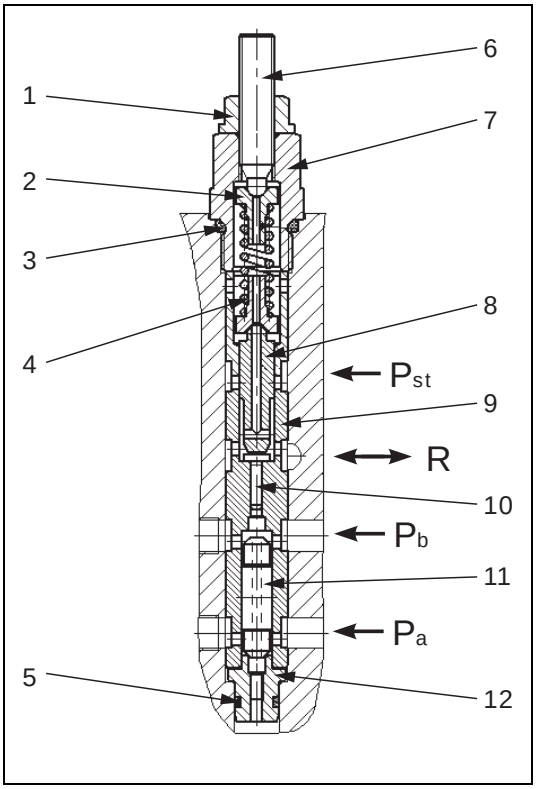
1. Plug connector
2. Direction control solenoid
3. Spring
4. Control piston
5. Valve housing
6. Feedback lever





Pressure cut-off valve

The cut off valve limits the maximum travel pressure in forward and reverse. When the valve is activated, it drains the control pressure from the servo piston to tank. The swash plate moves to minimum and reduces the flow , but to maintain the high pressure.



1. Seal nut
2. Spring cup
3. O-ring
4. Pressure spring
5. O-ring
6. Adjusting screw
7. Cap screw
8. Control piston
9. Valve bush
10. Piston
11. Control piston
12. Valve seat

Pa = Travel pressure
Pb = Travel pressure
R = Return oil to tank
Pst = Control pressure

Safety & charge valve

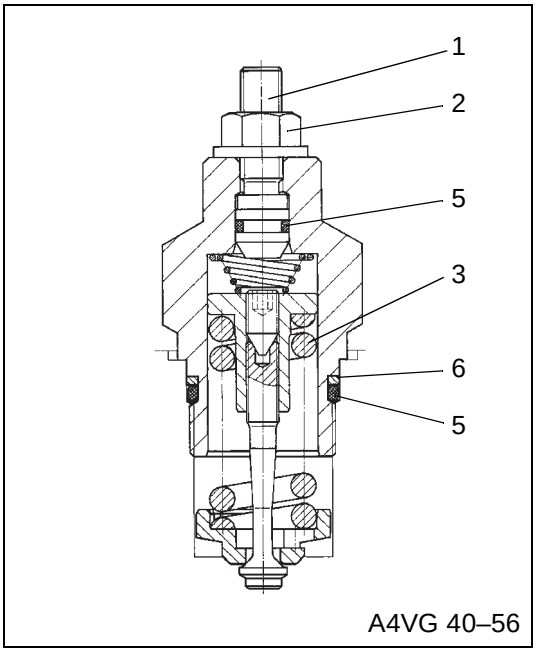
This safety & charge valve is used for 3 different purposes in the closed travel circuit.

- The safety valve limits the high travel pressure in the closed circuit above the cut off valve pressure.
- The HST charge pump oil flows permanently across the charge valves on the low pressure side to compensate the loss through leakages.
- For towing the machine in case of emergency both safety valves can be opened mechanically to form a short circuit between HST pump and motor.

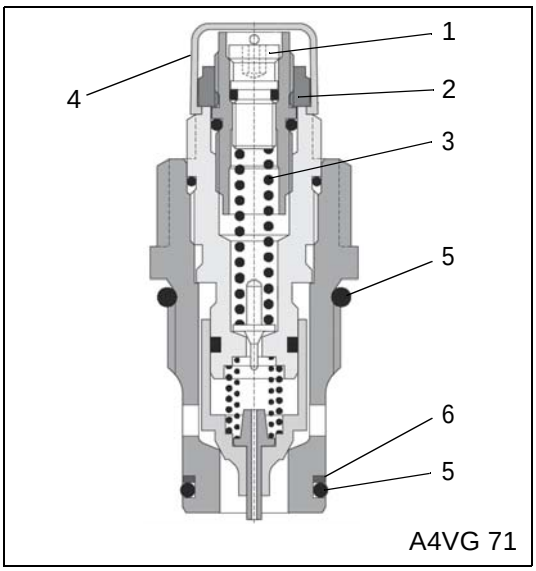
Towing :

In case of emergency it is allowed to pull the machine a few meters with a MAXIMUM SPEED of 2 km/h, only.

1. Adjusting screw
2. Lock nut
3. Pressure spring
4. Cap screw
5. O-ring
6. Backup ring



A4VG 40–56



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Towing

Function

- Machines with hydrostatic drives should only be towed when a connection is made in the drive pump between the high pressure and low pressure sides. To enable this, the high pressure safety valves in the pump have a by-pass function. That means, when screw (1) is turned the valve tension is released and the oil can flow between the high pressure and low pressure sides.

To prevent damage to the hydrostatic drive system do not tow faster than 2 km/h or further than 0.1 km. Because the charge pump is not working, the system will loose oil.
Care should be taken that the system does not overheat.

Bypass function WA80M-7

1. Switch off the engine.
2. Use an Allen key (WAF 8) to turn the shuttle valve (1) counter-clockwise to the stop (2).
   The bypass function is now active.

To deactivate the bypass function:

1. Immediately following towing, switch off the bypass function.
2. Turn the shuttle valve (1) clockwise to the stop and tighten it with a tightening torque of 50 Nm.

Bypass function WA100M-7

1. Switch off the engine.
2. Release the locknut (4) and take out the screw (3) for two turns.

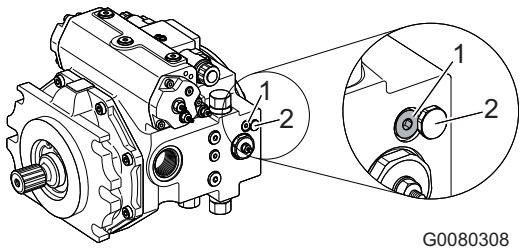
   Tighten the locknut.

After towing screw (3) should be returned to its original position. The setting of the high pressure control valve is not changed.

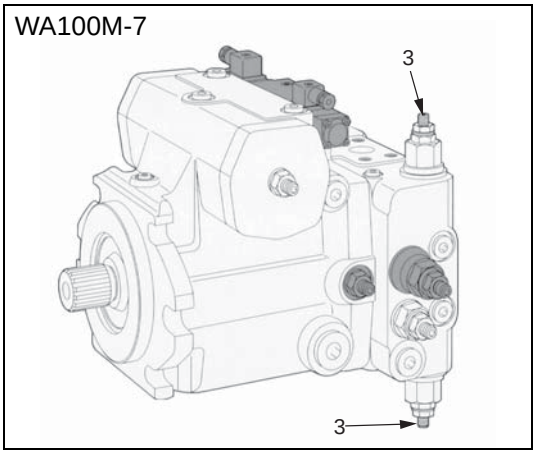
1. Immediately following towing, switch off the bypass function.
2. Release the locknut (3) and screw in the screw (4) until the screw reaches the end of its stroke and tighten the locknut.

NOTE
If the machine has to be towed over a longer distance and with higher speed the drive shaft has to be removed. The steering joint must be locked and a crane used to lift the rear axle.
If the bypass function was activated, then start the travel drive only after completely filling and air bleeding the hydraulic circuit.

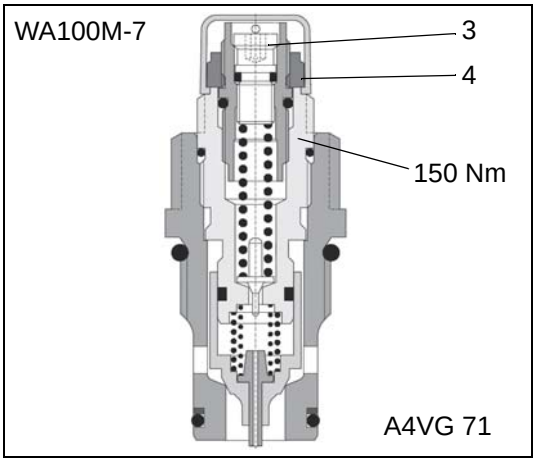
WA80M-7



WA100M-7

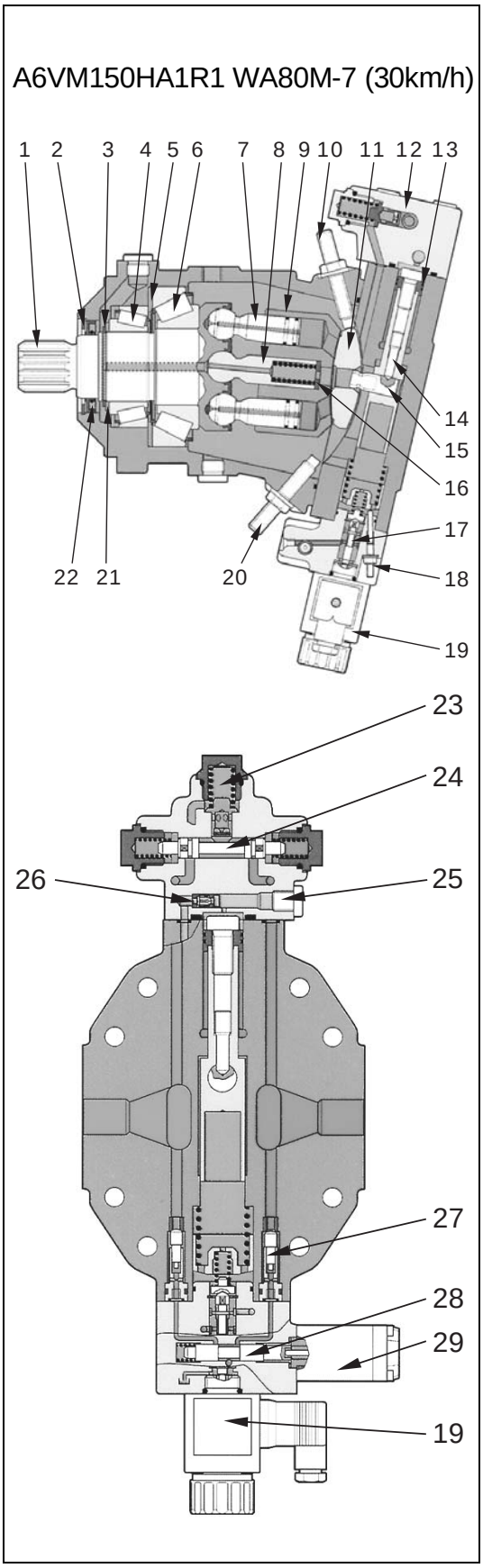


WA100M-7



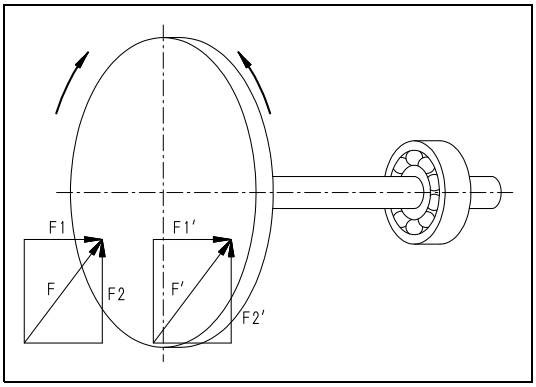
Variable displacement motor (HST motor with HA Control)

1. Output shaft
2. Retaining ring with washer
3. Retaining ring
4. Tapered roller bearing
5. Adjusting shim
6. Tapered roller bearing
7. Cone piston with piston rings, 7 units
8. Center pin
9. Cylinder
10. Adjusting screw for minimum swivel angle (max. speed)
11. Control lens
12. Control piston cover with throttle check valve (26)
13. Control piston
14. Swivel pin clamping screw
15. Swivel pin
16. Adjusting shim
17. Control piston
18. Adjusting screw for travel change over pressure (start of swivel angle change):
    - WA80M-7: 260 bar travel pressure (20km/h)
    - WA80M-7: 190 bar travel pressure (30km/h)
    - WA100M-7: 260 bar travel pressure (20 km/h)
    - WA100M-7: 210 bar travel pressure (30 km/h)
19. Control valve solenoid, 12 Volt:
    - Energized = max. swivel angle = 1st range
    - De-energized = min. swivel angle = 2nd range
20. Adjusting screw for max. swivel angle (min. speed)
21. Adjusting shim
22. Shaft seal
23. Safety valve
24. Flushing valve
25. Check point for travel change over pressure
26. Throttle check valve
27. Check valve
28. Electrical override valve
29. Solenoid for override valve, 12 Volt, energized when travelling forward



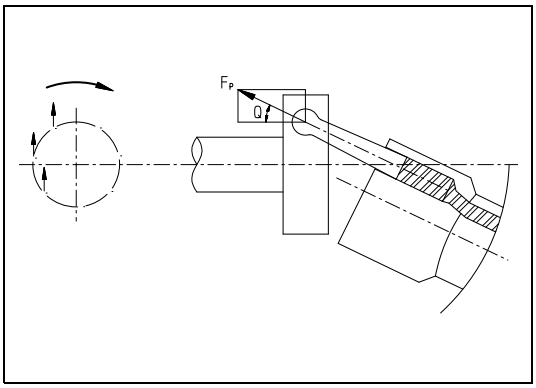
Principle

- It is assumed that the shaft of the disc is supported to enable free rotation of the disc. Force F being applied aslant to the disc is divided into force F1 orthogonal to the disc and force F2 that works in the circumferential direction of the disc. Force F1 pushes the disc in the axial direction and force F2 rotates the disc clockwise.
- Also when force F' works on the disc instead of force F, it is likewise divided into force F1' and F2'. Force F2' rotates the disc counterclockwise.



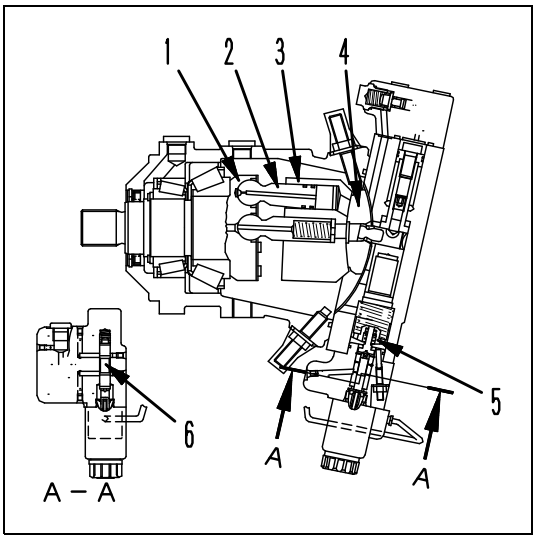
Operation

- Pressurized oil from the HST pump flows to the back side of piston (2) through the HST motor inlet port, and is activated by inclination of piston (2) and cylinder block (3) as the rotating force of drive shaft (1).
- As the HST motor is rotated forward or reverse, the oil in the high pressure circuit side is conducted to the directional shuttle valve (6).
- As a large load is applied to the motor being connected to servo valve (5), the pressure difference is generated between the high pressure circuit side and directional shuttle valve (6), allowing the servo cylinder to increase inclination of cylinder block (3).

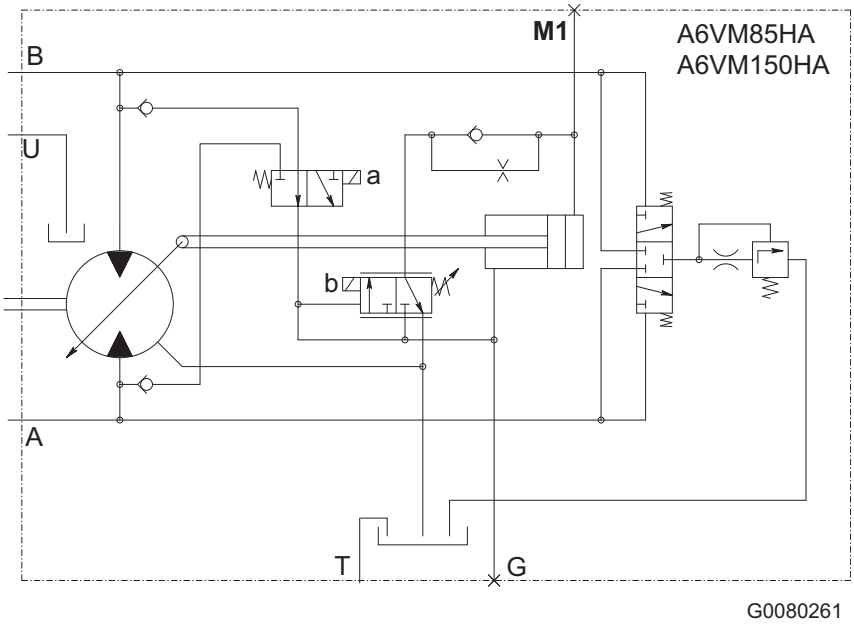


Structure

- 7 pistons (2) are installed on the disc portion of drive shaft (1) like spherical joints. They are housed in cylinder block (3) having a certain angle to drive shaft (1).
- As external load to the HST motor is increased, servo valve (5) and directional shuttle valve (6) work to increase inclination of cylinder block (3) and piston (2), reducing the revolving speed and increasing the torque.



Hydraulic diagram HST motor A6VM85 (or 150) HA1R1



B **Travel pressure forward**

A **Travel pressure reverse**

U **Lubrication oil port**

T **Return**

G **Check port travel pressure**

M1 **Check port motor displacement change pressure**

Override solenoid

a Forward: Energized, 12 Volt
Reverse: De-energized, 0 Volt

Speed range solenoid

b 1. Range: Energized, 12 Volt
2. Range: De-energized, 0 Volt

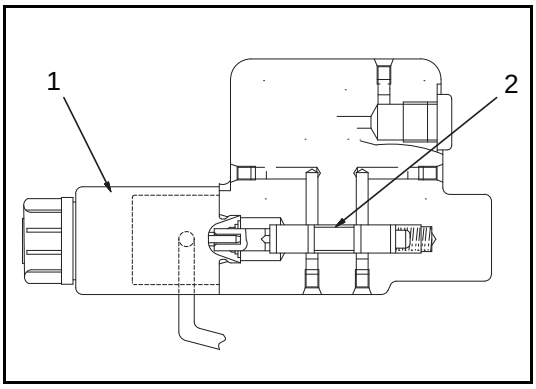
WA80M-7 (20 km/h)	**A6VM85HA1R1**
WA80M-7 (30 km/h)	**A6VM150HA1R1**
Type	Variable displacement, piston type
Displacement (cm^3/rpm)	18.3 to 85.2 38.9- 150
Safety pressure (kg/cm^2)	------
Cut off pressure (kg/cm^2)	430
HST charge pressure (kg/cm^2)	26 - 30

Directional shuttle valve

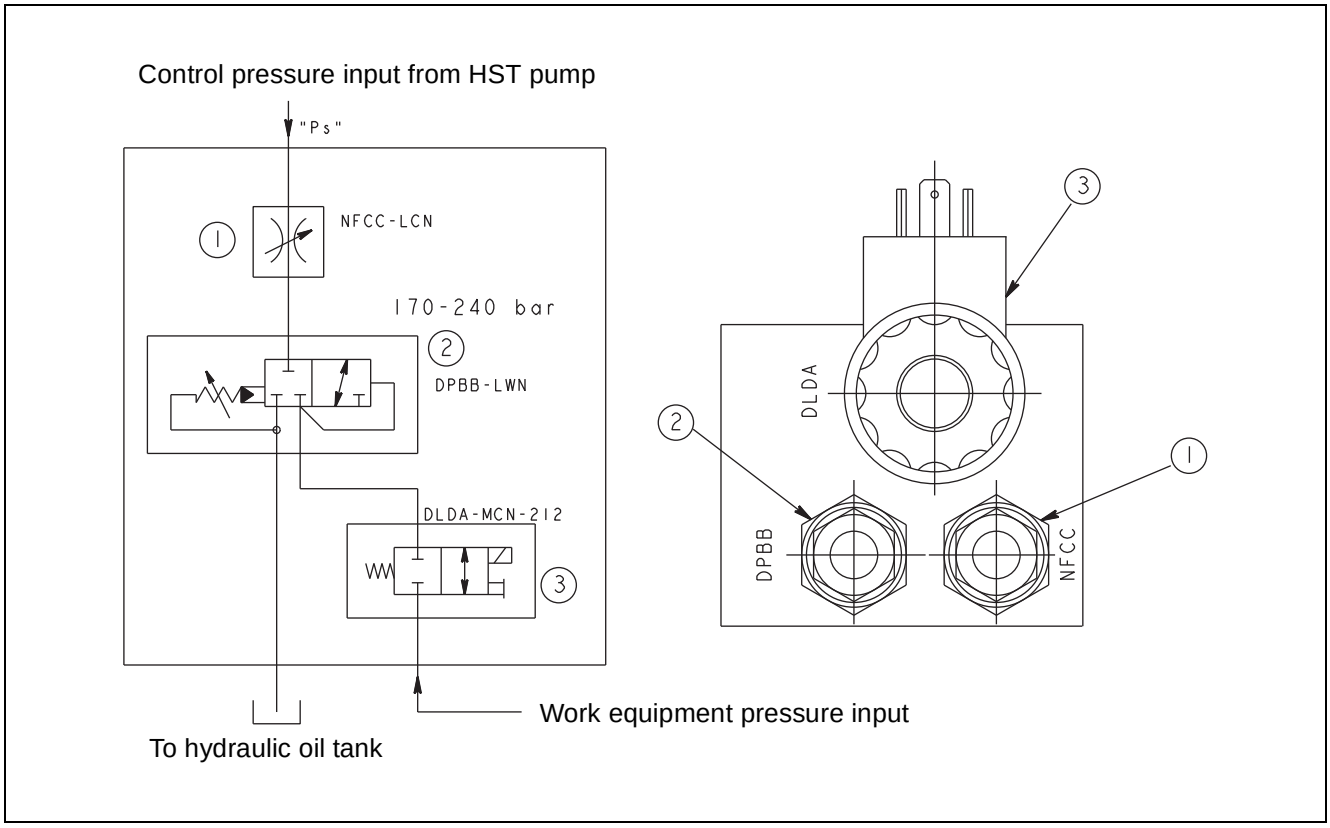
The directional shuttle valve is mounted to the HA controlled HST motor.

When the travel selector is set to forward, the solenoid valve (1) is energized. This allows the forward HST pressure to get control over the shuttle valve (2) of the HA servo valve to keep the HST motor at the specified angle, I.e. down hill travel.

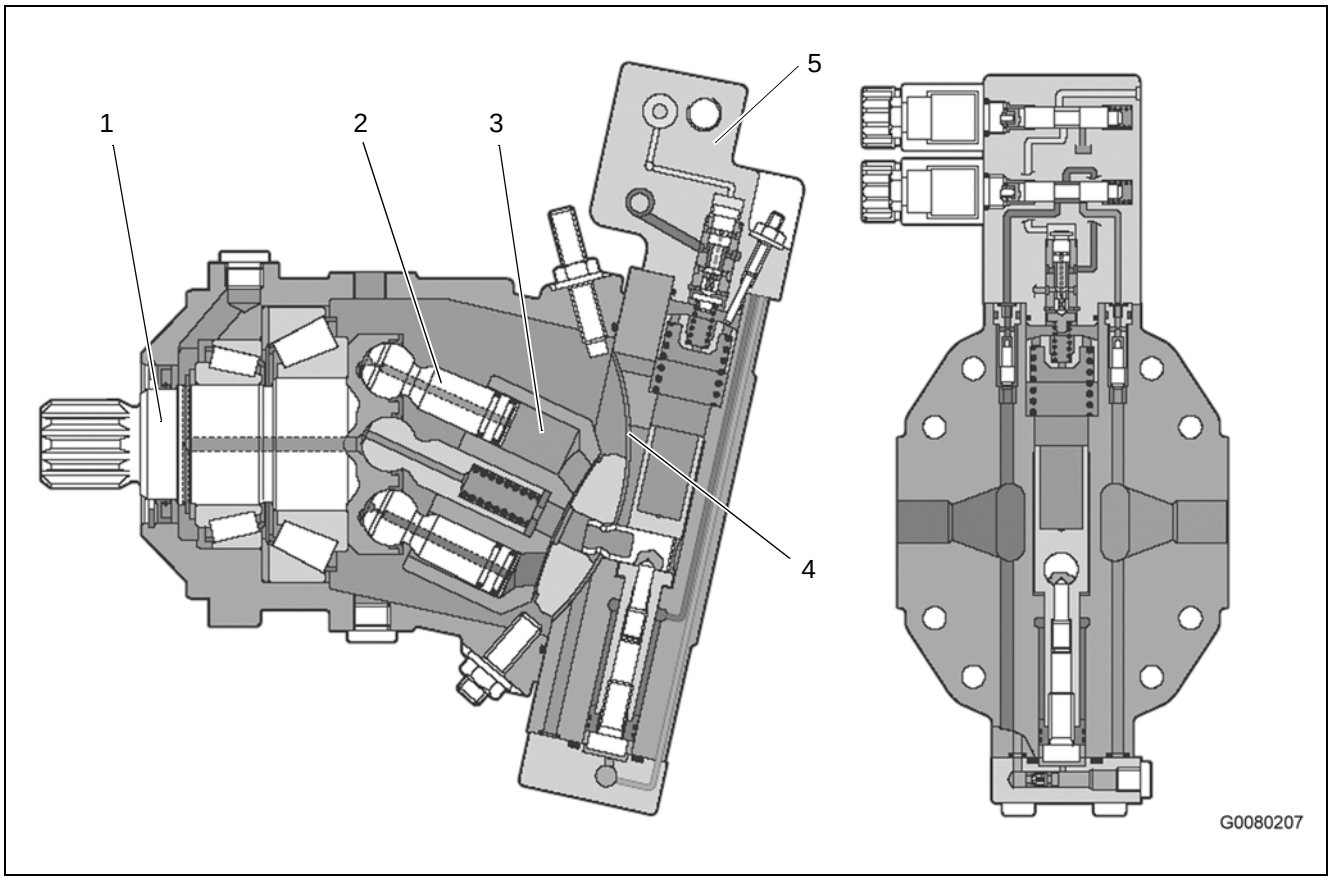
When the travel selector is set to neutral or reverse, the override solenoid (1) is de-energized.



Auto inch valve diagram (option)



HST motor with DA Control



1. Drive shaft
2. Piston
3. Cylinder block
4. Port plate
5. DA servo valve

The control pressure of the HST pump with the actual HST pressure controls the HST motor displacement.

If the engine speed is increased, the increased control pressure of the HST pump sets the HST motor displacement to MIN.

As a result, the travel speed increases while torque is lowered.

When the HST pressure rises above a set value under the above condition, the HST motor displacement is set to MAX.

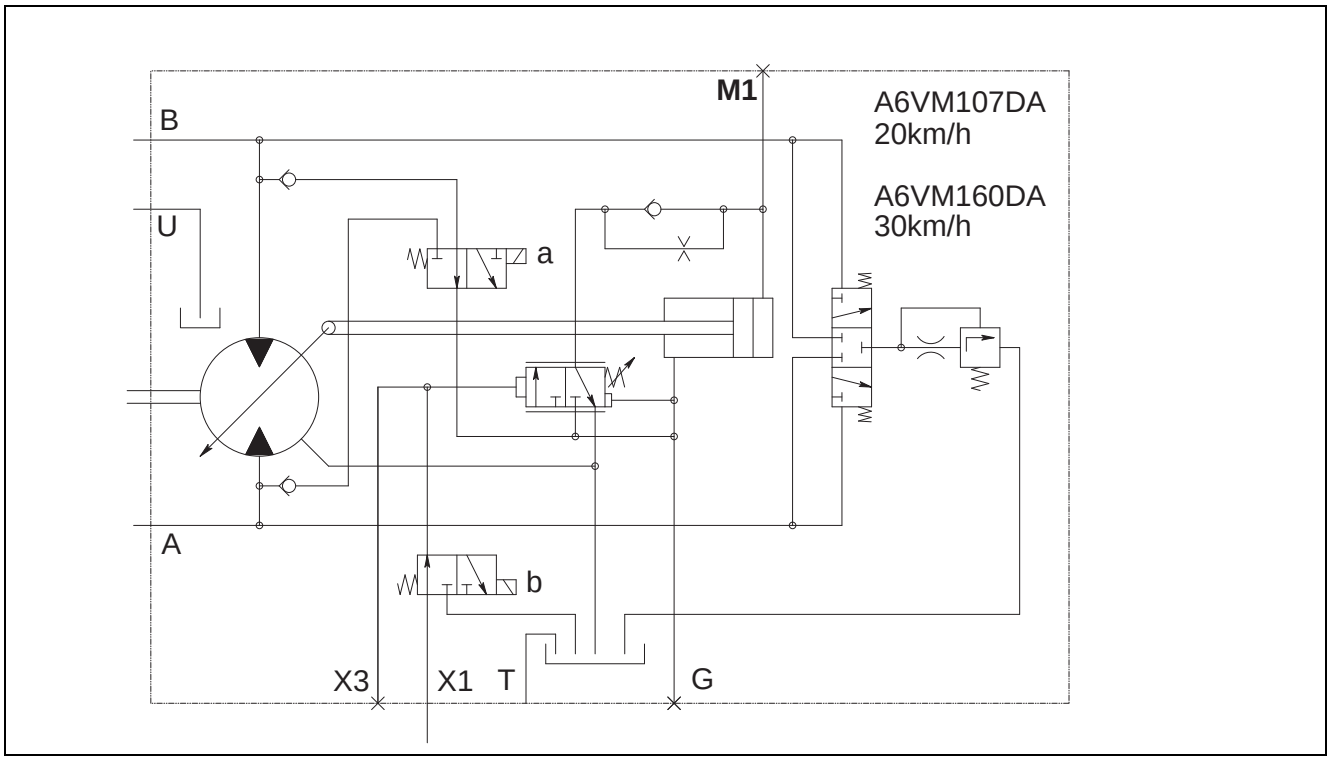
The travel speed drops while torque is increased. This happens even with high control pressure.

In forward the override solenoid valve (Y236.1) is de-energized, so that the machine is not braked while downhill driving.

The speed range solenoid valve (Y235) is energized to fix the HST motor at MAX. displacement.

20 km/h versions	**A6VM107DA2**
30 km/h versions	**A6VM160DA2**
Type	Variable displacement, piston type
Displacement (cm^3/rpm)	26.6 to 107 33.2 to 160
Safety pressure (kg/cm^2)	------
Cut off pressure (kg/cm^2)	430
HST charge pressure (kg/cm^2)	26 - 30

Hydraulic diagram HST Motor A6VM107(160)DA2



B **Travel pressure forward**

A **Travel pressure reverse**

X1 **Control pressure input port**

U **Lubrication oil port**

T **Return**

G **Check port travel pressure**

M1 **Check port motor displacement change pressure**

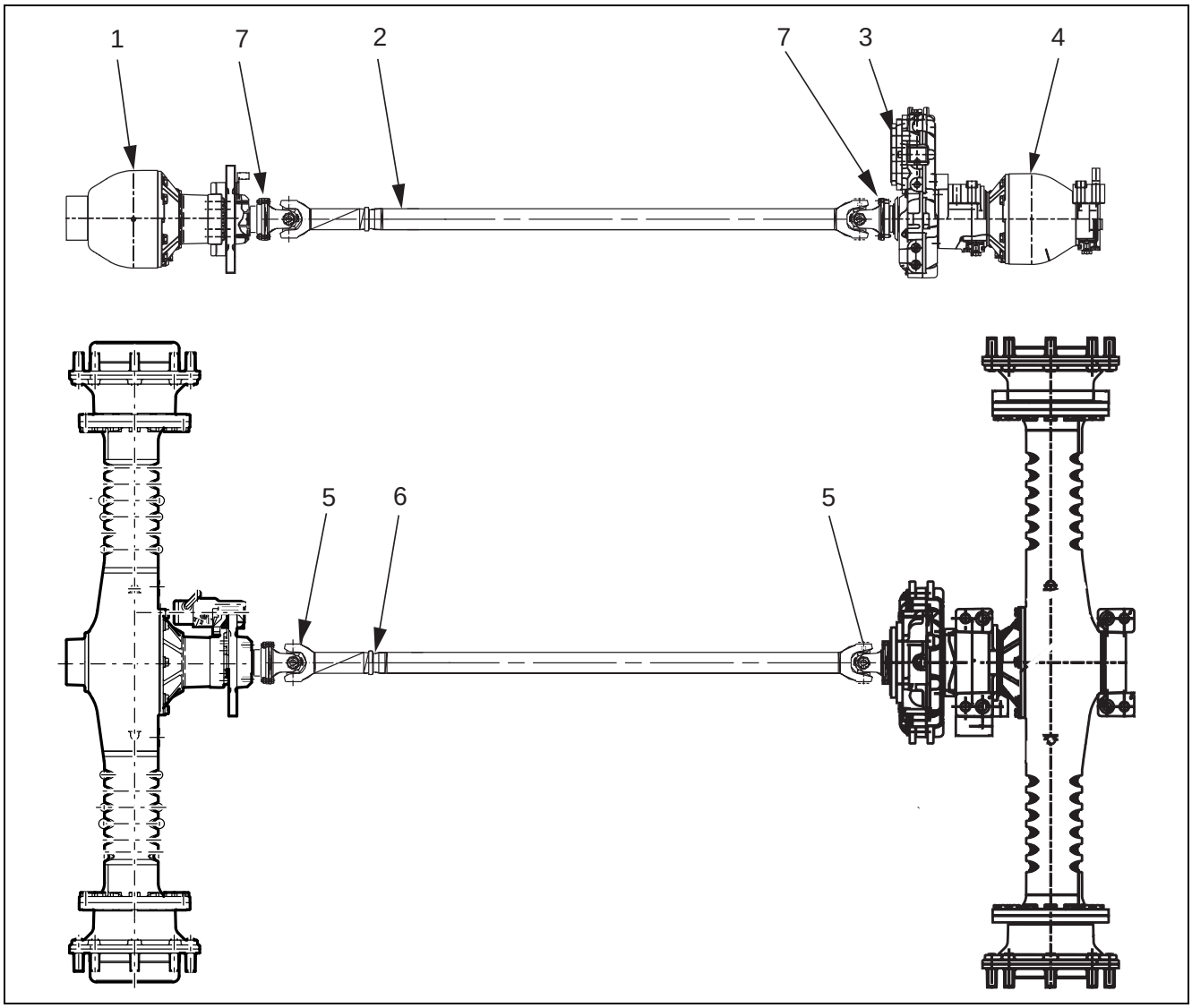
a Override solenoid
Forward: De-energized, 0 Volt
Reverse: Energized, 12 Volt

b Speed range solenoid
1. Range: Energized, 12 Volt
2. Range: De-energized, 0 Volt

NOTE
With HA control the HST motor is set to MIN. displacement in neutral.

NOTE
With DA2 control the HST motor is set to MAX. displacement in neutral.

Drive shaft



1. Front axle
2. Drive shaft
3. Distribution box
4. Rear axle
5. Universal joint
6. Slide cogging
7. Tightening screws

   Tightening torque:

   kgm **70 Nm**

Description

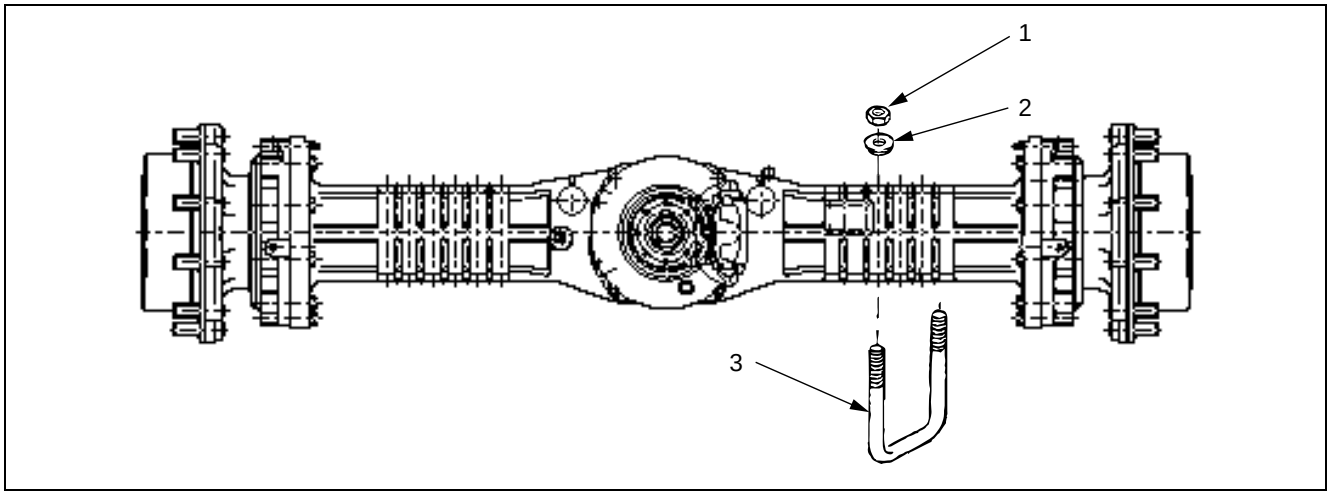
- The power created by the engine is transmitted through the drive pump, to the drive motor, and then to the distribution box. The power is transmitted from the distribution box (3) directly to the rear axle (4) and through the drive shaft (2) to the front axle (1).
- Besides transmitting torque the drive shaft has a further use:

  The drive shaft is fitted with universal joints (5) and a slide cogging (6).

During steering the angle and distance between the front and rear axle change.

Front axle – Mounting

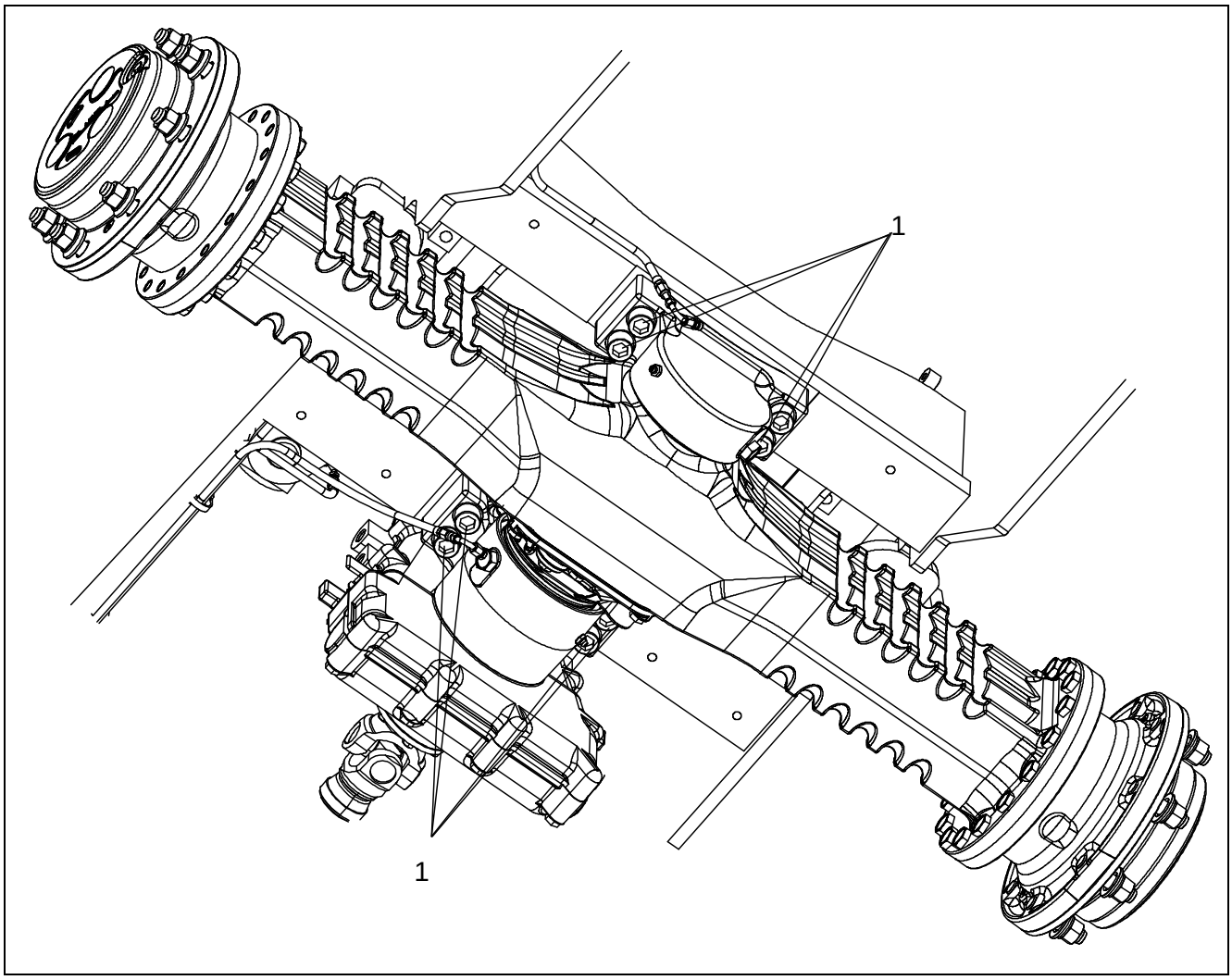
WA80M-7, WA100M-7 – Front axle mounting



1. Nut
2. Washer
3. U-bracket

Tightening torque: = 800 Nm

Rear axle – Mounting

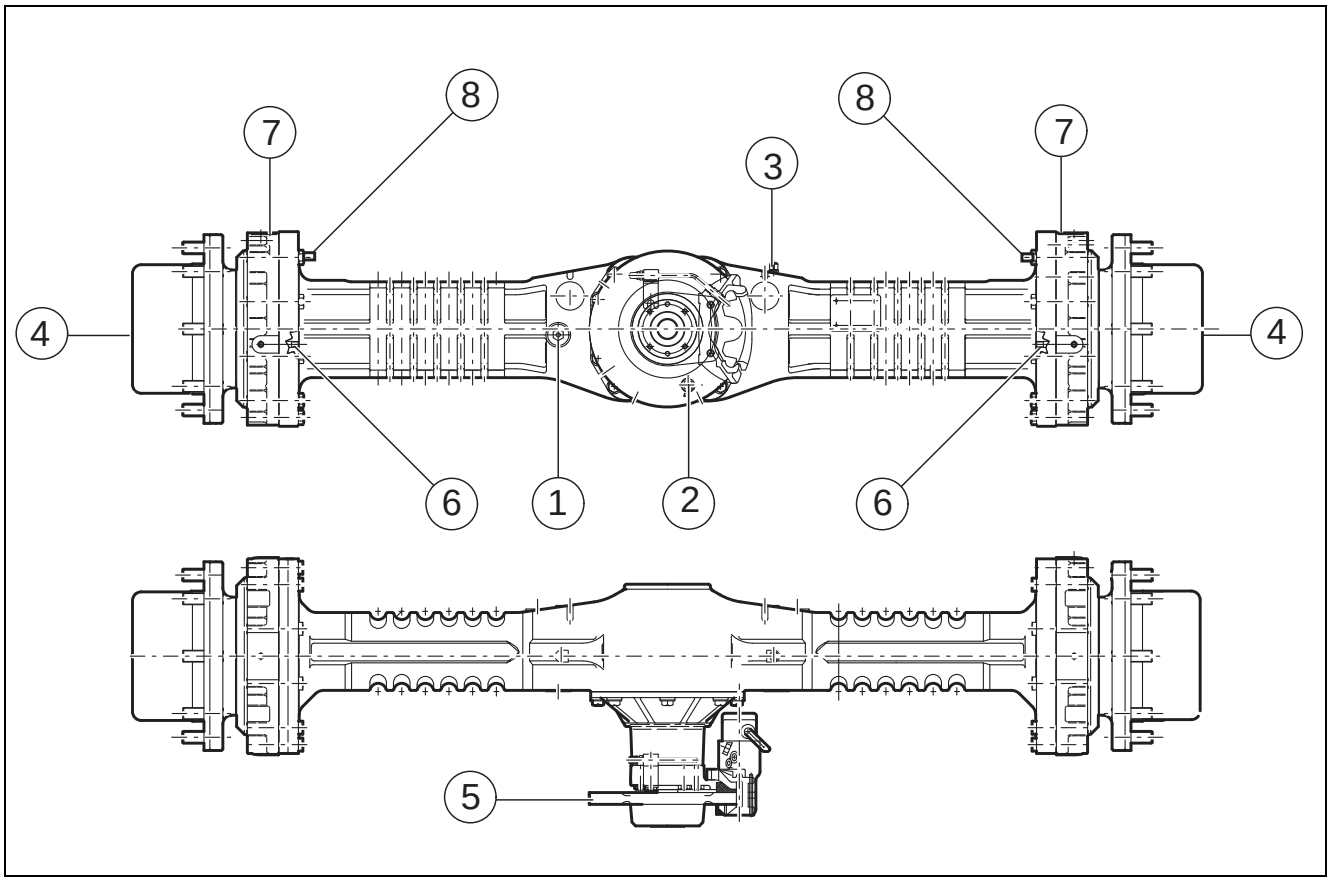


1. Tightening screws (8 units)

Tightening torque: kgm = 800 Nm

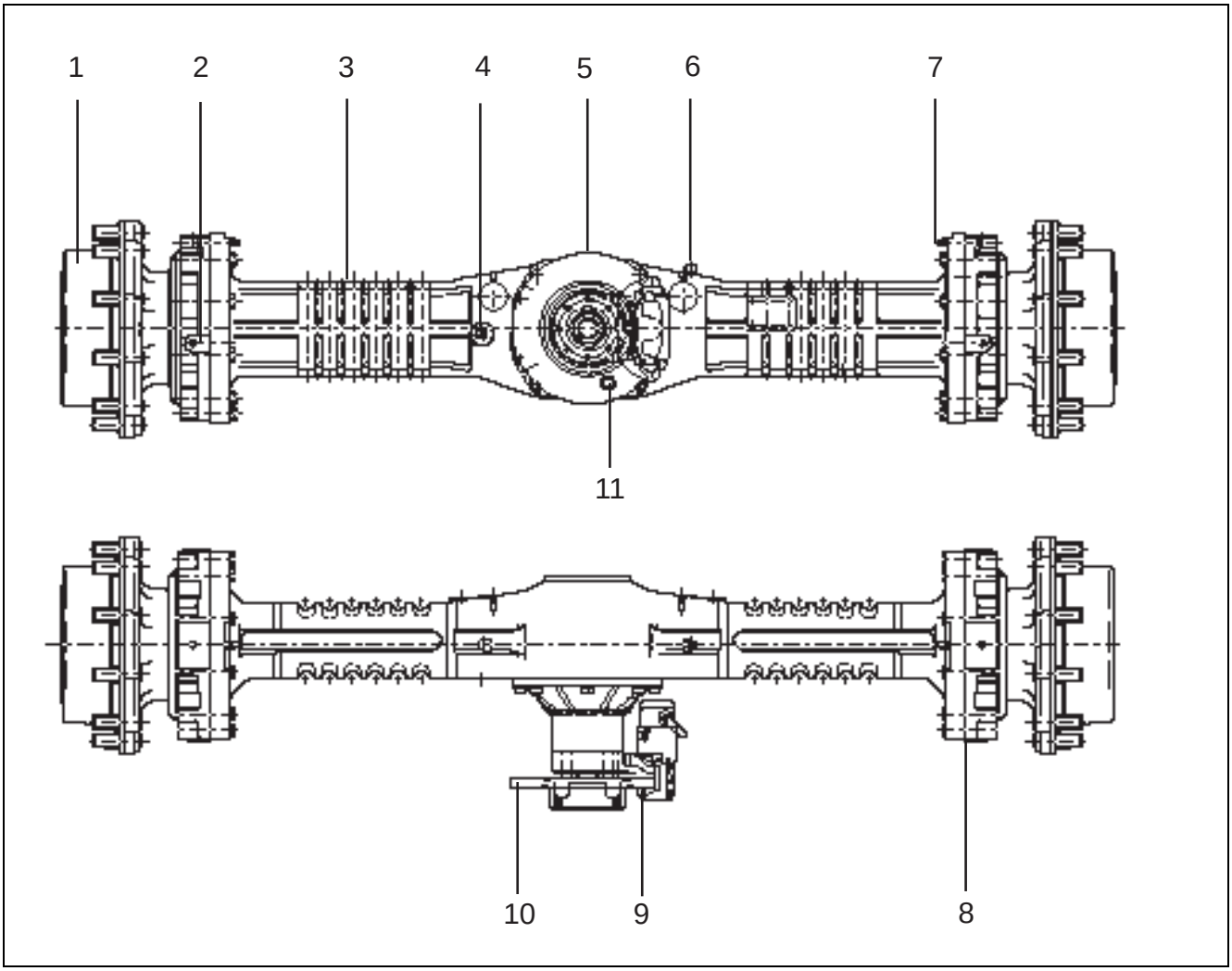
Front axle

WA80M-7 – Front axle with inner disc brake as service brake and outer disc brake as parking brake



1. Oil filling and level plug
2. Oil drain plug
3. Oil breather
4. Oil filling level and drain plug for planetar reduction gear
5. Parking brake (outer disc brake)
6 Brakes connection port for service brake
7 Service brake (inner disc brake)
8 Bleeding screw for service brake

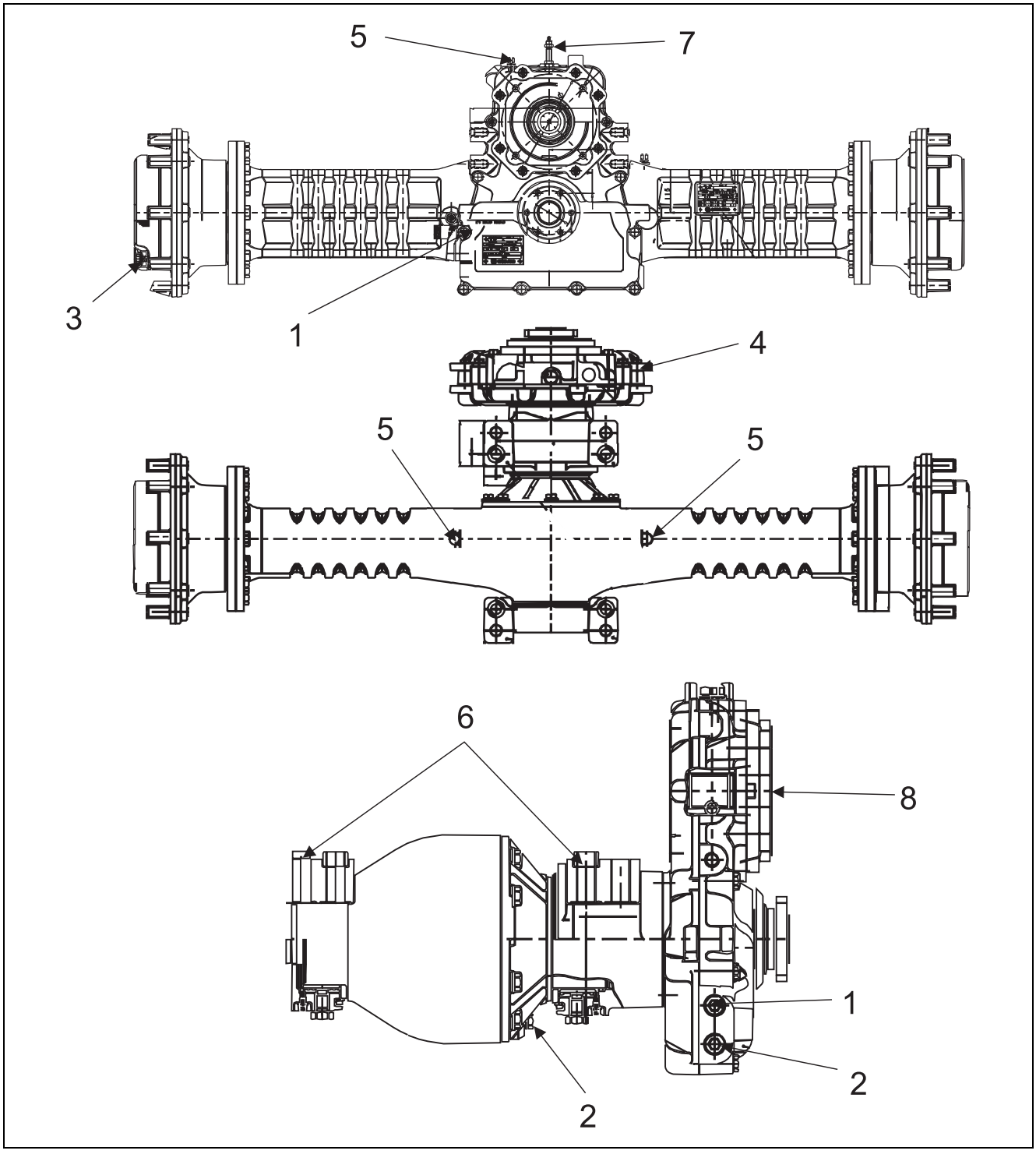
WA100M-7 – Front axle with inner disc brake as service brake and outer disc brake as parking brake



1. Wheel hub
2. Service brake (inner disc brake)
3. Axle housing
4. Oil filling and level plug
5 Differential support
6 Breather
7 Bleeding screw for service brake
8 Service brake (inner disc brake)
9 Service and parking brake
10 Parking brake (outer disc brake)

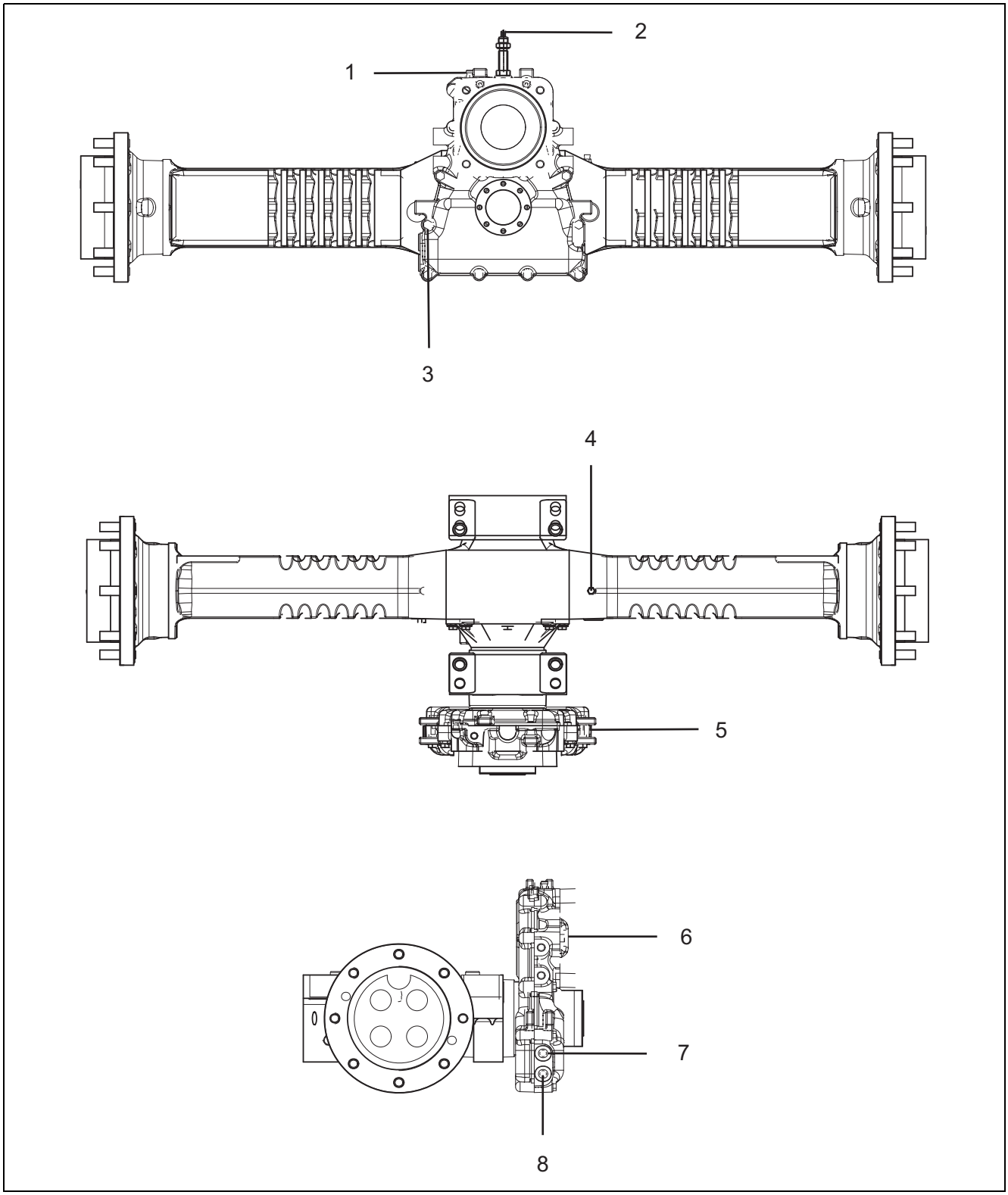
Rear axle with transfer box

WA80M-7 – Rear axle with transfer box



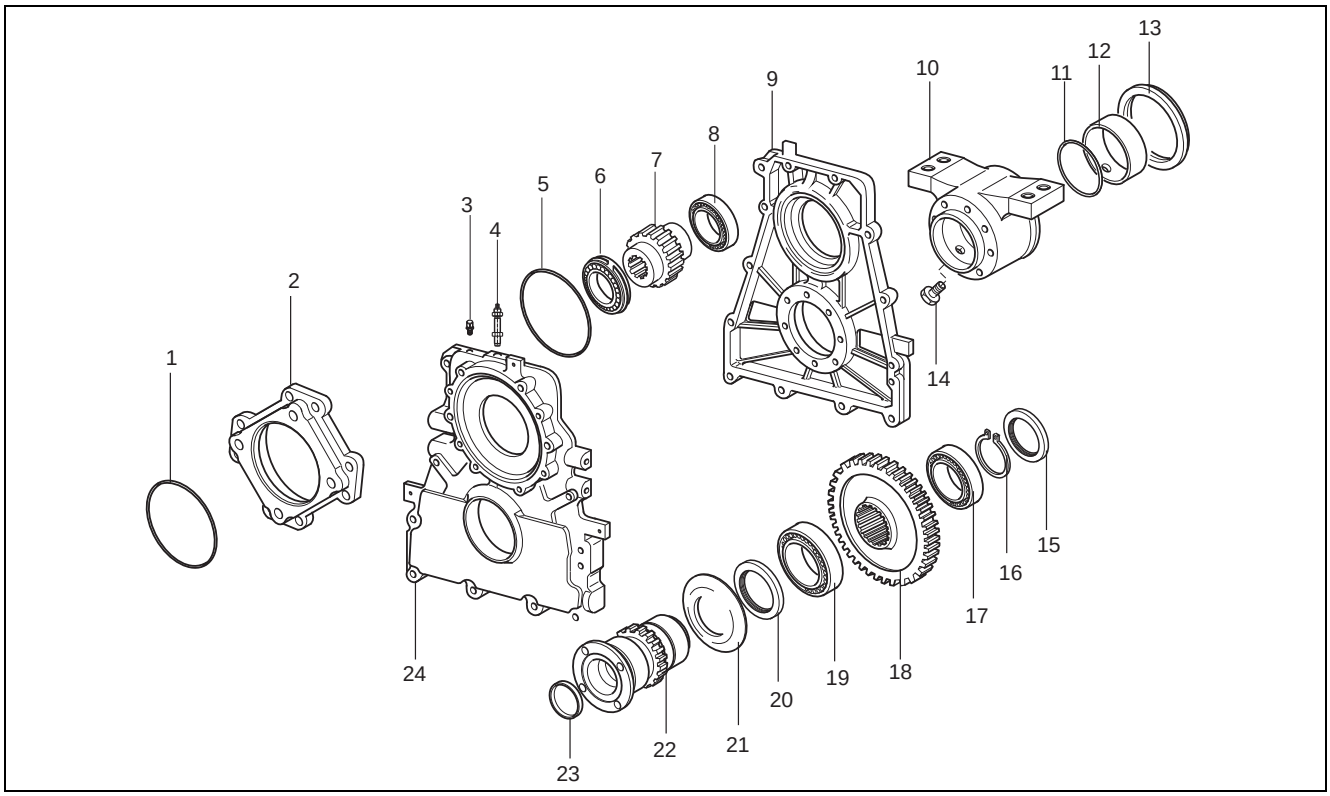
1. Oil control and fill screw
2. Oil drain screw
3. Oil drain and fill plug
4. Transfer box TB172
5. Breather
6. Oscillating bearings
7. Speed sensor
8. Flange for variable displacement motor

WA100M-7 – Rear axle with transfer box



1. Breather
2. Speed sensor
3. Oil control and fill screw
4. Breather
5. Transfer box TB172
6. Flange for variable displacement motor
7. Oil control and fill screw
8. Oil drain screw

Transfer box TB172



1.	O-ring	9.	Half housing	17	Bearing
2.	Flange	10.	Rear support	18	Output gear
3.	Breather	11.	O-ring	19	Bearing
4.	Speed sensor	12.	Bushing	20	Seal
5.	O-ring	13	Seal	21	Cover
6.	Bearing	14	Bolt	22	Shaft
7.	Input gear	15	Seal	23	Plug
8.	Bearing	16	Snap ring	24	Half housing

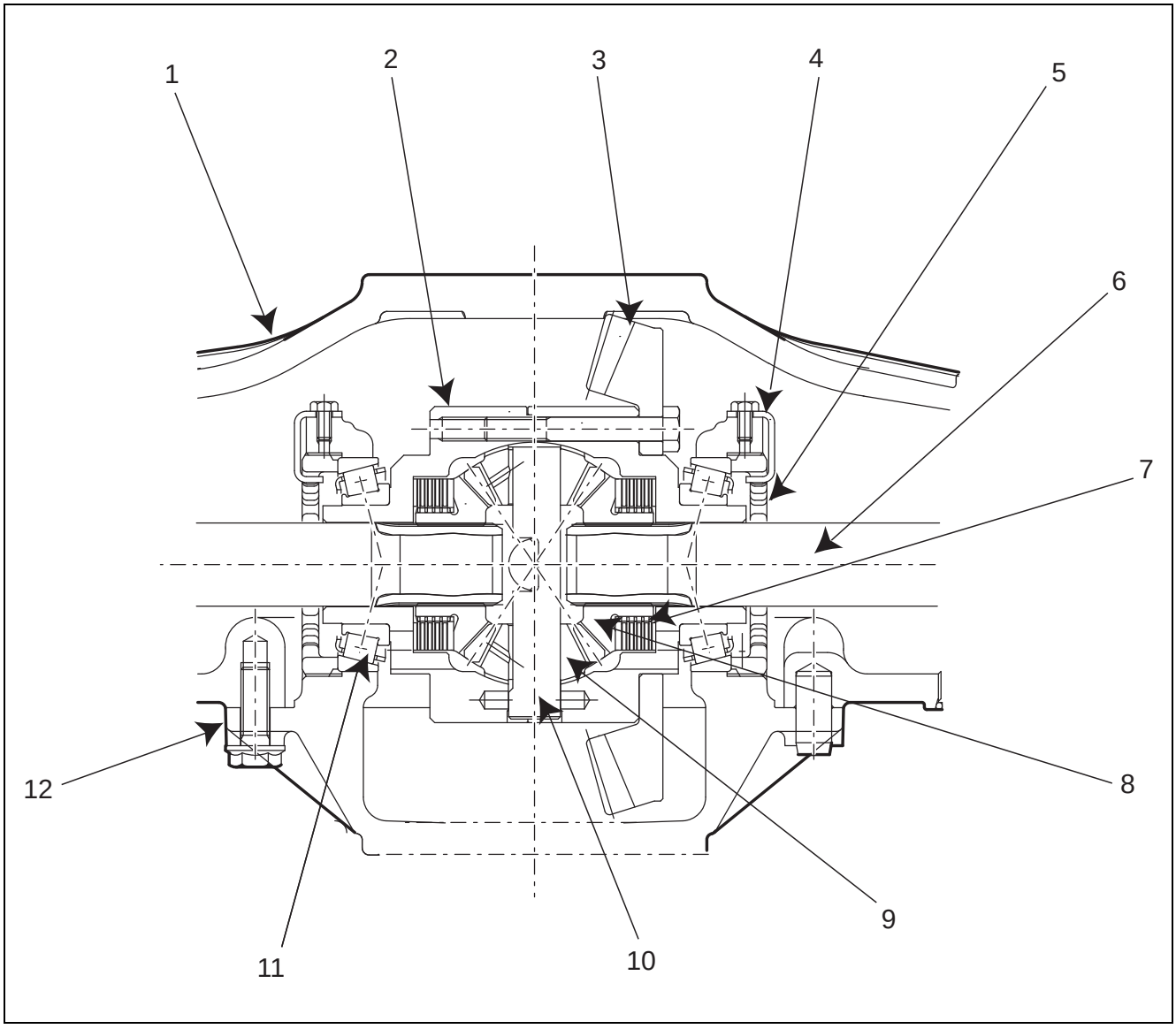
Description

- The variable displacement motor is mounted on the mounting flange (2). The drive torque is transmitted from the motor to the input gear (7). The torque is then transmitted mechanically to the output gear (18) and the output shaft (22). The torque is transmitted from the distribution box through the differential to the drive shafts.
- The transfer box is mounted on the rear axle.
    - There are 2 different transfer boxes available for WA80M-7 to WA100M-7.
      Ratio 1,179 / 1 for 30 km/h
      Ratio 2,031 / 1 for 20 km/h

Blank for technical reason

Limited slip differential

Limited slip differential – Locking value 25%



1. Axle housing
2. Differential housing
3. Crown gear
4. Locking plate
5. Ring nut
6. Half shaft
7. Disc pack
8. Sun gear
9. Planet gear
10. Pin
11. Bearing
12. Differential support

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 is reduced. The limited slip differential is installed to overcome this problem.

Operation

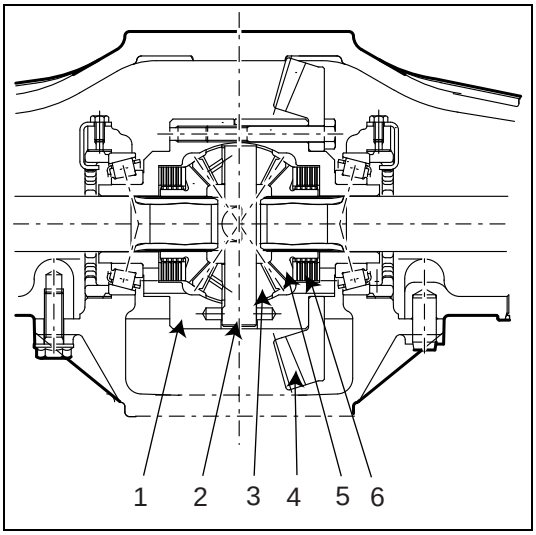
- The self locking effect depends on the internal friction of the differential. It is produced by two multi-disc brakes, which are arranged symmetrically in the differential cage. With a conventional differential, one wheel can be stopped or slowed down without any difficulty when the vehicle is jacked up when driving.

  The other wheel will then revolve correspondingly faster. With the selflocking differential this process is rendered more difficult due to the multi-disc brakes, in fact it will become increasingly more difficult with increasing torque.

- The crown wheel (4) is mounted on the differential housing (1) and transmits the drive torque to the pins (2). The pins carry the planet gears (3) and transmit the drive torque to the sun gears (5).

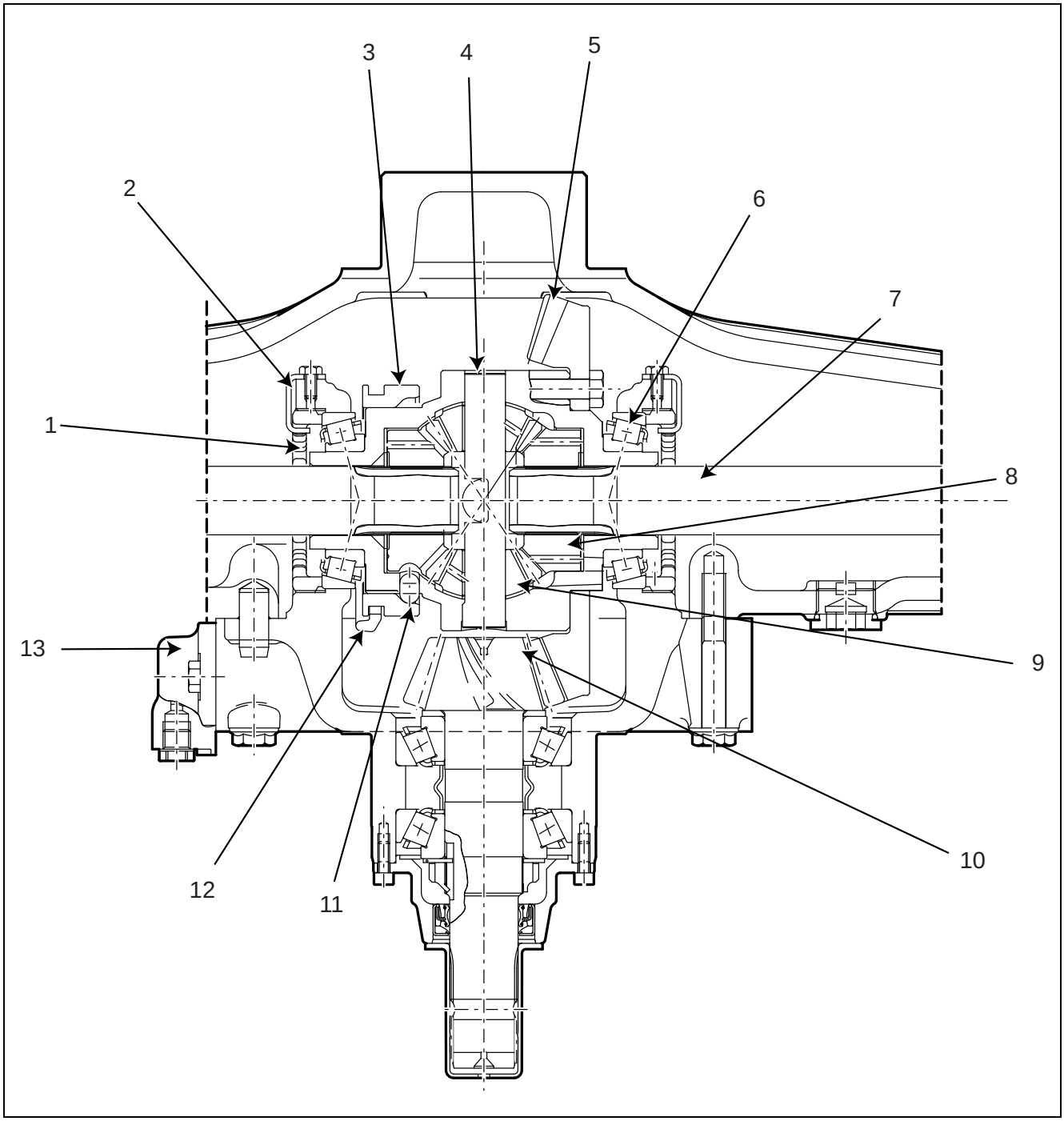
  If one drive wheel starts to lose traction with the ground the planet gears (3) turning on the pins (2) start to rotate around the sun gears (5). This takes place because the other drive wheel now turns slower than the wheel that is slipping.

  The reaction to this movement acts on the sun gears (5). These can move axially. This causes pressure to be applied to the disc pack (6) and the difference in turning speed between the two drive wheels is limited.



Locking differential

Locking differential – Locking value 100%



1. Ring nut
2. Locking plate
3. Lock sleeve
4. Pin
5. Crown gear
6. Bearing
7. Half shaft
8. Sun gear
9. Planet gear
10. Bevel gear
11. Lock pin
12. Lock fork
13. Differential locking

Operation

- With a conventional differential, one wheel can be stopped or slowed down without any difficulty when the vehicle is jacked up when driving.

  The other wheel will then revolve correspondingly faster. With the lock differential it is not possible due to the 100%-locking.

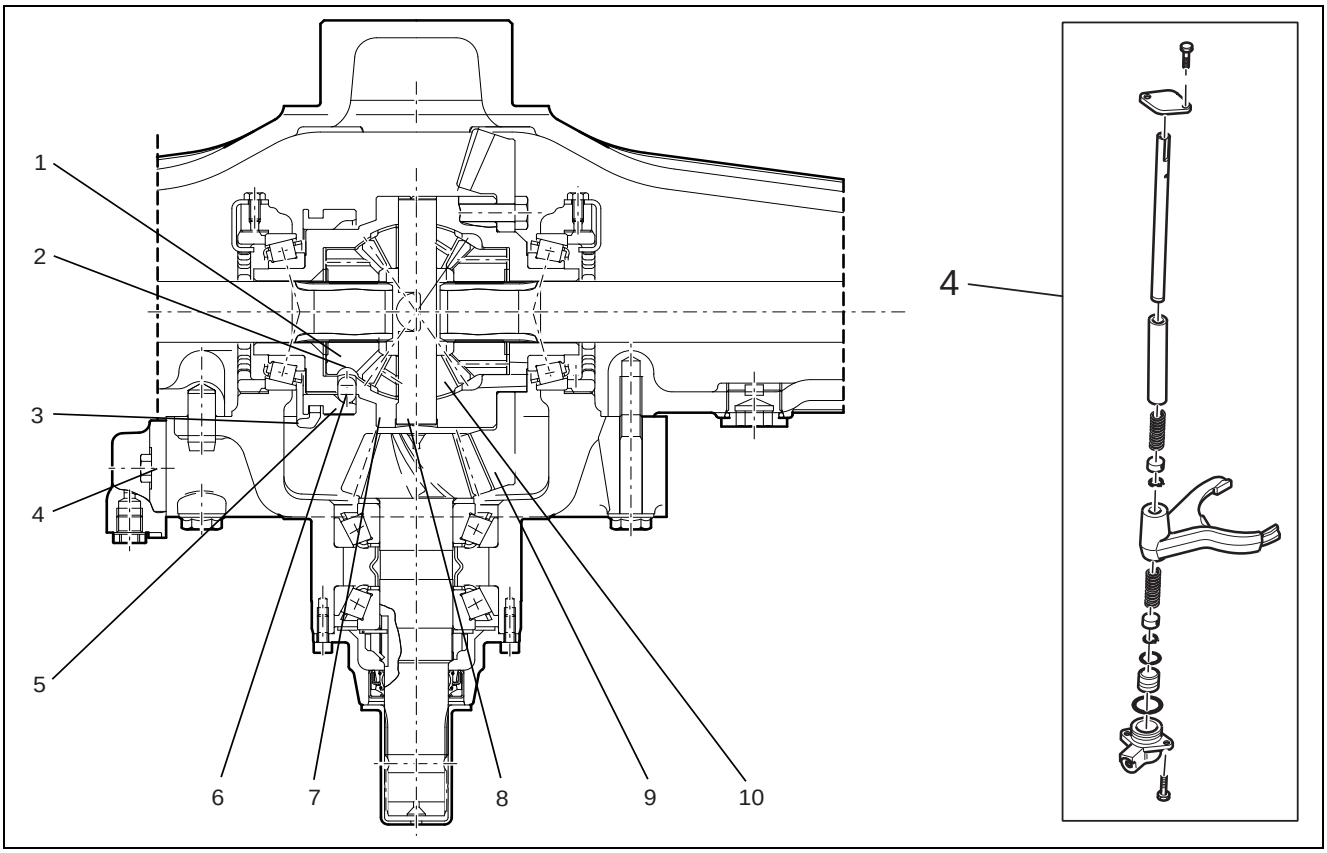
- The crown wheel (9) is mounted on the differential case (7) and transmits the drive torque to the pins (8). The pins carry the planet gears (10) and transmit the drive torque to the sun gears (1).

- If one drive wheel starts to lose traction with the ground the planet gears (10) turning on the pins (8) start to rotate around the sun gears (1). This takes place because the other drive wheel now turns slower than the wheel that is slipping.

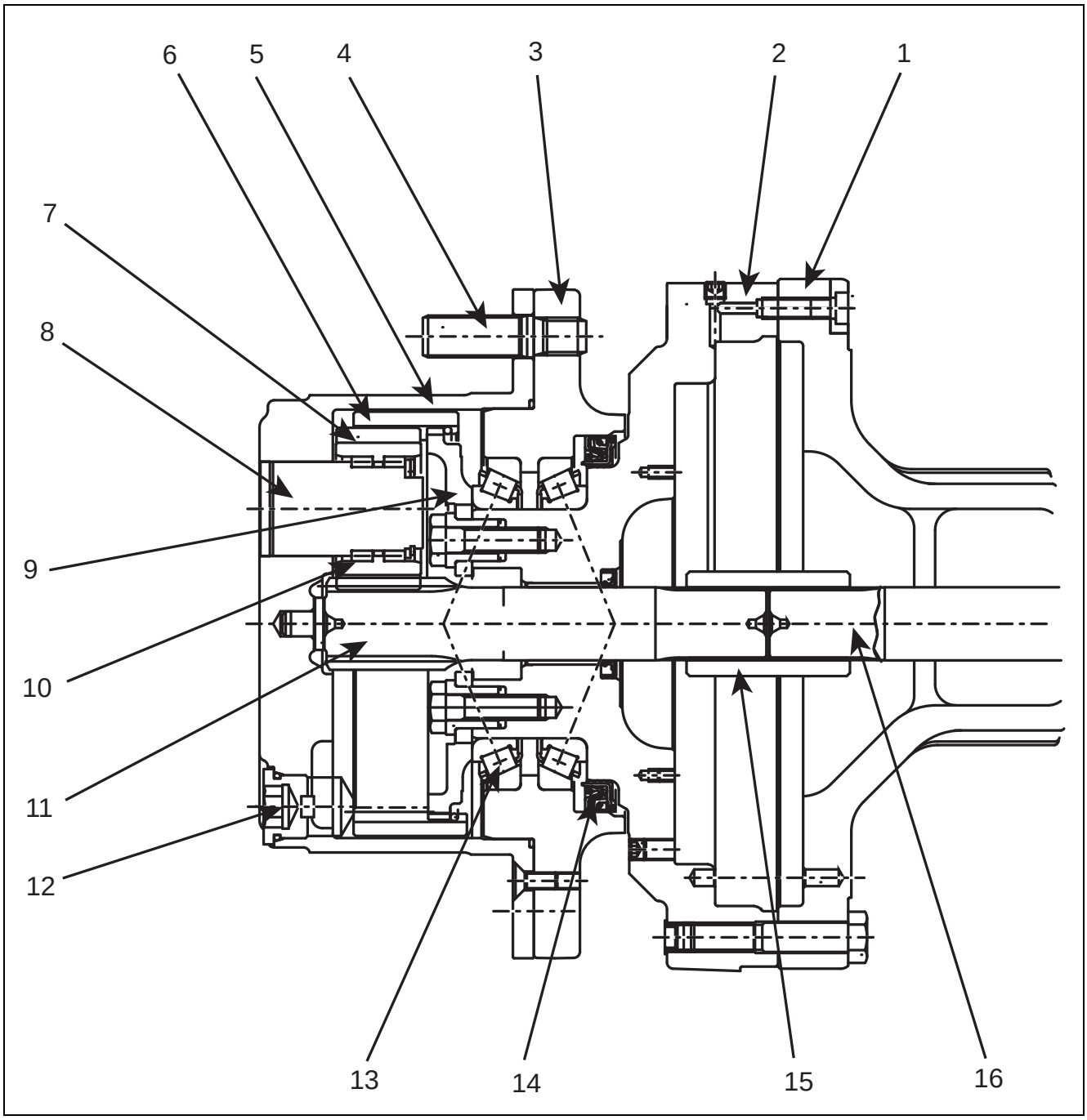
  If the differential lock is actuated by the locking group (4), the differential case, gearing and axle shafts are locked together.

  A fork (3) pull a sleeve (5) over the differential case (7) with three lock pins (6). The sleeve (4) pull the lock pins (6) into three holes in the sun gear (1). Now the differential case (7) is locked wth the sun gear (1).

  This feature maximizes traction to both wheels.



Wheel hub – Font axle and rear axle

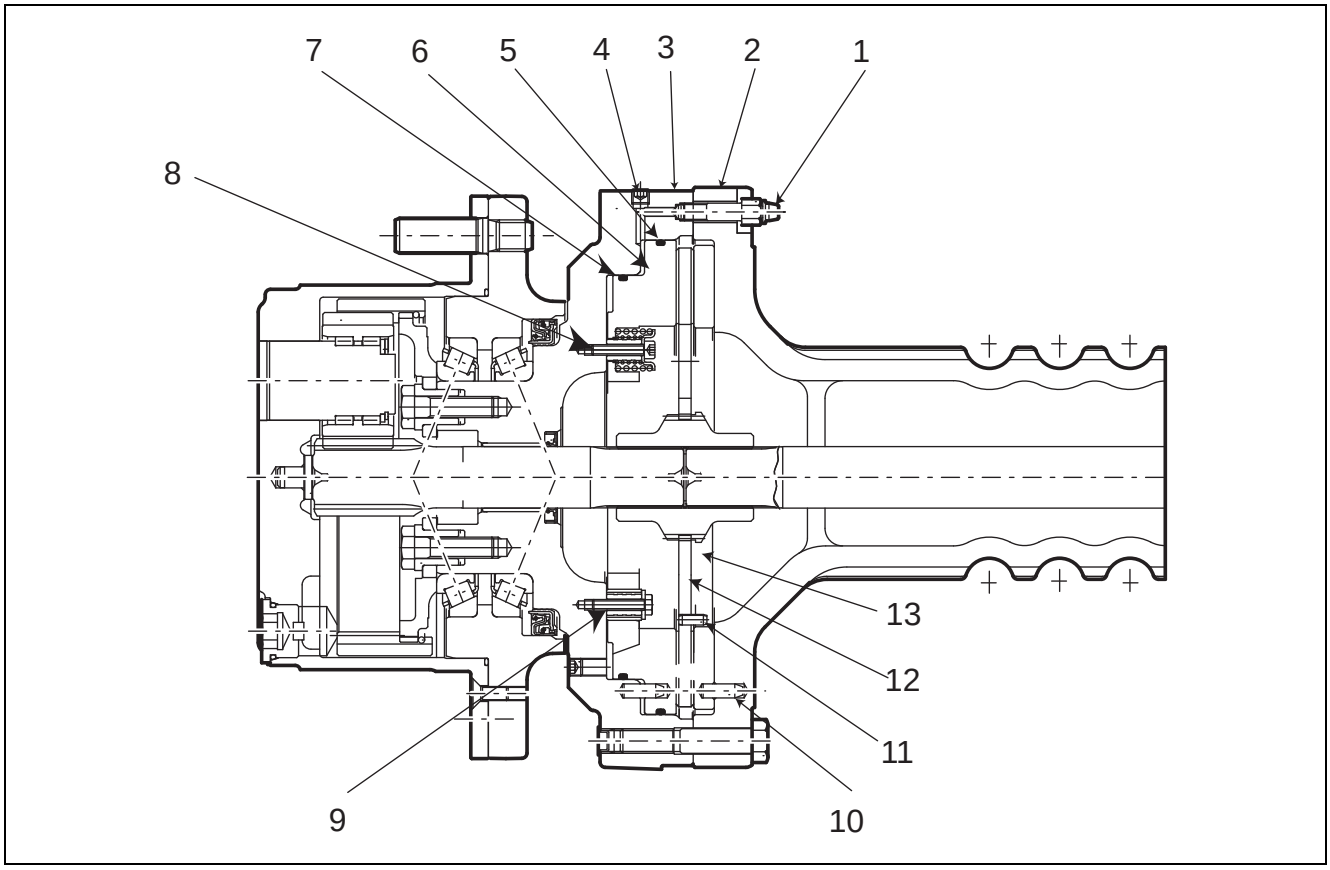


1. Axle mouth housing
2. Wheel hub carrier
3. Ring gear carrier
4. Wheel bolt
5. Planet gear carrier
6. Ring gear
7. Planet gear
8. Planet pin
9. Ring gear carrier
10. Needle roller bearing
11. Half shaft
12. Oil drain plug
13. Tapered roller bearing
14. Oil seal ring
15. Bushing
16. Half shaft

Blank for technical reason

Service and parking brake – Front axle

WA80M-7, WA100M-7 – Service brake



1. Bleeding screw
2. Axle mouth housing
3. Wheel hub carrier
4. Measuring point for brake pressure
5. Quadring
6. Brake piston
7. Quadring
8. Piston return kit
9. Self adjust kit
10. Brake disk pin
11. Dowel pin
12 Brake disc
13 Counterplate

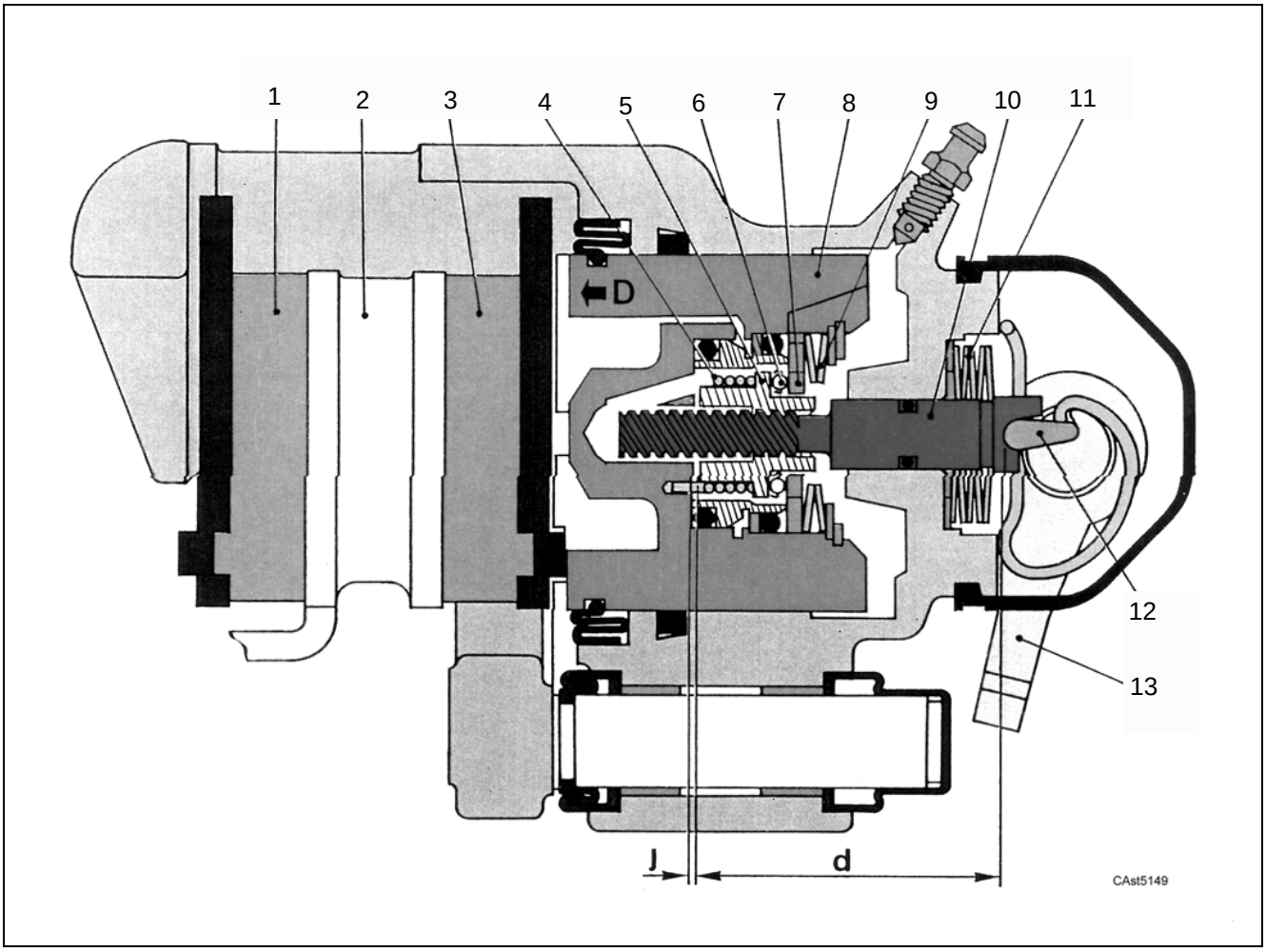
Service brake

- The service brakes are two disc wet type units operating in the front axle.

Function

- When pressing the brake pedal the inch valve opens and the servo oil in the variable displacement pump flows to the tank. At same time the brake master cylinder is operated. The oil from brake master cylinder flows to brake pistons. The brake pistons press the pressure plate against the brake disc. The disc is compressed and the drive shafts are braked.
- When the brake pedal is released the pressure on the pistons will be released. The return springs pull the brake pistons back and the brake is free.

WA80M-7, WA100M-7 – Parking brake



1. Brake pad
2. Brake disk
3. Brake pad
4. Coil spring
5. Adjusting nut
6. Thrust ball bearing
7. Washer
8. Brake piston
9. Elastic washers
10. Threaded rod
11. Elastic washers
12 Pusher
13 Lever for parking brake

Parking brake

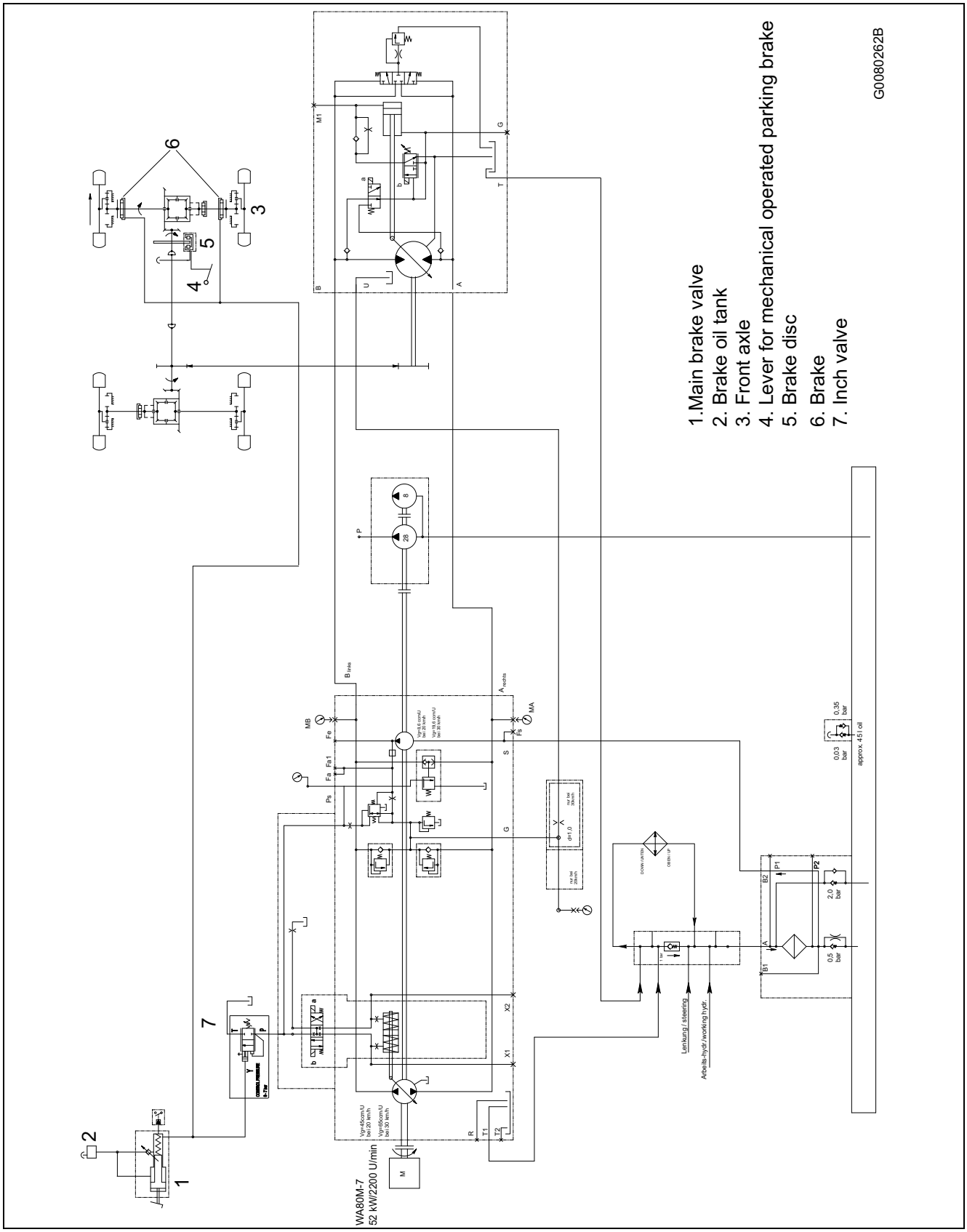
- The parking brake consists of: Hand brake lever, bowden cable, work lever and linkage lever.
- An electrical switch on the hand brake lever prevents the machine from being driven when the parking brake is applied.

Function

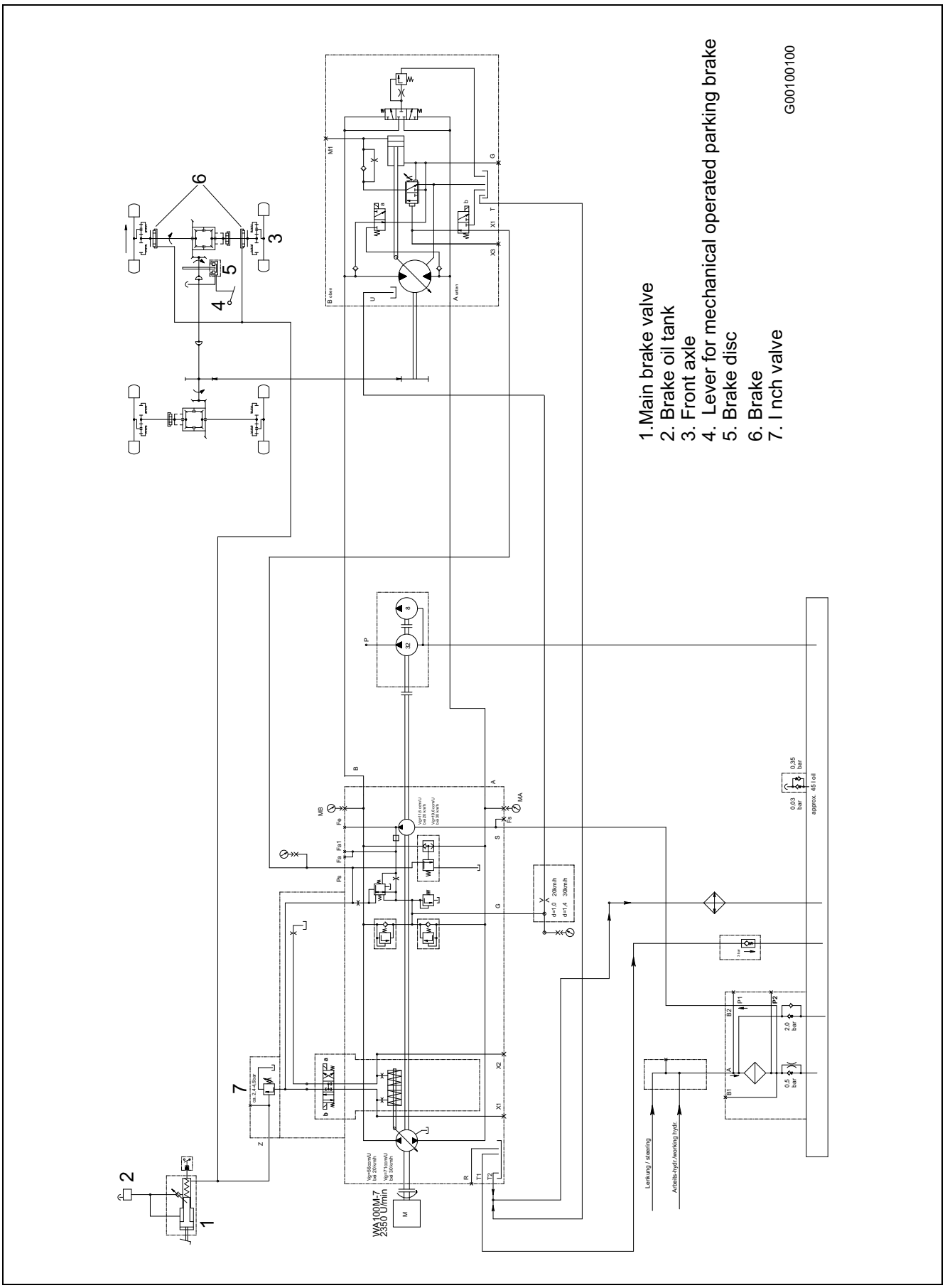
- When the hand brake lever is released, the remove springs returns the brake shoes and in their starting position. The parking brake is released.

Service and parking brake circuit

WA80M-7 – Service and parking brake circuit

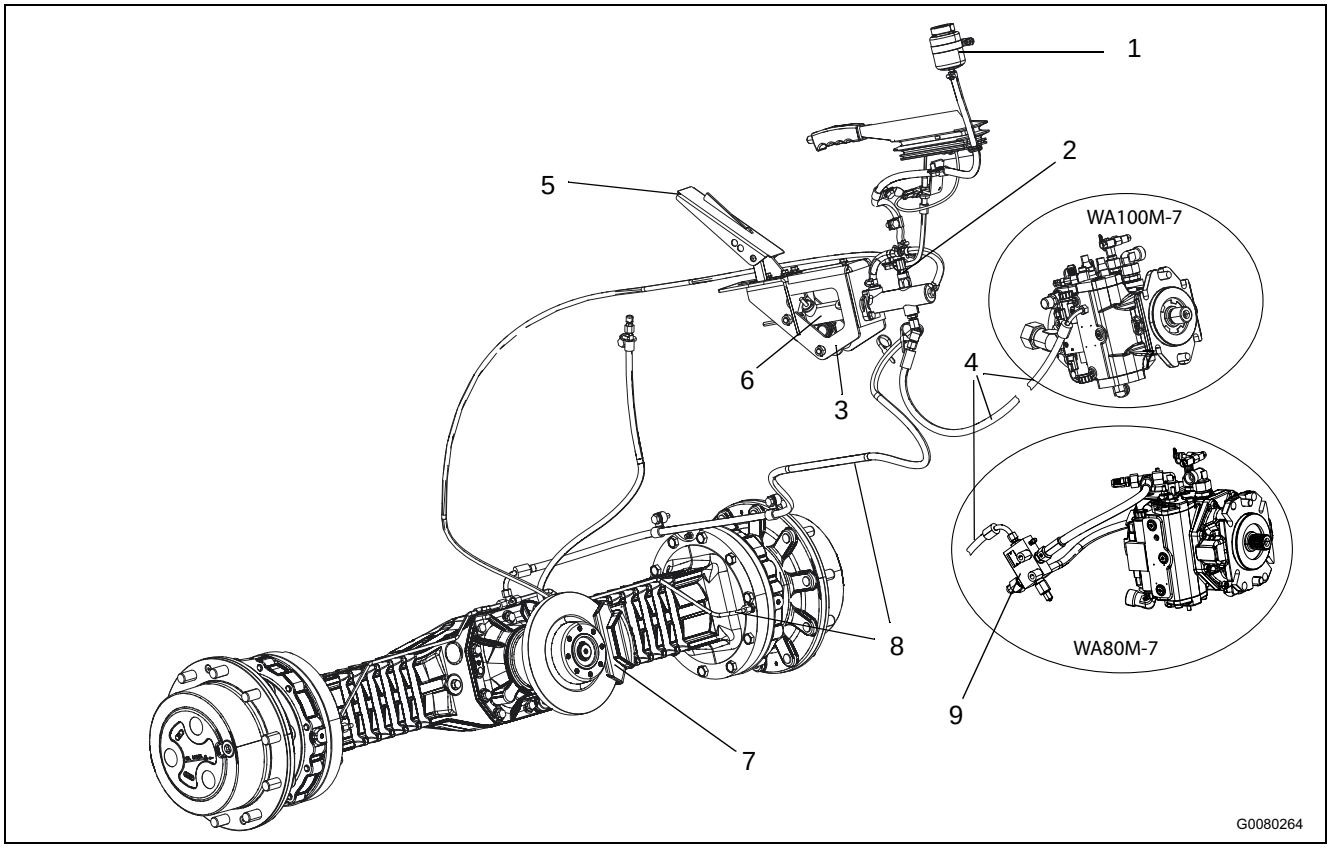


WA100M-7 – Service and parking brake circuit



Service brake assembly

WA80M-7, WA100M-7 – Service brake assembly



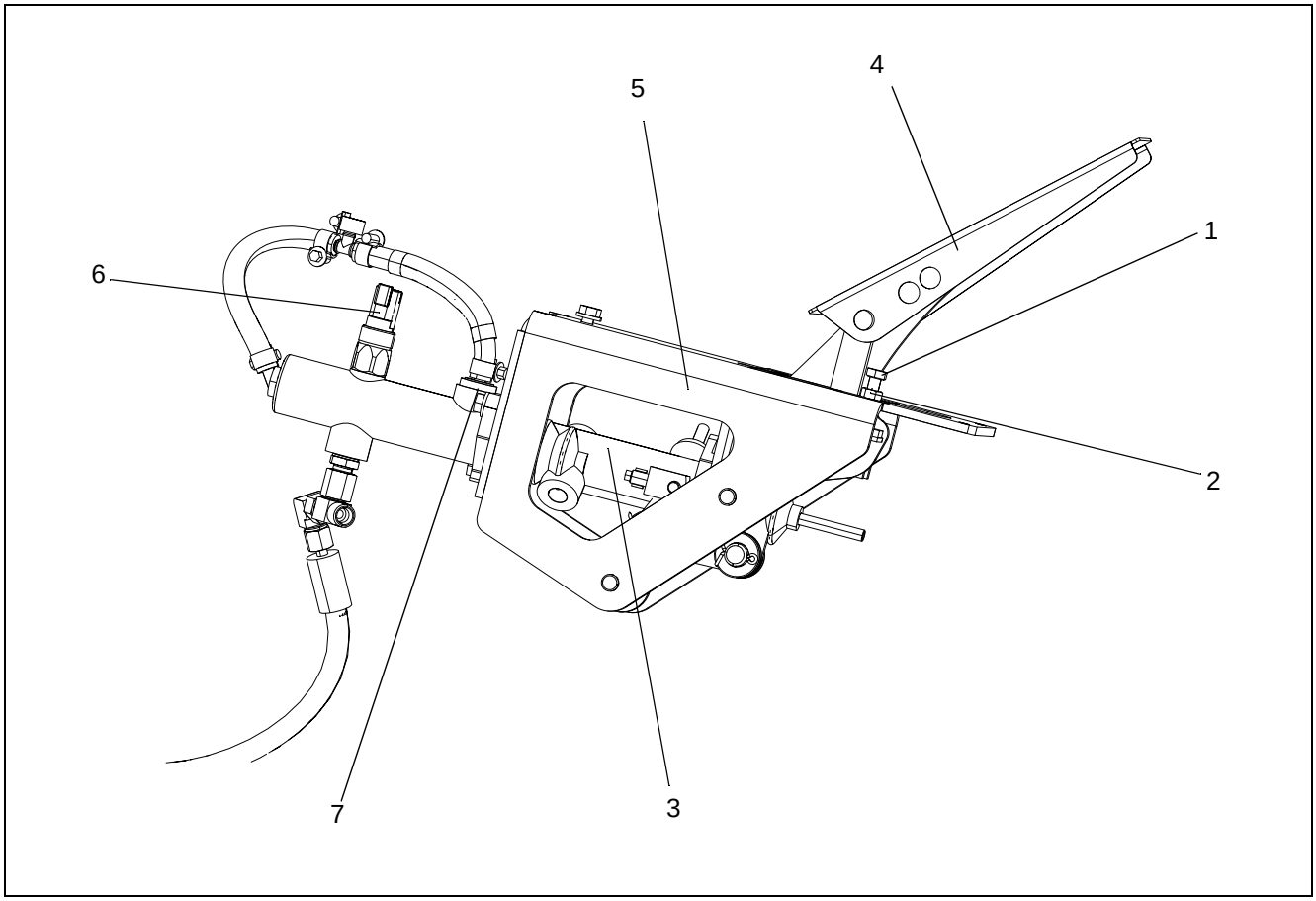
1. Expansion tank
2. Brake light switch
3. Bracket for pedal and brake master cylinder
4. Connection to the inch valve
5. Pedal
6. Brake master cylinder
7. Parking brake
8. Connection to the service brake
9. Inch valve (WA80M-7)

Function

- The inch valve on WA100M-7 is mounted in the variable displacement pump. The inch valve is connected to the brake pedal with a hydraulic hose (4).
- The inch valve allows, independent of engine speed and driving resistance, a variable speed reduction. When the inch valve is used, it reduces the servo pressure in the variable displacement drive pump, and the pump moves towards the no-displacement position (neutral). In this position no oil is pumped. When the pump moves through the neutral position the direction of the oil flow smoothly changes.
- That means, that when the pump moves towards the neutral position the drive torque is slowly reduced and the machine can roll to a stop. At the same time the brake master cylinder is activated and brakes the machine.

Main-brake valve

WA80M-7, WA100M-7 – Main-brake valve



1 Adjusting screw for pedal
2 Locknut
3 Brake master cylinder
4 Pedal
5 Bracket for pedal and brake master cylinder
6 Brake light switch
7 Pipe to expansion tank

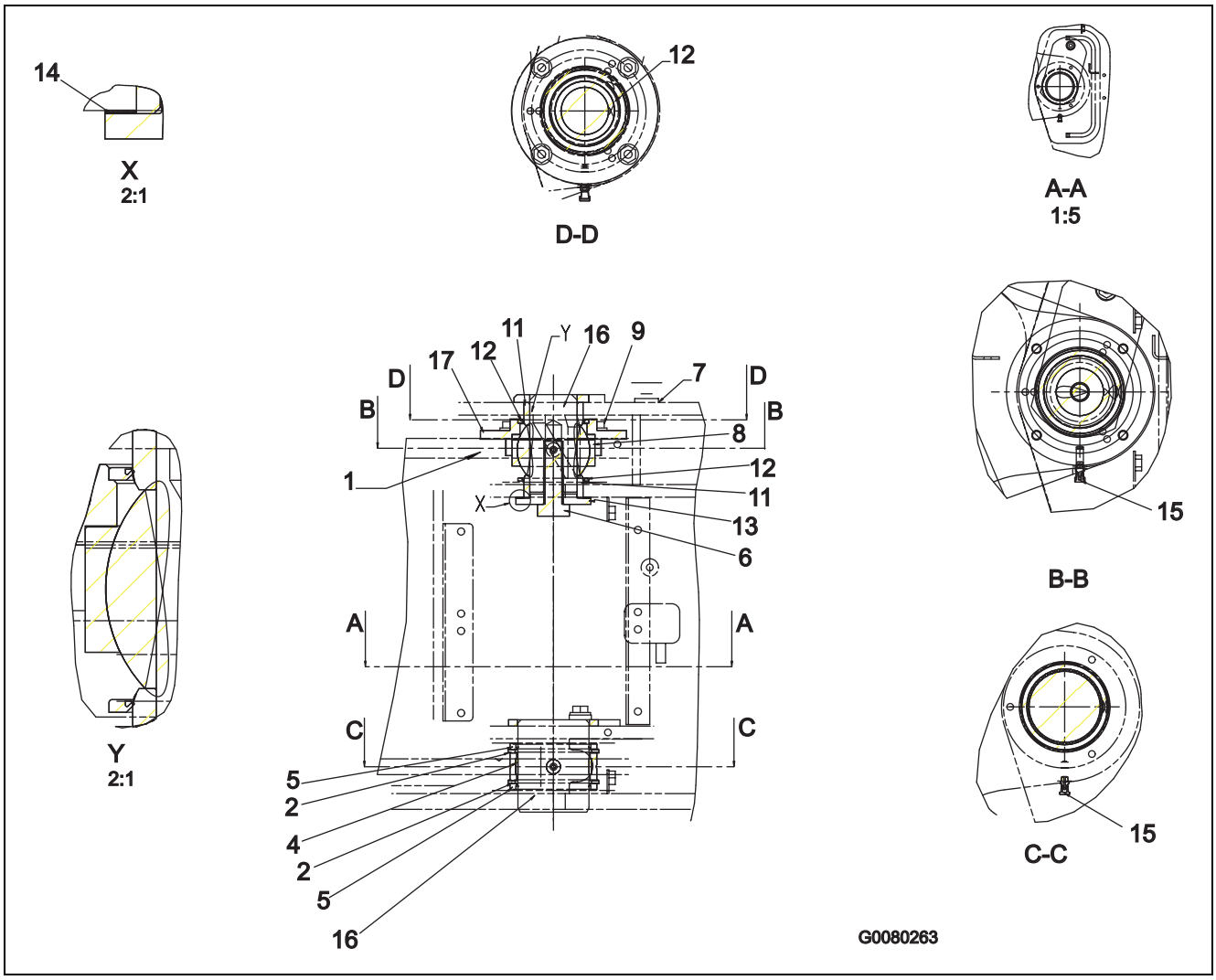
Function

- The inch valve in the variable displacement pump allows, independent of engine speed and driving resistance, a variable speed reduction.

  When the brake pedal is pressed, a pilot pressure is applicated to the inch valve. It reduces the servo pressure and the pump moves towards the no-displacement position (neutral). In this position no oil is pumped.

  The wheel loader stops. At the same time the brake master cylinder is activated and brakes the machine.

Steering articulation joint



1. Front frame
2. Safety ring
3. Pin
4. Needle roller bearing
5. Seal
6. Bolt, M24x80
7. Rear frame
8. Bearing
9. Bolt, M12x35
10. Pin
11. Bushing
12. Dust seal
13. Washer
14. Shim, 0.5 or 1.0 mm
15. Lubrication nipple
16. Pin
17 Retainer

Description

- The front frame (1) and the rear frame (7) are connected through the upper (10) and lower steering articulation joint (3).

- WA80M-7
  The steering cylinder is mounted on the left side of the machine and forms a connection between the front and rear frames (not shown).

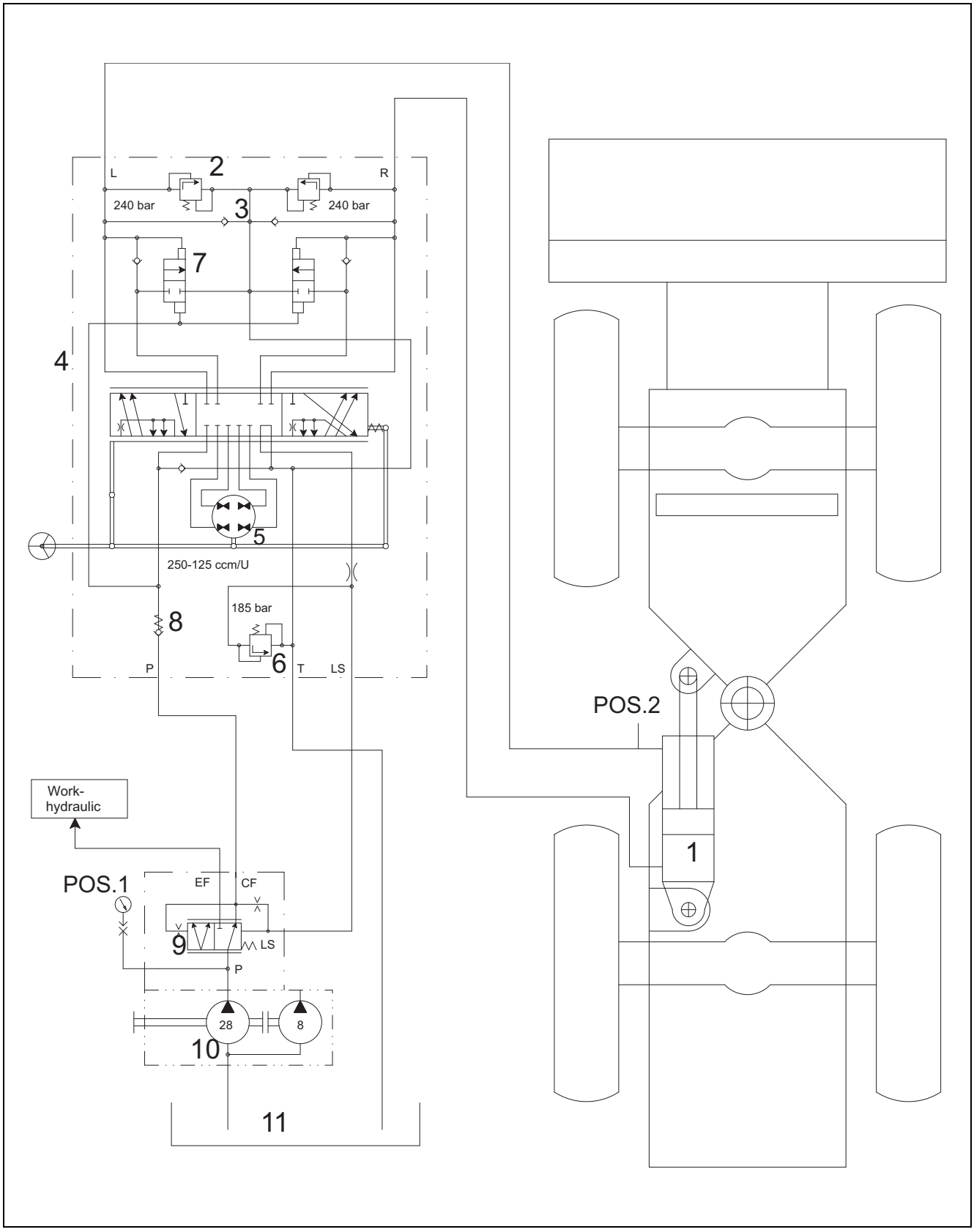
  The angle between the front and rear frames (the turning circle) is proportional to the steered angle.

- WA100M-7
  The steering cylinder is mounted on both sides of the machine and forms a connection between the front and rear frames (not shown).

  The angle between the front and rear frames (the turning circle) is proportional to the steered angle.

Steering system

WA80M-7 – Hydraulic circuit diagram of steering system



1. Steering cylinder
2. Shock valve
3. Anti-cavitation valve
4. Steering unit
5. Rotary spool
6. Steering pressure relief valve
7. Check valve (only for emergency steering)
8. Check valve
9. Priority valve
10. Working pump
11. Oil tank

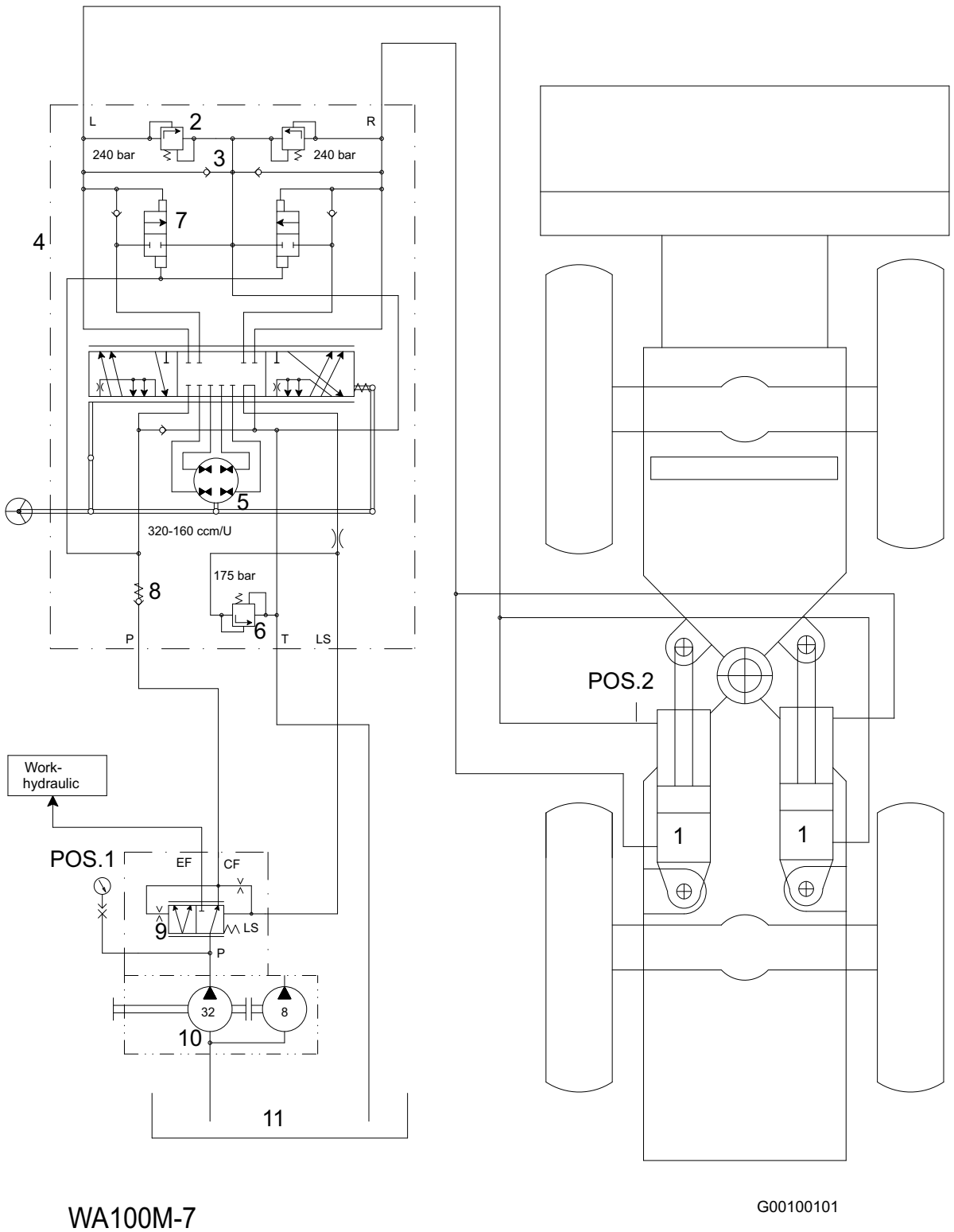
Priority valve port identification

P Inlet from pump
CF Outlet to steering unit
EF Outlet to main control valve
LS Control line from steering unit

Steering unit port identification

P Inlet from priority valve
T Return oil
L Connection to steering cylinder, left side
R Connection to steering cylinder, right side
LS Control line to priority valve

WA100M-7 – Hydraulic circuit diagram of steering system



Hydraulic circuit diagram of steering system

1. Steering cylinder
2. Shock valve
3. Anti-cavitation valve
4. Steering unit
5. Rotary spool
6. Steering pressure relief valve
7. Valve (only for emergency steering)
8. Check valve
9. Priority valve
10. Working pump
11. Oil tank

Priority valve port identification

P Inlet from pump
CF Outlet to steering unit
EF Outlet to main control valve
LS Control line from steering unit

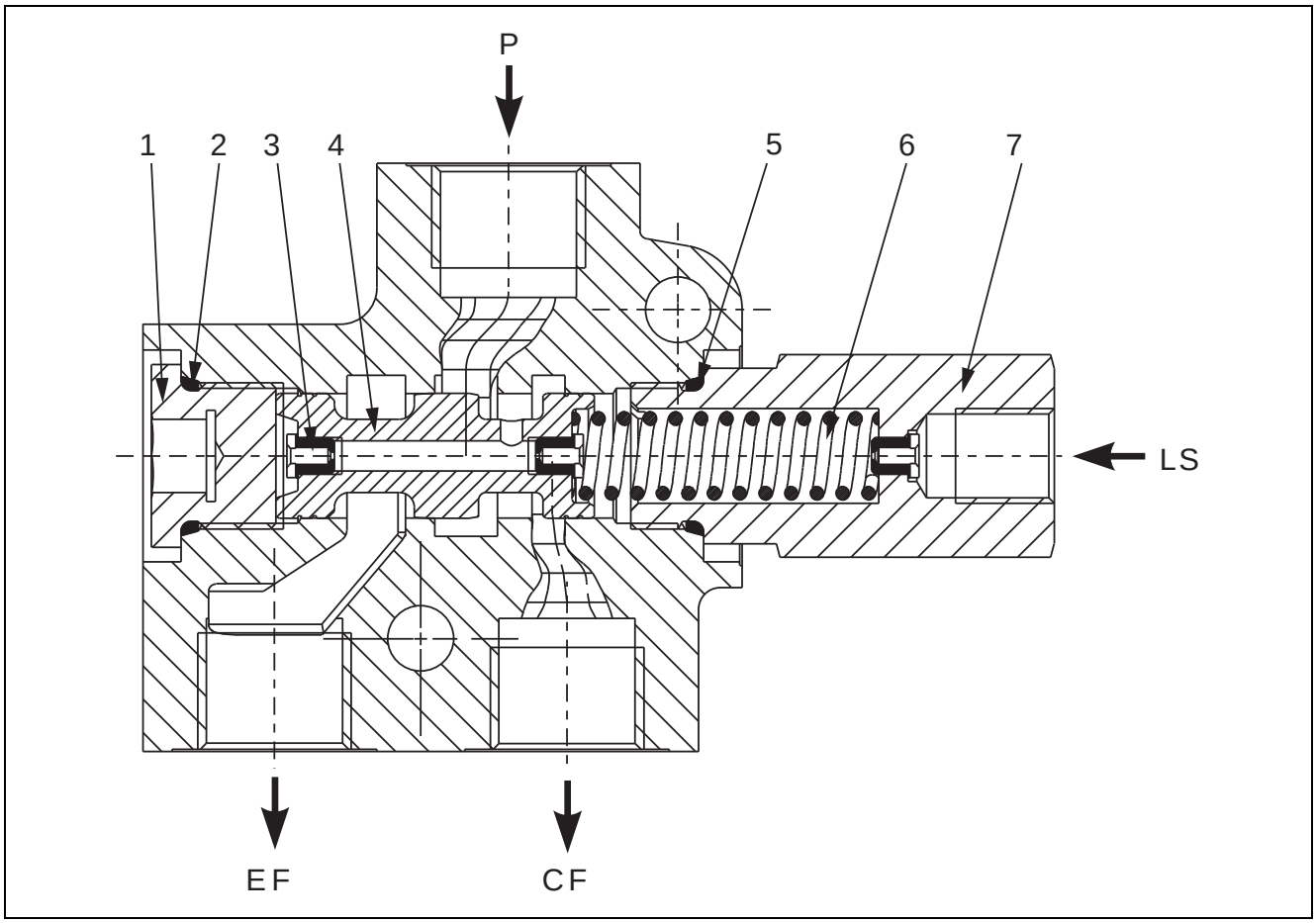
Steering unit port identification

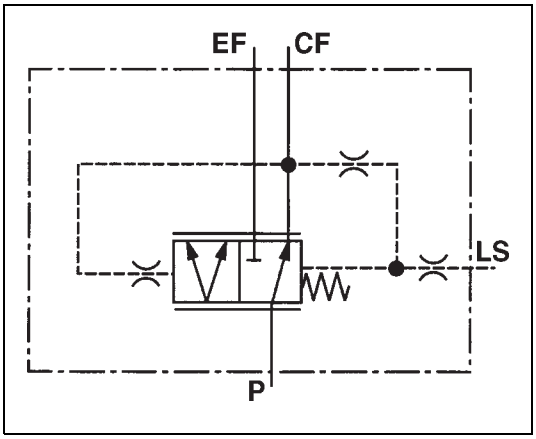
P Inlet from priority valve
T Return oil
L Connection to steering cylinder, left side
R Connection to steering cylinder, right side
LS Control line to priority valve

Priority valve

Outline

- The priority valve serves to ensure that in a steering operation oil is supplied to the steering system as a matter of priority; the residual quantity of oil is fed to the loader hydraulic system. When no steering takes place, all the oil is passed to the loader hydraulic system.





P Inlet from steering and working hydraulics pump
LS Control line inlet from steering unit
CF Outlet to steering unit
EF Outlet to control unit of loader hydraulics

1. Screw fitting
2. Sealing ring
3. Orifice
4. Control piston
5. Sealing ring
6. Spring
7. Spring sleeve with orifice

Orbit-roll-valve

Outline

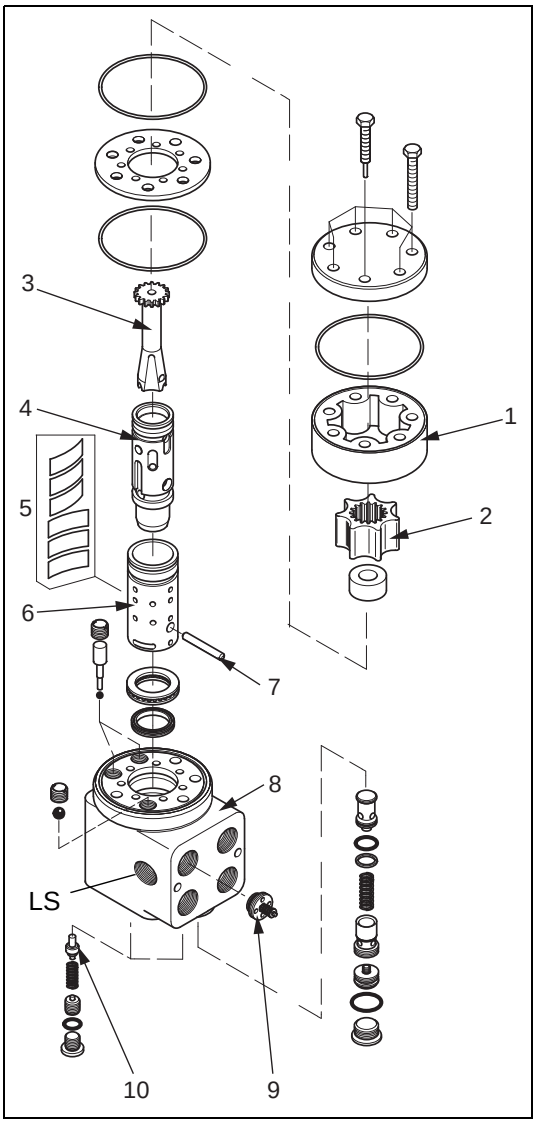
- The orbit-roll is connected to the steering wheel through the steering column. The orbit-roll controls the oil flow from the steering pump to the steering cylinder and sets the steering angle. The amount of oil delivered is proportional to the amount the steering wheel is turned.
- The control spool (4) and the control sleeve (6) form the steering control valve. In normal working condition the oil displacement system, made up of rotor (2) and stator (1) operates as a hydraulic pump. In an emergency steering situation the unit operates as a hand pump.

Structure

- The control spool (4) is directly connected to the steering wheel column and is connected to the control sleeve (6) by the centre pin (7) and the centring springs (5).

  The control spool (4) and the control sleeve (6) do not have contact with each other in the neutral position.
- The drive shaft (3) is meshed with the centre pin (7), and forms one unit with the control sleeve (6). The other end of the drive shaft (3) is meshed with the splines of the rotor (2) of the girotor.
- There are five ports in the valve body (8). They are connected to the steering pump, to the tank and to the steering cylinders. There is a check valve (9) mounted between the pump port and the tank port. If the steering pump or the engine fail, oil for the emergency steering can be drawn for the girotor through the check valve (9).

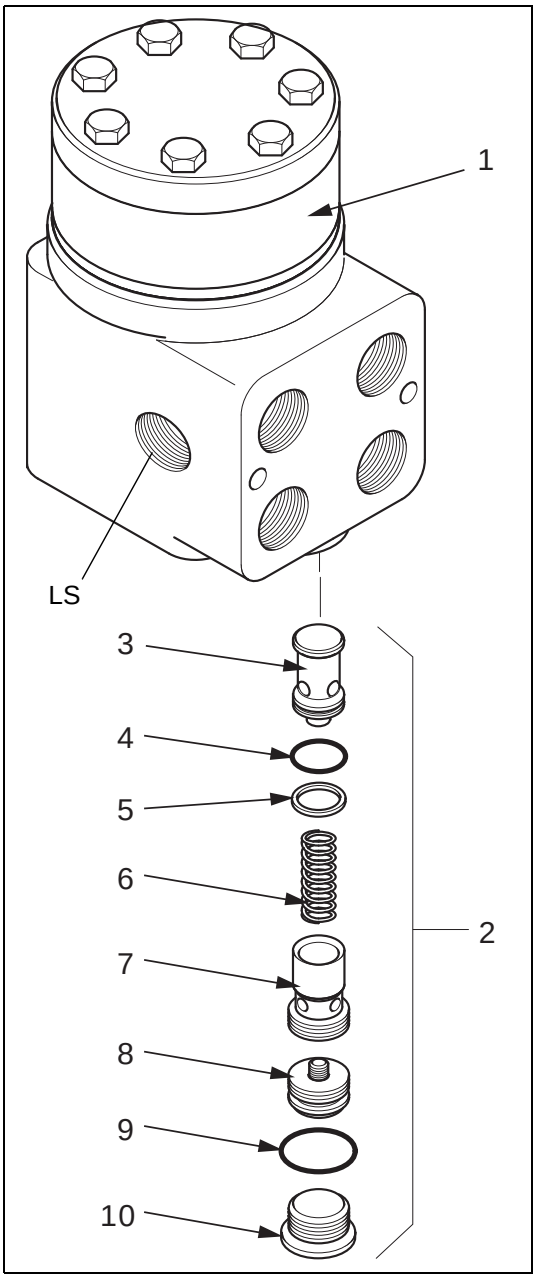
  In the orbit-roll, between the steering cylinder and the orbit-roll, are mounted shock valves (10) these prevent damage to the system from outside shocks.



1. Stator
2. Rotor
3. Drive shaft
4. Control spool
5. Centering springs
6. Control sleeve
7. Center pin
8. Valve body
9. Check valve
10. Shock valve (2)
11. Steering relief valve

Steering relief valve

1. Orbit-roll valve
2. Pressure limiting valve
3. Valve seat (spool)
4. O-ring
5. Backup ring
6. Pressure spring
7. Distance bush
8. Clamping screw
9. Sealing ring
10. Screw plug



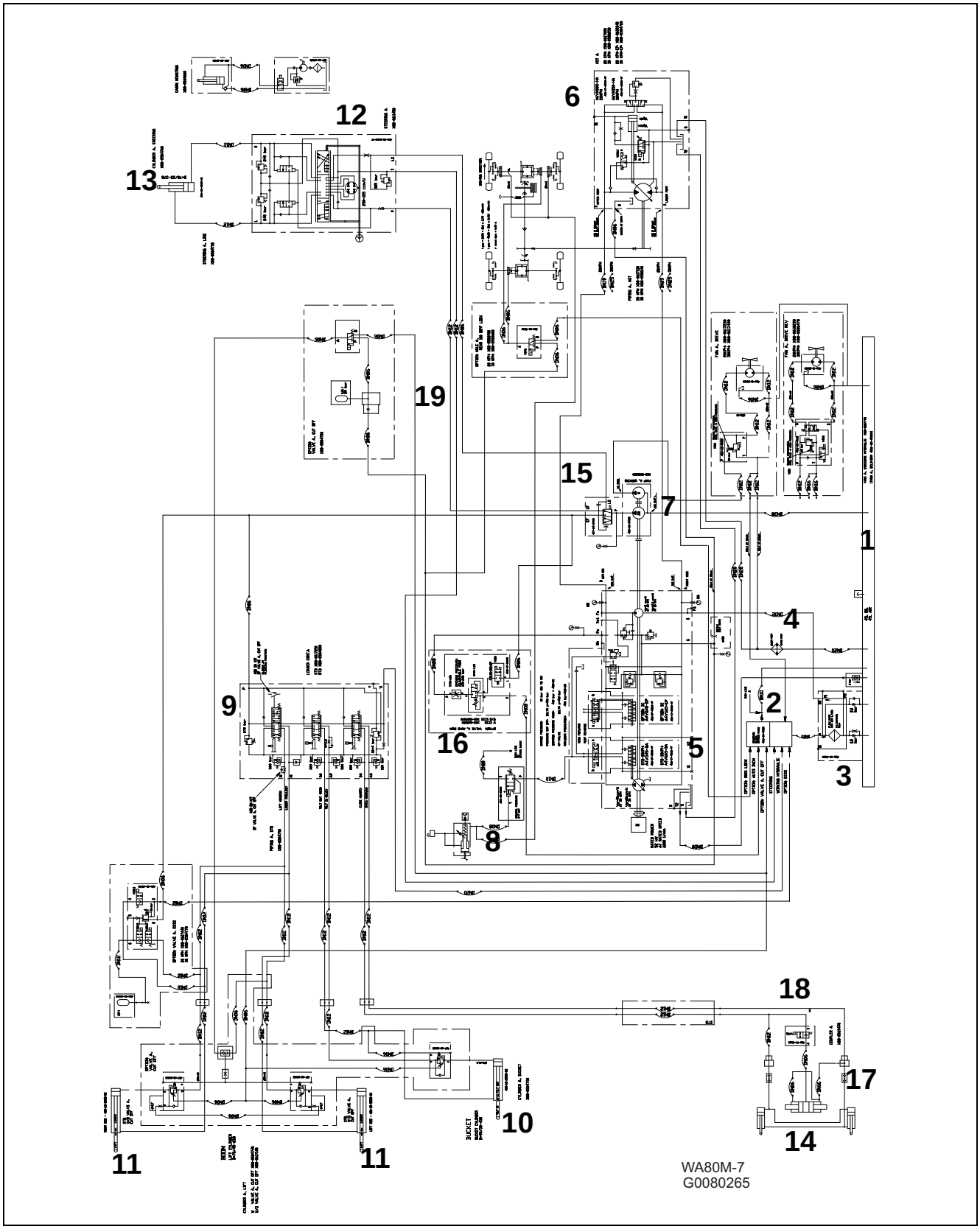
Function

- The steering relief valve (2) is inside the orbit-roll valve (1), and sets the maximum circuit pressure of the steering circuit when the orbit-roll valve is actuated. When the orbit-roll valve is being actuated, if the steering circuit goes above the set pressure of this valve, oil is relieved from this valve.

Blank for technical reason

Work equipment hydraulic

WA80M-7 – Travel, steering and work hydraulics

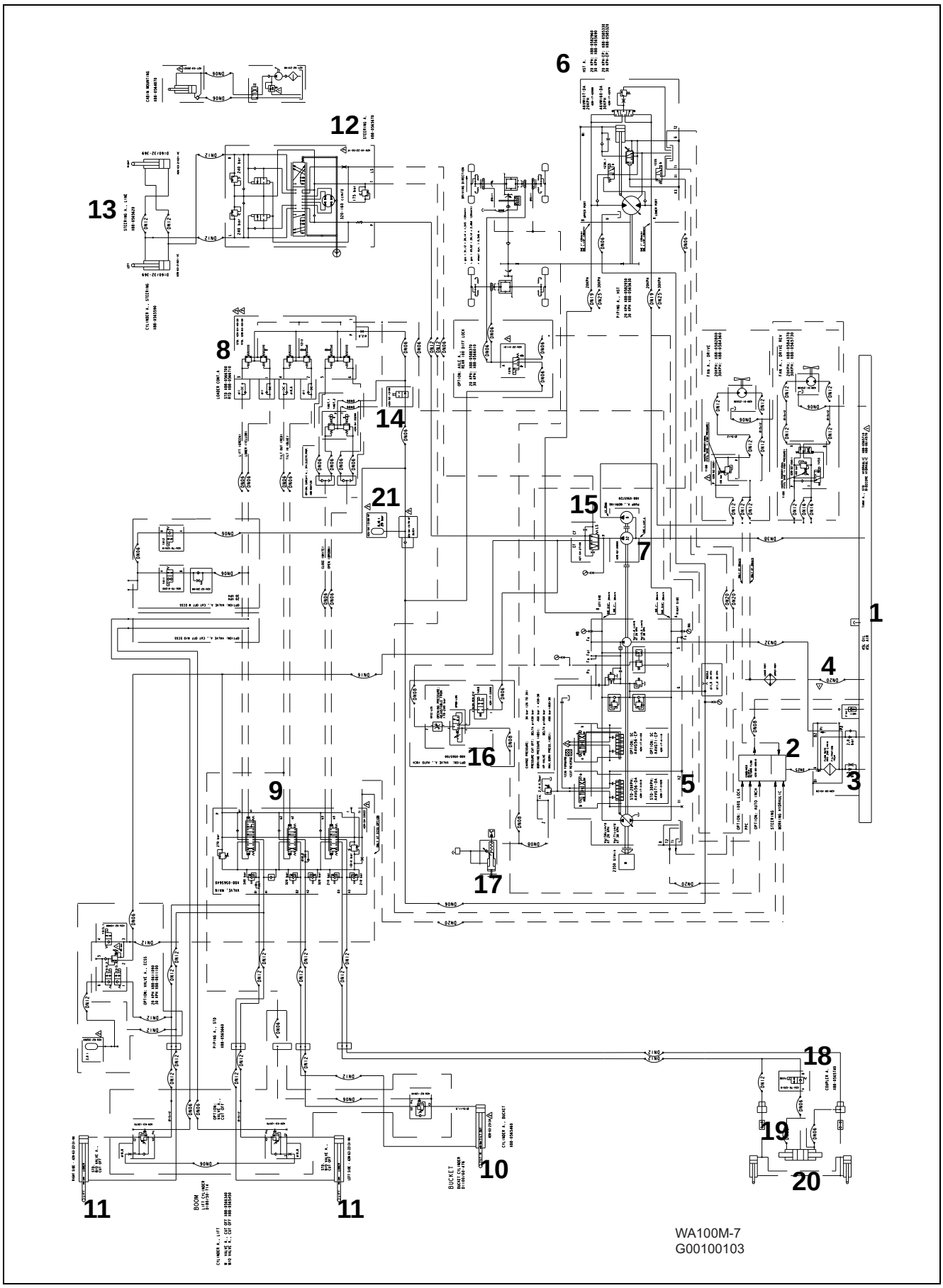


WA80M-7 – Travel, steering and work hydraulics

1. Hydraulic oil tank
2. Bypass valve
3. Suction and return filter
4. Oil cooler
5. Variable displacement pump
6. Variable displacement motor
7. Steering and work hydraulic pump
8. Main brake cylinder
9. Main control valve
10. Tilt cylinder
11. Lift cylinder
12. Steering unit
13. Steering cylinder
14. Cylinders on multi purpose equipment
15. Priority valve
16. Inch-brake valve
17. Bolt cylinder
18. 2/2-way valve
19. Pressure accumulator

For more details, see Hydraulic circuit diagram.

WA100M-7 – Travel, steering and work hydraulics

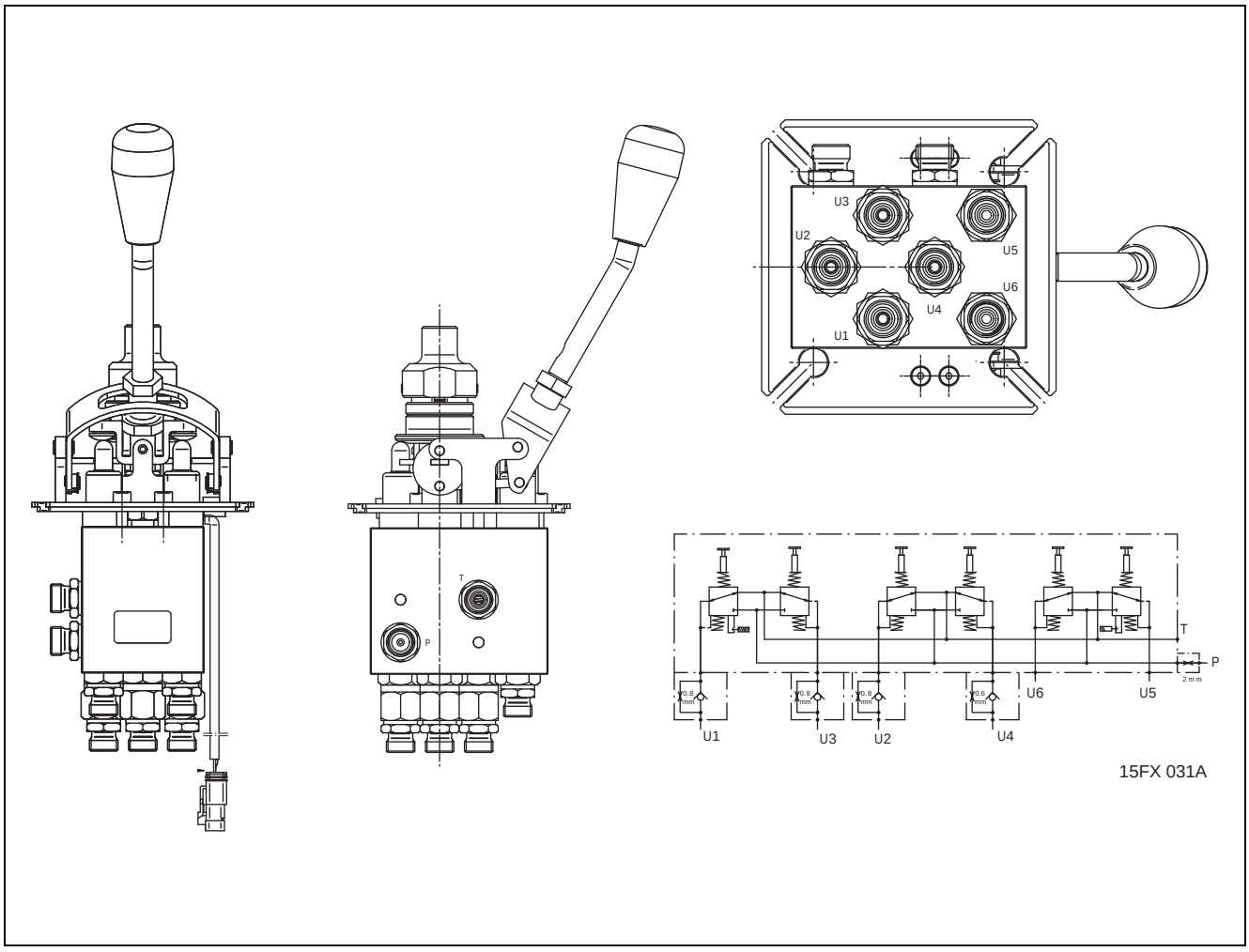


WA100M-7 – Travel, steering and work hydraulics

1. Hydraulic oil tank
2. Bypass valve
3. Suction and return filter
4. Oil cooler
5. Variable displacement pump
6. Variable displacement motor
7. Steering and work hydraulic pump
8. PPC-valve
9. Main control valve
10. Tilt cylinder
11. Lift cylinder
12. Steering unit
13. Steering cylinder
14. Ball valve for street travel lock
15. Priority valve
16. Inch-brake valve
17. Main brake cylinder
18. 2/2-way valve
19. Bolt cylinder
20. Cylinders on multi purpose equipment
21. Pressure accumulator

For more details, see Hydraulic circuit diagram.

PPC-Valve WA100M-7



U1. Connection boom lower/float with detent

U2. Connection bucket tilt back

U3. Connection boom raise

U4. Connection bucket dump

U5. Connection 3rd control unitwith detent

U6. Connection 3rd control unit

PPC-valve port identification

P Connection from pump

T Connection to tank

Operation of PPC-valve

Function

- The PPC-valve controls the oil comming from the charge pump. Depending on how the PPC-valve lever is moved, oil is sent to the servo face of one or other of the main control valve spools.

  The oil pressure acts on this spool face and moves the spool.

Operation

- With the engine running the operating lever is in the neutral position. The PPC system is supplied with oil from the variable displacement drive charge pump.

- The P-channel in the pilot control valve is filled with oil by the charge pump. After the pressure buildup the pilot control pressure is limited by the supply pressure limitation valve that is integrated into the variable displacement pump. Surplus oil that is not needed flows back into the return line through the housing of the variable displacement pump.

  The steering and working hydraulic pump supplies oil through a priority valve to the steering and hydraulic systems.

  If the steering is not used, the complete oil flow is sent to the working hydraulic system. It flows through the main control valve to the tank.

  All pilot control lines between main and pilot control valve are connected to the oil return line.

  When the PPC is activated pressure builds up in the pilot control line. The main spool valve is activated by the pressure and the main oil flow is redirected. Because of that the cylinder function is carried out as long as someone activates the control lever. When the mechanical stop of the working cylinder is reached the pressure increases until the pressure-relief valve opens.

- If the PPC control lever is moved through the boom lower position, that is moved to the end of its stroke, the PPC servo oil reaches a maximum pressure.

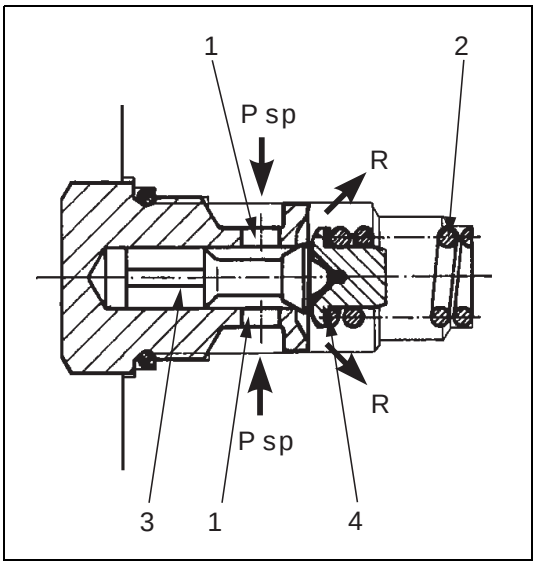
  Because of this the boom lower spool is moved to the boom float position. A short circuit is formed between boom lift and lower and the outlet to the tank is opened.

  The working equipment now follows the ground contours.

Servo pressure regulating valve

Function

- The servo pressure regulating valve is in the drive pump. Apart from limiting the drive system feed pressure it also limits the PPC servo pressure.If the PPC valve is not used the servo pressure regulating valve protects the PPC and the drive feed pressure system.



Operation

- The regulating valve is mounted in the end housing of the variable displacement drive pump.

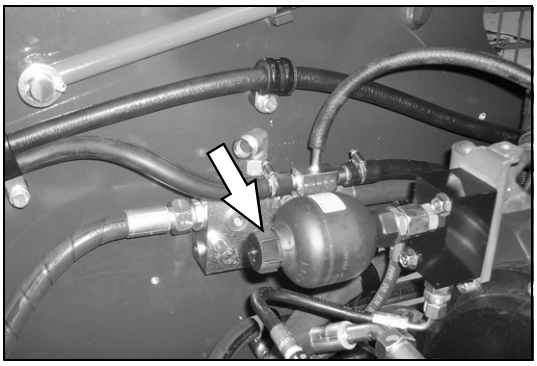
  When the oil pressure rises above the spring (2) preset pressure, the valve piston (3) compresses the spring and the seat lifts. the valve piston moves to the left and the oil can release to the tank.

  Psp Charge pump oil pressure

  R Return to tank

Emergency Lowering System

The PPC pressure accumulator is installed on WA100M-7 as standard for lowering the work equipment in case of emergency.



In combination with the option “Hose bust valves” the accumulator can be installed onWA8M-7.

Specifications:

Gas used: Nitrogen gas
Volume: 0,16 litre
Gas pressure: 20 bar

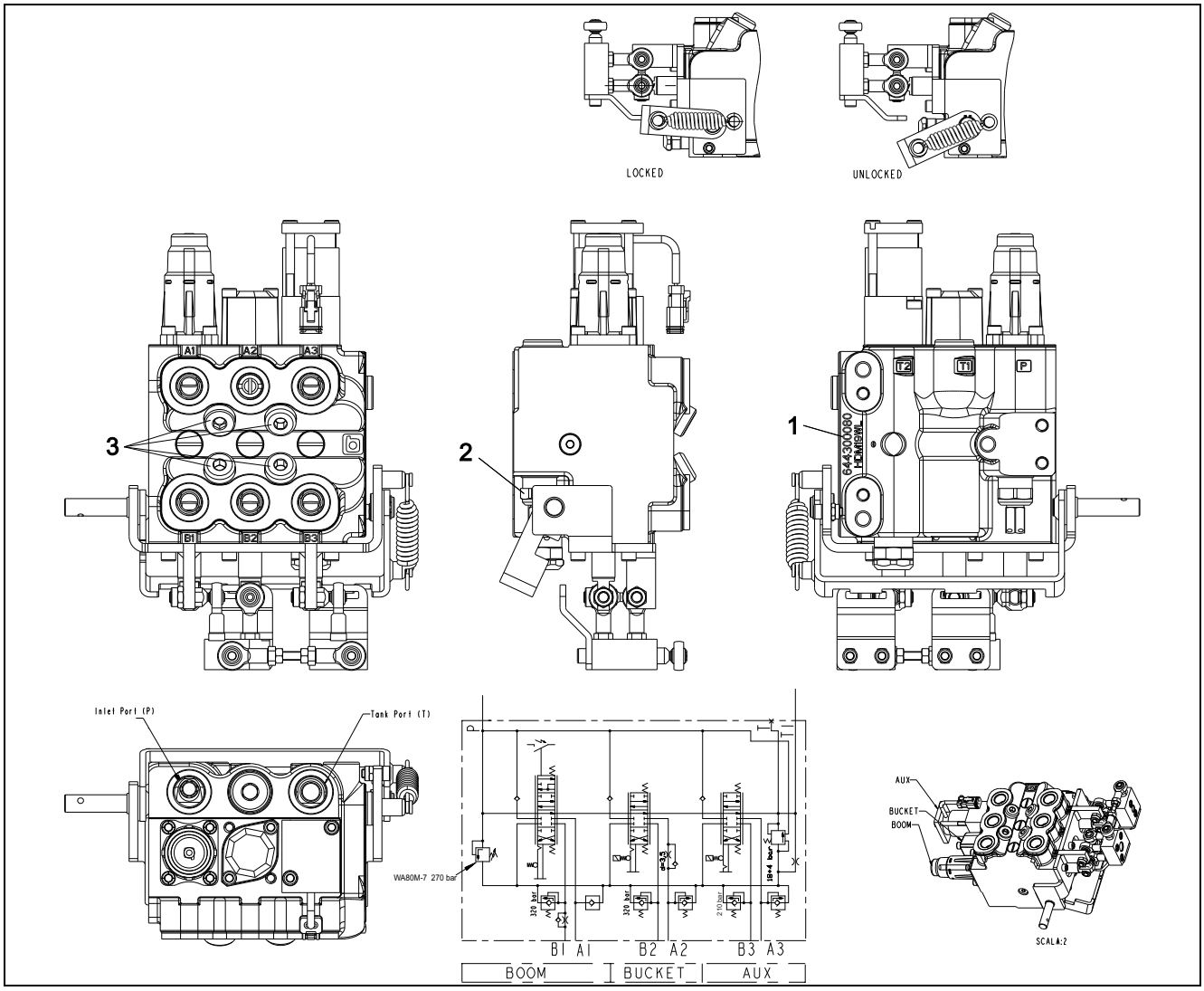
NOTE
If you have secured the work hydraulic system with the locking lever of the work hydraulic system, you cannot lower the work unit.

Make sure that nobody is standing below the work unit.

Press slowly the multi-function lever into position ‘‘S’’. The work unit is lowered.

Main control valve

Main control valve WA80M-7

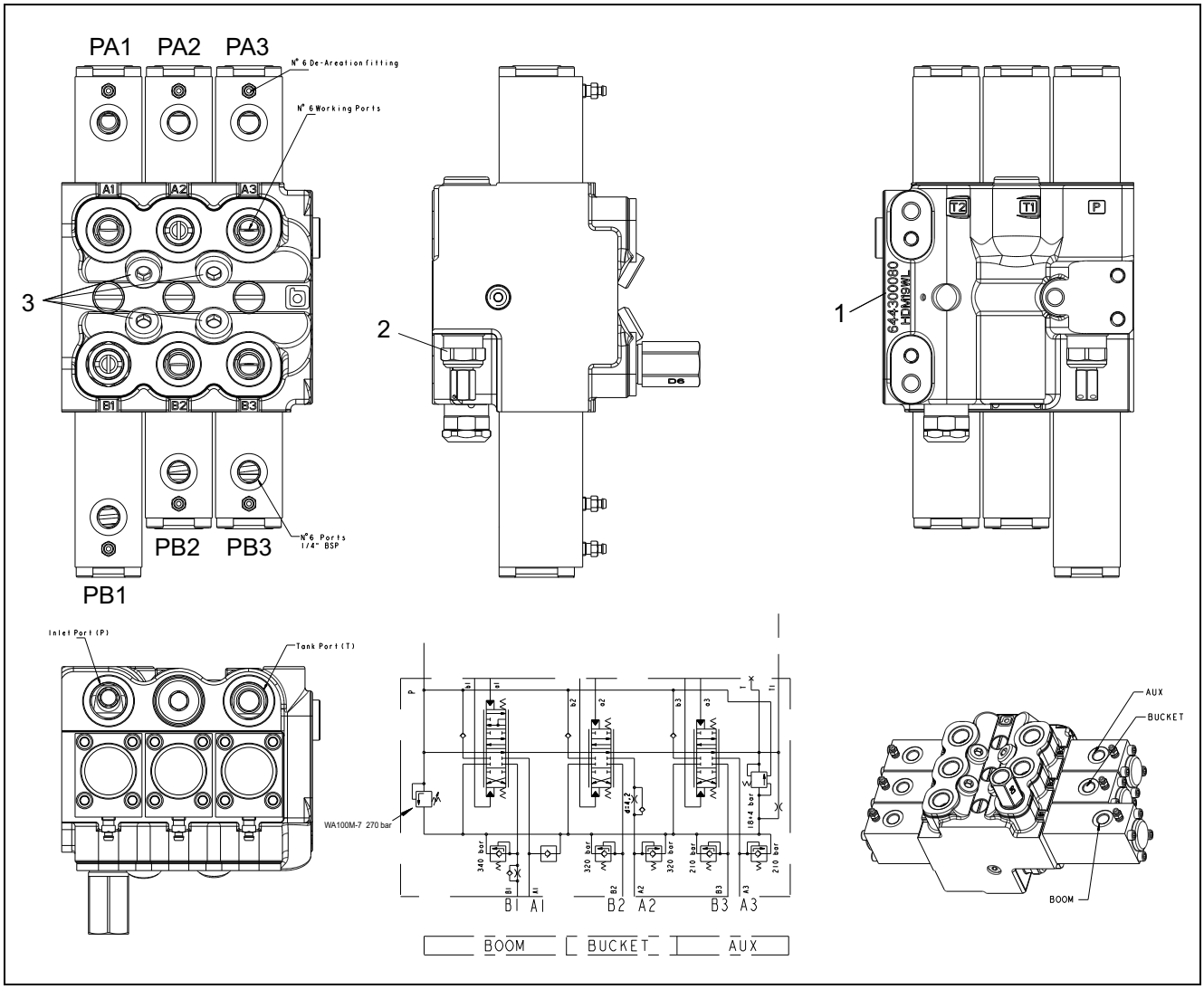


1. Data plate .
2. Main relief valve .
3. Shock and anticavitation valve

Main control valve port identification

P Connection from the pump
T2 Connection to the tank
A1 Connection raise, rod side
B1 Connection lower, piston side
A2 Connection dump, piston side
B2 Connection tilt back, rod side
A3 Connection 3rd control unit (electric quick coupler)
B3 Connection 3rd control unit (electric quick coupler)

Main control valve WA100M-7



1. Data plate .
2. Main relief valve .
3. Shock and anticavitation valve

Main control valve port identification

P Connection from the pump
T2 Connection to the tank
A1 Connection raise, rod side
B1 Connection lower, piston side
A2 Connection dump, piston side
B2 Connection tilt back, rod side
A3 Connection 3rd control unit (electric quick coupler)
B3 Connection 3rd control unit (electric quick coupler)
PA1 - PA3 Connection PPC valve
PB1 - PB3 Connection PPC valve

Lift cylinder

WA80M-7 – Lift cylinder

Dimensions

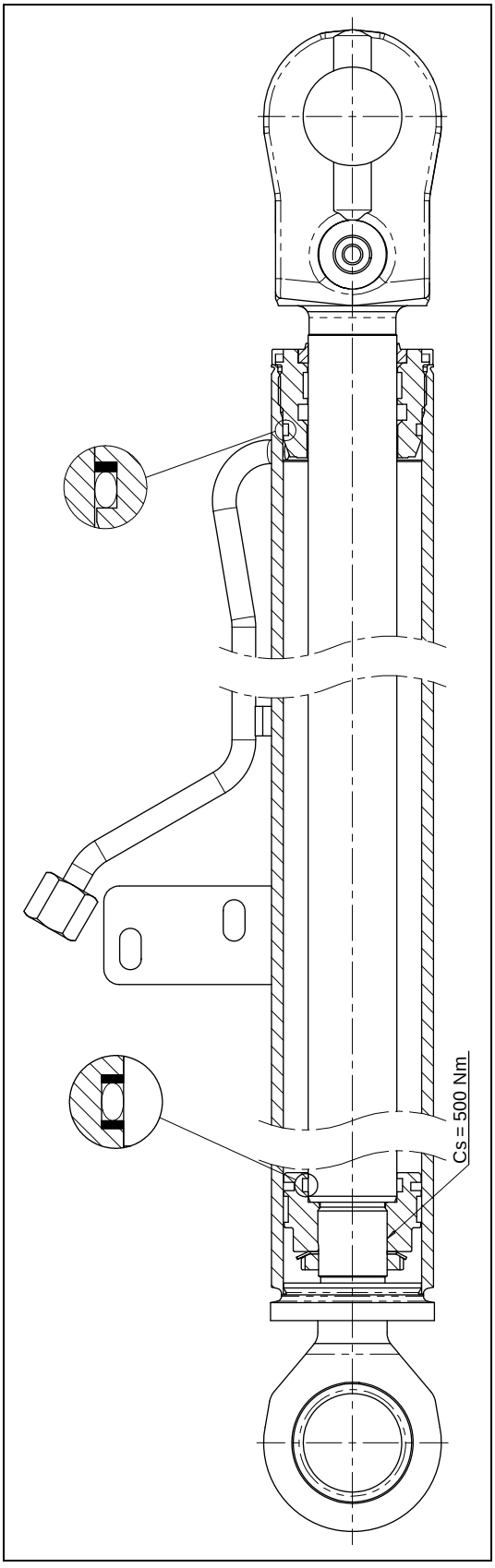
Closed length	968 ± 1.5 mm
Stroke	658 ± 1.5 mm
Piston rod	Ø 45 mm
Piston	Ø 70 mm
Weight	28.8 kg

Tightening torque

Guide bush	250 Nm
Lock nut	500 Nm

Pressures

Operating pressure	270 bar
Shock pressure	320 bar



WA100M-7 – Lift cylinder

Dimensions

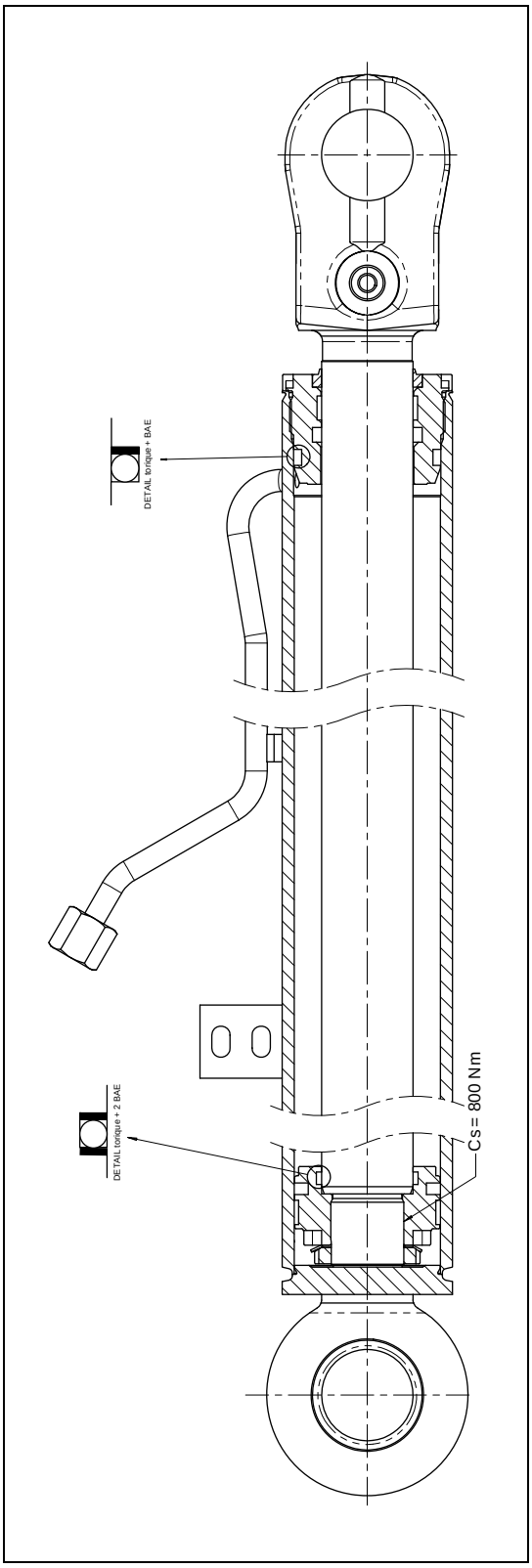
Closed length	1019 ± 1.5 mm
Stroke	714 ± 1.5 mm
Piston rod	Ø 50 mm
Piston	Ø 80 mm
Weight	32.9 kg

Tightening torque

Guide bush	400 Nm
Lock nut	800 Nm

Pressures

Operating pressure	270 bar
Shock pressure	340 bar



Dump cylinder

WA80M-7 – Dump cylinder

Dimensions

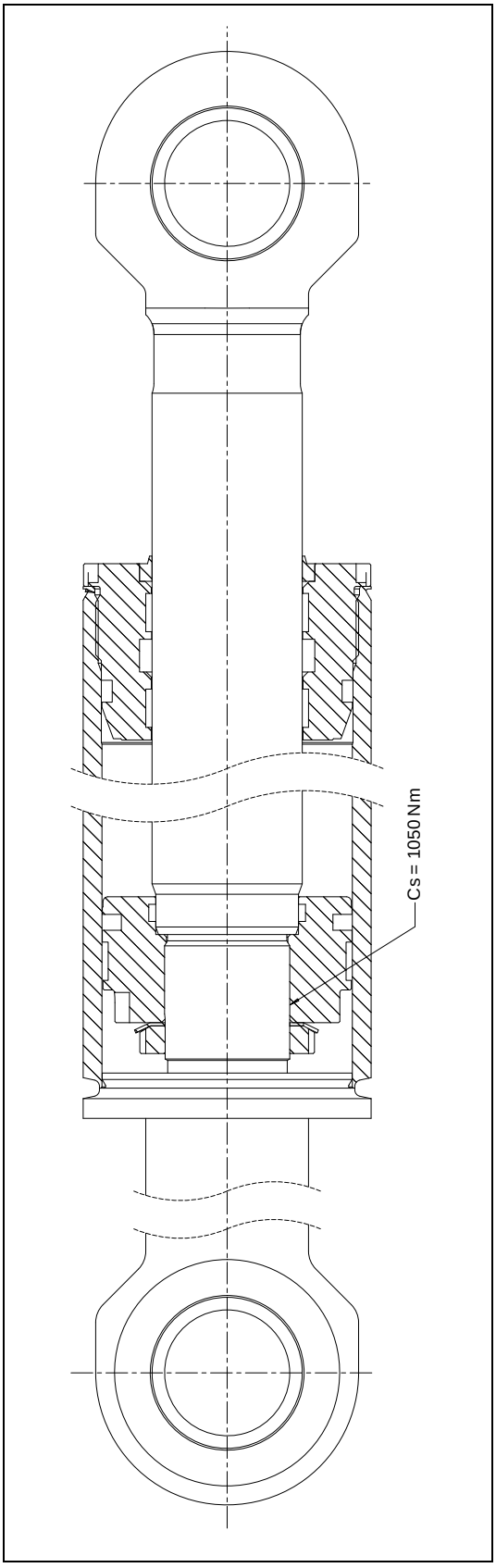
Closed length	1000 ± 2 mm
Stroke	450 ± 1.5 mm
Piston rod	Ø 65 mm
Piston	Ø 90 mm
Weight	40.6 kg

Tightening torque

Guide bush	400 Nm
Lock nut	1050 Nm

Pressures

Operating pressure	270 bar
Shock pressure	320 bar



WA100M-7 – Dump cylinder

Dimensions

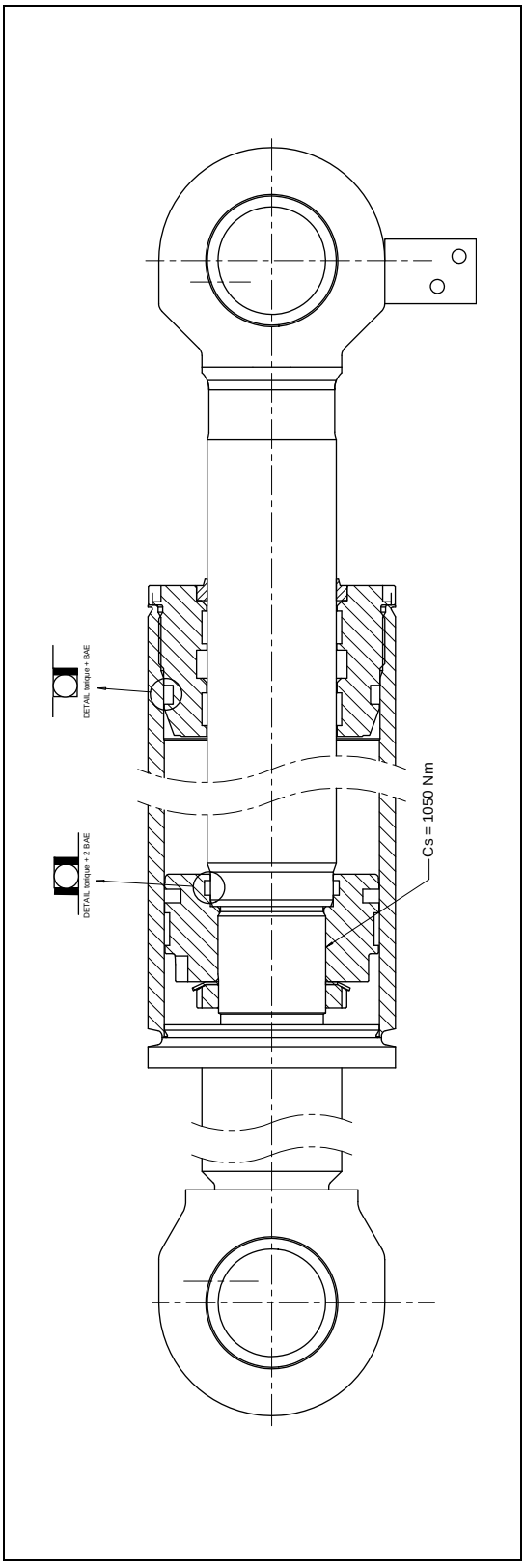
Closed length	1135 ± 2 mm
Stroke	476 ± 1.5 mm
Piston rod	Ø 60 mm
Piston	Ø 100 mm
Weight	53.7 kg

Tightening torque

Guide bush	400 Nm
Lock nut	1050 Nm

Pressures

Operating pressure	270 bar
Shock pressure	320 bar



Steering cylinder

WA80M-7 – Steering cylinder

Dimensions

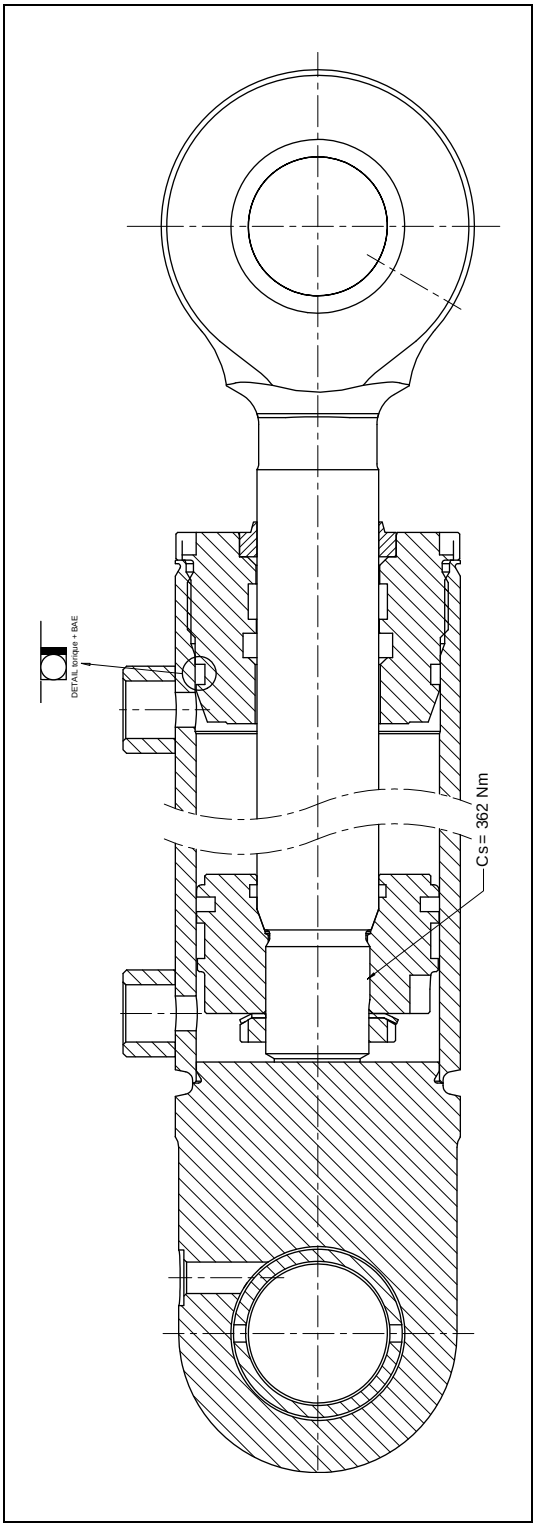
Closed length	683 ± 1.5 mm
Stroke	378 ± 1.5 mm
Piston rod	Ø 35 mm
Piston	Ø 70 mm
Weight	16.5 kg

Tightening torque

Guide bush	250 Nm
Lock nut	362 Nm

Pressures

Operating pressure	185 bar
Shock pressure	240 bar



WA100M-7 – Steering cylinder

Dimensions

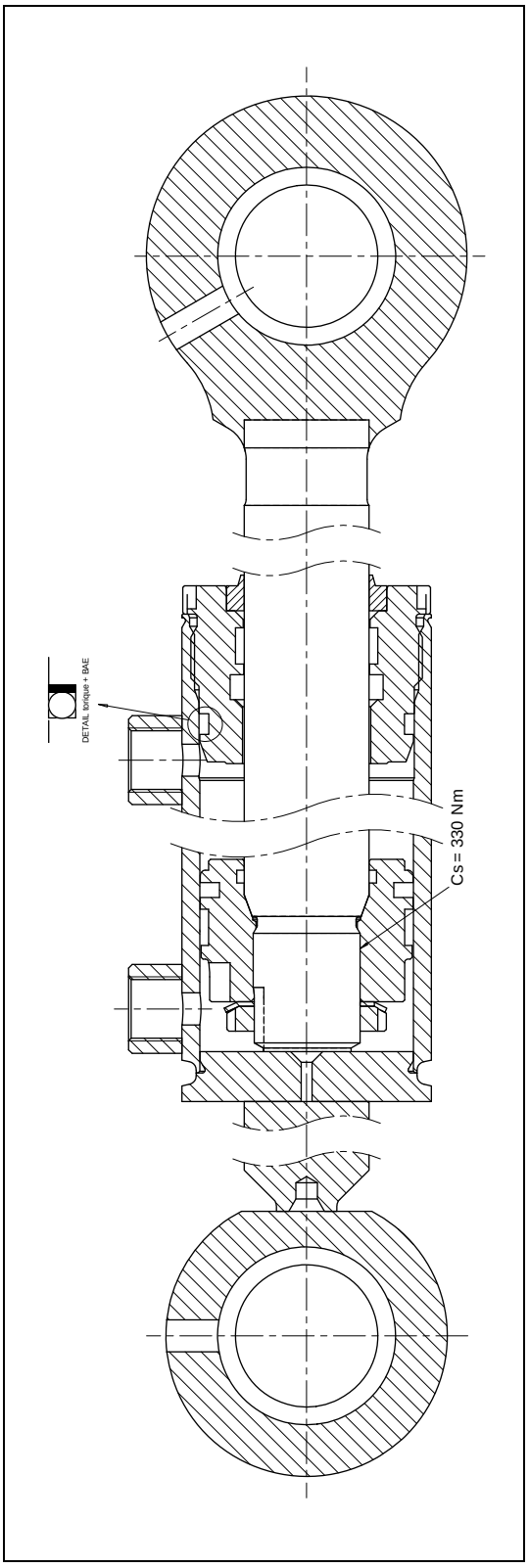
Closed length	737 ± 1.5 mm
Stroke	369 ± 1.5 mm
Piston rod	Ø 35 mm
Piston	Ø 60 mm
Weight	13.2 kg

Tightening torque

Guide bush	250 Nm
Lock nut	330 Nm

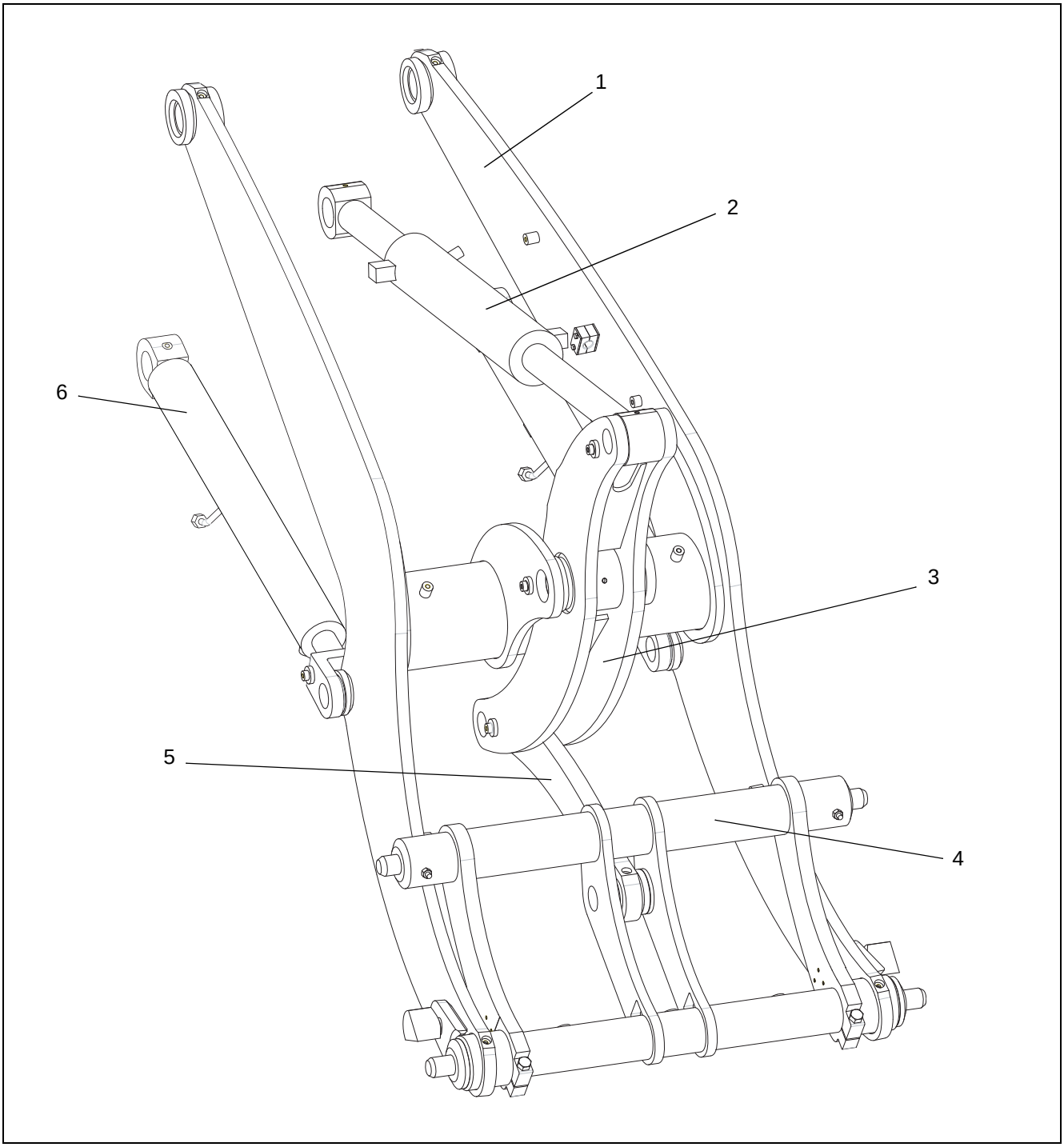
Pressures

Operating pressure	175 bar
Shock pressure	240 bar



Loader Linkage with quick-coupler

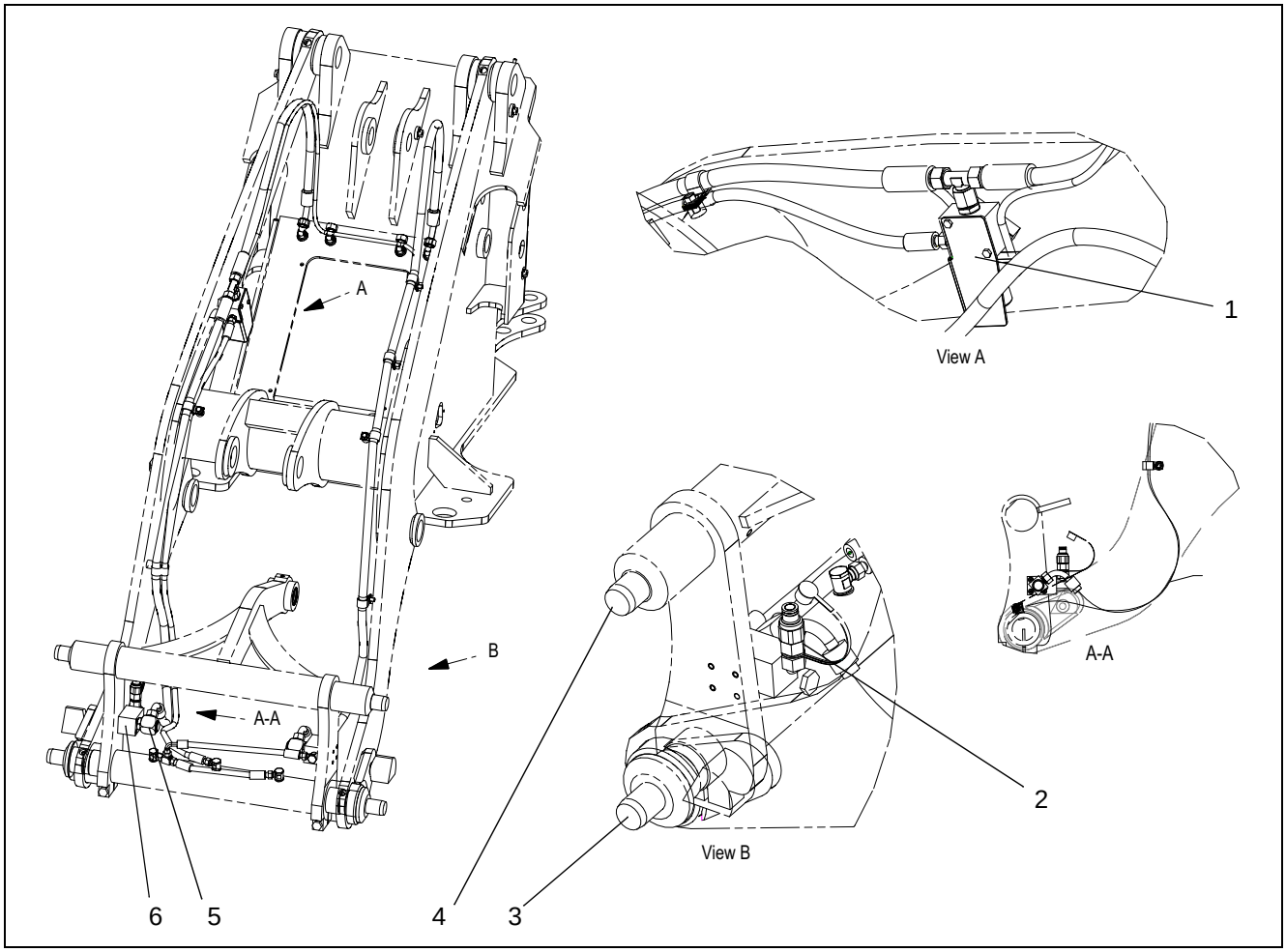
WA80M-7, WA100M-7 – Loader Linkage with quick-coupler



1. Boom
2. Bucket cylinder
3. Bellcrank
4. Quick-coupler
5. Link
6. Lift cylinder

Quick-coupler

WA80M-7 – Quick-coupler



1. Solenoid valve or hydraulic valve
2. Connector with dust protection
3. Lock bolts
4. Location bolts
5. Swivel banjo coupling
6. Block, RH

Function

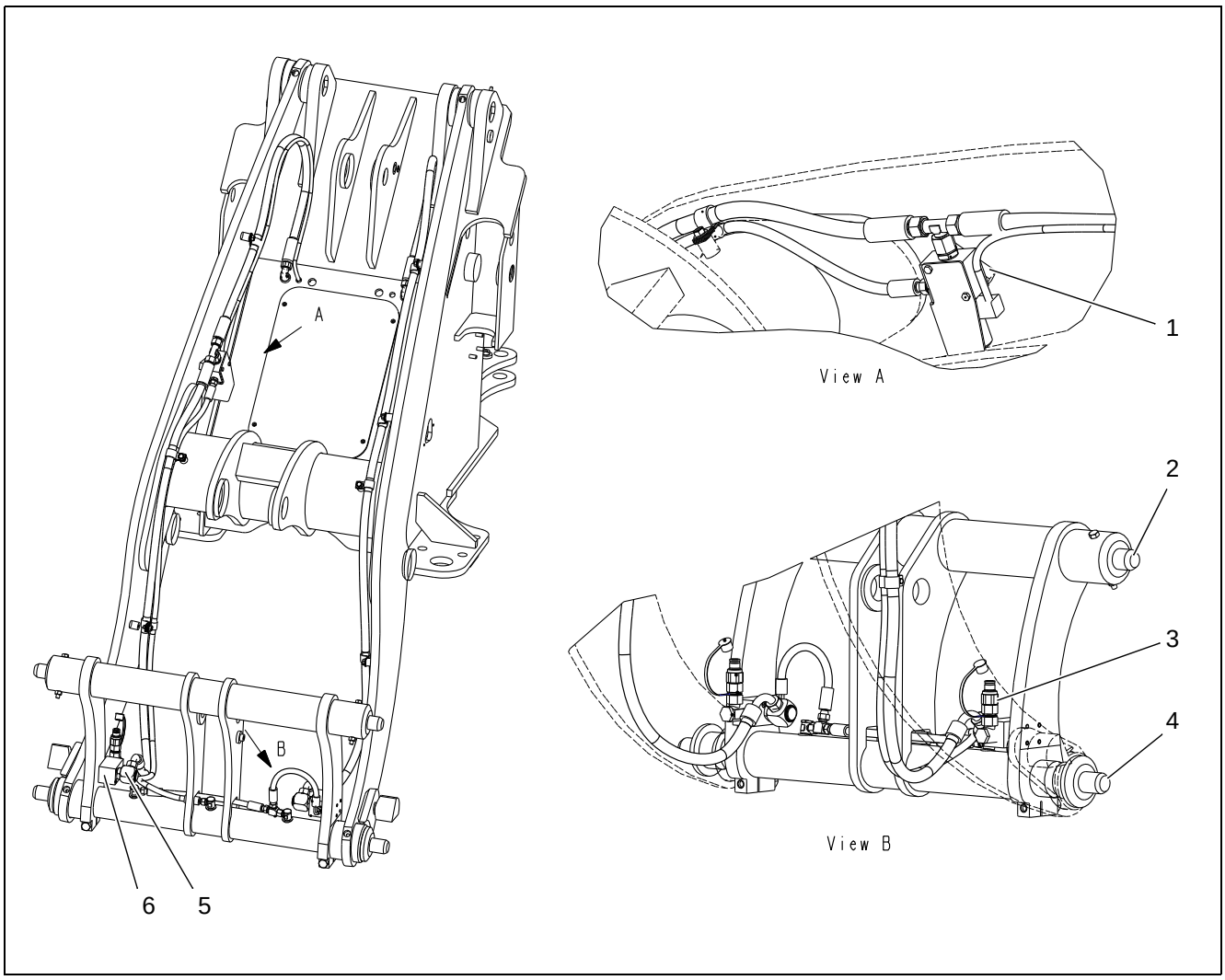
- The standard machine is equipped with a quick-coupler and the 3. control circuit for additional device. The locking of additional device, for example claw bucket or forklift ensures by hydraulic.

  After assembly of the additional device the hoses will be connected with the quick-couplers and a solenoid valve to the 3. control circuit.

- Block the quick-coupler using the by setting the special equipment control lever.

- When the oil flows to the additional device, the quick-coupler is automatically blocked.

WA100M-7 – Quick-coupler



1. Solenoid valve or hydraulic valve
2. Location bolts
3. Connector with dust protection
4. Lock bolts
5. Swivel banjo coupling
6. Block, RH

Function

- The standard machine is equipped with a quick-coupler and the 3. control circuit for additional device. The locking of additional device, for example claw bucket or forklift ensures by hydraulic.

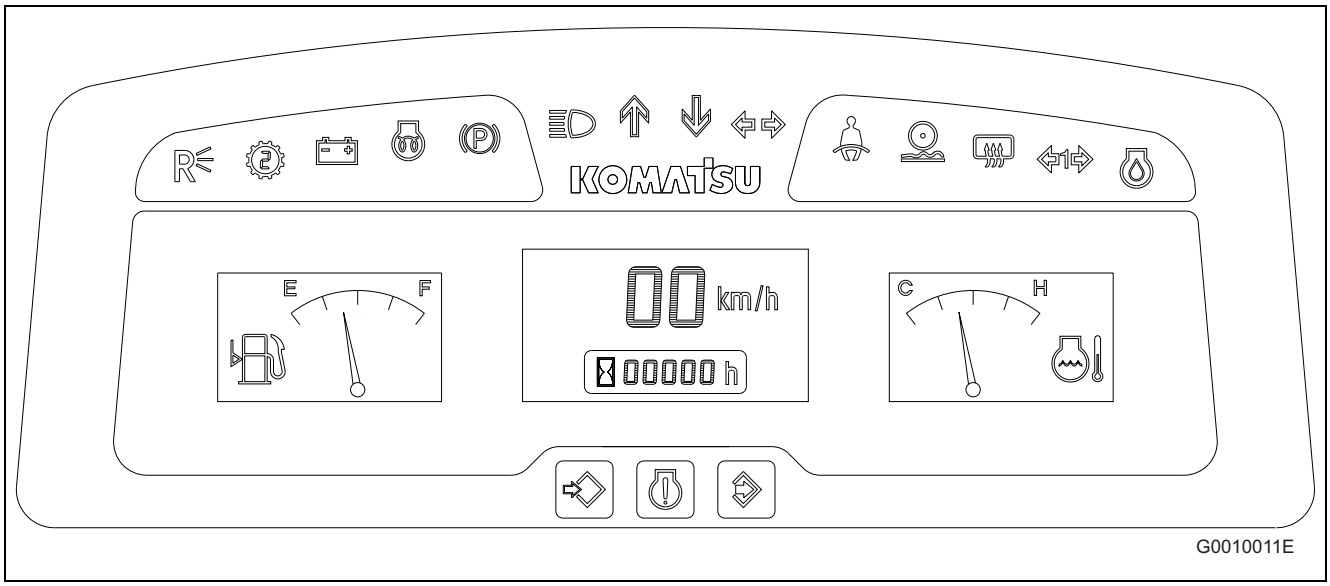
  After assembly of the additional device the hoses will be connected with the quick-couplers and a solenoid valve to the 3. control circuit.

- Block the quick-coupler using the by setting the special equipment control lever.

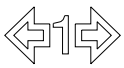
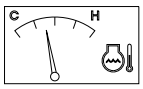
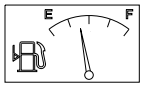
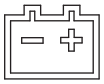
- When the oil flows to the additional device, the quick-coupler is automatically blocked.

Monitor display

WA80M-7, WA100M-7 – Monitor display



Display group	Symbol	System	Operation	Display type
Display		Rear windscreen heater	When switched on	Display lights up.
		Air intake pre-heater	When pre-heater is switched on	When the display lights up the ignition is switched on. Duration depends on the ambient temperature.
		Turning lights (left - right)	When switched on	Display lights up.
		Travel direction (forward, reverse)	When driving	Display lights up when the forward/ reverse lever is not in NEUTRAL.
		Parking brake	When the parking brake is applied	Display lights up and an acoustic warning is heard if the forward/ reverse lever is not in NEUTRAL.
		Headlight	When switched on	Display lights up.
		Speed Range 2	When switched on	Display lights up.
		100% differential lock	When switched on	Display lights up.
		E.C.S.S. circuit pilot lamp (option)	When switched on	Display lights up if the machine is traveling at a speed higher than 5 km/h (3 mph).

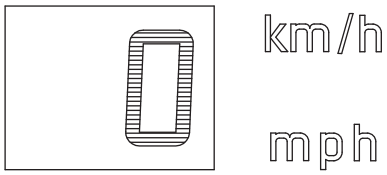
Display group	Symbol	System	Operation	Display type
Display		Trailer turn signal	When switched on	Display flashes up.
		Back-up light	When switched on	Display lights up.
Counter		Working hours	Engine working time in hours	Shows the current working time in hours, when the engine generator is charging.
Analogue display		Engine water temperature	Beam display	Display lights up and shows the current engine working temperature. By temperatures over 105°C, there also is an acoustic warning and the display changes von green to red.
		Fuel level	Beam display	Display lights up and shows the current fuel level. If the fuel is empty, the display changes from green to red.
		Speedometer	2-point display	Display lights up and shows the travel speed.
Warning light		Engine oil pressure	Lower than permitted	Display lights up and there is also an acoustic warning.
		Generator	Battery is not being charged	Display lights up when the battery is not being charged by the running engine.
		Air filter	When the vacuum in the air filter is too high	Display lights up when the filter is too dirty.
		Water seperator	When water is in the fuel filter	Display lights up.
		Engine controller	When the engine controller signals an error.	Display lights up.
		Engine stop	When the engine shutdown secondary is switched on or the engine has been stopped due to an error.	Display lights up and an acoustic warning is heard
		Seat belt	When the seat belt is not fastened	Display lights up and an acoustic warning signal sounds.
		Differential lock	When the differential lock is engaged	Display lights up.
Programming buttons		Programming button	see "Monitor Service Menu" auf Seite 78	see "Monitor Service Menu" auf Seite 78
		Fault code button	see "Monitor Service Menu" auf Seite 78	see "Monitor Service Menu" auf Seite 78
		Store button	see "Monitor Service Menu" auf Seite 78	see "Monitor Service Menu" auf Seite 78

Special monitor functions

Overrun Alarm Warning:

When the maximum speed of 30 km/h or 18 mph is exceeded the speed meter display back ground colour changes from green to red.

The speed indication starts flashing and the buzzer starts sounding.

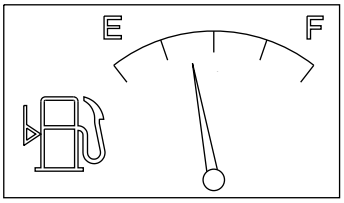


G0070271

Failure Monitor Connecting

When the fuel level sensor and / or the water temperature sensor are disconnected, only the two right segments of the display will light up.

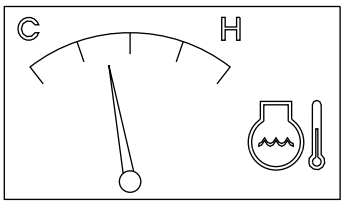
(In the table, convert the measured fuel level sensor resistance into remaining fuel quantity).



G0010069

SENSOR FUEL			
	OHM	**DISPLAY**	**LITRE**
EMPTY	162	RED	0,0
	147	RED	7,7
	140	RED	15,5
	131	GREEN	23,0
1/4	123	GREEN	31,0
	116	GREEN	38,5
	109	GREEN	46,3
	101	GREEN	53,9
1/2	91	GREEN	61,8
	79	GREEN	69,6
	67	GREEN	77,6
	57	GREEN	85,4
3/4	43	GREEN	93,1
	30	GREEN	101,1
	17	GREEN	109,1
	7	GREEN	116,9
FULL	3	GREEN	124,3

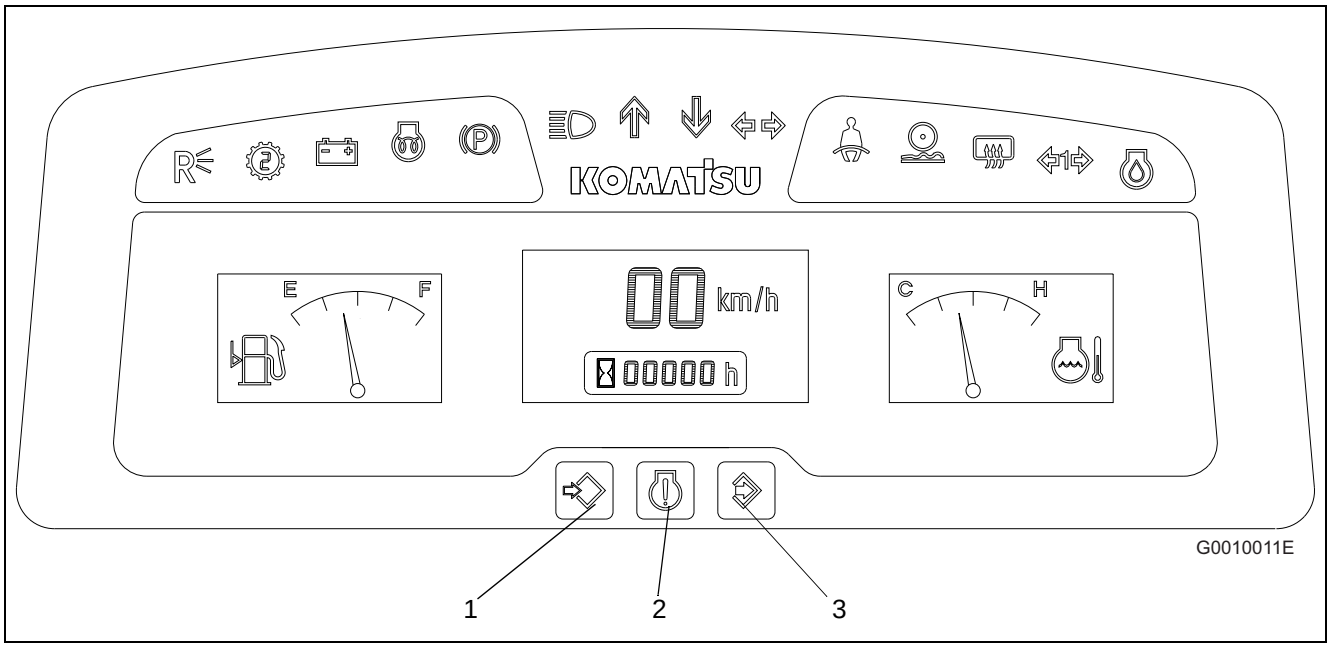
(In the table, convert the measured coolant temperature sensor resistance into coolant temperature).



G0010070

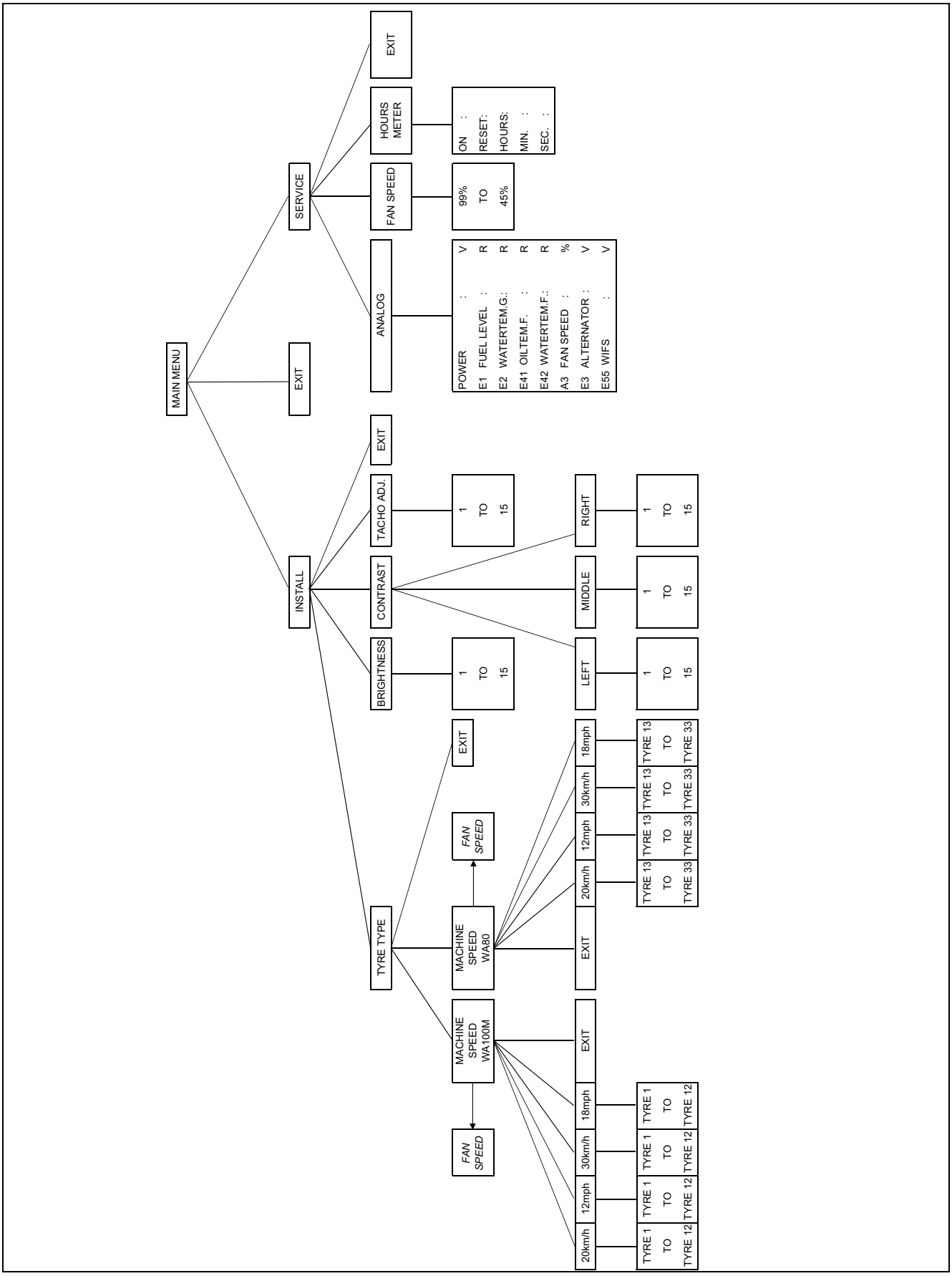
RESISTANCE ENGINE COOLANT TEMPERATURE BY SENSOR			
BEAM GAUGE	**TEMPERA-TURE**	**RESISTANCE**	**COLOUR BACKLIGHT**
(FROMLEFT TO RIGHT)	**(° CELSIUS)**	**(k Ohm)**	
1	67,5	2,713	GREEN
2	70,0	2,760	GREEN
3	72.5	2,807	GREEN
4	75.0	2,854	GREEN
5	77.5	2,902	GREEN
6	80,0	2,950	GREEN
7	82,5	2,998	GREEN
8	85,0	3,047	GREEN
9	87,5	3,096	GREEN
10	90,0	3,146	GREEN
11	92,5	3,196	GREEN
12	95,0	3,247	GREEN
13	97,5	3,298	GREEN
14	100,0	3,350	RED
15	102,5	3,402	RED
16	105,0	3,455	RED

Monitor Service Menu



1.	Programming button, Left push button: PROG - for change inputs
2.	Fault code button, Middle push button: FAIL - for read fail codes
3.	Store button switch, Right push button: STORE - for store inputs

Menu Structure Monitor



OPEN Menu

1. Press left PROG – push button switch for 3 seconds
2. Additional press the right STORE – push button switch for 3 seconds
3. Let off the left push button switch until press the right push button switch for 3 seconds
4. Let off the right push button switch - The main menu will open in the middle LCD - display.

MAIN – Menu

By push the PROG – push button switch will select 01-INSTALL, 02-SERVICE and 03-EXIT. Selected item will store by the STORE – push button switch.

By select EXIT the menu will close.

INSTALL – Menu

By push the PROG – push button switch will select 01-TYRE TYPE of the wheel loader, 02-CONTRAST, individual of each three LCD – displays, 03-BRIGHTNESS of all three LCD – displays, 04-TACHO ADJUSTMENT or 05-EXIT.

Selected item will store by the STORE - push button switch.

By select EXIT the menu will close.

TYRE TYPE – Menu

By push the PROG – push button switch will select MACHINE TYPE.

Selectable items are WA100M, WA80 or EXIT.

Selected item will store by the STORE - push button switch.

By select EXIT the menu will close.

MACHINE SPEED – Menu

By push the PROG – push button switch will select the maximal speed of the wheel loader.

Selectable items are 20km/h, 12mph, 30km/h, 18mph or EXIT.

Selected item will store by the STORE - push button switch.

Now it is possible to select the tyre type.

The display shows the supplier of the tyre, the type of the tyre, the wheel loader type, and the selected maximal speed of the tyre by “km/h” or “mph”.

If PROG+ will light up in the lower right corner of the LCD – display, it is possible to switch to next upper tyre type by push the PROG – push button switch.

Three second later will light up in the lower right corner of the LCD – display PROG-.

Now it is possible to switch to next lower tyre type by push the PROG – push button switch.

Selected item will store by the STORE - push button switch.

By select EXIT the menu will close.

SPEED ADJUST FOR MONITOR									
MACHINE TYPE	SUPPLIER	TIRE TYPE AND RIM TYPE	DIAME-TER [mm]	FREQUENCY [Hz]					
				20 km/h	12 mph	SPEED ALERT	30 km/h	18 mph	SPEED ALERT
WA100M-7									
01	CONTINENTAL	405 / 70 R20 MPT 70E	1062	3214,09	3103,53	+10%	2557,89	2469,91	+10%
02	CONTINENTAL	455 / 70 R24 MPT 70E	1223	2790,97	2694,97	+10%	2221,16	2144,76	+10%
03	DUNLOP	405 / 70 R20 SPT9	1093	3122,93	3015,51	+10%	2485,34	2399,85	+10%
04	DUNLOP	405 / 70 R24 SPT9	1183	2885,34	2786,10	+10%	2299,26	2217,28	+10%
05	DUNLOP	455 / 70 R20 SPT9	1146	2978,50	2876,05	+10%	2370,40	2288,87	+10%
06	DUNLOP	455 / 70 R24 SPT9	1238	2757,16	2662,32	+10%	2194,25	2118,77	+10%
07	GOODYEAR	400 / 70 R24 IT530	1182	2887,78	2788,46	+10%	2298,20	2219,15	+10%
08	GOODYEAR	400 / 80 R24 IT520	1250	2730,69	2636,76	+10%	2173,18	2098,43	+10%
09	MICHELIN	405 / 70 R20 XZSL	1102	3097,42	2990,88	+10%	2465,04	2380,25	+10%
10	MICHELIN	420 / 75 R20 XMCL	1138	2999,44	2896,27	+10%	2387,06	2304,96	+10%
11	MICHELIN	425 / 75 R20 XZSL	1142	2988,93	2886,12	+10%	2378,70	2296,88	+10%
12	MITAS / BARUM	405 / 70 R24 NB38	1178	2897,59	2797,92	+10%	2306,01	2226,69	+10%
WA80-7									
13	CONTINENTAL	335 / 80 R20 MPT 70E	1040	3031,11	2926,85	+10%	2173,39	2101,53	+10%
14	CONTINENTAL	365 / 80 R20 MPT 70E	1110	2839,96	2742,18	+10%	2039,14	1969,00	+10%
15	DUNLOP	365 / 70 R18 SPT9	972	3243,16	3131,61	+10%	2328,65	2248,55	+10%
16	DUNLOP	405 / 70 R18 SPT9	1026	3072,47	2966,79	+10%	2206,09	2130,21	+10%
17	DUNLOP	335 / 80 R20 SPT9	1035	3045,75	2940,99	+10%	2186,90	2111,58	+10%
18	DUNLOP	12.5 - 20 MPT TG32	1062	2968,32	2833,22	+10%	2131,30	2058,00	+10%
19	DUNLOP	16 / 70 - 20 TL EM	1075	2932,42	2831,56	+10%	2105,53	2033,11	+10%
20	DUNLOP	14.5 - 20 - MPT	1088	2897,64	2797,73	+10%	2080,37	2008,82	+10%
21	DUNLOP	365 / 80 R20 SPT9	1092	2886,77	2787,48	+10%	2073,75	2001,46	+10%
22	DUNLOP	405 /70 R20 SPT9	1093	2884,13	2784,93	+10%	2070,85	1999,63	+10%
23	GOODYEAR	400 / 70 R18 IT520	1017	3099,66	2993,05	+10%	2225,61	2149,06	+10%
24	GOODYEAR	400 / 70 R18 IT530	1017	3099,66	2993,05	+10%	2225,61	2149,06	+10%
25	GOODYEAR	340 / 80 R20 IT520	1055	2988,01	2885,24	+10%	2145,44	2071,65	+10%
26	GOODYEAR	400 / 70 R20 IT530	1067	2954,41	2852,79	+10%	2121,32	2048,35	+10%
27	GOODYEAR	400 / 70 R20 IT520	1068	2951,65	2850,12	+10%	2119,33	2046,43	+10%
28	MICHELIN	375 / 75 R20 XZSL	1067	2954,41	2852,79	+10%	2121,32	2048,35	+10%
29	MICHELIN	335 / 80 R20 XZSL	1068	2951,65	2850,12	+10%	2119,33	2046,43	+10%
30	MICHELIN	340 / 80 R20 XMCL	1047	3010,85	2907,28	+10%	2161,84	2087,48	+10%
31	MICHELIN	380 / 75 R20 XMCL	1070	2946,13	2844,79	+10%	2115,37	2042,61	+10%
32	MICHELIN	400 / 70 R20 XMCL	1069	2948,88	2847,45	+10%	2117,35	2044,52	+10%
33	MITAS / BARUM	12,5 - 20 MPT NB38	1040	3031,11	2926,85	+10%	2173,39	2101,53	+10%

CONTRAST – Menu

By push the PROG – push button switch will select the contrast individual of each three displays.

Selectable items are LEFT, MIDDLE and RIGHT.

If PROG+ will light up in the lower right corner of the LCD – display, it is possible to switch the contrast higher by push the PROG – push button switch.

Three second later will light up in the lower right corner of the LCD – display PROG-.

Now it is possible to switch the contrast lower by push the PROG – push button switch.

Selected item will be stored by the STORE - push button switch and the menu will be closed.

BRIGHTNESS – Menu

By push the PROG – push button switch will select the brightness of all three displays.

Selectable items are 1 to 15.

If PROG+ will light up in the lower right corner of the LCD – display, it is possible to switch the display brighter by push the PROG – push button switch.

Three second later will light up in the lower right corner of the LCD – display PROG-.

Now it is possible to switch the display darker by push the PROG – push button switch.

Selected item will be stored by the STORE - push button switch and the menu will be closed.

TACHO ADJUSTMENT – Menu

By push the PROG – push button switch will select the input level of the speed sensor.

Selectable items are 1 to 15.

If PROG+ will light up in the lower right corner of the LCD – display, it is possible to switch the level higher by push the PROG – push button switch.

Three second later will light up in the lower right corner of the LCD – display PROG-.

Now it is possible to switch the level lover by push the PROG – push button switch.

Selected item will be stored by the STORE - push button switch and the menu will be closed.

SERVICE – Menu:

By push the PROG – push button switch will select 01-ANALOG, 02-FAN SPEED,

03-HOURS METER or 04-EXIT.

Selected item will store by the STORE - push button switch.

By select EXIT the menu will close.

ANALOG – Menu:

This menu shows the real value of battery voltage, resistance of fuel level sensor, resistance of water temperature sensor for gauge, resistance of water temperature sensor for fan speed adjustment, resistance of hydraulic oil temperature sensor for fan speed adjustment, voltage of alternator, voltage of “Water In Fuel” sensor and fan speed.

Close this menu by push the PROG – push button switch.

Then monitor will go in “RESET” and then in the standard working mode.

FAN SPEED - Menu

By push the PROG – push button switch will select the speed of fan.

Selectable items are 99% to 45%.

Selected item will be stored by the STORE - push button switch and the menu will be closed.

HOURS METER – Menu

This menu shows working hours, minutes and seconds of the monitor, the number of

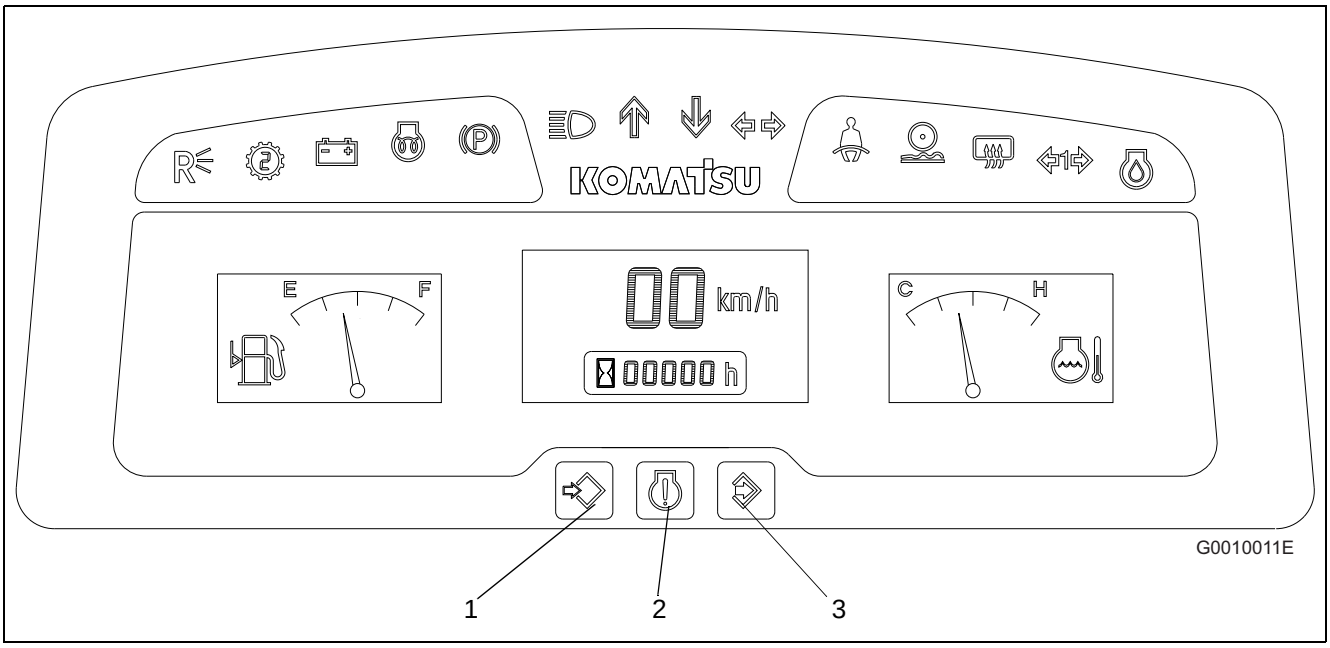
“Switch ON” of the monitor and the number of “RESET” for “0” hours of the monitor.

By select EXIT the menu will close.

WA80M-7 FAN SPEED						
	WATER TEMPERATURE			OIL TEMPERATURE		
TEMPERATURE [°C]	FAN SPEED [U/min]	PWM [%]	RESISTANCE [k Ohm]	FAN SPEED [U/min]	PWM [%]	RESISTANCE [k Ohm]
>30	360	95	2,000	360	95	2,000
30	360	95	2,078	360	95	2,078
35	450	60	2,157	450	60	2,157
40	450	60	2,238	450	60	2,238
45	450	60	2,320	450	60	2,320
50	450	60	2,404	450	60	2,404
55	650	55	2,490	650	55	2,490
60	650	55	2,578	650	55	2,578
65	650	55	2,668	650	55	2,668
70	650	55	2,760	650	55	2,760
72,5	900	50	2,807	900	50	2,807
75	1190	40	2,854	1190	40	2,854
77,5	1500	30	2,902	1500	30	2,902
80	1775	20	2,950	1775	20	2,950
82,5	1818	10	2,998	1818	10	2,998
85	1930	0	3,047	1930	0	3,047
87,5	1930	0	3,096	1930	0	3,096
90	1930	0	3,146	1930	0	3,146
92,5	1930	0	3,196	1930	0	3,196
95	1930	0	3,247	1930	0	3,247
97,5	1930	0	3,298	1930	0	3,298
100	1930	0	3,35	1930	0	3,35

WA100M-7 FAN SPEED						
	WATER TEMPERATURE			OIL TEMPERATURE		
TEMPERATURE [°C]	FAN SPEED [U/min]	PWM [%]	RESISTANCE [k Ohm]	FAN SPEED [U/min]	PWM [%]	RESISTANCE [k Ohm]
>30	360	95	2,000	360	95	2,000
30	360	95	2,078	360	95	2,078
35	450	60	2,157	450	60	2,157
40	450	60	2,238	450	60	2,238
45	450	60	2,320	450	60	2,320
50	450	60	2,404	450	60	2,404
55	650	55	2,490	650	55	2,490
60	650	55	2,578	650	55	2,578
65	650	55	2,668	650	55	2,668
70	650	55	2,760	650	55	2,760
72,5	900	50	2,807	900	50	2,807
75	1190	40	2,854	1190	40	2,854
77,5	1500	30	2,902	1500	30	2,902
80	1775	20	2,950	1775	20	2,950
82,5	1818	10	2,998	1818	10	2,998
85	1930	0	3,047	1930	0	3,047
87,5	1930	0	3,096	1930	0	3,096
90	1930	0	3,146	1930	0	3,146
92,5	1930	0	3,196	1930	0	3,196
95	1930	0	3,247	1930	0	3,247
97,5	1930	0	3,298	1930	0	3,298
100	1930	0	3,35	1930	0	3,35

Reading Fault codes



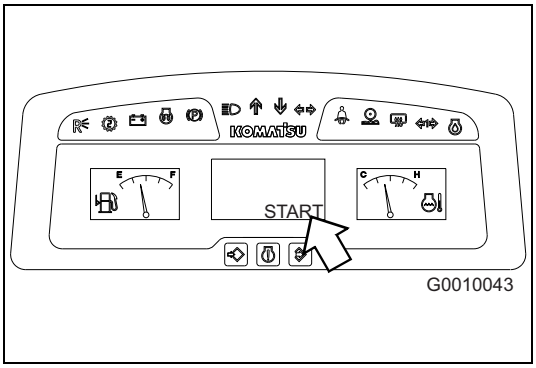
1.	Programming button: PROG - for change inputs
2.	Fault code button: FAIL - for read fail codes
3.	Store button switch: STORE - for store inputs

1. Press the fault code button (2) and hold it for 5 seconds.

   The background lighting starts to flash. All error codes are displayed after a short time.

2. When the background lighting stops flashing, the “START” key appears in the middle monitor area.

   Press the “START” key and the fault code is displayed.



Fault Codes List

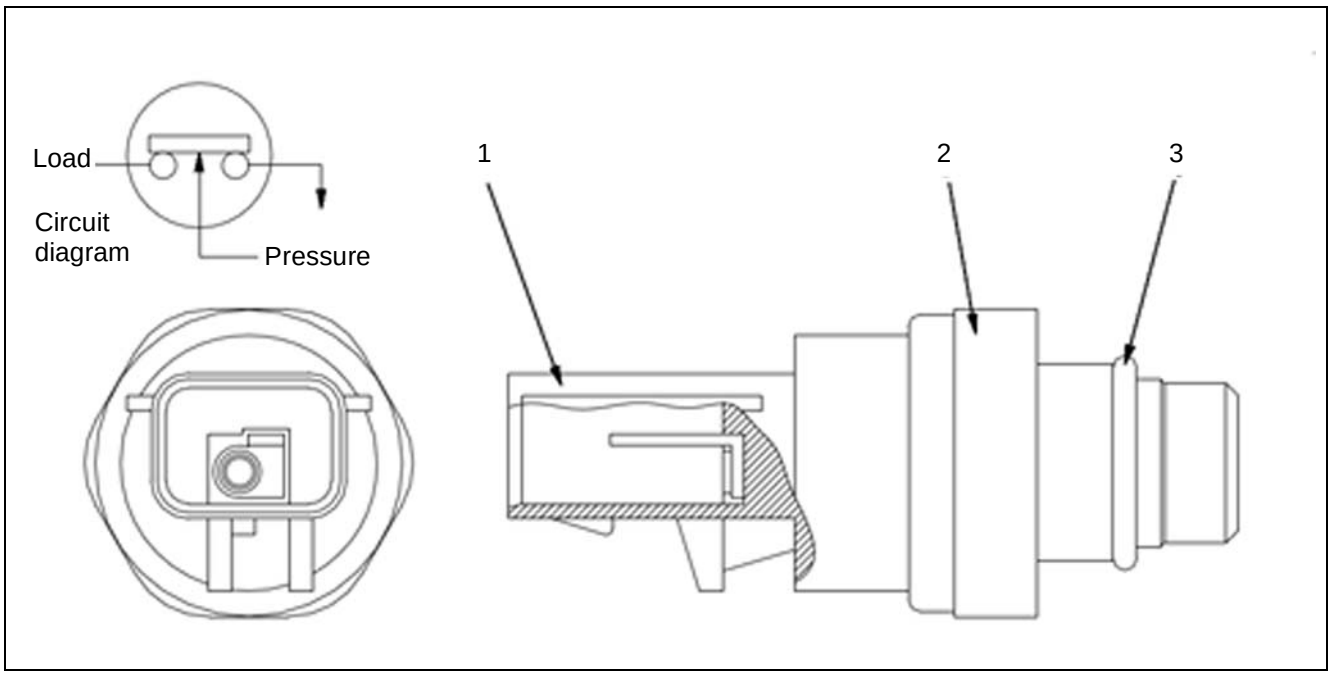
FAULT NAME	FAULT CODE	J1939 SPN	J1939 FMI	LAMP	Detection Condition	Recovery Condition	Treatment Action
Battery Voltage High Error	442	168	16	Warning (Solid)	Above 16V , 5sec	Below 36V , 5sec	Operate the engine with default value
Battery Voltage Low Error	441	168	18	Warning (Solid)	Below 5.7V, 5sec	Above 5.7V, 5sec	Operate the engine with default value
ECM Critical Internal Failure	343	629	12	Warning (Solid)	ECM internal hardware problem detection	After the problem is removed.	No treatment action
Persistent Data Lost Error	1117	3597	2	None	Internal data error detection	After the problem is removed.	No treatment action
ECM Int Temp Sensor High Error	697	1136	3	Warning (Solid)	Above 5V, 5sec	Below 5V, 5sec	No treatment action
ECM Int Temp Sensor Low Error	698	1136	4	Warning (Solid)	Below 0V, 5sec	Above 0V, 5sec	No treatment action
Eng Ne Speed Sensor Error	689	190	2	Warning (Solid)	No main speed signal, 3sec	After main speed signal detection	Controlled by Backup sensor only
Eng Bkup Speed Sensor Error	778	723	2	Warning (Solid)	No backup speed signal, 3sec	After backup speed signal detection	Controlled by Main(Ne) sensor only
Eng Bkup Speed Sens Phase Error	731	723	7	Warning (Solid)	Phase error detection between main pulse and backup pilse, Above 3 teeth	After 0rpm and no phase error	If it is during engine running, the engine is controlled by main sensor pulse only. If it is during starting, injection control is impossible.
Eng Ne and Bkup Speed Sens Error	115	612	2	Stop (Solid)	No detection of main sync pulse and backup sync pulse	After sync pulse detection, 10sec	Engine stop
Eng Overspeed	234	190	0	Stop (Solid)	Overspeed detection above 3250rpm, 1sec	Below reset speed 3150 rpm, 1sec	Fuel injection stop
Throttle Sensor High Error	131	91	3	Stop (Solid)	Above 4.5V, 1sec	Below 4.5V, 1sec	Depend on IVS position
Throttle Sensor Low Error	132	91	4	Stop (Solid)	Below 0.3V, 1sec	Above 0.3V, 1sec	Depend on IVS position
Coolant Temp Sens High Error	144	110	3	Warning (Solid)	Above 4.97V, 3sec	Below 4.97V, 3sec	Operate the engine with default value.
Coolant Temp Sens Low Error	145	110	4	Warning (Solid)	Below 0.23V, 3sec	Above 0.23V, 3sec	Operate the engine with default value.
Eng Oil Press SW Error	435	100	2	Warning (Solid)	Switch off when key on, 5times	Switch on after engine stop	No treatment action
Chg Air Press Sensor High Error	122	102	3	Warning (Solid)	Above 4.6V, 3sec	Below 4.6V, 3sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Chg Air Press Sensor Low Error	123	102	4	Warning (Solid)	Below 0.23V, 3sec	Above 0.23V, 3sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
IMV/PCV1 Short Error	271	1347	4	Warning (Solid)	Short detection, 0.2sec	After key-off and after condition recovery	Stop IMV(SCV) drive or keep drive Torque Derate
IMV/PCV1 Open Error	272	1347	3	Warning (Solid)	Open detection, 5V	After key-off and after condition recovery	Stop IMV(SCV) drive or keep drive Torque Derate
Rail Press Sensor High Error	451	157	3	Warning (Solid)	Above 4.59V, 3sec	Below 4.59V, 3sec	Pressure Derate Torque Derate
Rail Press Sensor Low Error	452	157	4	Warning (Solid)	Below 0.48V, 3sec	Above 0.48V, 3sec	Pressure Derate Torque Derate
Rail Press High Error	553	157	16	Warning (Solid)	(F/B press - Target press) > 130bar , 15sec	(F/B press - Target press) =< 100bar , 15sec	No treatment action
Rail Press Very High Error	449	157	0	Stop (Solid)	Above 2300bar, 1sec	Below 2300bar, 1sec	Torque Derate Pressure Derate
Rail Press Low Error	559	157	18	Warning (Solid)	(Target press - F/B press) > 130bar , 15sec	(Target press - F/B press) =< 100bar , 15sec	No treatment action
Rail Press Very Low Error	2249	157	1	Warning (Solid)	(Target press - F/B press) > 130bar , 60sec	After key-off and after condition recovery	Torque Derate Pressure Derate
IMV Solenoid Error	2311	633	31	Warning (Solid)	Solenoid resistance Out-Of-Range	After In-Range recovery	No treatment action
Injectors Drive Circuit Error	351	3597	12	Warning (Solid)	Charge voltage for drive below 40V, 10sec	Charge voltage for drive above 40V, 10sec	Torque Derate Pressure Derate
Inj #1(L#1) Open/Short Error	322	651	5	Warning (Solid)	Open or short detection, 17 times	No open detection and no short detection, Max 60sec	The error injector cannot carry out fuel injection.
Inj #2(L#2) Open/Short Error	331	652	5	Warning (Solid)	↑	↑	↑
Inj #3(L#3) Open/Short Error	324	653	5	Warning (Solid)	↑	↑	↑
Inj #4(L#4) Open/Short Error	332	654	5	Warning (Solid)	↑	↑	↑
Inj Trim Data error	2765	2797	13	None	Trim data mismatch detection	No mismatch detection	Injector trim is not carried out.
Sensor 1 Supply Volt Low Error	352	3509	4	Warning (Solid)	Below 4.64V, 0.1sec	Above 4.64V, 0.1sec	The power output is kept.
Sensor 1 Supply Volt High Error	386	3509	3	Warning (Solid)	Above 5.35V, 0.1sec	Below 5.35V, 0.1sec	The power output is kept.
Sensor 2 Supply Volt Low Error	187	3510	4	Warning (Solid)	Below 4.64V, 0.1sec	Above 4.64V, 0.1sec	The power output is kept.
Sensor 2 Supply Volt High Error	227	3510	3	Warning (Solid)	Above 5.35V, 0.1sec	Below 5.35V, 0.1sec	The power output is kept.
Ne Speed Sensor Supply Volt Error	238	3511	4	Warning (Solid)	Below 4.64V, 0.1sec	Above 4.64V, 0.1sec	The power output is kept.
Ne Speed Sens Supply Volt High Error	239	3511	3	Warning (Solid)	Above 5.35V, 0.1sec	Below 5.35V, 0.1sec	The power output is kept.
Throt Sensor Sup Volt Low Error	2186	3512	4	Warning (Solid)	Below 4.64V, 0.1sec	Above 4.64V, 0.1sec	The power output is kept.
Throt Sensor Sup Volt High Error	2185	3512	3	Warning (Solid)	Above 5.35V, 0.1sec	Below 5.35V, 0.1sec	The power output is kept.
Sensor 5 Supply Volt Low Error	1696	3513	4	Warning (Solid)	Below 4.64V, 0.1sec	Above 4.64V, 0.1sec	The power output is kept.
Sensor 5 Supply Volt High Error	1695	3513	3	Warning (Solid)	Above 5.35V, 0.1sec	Below 5.35V, 0.1sec	The power output is kept.
Rail Press Sens Sup Volt Low Error	516	3514	4	Warning (Solid)	Below 4.64V, 0.1sec	Above 4.64V, 0.1sec	The power output is kept.

FAULT NAME	FAULT CODE	J1939 SPN	J1939 FMI	LAMP	Detection Condition	Recovery Condition	Treatment Action
Rail Press Sens Sup Volt High Error	515	3514	3	Warning (Solid)	Above 5.35V, 0.1sec	Below 5.35V, 0.1sec	The power output is kept.
Mass Air Flow Sensor Sup Volt Low Error	3421	5125	4	Warning (Solid)	Below 9.55V, 0.1sec	Above 9.55V, 0.1sec	The power output is kept.
Mass Air Flow Sensor Sup Volt High Error	3419	5125	3	Warning (Solid)	Above 15.45V, 0.1sec	Below 15.45V, 0.1sec	The power output is kept.
Chg Air Temp Sensor High Error	153	105	3	Warning (Solid)	Above 4.94V, 3sec	Below 4.94V, 3sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Chg Air Temp Sensor Low Error	154	105	4	Warning (Solid)	Below 0.05V, 3sec	Above 0.05V, 3sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Intake Air Temp Sens High Error	691	1172	3	Warning (Solid)	Above 4.97V, 2.4sec	Below 4.97V, 2.4sec	Operate the engine with default value.
Intake Air Temp Sens Low Error	692	1172	4	Warning (Solid)	Below 0.23V, 2.4sec	Above 0.23V, 2.4sec	Operate the engine with default value.
Ambient Press Sensor High Error	221	108	3	Warning (Solid)	Above 4.6V, 0.2sec	Below 4.6V, 0.2sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Ambient Press Sensor Low Error	222	108	4	Warning (Solid)	Below 0.3V, 0.2sec	Above 0.3V, 0.2sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Grid Htr Relay Volt High Error	2556	729	4	Warning (Solid)	Short detection, 10sec	After normal recovery	No treatment action
Grid Htr Relay Volt Low Error	2555	729	3	Warning (Solid)	Open detection, 10sec	After normal recovery	No treatment action
Idle Validation Sw Error	431	558	2	Warning (Solid)	Switch error detection	Based on detail specification	Depend on IVS process specification
Idle Validation Process Error	432	558	13	Stop (Solid)	Process error detection	Based on detail specification	Depend on IVS process specification
EGR Valve Pos Sens Low Error	2272	27	4	Warning (Solid)	Position error detection, 5sec	After normal recovery, 30sec	EGR full close VFT Full open Torque Derate
EGR Valve Servo Error	2357	2791	7	Warning (Solid)	Overcurrent detection, 2 times	After key-off and after condition recovery	EGR full close VFT Full open Torque Derate
KVGT Servo Error 2	3921	5421	7	Warning (Solid)	Overcurrent detection, 2 times	After key-off and after condition recovery	EGR full close VFT Full open Torque Derate
EGR Valve Solenoid Open Error	2349	2791	5	Warning (Solid)	Open detection, 6sec	After normal recovery, 10sec	EGR full close VFT Full open Torque Derate
EGR Valve Solenoid Short Error	2353	2791	6	Warning (Solid)	Short detection, 6sec	After key-off and after condition recovery, or after normal recovery, 10sec	EGR full close VFT Full open Torque Derate
KVGT Stuck Error	3918	5421	13	Warning (Solid)	Zero position Out-Of -Range	After key-off and after condition recovery	EGR full close VFT Full open Torque Derate
KVGT Motor Driver IC Over Temp Error	3919	5372	15	Warning (Solid)	High temperature detection, 60sec	After key-off and after condition recovery, or after normal recovery, 60sec	EGR full close VFT Full open Torque Derate
KVGT Motor Driver Open Error	3922	5421	5	Warning (Solid)	Open detection, 6sec	After normal recovery	EGR full close VFT Full open Torque Derate
KVGT Motor Driver Short Error	3923	5421	6	Warning (Solid)	Short detection, 6sec	After key-off and after condition recovery, or after normal recovery, 10sec	EGR full close VFT Full open Torque Derate
KVGT Motor Driver Position Error	466	1188	4	Warning (Solid)	Position error detection, 5sec	After normal recovery, 30sec	EGR full close VFT Full open Torque Derate
EGR Valve Stuck Error	1896	2791	13	Warning (Solid)	Zero position Out-Of -Range	After key-off and after condition recovery	EGR full close VFT Full open Torque Derate
EGR/KVGT Motor Driver Power Low Error	3724	168	17	Warning (Solid)	Motor drive voltage low error detection, 6sec	After key-off and after condition recovery, or after normal recovery, 10sec	EGR full close VFT Full open Torque Derate
EGR Motor Driver IC Over Temp Error	1961	2791	15	Warning (Solid)	High temperature detection, 60sec	After key-off and after condition recovery, or after normal recovery, 60sec	EGR full close VFT Full open Torque Derate
Mass Air Flow Sensor High Error	356	132	3	Warning (Solid)	Above frequency 15000Hz, 3sec	After normal recovery, 3sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Mass Air Flow Sensor Low Error	357	132	4	Warning (Solid)	Below frequency 1000Hz, 3sec	After normal recovery, 3sec	Operate the engine with default value. EGR full close VFT Full open Torque Derate
Crankcase Press Sens High Error	1843	101	3	Warning (Solid)	Above 4.74V, 5sec	Below 4.74V, 10sec	Operate the engine with default value.
Crankcase Press Sens Low Error	1844	101	4	Warning (Solid)	Below 0.26V, 5sec	Above 0.26V, 10sec	Operate the engine with default value.
Crankcase Press Sens In Range Error	1942	101	2	Warning (Solid)	Above 2.5kPa_G at key-on	After key-off and after condition recovery	No treatment action
Crankcase Press High Error 1	555	101	16	Warning (Solid)	Above threshold 3.74 kPa_G, 10sec	Key off	No treatment action
Crankcase Press High Error 2	556	101	0	Stop (Solid)	Above threshold 4.97 kPa_G, 5sec	Key off	TorqueDerate
Eng Water Overheat	146	110	16	Warning (Solid)	Above 105 degC, 3sec	After normal recovery	TorqueDerate
OIL_PRESSURE_FUELING_ERROR	143	100	18	Warning (Solid)	Oil press switch on (below 0.5kg/cm2), 3sec	Oil press switch off (above 0.5kg/cm2), 3sec	Torque Derate RPM Derate
OIL_PRESSURE_RPM_ERROR	415	100	1	Stop (Solid)	Oil press switch on (below 0.5kg/cm2), 3sec	Oil press switch off (above 0.5kg/cm2), 3sec	Torque Derate RPM Derate

Sensors

Sensor detection item	Sensor method	When normal	When abnormal	Connector label name
Engine oil pressure switch	Contact Contact type: normally closed	ON	OFF	POIL
Engine coolant temperature	Resistance	25°C (2 kΩ) 50°C (2.4 - 2.43 kΩ) 100°C (3.35 - 3.43 kΩ)		
Fuel level	Resistance	FULL (178 -192 kΩ)	EMPTY (0-6 kΩ)	
Air filter negative pressure	Contact	OFF	ON	
Variable flow turbocharger motor (with built-in position sensor)				Variable flow turbocharger
Crankcase pressure sensor				CCV
Bkup (camshaft9 speed sensor				CAM
EGR valve motor (with built-in position sensor)				EGR/V
Charge (boost) pressure and temperature sensor				TMAP (PITM)
Ambient pressure sensor				PAMB
Common rail pressure sensor				PFUEL
Suction control valve				SCV
NE (crankshaft) speed sensor				NE
Mass air flow and temperature sensor				MAF

Engine oil pressure switch



1. Connector
2. Sensor
3. O-ring

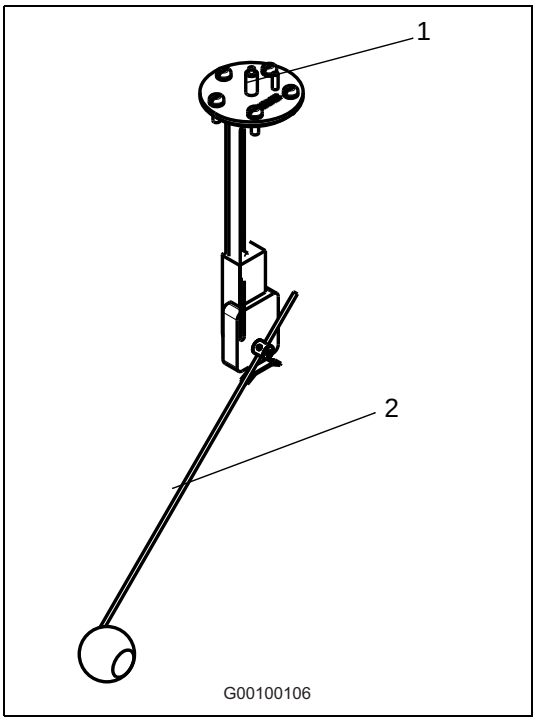
Function

- This sensor is installed to the cylinder block, senses the engine oil pressure, and turns "ON" when the engine oil pressure decreases below the specified pressure.

  This makes the monitor flash to warn of the abnormality. At the same time the alarm buzzer is actuated to warn of the abnormality.

Fuel level sensor

1. Connector
2. Float

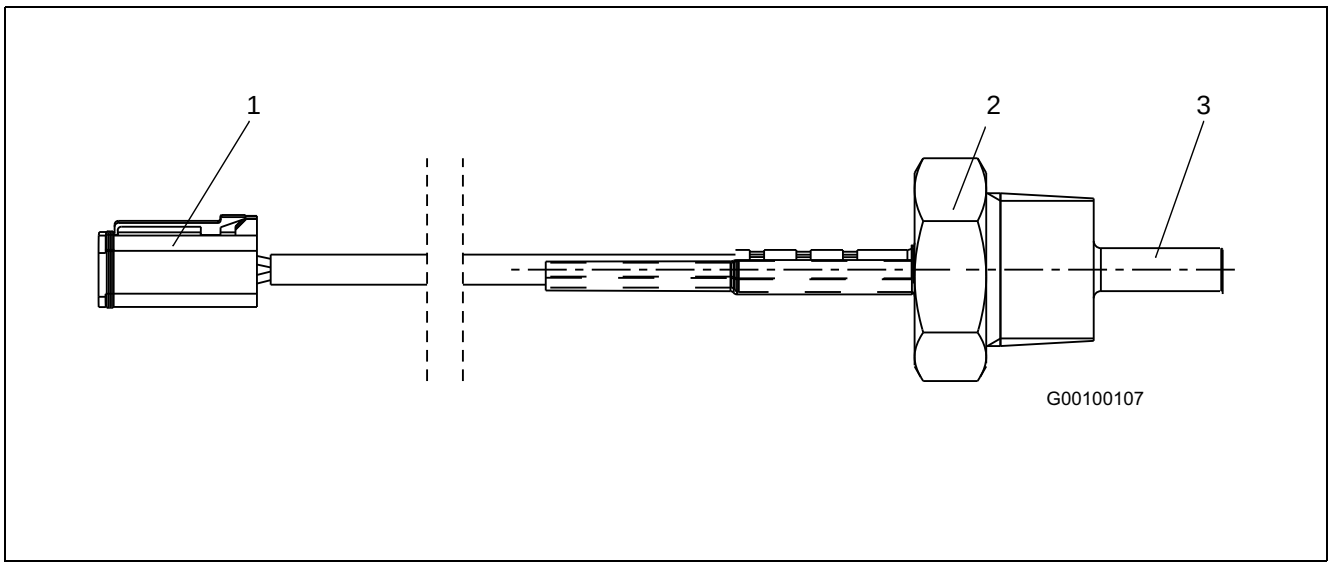


Function

- The fuel level sensor is mounted in the top of the tank. The float (2) moves up and down according to the fuel level.

  The measured resistance is sent to the monitor as an electrical signal and shows the fuel level.

Engine coolant temperature sensor



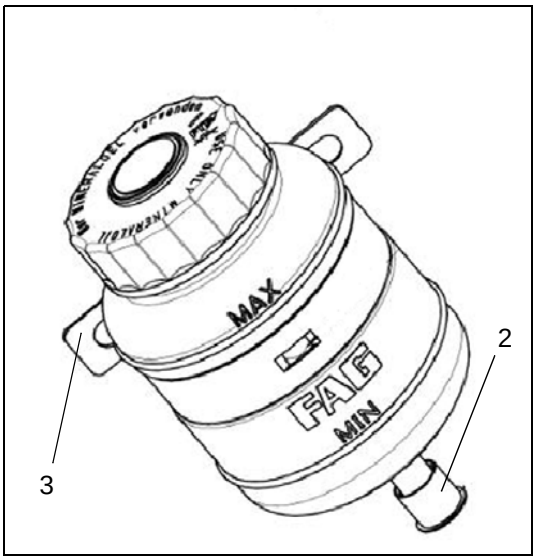
1. Connector
2. Plug
3. Thermistor

Function

- This sensor is installed to the engine cylinder block. The change in the temperature changes the resistance of the thermistor, and a signal is sent to the monitor to display the temperature.

  When the display on the monitor reaches the specified level, the caution lamp and alarm buzzer are also actuated at the same time to warn of the abnormality.

Brake oil reservoir sensor



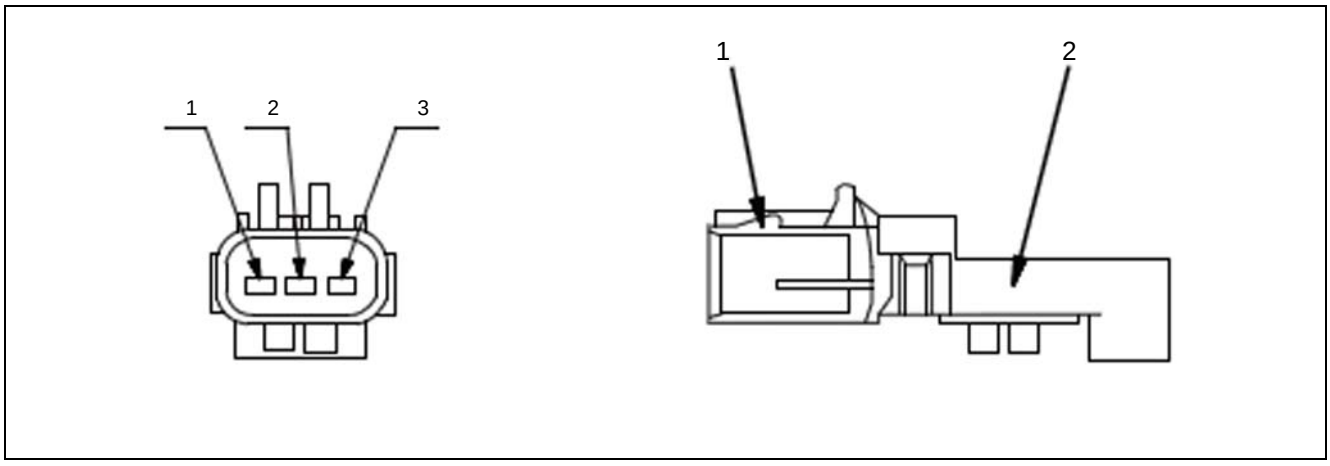
1. Contacts
2. Brake pipe connection
3. Mounting

Function

- The sender unit is mounted in the screw cap. When the oil level falls under a minimum the float sinks down until the switch contacts close (ON position).

  This lights the warning lamp to inform the driver that the brake oil level is low.

Ambient pressure sensor

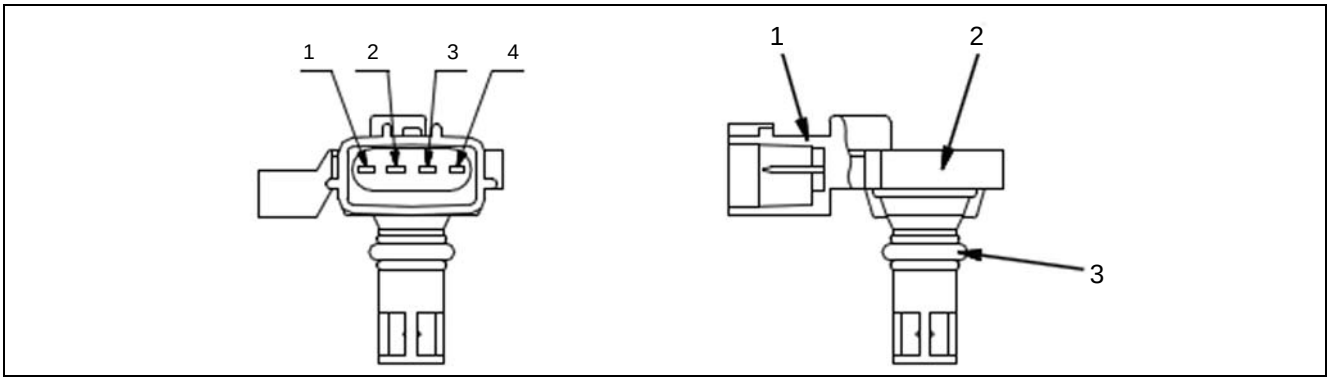


1. Contacts
2. Sensor

Function

- This sensor is installed to the bracket on the side of the cylinder block, senses the ambient temperature, and outputs it as a variable voltage.

Charge (boost) pressure and temperature sensor



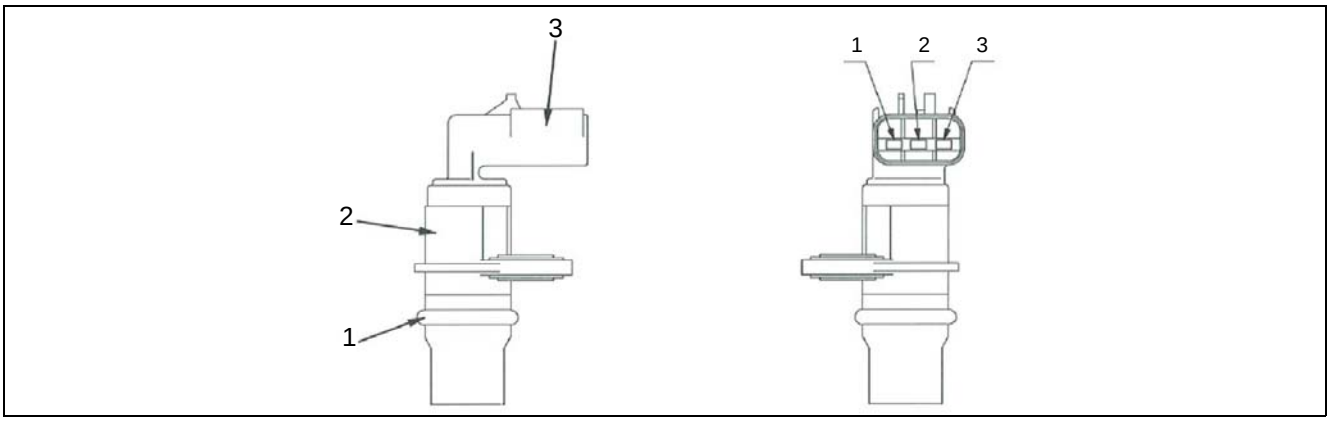
1. Contacts
2. Sensor
3. O-ring

Function

- This sensor is installed to the engine intake manifold. It detects the engine intake air pressure and its temperature, and outputs signals as a variable voltage for pressure, and as variable resistance for temperature.

★ "Charge pressure and temperature" are the engine air pressure and temperature of a turbocharged engine. These are also refered to as "boost pressure and temperature " or "intake air pressure and temperature".

NE (crankshaft) speed sensor

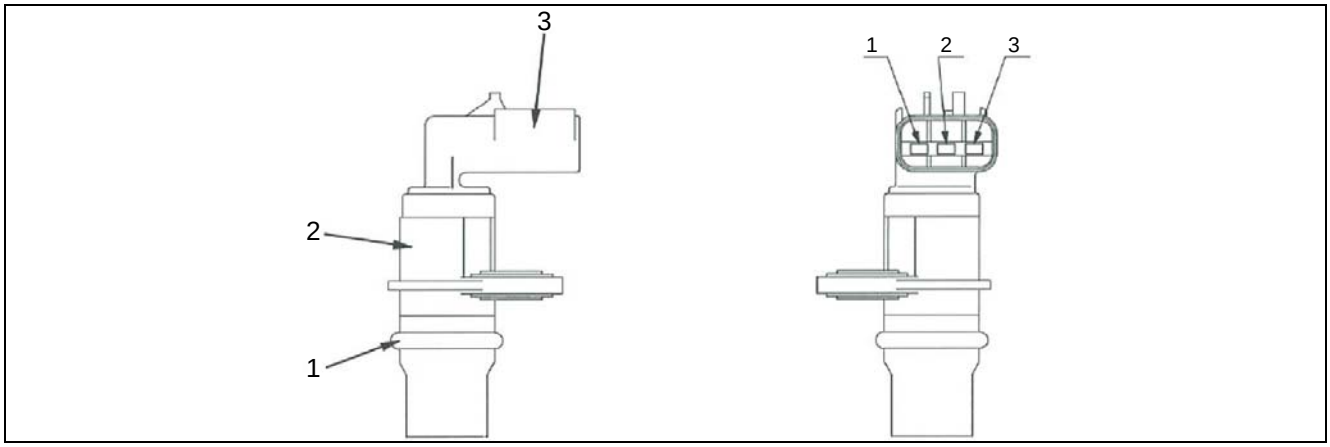


1. O-ring
2. Sensor
3. Connector

Function

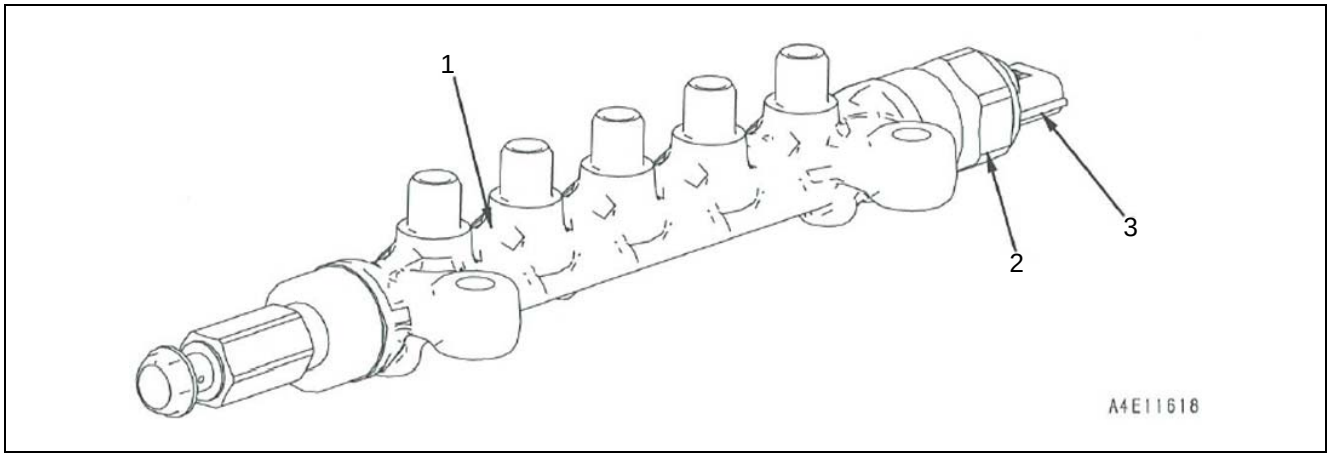
- This sensor, installed to the crankshaft pulley on the engine front cover, outputs the pulse voltage due to the gear rotation.

Bkup (camshaft) speed sensor



1. O-ring
2. Sensor
3. Connector

Common rail pressure sensor

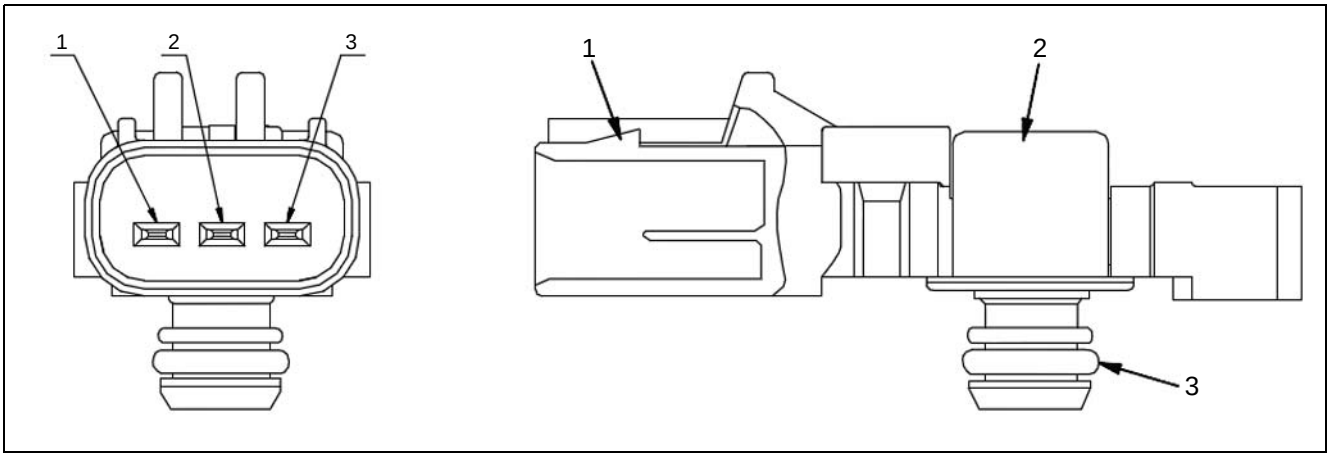


1. Common rail pressure
2. Sensor
3. Connector

Function

- This sensor, installed to the common rail in the engine, detects the fuel pressure to output the corresponding variable voltage.

Crankcase pressure sensor

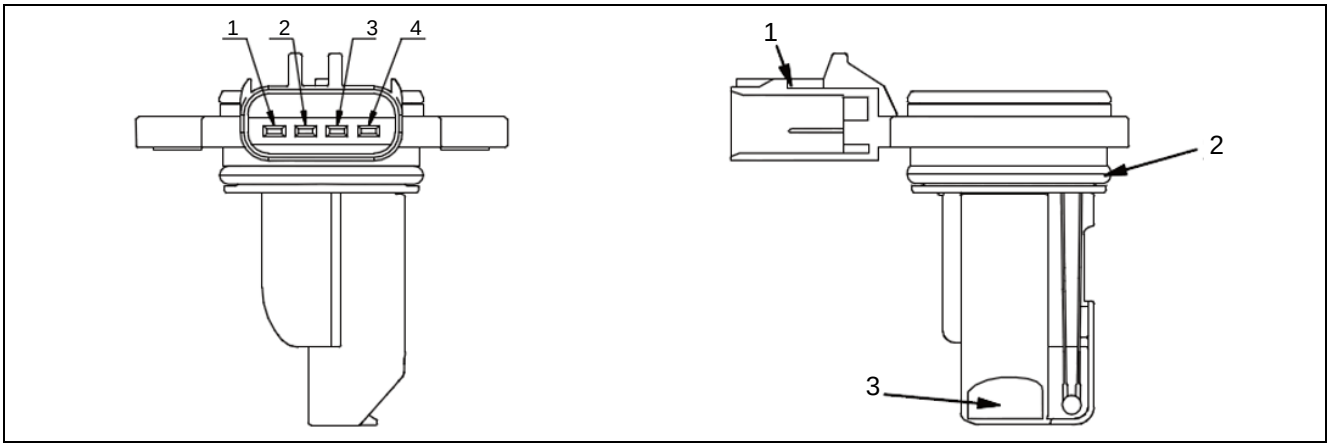


1. Connector
2. Sensor
3. O-ring

Function

- This sensor is installed to the breather top, senses the crankcase pressure (blowby pressure), and outputs it as a variable voltage.

Mass air flow and temperature sensor



1. Connector
2. O-ring
3. Sensor

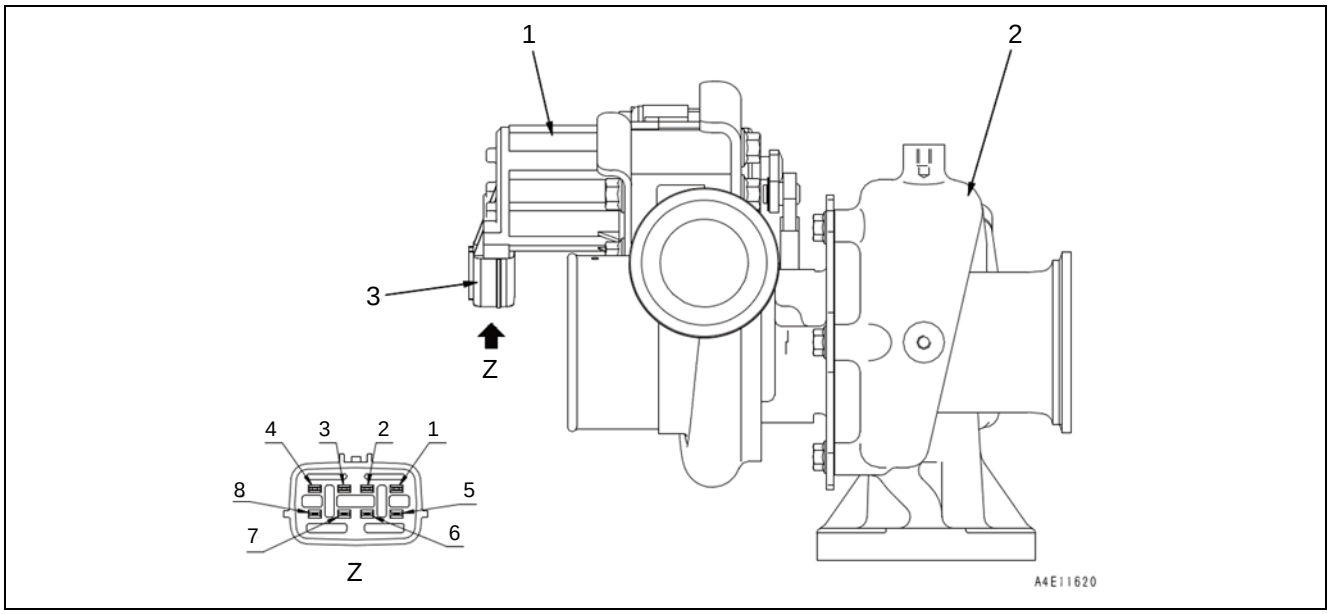
Function

- This sensor is installed to the outlet side of air cleaner, converts the variations of intake air flow and temperature into the resistance variation, and outputs the corresponding signals.

★ The "MAF (Mass Air Flow)" means the intake air flow.

Variable Flow Turbocharger motor (with built-in position sensor)

★ The shape is subject to the machine models.



1. Variable flow turbocharger motor

   (brushless motor with built-in position sensor)
2. Turbine part
3. Connector

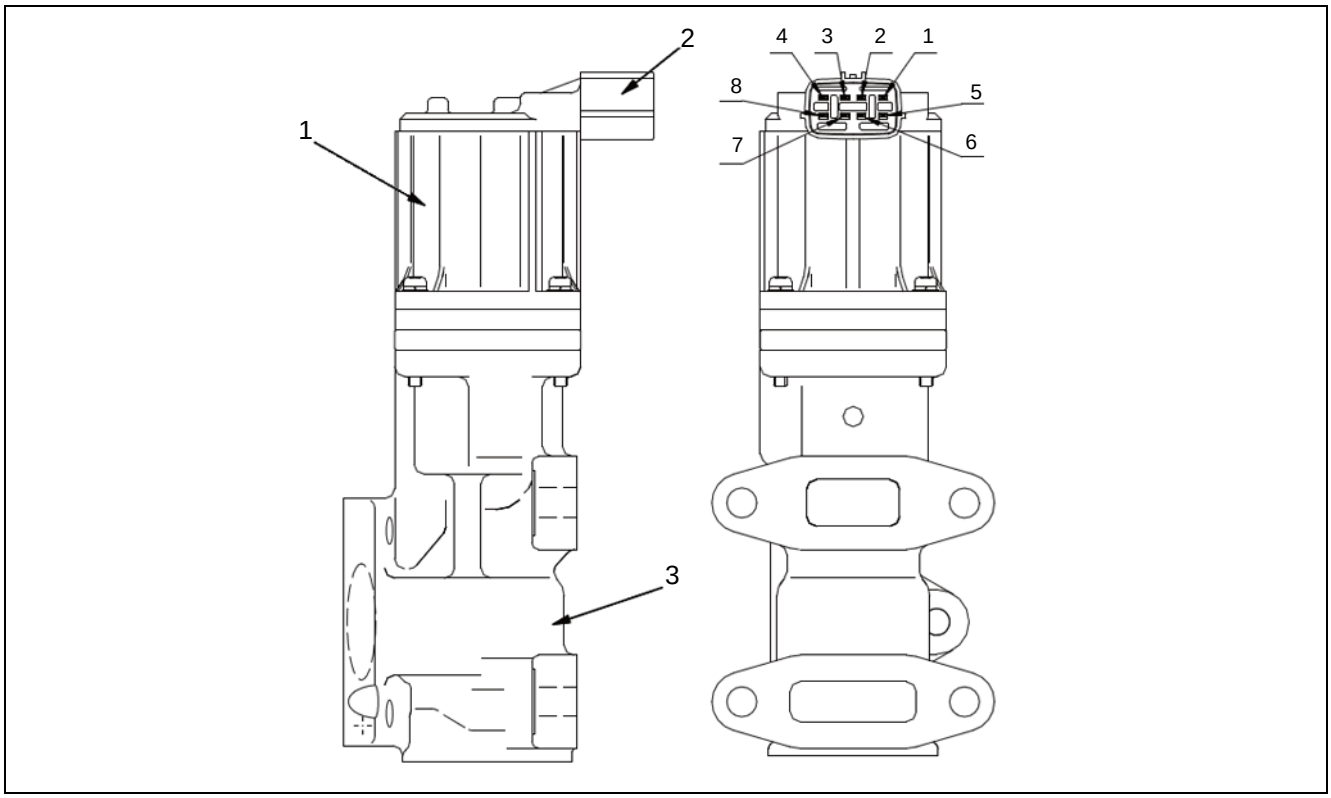
Function

- Controls the flow control valve with a DC motor.
- The variable flow turbocharger motor has a position sensor in it to sense the valve position.

EGR valve (with built-in position sensor)

★ EGR-Abbreviation for Exhaust Gas Recirculation

★ The shape is subject to machine models.



1. EGR valve motor (with built-in position sensor)
2. Connector
3. Body

Function

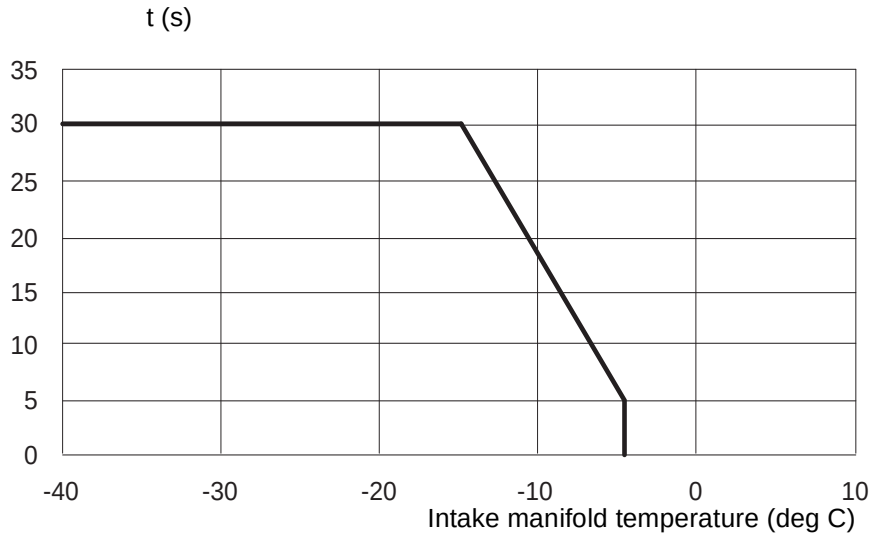
- Small-sized EGR valve driven with a DC motor.
- The EGR motor has a position sensor in it to sense the valve position.

Blank for technical reason

Pre-heater

WA80M-7, WA100M-7 – Ribbon heater

During cold start, auto pre-heating will activate with the intake air heater based on the sensed engine intake manifold temperature (boost air temperature). The time set for auto pre-heating function as follows.

Function	Operation
Electrical ribbon heater	Relationship between intake manifold temperature and auto preheat time 

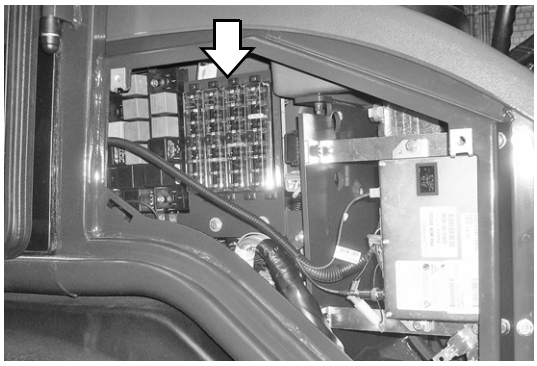
Operation point

- When key SW is on, a signal output will be sent from the engine controller to the heater relay and intake heater will be turned on at the above intake manifold temp and time.
- At the same time a pre-heater lamp will light due signal output from ECM. (It will turned off when electricity to the heater relay is shut off.)
- Operator needs to start the engine after the pre-heat lamp is turned off. If he/she starts it before the lamp is off, the signal output to the heater relay will be off.

GK100838

Electrical fuses and relays

Fuses



F1.1 10A S43 A450 K106 K158.2	F2.1 10A R397	F3.1 10A E1:56a E2:56a	F4.1 10A K385 E470 E68.4/E69.4 B279
F1.2 10A A510	F2.2 10A Y235 Y236 Y237 K167 K373	F3.2 10A E1:56b E2:56b	F4.2 10A M248 M182.2
F1.3 10A X47 R246	F2.3 10A E5/6 E68.2 K67 E69.2	F3.3 10A Y213 Y214 K209	F4.3 10A S469 R444 M441
F1.4 10A A249 E123	F2.4 10A P426 Y180	F3.4 10A K314 Y411 Y315 Y465	F4.4 10A M443 Y467 Y446 A449 K379
F1.5 10A E5/6 E68.2 K67 E69.2	F2.5 10A P426	F3.5 25A M296	F4.5 10A A454
F1.6 10A B8 K337 M7 M182.1	F2.6 20A E3 E60 E4 E61	F3.6 10A A249 Y453	F4.6 10A Y376 M407 K235
F1.7 10A E68.3 E69.3	F2.7 10A E1:58 E71/E72 E243 E244	F3.7 10A E130	F4.7 10A K464 Y461 Y462
F1.8 20A M78 K296 Y293	F2.8 10A E2:58 E69.1	F3.8 10A F2.7 F2.8 K56.1 K56.2	F4.8 10A KOP3

G0010012

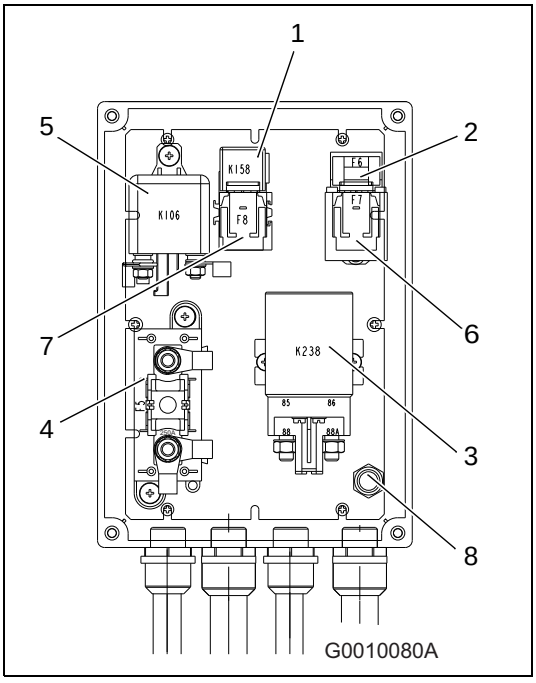
No.	Fuse rating	Circuit name
F1.1	10 A	Starting switch, KOMTRAX, battery relay
F1.2	10 A	KOMTRAX
F1.3	10 A	Connection socket, optional cigarette lighter
F1.4	10 A	Radio, interior lighting
F1.5	10 A	Turn signal, hazard warning light
F1.6	10 A	Switch, windshield wiper, horn
F1.7	10 A	Brake lights
F1.8	20 A	Blower switch, heater blower, air conditioner switch/relay, compressor
F2.1	10 A	Rear window defroster switch
F2.2	10 A	Forward/backward valve, speed range, stopwatch, back-up alarm relay, speed range relay
F2.3	10 A	Turn indicator
F2.4	10 A	Monitor, fan drive, engine starter relay
F2.5	10 A	Monitor
F2.6	20 A	Working lamps
F2.7	10 A	Left-side clearance lamp, license plate lighting, attachment clearance lamp
F2.8	10 A	Right-side clearance lamp
F3.1	10 A	High beam
F3.2	10 A	Low beam
F3.3	10 A	Solenoid switch, return to dig
F3.4	10 A	Auto-inch, ECSS, hose break safety device
F3.5	25 A	Relay and engine capacitor
F3.6	10 A	Radio
F3.7	10 A	Warning beacon
F3.8	10 A	Light switch, head lamp switch, left-side clearance lamp
F4.1	10 A	Back-up light, reverse gear light, back-up alarm
F4.2	10 A	Rear window wiper
F4.3	10 A	Seat heater, air suspension
F4.4	10 A	Quick-changer, window wiper, proportional controller, 3rd control circuit switch
F4.5	10 A	Speed control
F4.6	10 A	Central lubrication system
F4.7	10 A	4th control circuit
F4.8	10 A	Option (max.)
F5	250 A	Engine air pre-heater
F6	100 A	Battery relay
F7	30 A	Engine controller
F8	5 A	Engine controller

Slow-blow fuses

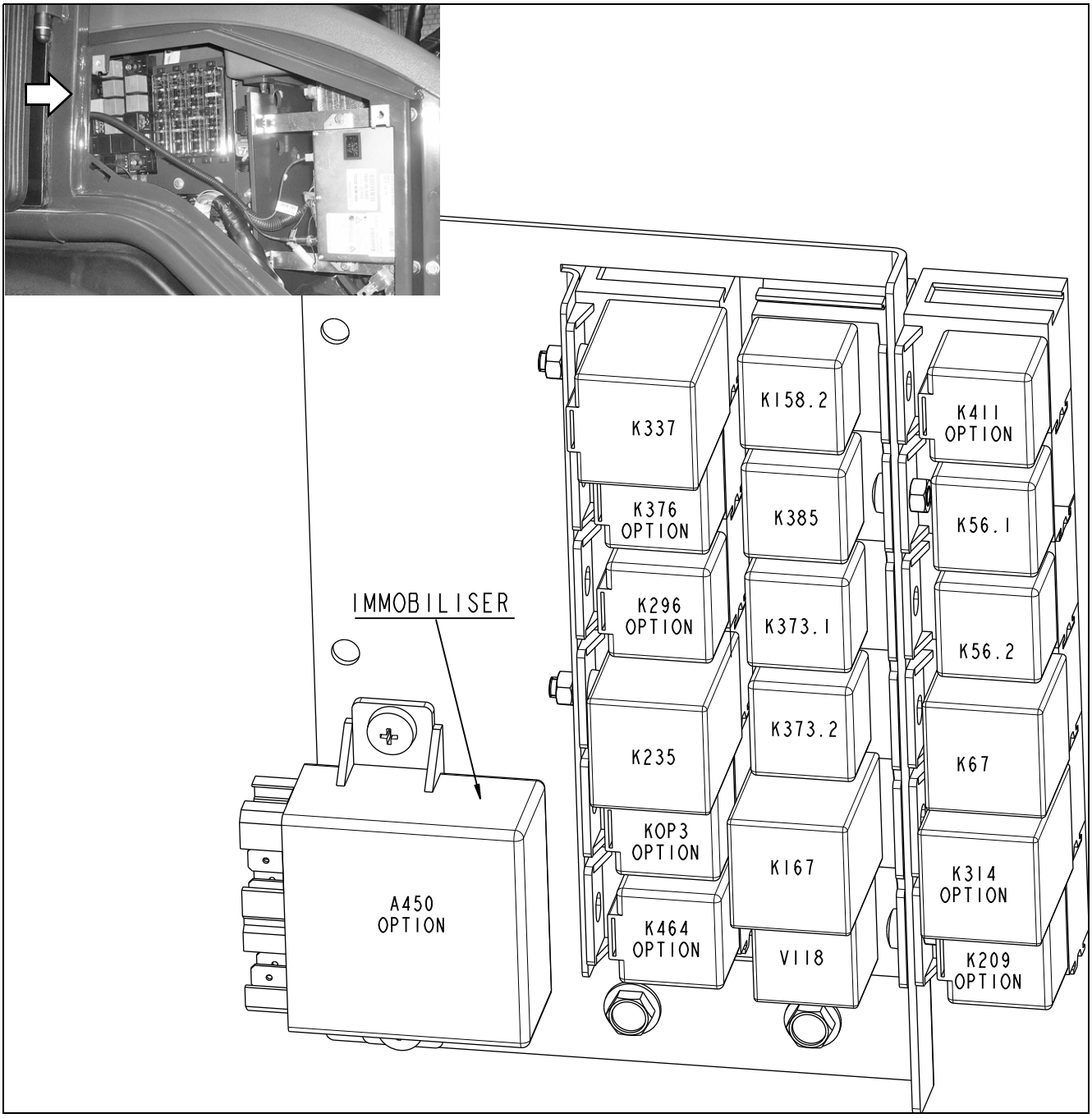
If the power supply fails, one of the slow-blow fuses might be blown. Check the electrical system and replace defective fuses.

The fuse box is located in the battery compartment.

1.	Starter motor relay	70 A
2.	Battery fuse	100 A
3.	Intake air pre-heater relay	200 A
4.	Intake air pre-heater fuse	250 A
5.	Battery relay	120 A
6.	Engine controller fuse	30 A
7.	Engine controller fuse	5 A
8.	Pilot lamp, controller	



Relays



K337	Intervall (wish/wash front)		K158.2	KOMTRAX		K411	Over center valve (option)
K376	Locking differential (option)		K385	Backup alarm		K56.1	Low beam
K296	Air condition (option)		K373.1	Parking brake forward		K56.2	High beam
K235	Driving range		K373.2	Parking brake reverse		K67	Flasher
KOP3	(option)		K167	Timer 0.8 sec.		K314	Switch frequency ECSS (option) 400Hz or 650Hz
K464	4th circuit (option)		V118	Diode		K209	Return to dig (option)

Diagrams

Wiring diagrams

NOTE
Wiring diagrams can be found in section 90 "Others".

Hydraulic circuit diagram

NOTE
Hydraulic circuit diagrams can be found in section 90 "Others".

Air conditioner (option)

Introduction

The air conditioning systems of our wheel loaders are filled with the environmentally friendly coolant R134a (tetrafluorethane).

General

- Liquid cooling gas absorbs heat when it turns into gas.

  This takes place in the vaporizer.

- When the gas turns into liquid gas the heat is dissipated.

  This takes place in the condenser.

- The air conditioner does not produce cold air, it takes the temperature from the surrounding warm air and dissipates it.

Physical principal

- Physically, heat moves from a warm element towards a cold element. When this occurs, the fast moving molecules in the warm element transfer a part of their energy to the slow moving molecules in the cold element. This causes the fluid used in the air conditioner to change form. Individual atoms, which make up the molecules, change their position. When this happens the fluid changes from gas to liquid.

- e.g.: This reaction can be seen with water. Water is normally liquid between 0°C and 100°C. If the water is heated, it becomes steam. The water changes from a liquid form into a gas form. If the water is cooled it becomes ice. The water changes from a liquid form into a solid form.

Physical datas - R134a		
Molecular formula	–	CH_2FCF_3
Molecular name	–	1,1,1,2-Tetraflourethan
Agent class	–	HFKW
Molecualr weight	–	102.03
Boiling point (at 1,013 bar)	°C	-26.5
Critical temperature	°C	101.15
Critical pressure	bar	40.64
Critical density	kg/l	0.508
ODP (Ozone Depletion Potential)	–	0
GWB (Global Warming Potential)	–	0.24 – 0.29

Characteristics - R134a
• Colourless, odorless, tasteless
• Incombustible, so there is no danger of ignition or explosion
• Chemically stable
• Does not decompose structural materials
• Ozone depletion potential (ODP) of 0

Function

The coolant circuit

- The coolant R134a circulates throughout the system in an enclosed circuit.
- Gaseous coolant under low pressure is sucked from the vaporizer (8) by the compressor (2). This places the gaseous coolant under high pressure (approx. 20 - 30 bar) and forwards it to the condenser (3).

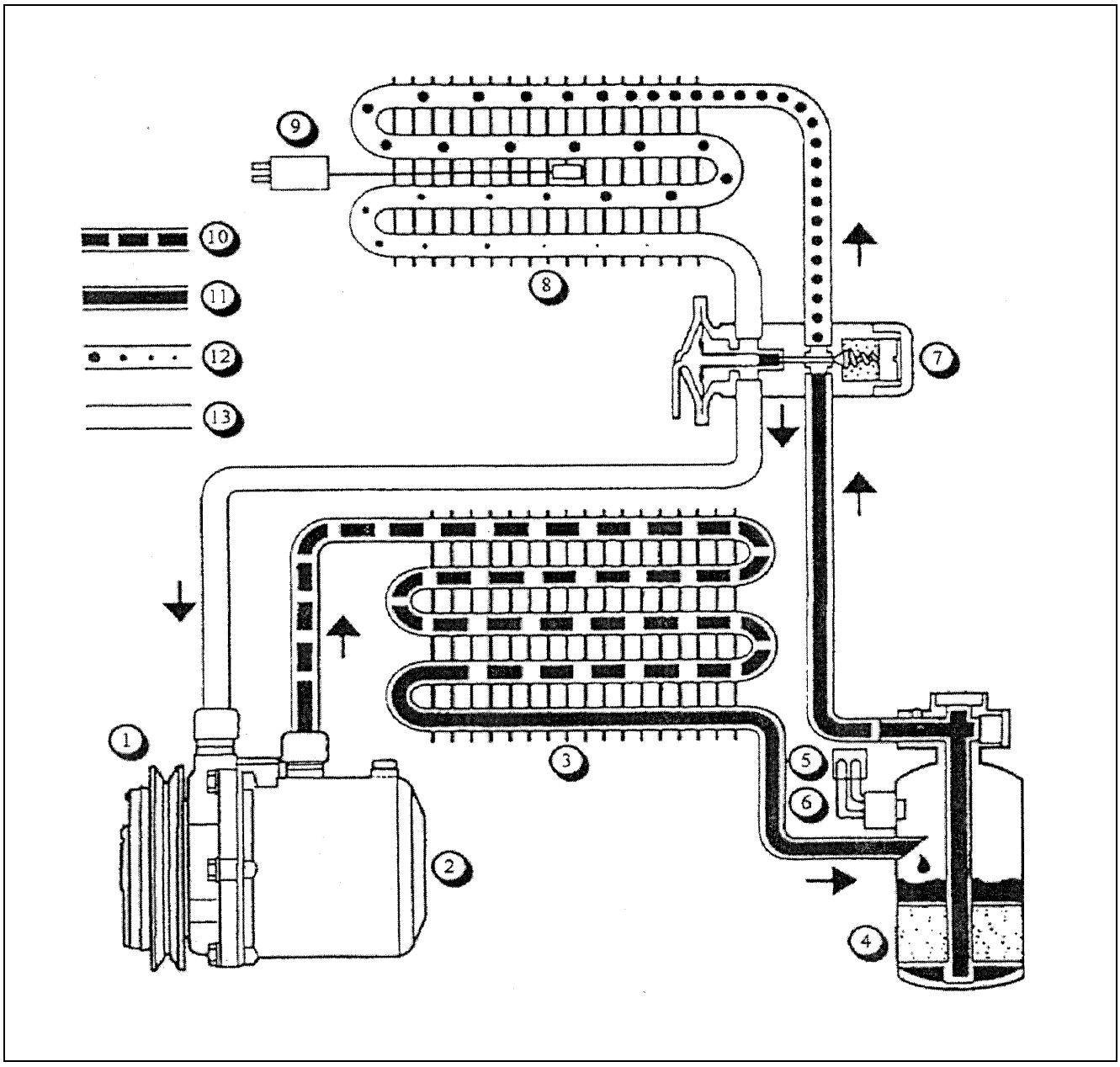
  The gaseous coolant transcends into a liquid state in the condenser (3) because of the applied pressure and removal of heat. Fans blow outside air through the condenser to cool the warming coolant. The heat removed from the air fed into the operator's cab is passed on to the outside air. The coolant is still under high pressure at this point.

  The coolant passes through the filter dryer (4) and the pressure switch (5) at the entrance to the vaporizer (8) in this state. The coolant is filtered and dried in the filter dryer (4). It is also a compensation tank at the same time.

  The throttle effect of the expansion valve (7) reduces the pressure and the temperature of the coolant. It makes sure that only as much coolant flows into the vaporizer (8) as can actually be vaporized. The liquid coolant then reverts to its gaseous state in the vaporizer.

  Outside air is fed through the vaporizer (8) by the fresh air fan. While passing through the vaporizer (8) , the warmth it contains is extracted from the outside air before it flows through the air vents into the operator's cab.

That completes the circuit.



1. Magnetic clutch
2. Compressor
3. Condenser
4. Filter dryer
5. High-pressure switch
6. Low-pressure switch
7. Expansion valve
8. Vaporizer
9. Icing protection switch
10. High-pressure, gaseous
11. High-pressure, liquid
12. Low-pressure, liquid
13. Low-pressure, gaseous

The condenser

With a cooling system, warmth at a place where it is not required is transported to another place where the warmth absorbed by the vaporizer is fed on to the condenser. In the condenser, the gaseous coolant is cooled and liquefied. The warmth removed during liquefying is dissipated into the air by the condenser.

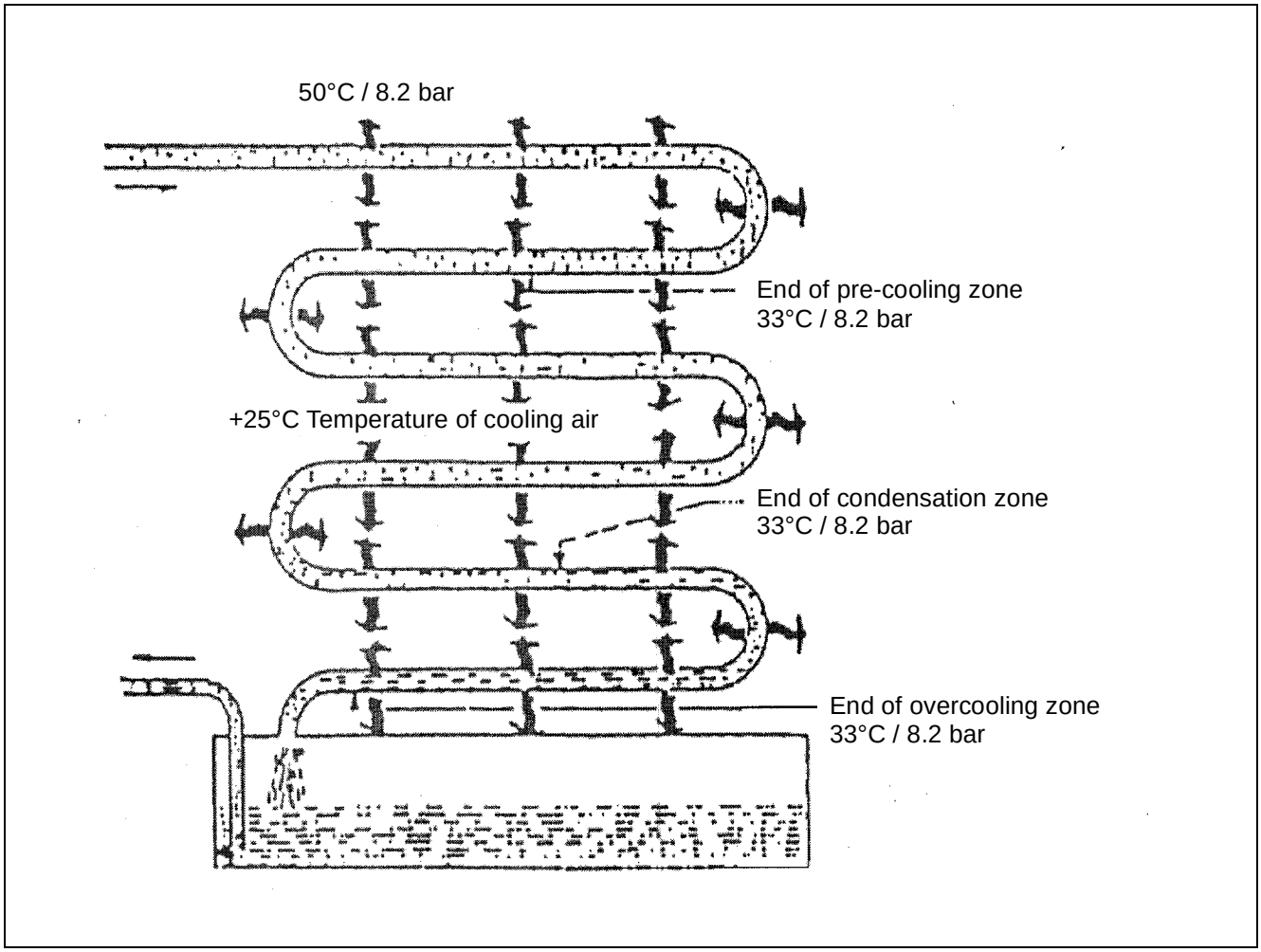
The coolant flows through **three zones** during this:

1st zone:
The gaseous coolant is cooled to condensation temperature by dissipation of warmth (pre-cooling zone).

2nd zone:
The coolant transcends into liquid state by dissipation of the condensation heat at a constant temperature (condensation zone).

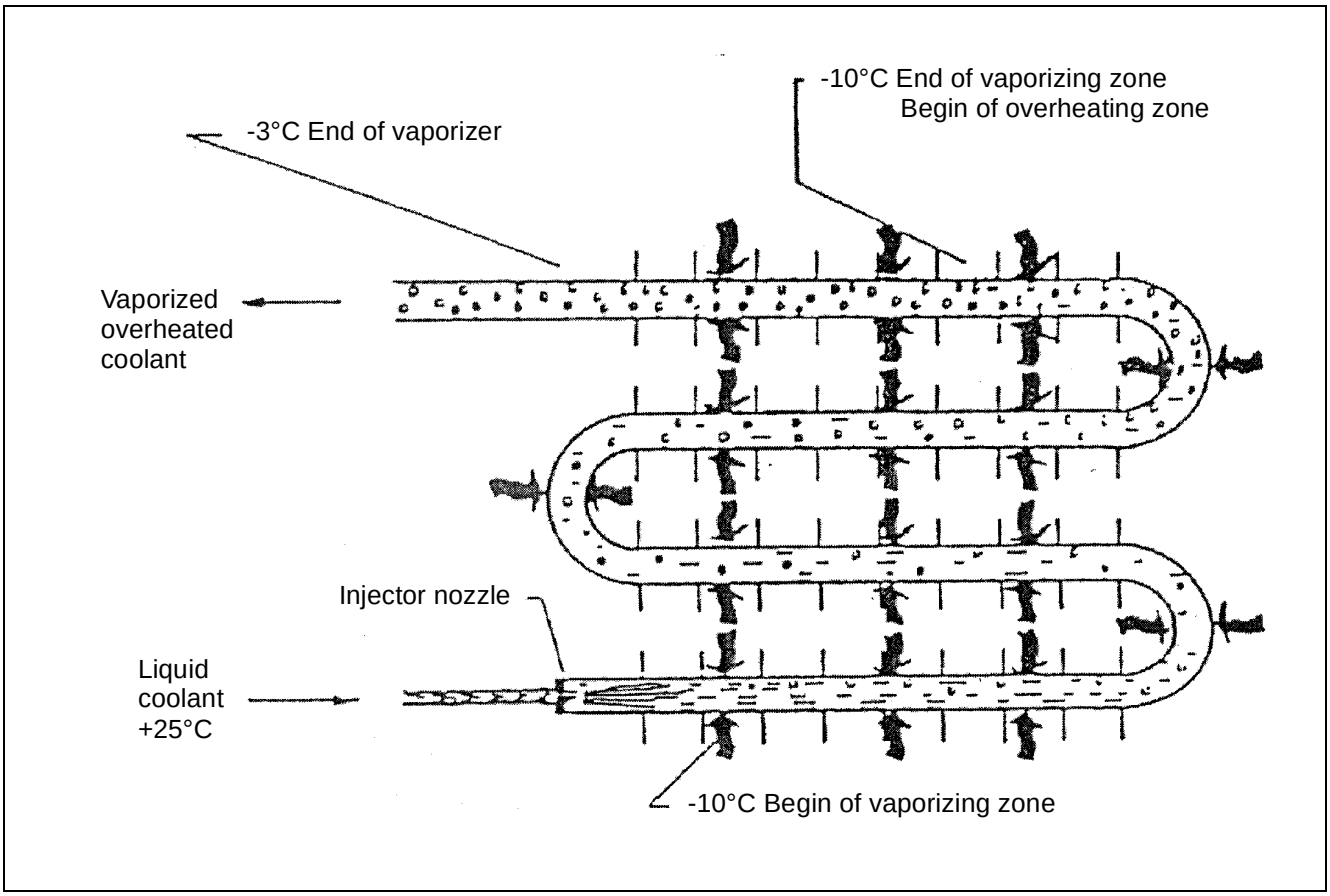
3rd zone:
The liquid coolant is cooled to below the condensation temperature, i.e. it is overcooled (overcooling zone).

The pressure (condensation pressure) is approximately constant in all three zones. The coolant leaves the condenser in a liquid state and, consequently, can be used again in the coolant circuit.



The vaporizer

Liquid coolant is sprayed into the vaporizer and converted to a gaseous state. During this process, the coolant boils in the vaporizer. The temperature of the coolant can fall well below the freezing point during boiling. The coolant adopts a very similar behaviour to boiling water in the vaporizer. The warmth which the coolant requires to evaporate is withdrawn from its environment. At the end of the vaporizing process, the coolant emerges as steam. The actual vaporizer has been lengthened in order to allow any liquid bubbles which may possibly have been carried along as a result of the turbulence time to evaporate as well. This extension is called the after-vaporizer.



There are two fundamental methods of operation for vaporizers:

- Inundated vaporizers (disc vaporizers)
- Dry expansion vaporizers (round pipe and serpentine vaporizers)

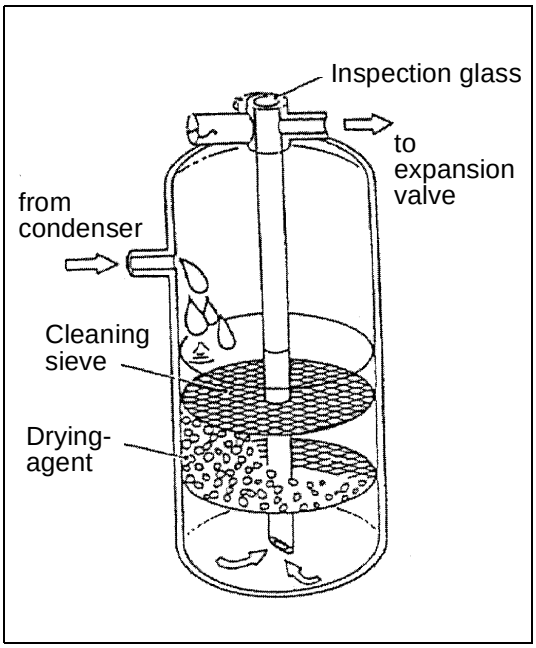
While inundated vaporizers are generally bound to upright installation and coolant flow and require special measures for ensuring oil return and avoiding cavitation, dry expansion vaporizers where overheated steam is fundamentally present at the outlet can be installed in virtually any position without any special measures having to be taken.

The filter dryer

The volume of circulating coolant varies with changing thermal load. The filter dryer contains the required quantity of coolant for this. It removes bubbles from the condensing coolant so that only liquid coolant is forwarded to the expansion valve (bubbles in the coolant reduce the performance of the air conditioning unit).

Remove moisture from the coolant.

Inspection glass allows a visual check of level of coolant in system.



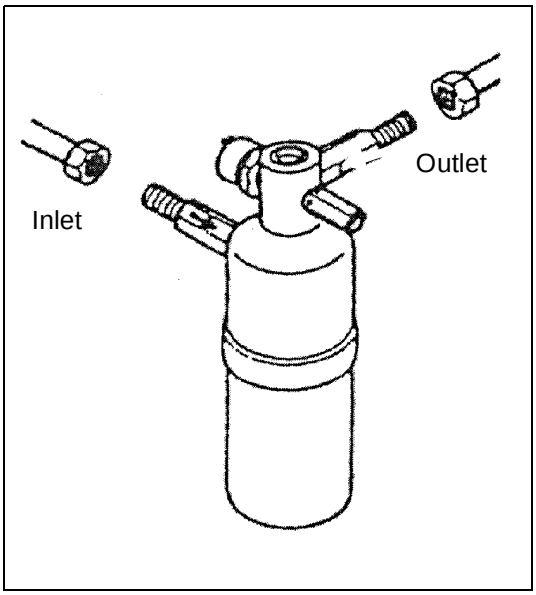
Design

The filter dryer contains a cleaning sieve, a drying agent for removing the moisture from the coolant, an inspection glass for checking the level of coolant and a pressure switch (high and low pressure) which switches the compressor off when the pressure on the high pressure side of the system is too low or too high.

Important instructions for operation

Because the drying agent in the filter dryer is very hygroscopic it immediately absorbs moisture on coming into contact with the air and loses its demoisturising property.

The drying agent cannot absorb more than approx. 6-12 g moisture. For this reason, the inlet and outlet have to be sealed tight with plugs whenever the filter dryer is removed.

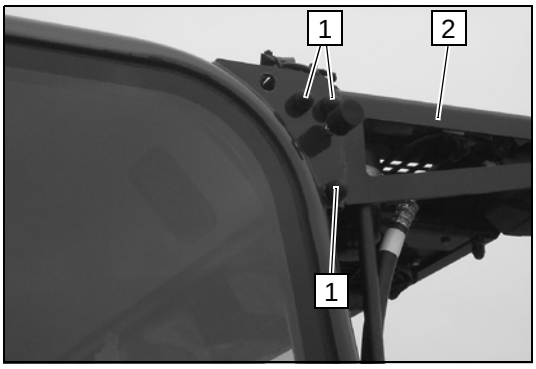


When installing the air conditioning unit in the vehicle, install all other parts and pipelines first before removing the plugs and mounting the filter dryer. Attention must be paid that the inlet and outlet are not confused. If the inlet and the outlet have the same form, the connection marked "IN" or with an arrow pointing in the direction of the housing has to be connected to the condenser side. If connected the other way round, gaseous coolant flows into the expansion valve which results in a considerable drop in the coolant performance of the system

Installation of air conditioner

Condenser/blower unit

The condenser/blower unit is fixed behind the Cab.

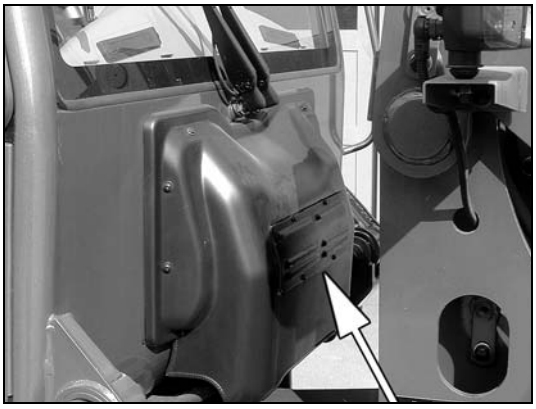


Before dismantling, the complete condenser/blower unit (2) must have its air-conditioning system drained first, all relevant hoses and cables disconnected and the unit then propped up.

1. Close the hoses and filter dryer with caps.
2. Secure the unit on frame against falling down.
3. Remove the 6 screws (1) on the left and right hand side .
4. Remove the condenser/blower unit.
5. Reinstall procedure in reverse order.
   Use new seal .

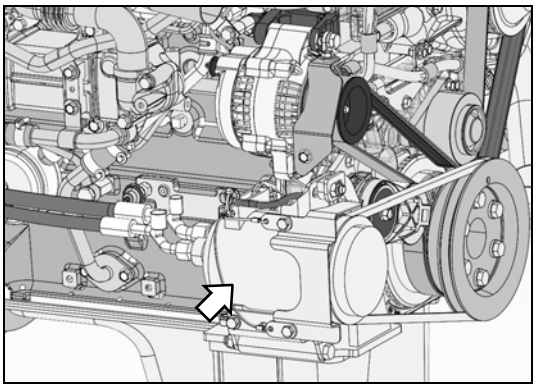
Heater/air conditioner

The heater/air conditioner is located below the cab's windshield, behind the front cover.



Compressor

The compressor is located in the engine compartment below the generator.



Safety when handling coolants

When coolant circuits are opened, the contents may escape in liquid or vapour form. The higher the pressure in the circuit, the more violently this will happen.

Wear safety goggles!

Wear safety goggles. These prevent coolant from getting into your eyes, which may cause severe frostbite damage.

Wear protective gloves!

Coolants are good solvents of greases and oils. They therefore remove the protective film of grease on contact with the skin. Degreased skin however, is sensitive to cold and disease-causing bacteria. Suitable protective gloves are an effective way of avoiding degreasing skin.

Do not get liquid coolant onto the skin!

A coolant is designed for cooling. For this purpose, it needs to evaporate. The coolant extracts the heat for evaporation from its environment, even if this is the skin, and very low temperatures are reached in the process. This leads to local freezing (frostbite).

Do not breathe in coolant vapours in high concentrations!

All coolants - even those which are liquid at room temperature - evaporate when the circuit is opened. The vapours mingle with the ambient air.

In the case of all types of coolant except for RI 1 and R113, the main risk is that they will displace the oxygen in the air which is necessary for breathing (risk of suffocation).

Ensure good ventilation!

In order to prevent occurrance of higher concentrations, workplaces must be well ventilated. The maximum working concentration must be observed.

Exhaust system!

Opening windows and doors may not be sufficient, that means an exhaust system must be installed at the point of exit if possible or close to the floor.

Do not smoke!

Coolants can decompose in the heat of a cigarette. The substances thus produced are toxic and should not be breathed in.

Do not let coolants escape during filling or repair work, but transfer to recycling containers!

If coolants are allowed to escape in closed rooms, higher concentrations can arise which poses a risk to life due to narcotic effects or lack of oxygen.

Always transfer coolants from plants in need of repair into recycling containers for temporary storage and, after the repair work, refill into the plant or return to the dealer.

If high concentrations of coolant are present in the air, use respiratory equipment which is independent of the ambient atmosphere!

Filter masks with breathing filter A (solvents) can only remove coolant vapours to a small extent. They may only be used if the concentration does not exceed 0.5 % vol. (see respiratory equipment specifications). If the concentration is too high, there is a risk of suffocation particularly in pits and shafts, since coolant vapours are heavier than air. In case of doubt, always use respiratory equipment which is independent of the ambient atmosphere.

Before carrying out welding and soldering work on cooling systems, remove coolant from the relevant section of the plant and eliminate residue by blowing through with air or nitrogen!

Decomposition products generated from the coolant are not only toxic but also have a strongly corrosive effect, so that pipelines and parts of the plant may be attacked.

Pungent odour indicates decomposition of the coolant due to overheating: Leave room immediately, ventilate well or use filter mask with breathing filter B (acidic gases)!

If a pungent odour occurs, the above mentioned decomposition products have already been generated. These substances should not be breathed in under any circumstances, as this can damage the respiratory channels, lungs and other organs. A filter mask with breathing filter B (acidic gases) provides effective protection against these decomposition products. Observe the instructions for use!

First aid

1. In the event of contact with the eyes or mucous membranes, rinse out immediately with plenty of running water and consult an eye specialist.

2. In the event of contact with the skin, remove wet clothing immediately and rinse affected area of skin with plenty of water.

3. If coolant vapours are breathed in in higher concentrations, get the affected person into the fresh air immediately. Summon a doctor. Administer oxygen in the event of breathing problems. If the affected person can no longer breathe or cannot breathe properly, bend head to back of the neck and resuscitate.

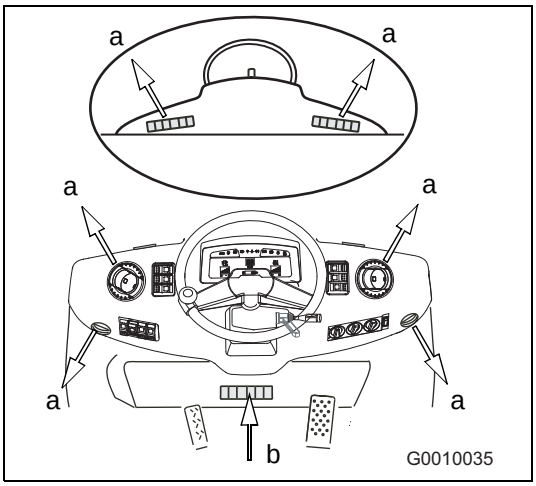
4. **Information for the doctor:**
   Higher concentrations of coolants can lead to a restriction or loss of consciousness. Since coolants make the heart sensitive to catecholamine, no adrenomimetics should be administered. A lung oedema can occur even after an indefinite latent period if decomposition products have been inhaled.

Operating the air conditioner

NOTE
Only use the air conditioner when the engine is running. Let the air conditioner run for about 10 minutes every month to prevent the compressor shaft seal from drying out.
Do not let the air conditioner run for an extended period of time at low engine speeds to prevent the battery from discharging.

Keep the cab doors and windows closed when the engine is running.

If the machine was exposed to strong sunlight for an extended period of time, it is recommended to air the cab thoroughly when starting the machine and turning on the air conditioner.



Turning on the air conditioner

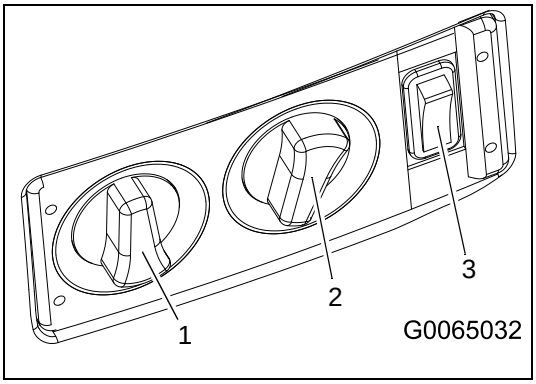
1. Open all air intake nozzles (b), if equipped.

   a = Air outlet nozzles
   b = Air intake nozzles

NOTE
If the air intake nozzles are closed (b), the cooling capacity decreases.

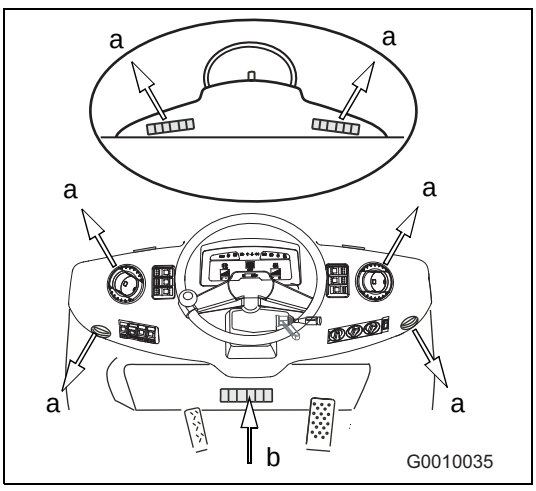
2. Turn the fan switch (1) to position '4'.
3. Turn the temperature control switch (2) to 'cold'.
4. Activate the air conditioner switch (3).

   The air conditioner is now on. This setting achieves the greatest cooling effect, especially if the engine is running at high speed.



5. Turn the fan switch (1) back one position when the desired temperature has been reached.
6. Use the temperature dial for further adjustment.
7. The air is distributed by means of air outlet nozzles (a).

   - You can open and close all air outlet nozzles (a) individually.
   - The airflow may be directed with the diffuser discs.
   - The upper, round air outlet nozzles (a) can be directed at the windscreen and at the side windows.



Maintenance of the air conditioner

Maintenance timetable	
VISUAL INSPECTION (once a month)	
Drive belts	Tension, condition
Compressor	Leaks, unusual noises
Magnetic clutch	Function
Condenser	Damage, dirt
Condensation outlet underneath the vaporizer	Dirt, blockages
Coolant	Filling level in inspection glass
FUNCTIONAL TESTS (once a year)	
High pressure, low pressure	High pressure:Low pressure:
Emission temperature at air vents	At maximum output:
Compressor control	ON and OFF switching points
Condenser fan	Rotational direction, noises
Air distribution, air circulation system	Emission, control
Magnetic clutch	Dirt, oil soiling
EXCHANGE (every 2 years)	
Replace filter dryer, suck off coolant, dispose in an environmentally safe manner and fill the system with new coolant.	

Maintenance instructions

- Always disconnect the battery if parts of the air conditioning system are to be removed.
- Keep the system free of moisture and dust.
- Always seal cable glands immediately with cap plugs when disconnecting cables.
- Only remove plugs or caps just before reconnecting cables or lines.
- Apply a few drops of low temperature oil to the contact surface of the O-ring or cone nut before connecting a hose or line.
- Always use two spanners when tightening a connection in order to prevent it from twisting.
- A disposal unit must be connected when draining the cooling section of the system.

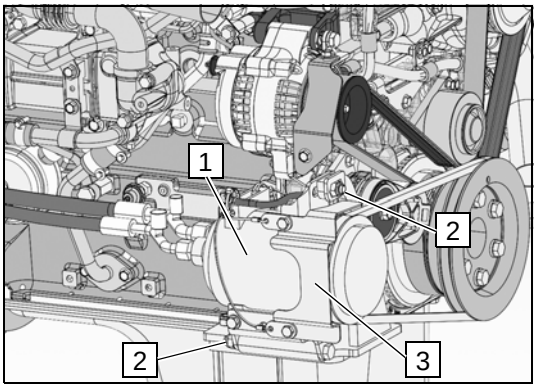
Regular maintenance

Check the air-conditioning system twice a year, in spring and autumn.

The air conditioning system must be switched on at least once a month for a brief time (approx. 10 min) so that the compressor is lubricated.

The following maintenance work must be carried out at the beginning, middle and end of a cooling period:

Check V-belt tension and compressor fastening.



1. Compressor
2. Fixing screw
3. Cover for Tension Pulley

Check coolant level, See chapter 10 STRUCTURE AND FUNCTION "Checking coolant level" on page 10-122.

NOTE
The coolant must flow through the filter dryer's inspection glass free of bubbles with the engine running and air conditioner at maximum output (max. blower setting, top idling speed, setting "cold").

Clean the condenser

The fins of the condenser must not be operating at excessive pressure as this could deform the fins and reduce the cooling output. Clean the condenser with cold water.

Clean filter fleece of heater unit

NOTE
If the filter fleece is to dirty it must be replaced.

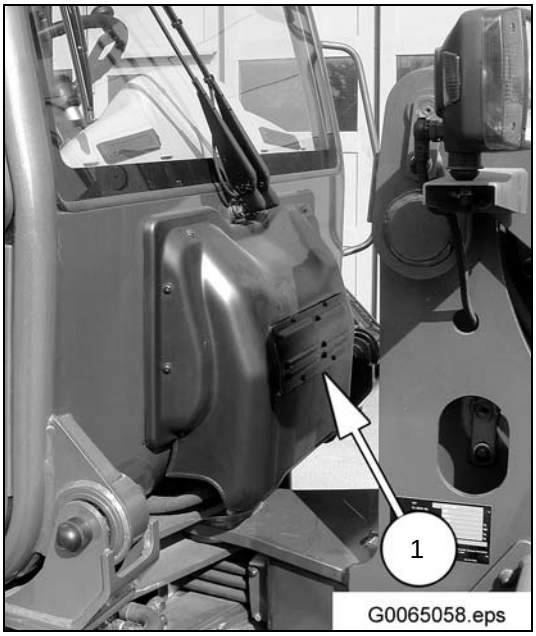
1. Remove screws on the front cover (1) on the driver's cab (4 screws).
2. Withdraw filter (2) from the heater unit (3).
3. Clean the filter in warm water (30 - 40°C) which has had a little household cleaning solvent added to it.

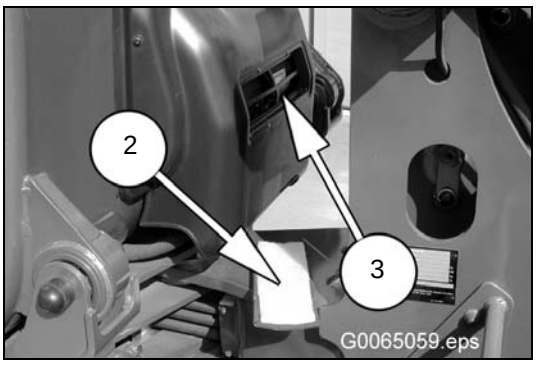
CAUTION! Neither rub the filter fleece nor wring it out!

4. Allow the filter fleece to dry.
5. Insert dried filter fleece (2) back into the heater unit (3).
6. Switch on the blower and check the air flow at the air outlet nozzles.

CAUTION! The circulating air jets must be open!

7. If the air flow is still too weak the filter fleece must be replaced.
8. Screw front cover (1) back on.





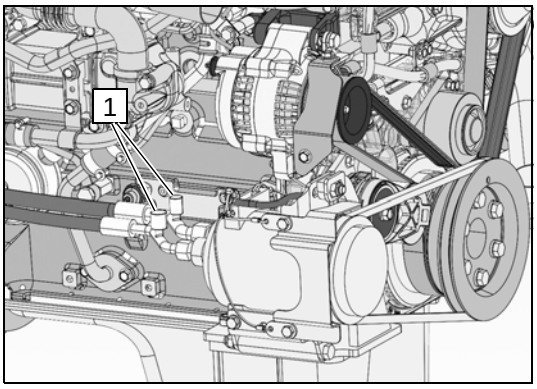
Instructions for filling

Filling the air conditioning system should only be carried out by a specialist for air conditioning systems.

For this reason, only a few instructions are provided here for filling the air conditioning systems installed in WA-6 models.

Use only original-coolant R134a and original PAG oil.

1. Drain valve and Filling valve



- **Mixing with other coolants or oils can result in the destruction of the air conditioning system.**
- **The valves on the testing manometer should be closed (manometer valves turned clockwise) when fastening the snap-fit connectors to the system. The central valve connection for selecting vacuum pump or filling canister connection is therefore closed.**
- **An ambient temperature of at least 20°C (room/air) is required for a correct evacuation.**

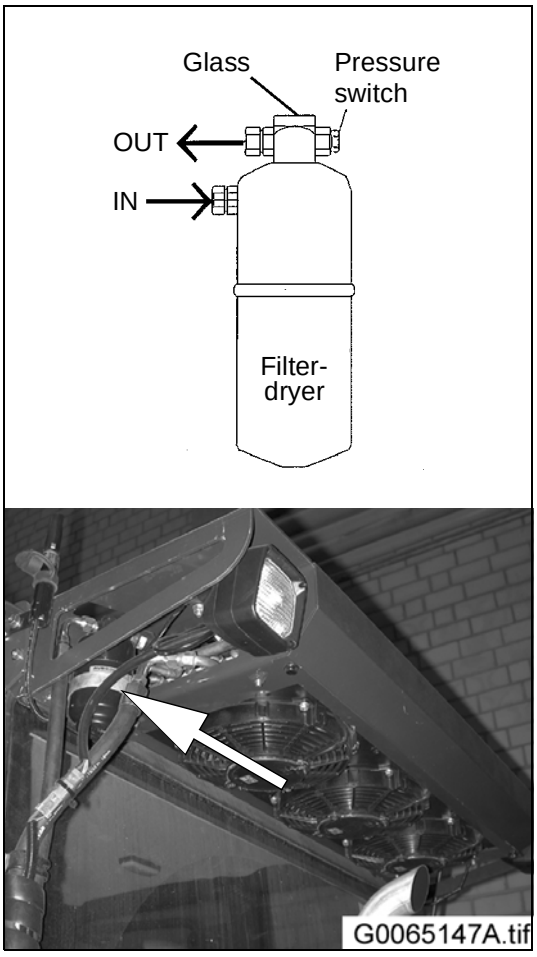
Filling

- Set prescribed quantity on fill unit or weigh.
- Commence filling.
- Start engine.
- Check on inspection glass of filter dryer.

NOTE
The filling is OK when the coolant flows without bubbles. See chapter 10 STRUCTURE AND FUNCTION "Checking coolant level" on page 10-122.

Filling quantities (R134a)

WA80-7	1200 g
WA100M-7	1200 g



Evacuation

- Connect ball valves
- Set vacuum meter to 100 mbar
- Evacuate, min. 45 minutes
- Stop the evacuation process when the vacuum meter approaches the 0-bar marking.

Vacuum test

- Check the vacuum meter after 10 minutes for pressure increase

A pressure increase is not permitted.

- In the event of pressure increase:
  - Fill system with approx. 200 g
  - Look for leakage points using leak finder
  - Repair leaks
  - Start siphoning off.
- No pressure rise:
  - Fill system

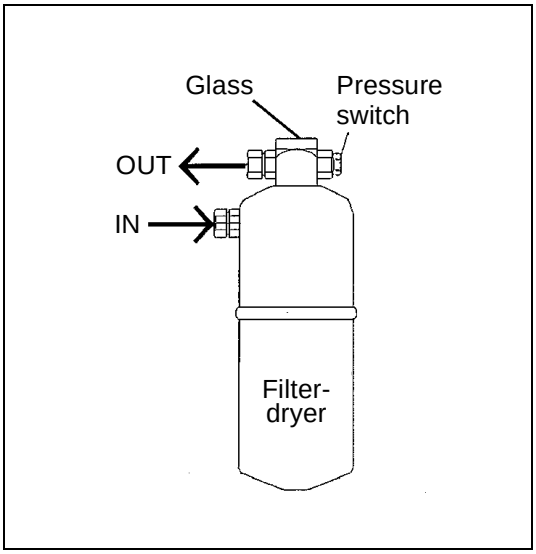
Siphoning off coolant

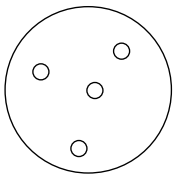
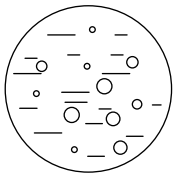
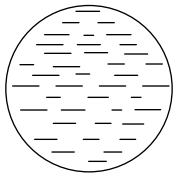
- Close ball valves.
- Siphon off coolant into a measuring container; a certain amount of compressor oil will also be siphoned off at the same time.
- The same amount of compressor oil as was siphoned off with the coolant must be replaced with new compressor oil.
- Extracted coolant and compressor oil must be disposed of in accordance with regulations.
- The siphon pressure gauge must indicate slight over-pressure before opening the drain valve in order to avoid any air being sucked in.

Checking coolant level

If the liquid gets into your eyes or on your hands, it may cause loss of sight or frostbite.

- Run the air conditioning system at maximum output for 5 - 10 minutes.
- Check the flow of coolant (R134a) through the inspection glass for correct level of coolant.



Color condition	Normal	Abnormal	
Temperature of high and low pressures pipes	High pressure pipe is hot. Low pressure pipe is cold. Clear difference in temperature.	High pressure pipe is warm. Low pressure pipe is cold. Little difference in temperature.	Almost no difference in temperature between high and low pressure pipes.
Sight glass	Almost transparent. All bubbles disappear if the engine speed is increased or reduced. 	Bubbles are always visible. Sometimes becomes transparent, or white bubbles appear. 	Opaque substance is visible in the fluid. 
Pipe connections	Properly connected.	Some parts contaminated with oil.	Some parts heavily stained with oil.
General conditions of cooler	Coolant level correct, no abnormalities. Ready for use.	There may be a leak somewhere. Call service repair shop for inspection.	Almost all coolant has leaked out. Contact service repair shop immediately.

Checking the compressor oil level

Check, top up or change if:

- Compressor, vaporizer, condenser or drier have to be changed.
- Coolant leaks from coolant circuit.
- Problems occur with the oil in the coolant circuit.
- The connectors from compressor or dryer was opened.

Compressor oil change

1. Remove compressor from the vehicle.
2. Drain the oil into a measuring beaker.

   After the oil has flown out through the line, drain off any residual oil at the drain outlet by turning several times by hand.
3. After the oil has flown out through the line, drain off any residual oil at the drain outlet by turning several times by hand.
4. Screw in drain plug with new washer and tighten.

   M_A = **13 - 15 Nm**
5. Fill up with new compressor oil to same amount as measured quantity of drained oil.

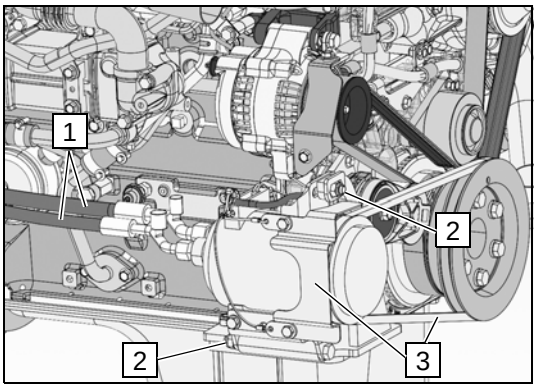
Exchange of magnetic clutch

If the magnetic clutch is faulty:

- Remove compressor
- Remove old clutch from compressor
- Connect new clutch to compressor
- Install compressor
- Switch on air conditioning system
- Operate compressor in neutral
- Switch air conditioning on for 10 seconds and off for 10 seconds at least 10 times, check function of new clutch while doing so.

Exchange of compressor

- Drain off coolant and dispose it in accordance with regulations.
- Remount the hoses (1) and close them with caps.
- Loosen the srews (2) on the compressor.
- Remove the protecting cover and belt.
- Remount the compressor.



Installing of a new compressor

NOTE
The new compressor is filled with 180 cm³ PAG oil and nitrogen gas (N_2).

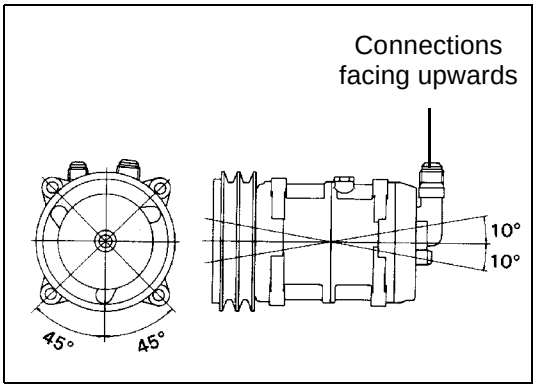
1. Loosen the discharge side connector's cap, release the nitrogen gas (N_2) from the compressor gently, close the connectors immediately.

No compressor oil should escape!

2. Rotate the compressor several times by hand to distribute the oil.
3. Replace the compressor under compliance of the ranges shown in the figure above. Adjust the clearance using the specified shims.
4. Remove the cabs and connect the hoses immediately.

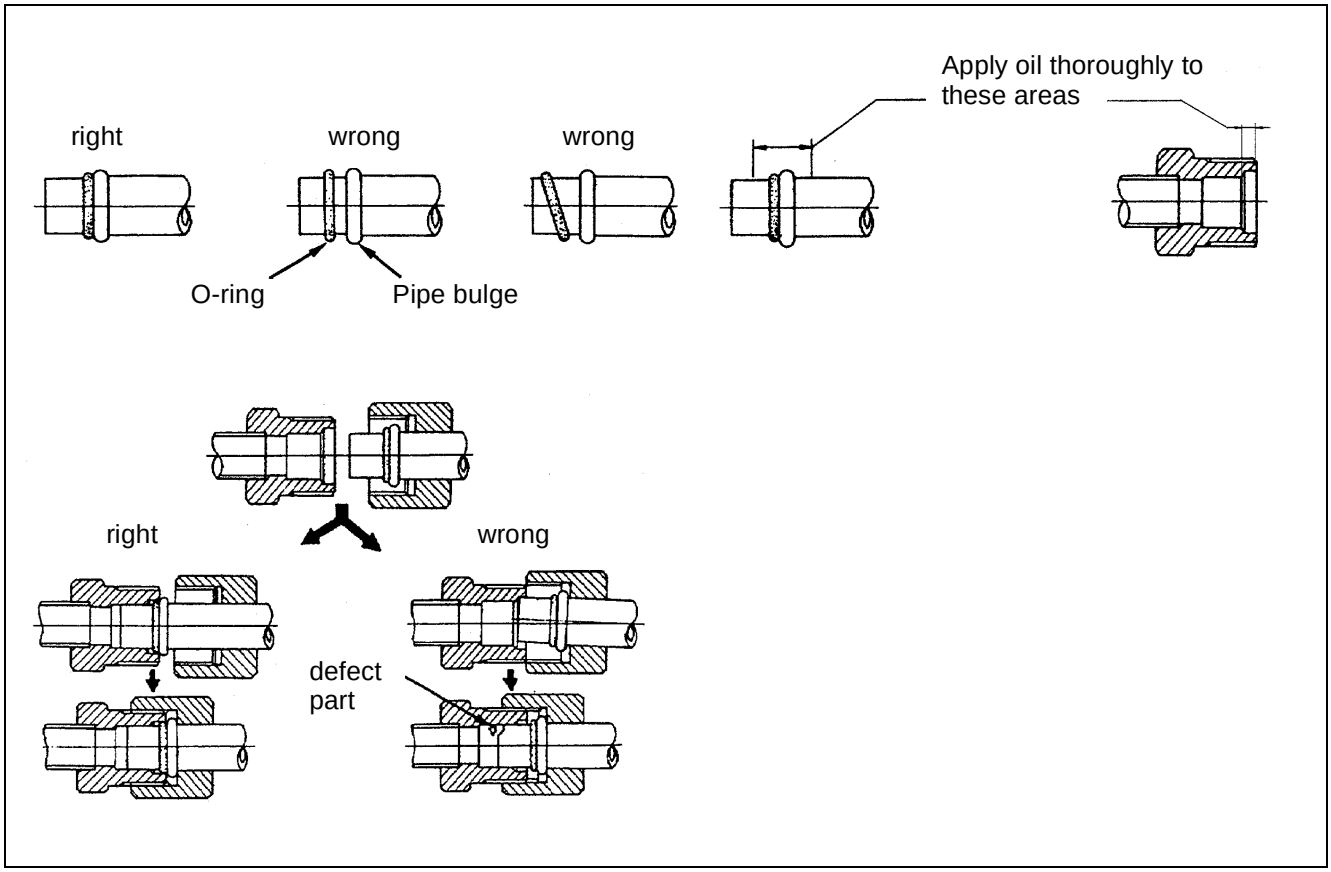
The PAG oil is highly hygroscopic. Single components must therefore be closed until they are installed.

5. Filling (See chapter 10 STRUCTURE AND FUNCTION "Instructions for filling" on page 10-120.



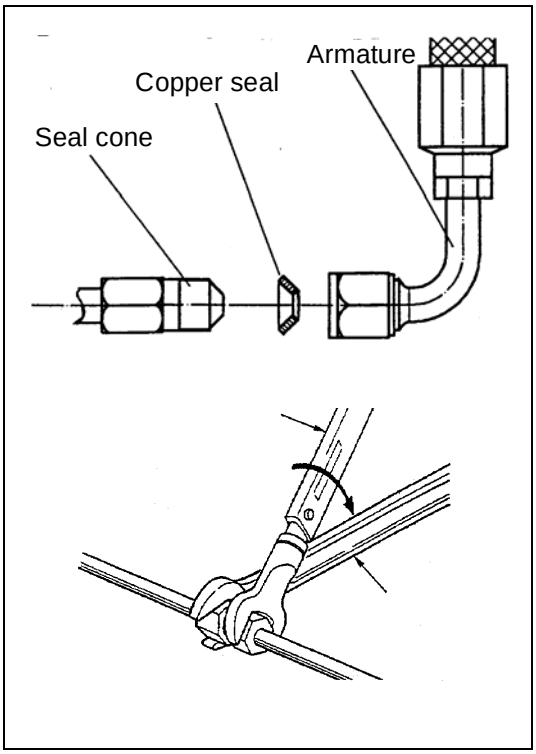
Service operations

Fit the nuts and unions tightly against the base of the companion pieces, then hand tighten the nut as much as possible to prevent cross-threading.



Cone packing connections

- Fit the nuts and unions tightly against the base of the companion pieces, then hand tighten the nut as much as possible to prevent cross-threading.
- Always use a back-up wrench and tighten fittings to the specified torque. The torque wrench should be used on the fitting which is being tightened.



Troubleshooting

Checks prior to trouble shooting:

- Check belt tension
- Check condenser
- Check condenser blower, rotation direction right
- Compressor switches on and off
- Compressor clutch OK
- Function of air vents OK
- Coolant level OK (inspection glass)
- Condensation drain away
- Air temperature OK

Fault	Cause	Remedy
Low pressure too high High pressure too high	• System too full • Condenser is dirty or blocked • Blower faulty or wrong rotational direction	• Check filling level • Clean condenser or replace • Repair blower or replace
Low pressure too low High pressure too high	• Dryer blockes • Faulty expansion valve • Compressor faulty	• Replace dryer • Replace expansion valve • Replace compressor
Low and high pressure the same	• Compressor faulty	• Check drive belt - belt pulley - magnetic clutch, if all correct, proceed as for "Compressor does not switch on"
Low pressure too low High pressure normal	• Faulty expansion valve • Dirty or blockes vaporizer	• Replace expansion valve • Clean or replace vaporizer
Low pressure too low High pressure too low	• Expansion valve faulty • Not enough coolant • Insufficient cooling effect only for short time; water in system, expansion valve iced up as a result • Dryer or expansion valve partially blocked • Vaporizer iced up • Thermoswitch not working	• Replace expansion valve • Refill air conditioning system • Evacuate system, replace dryer • Replace dryer or expansion valve • Check the ON and OFF times of the compressor • Adjust or replace the thermoswitch
Compressor switches on and off at speed	• Loose contact in the electric system • Coolant pressure too high	• Check electrical system (air conditioner switch, thermostat) • Check air conditioning system pressure and refill if necessary
Compressor constantly running as well	• Thermostat not working	• Check whether sensor lead has been pushed into the vaporizer correctly • Check wether the sensor lead is okay • Adjust or replace thermostat
Compressor does not switch on	• Not enough coolant in system • Air conditioning system power supply interrupted	• Check air conditioning system pressure and refill if necessary • Check electrical system
Condenser fan not working	• Fault in the electrical system • Fan faulty	• Check electrical system • Repair fan or replace

Fault	Cause	Remedy
System leaking	• O-ring connection leaking • Compressor shaft seal leaking • Hose/line leaking	• Check pipe and line connections • Check pipes and lines • Check whether magnetic clutch belt pulley is oily
Cooling output too low	• Vaporizer iced up	• Check whether sensor lead has been pushed into the vaporizer correctly • Check whether the sensor lead is okay • Adjust or replace thermostat
Cooling output drops after a while	• Compressor not switching off • Thermostat not working	• Check whether compressor switches on and off • Check whether sensor lead has been pushed into the vaporizer correctly • Check whether the sensor lead is okay • Adjust or replace thermostat
Air conditioning system not working	• Power supply interrupted • Not enough coolant in the system • Magnetic clutch faulty	• Check electrical system • Check filling level • Check magnetic clutch, replace if necessary
White smoke emerging from the air vents	• Vaporizer iced up • Thermostat set too cold	• Check whether compressor switches on and off • Check whether sensor lead has been pushed into the vaporizer correctly • Check whether the sensor lead is okay • Adjust or replace thermostat
Windows fogged up	• Circulating air flaps not working or not working properly • Condensation unable to drain away	• Check whether the circulating air system is working properly • Check that the condensation drain hose is not blocked and is correctly laid
Bad smell coming from air conditioning system	• Condensation not draining away	• Check that the condensation drain hose is not blocked and is correctly laid.

20 TESTING AND ADJUSTING

★ For more details of testing and adjusting of the engine, see Engine Manual in attachment.

• When using the standard value table to make judgement for testing, adjusting, and troubleshooting the following precautions are necessary.

1. The standard values in the table 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 and tear after the machine has been operated, and when carrying out repairs.

2. The permissible values given in the table are values estimated based on the results of various tests carried out on machines shipped from the factory. They should be used together with other information such as repair conditions or 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 other workers, always use signals and do not let unauthorized people near the machine.**
- **When checking the water level, always wait for the water to cool down. If the radiator cap is removed while the water is still hot, the water will spurt out and cause burns.**
- **Be careful not to get caught in the fan, fan belt, or other rotating parts.**

Standard value table for engine

WA80M-7 - Standard value table for engine

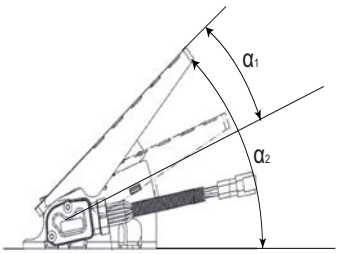
Engine model				SAA4D9SLE-6	
Applicable machine tmodel				WA80M-7	
Item	**Measurement conditions**		**Unit**	**Standard value**	**Permissible value**
Engine speed	Coolant temperature: 75 to 94°C	High idle RPM Low idle RPM	min^{-1}	2,520 ± 50 900±25	2,520 ± 50 900±25
Exhaust gas temperature	Whole speed range (20°C)		°C	Max. 650	Max. 700
Exhaust gas color	Coolant temperature: 75 to 94°C After kept for 5 secounds at normal condition	Exhaust pipe outlet	Bosch index	Max. 0.5	Max. 2.0
Valve clearance (cold or hot)	Intake valve Exhaust valve		mm	0.35 0.50	– –
Compression pressure	Oil temperature: 40 - 60°C (engine speed:200 to 250 rpm)		MPa	Min. 2.9	Min. 2.0
Blow by pressure	At rated horsepower (when KCCV is disconnected)		kPa	Max. 0.98	Max. 1.47
Oil pressure	Oil temperature: min. 80°C At high idle RPM At low idle RPM	EOS5W30-LA EOS5W40-LA EO10W30-LA EO15W40-LA	MPa	 0.29 to 0.69 Min. 0.15	 Min. 0.21 Min. 0.13
Oil temperature	Whole speed range (in oil pan) Min. Max.		°C	 90 110	 Max. 120
Oil consumption	At continuous rated horsepower Ratio to fuel consumption		%	Max. 0.15	Max. 0.3
Fuel injection system				High-pres sure common rail type	
Fuel injection system control				Electronic control system	
Fan belt tension	Deflection when pressed with finger force of approx. 10 kg		mm	Automatic adjustment (auto-tensioner)	Automatic adjustment (auto-tensioner)

WA100M-7 - Standard value table for engine

Engine model				SAA4D95LE-6	
Applicable machine tmodel				WA100M-7	
Item	**Measurement conditions**		**Unit**	**Standard value**	**Permissible value**
Engine speed	Coolant temperature: 75 to 94°C	High idle RPM Low idle RPM	min^{-1}	2,650±50 900±25	2,650±50 900±25
Exhaust gas temperature	Whole speed range (20°C)		°C	Max. 650	Max. 700
Exhaust gas color	Coolant temperature: 75 to 94°C After kept for 5 secounds at normal condition	Exhaust pipe outlet	Bosch index	Max. 0.5	Max. 2.0
Valve clearance (cold or hot)	Intake valve Exhaust valve		mm	0.35 0.50	– –
Compression pressure	Oil temperature: 40 - 60°C (engine speed:200 to 250 rpm)		MPa	Min. 2.9	Min. 2.0
Blow by pressure	At rated horsepower (when KCCV is disconnected)		kPa	Max. 0.98	Max. 1.47
Oil pressure	Oil temperature: min. 80°C At high idle RPM At low idle RPM	EOS5W30-LA EOS5W40-LA EO10W30-LA EO15W40-LA	MPa	 0.29 to 0.69 Min. 0.15	 Min. 0.21 Min. 0.13
Oil temperature	Whole speed range (in oil pan) Min. Max.		°C	 90 110	 Max. 120
Oil consumption	At continuous rated horsepower Ratio to fuel consumption		%	Max. 0.15	Max. 0.3
Fuel injection system				High-pres sure common rail type	
Fuel injection system control				Electronic control system	
Fan belt tension	Deflection when pressed with finger force of approx. 10 kg		mm	Automatic adjustment (auto-tensioner)	Automatic adjustment (auto-tensioner)

Standard value table for chassis

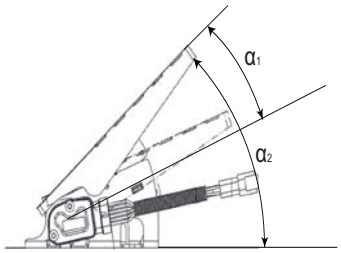
WA80M-7 - Standard value table for chassis

Cat.	Item	Measurement conditions	Unit	Standard value	Permissible value
Engine	Hydrostatic stall	• Engine water temperature green range • Hydraulic oil temperature: 50 - 60°C	RPM	2400 - 2500	–
	Hydrostatic and hydraulic stall			2300 - 2400	–
Accelerator pedal	Operating force		N (kg)	270-275	–
	Operating angle α		° (degree)	α_1=20 α_2=40	–
Steering wheel	Play	• Engine stopped • Machine facing straight to front	mm	0 - 40	–
	Operating force Emergency steering force	• Flat, even, straight, dry paved road surface • Hydraulic oil temperature: 50 - 60°C	N	175 350	–
	Steering time (block - block) at low idle RPM at rated speed		s	 LH: 4.4 RH: 5.5 LH: 2.5 RH: 2.6	 – –
Orbit-roll	Steering pressure	• Engine speed: rated speed • Hydraulic oil temperature: 50 - 60°C	bar	175 ± 5	–

Standard value table for chassis – WA80M-7

Cat.	Item		Measurement conditions	Unit	Standard value	Permissible value
Brake	Performance		• Flat, straight, dry paved road surface • Speed when applying brake, max. speed, 2nd travel range	m	Max. 5	Max. 5
Parking brake	Performance		• Tire inflation pressure: specified pressure • Flat, paved road with 18° gradient • Dry road surface • Machine at operating condition	–	Stopped	–
Work equipment control lever	Operating force	Tilt	• Engine speed: low idle RPM • Hydraulic oil temperature: 50 - 60°C • Operating force up to point of pressure	N	24.3	–
		Dump			24.9	–
	Boom	Lift		N	24.3	–
		Lower			29.3	–
Main control valve	Work equipment hydraulic		• Engine speed: rated speed • Hydraulic oil temperature: 50 - 60°C	bar	270 - 275	-
Servo valve	Servo pressure				26 - 30	–
Work equipment	Work equipment speed	Raising time	• Engine speed: rated speed • Hydraulic oil temperature: 50 - 60°C • Orbit-roll: neutral • Empty bucket	s	4.6 - 5.2	
		Lowering time			2.8 - 3.8	
		Dump time (top)			0.8 - 1.4	
		Rollback time (ground)			0.7 - 1.3	
	Hydraulic drift	Lift cylinder	• Bucket no load • Lift arm and bucket in level position • Stop engine and leave for 5 minutes, then measuring for 15 minutes.	mm/ 15 min.	Max. 15	Max. 20
		Bucket cylinder			Max. 15	Max. 20

WA100M-7 - Standard value table for chassis

Cat.	Item	Measurement conditions	Unit	Standard value	Permissible value
Engine	Hydrostatic stall	• Engine water temperature green range • Hydraulic oil temperature: 50 - 60°C	RPM	2400 - 2500	–
	Hydrostatic and hydraulic stall			2350 - 2450	–
Accelerator pedal	Operating force		N (kg)	270 - 275	–
	Operating angle α1 α2		° (degree)	α_1=20 α_2=40	–
Steering wheel	Play	• Engine stopped • Machine facing straight to front	mm	0 - 40	–
	Operating force Emergency steering force	• Flat, even, straight, dry paved road surface • Hydraulic oil temperature: 50 - 60°C	N	175 350	–
	Steering time (block - block) at low idle RPM at rated speed		s	 LH: 4.3 RH: 4.3 LH: 2.3 RH: 2.3	 – –
Orbit-roll	Steering pressure	• Engine speed: rated speed • Hydraulic oil temperature: 50 - 60°C	bar	170 - 180	–

Standard value table for chassis – WA100M-7

Cat.	Item		Measurement conditions	Unit	Standard value	Permissible value
Brake	Performance		• Flat, straight, dry paved road surface • Speed when applying brake, max. speed, 2nd travel range	m	Max. 5	Max. 5
Parking brake	Performance		• Tire inflation pressure: specified pressure • Flat, paved road with 18° gradient • Dry road surface • Machine at operating condition	–	Stopped	–
Work equipment control lever	Operating force	Tilt	• Engine speed: low idle RPM • Hydraulic oil temperature: 50 - 60°C • Operating force up to point of pressure	N	9.0	–
		Dump			9.0	–
	Boom	Lift		N	7.0	–
		Lower			7.0	–
Main control valve	Work equipment hydraulic		• Engine speed: rated speed • Hydraulic oil temperature: 50 - 60°C	bar	270 - 275	-
Servo valve	Servo pressure				26 -30	–
Work equipment	Work equipment speed	Raising time	• Engine speed: rated speed • Hydraulic oil temperature: 50 - 60°C • Orbit-roll: neutral • Empty bucket	s	4.8 - 5.4	
		Lowering time			3.0 - 4.0	
		Dump time (top)			1.3 - 1.9	
		Rollback time (ground)			0.7 - 1.3	
	Hydraulic drift	Lift cylinder	• Bucket no load • Lift arm and bucket in level position • Stop engine and leave for 5 minutes, then measuring for 15 minutes.	mm/ 15 min.	Max. 15	Max. 20
		Bucket cylinder			Max. 15	Max. 20

Standard value table for electrical parts

Name of component	Machine	Insp. method	Judgement table			Measurement conditions
Engine oil pressure sensor		Check continuity	If the condition is as shown in the table below, the sensor is normal. Oil pressure above 0.7 bar Oil pressure below 0.3 bar		no continuity continuity	Start engine. Disconnect connectors.
Fuel level sensor	WA80M-7 WA100M-7	Measure resistance	If the condition is as shown in the table below, the sensor is normal. Full Empty		ca. 3 Ω ca. 180Ω	Turn starting switch OFF.
Engine coolant temperature sensor		Measure resistance	If the condition is as shown in the table below, the sensor is normal. Temperature normal(25°C) 100°C		ca. 2.0 kΩ ca. 3.35 kΩ	Turn starting switch OFF.
Brake oil reservoir		Check continuity	Full Empty		open continuity	Turn starting switch OFF.
Ribbon heater temperature sender unit		Measure resistance	If the condition is as shown in the table below, the sensor is normal. Temp. normal (25°C) 0°C	Between connection and chassis	ca. 2.0 kΩ ca. 1.63 kΩ	Turn starting switch OFF.

Test certificate

WA80M-7 - Test certificate

Chassis Nº:			**Customer:**		
Test temperatures				Target	**Value**
	1	Cooling water	°C	80±5	
	2	Hydraulic oil (drive and working hydraulic, measured in the hydraulic oil tank)		40±5	
Engine speed				Target	**Value**
	3	Low idle speed	U/min	900±25	
	4	High idle speed		2520±50	
	5	Engine speed hydrostat full stall (oil temperature: min.55°c)		2450±50	
	6	Engine speed working hydraulic+hydrostat full stall		2350±50	
	7	Start of drive RPM		1100±50	
System pressures				Target	**Value**
★	8	Work hydraulic pressure	bar	270+5	
★	9	Steering hydraulic pressure		175±5	
	10	Feed pressure (low idle speed and test temperature)		min. 26	
	11	Feed pressure (high idle speed and test temperature)		max. 30	
★	12	Pressure (absolut) machine is full braked forward		455±5	
★	13	Pressure (absolut) machine is full braked backward		455±5	
Steering cycle times			sec	Target	**Value**
	14	Low idle speed, left and right (end to end)		LH: 4.4 RH: 5.5	
★	15	Rated idle speed, left and right (end to end)		LH: 2.5 RH: 2.6	
Lift and tilt times				Target	**Value**
★	16	Raising time with empty bucket		4.9±0.3	
★	17	Dump time of bucket on full raised position		1.1±0.3	
★	18	Roll back time from ground level of bucket to bucket stopper		1.0±0.3	
Lower times				Target	**Value**
★	19	Lowering time from full raised position to ground level of bucket		3.3±0.5	
★	20	Lowering time from full raised position to ground level of bucket joystick in float position		4.2±0.5	
Travel speeds			km/h	Target	**Value**
	21	1. drive range: 20 km/h (Tires 405/70R18)		0 - 4.5±1	
	22	2. drive range: 20 km/h (Tires 405/70R18)		0 - 20±1	
	23	1. drive range: 20 km/h (Tires 405/70R18)		0 - 8.5±1	
	24	2. drive range: 30 km/h (Tires 405/70R18)		0 - 30±1	
★	23	Fan speed 20 km/h version	U/min	1.ST: 1400±25 2.ST: 2000±25	
★	24	Fan speed 30 km/h version			

All measurements and setups has to do at operation temperature of machine!

★ Measurements with maximum engine speed!

WA100M-7 - Test certificate

Chassis Nº:			**Customer:**		
Test temperatures				Target	**Value**
	1	Cooling water	°C	80±5	
	2	Hydraulic oil (drive and working hydraulic, measured in the hydraulic oil tank)		40±5	
Engine speed				Target	**Value**
	3	Low idle speed		900±25	
	4	High idle speed		2650±50	
	5	Engine speed hydrostat full stall (oil temperature: min.55°c)	U/min	2450±50	
	6	Engine speed working hydraulic+hydrostat full stall		2400±50	
	7	Start of drive RPM		1100±50	
System pressures				Target	**Value**
★	8	Work hydraulic pressure		270+5	
★	9	Steering hydraulic pressure		175±5	
	10	Feed pressure (low idle speed and test temperature)	bar	min. 26	
	11	Feed pressure (high idle speed and test temperature)		max. 30	
★	12	Pressure (absolut) machine is full braked forward		455±5	
★	13	Pressure (absolut) machine is full braked backward		455±5	
Steering cycle times				Target	**Value**
	14	Low idle speed, left and right (end to end)		LH: 4.3 RH: 4.3	
★	15	Rated idle speed, left and right (end to end)		LH: 2.3 RH: 2.3	
Lift and tilt times				Target	**Value**
★	16	Raising time with empty bucket	sec	5.1±0.3	
★	17	Dump time of bucket on full raised position		1.6±0.3	
★	18	Roll back time from ground level of bucket to bucket stopper		1.0±0.3	
Lower times				Target	**Value**
★	19	Lowering time from full raised position to ground level of bucket		3.5±0.5	
★	20	Lowering time from full raised position to ground level of bucket joystick in float position		5.0±0.5	
Travel speeds				Target	**Value**
	21	1. drive range: 20 km/h (Tires 455/70R20)		0 - 4.8±1	
	22	2. drive range: 20 km/h (Tires 455/70R20)	km/h	0 - 19±1	
	23	1. drive range: 30 km/h (Tires 455/70R20)		0 - 6.6±1	
	24	2. drive range: 30 km/h (Tires 455/70R20)		0 - 29±1	
★	23	Fan speed 20 km/h version	U/min	1.ST: 1400±25 2.ST: 2000±25	
★	24	Fan speed 30 km/h version			

All measurements and setups has to do at operation temperature of machine!

★ Measurements with maximum engine speed!

Valve clearance

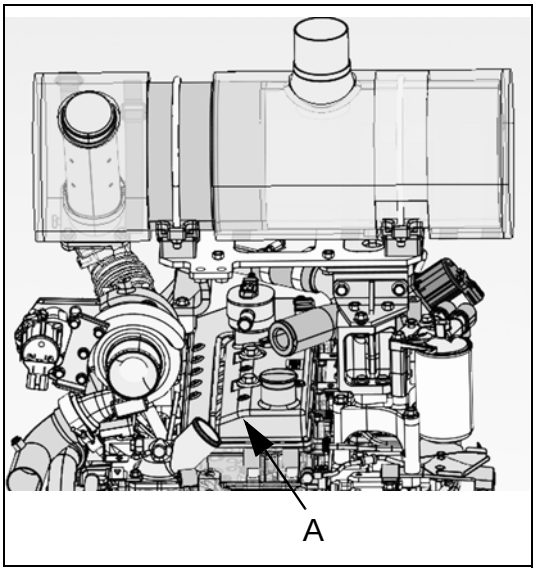
WA80M-7, WA100M-7 - Valve clearance

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

★ Adjusting tools for valve clearance

Symbol	Part No.	Part name
B	Commercially available	Clearance gauge

1. Remove cylinder head cover (A).

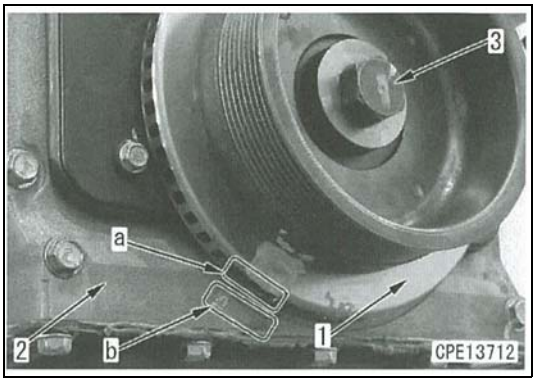


2. Rotate the crankshaft forward (clockwise seen from the front) and match notch (a) (Width: 25 mm) of signal plate (1) at the rear of the crankshaft pulley to embossed letters "1.4TOP" (b) of front cover (2).

   Reference:All of the other notches of the signal plate are 5 mm in width.

   ★ Rotate the crankshaft with the crankshaft pulley bolt (3) (Width across flats: 27 mm).

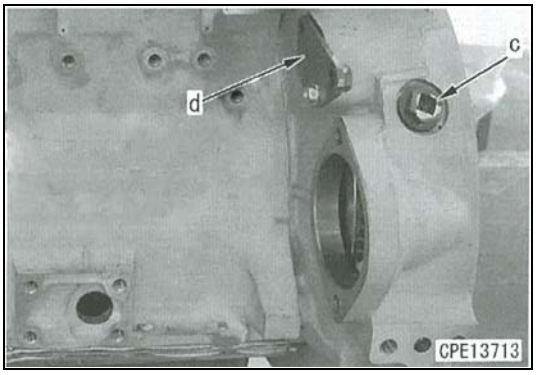
   ★ Always rotate the crankshaft pulley bolt forward to prevent it from being loosened.



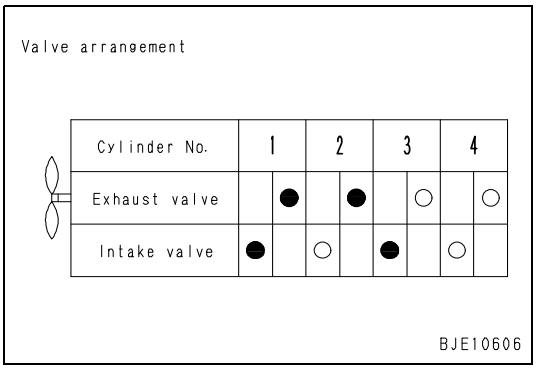
   [Reference information when mounted on machine]

   - If plug (c) of the flywheel housing is removed, you can check the No. 1 cylinder top dead center mark (white paint) on the flywheel side.
   - You can install the barring tool for rotating the crankshaft by removing cover (d) of the flywheel housing.

   ★ The air intake and exhaust rocker arm of No.1 cylinder with the piston at the No.1 cylinder compression top dead center can be moved by hand by the distance equivalent to the valve clearance. If the rocker arm cannot be moved by your hand, the No. 1 piston is not at its compression top dead center. In that case, rotate the crankshaft one more turn.



3. Adjust the clearances of the valves marked with ● in the valve arrangement drawing according to the following procedure.



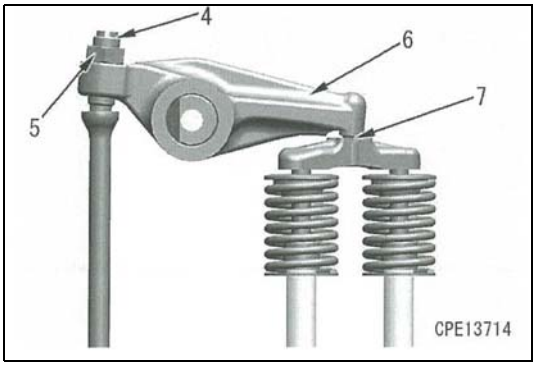
   1) While fixing adjustment screw (4), loosen locknut (5).
   2) Insert tool N into clearance between rocker arm (6) and crosshead (7).
   3) Adjust the valve clearance by using adjustment screw (4).

★ With tool N inserted, turn the adjustment screw to a degree that you can move the clearance gauge lightly.

★ Adjust the valve clearance to within the following target value.

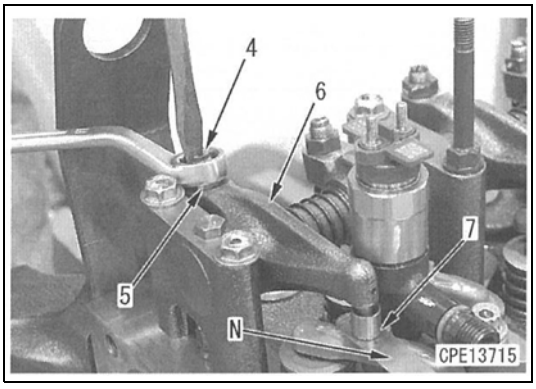
★ Valve clearance (when cold)
Intake valve: 0.35 ± 0.02 mm
Exhaust valve: 0.50 ± 0.02 mm

   4) While fixing adjustment screw (4), tighten locknut (5).
      Locknut:
      39.2 – 49 Nm {4 – 5 kgm}



★ After tightening the locknut, check the valve clearance again.

4. Rotate the crankshaft forward by one turn to set the No. 4 piston to the compression top dead center and adjust the valve clearances marked with ○, similarly to the valves marked with ●.



   Reference: You may rotate the crankshaft pulley by 180° and adjust the valve clearance of the cylinder which is set to the compression top dead center at this time (Firing order: 1 – 2 – 4 – 3).

5. After finishing adjustment, remove the adjusting tools. and restore the machine.

   Cylinder head cover mounting nut:
   8.82 ± 0.98 Nm {0.9 ± 0.1 kgm}

Engine compression test

WA80M-7, WA100M-7 - Engine compression test

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Turn the battery connect switch to OFF position, and remove the key.**
- **Make sure, while testing the engine compression, that you do not come in contact with hot engine parts and that clothes do not come in contact with rotating parts, such as the V-belt or pulleys!**
- **When measuring the compression pressure, take care not to burn yourself on the exhaust manifold, muffler, etc. or get caught in a rotating part.**

★ Testing tools for compression pressure

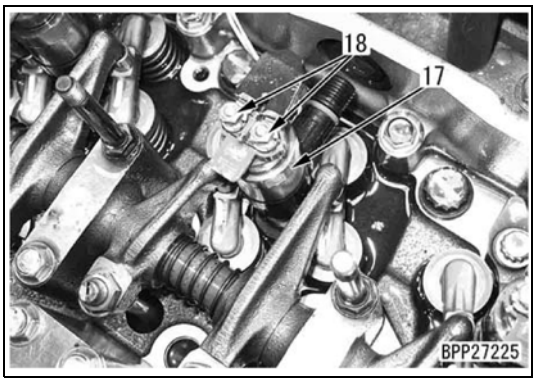
Symbol		Part No.	Part name
C	1	795-502-1590	Compression gauge
	2	795-502-1800	Adapter
	3	6275-11-3880	Gasket
	4	6275-11-3890	O-ring
	5	Commercially available	Hose, inside diameter: approx. 15mm

★ Measure the compression pressure after the engine is warmed up
(Engine oil temperature: 40 – 60°C).

1. Remove the cylinder head cover an set the piston in the target cylinder of testing to the compression top dead center.
   ★ Before engine compression test, the valve clearance must be tested and adjusted.

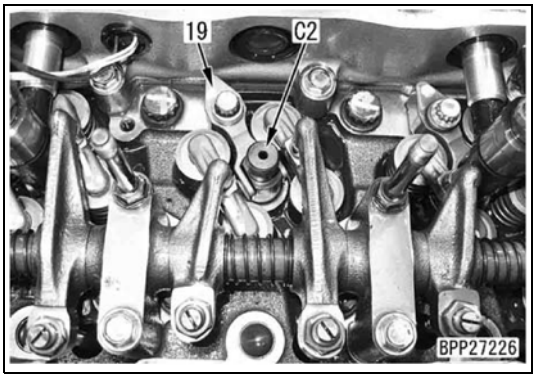
2. Drain the fuel and its level lowers to 1/4.
   ★ It is because, it may flow back from the return circuit when the engine is cranked.

3. Loosen injector terminal nuts (18), and remove the terminals from injector.
   ★ Insulate the terminal with tape etc. so that they do not touch each other.
   Remove the holder to remove injector (17).



4. Install gasket C3 to the tip of adapter C2 and insert them into the mounting portion of injector (17).
5. Fix adapter C2 with injector mounting holders (19).
   Mounting bolt:
   39 – 49Nm {4.0 – 5.0 kgm}
   ★ Tighten the mounting bolt while the fulcrum of the holder is seated perfectly.

   ⚠ **Do not reuse the holder mounting bolt!**

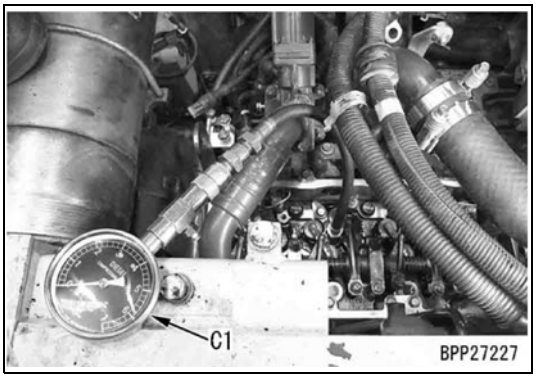


6. Connect compression gauge **C1** to adapter **C2**.

7. Install hose C5 to the disconnected part of the tube on the common rail side to drain the injected fuel into a container.

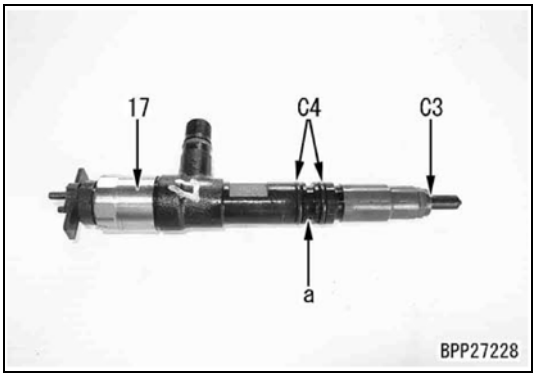
8. Return the engine parts disconnected for the compression pressure to their original positions to enable cranking.

9. Crank the engine with the starting motor and measure the compression pressure.
   ★ Read the pressure when the gauge pointer is stabilized.



10. After finishing measurement, remove the testing instruments and restore the machine.
    ★ Install injector (17) and spill hose connector according the following procedure.

    1) Install O-ring (C4) and gasket (C3) to injector (17).
       ★ Do not install O-ring (C4) to groove "a"..
       ★ Install gasket (C3) so that it does not fall from the end of injector (17) due to its own weight.
       Apply grease, if necessary.
    2) When inserting injector (17) into the head, apply engine oil to the O-ring and insertion hole on the head.
    3) Be sure to use a new injector holder bolt since the engine oil may enter into the fuel return circuit.



Testing blowby pressure

★ Testing tool for blowby pressure

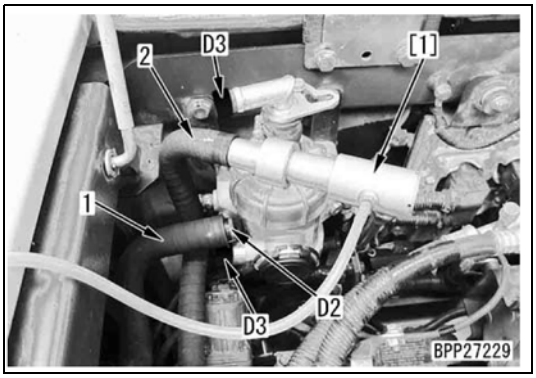
Symbol		Part No.	Part name
D	1	799-201-1504	Blow-by checker
	2	799T-201-3210	Plug
	3	799T-201-3220	Cap

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
- **Lower the bucket, switch the engine off and actuate the parking brake!**

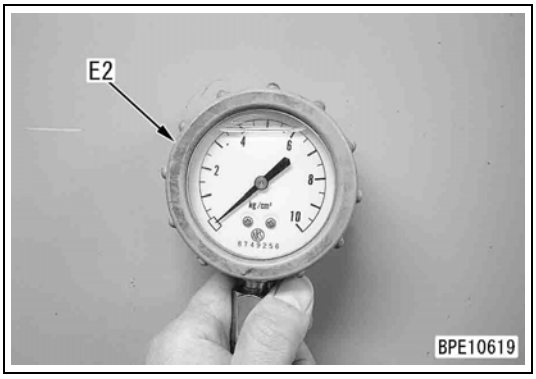
★ Measure the blowby pressure under the following conditions.

- Coolant temperature: 75 to 94°C
- Hydraulic oil temperature: 45 to 55°C

1. Open the engine hood.
2. Disconnect KCCV gas outlet hose (1), block the hose by using plug D2, and block KCCV hose insertion pipe by using cap D3.
3. Disconnect KCCV gas inlet hose (2), block KCCV hose insertion pipe by using cap D3, install tool and adapter [1] of the blowby checker to hose (2), and connect to gauge [3].



4. Run the engine at the rated output and test the blowby pressure.
5. Measure the blowby pressure at engine high idle.
   ★ Read the blowby gas pressure when the gauge pointer stands still.
6. After finishing testing, remove the testing tools and return the removed parts.



Fuel system

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

Handling fuel system parts

★ Precautions for testing and maintaining fuel system
The common rail fuel injection system (CRI) consists of more precise parts than the conventional fuel injection pump and nozzle. If foreign matter enters this system, it may cause a failure. Use special care to prevent entry of the foreign material when servicing the fuel system.

★ Use care for working environment
Avoid filter change or repairing the machine in rain or high winds, or at places where there is a lot of dust.

★ Sealing openings
Plug the pipes and the openings of the components which are removed with the caps, tapes, vinyl bags, etc. to prevent foreign material from entering. Never perform repair works under the condition that the openings are left as they are or plugged with cloths as foreign material may enter or environment may be polluted by the oil leaked. Do not discard the waste oil somewhere or other. Hand it over to your customer for disposal, or dispose it by yourself.

★ How to clean parts when dirt is stuck
If any dirt or dust sticks the parts of the fuel system, clean it off thoroughly with clean fuel.

★ Precautions for replacing fuel filter cartridge
Be sure to use the Komatsu genuine fuel filter cartridge.
The common rail fuel injection system (CRI) consists of more precise parts than the parts used in the conventional fuel injection pump and nozzle. In order to prevent foreign material from entering this system, the filter employs a specially high performance of filter element. If a filter element other than the genuine one is used, the fuel system may have a failure. Accordingly, never use such a filter element.

Handling of intake system parts

★ The Komatsu Variable Geometry Turbocharger (KVGT) consists of more precise parts (variable mechanism) than the parts used in the conventional turbocharger. If foreign material enters this system, it may cause a failure. Use special care to prevent entry of the foreign material when servicing the air intake system.

★ Be careful of working environment
Avoid the repair work of the machine in rain or strong wind or at the places where there is a lot of dust.

★ Sealing openings
Plug the pipes and the openings of the components which are removed, with the caps, tapes, vinyl bags, etc. to prevent foreign material from entering. Never perform repair

works under the condition that the openings are left open or plugged with rag since foreign material may enter.

Releasing residual pressure in fuel system

★ Pressure is generated in the low-pressure circuit and high-pressure circuit of the fuel system while the engine is running.
Low-pressure circuit:
Feed pump – Fuel filter – Supply pump
High-pressure circuit:
Supply pump – Common rail – Injector

★ The pressure in both low-pressure circuit and high-pressure circuit lowers to a safety level automatically 30 seconds after the engine is stopped.

★ Before the fuel circuit is tested and its parts are removed or installed, the residual pressure in the fuel circuit must be released completely. Accordingly, observe the following.

⚠ **Before testing the fuel system or removing its parts, wait at least 30 seconds after stopping the engine until the residual pressure in the fuel circuit is released. (Do not start the work just after stopping the engine since there is residual pressure.)**

WA80M-7, WA100M-7 - Testing fuel pressure

★ Testing tools for fuel pressure

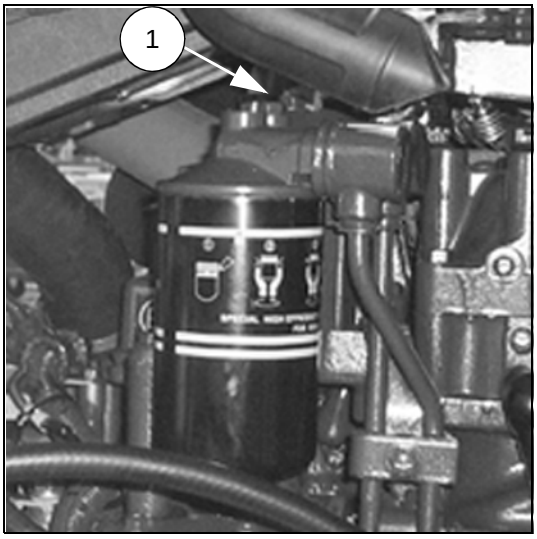
Symbol		Part No.	Part name
F	1	799-101-5002	Hydraulic tester
	2	795-471-1450	Adapter
		07005-00812	Seal washer
	3	799-401-2320	Gauge

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

★ Test only the fuel pressure in the low-pressure circuit from the priming pump through the supply pump to the fuel main filter, and in the return circuit between the supply pump/ common rail/injector and fuel tank.

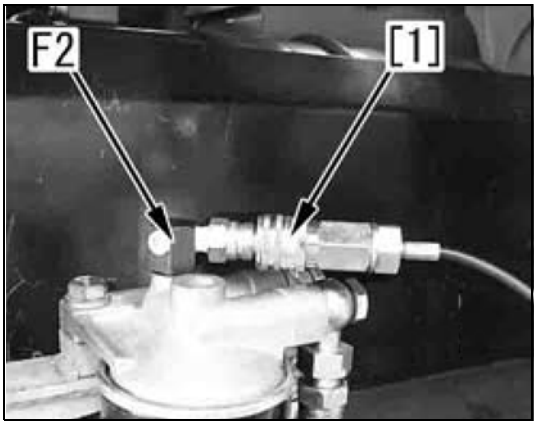
⚠ **Testing of the high-pressure circuit connecting the supply pump, the common rail and the injector cannot be performed due to the extremely high pressure generated there!**

1. Remove plug (1) from the fuel filter head.



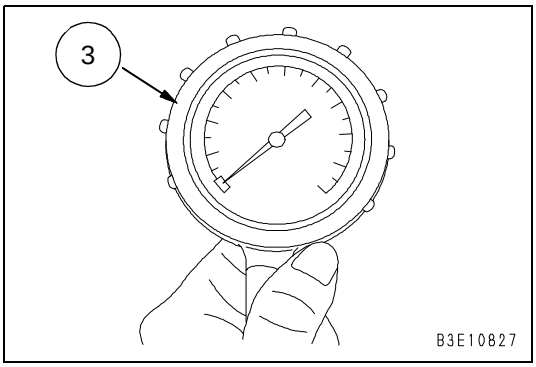
2. Install adapter **F2** and nipple [1] of hydraulic tester **F1** and connect it to hydraulic tester **F2**.

★ Use the oil pressure gauge 2.5 MPa



3. Start the engine, and measure the pressure in the fuel low-pressure circuit with the engine at high idle.
   ★ The pressure in the fuel low-pressure circuit is normal when it is within the following standard range.

Engine speed	Fuel pressure
High idle	883 to 1,471 kPa {9 – 15 kg/cm^2}



4. After finishing testing, remove the testing tools and return the removed parts.
   Plug:

7.8 – 9.8 Nm {0.8 – 1.0 kgm}

Reduced cylinder mode operation

(Only with INSIDE tool)

★ Reduced cylinder mode operation means to run the engine with the fuel injectors of 1 or more cylinders disabled electrically to reduce the number of effective cylinders. The purposes and effects of this operation are as follows.

1. This operation is used to find out a cylinder which does not output power normally (or, combustion in it is abnormal).
2. When a cylinder is selected for the reduced cylinder mode operation, if the engine speed and output do not change from the normal operation (all-cylinder operation), that cylinder has 1 or more defects.
   The possible defects are as follows.
   - Compression leakage through cylinder head gasket
   - Defective injection
   - Defective piston, piston ring, or cylinder liner
   - Defective valve mechanism (Moving valve system)
   - Defect in electrical system
3. Since the common rail fuel injection system controls the injector of each cylinder electronically, the operator can perform the reduced cylinder mode operation easily with switches to find out a defective cylinder.
   ★ For more information, please contact your KOMATSU distributor.

WA80M-7, WA100M- 7 Testing leakage from pressure limiter and return rate from injector

★ The locations of the fuel circuit parts are subject to machine models.
★ Testing tools for leakage from pressure limiter and return rate from injector

Symbol		Part No.	Part name
	1	6151-51-8490	Spacer
	2	6206-71-1770	Joint
	3	07005-01012	Seal washer
G	4	Commercially available	Hose
	5	Commercially available	Hose
	6	Commercially available	Measuring cylinder
	7	Commercially available	Stopwatch

★ Prepare an oil pan of about 20 ℓ to receive the fuel flowing out during the test.

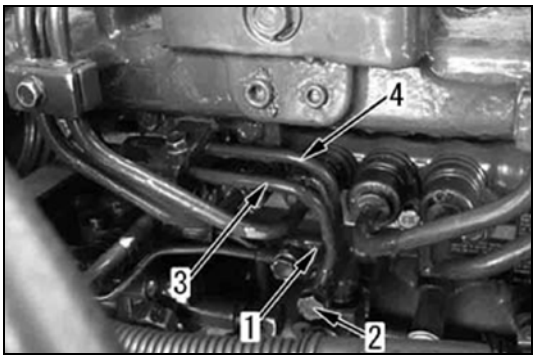
⚠

⚠

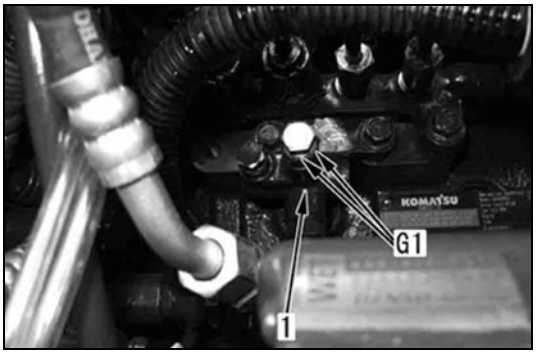
- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
- **Lower the bucket, switch the engine off and actuate the parking brake!**
- **Be careful not to touch any hot parts when installing or removing the testing tools.**

1. Preparation work

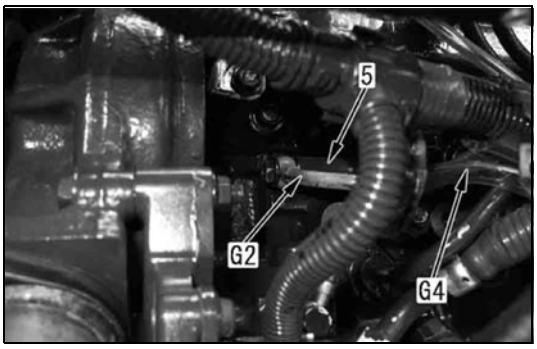
1) Remove the air compressor.
2) Remove the injector return tube and pressure limiter (4) connected to join bolt (2) of return block (1).



3) Insert spacer **G1** on return block side and tighten the removed joint bolt again.
   ★ Be sure to fit the seal washers to both ends of the spacer **G1.**



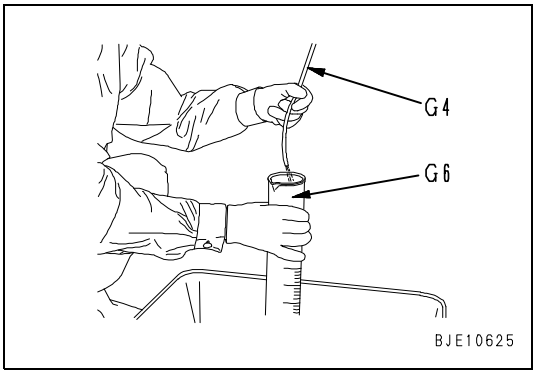
4) Remove the joint bolt on the cylinder head side of injector return tube (3), insert joint **G2**, and tighten the removed joint bolt again.
   ★ Be sure to fit the gaskets to both ends of the joint.
5) Connect test hose G4 to the end of joint G2.



6) Set joint G2 to pressure limiter (5), and tighten the removed joint bolt again.
7) Connect test hose **G4** to the end of joint **G2**.
   ★ Bind the connecting part of the test hose with a wire, etc. to prevent it from coming off.
8) Return the air compressor.
   Preparation work is completed.

The above is the preparation work for testing.

2. Testing leakage from pressure limiter

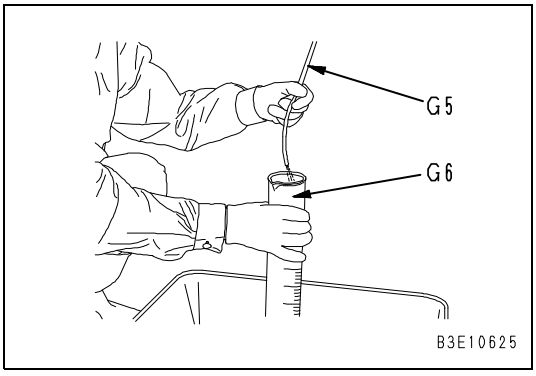


1) Arrange the route of test hose G4 so that it does not sag, and put its end in a oil pan (container to catch the fuel).
2) Start the engine, and run it at 1,600 rpm with no load.
3) Lay test hose **G4** so that it will not slacken and put its end in the oil pan.
4) Connect INSITE (bench test tool) to the engine and set it so that it can check the engine speed.
   ● Or set the installed equipment so that it can check the engine speed.
5) After the engine speed is stabilized, test the leakage in 1 minute with measuring cylinder **G6**.
   ★ You may test for 20 seconds and judge by multiplying the result by 3.
   ★ If the leakage from the pressure limiter is in the following range, it is normal.

Engine speed (rpm)	Leakage (cc/min)
At rated output	Max. 20

   Reference:
   A limit value is the value mentioned above, but a standard value in normalcy is “0 cc/min. (no leak)”.
6) After finishing testing, stop the engine.

3. Testing return rate from injector



1) Lay test hose **G5** so that it will not slacken and put its end in the oil pan.
2) Connect INSITE (bench test tool) to the engine and set it so that it can check the engine speed.
3) Start the engine, and run it at the rated output.
4) After the engine speed is stabilized, test the return rate in 1 minute with measuring cylinder **G6**.
   ★ You may test for 20 seconds and judge by multiplying the result by 3.
   ★ If the supply pump is not supplying fuel, the engine speed may not rise. In this case, record the engine speed, too, during the test.

★ If the return rate (spill) from the injector is in the following range, it is normal.

Rated output speed (rpm)	Return (Spill) limit (cc/min)
1,600	190
1,700	200
1,800	210
1,900	220
2,000	230

5) After finishing testing, stop the engine.

4. Work after finishing testing

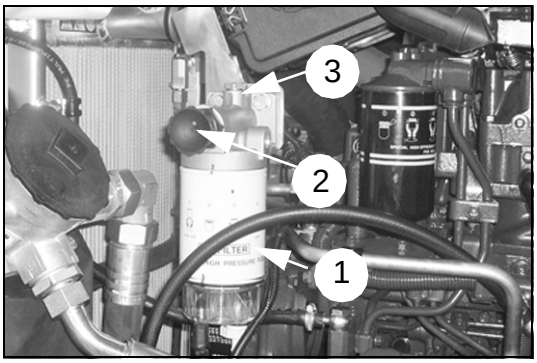
After finishing all testing, remove the testing tools and return the removed parts.

Joint (5): **3.9 – 6.9 Nm {0.4 – 0.7 kgm}**

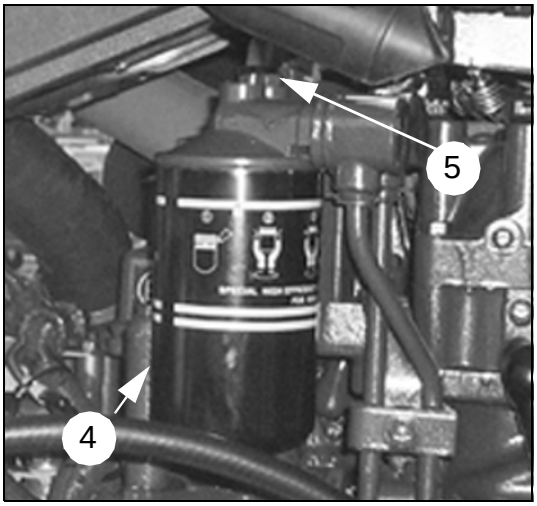
WA80M-7, WA100M-7 - Bleeding air from fuel circuit

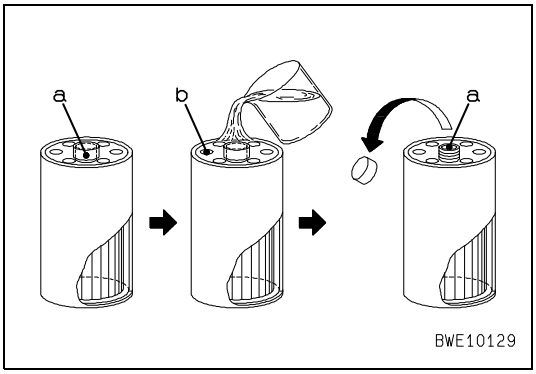
The fuel in the injection system is pressurised! Ejected fuel may puncture the skin and cause blood poisoning. Wear safety goggles and rubber gloves when working on the injection pump. In the event of being hit by a high-pressure fuel jet, immediately consult a doctor.

★ If fuel is used up or if a fuel circuit part is removed and installed, bleed air from the fuel circuit according to the following procedure.
★ The locations of the fuel circuit parts are subject to machine models.
★ Fuel prefilter (1), feed pump (2) and air bleeding plug (3) on the fuel prefilter side are installed to the chassis.



1. Remove fuel pre-fuel filter (1) and fill it with fuel.
   ★ Fill the fuel filter with clean fuel and take care that dirt will not enter it.
   ★ Check that the cap is fitted to part (a) (central hole) of the pre-fuel filter, and then add fuel through part (b) (holes around the central hole).
   ★ After filling the pre-fuel filter with fuel, remove the cap from part (a).
   ★ If clean fuel is not available, do not remove the pre-fuel filter but fill it with the fuel by operating feed pump (2).
   ★ Do not add fuel to fuel main filter (4) externally.

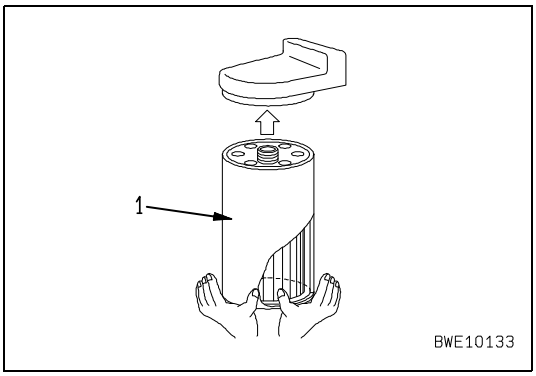




2. Install pre-fuel filter (1) to the filter head.
   - ★ Apply engine oil thinly over the packing on the pre-fuel filter side.
   - ★ After the packing of the pre-fuel filter touches the sealing face of the filter head, tighten the fuel filter 3/4 turns.
3. Remove air bleeding plug (3) of the fuel prefilter bracket and operate feed pump (2).
   - ★ Operate the feed pump until fuel flows out of the plug hole. After checking that fuel flows out, install the plug.
4. Remove air bleeding plug (5) of the fuel main filter (4) and operate feed pump (2).
   - ★ Operate the feed pump until fuel flows out of the plug hole. After checking that fuel flows out, install the plug.

   Air bleeding plug:

   7.8 – 9.8 Nm {0.8 – 1.0 kgm}
5. Start the engine with the starting motor.
   - ★ The air in the high-pressure circuit is bled automatically if the engine is cranked.
   - ★ If the engine does not start, there may be still air in the low-pressure circuit. In this case, repeat the above procedure from step 3.



WA80M-7, WA100M-7 - Testing fuel system for leakage

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

⚠ **Very high pressure is generated in the high-pressure circuit of the fuel system. If fuel leaks while the engine is running, it is dangerous since it can catch fire.**
After testing the fuel system or removing its parts, test it for fuel leakage according to the following procedure.

★ Clean and degrease the engine and the parts around it in advance so that you can test it easily for fuel leakage.

1. Spray color checker (developer) over the fuel supply pump, common rail, fuel injector, and joints of the high-pressure piping.

2. Run the engine at speed below 1,000 rpm and stop it after its speed is stabilized.

3. Stop the engine, and inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

4. Start the engine and run it at low idle.

5. Stop the engine, and inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

6. Start the engine and run it at high idle.

7. Stop the engine, and inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

8. Run the engine at high idle and load it.

9. When testing the engine mounted on the machine, stall the torque converter or relieve the oil from the hydraulic pump. Inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.

★ If any fuel leakage is detected, repair it and inspect again from step 1.
★ If no fuel leakage is detected, inspection is completed.

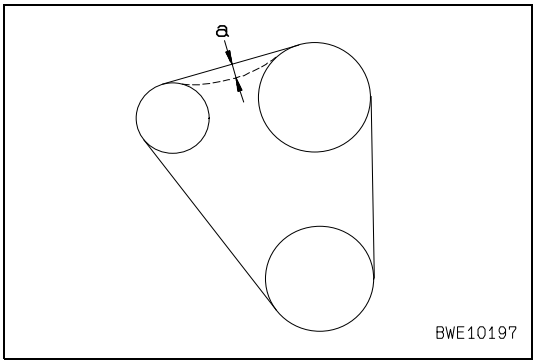
V-belt tension

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

Testing

Press the intermediate point of the belt between alternator pulley and fan pulley with a finger and measure deflection (a) of the belt.

★ Pressing force: approx. 98 N {approx. 10 kg}
★ Deflection (a): 7 – 10 mm

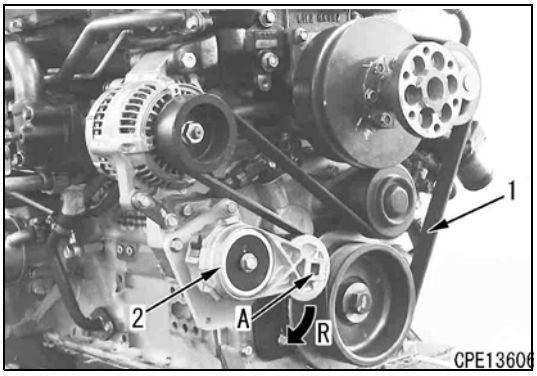


Do not adjust the belt tension to maximum. The tension can rise when the locking nut is tightened. The life of the pulleys and bearings is reduced if the tension is too high!

Adjusting

An automatic tensioning device is installed, so there is no need to set the tension.

To replace a new fan belt, insert a wrench on the portion A (with across flates: 12.7 mm) of the tensioner assembly (2), and rotate it in the counter-direction (R) to the winding-up direction, then remove the fan belt (1) and install a new.



- **Be sure that the wrench is secured at the portion A of the tensioner assembly before turning it. If trying to rotate the wrench before it is securely attached due to the strong spring force of tensioner assembly, the wrench may come off and that is very dangerous.**
- **After installation of the fan belt, restore tensioner assembly slowly with care.**
- **Be careful not to get your fingers caught between the pulley and fan belt during work.**

Engine RPM

WA80M-7 and WA100M-7 are electronically controlled.

Do not touch hot engine parts during fitting or removing test equipment!

★ Testing conditions

- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C

1. Fit the RPM tester to the engine.
2. Engine RPM per machine

Machine	Low idle	High idle
WA80M-7	875 to 925RPM	2470 to 2570 RPM
WA100M-7	875 to 925RPM	2600 to 2700 RPM

NOTE
Do not adjust the fuel injection pump.

Testing travel speed

Make sure that the test area is safe!

★ Testing conditions

- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C
- Ground: flat, even, dry and hard surface
- Tire pressure: recommended pressure

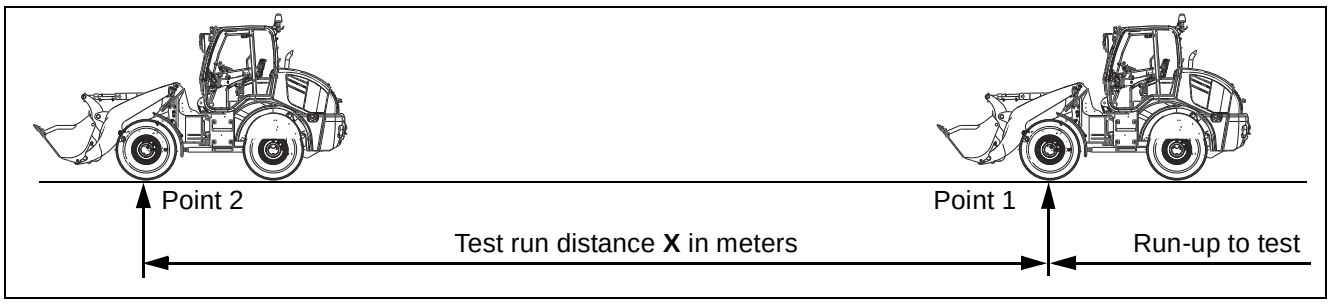
Testing

1. Mark to points on the road surface
2. Run up with the machine and pass point 1 with maximum speed.
3. Drive the machine with maximum speed to point 2.
4. Measure the time between point 1 and point 2.
5. Calculate the travel speed in accordance to the given formular.

Formula for testing machine speed

$$\frac{x}{y} \times 3.6 = \text{km/h}$$

Example: $\frac{100\ m}{18s} \times 3.6 = 20\ km/h$



Engine stall torque RPM

- **Do not touch hot engine parts during fitting or removing test equipment!**
- **Chock the wheels!**

★ Testing conditions

- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C

1. Fit the RPM tester to the engine and take the RPM tester's display into the cab.
2. Block the drive train (1). Make sure that the wheels cannot slip during the test.

   ★ Make sure that the correct low and high idle speeds are adjusted and that the oil pressures is in between the set limits. If these are not correct, check the connections and the linkages.

Engine stall torque RPM, test with the hydrostatic drive

Clear the possible danger area, in case the machine becomes free from the safety arrangements!

1. Run the engine in low idle.
2. Release the parking brake.
3. Select FORWARD.
4. Block the drive train so that the machine cannot move forward and slowly rise the engine RPM to max.

   ★ Make sure that the wheels do not turn during the test.

5. Note the maximum engine RPM when the engine is under hydrostatic load.

   ★ Do not hold this test condition for more than 20 sec. Check that the oil temperature does not exceed 60°C.

Engine stall torque RPM, test with hydrostatic drive and working hydraulics

★ The test is the same as the previous one except that now the working hydraulics are also used at the same time.

Clear the possible danger area, in case the machine becomes free from the safety arrangements!

1. Run the engine in low idle.
2. Release the parking brake.
3. Select FORWARD.
4. Block the drive train so that the machine cannot move forward and slowly rise the engine RPM to max.

   ★ Make sure that the wheels do not turn during the test.
5. Move the boom lift hydraulic control lever and raise the boom until the main pressure relief valve opens. The boom is held in the upper stop position.

   ★ Use the control lever positively.
6. Note the engine max. RPM in this condition, with hydrostatic drive and boom rise.

   ★ Do not hold this test condition for more than 20 sec. Check that the oil temperature does not exceed 60°C.

Feed pump (and servo oil pressure)

WA80M-7 and WA100M-7

★ The hydrostatic drive feed pump oil is also used for the servo control system. If the feed pump oil pressure is changed this will also influence the servo control oil pressure.
The feed pump oil pressure and the servo system oil pressure are the same.

Apply the parking brake and chock the wheels!

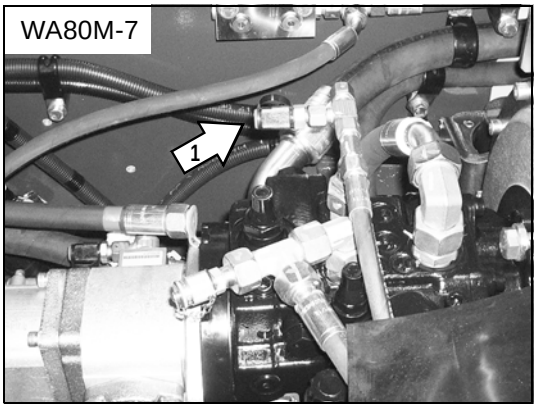
★ Testing conditions

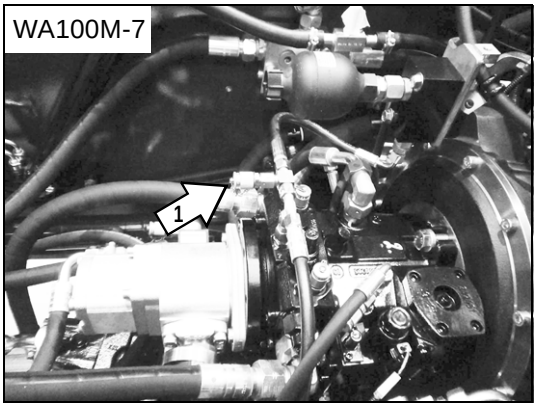
- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C

Testing

1. Connect a pressure testing gauge (60 bar) to the testing point (1).
2. Run the engine at high idle RPM.
3. Note the pressure shown on the pressure testing gauge.

   Feed pump oil and servo oil pressure: **30 bar**





Hydraulic pressure cut-off

Clear the possible danger area, in case the machine becomes free from the safety arrangements!

★ Testing conditions

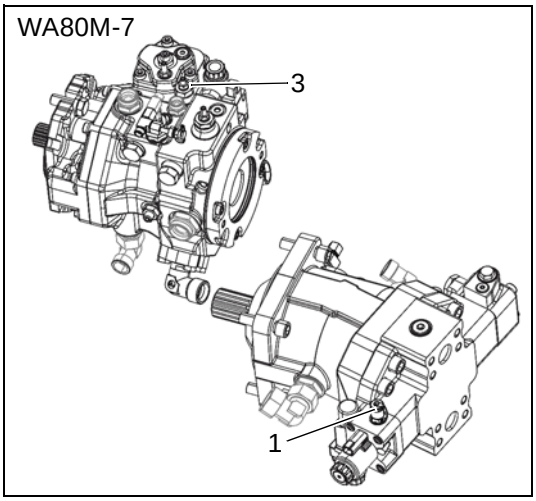
- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C
- Ground: flat, even, dry and hard surface
- Tire pressure: recommended pressure

Testing WA80M-7

1. Connect a pressure test gauge (testing range up to 600 bar) to the test connector (1).
2. Block the drive train so that the machine cannot move forward. Make sure that the wheels cannot slip during the test.

   ★ Do not use the service or park brake during the test!
3. Start the engine and select FORWARD.
4. Run the engine to max. RPM and note the pressure shown on the pressure gauge.

   Hydraulic pressure cut-off (forward): **450 - 460 bar**



Adjustment WA80M-7

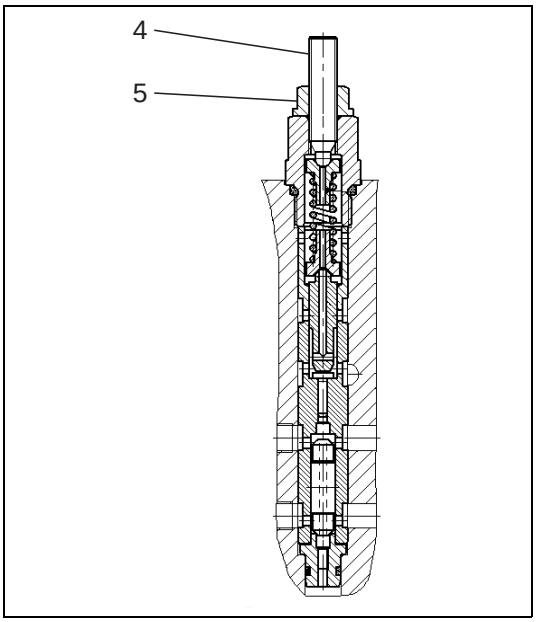
Always stop the engine when adjusting oil pressure!

1. Release the locknut (5) of the cut-off valve (3).
2. Adjust the pressure by turning the adjusting screw (4).

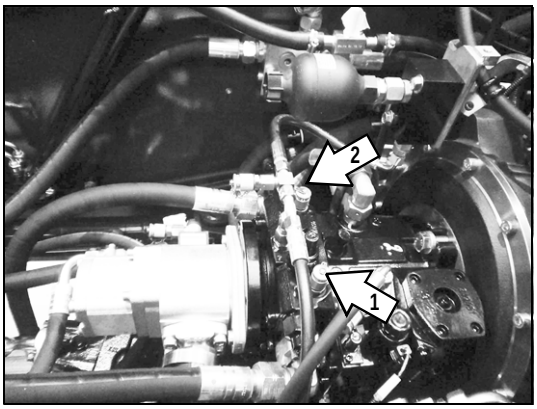
To rise the pressure	screw in
To lower the pressure	screw out

   ★ Repeat the test procedure and check that the pressure is in the specified limits.

Tighten the locknut (5).



Testing WA100M-7



1. Connect a pressure test gauge (testing range up to 600 bar) to the test connector (1) for FORWARD.
2. Block the drive train so that the machine cannot move forward. Make sure that the wheels cannot slip during the test.

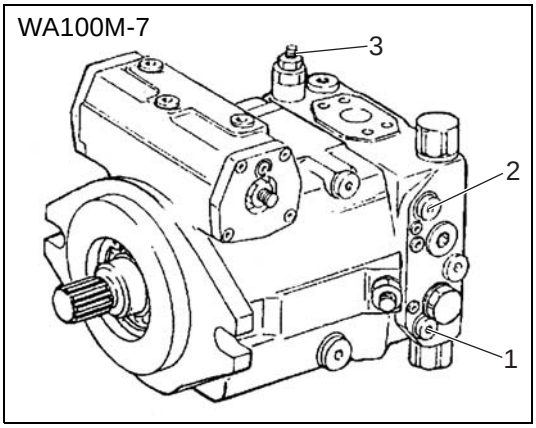
   ★ Do not use the service or park brake during the test!
3. Start the engine and select FORWARD.
4. Run the engine to max. RPM and note the pressure shown on the pressure gauge.

   Hydraulic pressure cut-off (forward): **450 - 460 bar**

   ★ Repeat the test when the machine is blocked in reverse only for controlling on test connector (2) for REVERSE.

Adjustment WA100M-7

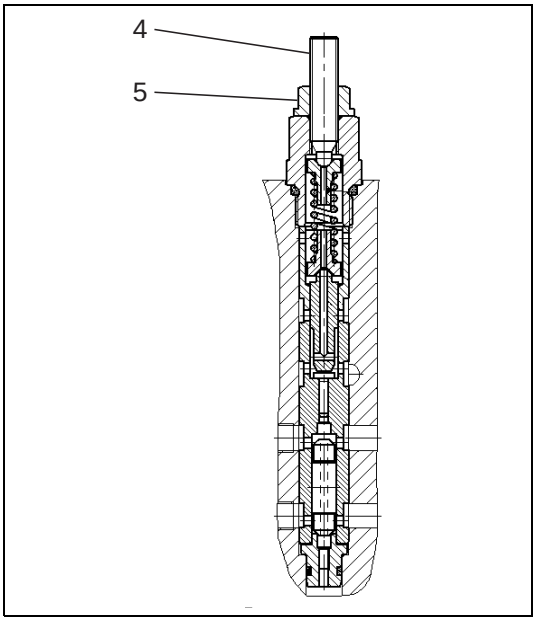
Always stop the engine when adjusting oil pressure!



1. Release the locknut (5) of the cut-off valve (3).
2. Adjust the pressure by turning the adjusting screw (4).

To rise the pressure	screw in
To lower the pressure	screw out

   ★ Repeat the test procedure and check that the pressure is in the specified limits.
3. Tighten the locknut (5).

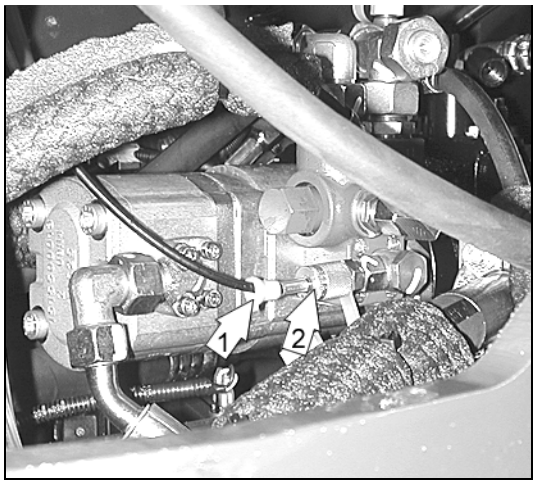


Working hydraulic pressure

Apply the parking brake and chock the wheels!

★ Testing conditions

- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C



Testing

1. Connect a pressure testing gauge (1) (testing range up to 250 bar) to the test point (2).
2. Start the engine and run at full RPM.
3. Move the hydraulic control lever to LIFT and hold it in the end position so that the main pressure release valve opens.
4. Note the pressure on the pressure testing gauge.

   ★ Do not hold the pressure for more than 20 sec. Use the control lever by quick handling.

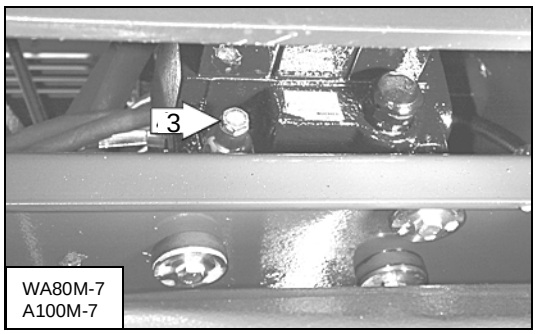
   Working hydraulic pressure:

   - **270 to 275 bar** (WA80M-7, WA100M-7)

Adjusting

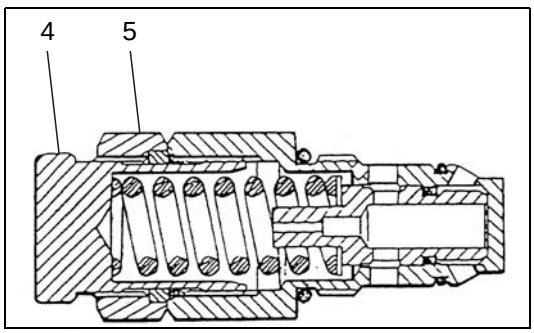
Always stop the engine when adjusting oil pressure!

★ The main pressure release valve of the WA80M-7/ WA100M7 is on the front of the main control valve (3). It can be adjusted through the opening between front frame and front axle without opening the front frame.



1. Release the locknut (5) on the main pressure release valve.
2. Adjust the pressure by turning the pressure adjusting screw (4).

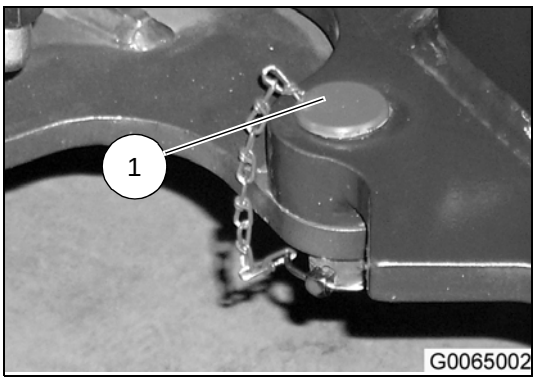
To rise the pressure	screw in
To lower the pressure	screw out



★ Repeat the test procedure and check that the pressure is in the specified limits.

Steering oil pressure

Apply the parking brake and chock the wheels!



★ Testing conditions

- Normal engine working temperature
- Hydraulic oil temperature: 50 - 60°C

Testing

1. Fit the steering safety bolt (1) in the articulation joint so that the machine can not be steered.
2. Connect a pressure testing gauge (testing range up to 250 bar) to the test point (2).

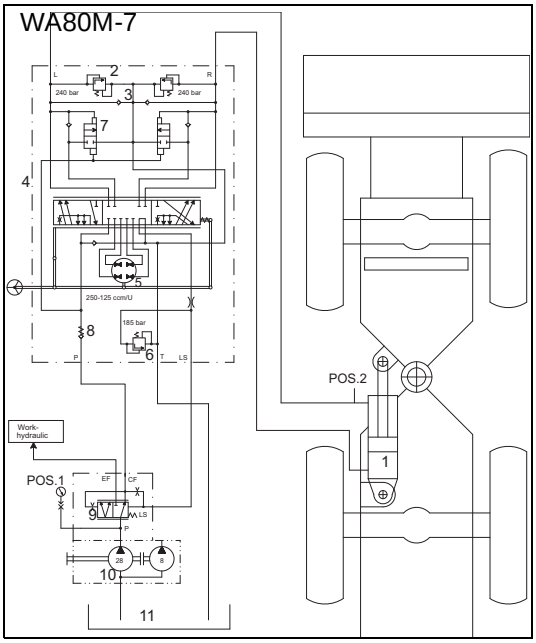
   ★ Test point (2) corresponds to "POS. 1" in the hydraulic diagrams. By connecting the pressure testing gauge the pressure is increased by 10 bar.

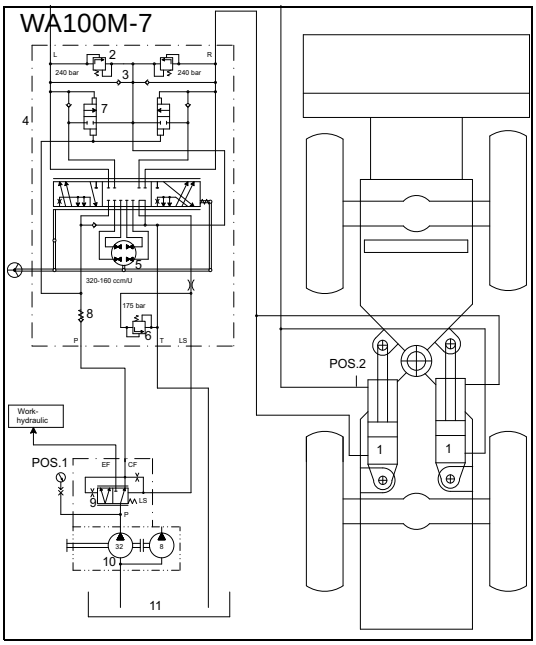
   ★ It is also possible to install a T-joint to the steering cylinder ("POS. 2" in the hydraulic diagrams) to measure the pressure.
3. Start the engine and run at full RPM.
4. Turn the steering wheel to the right until the end position is reached and hold.

   ★ The steering safety rod is pulled to the right when the steering wheel is turned.
5. Note the pressure shown on the pressure testing gauge.

   Steering oil pressure on Test point (2) ("POS. 1"):
   WA80M-7: **170 to 180 bar**
   WA100M-7: **170 to 180 bar**

   Steering oil pressure on "POS. 2":
   WA80M-7: **180 bar**
   WA100M-7: **180 bar**





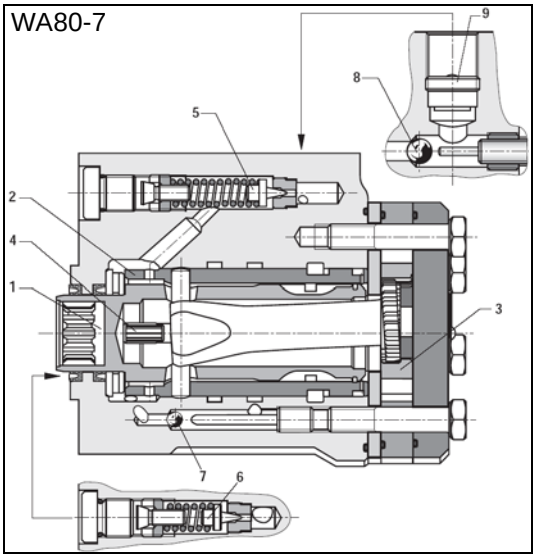
Adjusting

DANGER! Risk of accident!
If the steering oil pressure is not correctly adjusted, the steering may malfunction. Adjustment of the steering oil pressure must be performed by qualified personnel, only!

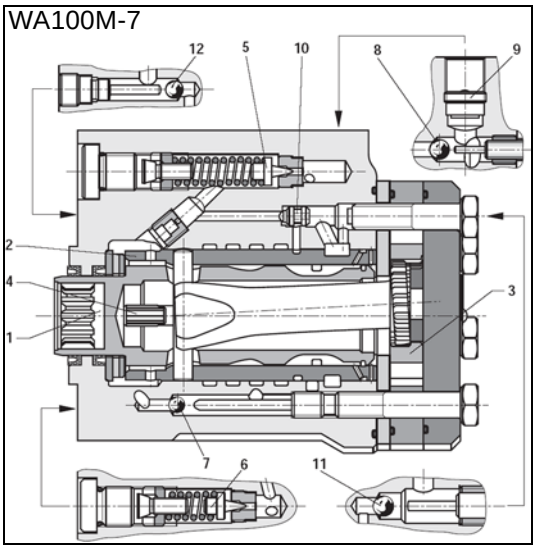
6. Adjust the steering oil pressure with the pressure limiting valve (5) (primary side) and with the shock valve (6) (secondary side).

1	control piston	7	prefill valve
2	control bushing	8	prefill valve
3	rotor set	9	non-return valve
4	centring spring	10	cut off valve
5	pressure limiting valve	11	non-return valve
6	shock valve	12	non-return valve

WA80-7



WA100M-7



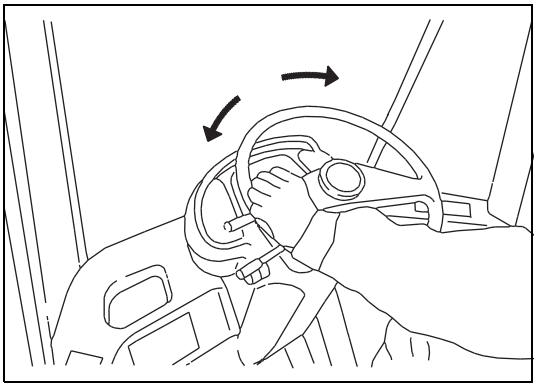
Operating time for steering wheel

★ Testing conditions

- Ground: flat, even, dry and hard surface
- Normal engine working temperature
- Hydraulic oil temperature: 45 - 55°C
- Tire pressure: recommended pressure

Testing

1. Start the engine, raise the bucket approx. 400 mm.
2. Operate the steering wheel to one end of its stroke to turn the machine to the left or right.
3. Measure the time to operate the steering wheel from one end to the other end of the stroke.
   - ★ Operate the steering wheel as quickly as possible without using force.
   - ★ Carry out the measurements both at low and high idle speed and to both sides left and right.



	Operating time low idle speed	Operating time high idle speed
WA80M-7	4.4 - 5.5 s	2.5 - 2.6 s
WA100M-7	4.3 - 4.3 s	2.3 - 2.3 s

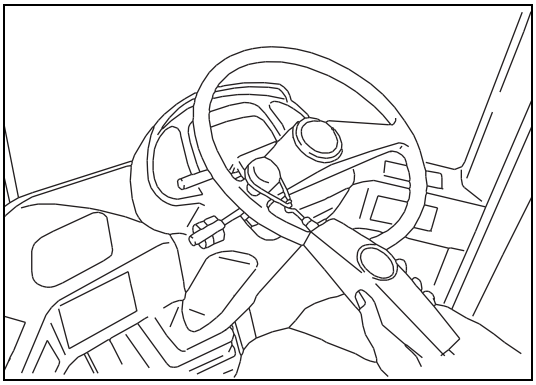
Operating force of steering wheel

★ Testing conditions

- Ground: flat, even, dry and hard surface
- Normal engine working temperature
- Hydraulic oil temperature: 45 - 55°C
- Tire pressure: recommended pressure

Testing

1. Install a push-pull scale to the steering wheel knob.
2. Start the engine, raise the bucket approx. 400 mm.
3. Pull the push-pull scale in the tangential direction and measure the value when the steering wheel moves smoothly.
   ★ Avoid measuring when the steering wheel starts to move.



Disc brake (foot brake)

WA80M-7, WA100M-7 - Disc brake (foot brake)

Testing

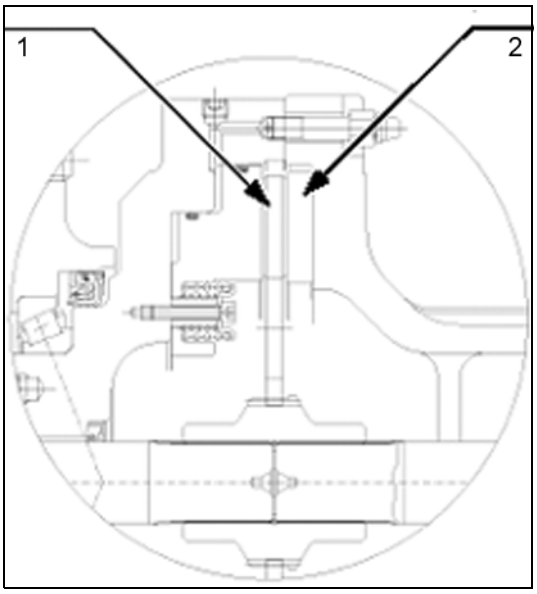
★ The axle has to be disassembled to check the brake disc and separator disc thicknesses. See chapter 30 DISASSEMBLY AND ASSEMBLY "Brake group - wheel shaft" on page 30-76.

1. Check the friction plate (1) thickness.

   Friction plate thickness (new):**10.0 ± 0.1 mm**
   (worn):**8.8 mm**

2. Check the separator plate (2) thickness.

   Separator plate thickness (new): **11.7 ± 0.05 mm**



Main brake valve – basic adjustment

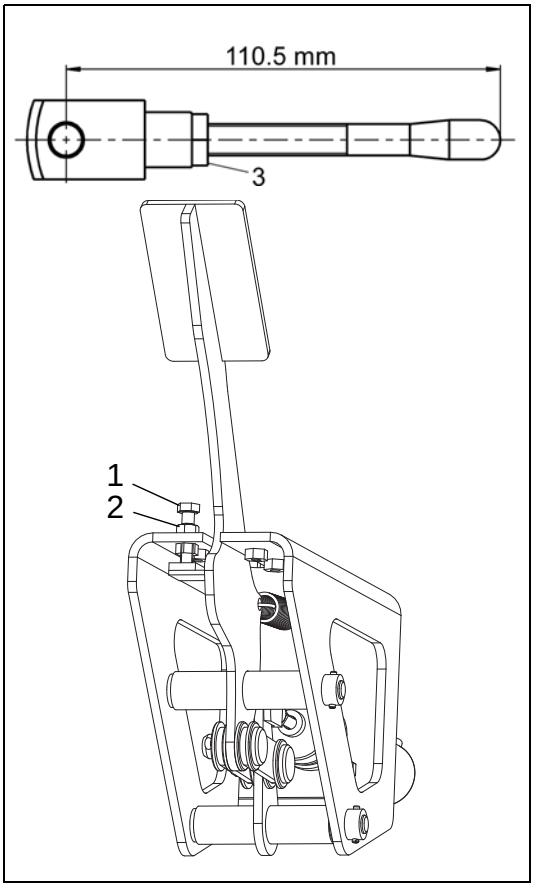
Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

Length of rod

1. Mount the fork joint to the brake rod, loosen the locking nut (3) and set the length of the brake rod to approx. **110.5 mm**.
2. Install the brake rod to the brake pedal.

Angle of brake pedal

1. Release the locknut (2) and turn the adjusting nut (1) to move the pedal angle to **50°**.
2. Tighten the locknut (2) and check the pedal angle adjustment



Brake efficiency

Measuring the stopping distance

Danger! Fasten the seat belt before testing the brakes!

★ Testing conditions

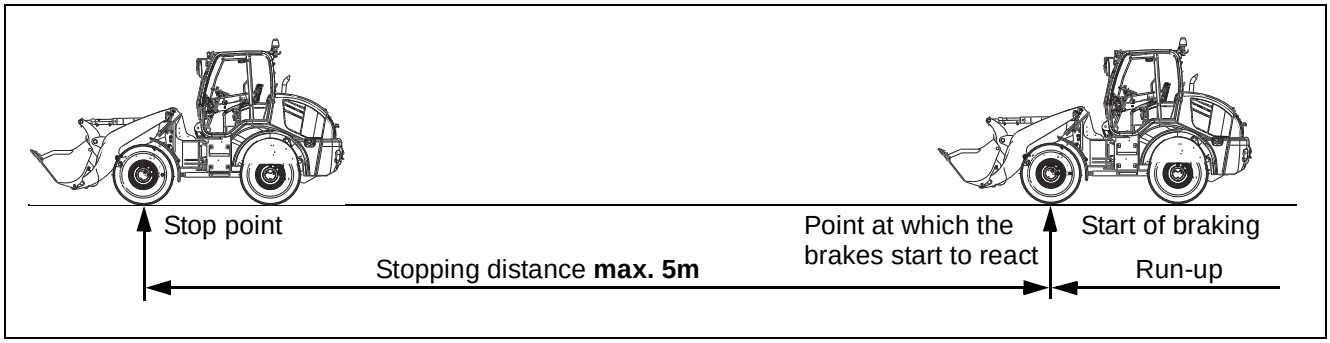
- Ground: flat, even, dry and hard surface
- Speed: highest speed when starting to brake
- Tire pressure: recommended pressure

Testing

★ Set up a test run and mark the point where you will start to brake. Brake as soon as you pass this point.

1. Start the engine and drive off.
2. Set the speed at 20 km/h.
3. Using the correct force, press the brakes when passing the braking point with 20 km/h.
4. Measure the distance taken to stop from the point of starting to brake.

   ★ The distance should be less than 5 m!



Parking brake efficiency

★ Testing conditions

- Ground: flat, even, dry and hard surface, 18% gradient.
- Tire pressure: correct pressure
- Normal engine working temperature
- Bucket: empty

Testing

1. Start the engine and set the machine straight ahead. Drive the machine up the 18% gradient.
2. Use the foot brake to stop the machine and hold.
3. Lower the bucket.
4. Put the forward/ reverse lever in NEUTRAL.
5. Stop the engine.
6. Apply the parking brake, slowly release the foot brake. The machine should not move.

   ★ Test the parking brake twice. Once facing up the gradient and once facing down the gradient.

Adjusting (WA80M-7, WA100M-7)

★ The operation shall be repeated at intervals of 2000 hours and additionally if the function of the parking brake is not given.

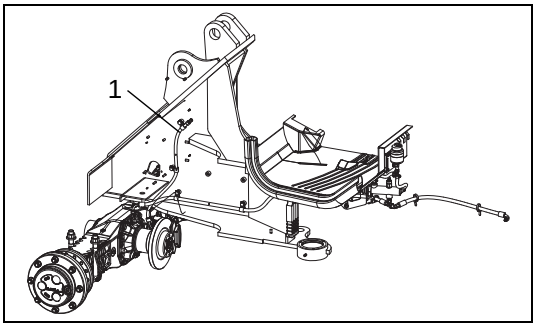
1. Clean the brake pads and the disc.
2. Loosen the parking brake cables.
3. Loosen the hydraulic hose (1) in the front frame.
4. Remove the breather from the hose.

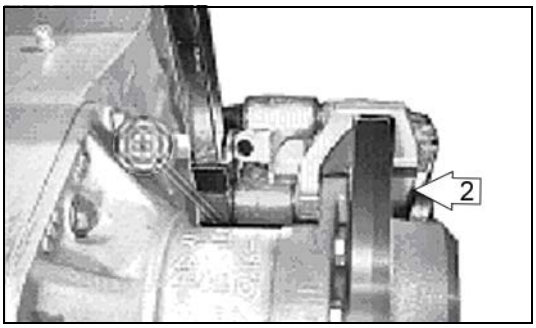
   ★ The line is filled with oil. Take care not to spill this oil.

5. Apply slight pressure (4 - 20 bar) for three times on the hydraulic line (1).

   ★ Do not apply excessive pressure. The pressure causes the brake pads (2) to move towards the brake disc.

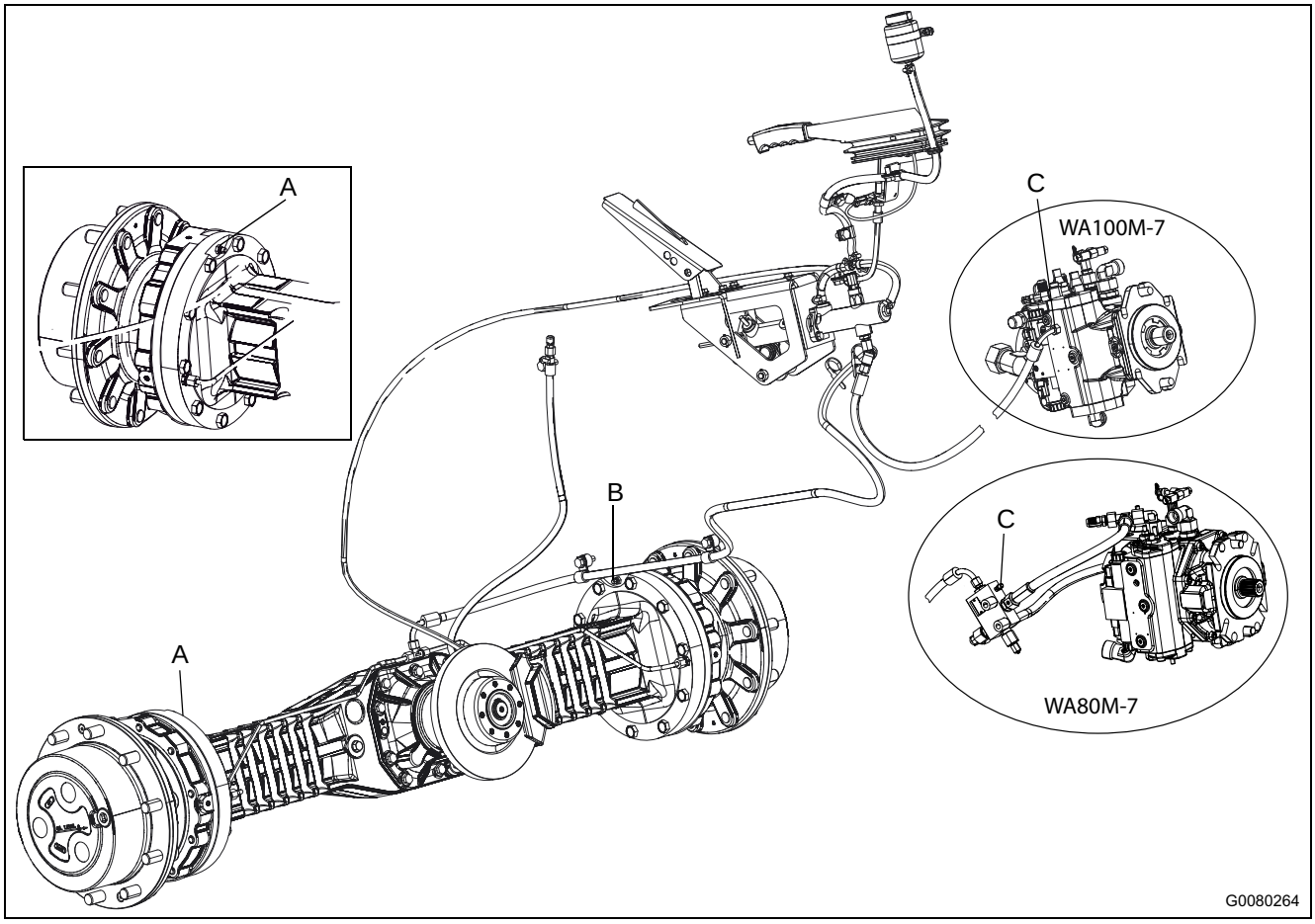
6. Fill up the hydraulic hose (1) with AGIP LHM - Super and mount the breather on the hose.
7. Reconnect the hydraulic line (1).
8. Reconnect the parking brake cable.





Ventilation / filling up the brake circuit

WA80M-7, WA100M-7 - Ventilation / filling up the brake circuit



The ventilation must be done from the axle!

★ It is recommended to operate the ventilation with bleeding device.

Ventilation with bleeding device

1. Connect the ventilation device to the expansion tank in the cabin.
2. Push brake pedal until pressure build up.
3. Open the port "A" on the axle until there is no more air, and close the port "A". After that, the brake pedal can be released. Repeat this procedure if necessary, until there is no more air in brake piping.
4. Repeat the same procedure with the port "B" on the axle and the port "C" on the inching valve.
5. After the ventilation of the brakes and the inching line is completed, check the brake fluid level in the expansion tank. And refill it, if necessary.

Manually ventilation

1. Open the expansion tank in the cabin and fill up to Max mark.

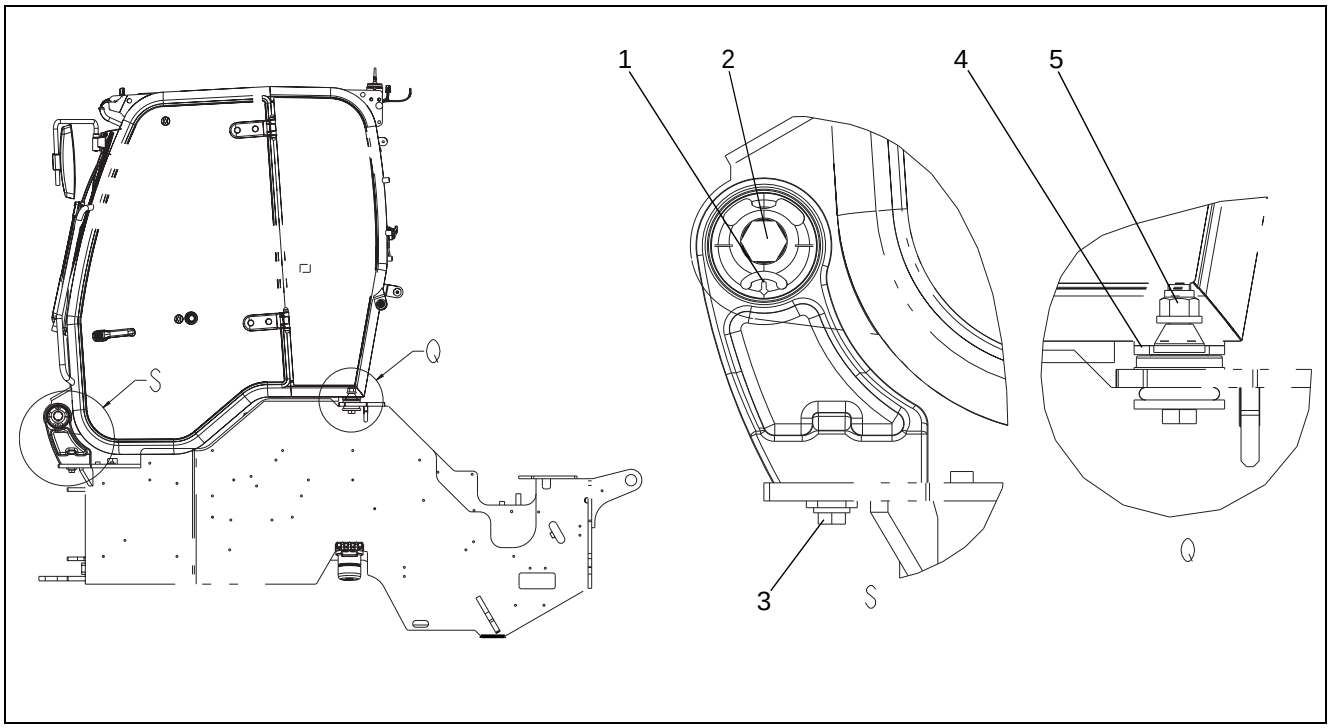
2. Push brake pedal until pressure build up.

3. Open the port "A" on the axle until there is no more air, and close the port "A". After that, the brake pedal can be released. Repeat this procedure until there is no more air in brake piping. And take care, that there is always enough brake oil in the expansion tank. If not, refill again.

4. Repeat the same procedure with the port "B" on the axle and the port "C" on the inching valve.

5. After the ventilation of the brakes and the inching line is completed, check the brake fluid level in the expansion tank. And refill it, if necessary.

Cabin - adjustment



1. Keep mounting direction!
   The arrow shape of the bushing (1) must be pointing to the bottom.

2. Tighten the selflocking nuts (2) until the side plates of the cabin touch the inner spacer of the cabin mount, then unlock the selflocking nuts 1/4 rotation.

3. Tighten the bolts (3).

   Bolt: 250 Nm

4. Tighten the selflocking nuts (5) of the washers (4).(wrench size: 60)

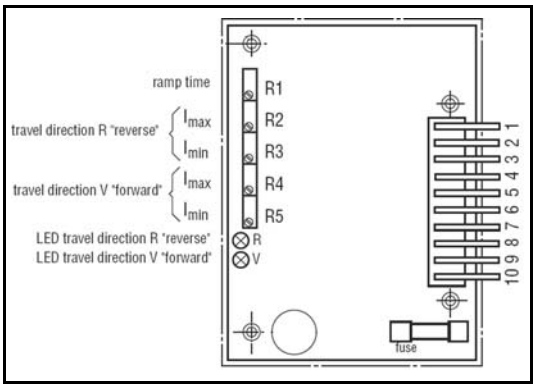
   Bolt (4): 300 nm
   Nut (5): 150 Nm

Proportional amplifier

Setting Instruction PVR.../11

(change of presetting)

1. Acting control potentiometer until LED "V" or LED "R" starts-to light. Adjust start current Imin with R5 or R3.
   (current increase by rotating in clockwise direction)
2. Set control potentiometer to maximum forward "V" or reverse "R". Adjust maximum current Imax with R4 or R2.
   (current increase by rotating in clockwise direction)
3. The same adjustment for the reverse direction ("V" or "R").
4. Adjust duration of time ramp with R1.
   (ramp time increase by rotating in clockwise direction)



Presetting for Delivery

(suitable in connection with variable displacement pump A4VG or A10VG)

Amplifier	PVR12.../11	PVR24.../11
Nominal voltage	12 V	24 V
Solenoid current V ("forward")	I_{min} = 400 mA I_{max} = 1200 mA	I_{min} = 200 mA I_{max} = 600 mA
Solenoid current R ("reverse")	I_{min} = 400 mA I_{max} = 1200 mA	I_{min} = 200 mA I_{max} = 600 mA
Ramp time	approx. 5 s	approx. 5 s

30 DISASSEMBLY AND ASSEMBLY

Comments

Chapter 30 contains descriptions, illustrations and diagrams, which may vary according to the type of machine and equipment variants concerned.

Over and above this, the illustrations and diagrams may also contain optional extras and auxiliary equipment that are also available.

NOTE
An illustration representing a particular way of handling something does not necessarily represent the machine part's actual state. In other words, parts may be shown that, according to the assembly instructions, should have been removed beforehand. Similarly, parts may not be shown that should actually still be mounted on the machine.

Weight dimensions/fluid capacities

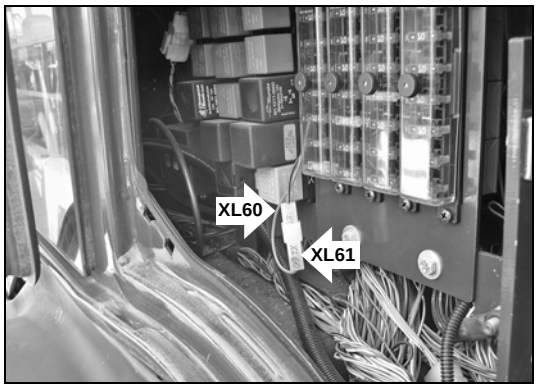
In cases of any deviations to weight dimensions and fluid capacities resulting from the different machine types, the minimum and maximum values for the weight or the fluid capacity for the part to be dismantled are given.

The exact details for the corresponding type of machine can be found in the Weight or Lubricants Table contained in chapter 10.

Depressurise of E.C.S.S. system

Danger of injury! Pressure accumulators are filled with highly pressurised nitrogen.
Do not work on hydraulic system before E.C.S.S. system is depressurised.

Before starting the inspection and maintenance, lower the work equipment to the ground and turn the E.C.S.S. switch to the ON position and keep it ON, then stop the engine.



For depressurise of E.C.S.S. system, connect connector XL60 with XL61 and switch the starter switch in the ON position.

Please note that the work equipment could shortly move because of rest of pressure in accumulator.

The remaining hydraulic pressure is released by doing this.

Lower the work equipment to the ground.

For depressurise of PPC accumulator, move the PPC lever min. 10-times in all directions (only WA100M-7).

Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.

Starter assembly

Removal of starter assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

a. Open engine cover.

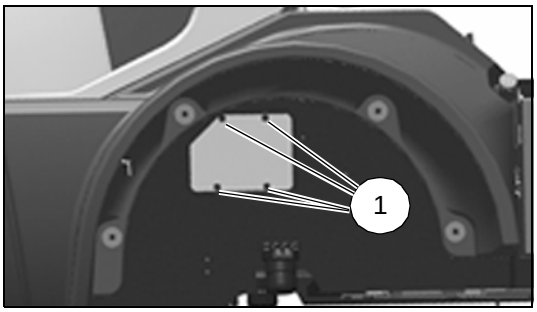
b. Loosen the four fastening screws (1) on the right side and remove the cover.

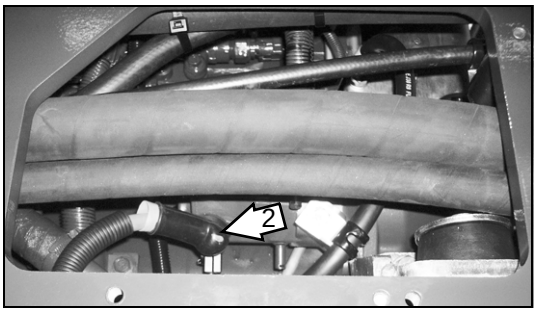
c. Remove the two cables (2) and (3) from the starter.

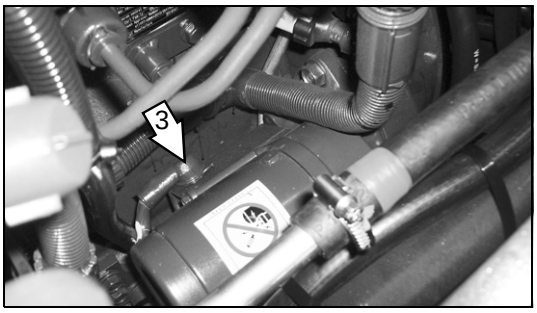
d. Loosen the two fastening (4) screws and remove the starter.

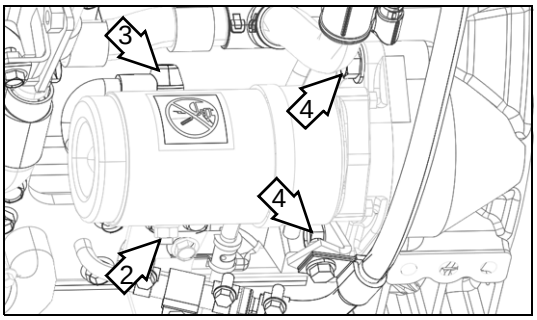
✳ 4

kg Starter: **4.7 kg**









Installation of starter assembly

- To fit the starter carry out the removal procedure in reverse order.

✳ 4

kgm Two screws (3): **98 - 122.5 Nm**

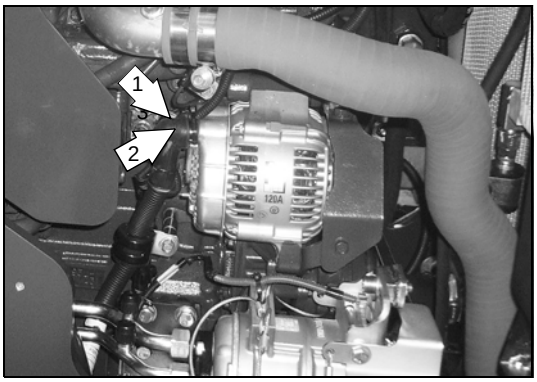
Alternator assembly

Removal of alternator assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

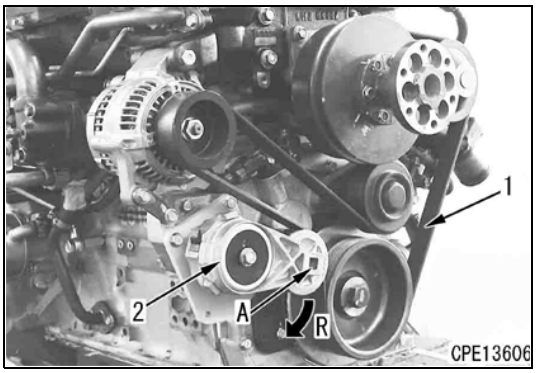
1. Electrical connections

Disconnect the two cables (1) and (2).



2. Remove fan belt

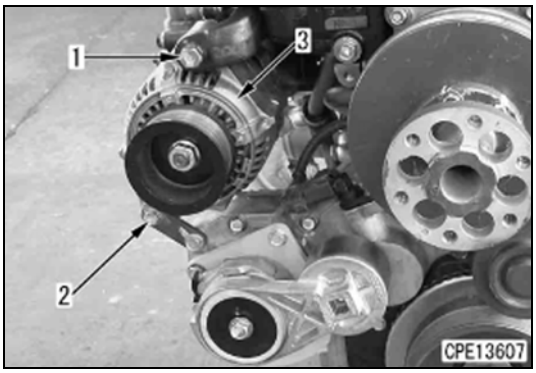
Insert a wrench in the portion A (width across flats: 12.7 mm) of the tensioner assembly (2), and rotate it in the counter-direction (R) to the winding-up direction to decrease fan belt tension, then remove.



- **Be sure that the wrench is secured at portion A of tensioner assembly before turning it. (If you try to rotate the wrench before it is securely attached due to the strong spring force of tensioner assembly, the wrench may come off that is very dangerous.**
- **After removing the fan belt, slowly and carefully restore the tensioner assembly.**
- **Be careful not to get your fingers caught between the pulley and fan belt during work.**

3. Alternator assembly

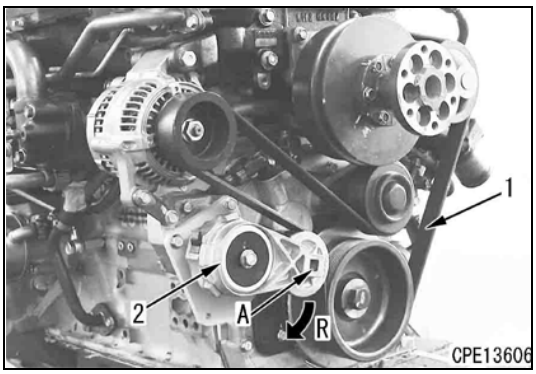
Remove mounting bolts (1) and (2), and alternator (3).



Installation of alternator assembly

- To fit the alternator carry out the removal procedure in reverse order.
- Install fan belt (1).

  Insert a wrench in the portion A (width across flats: 12.7 mm) of the tensioner assembly (2), and rotate it in the counter-direction (R) to the winding-up direction, then install the fan belt.



- **Be sure that the wrench is secured at portion A of tensioner assembly before turning it. (If you try to rotate the wrench before it is securely attached due to the strong spring force of tensioner assembly, the wrench may come off that is very dangerous.**
- **After installation of the fan belt, restore tensioner assembly slowly with care.**
- **Be careful not to get your fingers caught between the pulley and fan belt during work.**

Counterweight assembly

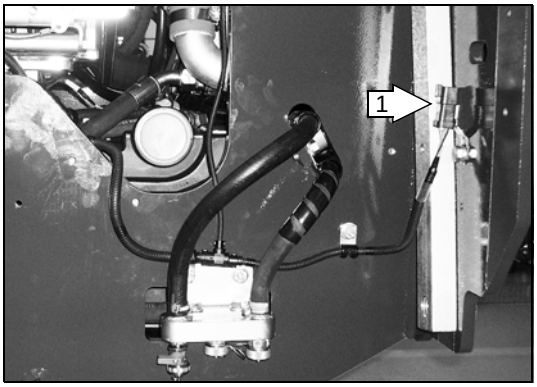
Removal of counterweight assembly

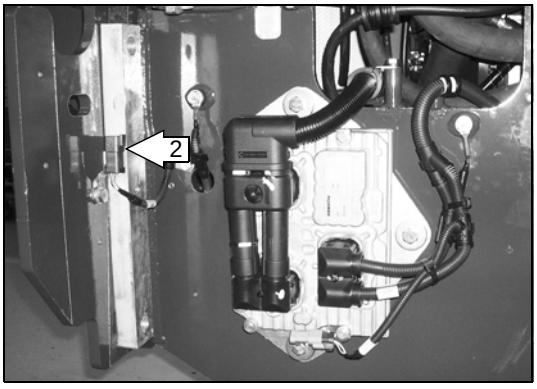
Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!
Remove the earth lead from the (-) pole of the battery, or throw the battery main switch!

1. Rear lights

a. Disconnect the electrical plug-type connectors on the right-hand side (1) and on the left-hand side (2).

b. Remove the attachment (3).



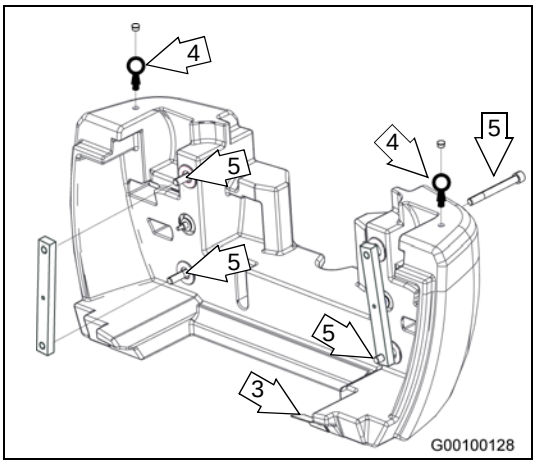


2. Counterweight

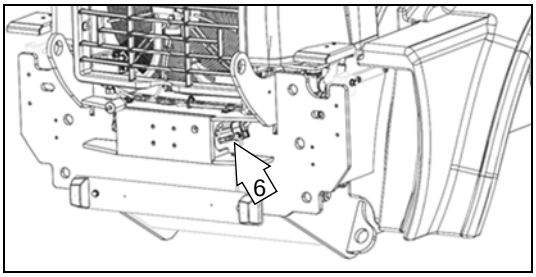
a. Screw the two eye bolts (M20) (4) into the threaded holes from above into the counterweight.

b. Suspend the counterweight by means of hoisting gear.

c. Unscrew the four fastening bolts (5) and lower the counterweight to the ground.



NOTE
Disconnect the connector (6), if the machine equipped with option licence plate lighting.



※ 1

★ When lifting make sure that the load is properly balanced.

kg Counterweight:	kg	WA80M-7
	1081 kg	WA100M-7

Installation of counterweight assembly

- To fit the counterweight carry out the removal procedure in reverse order.

※ 1

kgm Screws: **960 Nm (WA80M-7, WA100M-7)**

Engine cover assembly

Removal of engine cover assembly

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

Remove the counterweight.
See "Removal of counterweight assembly" on page 30-10.

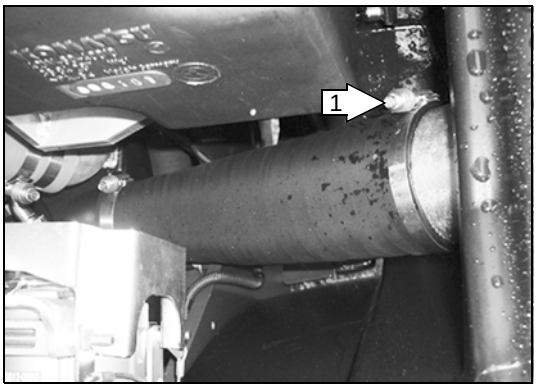
1. Preliminary work

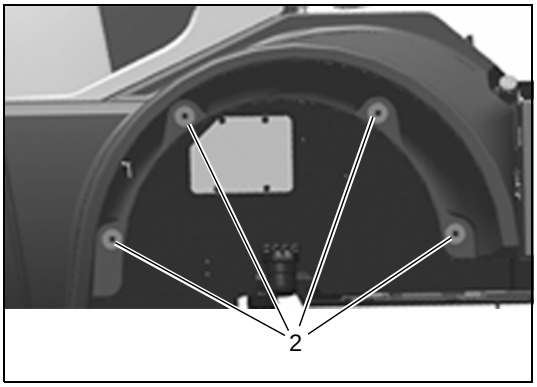
Open the engine cover and secure it against falling down by means of a support rod.

2. Remove rear fender

a. Loosen clamp (1) for fuel hose on left side.

b. Loosen the eight fastening screws (2) on both sides and remove the both fender.





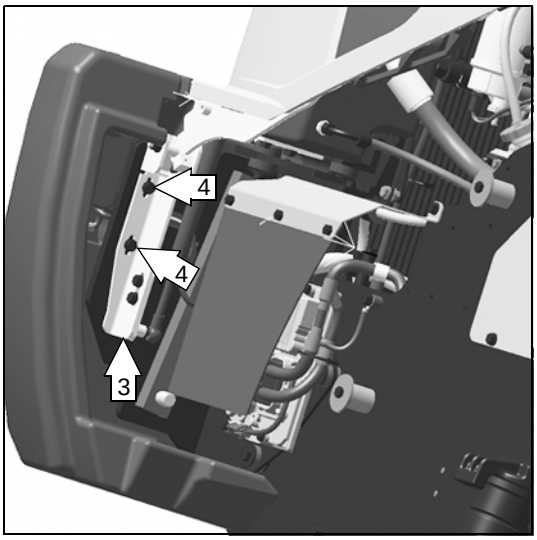
3. Engine cover

a. Mark the position of holders (3) on both side.

b. Remove two fastening screws (4) on both sides of the mounting.

c. Two people should then remove the engine cover.

kg Engine cover: **54 kg**



Installation of engine cover assembly

- To fit the engine cover carry out the removal procedure in reverse order. Note your mark of the holder, otherwise the engine cover must be adjusted.

Radiator and hydraulic tank assembly

Removal of radiator and hydraulic tank assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
- **Lower the bucket, switch the engine off and actuate the parking brake!**
- **Depressurise the E.C.S.S. system. See on page 30-5**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch.**

Remove the counterweight.
See "Removal of counterweight assembly" on page 30-10.

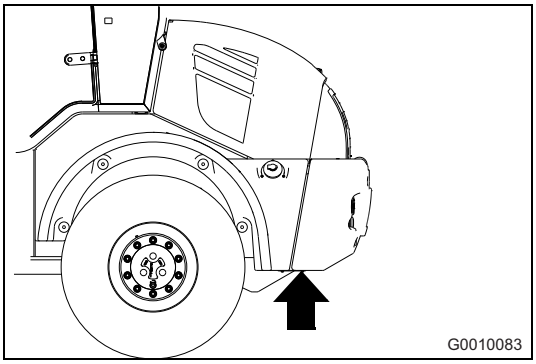
Remove the engine cover.
See "Removal of engine cover assembly" on page 30-12.

1. Draining the coolant

See Operation Manual: MAINTENANCE - Draining the coolant

Coolant:

Coolant:	**11.5 l**	WA80M-7, WA100M-7

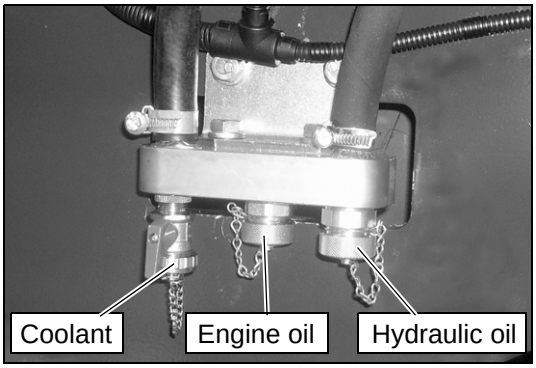


2. Draining the hydraulic oil from the radiator

See Operation Manual: MAINTENANCE – Hydraulic system – change hydraulic oil

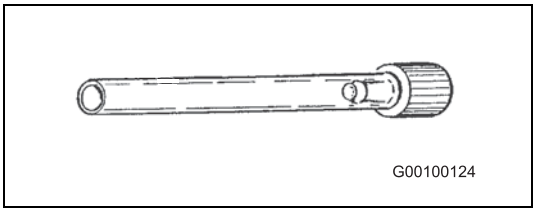
Hydraulic oil:

Hydraulic oil:	80 l	WA80M-7, WA100M-7



★ Screw a drain hose onto the drain valve. This opens the drain valve.

★ Close the hydraulic lines and coolant lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.Remove air filter assembly.

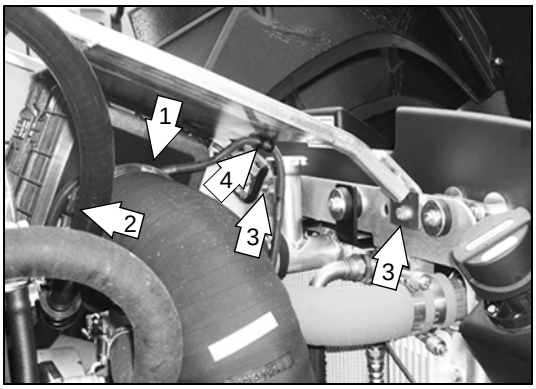


a. Loosen the clamp (1) and remove hose from the air filter.

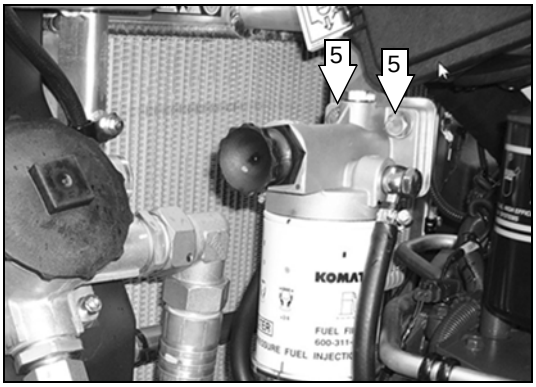
b. Disconnect the connector (2).

c. Mark the position of holders and remove the both fastening screws (3).

d. Remove clamp (4)

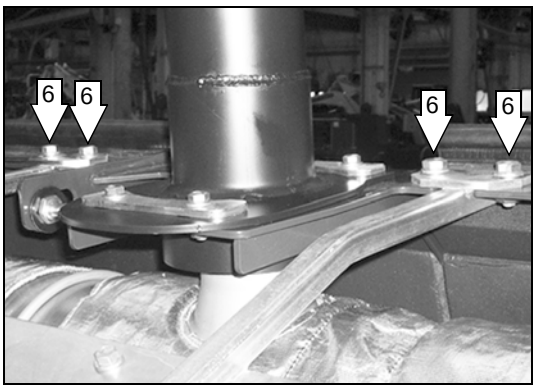


e. Loosen the fastening screws (5) of the fuel filter holder, then fix these on the engine.



f. Mark the position of holders and remove the four fastening screws (6).

g. Remove air filter assembly.



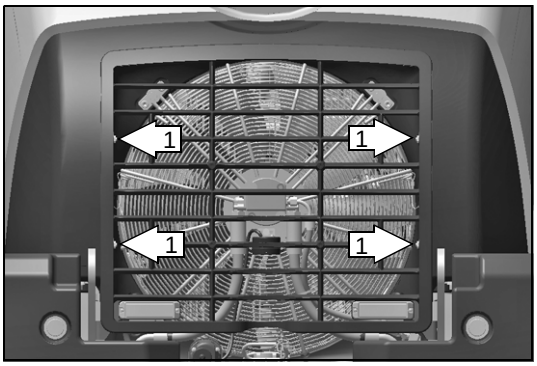
3. Remove hydraulic and coolant hoses

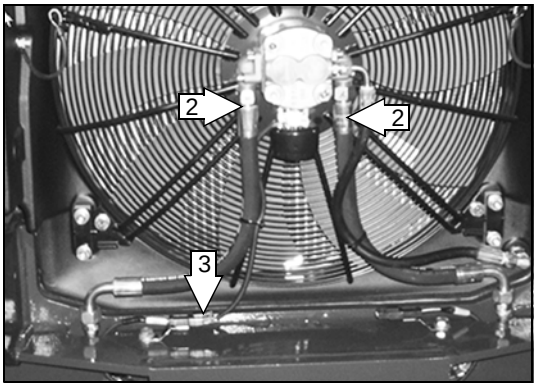
Allow residual oil and coolant will flow out of the radiator.

a. Loosen the four screws (1) and remove the radiator guard.

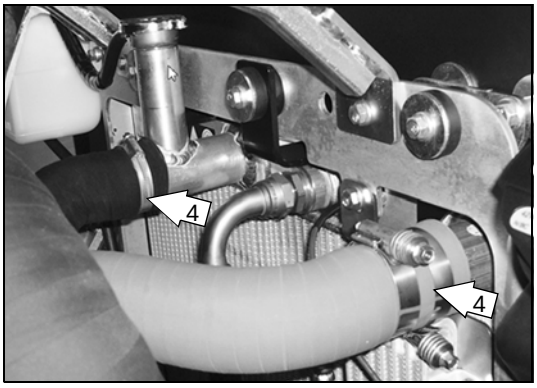
b. Disconnect the both hydraulic hoses (2) from the fan drive.

c. Disconnect the connector (3) from the backup buzzer.

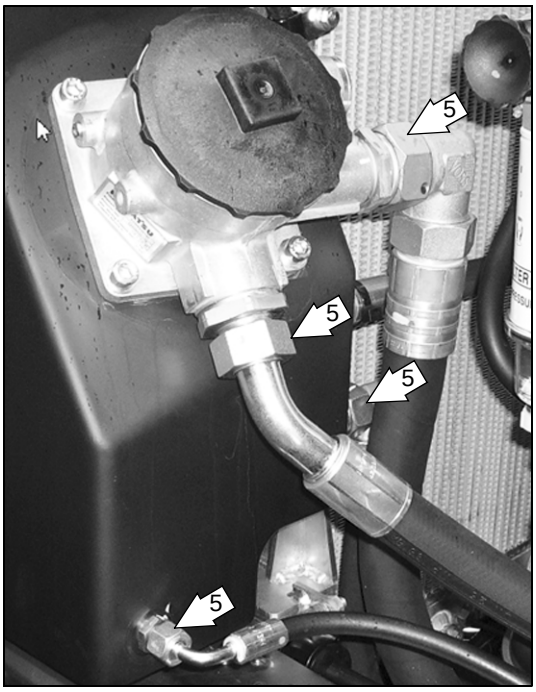




d. Disconnect the hoses (4).

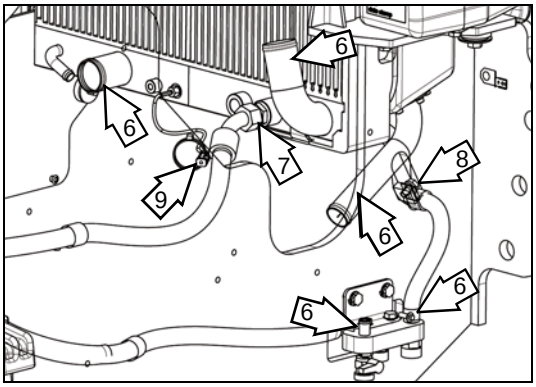


e. Disconnect the hydraulic hoses (5).



f. Disconnect the hoses (6).

g. Disconnect the hydraulic hose (7).



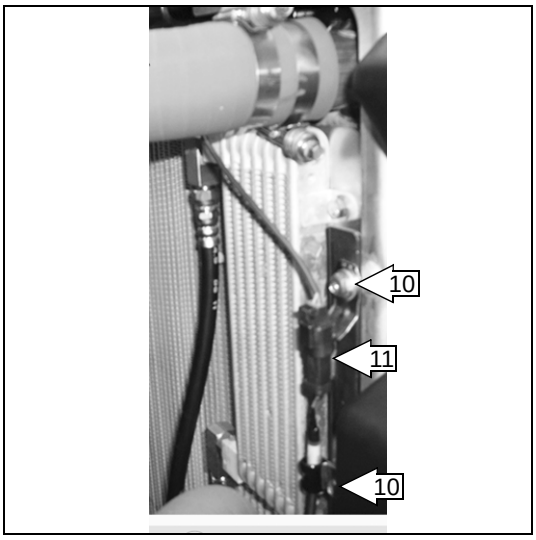
NOTE
About 0.5 litre oil will runs out when you disconnect hose (7).
Use plug to close connection on cooler.

h. Remove clamp (8).

i. Disconnect the wire (9) of temperature sensor.

j. Loosen the fastening screws (10) of the fuel cooler.

k. Disconnect the wire (11)

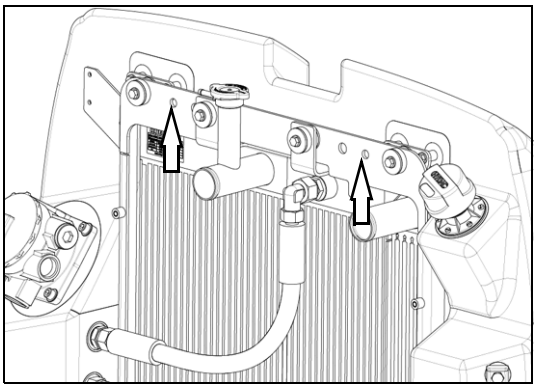


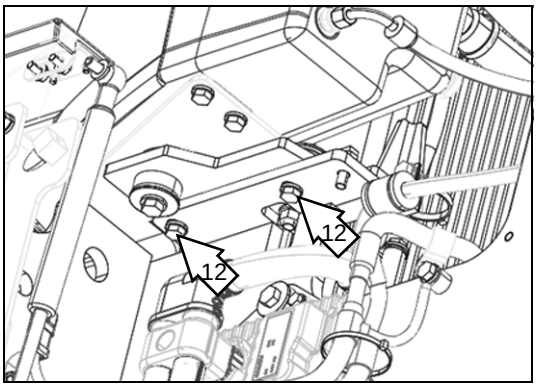
4. Removal of radiator and hydraulic tank assembly

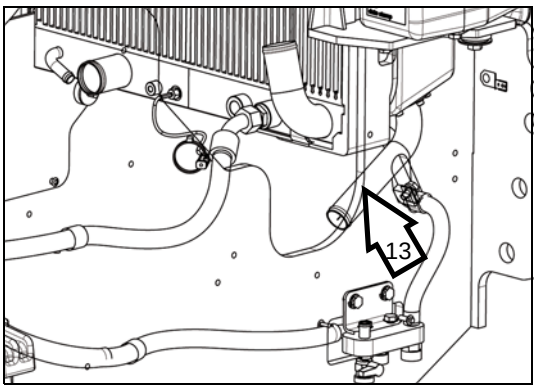
l. Mounting shackles in the holes for lifting the radiator and hydraulic tank assembly by using a crane.

m. Use the crane to safe the assembly against falling and turn over.

n. Unscrew the four fastening bolts (12) on both sides of the machine and lift the radiator and hydraulic tank assembly.







NOTE

Take care that:
1. all clamps and cables are removed
2. remove the hose (13) during lifting the assembly.
3. no other part of the machine is damaged.

kg Radiator assembly:

kg		
Radiator assembly	32 kg	WA80M-7, WA100M-7

Installation of radiator and hydraulic tank assembly

- To fit the radiator carry out the removal procedure in reverse order.

  ★ Before installing the radiator, remove any residual oil and dirt from the engine compartment.

- Make sure that the fan is not damaged in any way when replacing the radiator.

- Fill the radiator up with coolant again. See Operation Manual: COOLANT SYSTEM, CHANGING THE COOLANT AND CLEANING THE SYSTEM.

  Coolant:

Coolant:	**11.5 l**	WA80M-7, WA100M-7

- Fill the hydraulic tank with oil again and check the hydraulic oil level.

  Hydraulic oil:

Hydraulic oil:	80 l	WA80M-7, WA100M-7

Correct the oil level if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL.

Fan assembly

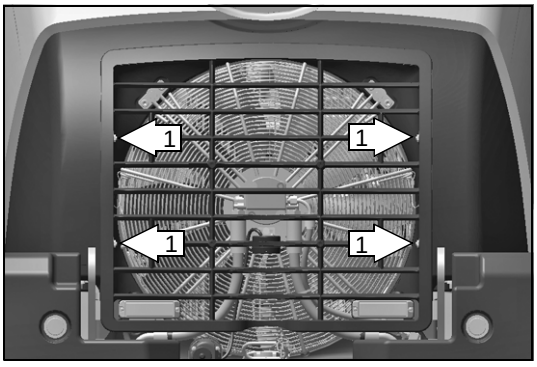
Removal of fan assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch!**

1. Remove fan

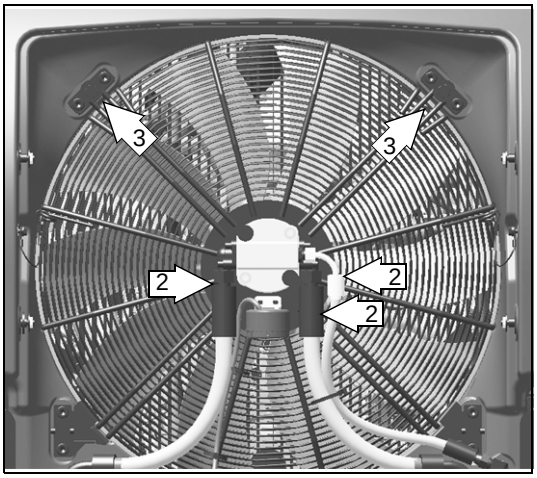
Allow residual oil and coolant will flow out of the radiator.

a. Loosen the four screws (1) and remove the radiator guard. ✳1



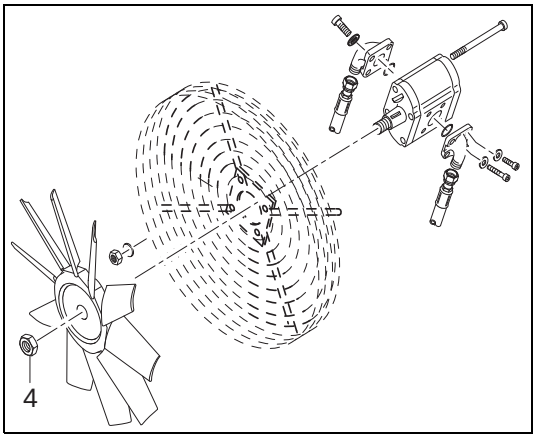
b. Disconnect the three hydraulic hoses (2) from the fan drive.

c. Unscrew the both fastening screws (3) to get access to the back side of the fan.



d. Unscrew the nut (4) from the hydraulic engine and remove the fan.

✳2



Installation of fan assembly

- To fit the fan and pulley carry out the removal procedure in reverse order.

✳ 1

kgm Screw: **10 Nm**

✳ 2

kgm Screw: **70 Nm**

Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL.

Water pump assembly

Removal of water pump assembly

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

1. Draining the coolant ✳1

See Operation Manual: MAINTENANCE AFTER REQUIRED (corrective maintenance)- Cooling system-cleaning internal area the cooling system

Coolant: **l**

Coolant:	**11.5 l**	WA80M-7, WA100M-7

2. Removal

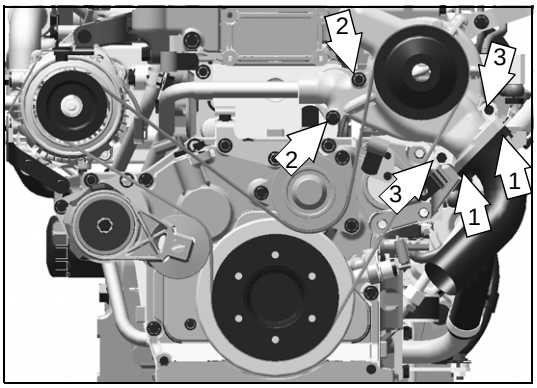
a. Remove the V-belt.
See "Removal of alternator assembly" on page 30-8.

b. Unscrew the two fastening screws (1) of the connecting flange from the hose.

c. Unscrew the four fastening screws (2) and (3) and remove the water pump.

✳1

kg Water pump: **7 kg**



Installation of water pump assembly

- To fit the water pump carry out the removal procedure in reverse order.
- Replace the O-rings with new ones.
- Mount the V-belt.

  See "Installation of alternator assembly" on page 30-9.

- Top the radiator up with coolant.

  See Operation Manual: MAINTENANCE AFTER REQUIRED (corrective maintenance)- Cooling system-cleaning internal area the cooling system

  Coolant:

Coolant:	**11.5 l**	WA80M-7, WA100M-7

Engine assembly

Removal of engine assembly

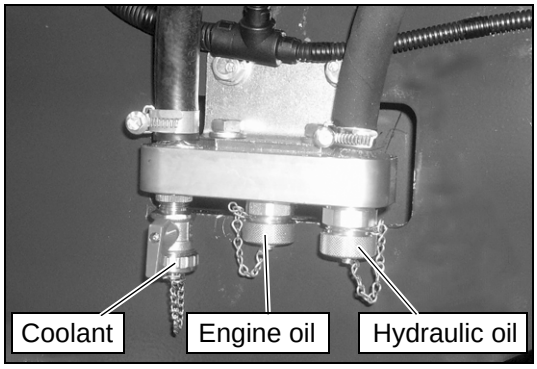
- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the E.C.S.S. system. See on page 30-5**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch!**

- Remove the counterweight.
  See "Removal of counterweight assembly" on page 30-10.
- Remove the engine cover.
  See "Removal of engine cover assembly" on page 30-12.

3. Draining the coolant ✳ 1

See Operation Manual: MAINTENANCE AFTER REQUIRED (corrective maintenance)- Cooling system-cleaning internal area the cooling system.

Coolant:	**11.5 l**	WA80M-7, WA100M-7



4. Draining the engine oil ✳ 2

See Operation Manual: ENGINE, CHANGE ENGINE OIL.:

Engine oil:	**11.5 l**	WA80M-7, WA100M-7

5. Draining the hydraulic oil ✳ 2

See Operation Manual: HYDRAULIC SYSTEM - CHANGE HYDRAULIC OIL.

Hydraulic oil:	80 l	WA80M-7, WA100M-7

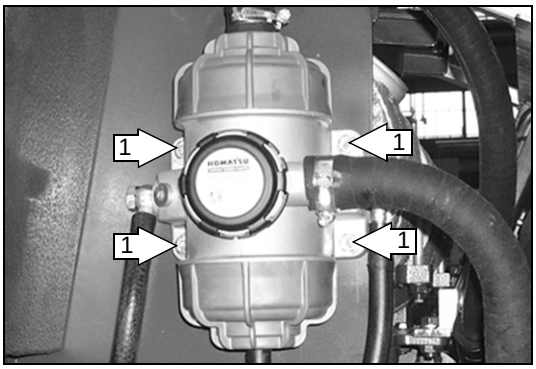
6. Removing the radiator and hydraulic tank assembly

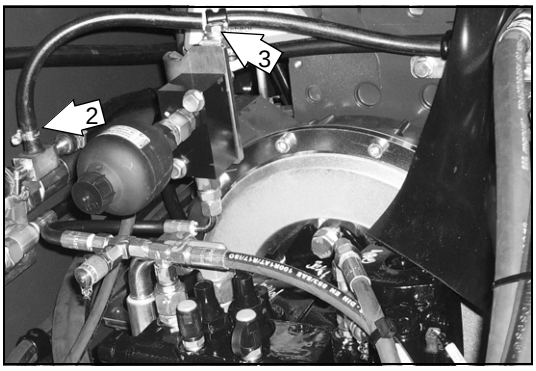
See "Removal of radiator and hydraulic tank assembly" on page 30-14.

7. Remove the bulkhead

a. Remove 4 mounting bolts (1) from the CCV filter.

b. Remove the hose (2) with clamp (3) (to CCV filter).

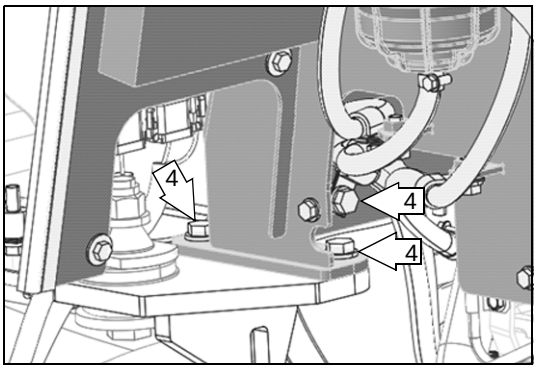


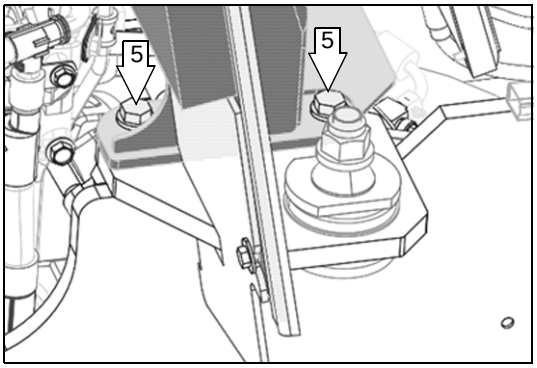


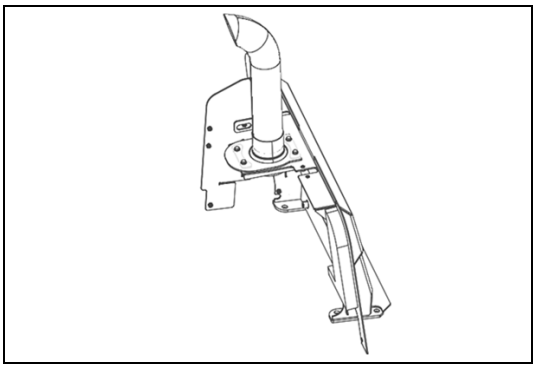
c. Remove 3 mounting bolts (4) on the left side.

d. Remove 2 mounting bolts (5) on the right side.

e. Remove the bulkhead with exhaust pipe by using crane.



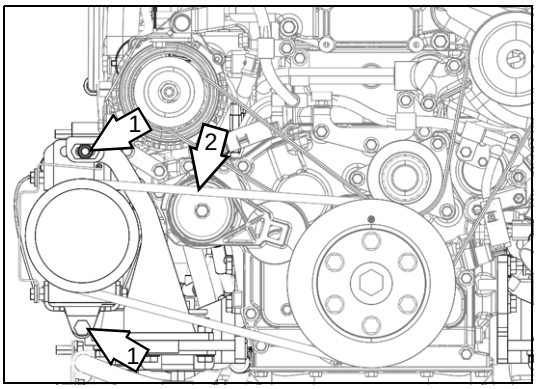




8. Remove air conditioner compressor

a. Loosen the two screws (1) of the air conditioner compressor and remove the fan belt (2).

b. Remove the two screws (1) and put the air conditioner compressor aside.

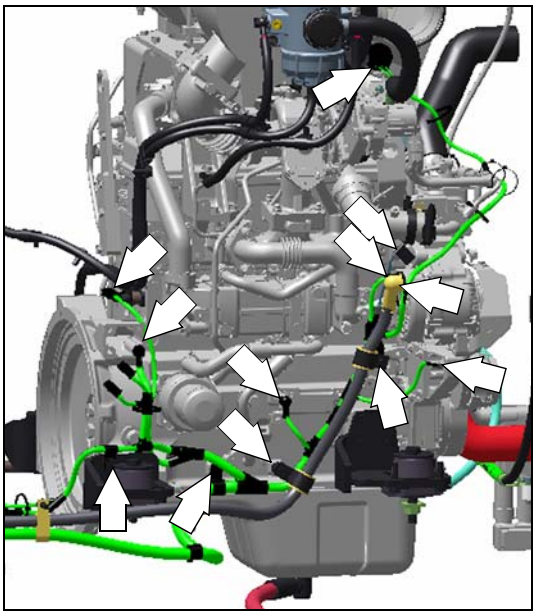


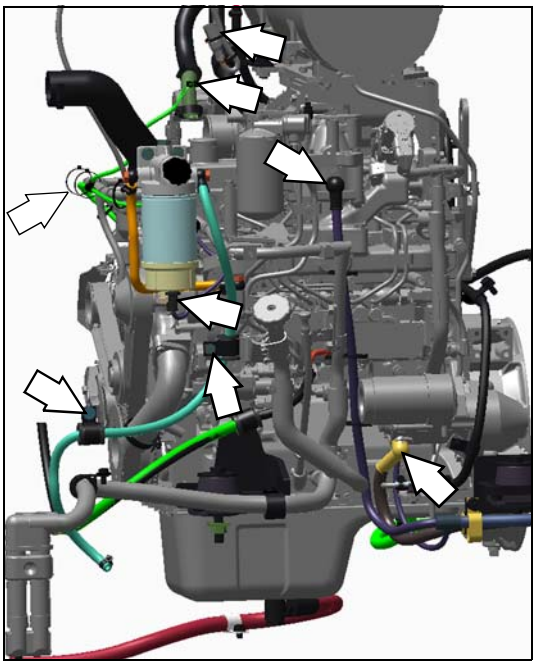
9. Electrical connections

★ Mark the cables in order to prevent flaws when reconnecting. ※3

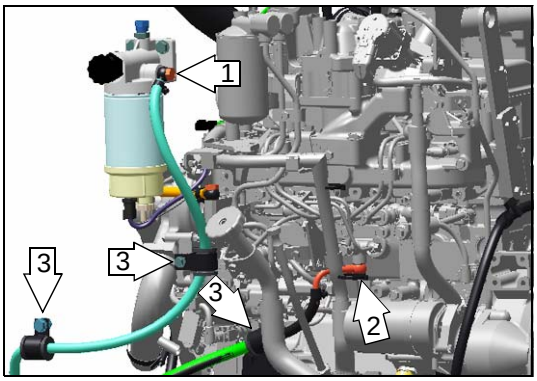
Disconnect (if equipped) the following electrical cables with fasting screws from the engine:

- Sensor air cleaner
- Connection to alternator
- Connection to starter
- Connector to sensor „water in fuel“
- Connector to magnet clutch compressor
- Sensor cooling water temperature
- Sensor engine oil pressure





10. Fuel supply lines



DANGER - Explosion hazard!
Leakage or evaporation of fuel might lead to an explosion. Avoid any source of ignition such as open flames, cigarettes or sparks. Close the fuel filter and the hoses immediately with a plug.

★ Mark the lines in order to prevent flaws when reconnecting. ✳ 4

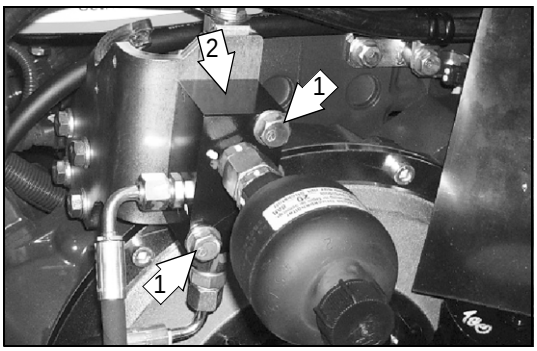
a. Disconnect the fuel supply line (1) from the fuel filter.

b. Disconnect the fuel return line (2) to the Fuel cooler.

c. Unscrew the three clams (3).

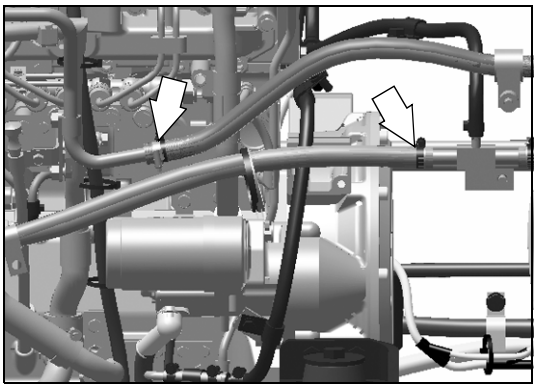
11. Brackets

Unscrew the two screws (1) and put the holder (2) including accumulator aside.



12. Heating lines

Unscrew the heating lines from the engine.



13. Variable displacement pump

See "Removal of variable displacement pump assembly" on page 30-119.

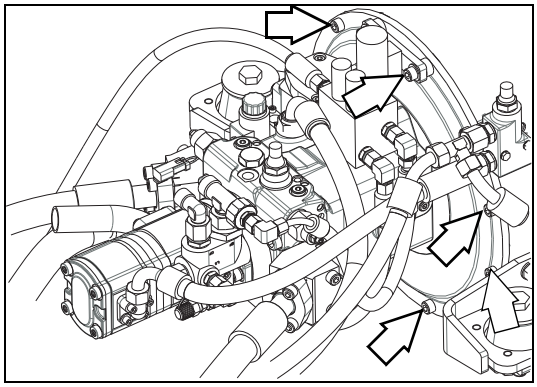
a. Unscrew the clutch cover from the flywheel housing

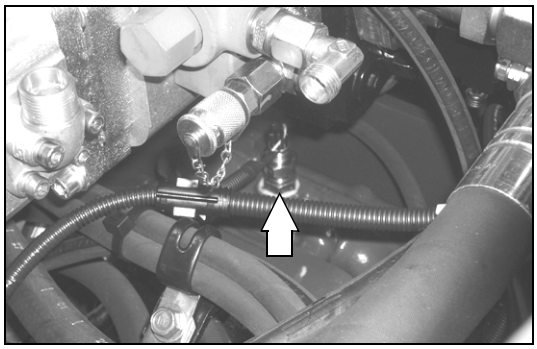
b. Suspend the variable displacement pump from a hoisting gear.

c. Pull the variable displacement pump forwards away from the engine.

★ The amount of space for removing the pump is very limited. For this reason you should ensure that no other machine parts are damaged when lifting and removing the variable displacement pump.

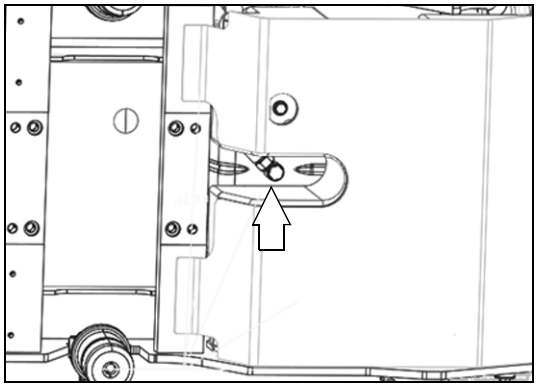
★ To avoid damage on speed sensor on transfer box hold up the variable displacement pump.





14. Engine oil drain plug

Unscrew the drain plug from the engine oil pan.



15. Engine support

a. Insert the hoist gear into the two contact lugs (1).

b. Remove the engine's four fastening screws (2) at the engine supports. ✳ 2

★ Make sure that all lines to the engine have been disconnected.

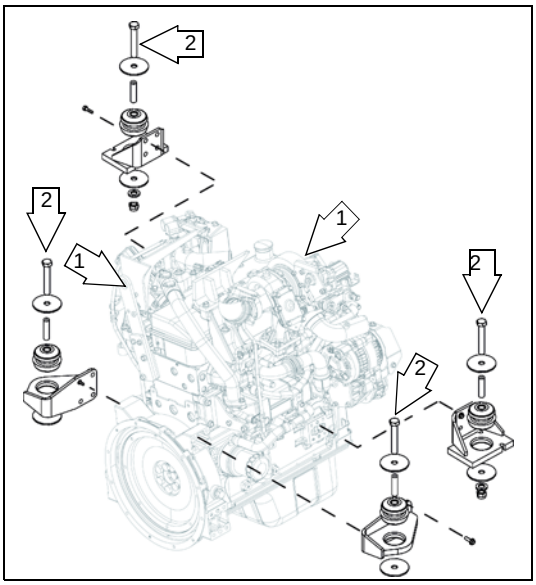
★ Place a collector tray below the engine to collect any residual fluid which may drip out.

★ When lifting the engine out of its mount keep it balanced and make sure that no other engine parts are damaged.

c. Lift the engine slowly out of its support.

kg Engine: approx.

WA80M-7	**382 kg**
WA100M-7	**382 kg**



The tasks described below are to be carried out before the new engine is installed, as some of the parts concerned are not part of the replacement engine's delivery specification. In other words, certain assemblies and parts that were mounted on the old engine will be required when installing the new engine.

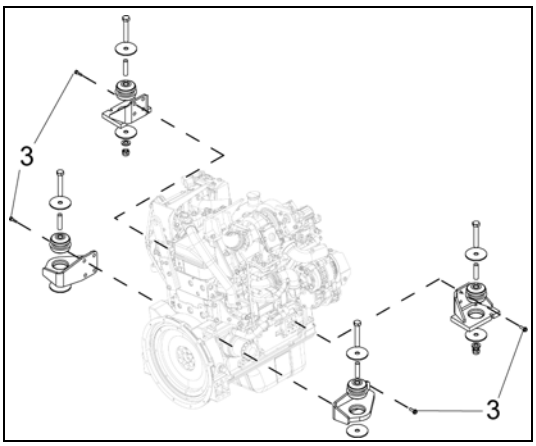
16. Clutch

See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of clutch assembly" on page 30-33.

17. Engine support

★ Mark the brackets to ensure that when the engine is installed again their position and installation location are correct.

Unscrew 16 screws (3) and (4) and remove the engine's four support brackets. ✳ 3



Installation of engine assembly

- To install the engine carry out the removal procedure in reverse order.

  ★ Before installing the engine, clean all the parts to be mounted to it and remove any residual oil and dirt from the engine compartment.

  ★ Before the new engine is installed in the machine, the parts dismantled from the old engine have to be fitted again.

※ 3

- Make sure that the engine support is in the correct position and installation location when screwing it back on.

  kgm Screws: **60 Nm**

※ 1

  kgm Screws: **200 Nm**

★ When installing the engine make sure that no other engine parts are damaged.

★ Make sure that the engine is correctly positioned and aligned precisely.

- See chapter 30 DISASSEMBLY AND ASSEMBLY "Installation of variable displacement pump assembly" on page 30-121.
- When reconnecting the hydraulic lines check that the markings coincide.
- Tighten the hollow screws carefully.
- When reconnecting the fuel lines check that the markings coincide.
- When reconnecting the electrical cables check that the markings coincide.
- Vent the fuel system.

- Fill the engine up with oil. See Operation Manual: CHANGING OIL UND OIL FILTER CARTRIDGE.

Engine oil:	**11.5 l**	WA80M-7, WA100M-7

- Fill the radiator up with coolant again.
  See Operation Manual: COOLANT SYSTEM, CHANGING THE COOLANT AND CLEANING THE SYSTEM.:

Coolant:	**11.5 l**	WA80M-7, WA100M-7

- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL.
- Vent the hydrostatic travel gear and check the function:

  Variable displacement pump and induction lines are filled with oil.

  - Open the filler pipe at the hydraulic tank.
  - Start the engine and dump the bucket.
  - Raise the lifting arm to its full extension upwards and tilt the bucket fully.
  - Let the engine continue to run and close the filler pipe on the hydraulic tank.
  - Lower the lifting arm to the ground and switch the engine off.
  - Check the oil level and top up with oil, if necessary.
  - Finally, conduct a check of the seals and the various functions.

- Check the engine speed.
  See chapter 20 TESTING AND ADJUSTING "Engine RPM" on page 20-31.

Clutch assembly

Removal of clutch assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

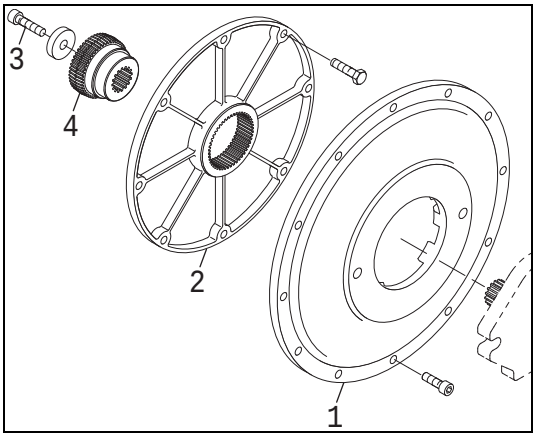
- Remove the variable displacement pump.
  See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of variable displacement pump assembly" on page 30-119.

1. Clutch

a. Unscrew the clutch cover (1) from the flywheel housing.
※ 1

b. Unscrew the clutch flange (2) from the flywheel.
※ 2

c. Unscrew the screw (3) to remove the hub (4) from the pump.



Installation of clutch assembly

- To fit the clutch carry out the removal procedure in reverse order.

※ 2

- Clean the fastening screws for the flange and apply adhesive to the screws.

  Loctite® 242 (blue) or Omnifit® 80M (red)

  kgm Screws: **49 Nm**

※ 1

  kgm Screws: **37 Nm**

※ 3

  Loctite® 242 (blue) or Omnifit® 80M (red)

  kgm Screws: **86 Nm**

- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Fuel tank assembly

Removal and installation of fuel tank assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
- **Lower the bucket, switch the engine off and actuate the parking brake!**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch!**

See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of counterweight assembly" on page 30-10.

See "Removal of engine cover assembly" on page 30-12.

See "Removal of radiator and hydraulic tank assembly" on page 30-14.

See "Removal of engine assembly" on page 30-24.

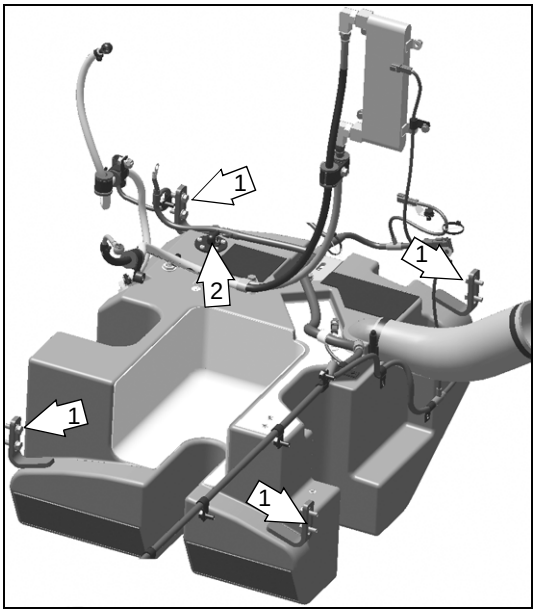
Drain the fuel.

a. Loose 8 mounting bolts (1) and remove the holder

b. Disconnect wiring connector (2) from the top of fuel tank

c. Push all hoses and cables aside and remove fuel tank with fuel cooler.

kg Fuel tank: **18 kg**



Installation

Carry out installation in the reverse order to removal.

Fueling (fuel tank)

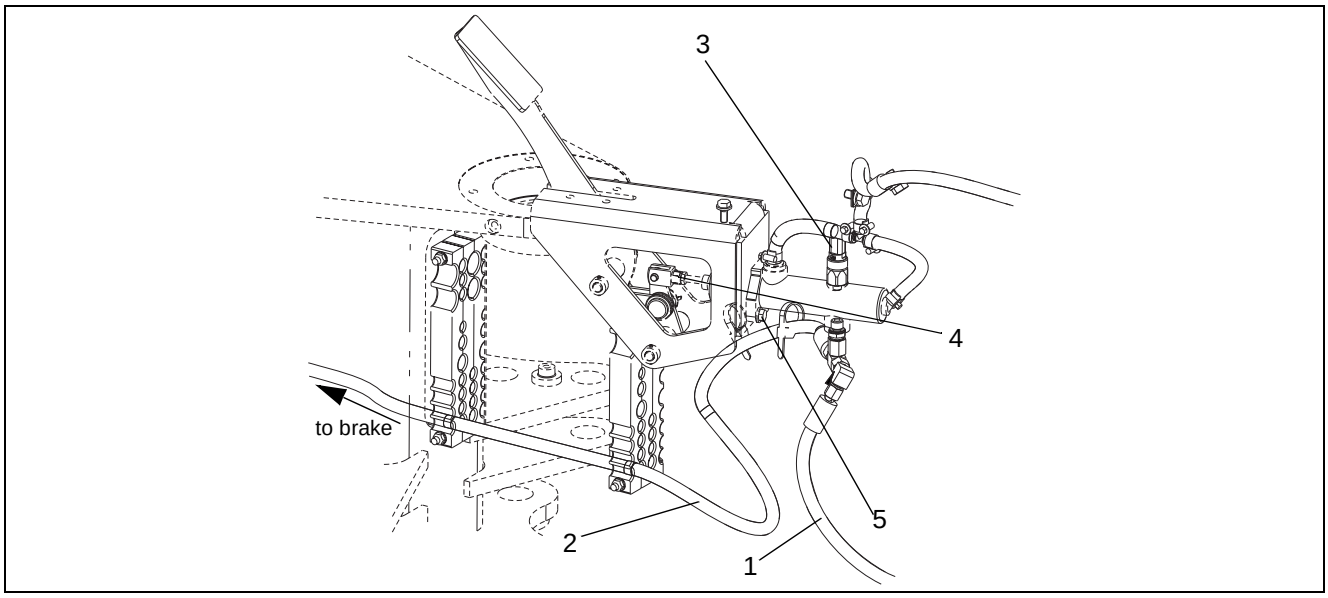
Feed fuel through the fuel filler.

Bleeding/Vent the fuel system.

Main brake valve assembly

Removal of main brake valve assembly

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!



1. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ※ 1

a. Disconnect the hydraulic line (1) and (2) from the main brake valve.

★ Close the lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

b. Disconnect the connector (3) from the main brake valve.

2. Brake pedal

Release the threaded rod's fork head (4) from the brake pedal. ※ 2

3. Main brake valve

Unscrew the two fastening screws (5) and remove the valve. ※ 3

Installation of main brake valve assembly

- To fit the inch brake valve carry out the removal procedure in reverse order.

✳ 3

kgm Screws: **35 Nm**

✳ 2

- Check the setting dimension on the inch brake valve.

  ★ See chapter 20 TESTING AND ADJUSTING "Main brake valve – basic adjustment" on page 20-45.

✳ 1

- When reconnecting the hydraulic lines make sure that the markings coincide.
- Fill the brake oil tank and lines as follows:

  ★ See chapter 20 TESTING AND ADJUSTING "Ventilation / filling up the brake circuit" on page 20-48.

- Check the oil level of the brake and top up with oil if necessary.
- See Operation Manual: MAINTENANCE PROCEDURE, EVERY 500 SERVICE HOURS, SERVICE BRAKE - CHECK BRAKE PADS AND BRAKE DISC, CHECK OIL LEVEL.

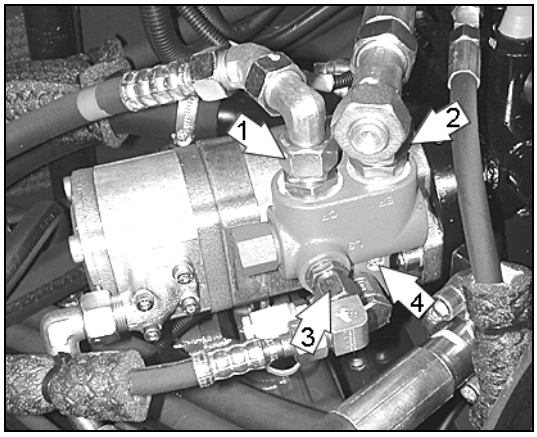
Priority valve assembly

Removal of priority valve assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the E.C.S.S. system. See on page 30-5**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

1. Hydraulic lines

★ Mark the three hydraulic lines (1), (2) and (3) to make sure that they don't get mixed up when being reconnected. ✳ 1



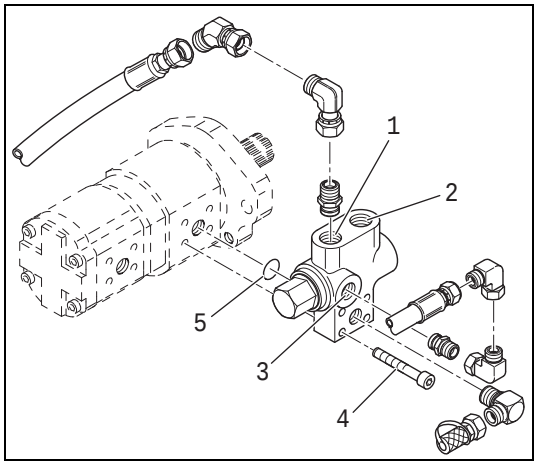
Disconnect the hydraulic lines (1), (2) and (3) from the priority valve.

★ Close the lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

2. Mounting

Unscrew the four fastening bolts (4) and remove the priority valve.

★ Take care not to loose the O-ring (5).



Installation of priority valve assembly

- To fit the priority valve carry out the removal procedure in reverse order.

※1

- When reconnecting the lines make sure that the markings coincide.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

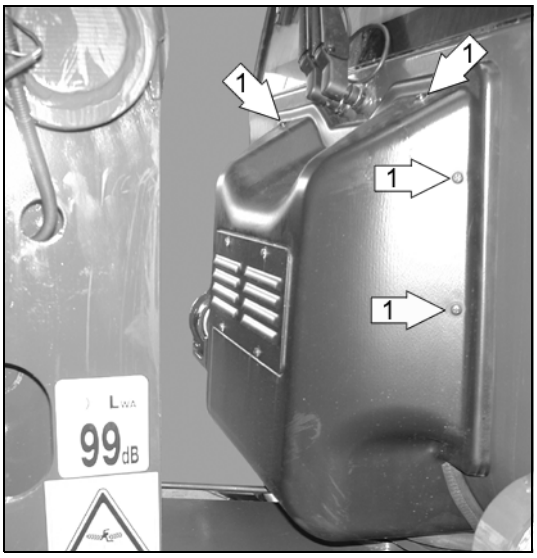
Orbit-roll-valve assembly

Removal of orbit-roll-valve assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

1. Cover

Remove the six fastening screws (1) and remove the cab's centre cover.

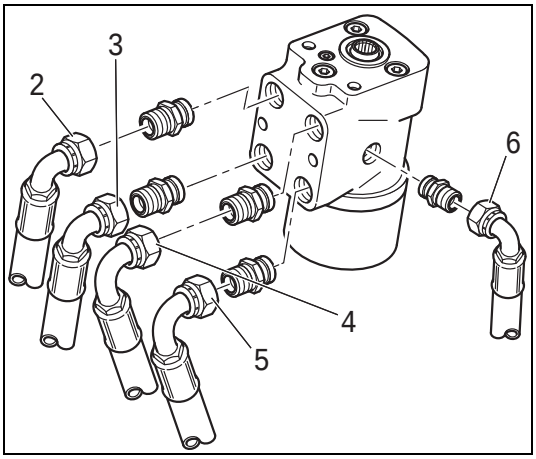


2. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ※1

Unscrew all five hydraulic lines (2) to (6) from the orbit-roll-valve.

★ Close all hoses immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

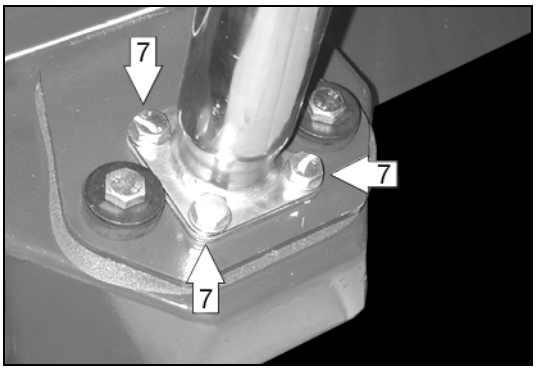


3. Orbit-roll-valve

Remove the four fastening screws (7) and withdraw the orbit-roll-valve downwards and away from the steering column's gearing.

✳ 2

kg Steering valve: **6.5 - 7 kg**



Installation of orbit-roll-valve assembly

- To fit the orbit-roll-valve carry out the removal procedure in reverse order.

※ 2

- Grease the gearing before reinstalling the steering valve.

kgm Screws: **30 Nm**

※ 1

- When reconnecting the lines make sure that the markings coincide.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

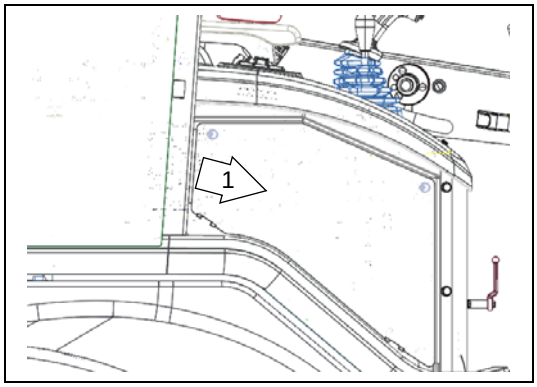
Main control valve assembly WA80M-7

Removal of pilot valve assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the E.C.S.S. system. See on page 30-5**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

1. Cladding

a. Open the right door. Unlock the cladding (1) and remove it.

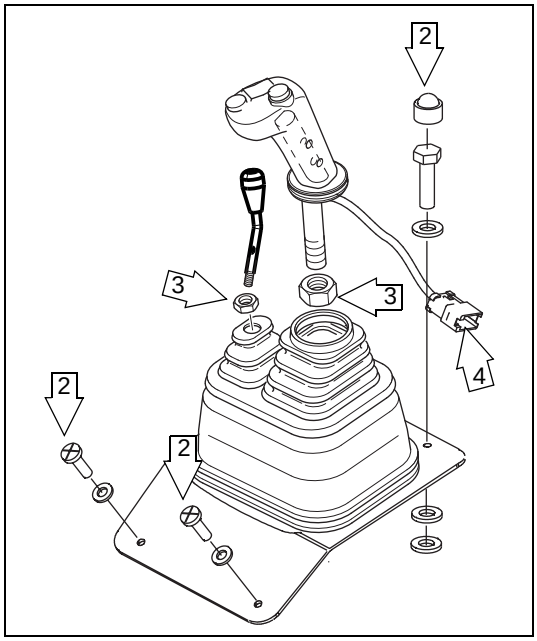


b. Unscrew the four screws (2) and remove the cover.

c. Pull the rubber collar up and loose the both lock nuts (3).

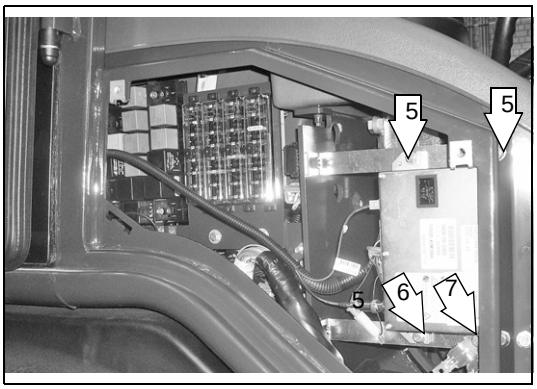
d. Disconnect the connector (4) of the multi lever.

e. Remove the both lever.



2. KOMTRAX controller

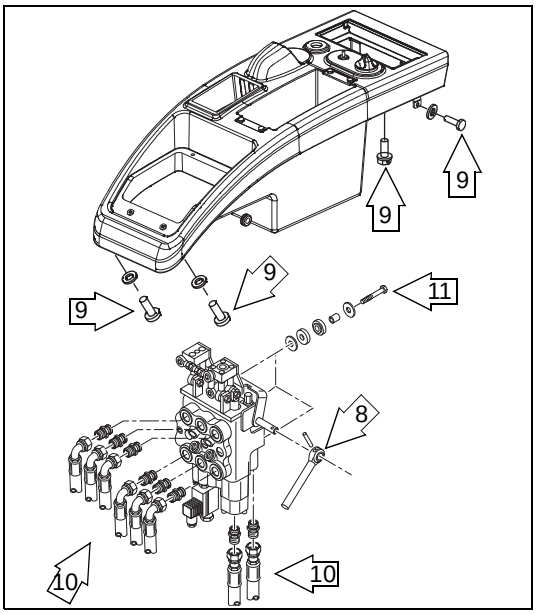
Remove the screws (5) to (7), and turn away the KOMTRAX controller.



3. Console

a. Remove the safety lock lever (8) in the operator's cab.

b. Loose the four screws (9) and remove the console. Please note that all wires are disconnected (radio, cigarette lighter etc.)



4. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ✳ 1

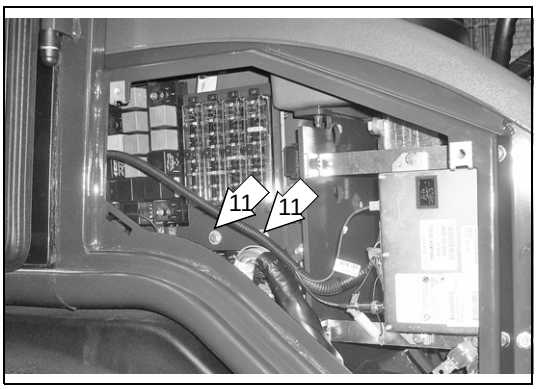
Unscrew the hydraulic lines (10) from the control valve.

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

5. Control valve

Remove the fastening screws (11), incline the control valve towards the front of the wheel loader and lift the control valve upwards out of its compartment. ✳ 2

kg Control valve: **15 kg**



Installation of main control valve assembly

- To fit the main control device carry out the removal procedure in reverse order.

✳ 1

kgm Screws: **Nm**

✳ 2

kgm Screws: **Nm**

- When reconnecting the lines make sure that the markings coincide.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Main control valve assembly - WA100M-7

Removal of main control valve assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
- **Raise the bucket to its highest position, dump the bucket completely and suspend the boom from hoisting gear.**
- **Switch the engine off and actuate the parking brake!**
- **Depressurise the E.C.S.S. system. See on page 30-5**
- **For depressurise of PPC accumulator, move the PPC lever min. 10-times in all directions.**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

1. Compartment

Unscrew the four screws and open the compartment in the front frame.

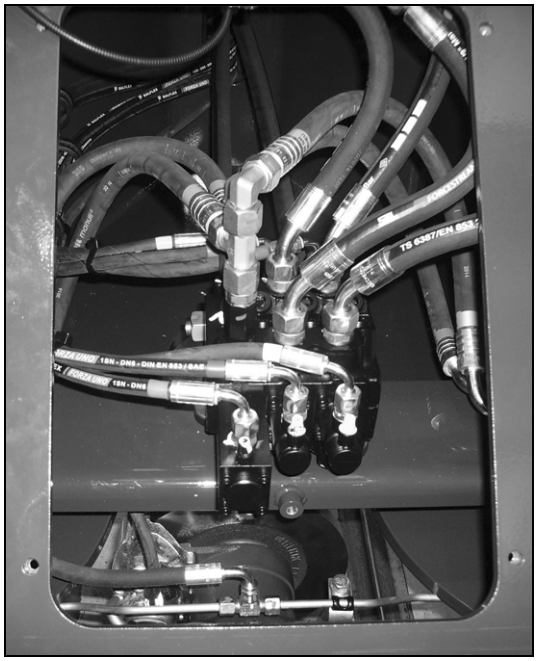
2. Hydraulic lines

DANGER of crushing!
When you disconnect the hydraulic lines, the boom will lower. Make sure the boom is secured against lowering by suspending it to a hoist before you disconnect the hydraulic lines.

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ✳ 1

Unscrew all hydraulic lines (14 in all) from the main control valve.

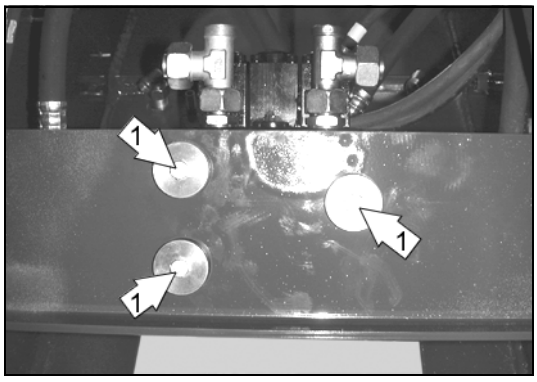
★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.



3. Main control device

Unscrew the three fastening screws (1) under the front frame and lift the main control valve out of the machine. ✳ 2

kg Main control valve: **15 kg**



Installation of main control valve assembly

- To fit the main control valve carry out the removal procedure in reverse order.

✳ 2

kgm Screws: **35 Nm**

✳ 1

- When reconnecting the lines make sure that the markings coincide.
- When reconnecting the lines vent the six PPC hydraulic lines one after the other as follows:

⚠

- **Make sure the boom ist suspended from hoisting gear!**
- **Tilt the bucket completely!**

a. Start the engine to recharge the PPC pressure accumulator.

b. Stop the engine.

c. Remove one of the six PPC hydraulic lines from the control valve and place a tray under the hydraulic line to collect leaking hydraulic oil.

d. Operate the PPC that corresponds to the removed hydraulic line for approx. 20 s.

Front side of control valve		Back side of control valve	
Hydraulic line color indication	**Operation**	**Hydraulic line color indication**	**Operation**
green	lift	yellow	lower
red	dump	blue	tilt
white	open	brown	close

e. Reconnect the hydraulic line to the control valve.

f. Repeat the steps a to e for the other five PPC hydraulic lines.

- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

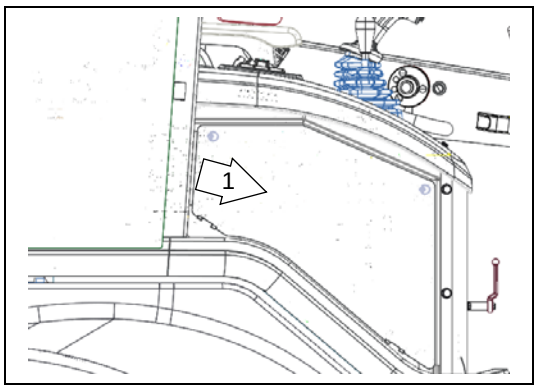
Pilot valve assembly WA100M-7

Removal of pilot valve assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the E.C.S.S. system. See on page 30-5**
- **For depressurise of PPC accumulator, move the PPC lever min. 10-times in all directions.**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

1. Cladding

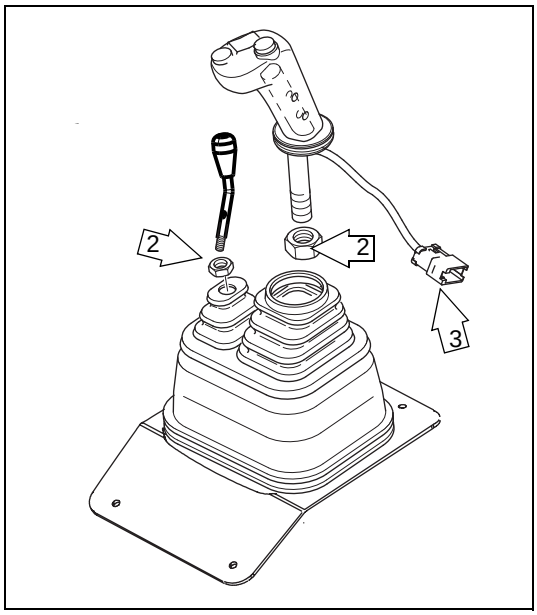
a. Open the right door. Unlock the cladding (1) and remove it.



b. Pull the rubber collar up and loose the both lock nuts (2).

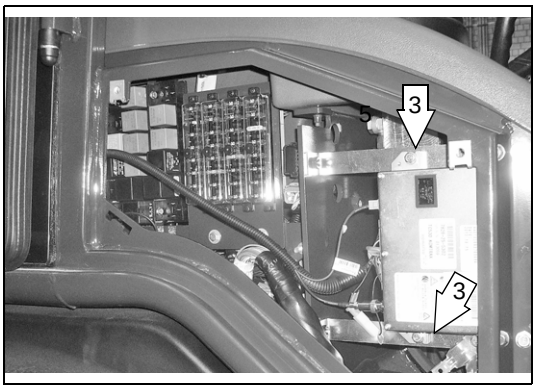
c. Disconnect the connector (3) of the multi-lever.

d. Remove the both lever.



2. KOMTRAX controller

Remove the four screws (3) and turn away the KOMTRAX controller.

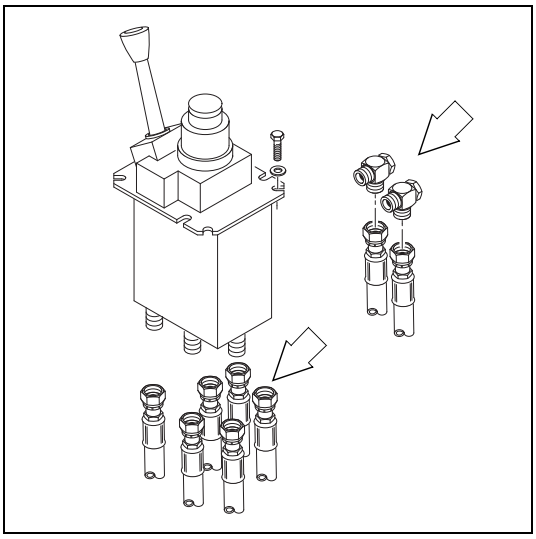


3. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ※ 1

Unscrew the hydraulic lines (8 in all) from the control valve.

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

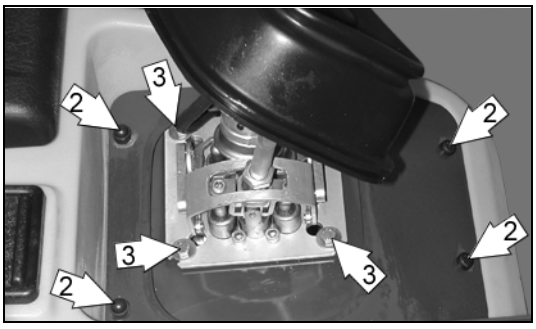


4. Pilot valve

a. Unscrew the four screws (2) ※ 2

b. Unscrew the four fastening screws (3) and remove the pilot valve. . ※ 3

kg Control valve: **25 kg**



Installation of pilot valve assembly

- To fit the pilot valve carry out the removal procedure in reverse order.

✳ 3

kgm Screws: **35 Nm**

✳ 2

kgm Screws: **35 Nm**

✳ 1

- When reconnecting the lines make sure that the markings coincide.
- When reconnecting the lines vent the six PPC hydraulic lines one after the other as follows:

Tilt the bucket completely!

a. Start the engine to recharge the PPC pressure accumulator.

b. Stop the engine.

c. Remove one of the six PPC hydraulic lines from the control valve and place a tray under the hydraulic line to collect leaking hydraulic oil.

d. Operate the PPC that corresponds to the removed hydraulic line for approx. 20 s.

Front side of control valve		Back side of control valve	
Hydraulic line color indication	**Operation**	**Hydraulic line color indication**	**Operation**
green	lift	yellow	lower
red	dump	blue	tilt
white	open	brown	close

e. Reconnect the hydraulic line to the control valve.

f. Repeat the steps a to e for the other five PPC hydraulic lines.

Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Monitor assembly

Removal of monitor assembly

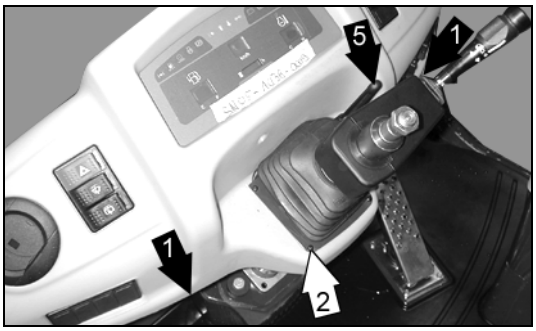
Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

1. Monitor housing

a. Remove the steering wheel.

b. Unscrew the two fastening screws (1) under the monitor housing.

c. Unscrew the four fastening screws (2), remove the bracket and lift the bellows to get access to the steering column.



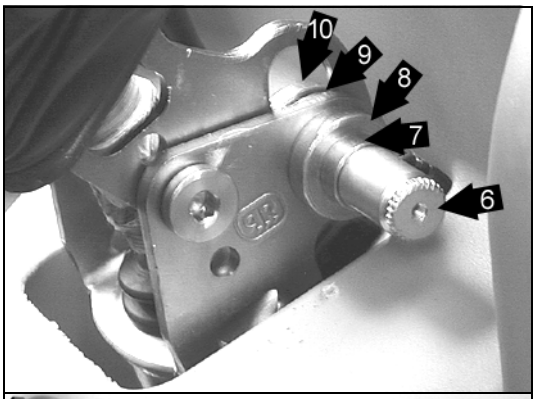
d. Unscrew the bolt (3) from the handle (5) and remove the bolt (3), the spring (4) and the handle (5).

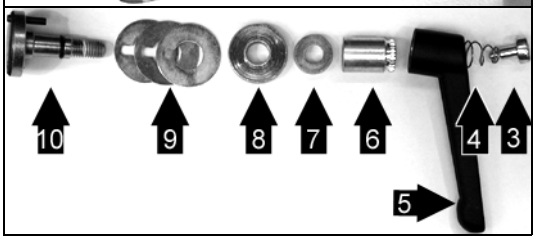
e. Unscrew the bushing (6), and remove the bushings (7) and (8), the three discs (9) and the positioner (10).

★ When removing the positioner (10) prevent any part from falling into the steering column. ※1

f. Slightly lift and incline the housing so that the electrical cables underneath the monitor are visible.

★ When handling the monitor housing do not use excessive force to pull the cables out.



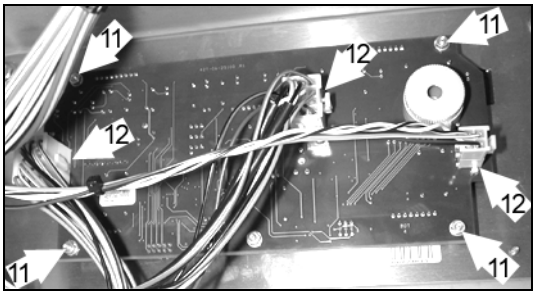


2. Electrical connections

Disconnect the three plugs (12).

3. Monitor

Unscrew the four fastening screws (11) and take the monitor out of its housing.

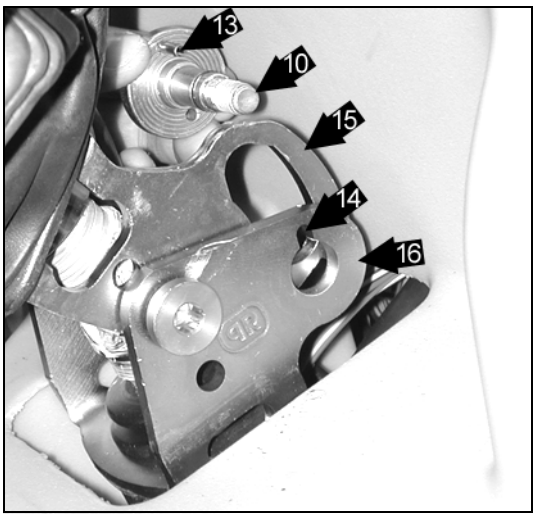


Installation of monitor assembly

- To fit the monitor carry out the removal procedure in reverse order.

※ 1

- When inserting the positioner (10) prevent any part from falling into the steering column.
- The three discs (9, see previous page) must be inserted between the two parts (15) and (16).
- The positioner's nose (13) must fit in the notch (14).



Articulated joint assembly

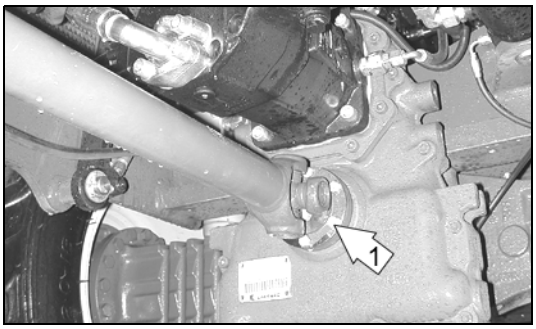
Removal of articulated joint assembly

Park the machine on level ground and secure it against rolling away and jack-knifing!
Lower the bucket, switch the engine off and actuate the parking brake!

1. Articulated joint

★ Support the articulated joint and mark its installation position before loosening the bolted connections. ※ 1

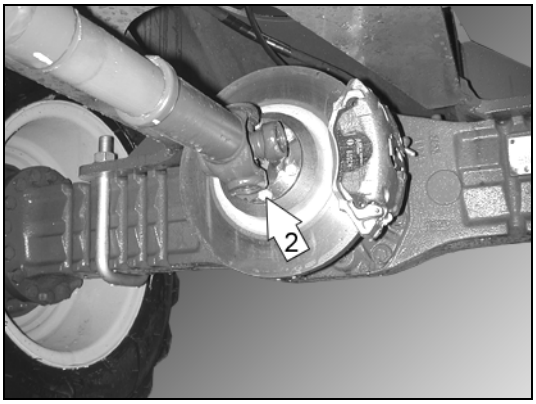
a. Remove the bolted connections (1) between the articulated joint and the transfer gear. ※ 2



b. Remove the bolted connections (2) between the articulated joint and the front axle. ※ 3

c. Remove the articulated joint.

kg Articulated joint: **22 kg**



Installation of articulated joint assembly

- To fit the articulated joint carry out the removal procedure in reverse order.

※ 1

- When reinstalling the articulated joint make sure that the installation position lines up with the markings.
- Align the universal joints to each other.

※ 3 ※ 2

- Tighten the bolts in a crosswise pattern.

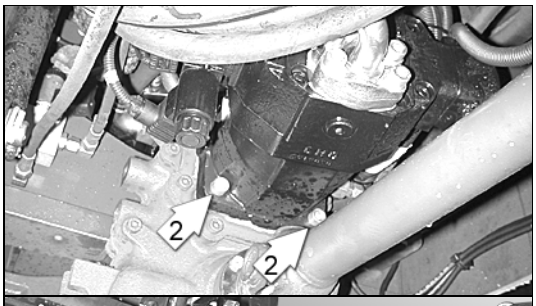
  kgm Screws: **70 Nm**

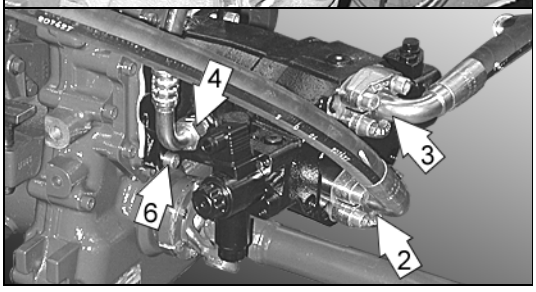
Variable motor assembly

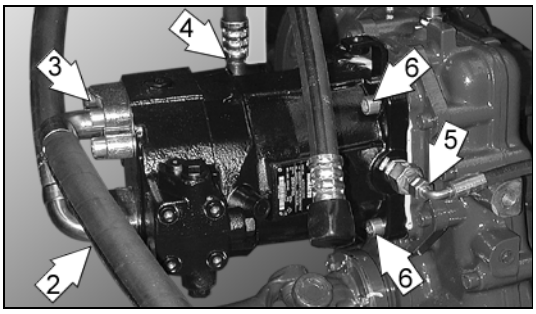
Removal of variable motor assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and actuate the parking brake!
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

- Remove the articulated joint.
  See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of articulated joint assembly" on page 30-53.







1. Draining the hydraulic oil from the radiator ✳ 2

See Operation Manual: HYDRAULIC SYSTEMS – CHANGING OIL.

Hydraulic oil:

Hydraulic oil:	80 l	WA80M-7, WA100M-7

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

2. Electrical connections

★ Mark the connectors in order to prevent flaws when reconnecting. ✳ 1

Disconnect the two connectors (1) from the solenoids.

3. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ✳ 2

a. Disconnect the two travel hydraulic lines (2) and (3) from the pipes.

b. Unscrew the hose line (4) which leads from the hydraulic oil tank to the variable motor.

c. Only 35 km/h version: Unscrew the hose line (5) leading from the variable displacement pump to the variable motor.

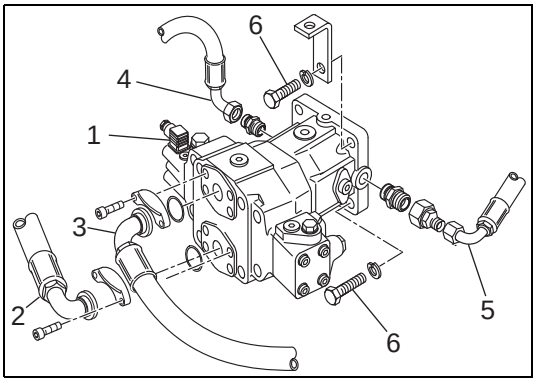
★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

4. Variable motor

a. Support the variable motor by means of a jack and secure the motor against falling to the ground.

★ Unscrew the four fastening bolts (6) and remove the variable motor. ✳ 3

kg Variable motor: **34 kg**



Installation of variable motor assembly

- To fit the variable motor carry out the removal procedure in reverse order.

✳ 3

Grease the toothing before remounting the variable motor.

kgm Screws: **115 Nm**

✳ 2 ✳ 1

- When reconnecting the lines make sure that the markings coincide.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.
- Vent the hydrostatic travel gear and check the function:

  Variable displacement pump and induction lines are filled with oil.

  - Open the filler pipe at the hydraulic tank.
  - Start the engine and dump the bucket.
  - Raise the lifting arm to its full extension upwards and tilt the bucket fully.
  - Let the engine continue to run and close the filler pipe on the hydraulic tank.
  - Lower the lifting arm to the ground and switch then engine off.
  - Check the oil level and top up with oil, if necessary.
  - Finally conduct a check of the seals and the various functions.

Rear axle assembly

Removal of rear axle assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing! Move the bucket to the transport position, switch the engine off and apply the parking brake.**
- **Danger of tipping over! Make sure that the machine cannot tip over when being lifted up.**

- Removing and/or installing the rear axle has to be performed by two people!

1. Raising the rear end

a. Slide a jack from the rear into the centre position below the rear axle and place a block of hardwood between the jack and the rear axle.

The jack's load-bearing capacity must be at least 3000 kg!

b. Raise the machine so that the rear wheels are lifted approximately 15 cm off the ground.

c. Place a supporting chock or a block of hardwood under the left and right-hand sides of the machine's rear end.

The chock's load-bearing capacity must be at least 3000 kg!

d. Lower the machine slowly to the ground and make sure that the rear end rests safely on the support chocks.

e. Lower the bucket to the ground.

2. Wheels

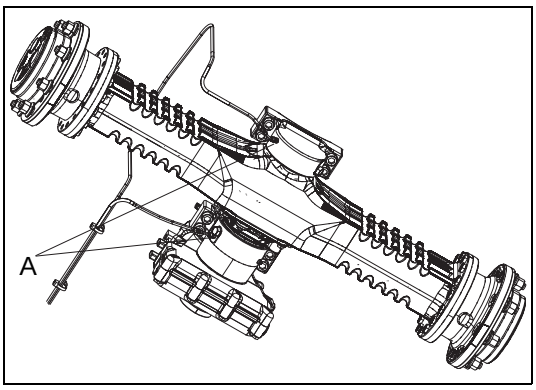
★ Make sure that the wheels cannot tip over when being removed.

a. Unscrew the wheel nuts (1). ✳ 1

b. Two people should then remove the wheel from the rear axle.

kg Wheel: **60 - 90 kg**

- Carry out the same procedure on the opposite side of the machine.
- Remove the articulated joint. See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of articulated joint assembly" on page 30-53.
- Remove the lubrication hoses (A) from the swing-axle bearing box.



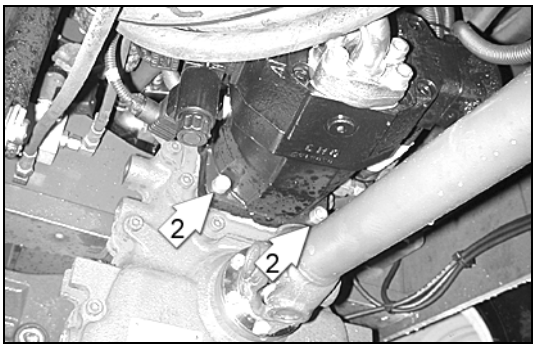
3. Variable motor

a. Support the variable motor and secure it against falling to the ground.

b. Unscrew the four fastening bolts (2) and remove the variable motor from the transfer gear. ✳ 2

c. Leave the variable motor attached to the rear frame and fasten it so that the rear axle dismantling process is not inhibited in any way.

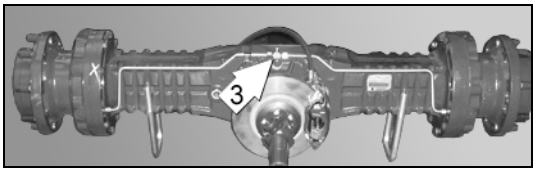
kg Variable motor: **34 kg**



4. Brake lines (applies to WA80M-7 and WA100M-7)

Unscrew the hose lines (3) at the t-connection.

★ Close the tank inlet and the t-connection immediately with vent plugs in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.



5. Parking brake's control cable

Unhook the control cable from the brake lever. ✳ 3

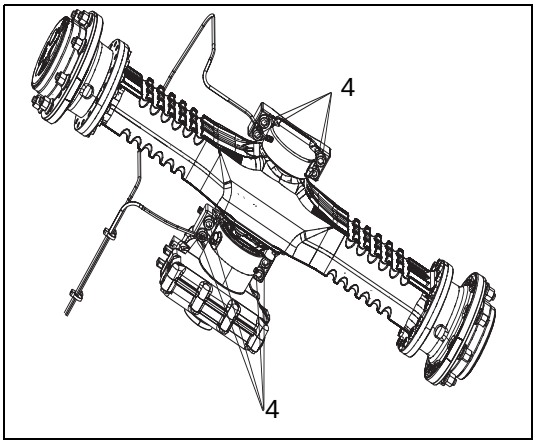
6. Axles

a. Slide the jack under the rear axle at the centre and place a block of hardwood between the jack and the axle. Make sure that the jack is tightly pressed up against the axle.

b. Unscrew the 8 tightening screws (4). ✳ 4

c. Lower the rear axle together with the transfer gear slowly to the ground and then withdraw the entire axle from underneath the machine.

kg Rear axle with transfer gear: **272 - 336 kg**



Installation of rear axle assembly

- To fit the rear axle carry out the removal procedure in reverse order.

※ 4

kgm Screws: **800 Nm**

※ 2

kgm Screws: **115 Nm**

※ 1

kgm Nuts: **400 - 450 Nm**

※ 3

- Bleed the brake system. See chapter 30 DISASSEMBLY AND ASSEMBLY "Installation of main brake valve assembly" on page 30-37.

Front axle assembly

Removal of front axle assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing! Lower the bucket, switch the engine off and apply the parking brake.**
- **Danger of tipping over! Make sure that the machine cannot tip over when being lifted up!**

- Removing and/or installing the rear axle has to be performed by two people!
- Remove the articulated joint. See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of articulated joint assembly" on page 30-53.
- Remove the disc brake. See chapter 30 DISASSEMBLY AND ASSEMBLY "Brake disc group" on page 30-64.

1. Raising the front end

a. Press the bucket down onto the ground so that the machine's front wheels lift approximately 15 cm off the ground.

b. Place a supporting chock or a block of hardwood on the left and right-hand sides of the machine's front end.

The chock's load-bearing capacity must be at least 3000 kg!

2. Wheels

★ Make sure that the wheel cannot tip over when being removed.

a. Unscrew the wheel nuts. ✳ 1

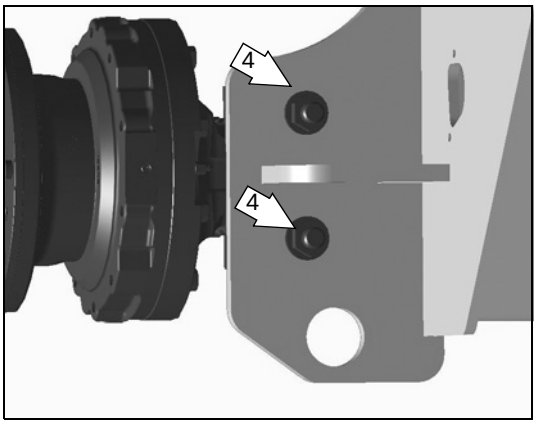
b. Two people should then remove the wheel from the front axle.

kg Wheel: **60 - 90 kg**

- Carry out the same procedure on the opposite side of the machine.

3. Axles

a. Slide the jack under the front axle at the centre and place a block of hardwood between the jack and the axle. Make sure that the jack is tightly pressed up against the axle.



The chock's load-bearing capacity must be at least 2000 kg!

b. Unscrew the stirrup bolts located on both sides of the axle. ✳ 2

c. Lower the front axle together with the transfer gear slowly to the ground and then withdraw the entire axle from underneath the machine.

kg Front axle: **240 - 302 kg**

Installation of front axle assembly

- To fit the front axle carry out the removal procedure in reverse order.

✳ 2

kgm Stirrup bolts: **800 Nm**

✳ 1

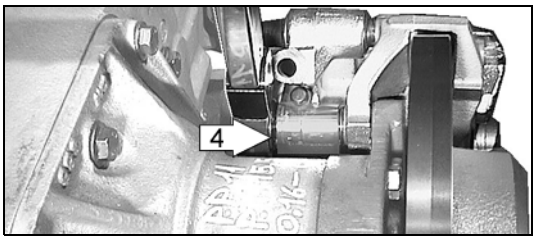
kgm Wheel nuts: **400 - 450 Nm**

Front axle

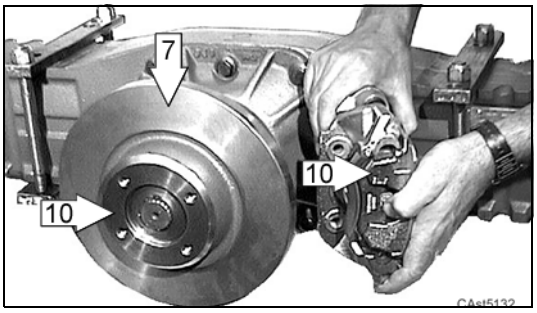
Brake disc group

Disassembly

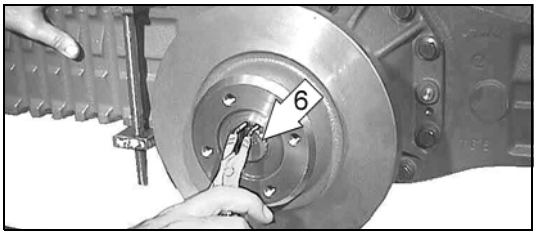
1. Unscrew the bolts (4).



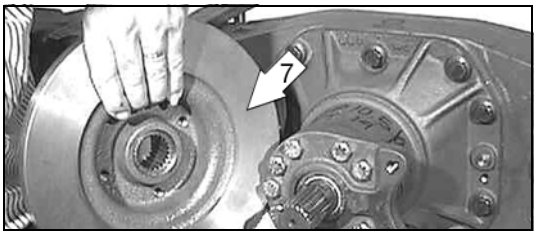
2. Remove the brake calliper (5) from the support (10) and from the brake disc (7).



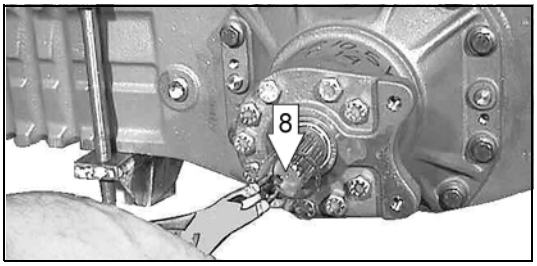
3. Remove the snap ring (6).



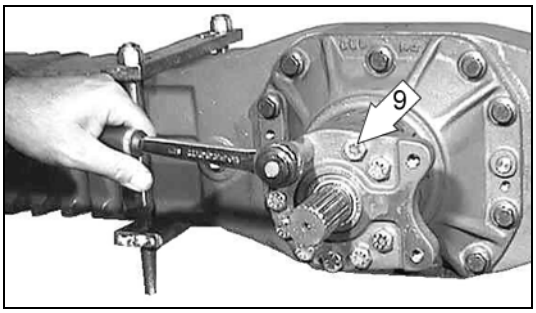
4. Remove the brake disc (7).



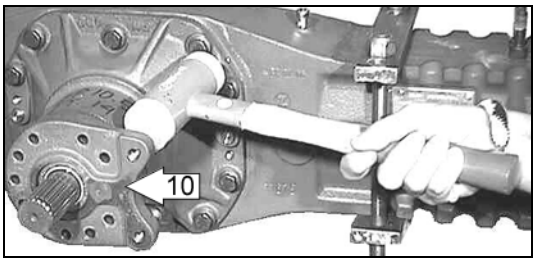
5. Remove the snap ring (8).



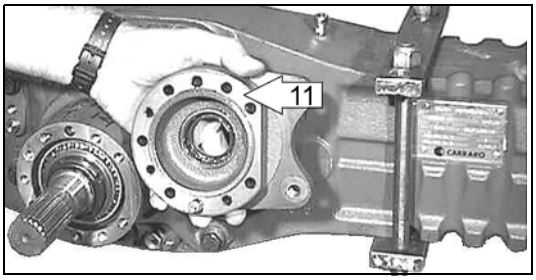
6. Unscrew the bolts (9).



7. Remove the brake calliper support (10).

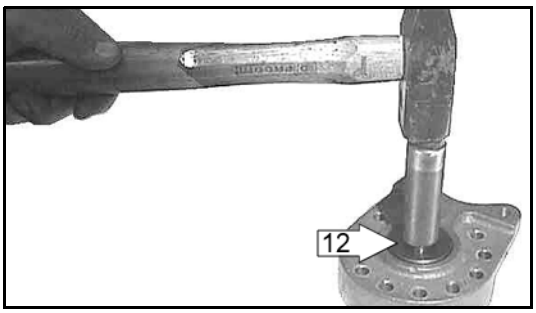


8. Only if necessary remove the dowel pin (11).



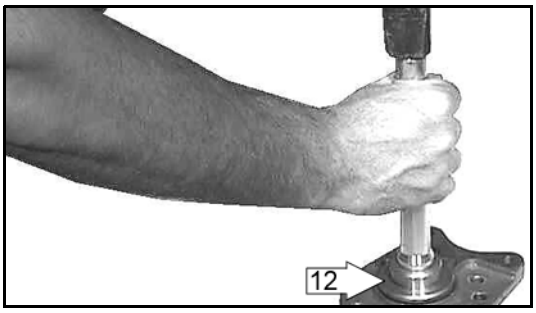
9. Remove the seal ring (12).

NOTE
This is a destructive operation for the seal ring.



Assembly

1. Assemble the seal ring (12) into the brake calliper support (10) with special tool CA715476.



2. Before matching worked surfaces, make sure they are perfectly clean.
3. Degrease and clean with appropriate detergents.
4. Spread a film of grease on the contact surface of the brake calliper support and the differential support (2).

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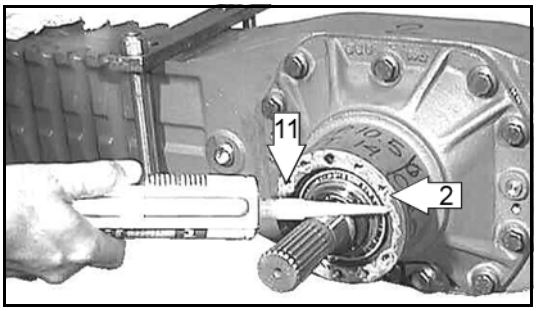
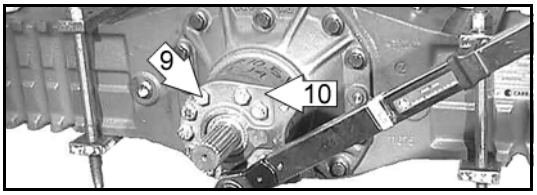


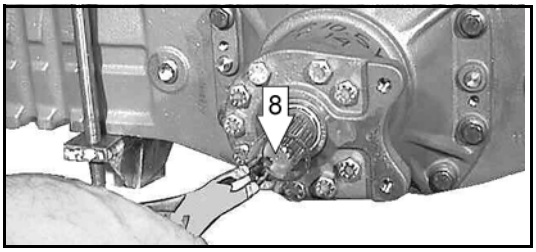
Check that the dowel pin (11) is in its seat.

5. Assemble the brake calliper support (10) with the bolts (9).
6. Tighten the bolts (9).

   kgm **50 Nm**

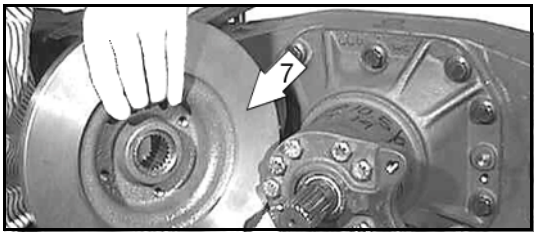


7. Insert the snap ring (8) on the pinion end.



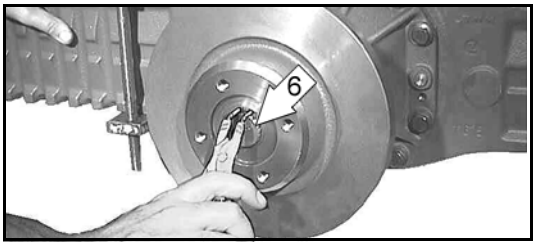
NOTE
Heat up the brake disc for a better assembling.

8. Assemble the brake disc (7).

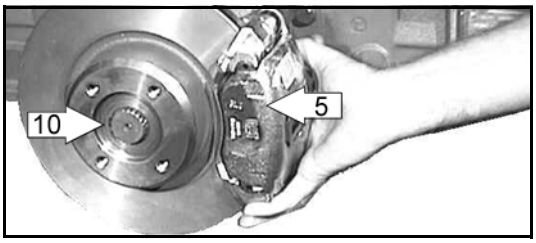


The brake disc is very hot after heating up! Use gloves!

9. Assemble the snap ring (6).



10. Assemble the brake calliper (5) on the support (10) with the fastening bolts (9).



11. Apply sealant on fastening bolts (9).

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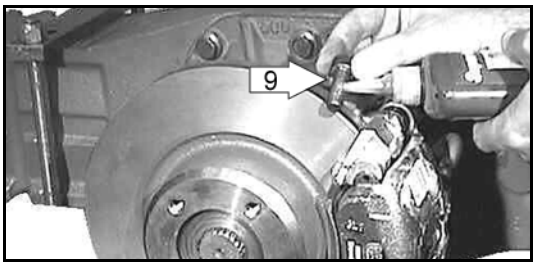
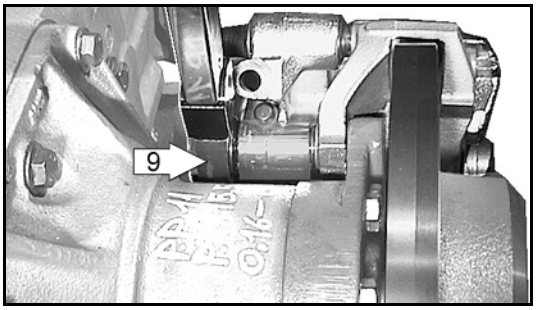


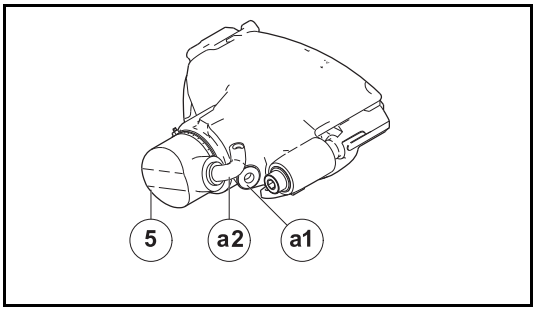
12. Tighten the bolts (9).

169 Nm



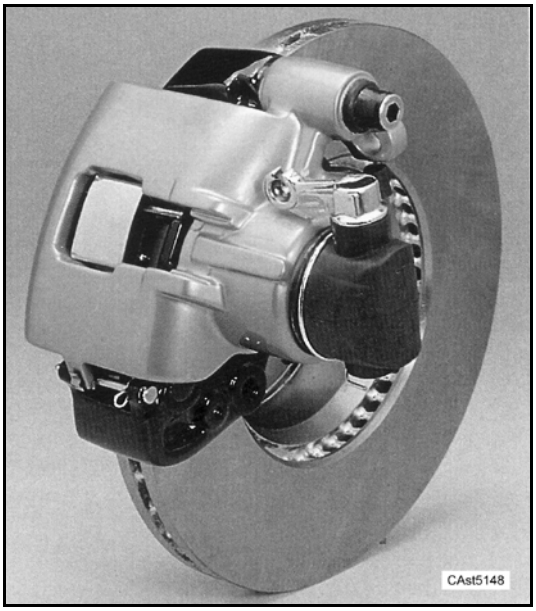
13. Check the brake calliper correct running blowing 5 bar pressure air into the hole (a1).

Warning: never apply the brake lever (a2) during brake calliper assembly.



Brake calliper

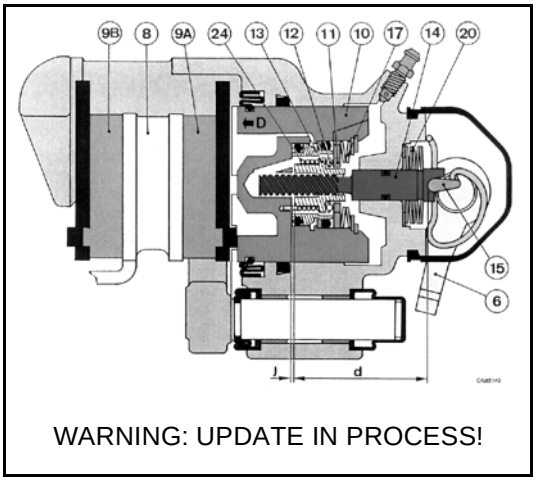
All checking the disassembly and assembly instructions have been taken from the brake caliper manufacturer manual of CARRARO. KOMATSU is not responsible for any change made by the manufacturer.



Hydraulic principle of operation

When the brakes are applied, hydraulic pressure acts on the brake piston (10) moving it in the direction indicated by arrow “D” and causing the pad to be applied to the disc (8).

While increased pressure ensures harder braking, it also results, above a predetermined threshold, in the actuation of the auto-adjust-mechanism as follows:
when washer (II) bears on thrust ball bearing (12), it causes adjusting nut (13), mounted on threaded rod (14), to rotate while rod rotation is prevented by pusher (15) and lever (6).
At the same time, coil spring (24), attached to the brake piston (10), is unwound a little, allowing the adjusting nut to rotate. The mechanical brake (parking brake), actuated through lever (6), is thus automatically adjusted each time the footbrake is applied.

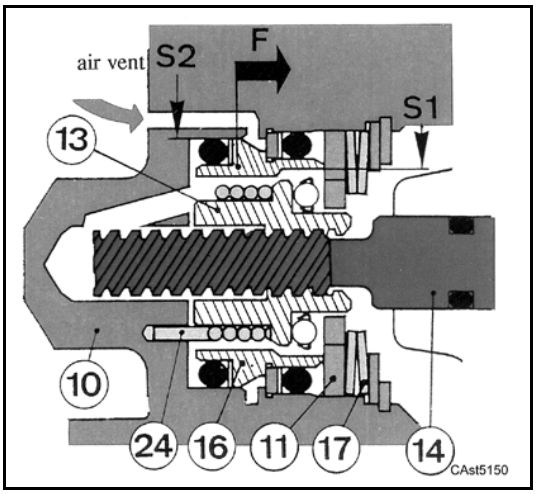


WARNING: UPDATE IN PROCESS!

Differential position

Compensation of parking brake auto-adjustment basic principle

Aim: To maintain constant adjustment of parking brake linkage by increasing distance “d” to match pad wear. Above a certain predetermined pressure, the hydraulic forces acting on the pressure faces of differential piston (16) are out of balance, causing it to move. Since the cross-section of face S2 is larger than that of face SI, the piston moves in the direction of arrow “F”. The piston (16) compresses elastic washers (17), relaxing the force acting on adjusting nut (13), thus avoiding any risk of over-adjustment due to caliper deflection of the compressibility of the pad friction material.

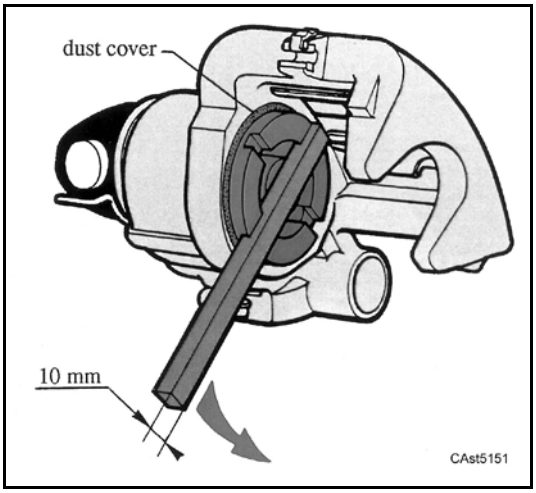


Mechanical principle of operation

When the parking brake is applied, lever (6) acts on pusher (15) and threaded rod (14), causing adjusting nut (13) to come into contact with brake piston (10). At the same time, the opposing (winding) force of coil spring (24) prevents the nut from rotating. Brake pad (9A) is applied directly to the disc (8) while the reaction force causes the calliper to slide sideways on its guide so pad (9B) also bears on the disc. The parking brake is thus “on”. As soon as the parking brake is released, and cable tension reduced, lever (6) is returned to its original position as a result of the relaxation of the elastic washers (20).

Calliper removal

1. Disconnect the electrical pad wear indicator leads.
2. Remove the safety clip.
3. Press down on the calliper and drift out the retaining pin.
4. Disconnect the parking brake cable.
5. Disconnect the flexible hose from the inlet port.
6. Rotate the calliper about the guide.
7. Slide the calliper off the guide.



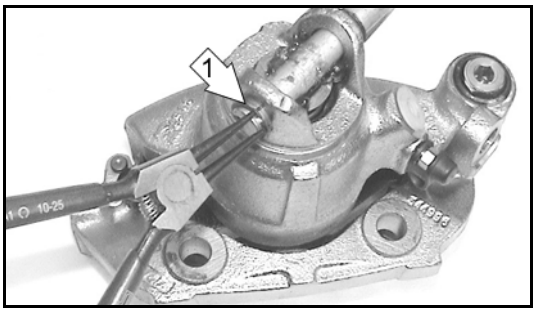
Disassembly (calliper removed)

1. Remove the piston dust cover.
2. Using a square-section tool (10 mm on a side) as indicated, unscrew the piston until it rotates freely.
3. Place a piece of wood between the piston and the calliper. Eject the piston from the calliper body by gradually applying compressed air to the inlet port. If the piston is to be reused take special care not to damage or dirty it. Clean only with unused LHM mineral brake fluid.
4. Extract the seal from its groove using a smooth, round-edged tool.

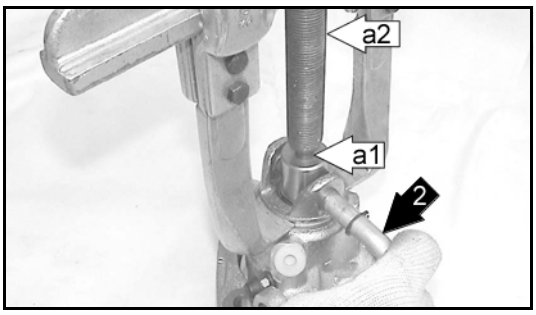
Under no circumstances should the internal piston components be disassembled.

Disassembly

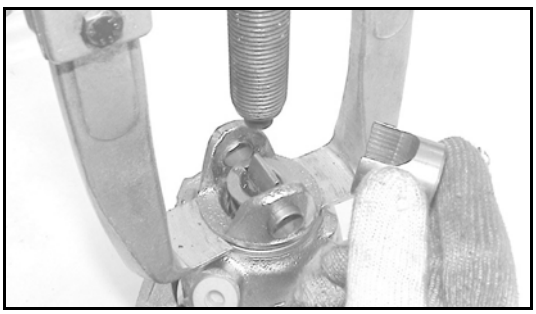
1. Remove the dust cover protecting the parking brake assembly.
2. Clean all grease off the assembly.
3. Remove the snap ring (1).



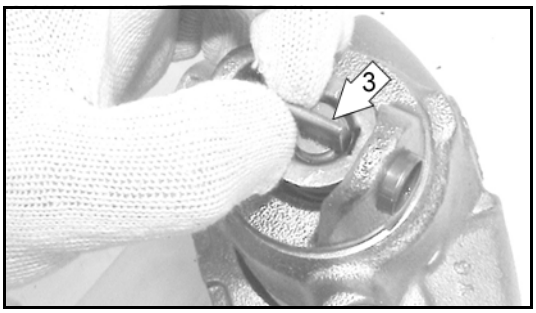
4. Fit an extractor by sliding the legs into the grooves normally intended for the lip of the parking brake assembly dust cover.
5. To compress the cover and the spring, use special tool (793-H70-0180) (a1).
6. Screw the extractor bolt (a2). Remove the cam shaft (2).



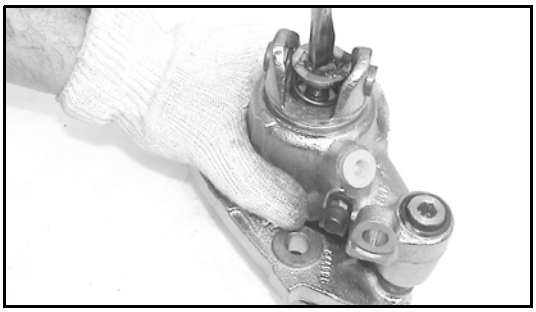
7. Remove the extractor and the special tool.



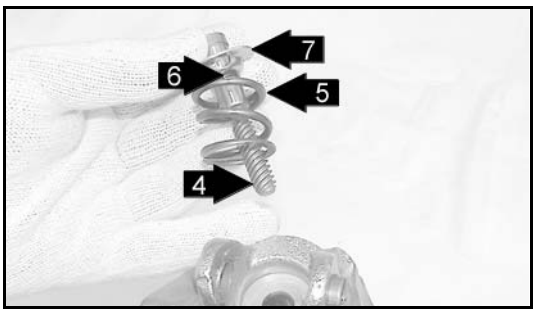
8. Remove the pusher (3).



9. Unscrew the threaded rod (4).

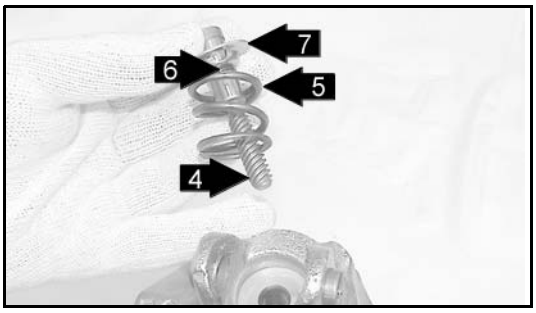


10. Remove the threaded rod (4), the helical spring (5) and the cover (7).
11. Remove the O-ring (6) from the threaded rod (4).
12. Clean the calliper body and seal groove, then dry with compressed air.

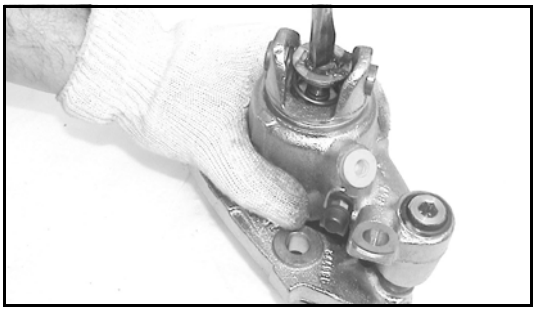


Assembly

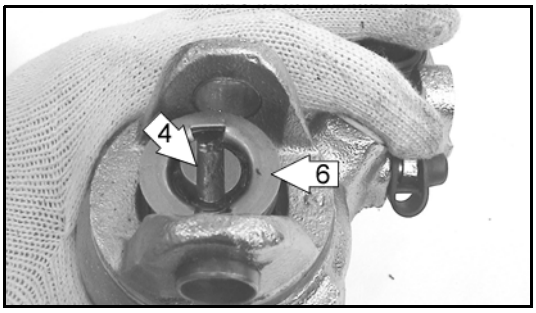
1. Apply grease to the various parts of the assembly, and most particularly to the bore receiving the threaded rod.
2. Assemble a new O-ring (6) on the threaded rod (4).
3. Assemble the threaded rod (4), the helical spring (5) and the cover (7) on the brake calliper.



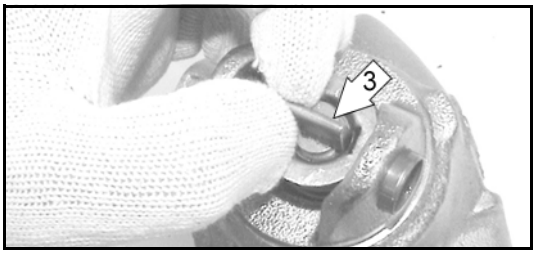
4. Screw the threaded rod (4).



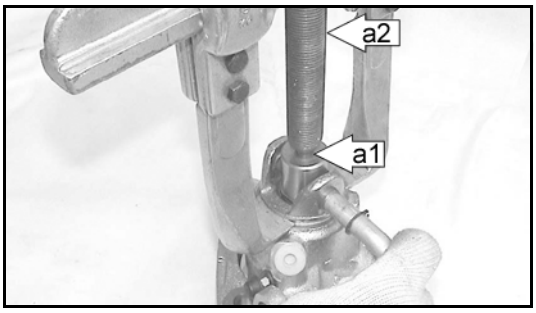
5. Place the threaded rod (4) and the cover (6) as shown in figure to allow the cam shaft (2) insertion.



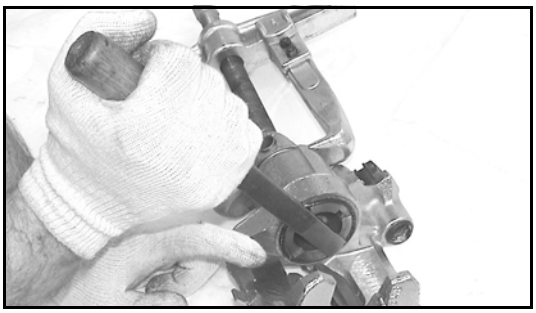
6. Grease the pusher (3).
7. Place the pusher into its seat.



8. Fit an extractor by sliding the legs into the grooves normally intended for the lip of the parking brake assembly dust cover.
9. To compress the cover and the spring, use special tool (793-H70-0180) (a1). Screw the extractor's bolt (a2).

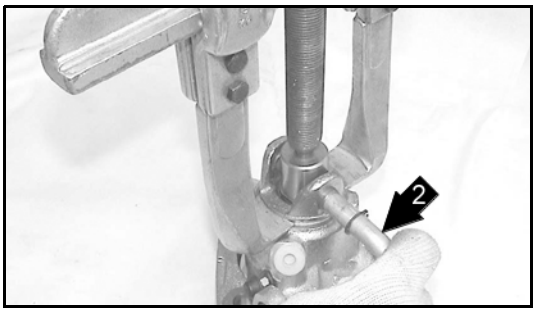


10. Screw the piston with a wrench to further compress the spring (5).

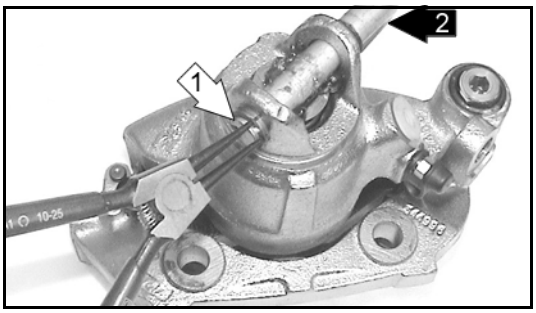


11. Insert the cam shaft (2).

12. Verify that the pusher (3) is in its seat.

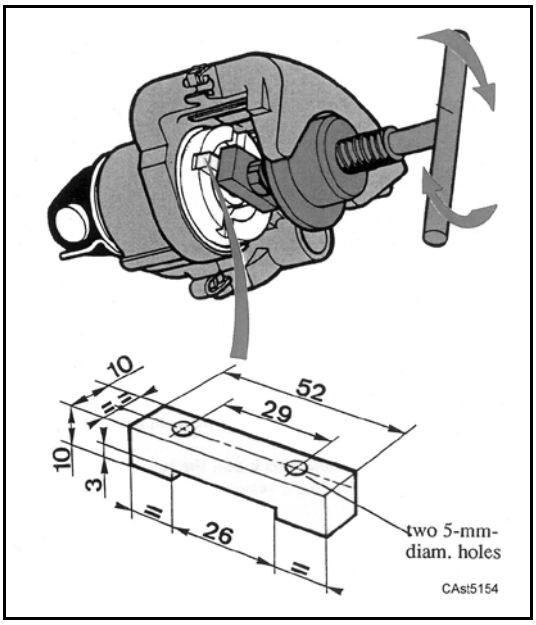


13. Lock the cam shaft (2) with the snap ring (1).



Calliper reassembly

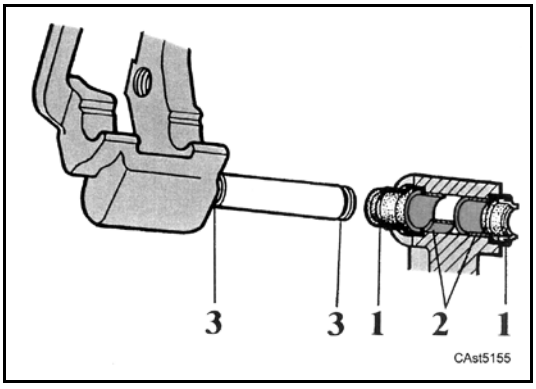
1. Dip the new piston seal into unused LHM fluid, then insert it into the groove in the cylinder body.
2. Using clean LHM fluid, lubricate the cylinder bore and piston. Insert the piston into the bore.
3. Push the piston home while rotating. This operation is facilitated by using a special tool (as illustrated).
4. Screw the piston home. Rotate the piston until the slot is perpendicular to the yoke when the calliper is locked in position, i.e. with the air vent and bleed screw in line with each other.
5. Apply mineral grease to the inner surface of the dust cover then fit to cylinder body.



Before attempting to use the parking brake, it is essential to bleed the hydraulic circuit and depress the footbrake pedal several times in order to move the pads to their normal operating positions.

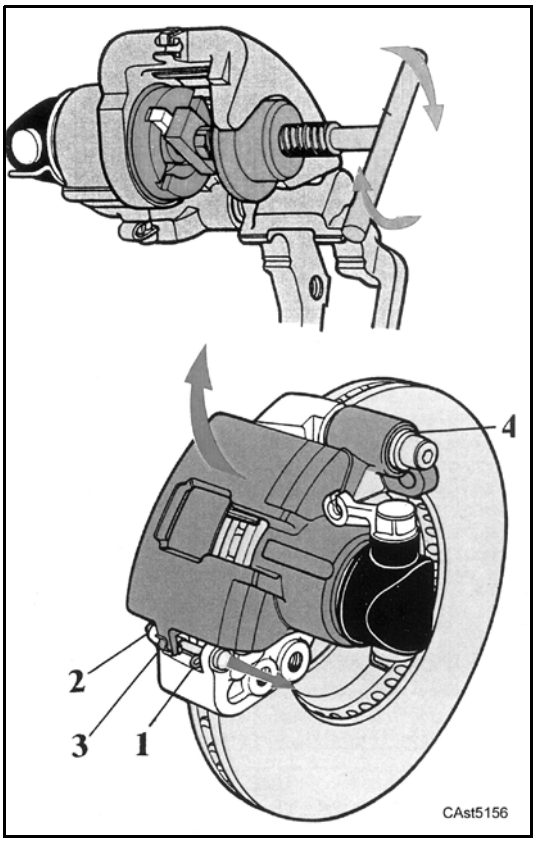
Replacement of guide protective covers

1. Do not remove the guide sleeve from the yoke.
2. Remove the complete protective covers with the bonded collars.
3. Remove grease. Replace the guide bushes (2).
4. Using a mallet and a tube with an inside diameter a little under 24 mm, fit the new protective covers (1).
5. Liberally smear the parts with the grease supplied in the sachet.
6. Slide the calliper onto the guide sleeve (3), then insert the lips of the protective covers into the grooves at each end of the sleeve.



Pad replacement

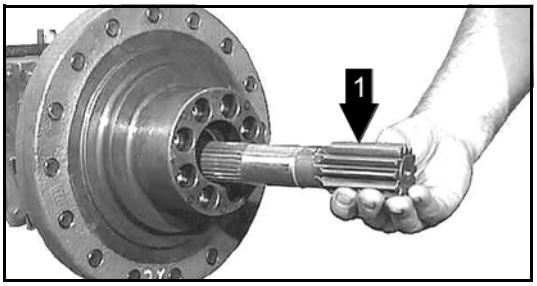
1. Disconnect the electrical pad wear indicator leads.
2. Remove the safety clip (1).
3. Press down on the calliper and drift out the retaining pin (2).
4. Rotate the calliper about the guide.
5. Remove the brake pads. Screw the piston fully down (using a special tool).
6. Rotate the piston until the slot is perpendicular to the yoke when the calliper is locked in position, i.e. with the air vent and bleed screw in line with each other.
7. Fit the new pads, making sure to place the pad with the lug on the piston side.
8. Fit the new anti-clog pin (3) supplied with the Service Kit.
9. Rotate the calliper and check that the lug on the pad fits correctly into the slot in the piston.
10. Push the calliper back to its normal position.
11. Fit the retaining pin and safety clip.
12. Feed the pad wear indicator leads through the anti-clog pin.
13. Reconnect the pad wear indicator leads.
14. Depress the footbrake pedal several times to move the pads to the normal operating position.



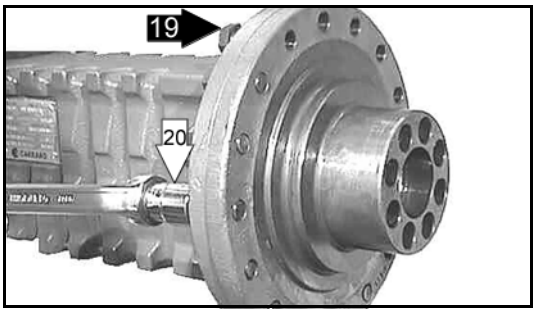
Brake group - wheel shaft

Disassembly

1. Drain the oil completely from the axle beam.
2. Remove the short half shaft (1) from the wheel shaft.

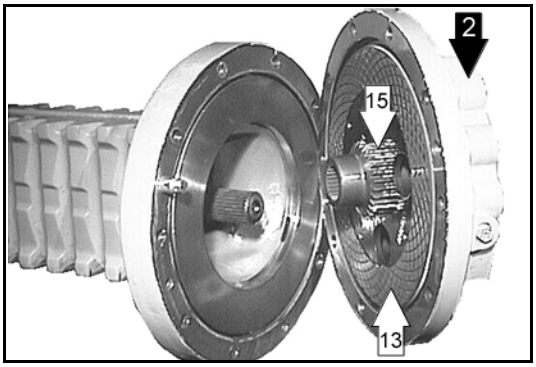


3. Remove the brake bleed plug (20).
4. Unscrew and remove the wheel shaft retaining bolts (19).

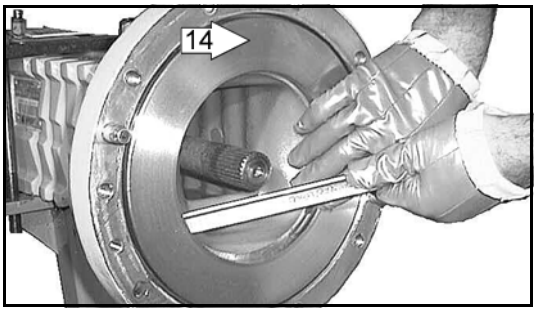


Warning: do not drop the wheel shaft; if necessary use a sling to hold it.

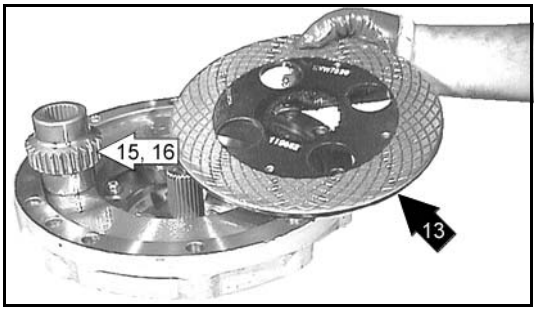
5. Remove the wheel shaft (2) carefully, making sure neither the brake disc (13) nor the brake disc carrier (15) drop out.



6. With a lever remove the counterplate (14) from the axle beam.

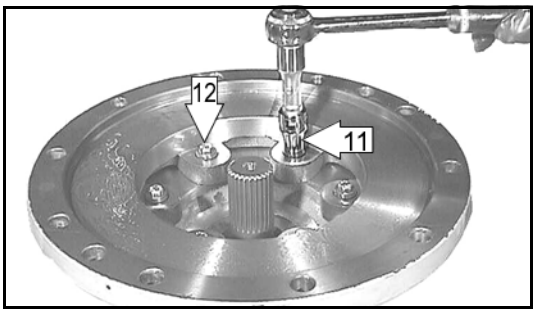


7. Remove the brake disc (13) and the brake disc carrier (15).
8. If necessary, remove the snap ring (16) inside of the brake disc carrier (15).

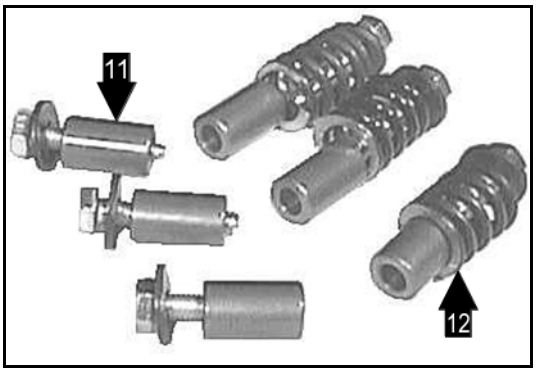


9. Unscrew and remove the screw of the self-adjust kit (11) and of the brake mechanism return kit (12).

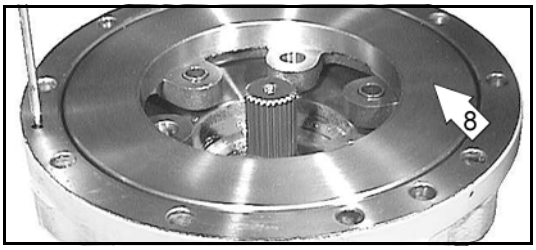
10. Remove the relevant components.



11. Check the operating and wear conditions of the kit components (11) and (12).

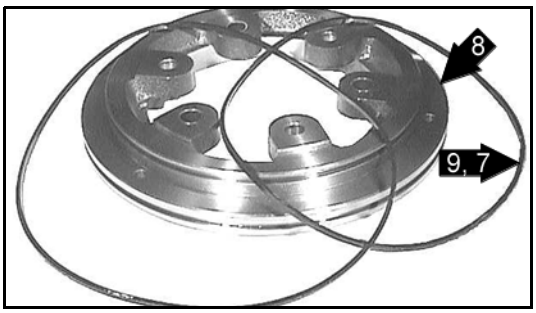


12. In order to extract the brake piston (8), use the hydraulic connection applying the lowest oil or air pressure necessary to dislodge the piston.

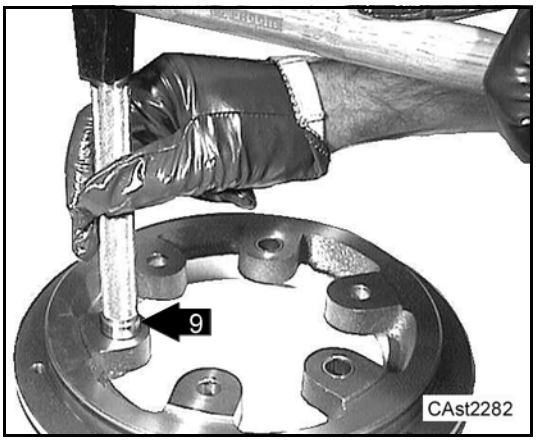


Warning: this operation must be performed with extreme care.

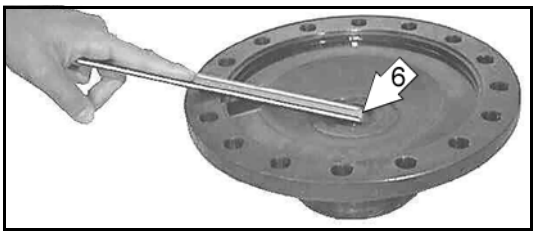
13. Collect the quadrings (7) and (9) from the brake piston (8).



14. Remove the three split pins (9) of the brake piston with a hammer and a punch.

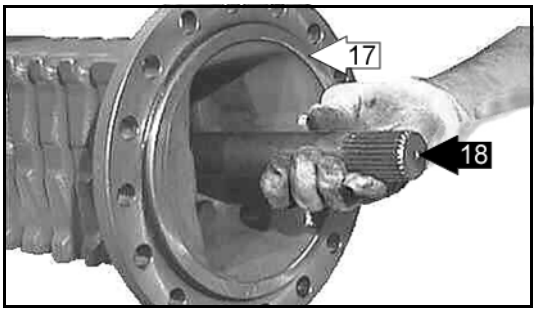


15. Remove the seal ring (6) with a lever.



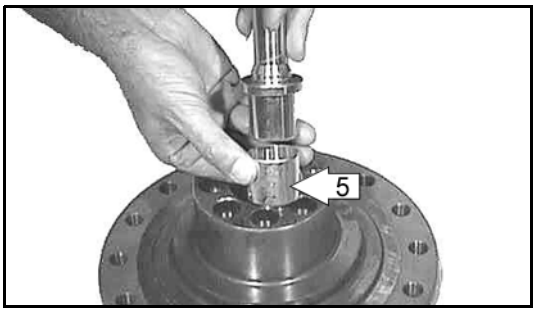
16. Turn the wheel shaft. Position the wheel shaft on a flat surface and remove the bushing (5) using a suitable drift and a hammer.

17. Remove the long half shaft (18) from the axle housing (17).

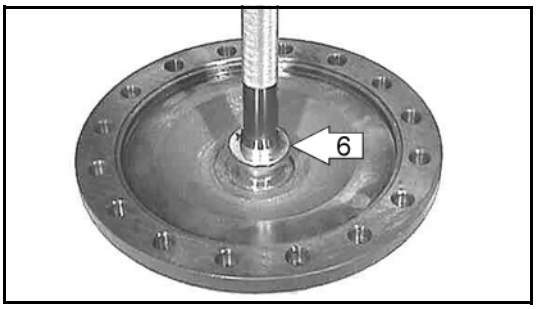


Assembly

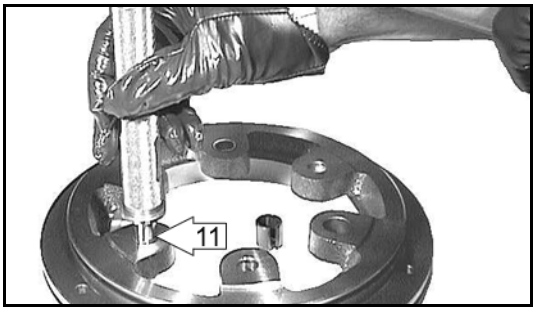
1. Force the bushing (5) into the wheel shaft with the special tool (793-H70-0150) and a hammer.



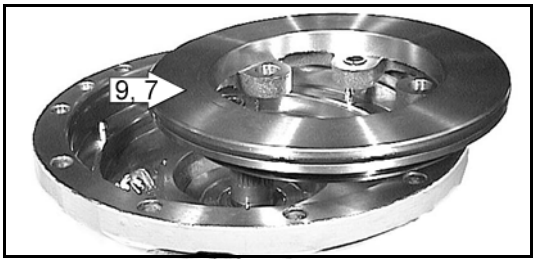
2. Turn the wheel shaft. Assemble the seal ring (6) into the wheel shaft with the special tool (793-H70-0100) and a hammer.



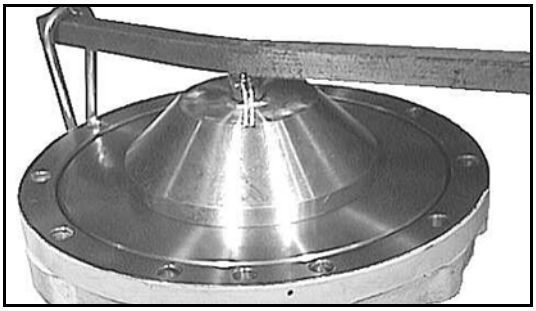
3. Assemble the split pin of the self-adjust kit (11) in the brake piston, using the special tool (793-H70-0170).



4. Clean the piston and the seat of the Quad-rings.
5. Grease the Quad-ring seat.
6. Insert and grease the Quad-rings (7) and (9).



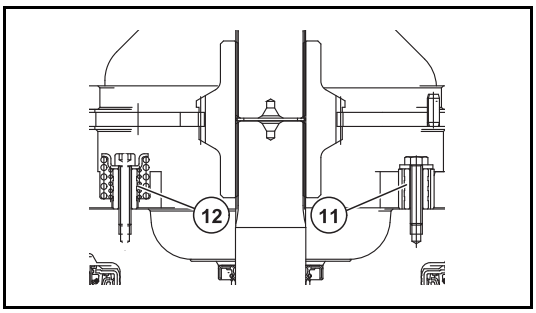
7. Position a flat disc on the piston.
8. With a lever anchored to an eyebolt, exert a pressure just enough to insert the piston into the wheel shaft.



Warning: do not damage the Quad-rings.

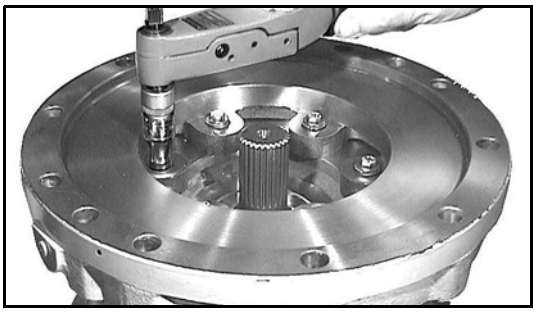
9. Collect the components of the self-adjust kit (11) and the piston return kit (12).

10. Install them into the piston as shown in the picture.

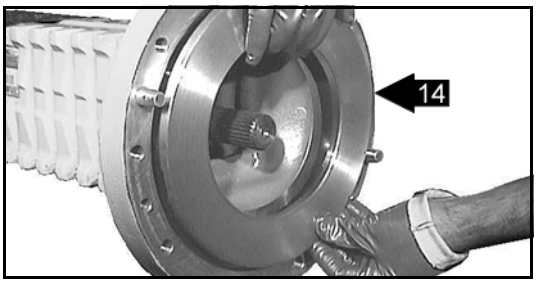


11. Tighten the fastening screws of the kits to the prescribed torque.

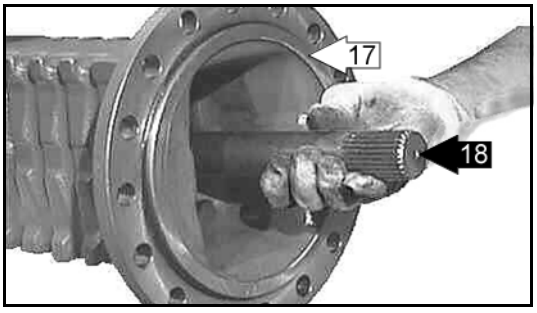
kgm **10 Nm**



12. Assemble the counterplate (14).

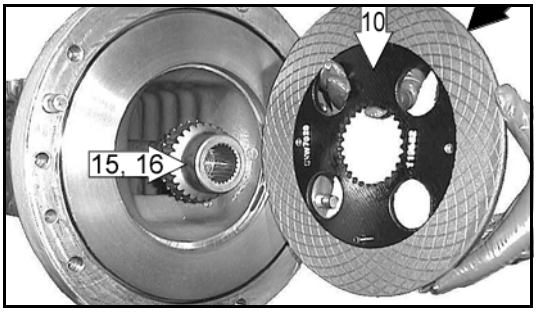


13. Fit the long half shaft (17) into the axle beam (18).



14. Check that the snap ring (16) is already assembled into the brake disc carrier (15).

15. Assemble the brake disc.

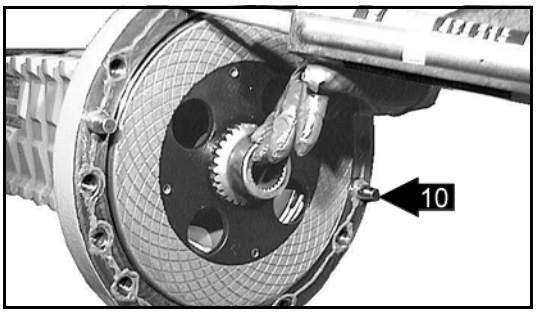


Warning: check that the brake disc pin (10) is towards the bottom (see picture).

16. Before matching surfaces, make sure they are perfectly clean. Degrease and clean with appropriate detergents.

17. Spread a film of sealant on the contact surface between the axle beam and the wheel shaft.

    Loctite® 510 / Superbond® 529



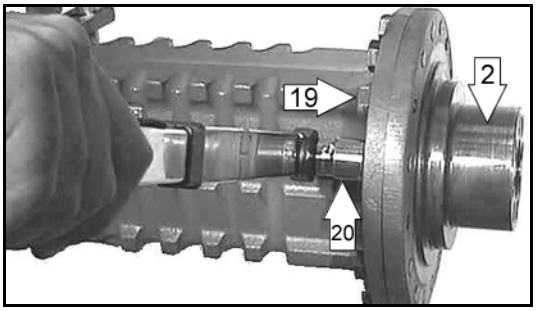
NOTE
Check that the dowel pins (10) are in their seats.

18. Position the wheel shaft (2) on the axle housing and tighten the retaining bolts (19) to the requested torque.

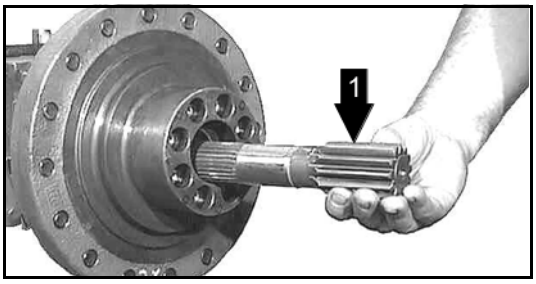
    190 Nm

19. Assemble the breather (20) and top up the oil.

    8 - 12 Nm



20. Assemble the short half-shaft (1) into the wheel shaft.

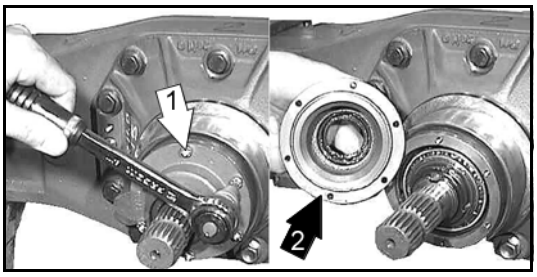


Rear axle

Trunnions group and flange

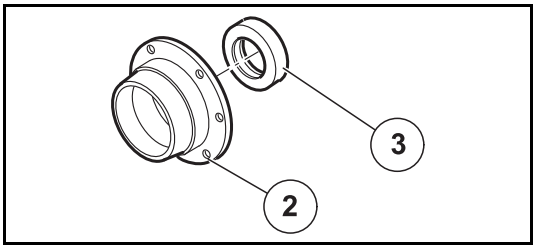
Disassembly

1. Unscrew the fastening screws (1) and remove the cover with seal ring (2).

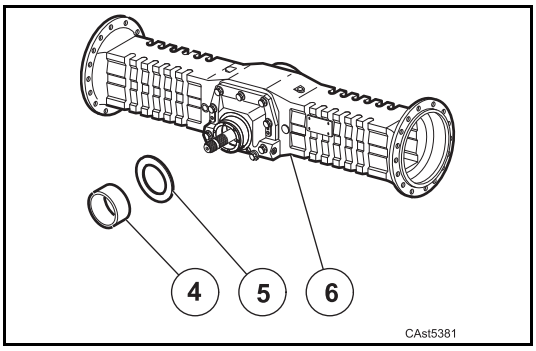


2. Remove the seal ring (3).

NOTE
This is a destructive operation for the seal ring.

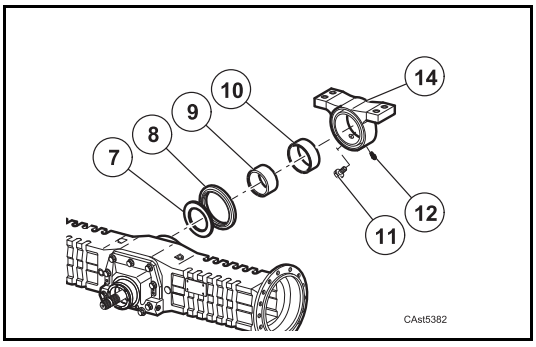


3. Remove the bush (4) from the differential support.
4. Remove the thrust washer (5).



5. Unscrew the bolt (11) and remove the support (14).
6. Remove the bush (10) and the bush (9).
7. Remove the seal ring (8).

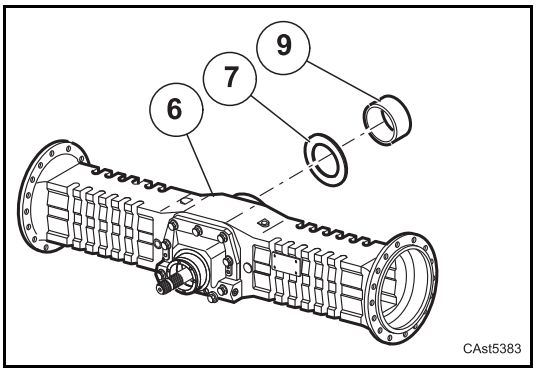
NOTE
This is a destructive operation for the seal ring. Remove the thrust washer (7).



Assembly

1. Apply grease to the thrust washer (7) surface on the axle beam side. Assemble the thrust washer (7).

2. Heat the bush (9) to **110 - 120 °C** then assemble it to the differential support.

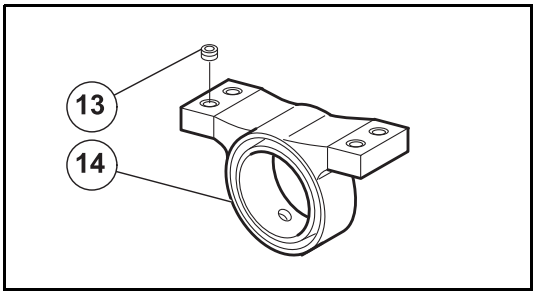


NOTE
If necessary assemble the bush (9) with a pad and a hammer.

Warning: observe safety instructions.

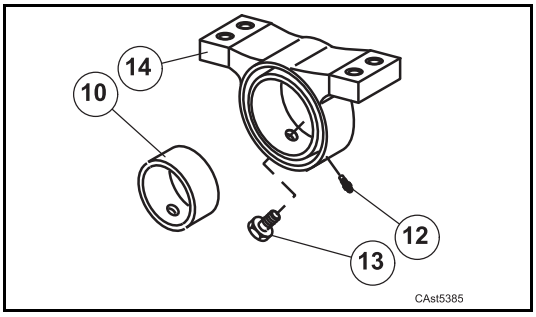
3. Apply sealant on bushes (13) contact surface.

4. Assemble the bushes (13) to the rear support (14) with a pad and a hammer.



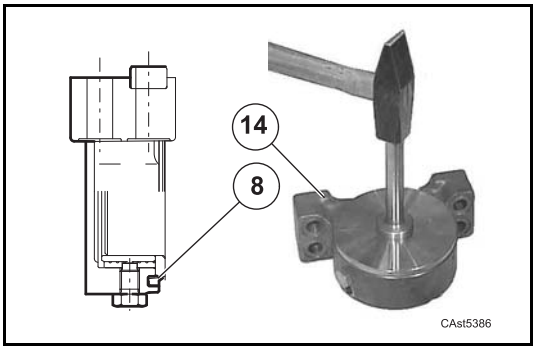
5. Assemble the bush (10) in the rear support (14).

Warning: align the bush hole with the fastening bolt (13) hole.



6. Assemble the bolt (13) and the nipples (12) and tighten them to the prescribed torque.

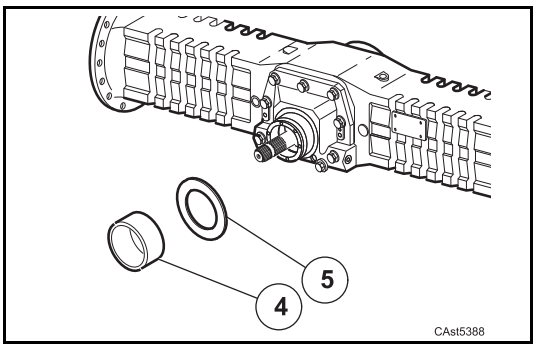
7. Assemble a new seal ring (8) well lubricated into the front support (14) with the special tool (793-H70-0120).



8. Insert the front support (14) on the axle beam (6).

9. Place the washer (5) on the differential support.

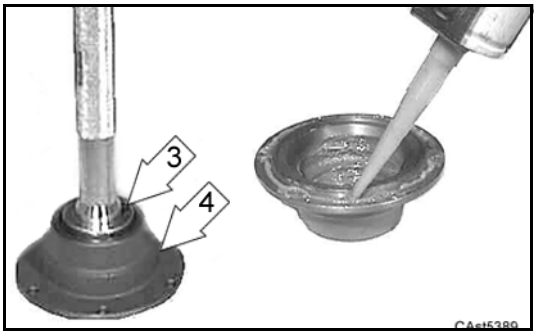
10. Heat the bush (4) to **110 - 120 °C** then assemble it to the differential support.



NOTE
If necessary assemble the bush (4) with a pad and a hammer.

Warning: observe safety instructions.

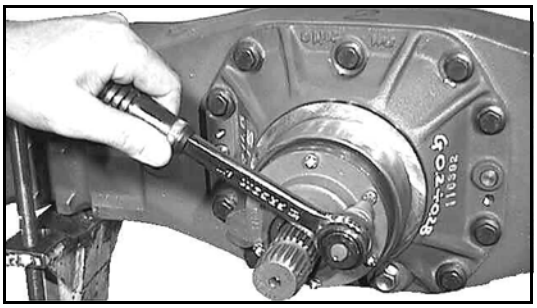
11. Assemble a new seal ring (3) into the cover (2) with the special tool (793-H70-0140). Apply prescribed sealant on the cover.



12. Assemble the cover with seal ring.

13. Screw the fastening screws.

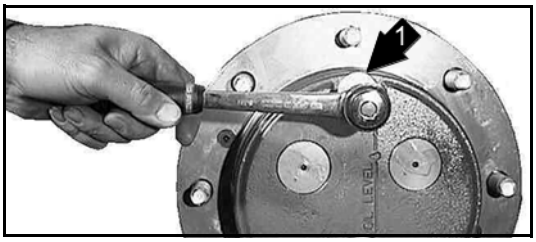
kgm **50 Nm**



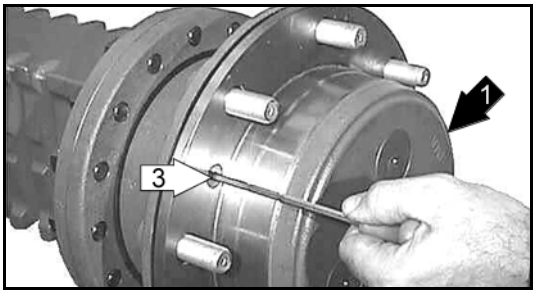
Epicyclic reduction gear group

Disassembly

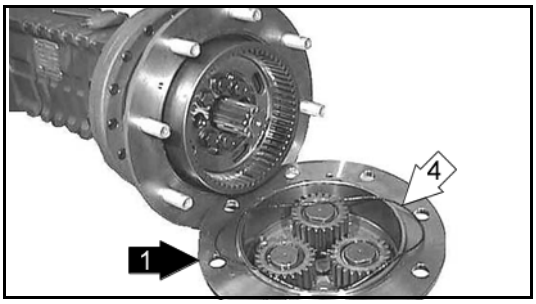
1. Drain the oil completely from the epicyclic reduction gear.



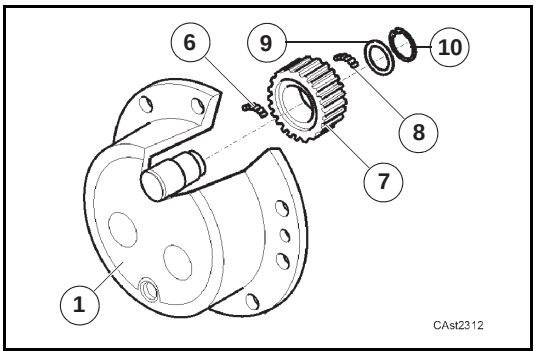
2. Unscrew and remove the two fastening bolts (3) of the planetary carrier (1) with a wrench.



3. Remove the planetary carrier (1) from the wheel hub and collect the relative O-Ring (4).
4. Position the planetary carrier (1) on a workbench and check its wear conditions.

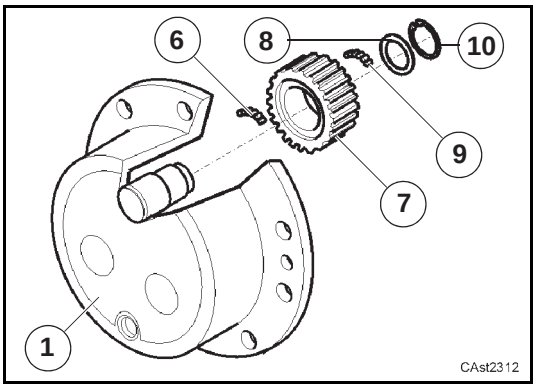


5. If required, replace the planetary gears (7) as follows:
   a. remove the snap rings (10) from every pin (5);
   b. remove the thrust washers (9);
   c. remove the planetary gears (7) from the pins (5);
   d. collect the needle bearings (6) and (8) checking their conditions.



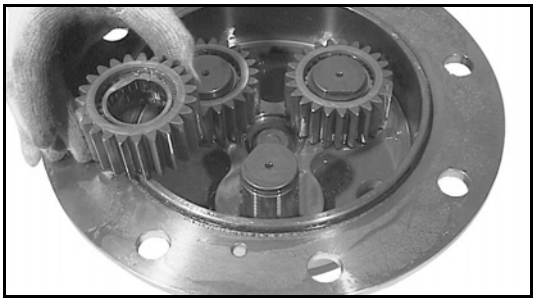
Assembly

1. Collect all epicyclic reduction gear parts: the planetary carrier (1), the snap ring (10), the thrust washer (9), the planetary gear (7) with the needle bearings (6) and (8).



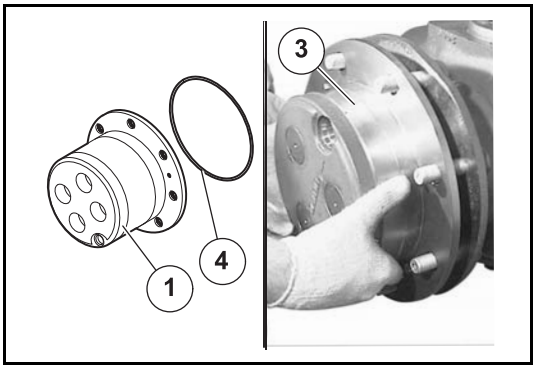
NOTE
With new planetary gears (7) it is advisable to assemble new needle bearings (6) and (8).

2. Position the planetary carrier (1) on a workbench.



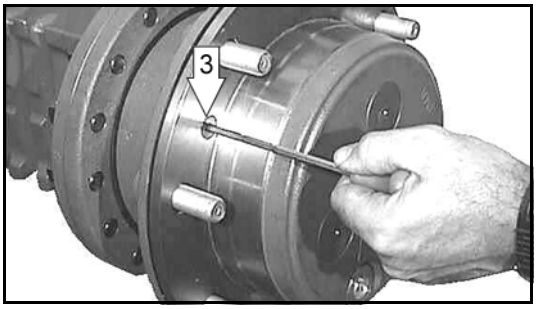
NOTE
Grease well the needle bearings (6) and (8).

3. Insert the needle bearings (6) and (8) in the epicyclic gears (7).
4. Fit the epicyclic gears (7) to the planetary carrier (1) pins.
5. Insert the thrust washer (9) and the snap rings (10) to the planetary carrier (1) pins.
6. Assemble a new O-Ring (4) on the planetary carrier (1).
7. Assemble the epicyclic reduction gear on the wheel hub.



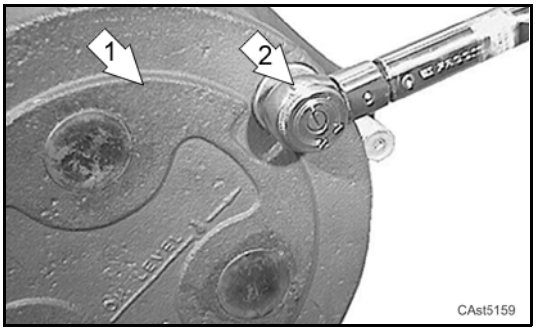
8. Assemble the screws (3) and tighten them.

kgm **25 Nm**



9. Top up the oil on the wheel hub.
10. Fit the oil plug (2) on the planetary carrier (1) and tighten it.

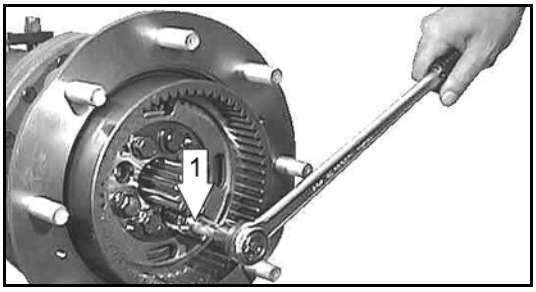
kgm **60 Nm**



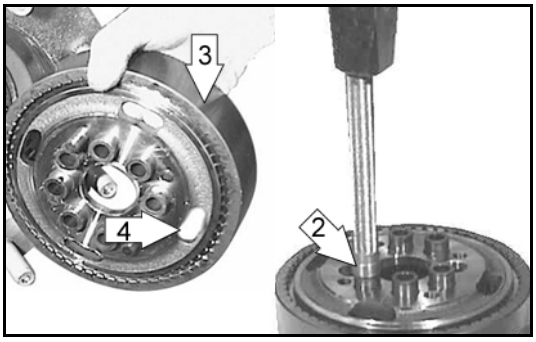
Wheel hub

Disassembly

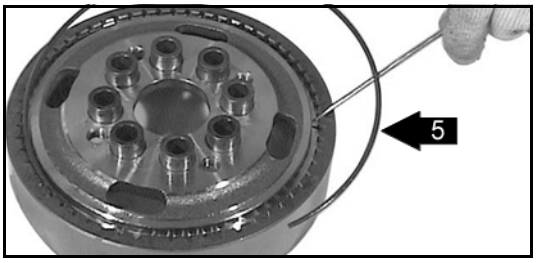
1. Slide the half-shaft from the axle beam. Unscrew and remove the fastening bolts (1) from the wheel carrier group.



2. In order to remove the wheel carrier group from its housing, screw at least two of the just removed bolts (1) in the threaded extraction holes.
3. Remove the wheel carrier (4) together with the ring gear (3).
4. Only if necessary, remove the centering bushes (2) of the wheel carrier with a hammer and the special tool (793-H70-0160).

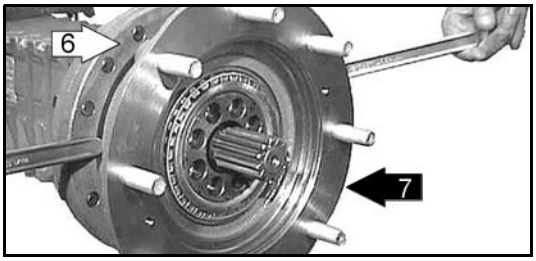


5. Remove the lock ring (5).



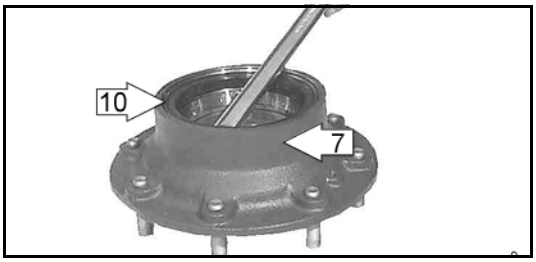
6. Remove the wheel hub (7), using levers and a hammer to facilitate the operation.

NOTE
Collect the bearing cone (6).

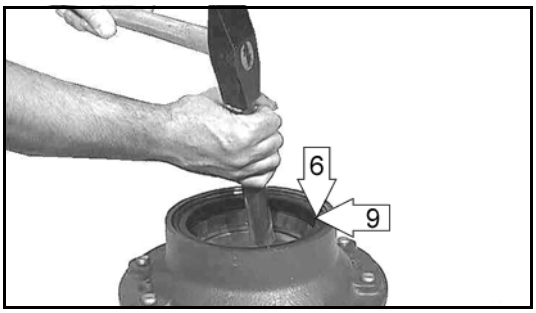


7. Position the wheel hub (7) on a flat surface and remove the seal ring (10) with a lever.

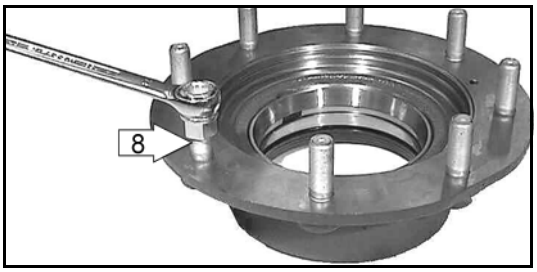
NOTE
This is a destructive operation for the seal ring.



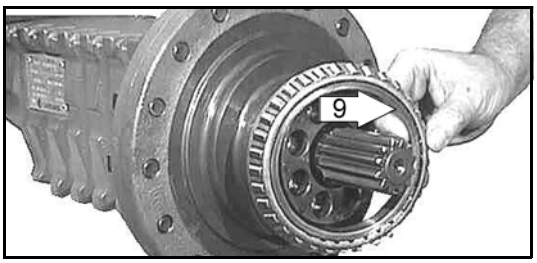
8. Remove the bearing cups (6) and (9) using a hammer and a drive.



9. To unscrew and replace worn-out hub studs (8), use a nut and a lock nut on the studs, first heating the area where they are positioned.



10. Remove the bearing cone (9) from the wheel shaft end using a suitable extractor.



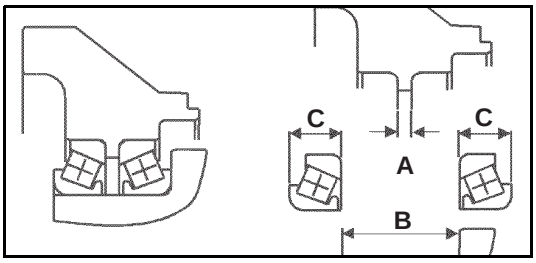
Assembly

The special operation “Set Right“ of the bearings does not require preload or backlash adjustment. Anyway, before assembling new components check the indicated dimensions.

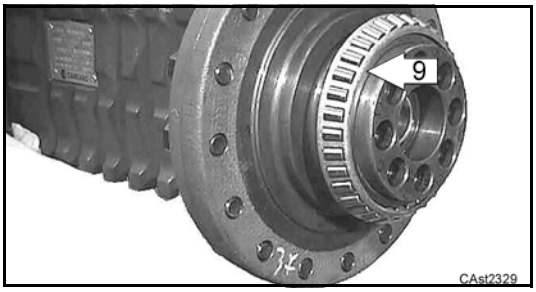
A = 08.450 - 08.500 mm

B = 54.775 - 54.825 mm

C = 23.072 - 23.173 mm

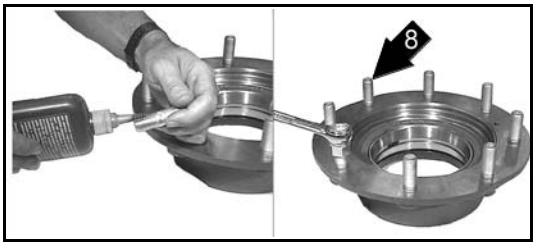


1. Heat the bearing (9) to **80 - 100 °C (176 - 212 °F)**.
2. Assemble the bearing cone on the wheel shaft end.

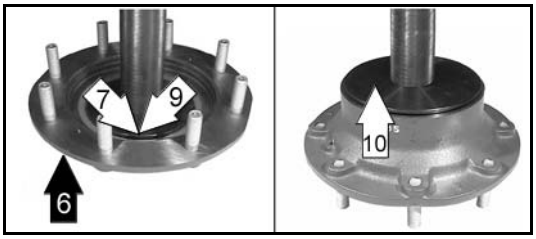


Caution! Wear safety gloves!

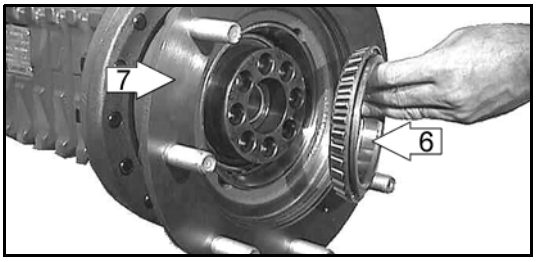
3. Apply the prescribed sealant on the threads and tighten the studs (8) to the prescribed torque using two nuts (nut and lock nut).



4. Position the wheel hub (7) on a workbench and force the two bearing cups (6) and (9) in position with the special tool (793-H70-0110) under a press or with a hammer.
5. Insert the seal ring (10) into the wheel hub with the special tool (793-H70-0080) and a hammer.



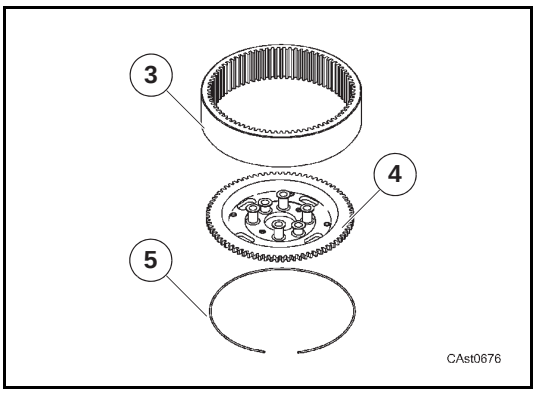
6. Assemble the wheel hub (7) on the wheel shaft.
7. Heat the bearing (6) to **80 - 100°C (176 - 212°F)**.
8. Assemble bearing cone.



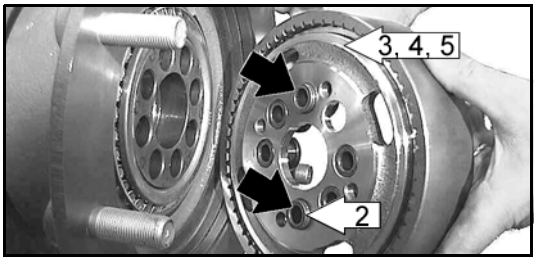
Warning: wear safety gloves

9. Position the wheel carrier (4) on a workbench and force the bushes (2) to the carrier surface level with the special tool (793-H70-0160). At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.

10. Preassemble the wheel carrier (4) and the epicyclic ring gear (3) with the locking ring (5).

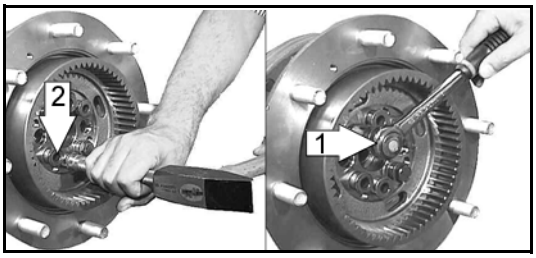


11. Assemble the wheel carrier group (3), (4) and (5) on the wheel hub using the two projecting bushes (2) as dowel pins.



12. Force all hub dowel bushes (2) completely with the special tool (793-H70-0160) and a hammer.

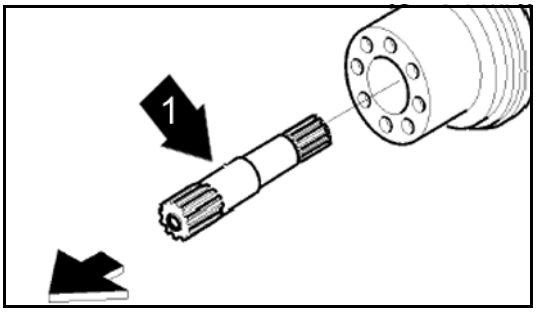
13. Assemble the wheel carrier (4) fastening bolts and tighten to the requested torque. Assemble the short half-shaft.



Wheel shaft - WA80M-7, WA100M-7

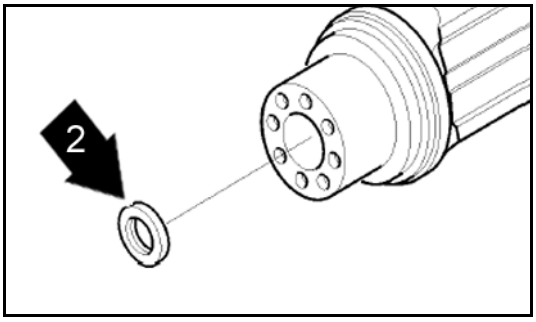
Disassembly

1. Drain the oil completely from the axle beam.
2. Remove the short half shaft (1) from the axle beam.

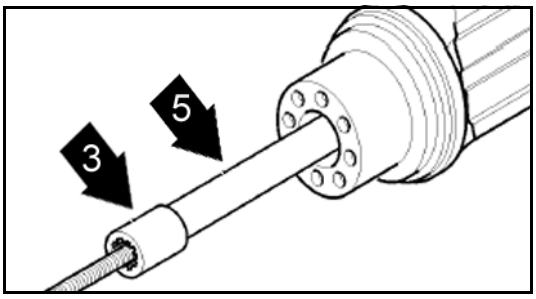


3. Remove the seal ring (2) with a lever.

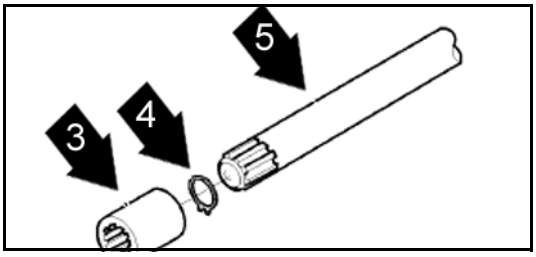
NOTE
This is a destructive operation for the seal ring.



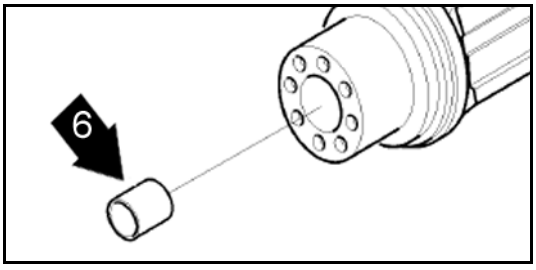
4. Remove the long half shaft (5) with the splined sleeve (3) from the axle housing with a threaded puller M10x1.5 screwed in the hole in the long half shaft.



5. Collect the splined sleeve (3).
6. Remove the sleeve inner snap ring (4) if replacement is required.

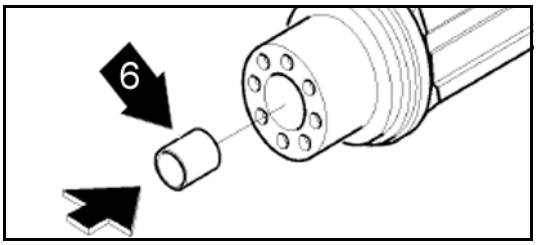


7. If necessary, extract the bush (6) using a suitable puller.

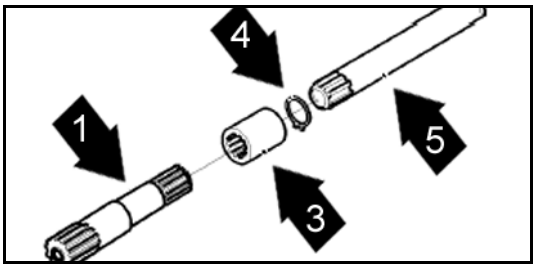


Assembly

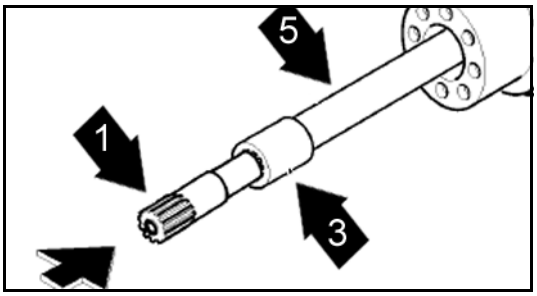
1. Fit the bushing (6) into the axle housing with the special tool (793-H70-0190) and a hammer.



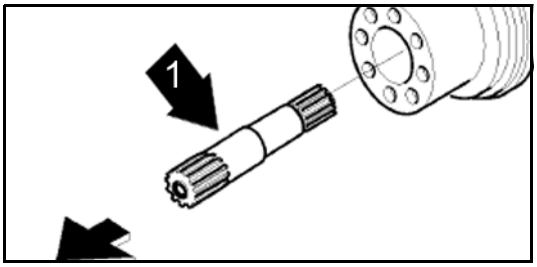
2. Assemble the snap ring (4) on the splined sleeve (3).
3. Assemble the splined sleeve (3) to the long half shaft and to the short half shaft (1).



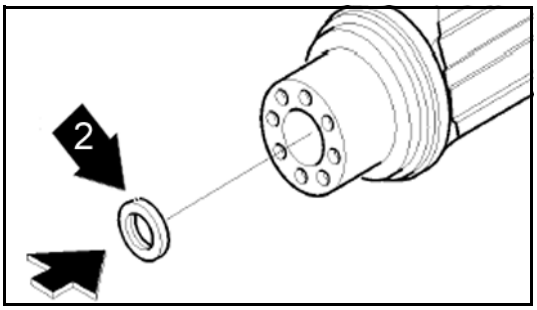
4. Insert the long half shaft (5) with the splined sleeve (3) and the short half shaft (1) on the axle beam (7).



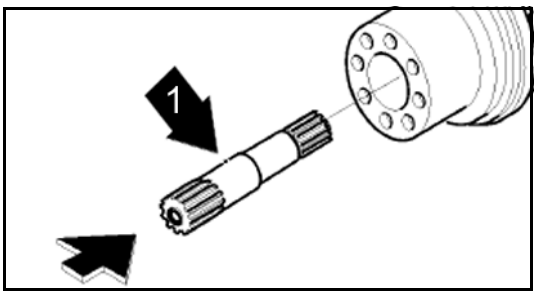
5. Remove the short half shaft (1).



6. Assemble the seal ring (2) into the wheel shaft with the special tool (793-H70-0200) and a hammer.



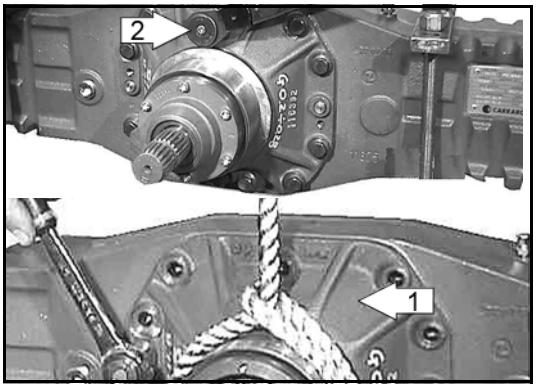
7. Assemble the short half-shaft (1) into the axle housing (7).



Differential support group

Disassembly

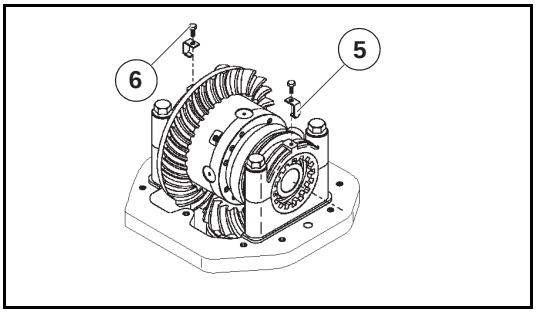
1. Drain the oil completely from the differential.
2. Loosen and remove the bolts (2)



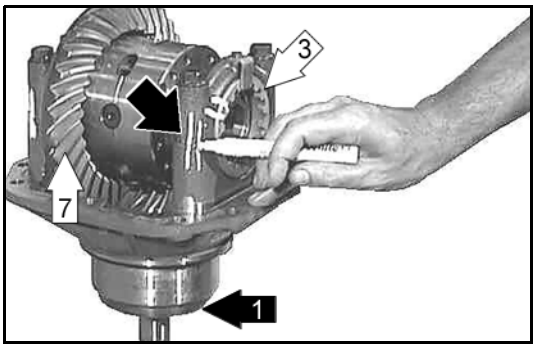
NOTE
To remove the differential (1), screw two bolts into the threaded lift-out bores of the differential carrier, then tighten.

Warning: support the differential support with a rope or other appropriate means.

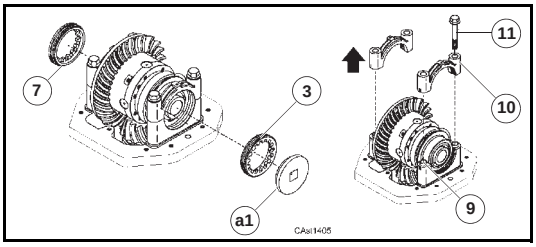
3. Loosen and remove the screws (6) to remove the two ring nut retainers (5).



4. Before removing bolts, mark half bridles and the differential carrier with permanent reference marks to avoid inverting them when reassembling the unit.
5. Mark the area between the ring nuts (3) and (7) and the differential carrier (1) as well.

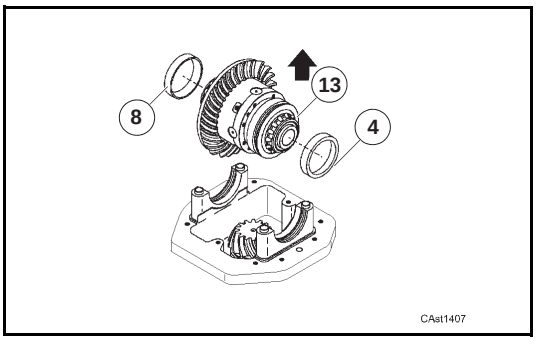


6. Unscrew the adjuster ring nuts (3) and (7) using tools (793-H70-0060) (a1) and a wrench.
7. Loosen and remove the 4 screws (11) and remove the 2 half-collars (10).
8. Check that the bushes (9) remain in their housings.



9. Remove the differential housing (13).

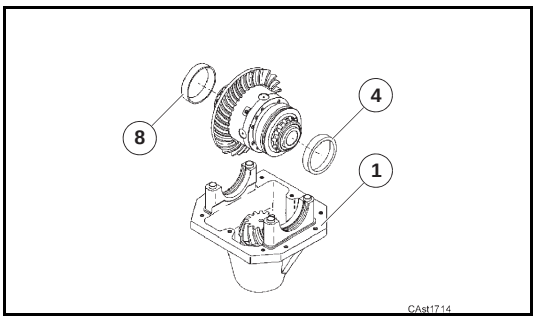
10. The bearing cups (4) and (8) are removed together with the differential housing.



Warning: do not invert the bearing cups if they are not going to be replaced.

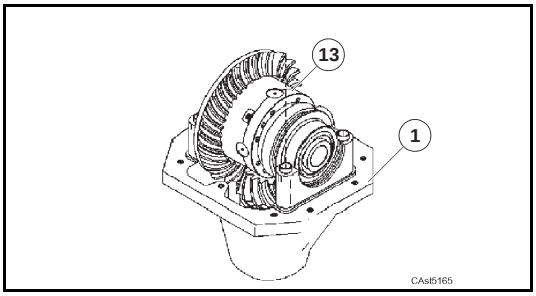
Assembly

1. Assemble the bearings cups (4) and (8) on the differential group (1) with pins and locking differential sleeve.



Warning: do not invert the bearing cups if the bearings are not replaced.

2. Position the complete differential housing (13) on the differential support (1). At the same time insert the differential locking fork into the sleeve.

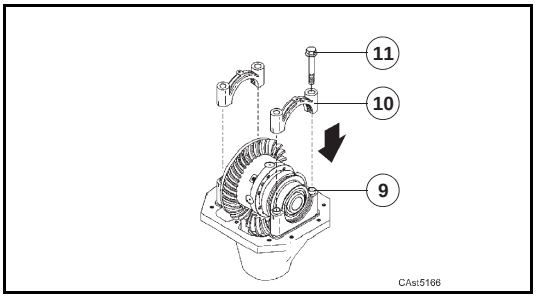


Warning: check the right side of the bevel crown assembly.

3. Move the differential group so to place the bevel crown gear on the pinion.

4. Check that all bushes (9) are in their housings and position both half collars (10) on their seats using the previously traced reference marks.

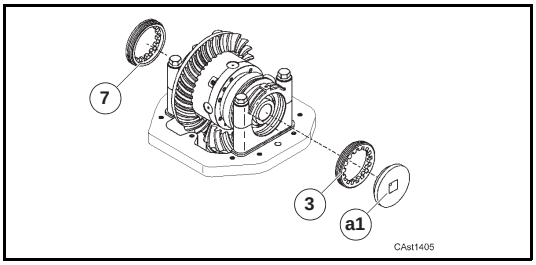
5. Lock both half collars with their fastening bolts (11).



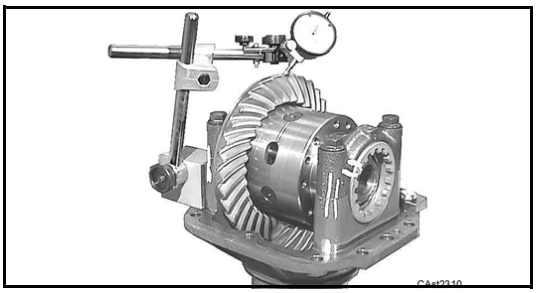
6. Assemble the adjusting ring nuts (3) and (7) to the differential support.

7. Tighten both ring nuts (3) and (7) with special tools (793-H70-0060) (a1), till the backlash is eliminated and the differential bearings are slightly preloaded.

8. Check that the differential bearings are well settled; if necessary, knock slightly with a soft hammer, in order to properly set the bearings in position.



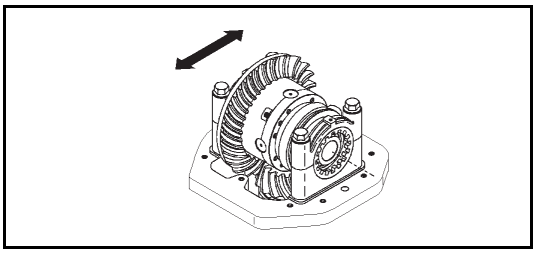
9. Position a magnetic-base dial gauge on the differential support, so that the feeler stylus touches the surface of one tooth of the crown gear with a 90° angle.



10. Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.

11. Repeat the operation on two or more points (teeth), rotating the crown gear to obtain an average value.

12. Check if the measured backlash value is within the requested range: **0.10 - 0.15 mm**.

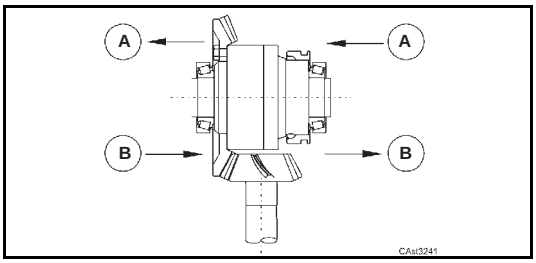


13. Set the bevel gear set backlash by turning adjusting rings (3.7) with the appropriate tool (793-H70-0060) .

14. Adjust the ring nuts, remembering that:

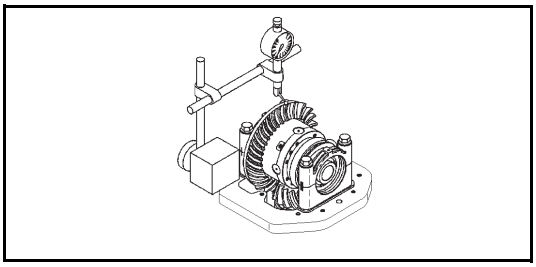
    (A): If the measured backlash is greater than the given tolerance range, unscrew the ring nut (3) and screw in the adjuster ring nut (7) by the same measure;

    (B): If the measured backlash is less than the given tolerance range, unscrew the adjuster ring nut (7) and screw in the adjuster ring nut (3) by the same measure.



15. After pinion-ring gear backlash adjustment, check that there is a minimum preloading on the differential box bearings.

16. Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.

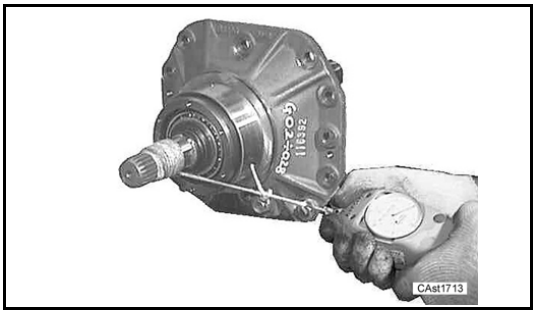


17. Once the pinion-ring gear backlash has been established, measure the total preloading (T) of the bearings (pinion-ring gear system), using a dynamometer whose cord is wound on the end of the pinion.

    The measured value should be within the following range:

    T = (P + 2.9) - (P + 4.4) daN (WA80M-7)
    T = (P + 3.1) - (P + 4.7) daN (WA100M-7)

    where P is the preloading effectively measured on the pinion.

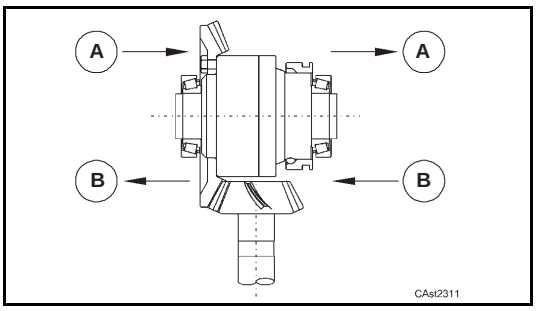


Warning: all the preloadings must be measured without the seal ring.

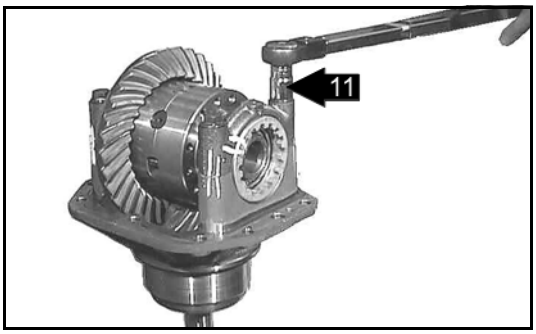
If the measurement is not within the requested range, check well the assembly of each component and operate on the adjusting ring nuts (3) and (7) of the differential support:

If the total preloading is less than the given range, screw in both adjuster ring nuts (3) and (7) by the same measure, keeping the pinion-ring gear backlash value unchanged (A);

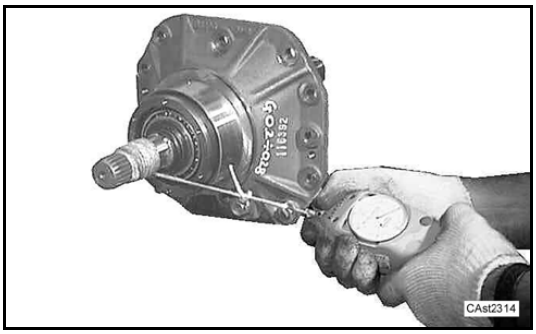
If the total preloading is greater than the given range, unscrew both adjuster ring nuts (3) and (7) by the same measure, keeping the pinion-ring gear backlash (B) value unchanged.



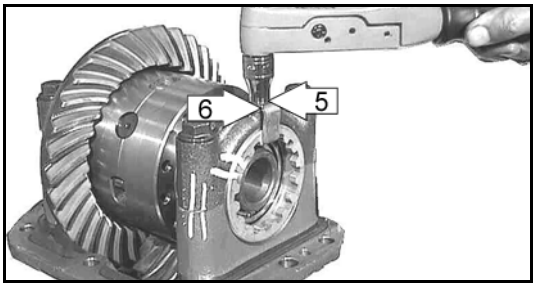
18. Tighten the bolts (11) of both half collars to the requested torque.



19. Check bearings total preload (T).
See previous page.



20. Once all the adjustment operations have been completed, fit the adjuster ring nut retainers (5) and their respective screws (6), tightening them to the requested torque.

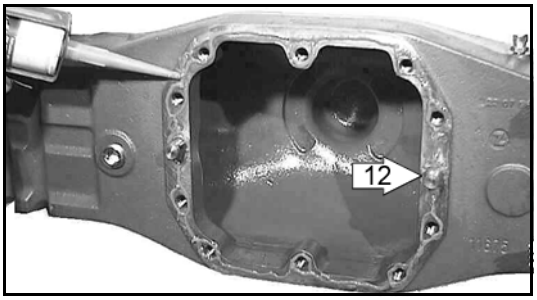


21. Before matching surfaces, make sure they are perfectly clean.

22. Degrease and clean with appropriate detergents.

23. Spread a film of sealant on the contact surface between the axle beam and the differential carrier.

24. Check that the dowel pins (12) are in their seats.



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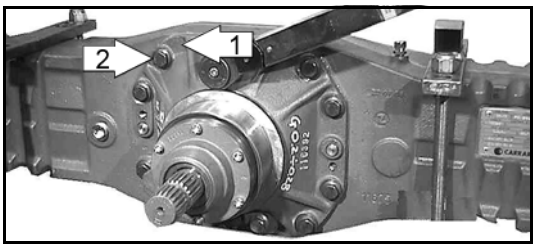
25. Position the differential carrier (1) on the axle housing and tighten the retaining bolts (2).

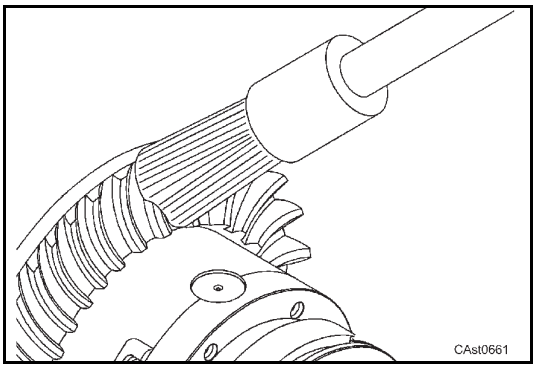


kgm **169 Nm**

26. Top up the oil.

Bevel gear marking test

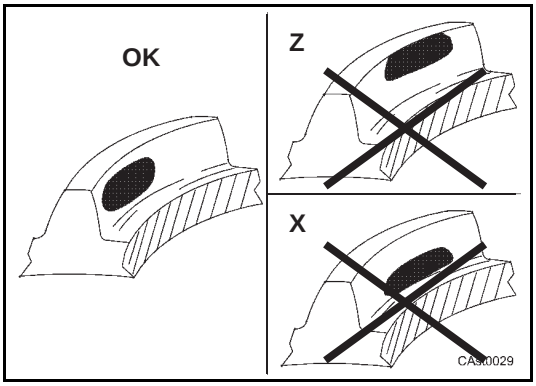
- To test the marks of the bevel gear teeth, paint the ring gear with red lead paint. The marking test should be always carried out on the ring bevel gear teeth and on both sides.



OK: Correct contact: If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.

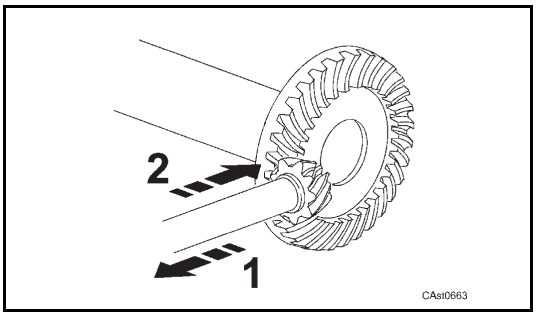
Z: Excessive contact on the tooth tip: Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.

X: Excessive contact at the tooth base: Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.



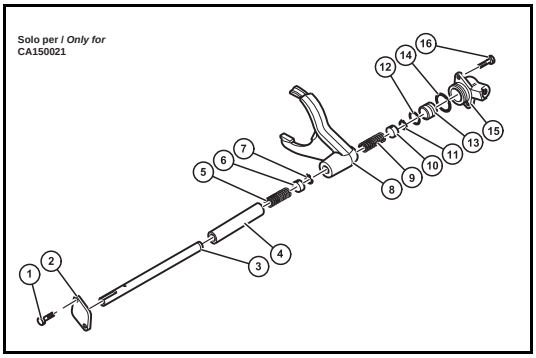
Movements to correct:

1. Move the pinion for type X contact adjustment.
2. Move the pinion for type Z contact adjustment.

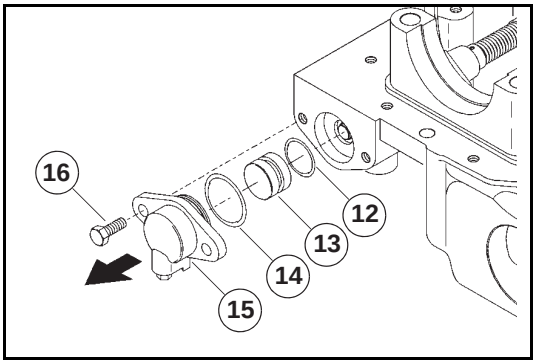


Differential locking group

Disassembly

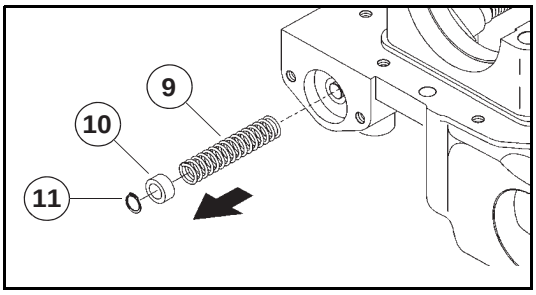


1. Remove the differential group before disassembling the differential locking device.
2. Unscrew the bolts (16) and remove the cylinder support (15).
3. Collect the piston (13) and the O-rings (14) and (12).



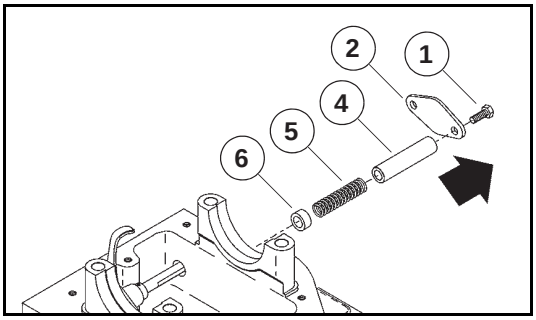
4. Remove the lock ring (11) preventing the bush (10) from being pushed out by the spring (9).

Danger: possible ejection of the bush (10) and spring (9).

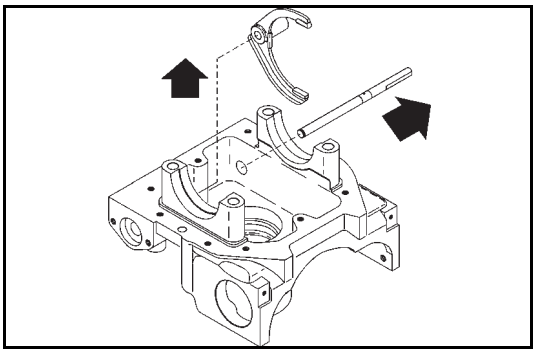


5. Remove the bush and the spring from the control shaft (3).
6. Remove the bolt (1) and the cover (2) keeping the bush (4) from being pushed out by the spring (5).

Danger: possible ejection of the bush (4) and spring (5).

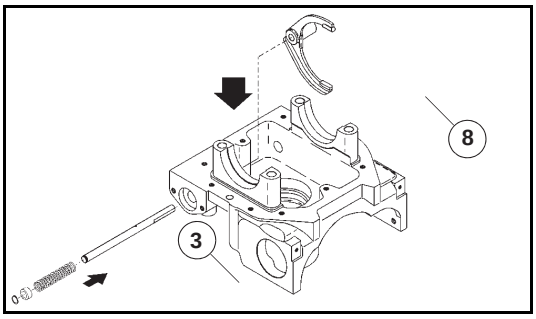


7. Remove the bush, the spring and spacer (6) from the control shaft (3).
8. Remove the control shaft (3), then collect the lock ring (7) and the fork (8).



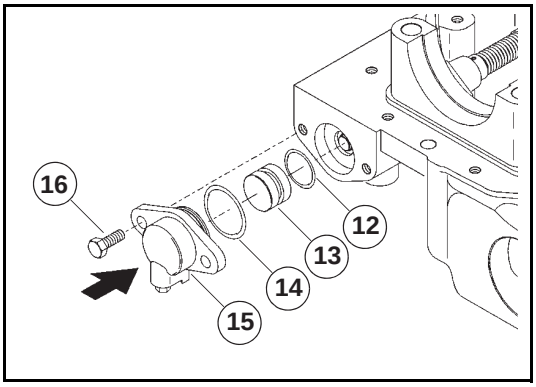
Assembly

1. Place the differential support on a workbench.
2. Assemble the lock ring (11) in the housing at the end of the control shaft (3).
3. Insert the spacer (10) and the spring (9) on the control shaft (3).
4. Insert the shaft in the differential support and in the fork (8), respecting for each element the shown position.

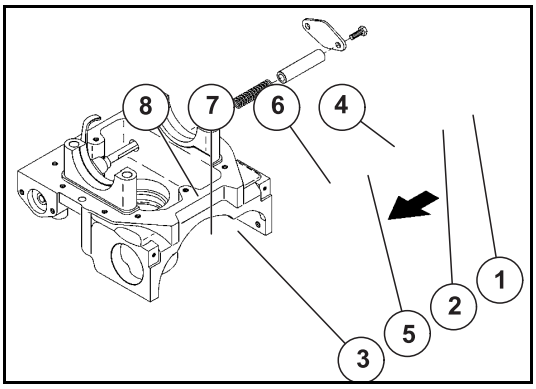


5. Assemble the new O-ring (12) to the piston (13).
6. Insert the piston (13) at the ends of the shaft.
7. Assemble the new O-ring (14) to the support (15).
8. Assemble the support (15) with the fastening screws (16).
9. Tighten the screws (16) to the requested torque.

   kgm **27.6 Nm**



10. Insert the lock ring (7) on the control shaft (3) from the fork side by pushing it in the housing with a pipe of suited dimension.
11. Insert the spacer (6), the spring (5) and the bush (4) on the control shaft.
12. Apply sealant on the cover (2).
13. Assemble the cover (2), pushing the spring (5), with the fastening screws (1).



Danger: possible ejection of the bush and the spring.

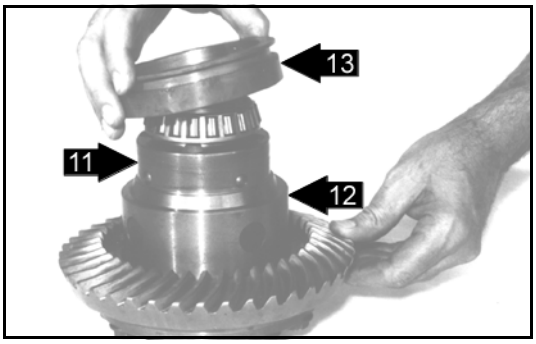
14. Tighten the screws to the requested torque.

    kgm **27.6 Nm**

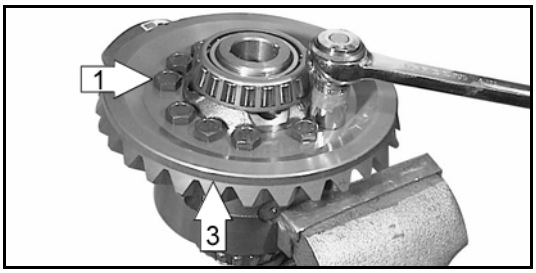
Differential group (100% Differential Lock)

Disassembly

1. Remove the sleeve (13) and pins (11) from the differential housing (12).

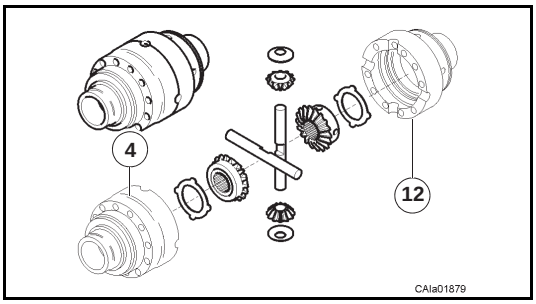


2. Lock the differential with a clamp.
3. Unscrew the fastening bolts (1) and remove the bevel gear (3).

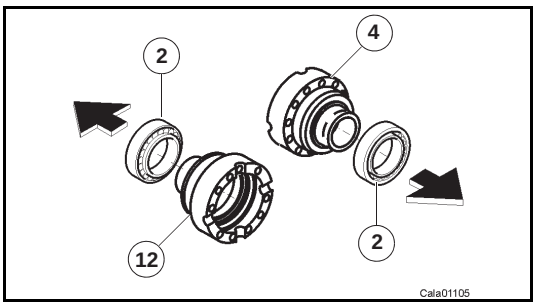


Warning: this will make both differential half housing (4 and 12) free, so take care not to drop the internal components.

4. Disassemble the two differential half housing (4 and 12).
5. Make alignment marks on the half boxes before splitting them.
6. Disassemble all the components. Check the operating and wear conditions of the components.

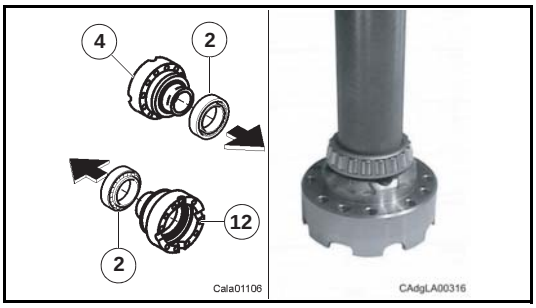


7. Remove the bearing cones (2) from the half boxes (4 and 12) using a standard extractor.

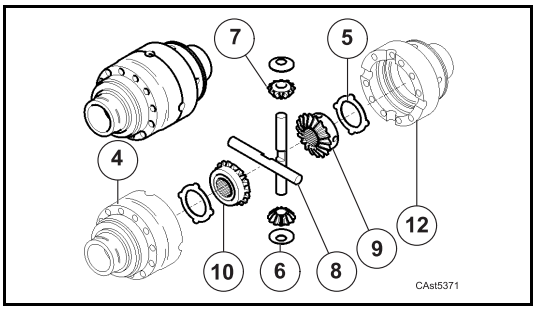


Assembly

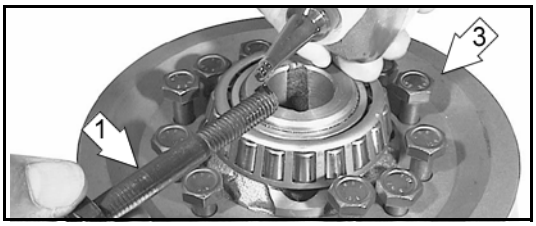
1. Assemble the bearing cones (2) on the half housing (3 and 10), using the special tool (793-H70-0090) and a hammer.



2. Position a half housing (4) on a workbench and assemble all inner components (locking differential counterdiscs (5), sun gears (9 and10), spiders (8), spider gears (7), thrust washers (6)), as shown in the picture.
3. Join the two half boxes, aligning the reference marks made during disassembly.



4. Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents.
5. Place the bevel gear (3) on the differential housing.
6. Apply sealant on the threads and tighten the bolts (1) to the requested torque.



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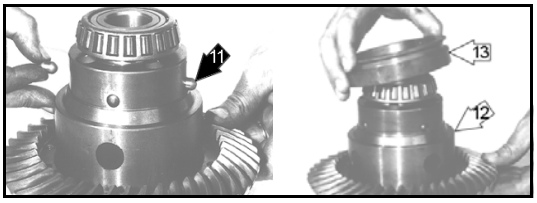
95 Nm

7. Insert the pins (11) into their seats.
8. Assemble the sleeve (13) on the differential housing (12).

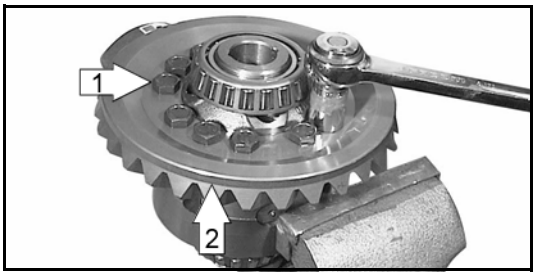


Warning: take care to assemble it in the correct position.

Differential group (LSD 25%)

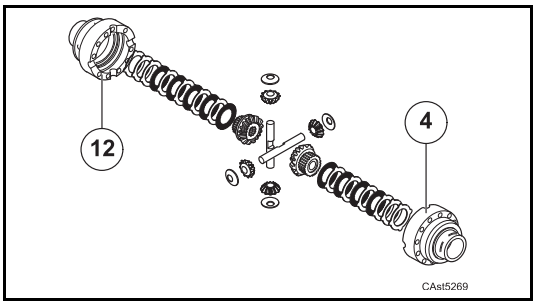
Disassembly

1. Lock the differential with a clamp. Unscrew the fastening bolts (1) and remove the bevel gear (2).

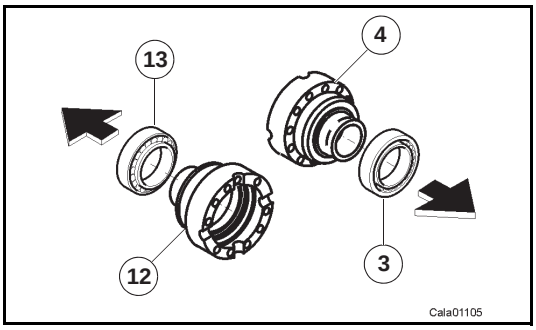


Warning: this will make both differential half boxes (4) and (12) free, so take care not to drop the internal components.

2. Disassemble the differential box in two half boxes (4) and (12) with the relative components.
3. Make alignment marks on the half boxes before splitting them.
4. Disassemble all the components. Check the operating and wear conditions of the components.

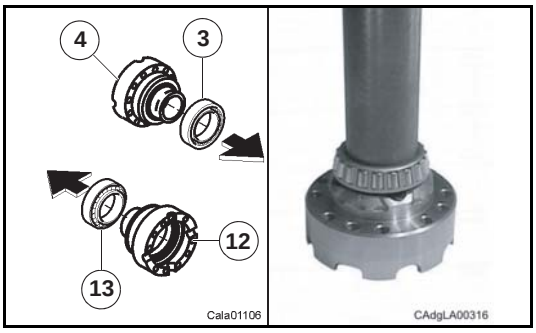


5. Remove the bearings cones (3) and (13) of the half boxes (4) and (12), using two levers or a three-hold extractor.

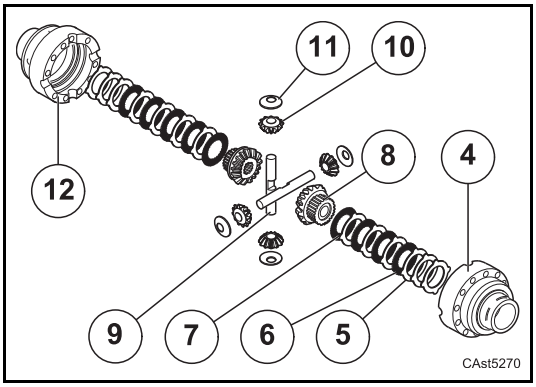


Assembly

1. Assemble the bearing cones (3) and (13) on the half housings (4) and (12), using the special tool (793-H70-0090) and a hammer.



2. Position a half housing (4) or (12) on a workbench and assemble all inner components (locking differential counterdisks (5), locking differential discs (6) and (7), sun gears (8), spiders (9), spider gears (10), thrust washers (11), as shown in the picture.

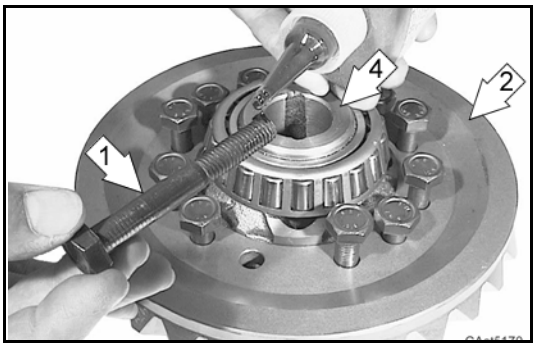


NOTE
The first disc (7) must be assembled with friction material on the discs side and the flat surface on the sun gear (8) side.

3. Join the two half boxes, aligning the reference marks made upon them.

4. Position the bevel gear (2) on the half box (4).

5. Apply sealant on the thread and tighten the bolts (1).



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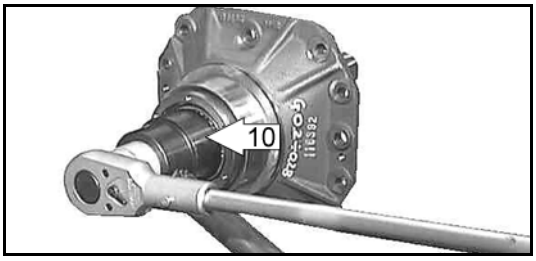
95 Nm

Pinion group

Disassembly

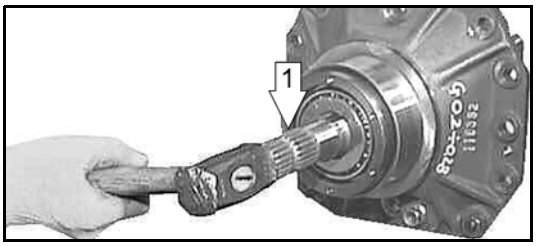
1. Lock the differential carrier in a vice.

2. Unscrew the lock nut (10) using special tools (793-H70-0070) and (793-H70-0220).



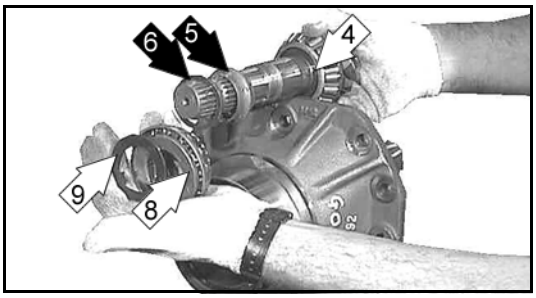
NOTE
This is a destructive operation for the ring nut.

3. Tap the shaft with a soft hammer to remove the bevel pinion (1).

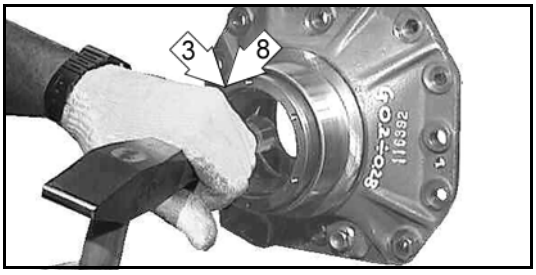


Warning: take care not to drop the pinion.

4. Collect the washer (4) and (6), the collapsible spacer (5), the bearing cone (8) and the retaining washer (9).

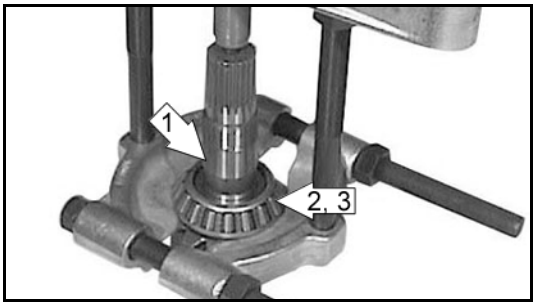


5. Remove the bearing cups (3) and (8) using a driver and a hammer.



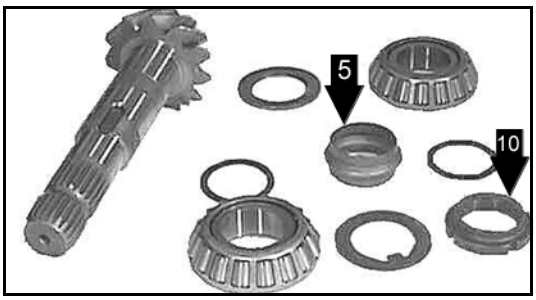
6. To remove the bearing cone (3) of the pinion (1), use a standard extractor.

7. Collect the bearing cone (3) and the underlying shim (2).



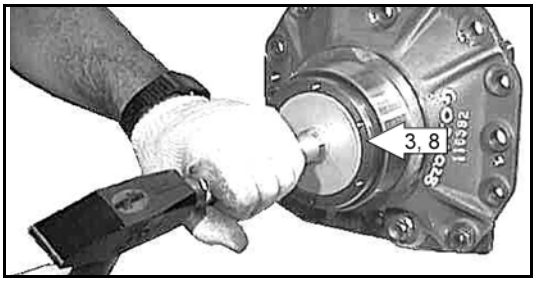
8. Check all pinion components for wear.

9. The ring nut (10) and the collapsible spacer (5) must be replaced when reassembling the unit.

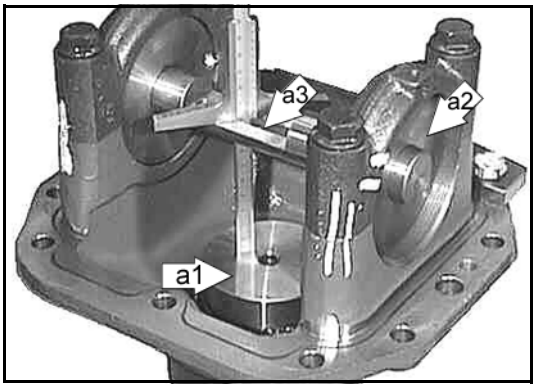


Assembly

1. Fit the bearings cups (3) and (8) using the special tool (793-H70-0010) and a hammer.



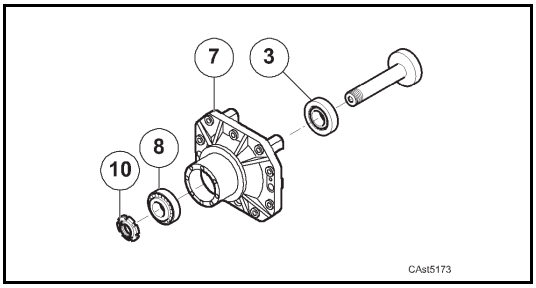
2. Prepare the kit consisting of the special tools called "false pinion" (a1) (793-H70-0020) and "false differential box" (793-H70-0030) (a2) and (793-H70-0040) (a3) and a depth gauge (a4).



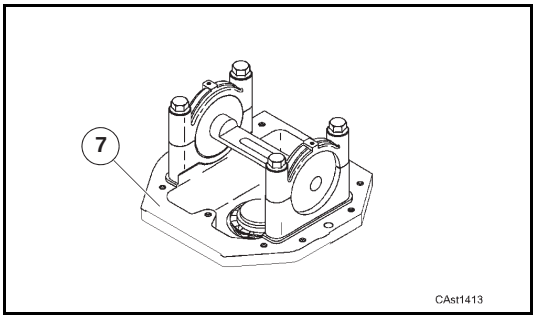
3. Insert the bearing cones (3) and (8) in their seats.

4. Assemble the "false pinion" and its ring nut (10).

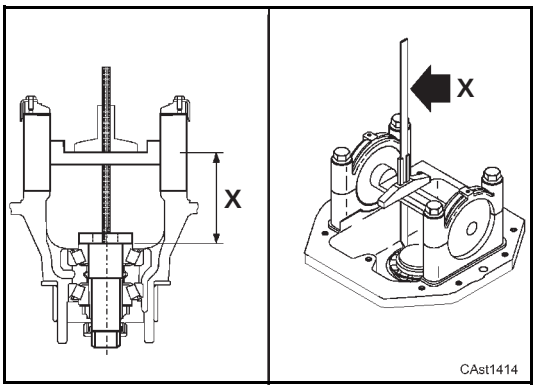
5. Tighten without exceeding the ring nut, till the backlash is eliminated.



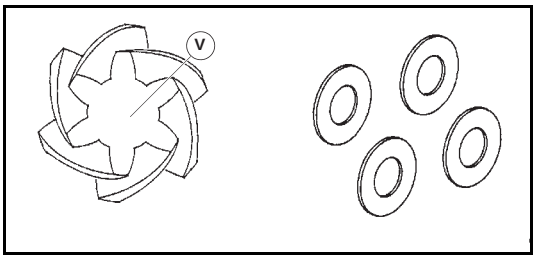
6. Install "false differential box" special tools into the differential group support (7) and lock it with the half collars. See: next figure.



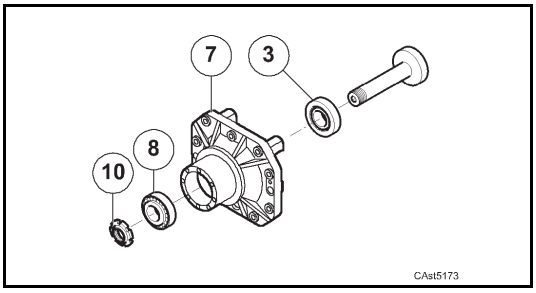
7. Assembly diagram of the "false differential box" (on the left).
8. Use a depth gauge to measure distance (X) (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).



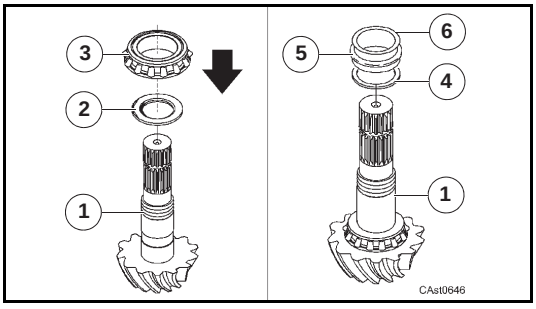
9. In order to determine the necessary thickness value (S) between pinion and bearing, subtract the value (V) stamped on pinion head (V = requested distance) from the measured value (X).
10. Select the shim (2) of thickness valve (S) among the range of available shims.



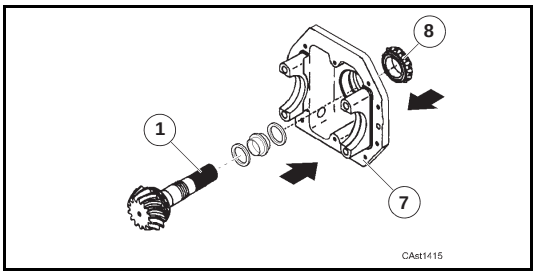
11. Remove the "false differential box" special tool from the differential support (7).
12. Remove the ring nut (10), the "false pinion" and the bearing cones (3) and (8).



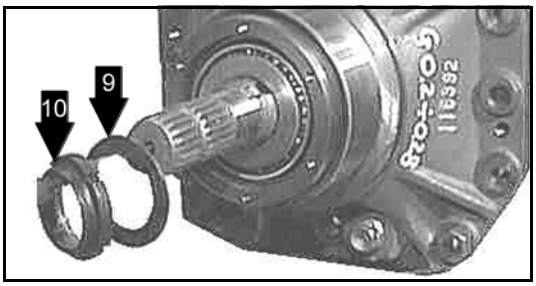
13. Insert the chosen shim (2) with the chamfer against the gear into the pinion shaft (1).
14. Force the bearing (3) into the pinion shaft (1) with the special tool (793-H70-0130) under a press, making sure that it is well set.
15. Insert the shims (4) and (6) and the new collapsible spacer (5).
16. Always use a new collapsible spacer (5).



17. Insert the bevel pinion (1) unit into the differential support housing (7) and the bearing cone (8) into the pinion end, as shown in the picture.
18. Use the special tool (793-H70-0050) and a hammer to drive the bearing (8).



19. Insert the ring nut washer (9) and screw a new lock ring nut (10) on the pinion end.



20. Screw the ring nut (10) in, using the wrench for ring nut (793-H70-0070) and for pinion retainer (793-H70-0220).

Warning: The torque setting is given by the preloading measurement on bearings (3) and (8).

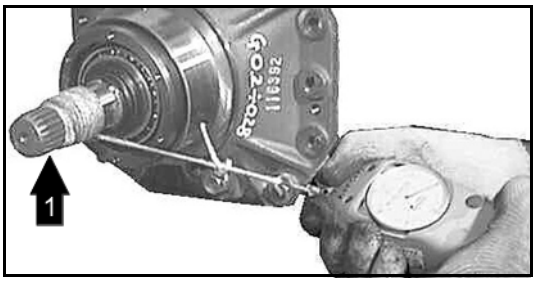
21. Tighten the ring nut (10) gradually. If the tightening is excessive, the collapsible spacer (5) must be replaced and the procedure repeated.

22. When you check the preloading, it is advisable to beat slightly both pinion ends with a soft hammer, so as to help setting the bearings (3) and (8).

P = 9.2 - 13.8 daN

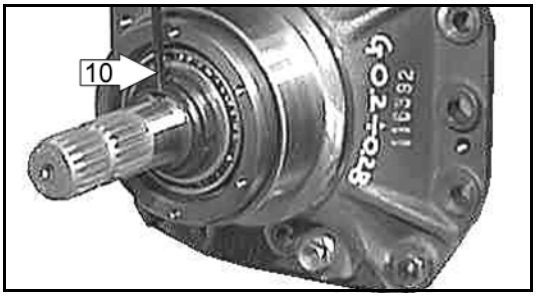
23. Carry out the preloading measurement (P) of the pinion taper roller bearings (3) and (8), using a dynamometer whose cord is wound on the end of pinion spline (1).

24. The adjustment is carried out by increasing the ring nut (10) torque gradually, being careful not to exceed.



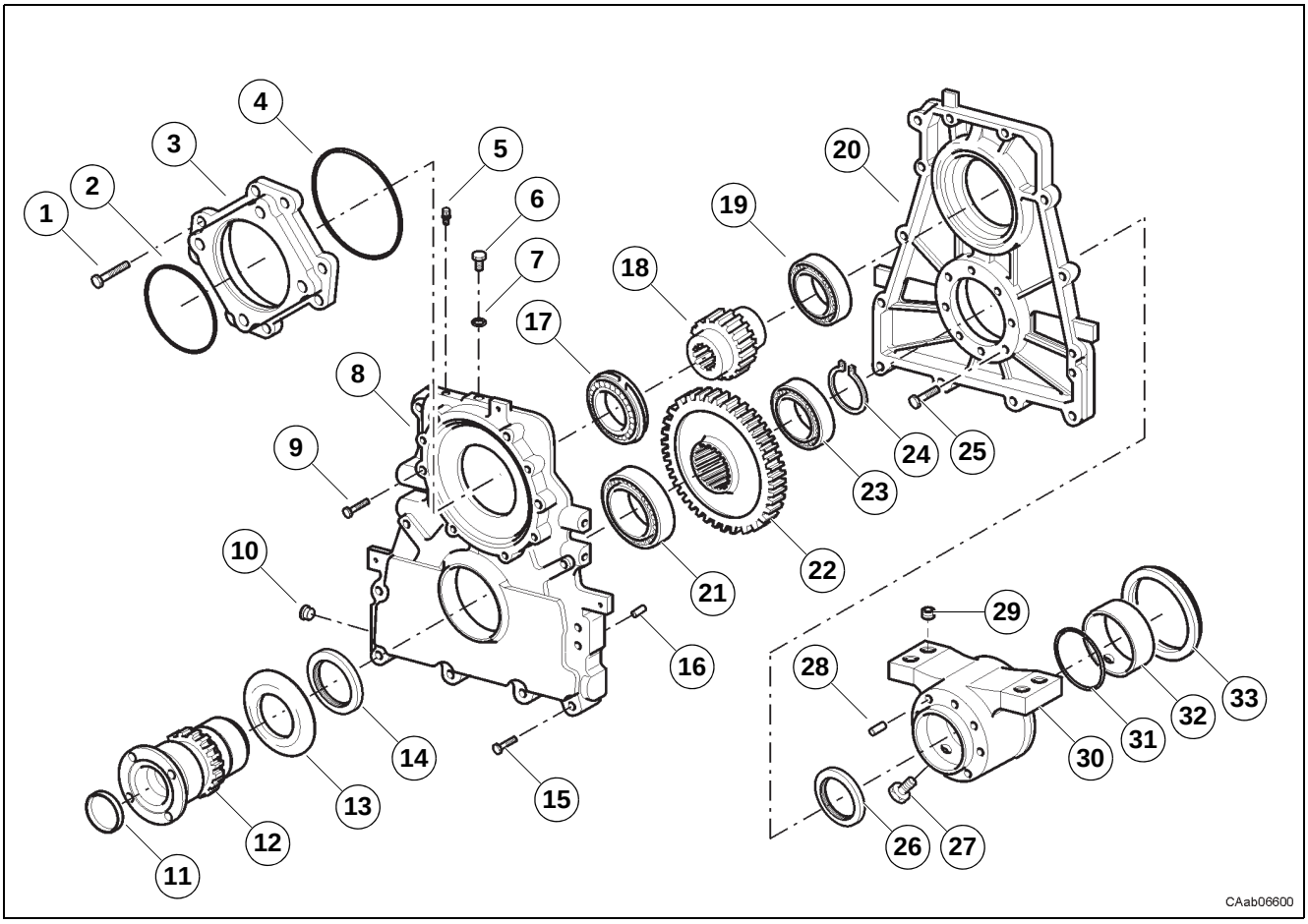
Warning: all preloadings must be measured without the seal ring.

25. Once the requested preloading value is achieved, caulk the ring nut (10), using a hammer and a chisel.



Transmission box

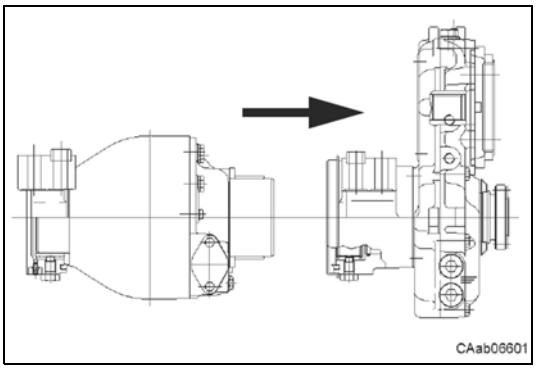
Disassembly



Some of the following pictures may not show exactly your transmission, but the indicated operations are correct anyway.

Warning: Before operating on the group, drain the oil.

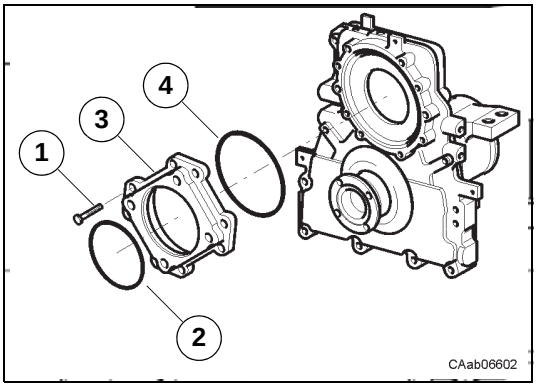
1. Disassembly the transmission box from the axle.



2. Remove the O-Ring (2).

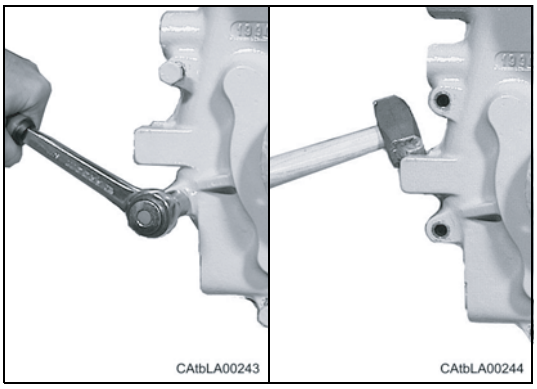
   Unscrew fastening bolts (1) and disassemble the motor flange (3).

   Collect the O-Ring (4).



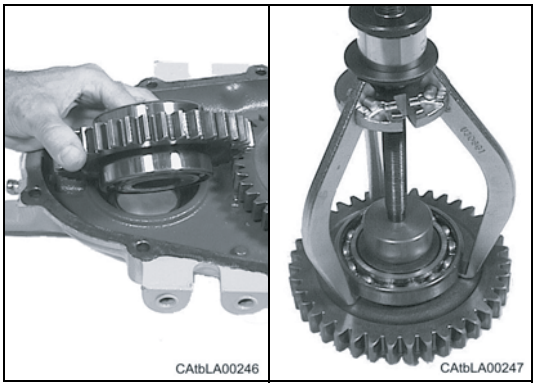
3. Remove fastening bolts (9) and (15) from the half box.

   Separate half boxes by beating on the fitting parts with a hammer made of soft material.

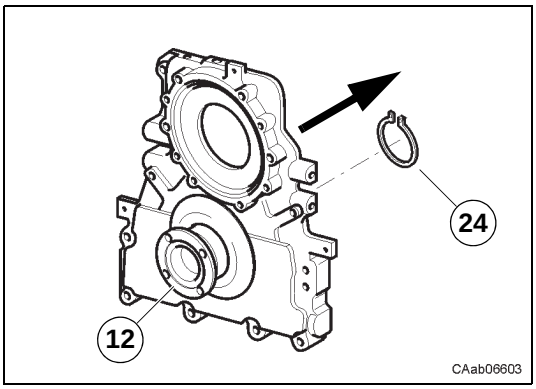


4. Remove the gear (18) with the bearings from the housing (8).

   Remove the bearings (17) and (19) from the gear (18) with a three-hold extractor.

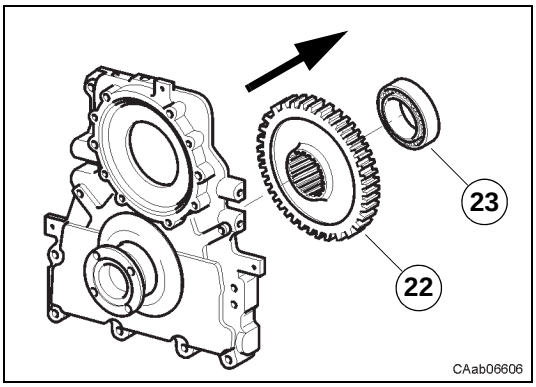


5. Remove the lock ring (24) from the shaft (12).



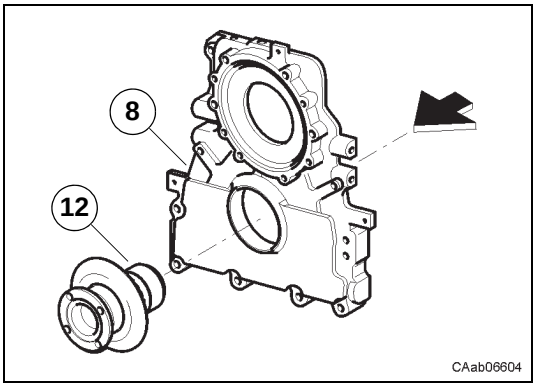
6. Remove the gear (22) and the bearings (23) from the shaft (12).

NOTE
Use a three-hold extractor if necessary.



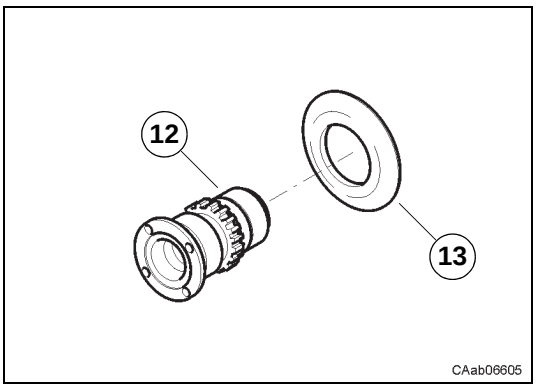
7. Extract the shaft (12) from the housing (8).

   If necessary, beat on the shaft end with a pad and a hammer.



8. Remove the cover (13) from the shaft (12) only if the cover is damaged.

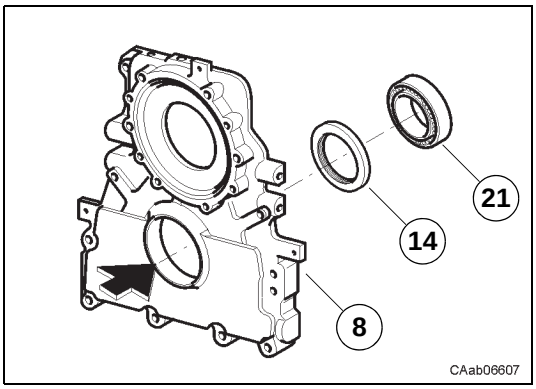
NOTE
This is destructive operation for the cover.



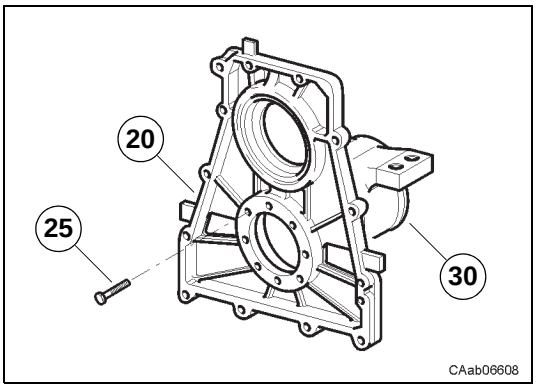
9. Remove the gear (18) with the bearings from the housing (8).

10. Extract the seal ring (14) with a pad and a hammer.

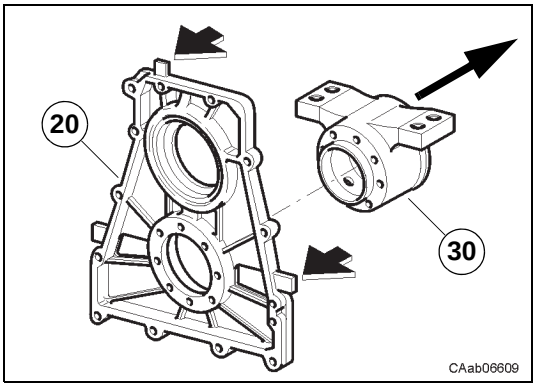
NOTE
This is destructive operation for the seal ring.



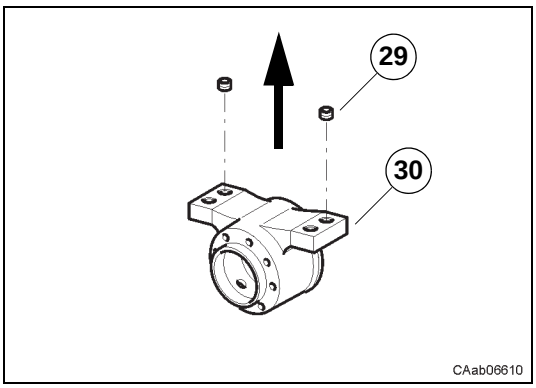
11. Remove the support (30) fastening screws (25) from the housing (20).



12. Remove the support (30) from the housing (20) using a pad and a hammer.



13. Remove the bushes (29) from the support (30) only if required.



14. Remove the seal ring (33).

NOTE
This is destructive operation for the seal ring.

15. Loosen the bush (32) fastening bolt (27).

16. Remove the bush (32) and O-Ring (31).

NOTE
This is destructive operation for the O-Ring.

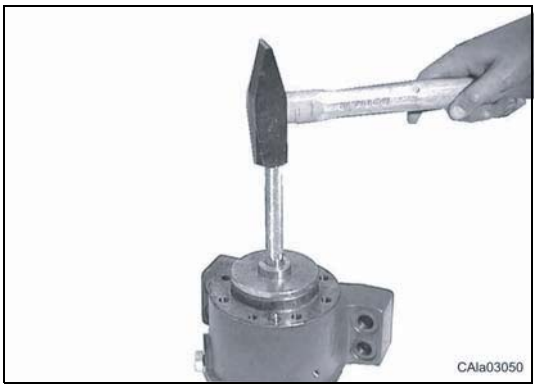
17. Remove the seal ring (26) with a pad and a hammer.

NOTE
This is destructive operation for the seal ring.

Assembly

1. Assemble the seal ring (26) into the support (30) with the special tool (793-H70-0230) band a hammer.

   Lubricate with care the seal ring lip.

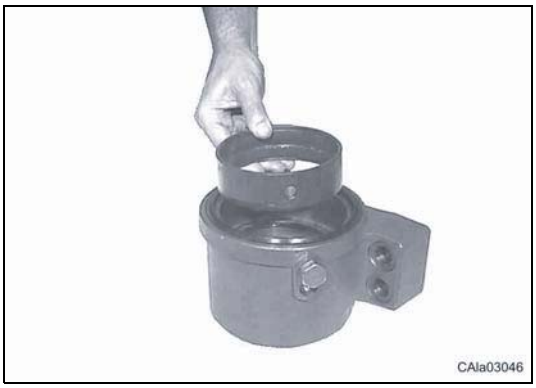


2. Overturn the support (30).

   Lubricate a new O-Ring (31) and assemble it into the support (30).

3. Insert the bush (32) into the support (30).

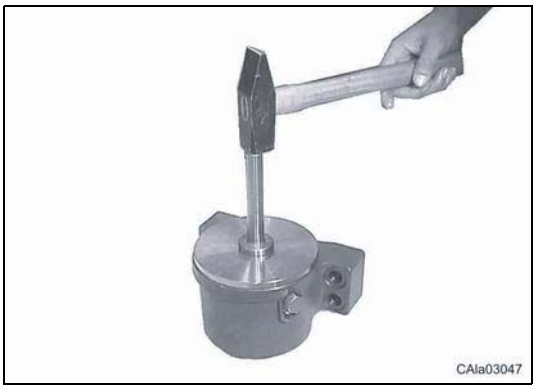
NOTE
Align the bush hole to the bolt (27).



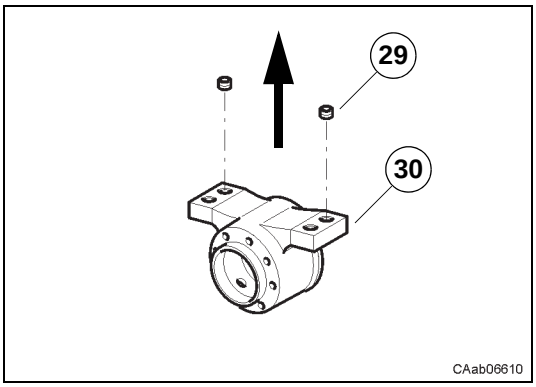
4. Tighten the bush (32) fastening bolt (27) to the prescribed torque (section C.6).

5. Assemble the seal ring (33) to the support (30) with the special tool (793-H70-0240) and a hammer.

   Lubricate with care the seal ring lip.



6. Apply prescribed sealant (section C.4) and assemble the bushes (29) to the support (30).



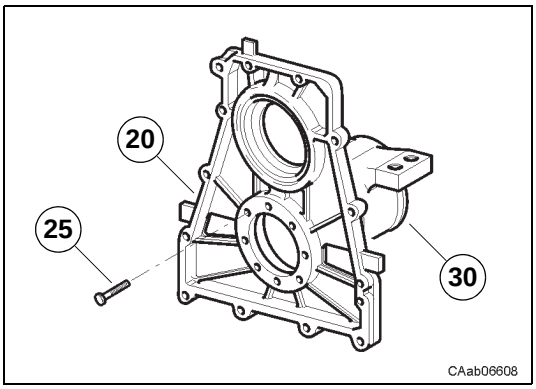
7. Cleaning well the support and housing contact surfaces then apply the prescribed sealant (Sec. C.4).

   Assemble the support (30) to the housing (20).

NOTE
Check the correct position of the dowel pin (28).

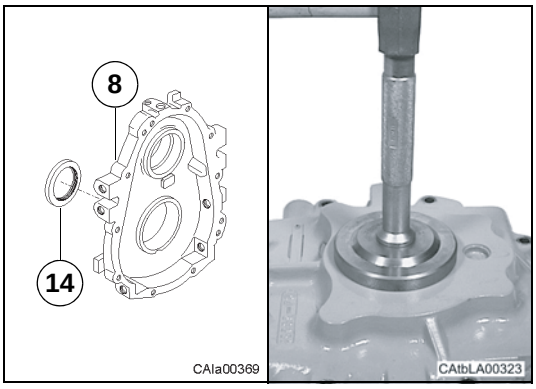
   Apply the specified sealant (Sec. C.4) to the fastening screws (25).

   Assemble the screws (25) to the prescribed torque (section C.6)

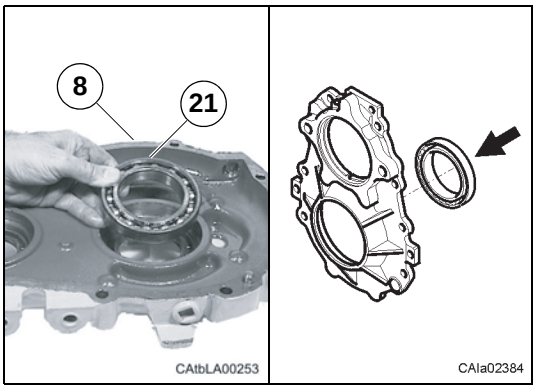


8. Position the half box (8) on a flat surface.

   Assemble the seal ring (14) using the special tool (793-H70-0250).



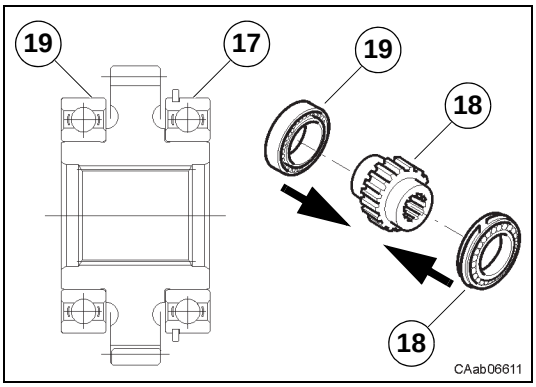
9. Assembly the bearing (21) to the half box (8) using the special tool (793-H70-0260).



10. Assembly the bearings (17) and (19) to the gear (18) using the special tool (793-H70-0270) and a hammer.

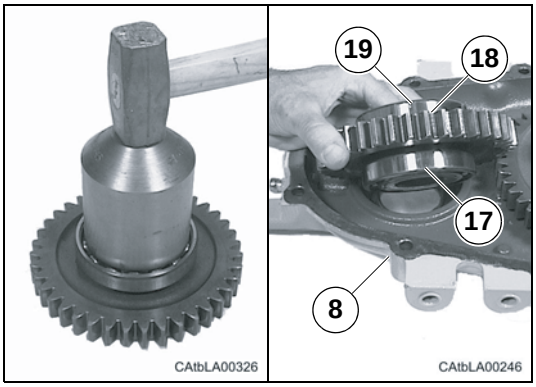
    See: next figure.

NOTE
The parts must be assembled as shown in the figure.

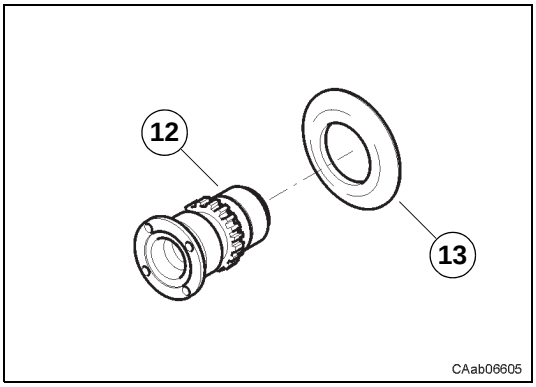


11. Assemble the group gear-bearings to the half box (8), fitting it by mean of a hammer and a pad.

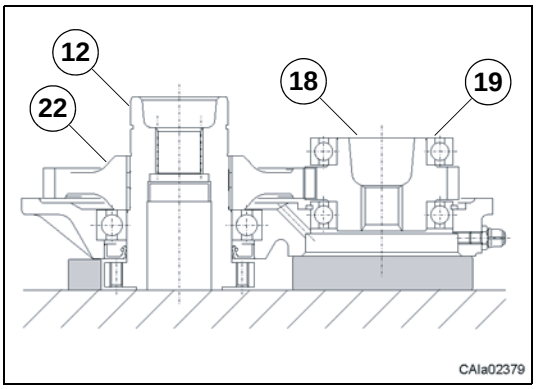
NOTE
The parts must be assembled as shown in the figure.



12. Assemble the cover (13) to the shaft (12) with a cylindrical pad and a hammer.



13. Insert the half box (20) onto shaft and position it with suitable supports.

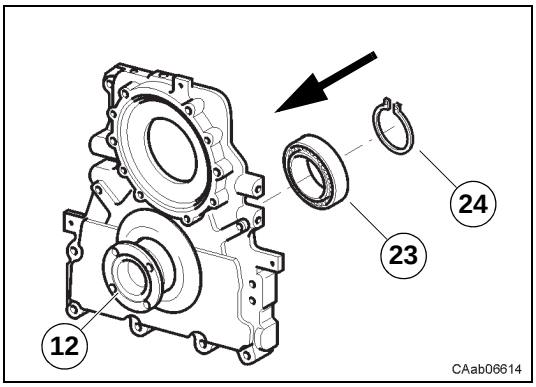


Warning: position the group as shown in the picture; do not damage the seal ring (14).

Fit the gear (22) to the shaft (12).

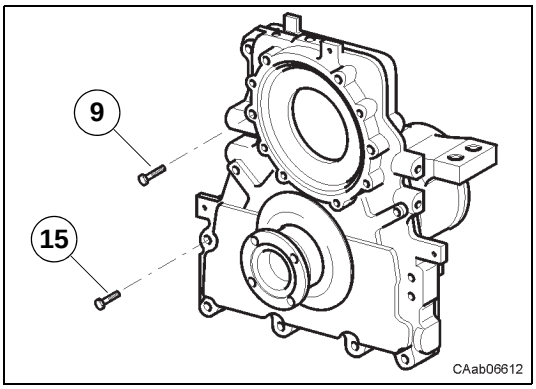
14. Assemble the bearing (23) to the shaft (12) using the special tool (793-H70-0280) and a hammer.

Assemble the lock ring (24) to the shaft (12).



15. Cleaning well the contact surfaces and apply sealant (Sec. C.4).

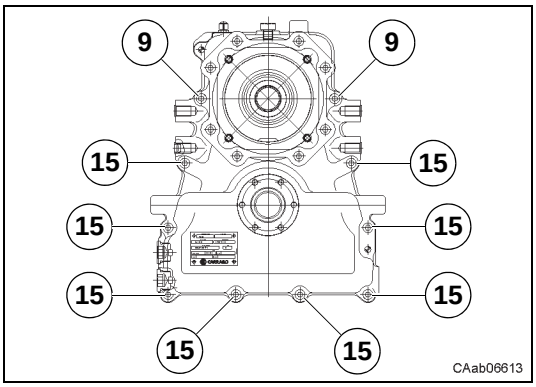
Assemble the half boxes (8) and (20) using a soft hammer to fit.



NOTE
Check the correct position of the dowel pin (16).

Assemble the fastening bolts (9) and (15) as indicated in the next step.

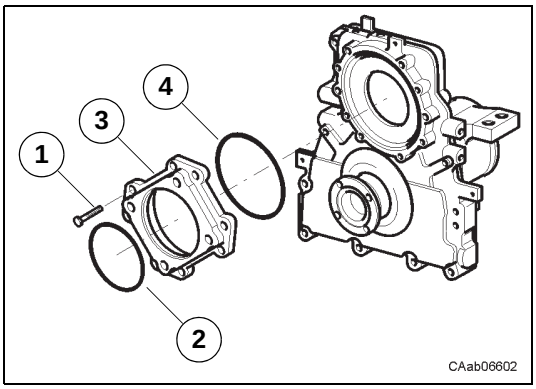
16. Note: bolts (9) length is 70 mm and bolts (15) length is 60 mmTighten the fastening bolts (9) and (15) with dynamometric wrench to the requested torque (Sec.C.6).



17. Assemble new O-Rings (2) and (4) on the motor flange (3).

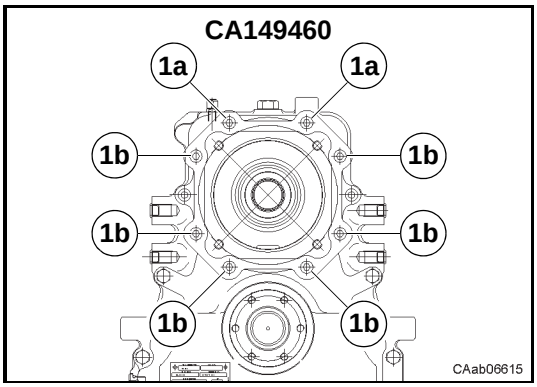
    Position the motor flange on the transmission box.

    Assemble the fastening bolts (1) as indicated in the next steps.



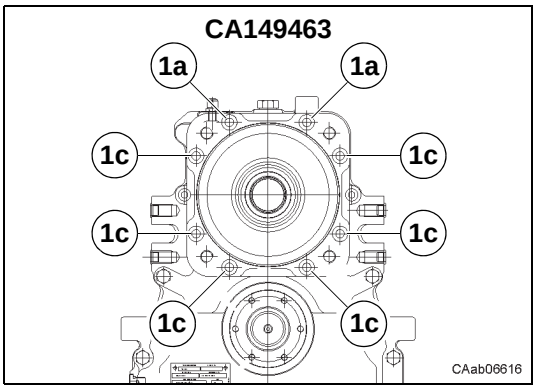
18. Note: bolts (1a) length is 90 mm and bolts (1b) length is 30 mm.

    Tighten the fastening bolts (1) with dynamometric wrench to the requested torque (Sec.C.6).



19. Note: bolts (1a) length is 90 mm and bolts (1c) length is 35 mm.

    Tighten the fastening bolts (1) with dynamometric wrench to the requested torque (Sec.C.6).



Variable displacement pump assembly

Removal of variable displacement pump assembly

- **Park the machine on a piece of level, solid ground and secure it against rolling away and jack-knifing!**
  Lower the bucket, switch the engine off and put the parking brake on.
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**
- **Remove the earth lead from the (-) pole of the battery, or throw the battery main switch if one has been installed!**

- Remove the engine cover.
  See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of engine cover assembly" on page 30-12.

- Remove both hydraulic pumps
  See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of the two hydraulic pump assemblies" on page 30-122.

1. Electrical connections

★ Mark the cables in order to ensure that they are not mixed up when being reconnected. ※1

Disconnect the two connectors (1) and (2) from the solenoids.

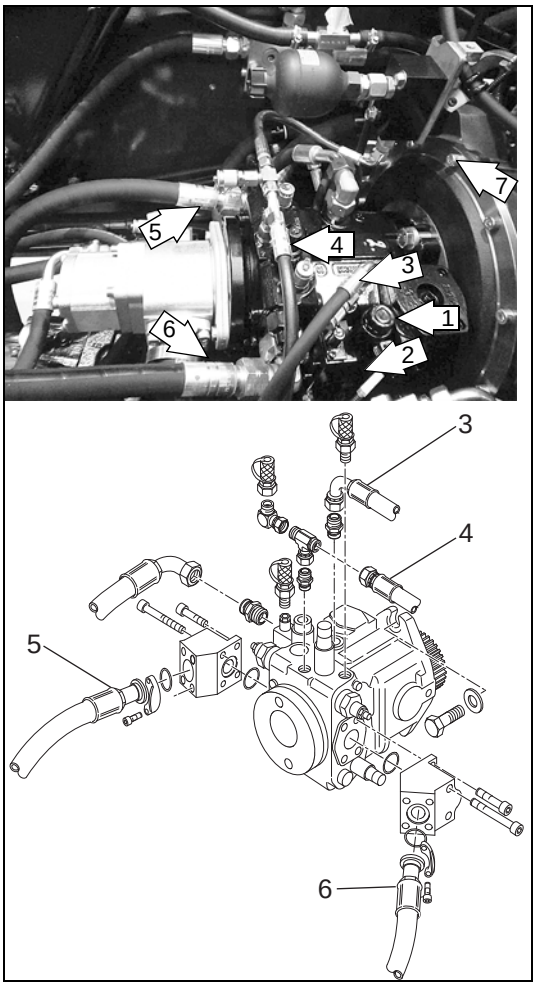
2. Hydraulic lines

★ Mark the lines in order to ensure that they are not mixed up when being reconnected. ※2

a. Disconnect four hydraulic lines (3) to (6) from the variable displacement pump.

b. Disconnect hydraulic lines from auto inch valve and diff. lock valve if required.

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.



3. Variable displacement pump

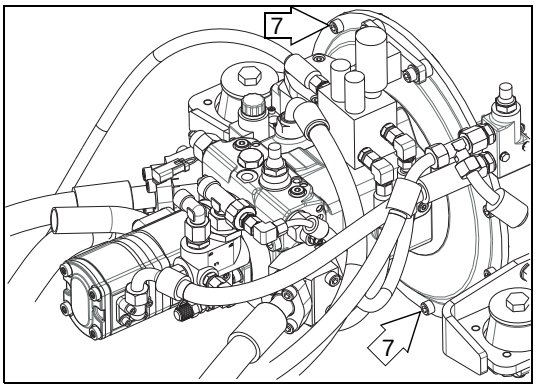
a. Remove the ten fastening screws (7). ✳ 3

b. Suspend the variable displacement pump from a hoisting gear.

c. Pull the variable displacement pump forwards away from the engine. ✳ 4

★ The amount of space for removing the pump is very limited. For this reason you should ensure that no other machine parts are damaged when lifting and removing the variable displacement pump.

d. Lift the variable displacement pump out of the machine.



kg **Variable displacement pump**	40 - 61 kg	WA80M-7
	48 - 70 kg	WA100M-7

Installation of variable displacement pump assembly

- To fit the variable displacement pump carry out the removal procedure in reverse order.

✳ 4

- Grease the gearing before reinstalling the pump.

✳ 3

kgm Screws: **250 Nm**

✳ 2 ✳ 1

- When reconnecting the lines make sure that the markings coincide.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL.
- Variable displacement pump and induction lines are filled with oil.
- Vent the hydrostatic travel gear and test the function:
  - Open the filler pipe at the hydraulic tank.
  - Start the engine and dump the bucket.
  - Raise the lifting arm to its full extension upwards and tilt the bucket fully.
  - Let the engine continue to run and close the filler pipe on the hydraulic tank.
  - Lower the lifting arm to the ground and then switch off the engine.
  - Check the oil level and top up with oil, if necessary.
  - Finally conduct a check of the seals and the various functions.

Hydraulic pump assemblies

Removal of the two hydraulic pump assemblies

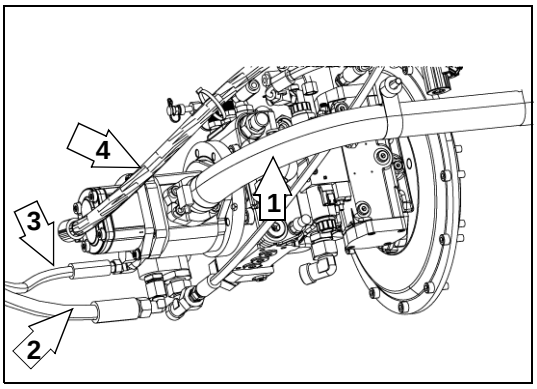
- **Park the machine on a piece of level, solid ground and secure it against rolling away and jack-knifing! Lower the bucket, switch the engine off and put the parking brake on.**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**

- Remove the engine cover.
  See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of engine cover assembly" on page 30-12.
- Remove the priority valve.
  See chapter 30 DISASSEMBLY AND ASSEMBLY "Removal of priority valve assembly" on page 30-38.
- The shape is subject to machine models.

1. Hydraulic lines

Disconnect the two hydraulic lines (1) to (4) from the hydraulic pump.

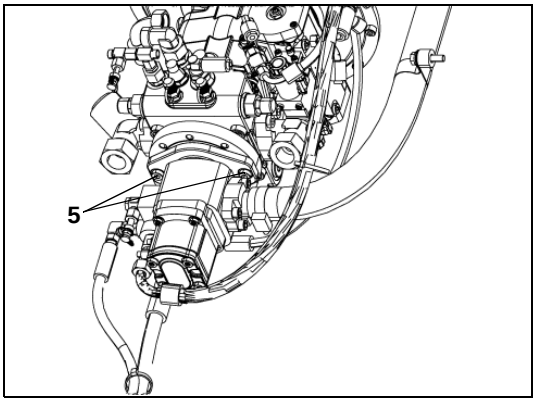
★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.



2. Hydraulic pump

Remove the two fastening screws (5) and take the hydraulic pump off. ✳ 1

kg Two hydraulic pumps: **8 kg**



Installation of hydraulic pump assembly

- To fit the hydraulic pump carry out the removal procedure in reverse order.
- Bleed the air from the hydraulic system.

✻ 1

kgm Screws: **70 Nm**

- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Variable geometry turbocharger assembly - WA80M-7, WA100M-7

Removal of the turbocharger

For details, see Shop manual Engine in attachment.

Installation of the turbocharger

For details, see Shop manual Engine in attachment.

Quick coupler assembly

Removal of quick coupler assembly

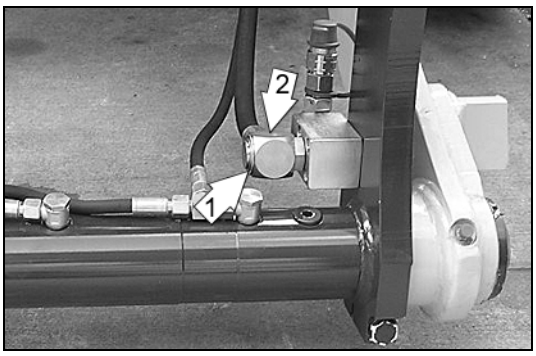
- Prior to removing the quick coupler the working equipment must be disengaged. See the Operation manual.
- Unlock the quick coupler.

- **Park the machine on level ground and secure it against rolling away and jack-knifing! Lower the bucket, switch the engine off and apply the parking brake!**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**

1. Hydraulic lines

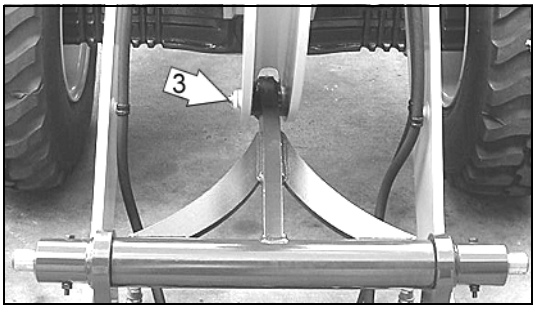
Remove the locking rings (1) on both sides of the quick coupler system at the connecting block and withdraw the angular part (2).

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.



2. Rocker arm

Unscrew the locking bolt (3) and remove the bolt from the rocker arm. ✳ 1



3. Quick coupler

a. Loosen the clamping screws (4) on the quick coupler's joint rod. ✳ 2

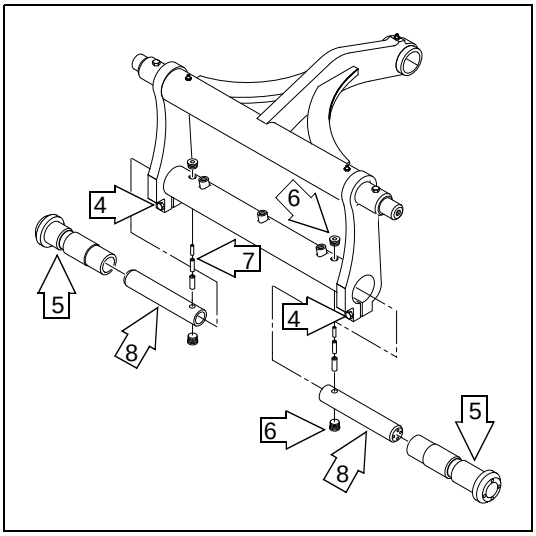
b. Unscrew the bearing bushes (5) ✳ 3

c. Unscrew the four plugs (6) and knock out the three female pins (7).

d. Remove the two pins (8).

e. Use hoisting gear to lift the quick coupler out of the lifting arms.

kg Quick coupler system: **110 kg**



Installation of quick coupler assembly

- To fit the quick coupler carry out the removal procedure in reverse order.

✳ 3

- Tighten the bearing bushes as far as possible and then loosen the bolted connections by approximately half a rotation.

✳ 2

kgm Bolted connections: **280 Nm**

✳ 1

Danger of crushing! Use a rod to align the quick couplers. Never insert your fingers into any of the holes!

kgm Screws: **70 Nm**

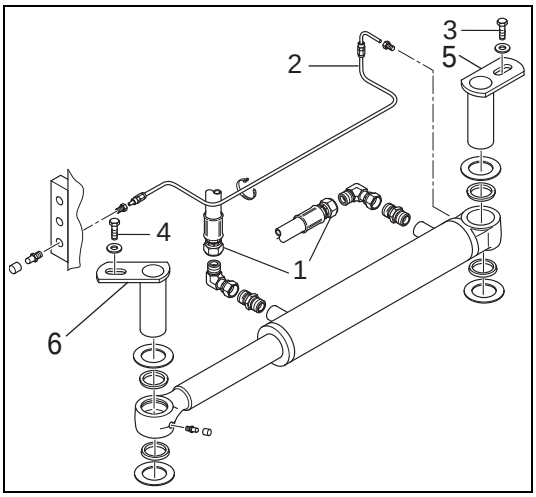
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Steering cylinder assembly

Removal of steering cylinder assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing! Lower the bucket, switch the engine off and apply the parking brake!**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**

★ In contrast to WA80M-7 the WA100M-7 is equipped with two steering cylinders. However, the procedure for installing and removing the cylinders is almost identical.



1. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ✳ 1

Disconnect the hydraulic lines (1) from the cylinder.

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

2. Lubricant lines

Disconnect the lubricant line (2) from the cylinder.

3. Steering cylinder

a. Support the steering cylinder or suspend it from hoisting gear.

b. Unscrew the locking screws (3) and (4). Remove the bolts (5) and (6) from the front or rear frame, respectively. ✳ 2

★ Keep the distance washer and seals in a safe place or, if they are worn, replace them with new ones.

c. Lift the steering cylinder up and out of the frame.

★ Make sure that when doing so the piston rod is not damaged.

kg Steering cylinder: **kg**

kg **Variable displacement pump**	**17 kg**	WA80M-7
	14 kg	WA100M-7

Installation of steering cylinder assembly

- To fit the steering cylinder carry out the removal procedure in reverse order.

✳ 2

Danger of crushing! Use a rod to align the steering cylinders. Never insert your fingers into any of the holes!

kgm Screws: **70 Nm**

✳ 1

- When reconnecting the hydraulic lines make sure that the markings coincide.
- Greasing

  Grease the steering cylinders.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Lift cylinder assembly

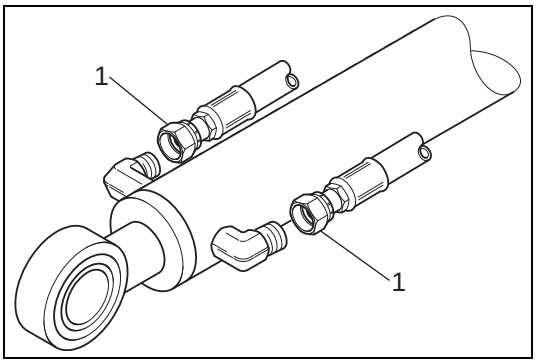
Removal of lift cylinder assembly

- **Park the machine on level ground and secure it against rolling away and jack-knifing!**
- **Lift the bucket to its highest position and secure it against lowering.**
- **Switch the engine off and apply the parking brake!**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**

★ The WA80M-7, and WA100M-7 are equipped with two lift cylinders. However, the procedure for installing and removing the cylinders is almost identical.

1. Hydraulic lines

★ Mark the hydraulic lines (1) to make sure that they don't get mixed up when being reconnected. ✳ 1



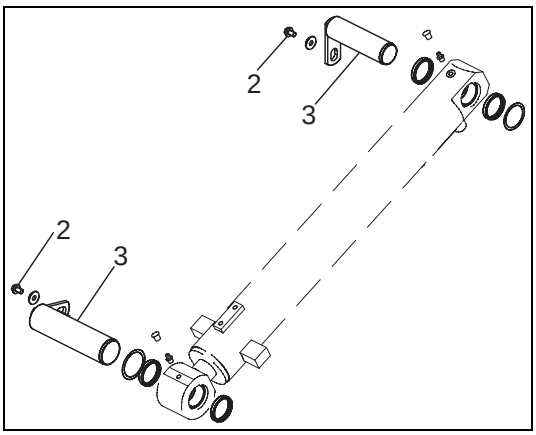
Disconnect the hydraulic lines from the lift cylinder. (If a hose rupture safety device has been installed, disconnect it's hydraulic lines too.)

★ Close the hydraulic lines immediately with a plug in order to prevent vapours from exiting and to prevent any dirt and foreign particles from entering.

2. Lift cylinder

a. Suspend the lift cylinder from hoisting gear.

b. Unscrew the two locking screws (2) and remove the two bolts (3) from the lifting rack or front frame, respectively. ✳ 2



★ Keep the distance washer and seals in a safe place or, if they are worn, replace them with new ones.

c. Lower the lift cylinder with the hoisting gear down to the ground or onto a jack.

★ Make sure that when doing so the piston rod is not damaged.

kg Lift cylinder (WA80M-7): 29 kg

(WA100M-7): 33 kg

Installation of lift cylinder assembly

- To fit the lifting cylinder carry out the removal procedure in reverse order.

✳ 2

Danger of crushing! Use a rod to align the lifting cylinders. Never insert your fingers into any of the holes!

kgm Screws: **70 Nm**

✳ 1

- When reconnecting the hydraulic lines make sure that the markings coincide.
- Greasing

  Grease the lifting cylinders.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

Dump cylinder assembly

Removal of dump cylinder assembly

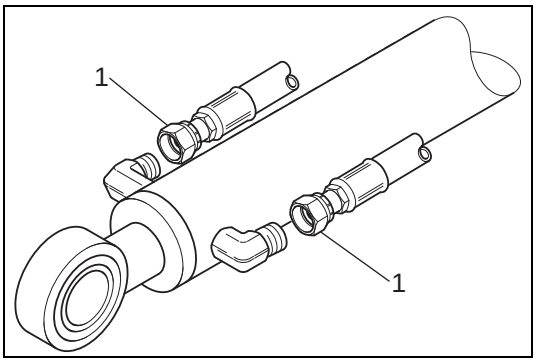
- **Park the machine on level ground and secure it against rolling away and jack-knifing! Lower the bucket, switch the engine off and apply the parking brake!**
- **Depressurise the hydraulic system: loosen the filler/vent plug a few turns to relieve the pressure in the tank.**

1. Hydraulic lines

★ Mark the hydraulic lines to make sure that they don't get mixed up when being reconnected. ✳ 1

Disconnect the hydraulic lines (1) from the cylinder. (If a hose rupture safety device has been installed, disconnect it's hydraulic lines too.)

★ Close the hydraulic lines immediately with a plug in order to prevent the vapours from exiting and to prevent any dirt and foreign particles from entering.



2. Dump cylinder

a. Suspend the cylinder from hoisting gear.

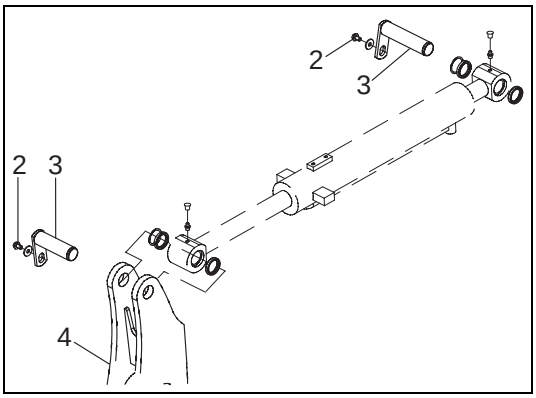
b. Unscrew the two locking screws (2) and remove the two bolts (3) from the rocker arm (4) or front frame, respectively. ✳ 2

★ Keep the distance washer and seals in a safe place or, if they are worn, replace them with new ones.

c. Lift the dump cylinder with the hoisting gear up and out of the frame.

★ Make sure that when doing so the piston rod is not damaged.

kg Dump cylinder:



kg **Dump cylinder:**	**41 kg**	WA80M-7
	54 kg	WA100M-7

Installation of dump cylinder assembly

- To fit the tilt cylinder carry out the removal procedure in reverse order.

※ 2

Danger of crushing! Use a rod to align the tilt cylinders. Never insert your fingers into any of the holes!

kgm Screws: **70 Nm**

※ 1

- When reconnecting the hydraulic lines make sure that the markings coincide.
- Greasing

  Grease the tilt cylinder.
- Check the hydraulic oil level and top up with oil if necessary. Once finished you should vent the hydraulic oil tank. See Operation Manual: HYDRAULICS, CHANGING OIL, VENTING HYDRAULIC OIL TANK.

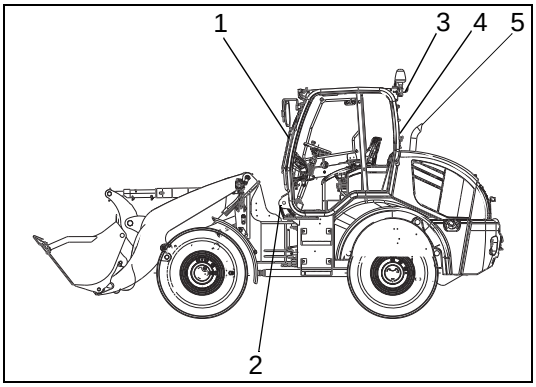
Replacing windows in driver's cab

Stuck glass

Park the machine on level ground and secure it against rolling away and jack-knifing! Lower the bucket, switch the engine off and apply the parking brake!

Preparation work for replacing the front window:

- Dismantle the front windscreen wiper (1).
  a. Unscrew the wiper arm.
  b. Remove the wiper axle and the motor.
- Dismantle the heating's panelling (2) at the front.

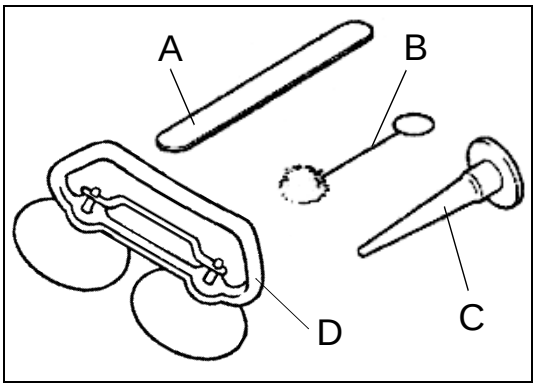


Preparation work for replacing the rear window:

- Remove the exhaust pipe (5).
- Dismantle the rear window windscreen wiper (4).
  a. Unscrew the wiper arm.
  b. Remove the wiper axle and the motor.
- Disconnect the plug-type connector for the rear window heater system (3).

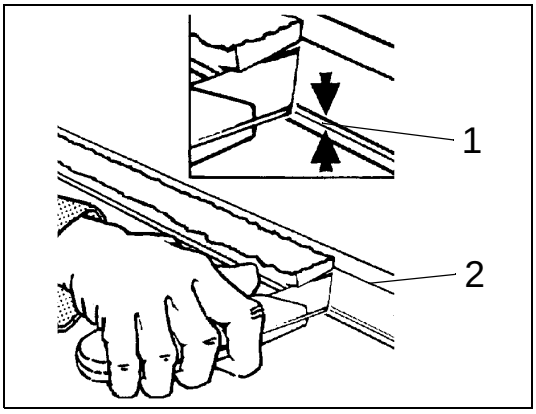
Tools for reworking tasks:

- Wooden spatula for spreading the sealing compound (A).
- Applicator for the prime coating (B)
- Nozzle for the sealing cartridge (C)
- Suction gripper (D)
- Cleaning cloths
- Knife
- Masking tape
- Glue gun for the sealing compound cartridge



Replacing a window:

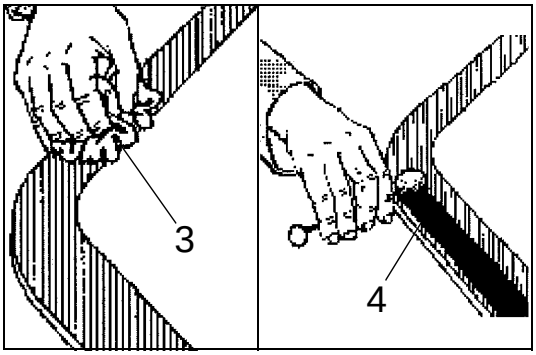
★ The order numbers for the respective parts are listed in the following table.



- Cut the glass out.
  Make sure that a sealing strip (1) of at least 1 - 2 mm is left around the frame.
- Remove the pane of glass.
- Cut away the sealing compound strip (2) from the door frame to at least 1 - 2 mm.
- Use masking tape to mask the left and right-hand side areas.
- Clean the cab door's frame.
- Clean the frame and glass edge with the cleaner **BETACLEAN 3350.**
- Wipe the area clean with a damp cloth.
- Apply the sealing compound to the frame with the **BETAPRIME 5402** applicator (B).

  Allow to dry for at least 15 minutes. Max. 24 hours.
- Coat the glass edge (3) with activator cleaner **BETAWIPE VP 04604** and then wipe it down with a clean cloth.
- Use an applicator (B) to apply **BETAPRIME 5001** to the glass edge.

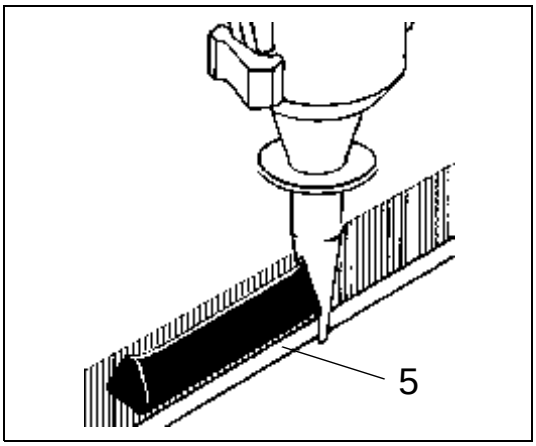
  Allow to dry for at least 15 minutes. Max. 24 hours.



- Use the glue gun to apply **BETASEAL 8000** to the frame's designated area (5).

  Processing temperature: 10° - 35° C
- Using two suction grippers insert the glass into position and press slightly against it.
- Hold the glass in the correct position and apply the sealing compound completely around the inside and outside of the glass window's edge.
- Use adhesive tape to hold the glass firmly in place to the cab.

  Cure time: 24 hours
- Remove the masking tape after the glass sealant has dried.



Spare Parts:

Pos.	Name		Order No.	Qty.
1	Cleaner, frame	Betaclean 3350	42U-56-H0P00	1
2	Cleaner, glasses	Betawipe VP 04604	42U-56-H0P20	1
3	Primer, glass	Betaprime 5001	42U-56-H0P19	1
4	Primer, frame	Betaprime 5402	42U-56-H0P02	1
5	Sealer, cartridge (300 ml)	Betaseal 8000	42U-56-H0P06	2 off

Installation

- To mount the wipers and the window heater systems carry out the removal procedure in reverse order.

Rear window

a. Reconnect the plug-type connector for the rear window heater system (3).

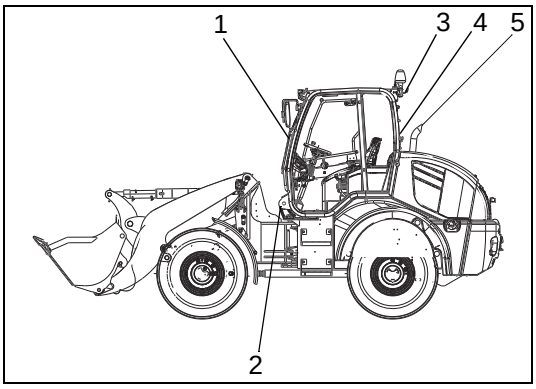
b. Reassemble the rear window windscreen wiper (4).

kgm Wiper axle screws (M18): **10 Nm**

kgm Wiper arm screws (M8): **20 Nm**

kgm Wiper motor screws (M8): **8 Nm**

c. Reinstall the exhaust pipe (5)



Front window

a. Reassemble the heating's panelling (2) at the front.

b. Reassemble the front windscreen wiper (1).

kgm Wiper axle screws (M24): **60 Nm**

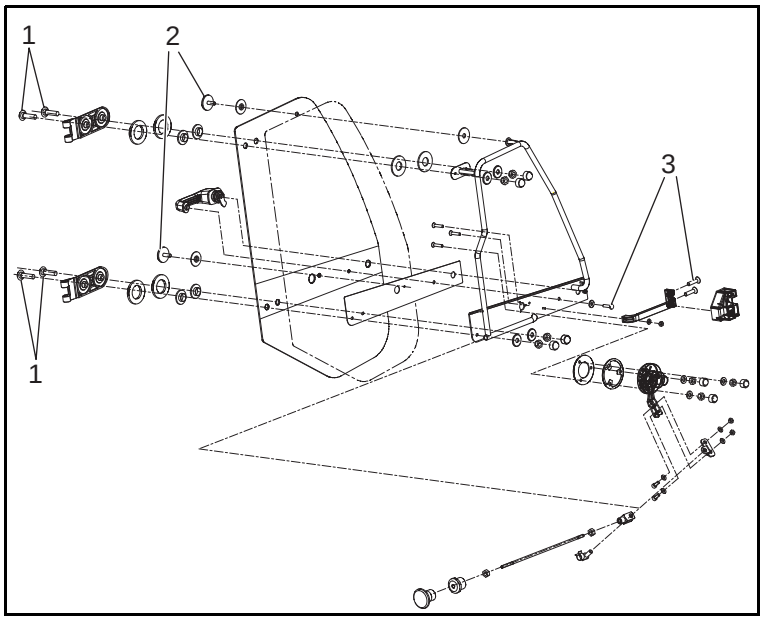
kgm Wiper arm screws (M8): **20 Nm**

kgm Wiper motor screws: **60 Nm**

Door and side windows

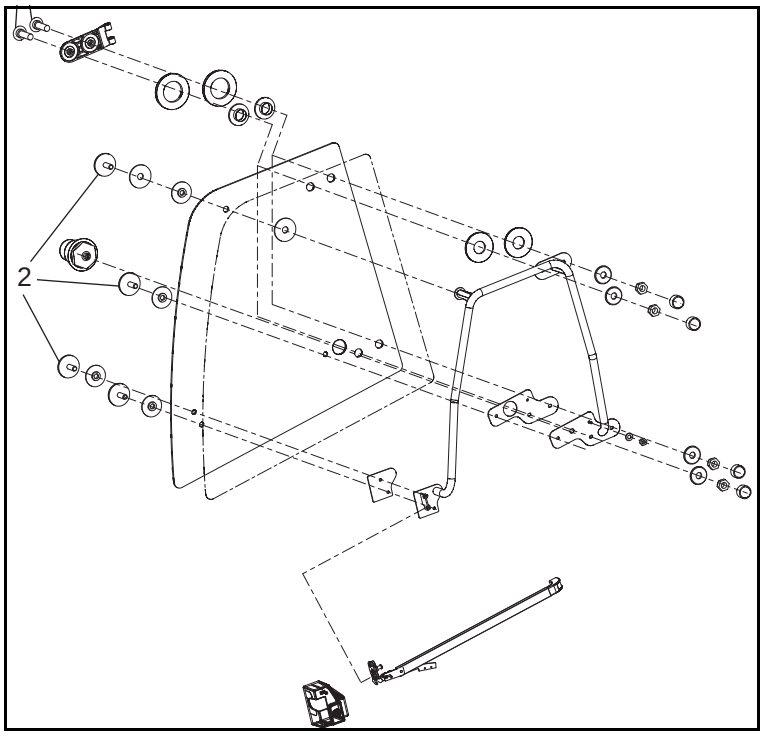
★ Unscrew the door or the side window assembly from the driver's cab. Then disassemble the door and side windows according to the scetches below.

Door window assembly



kgm 1: **15 Nm** kgm 2: **15 Nm** kgm 3: **22 Nm**

Side window assembly

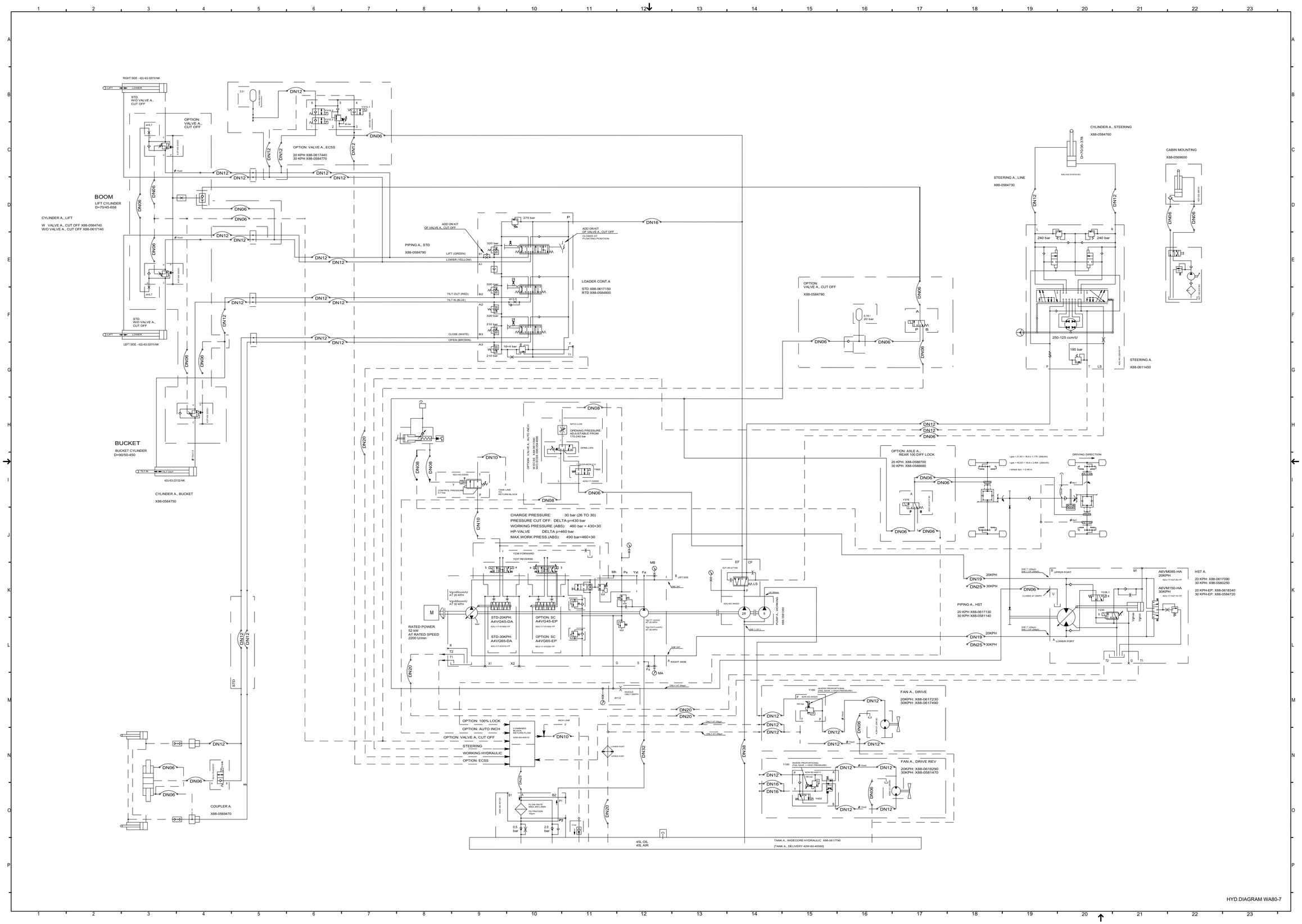


kgm 1: **15 Nm** kgm 2: **15 Nm**

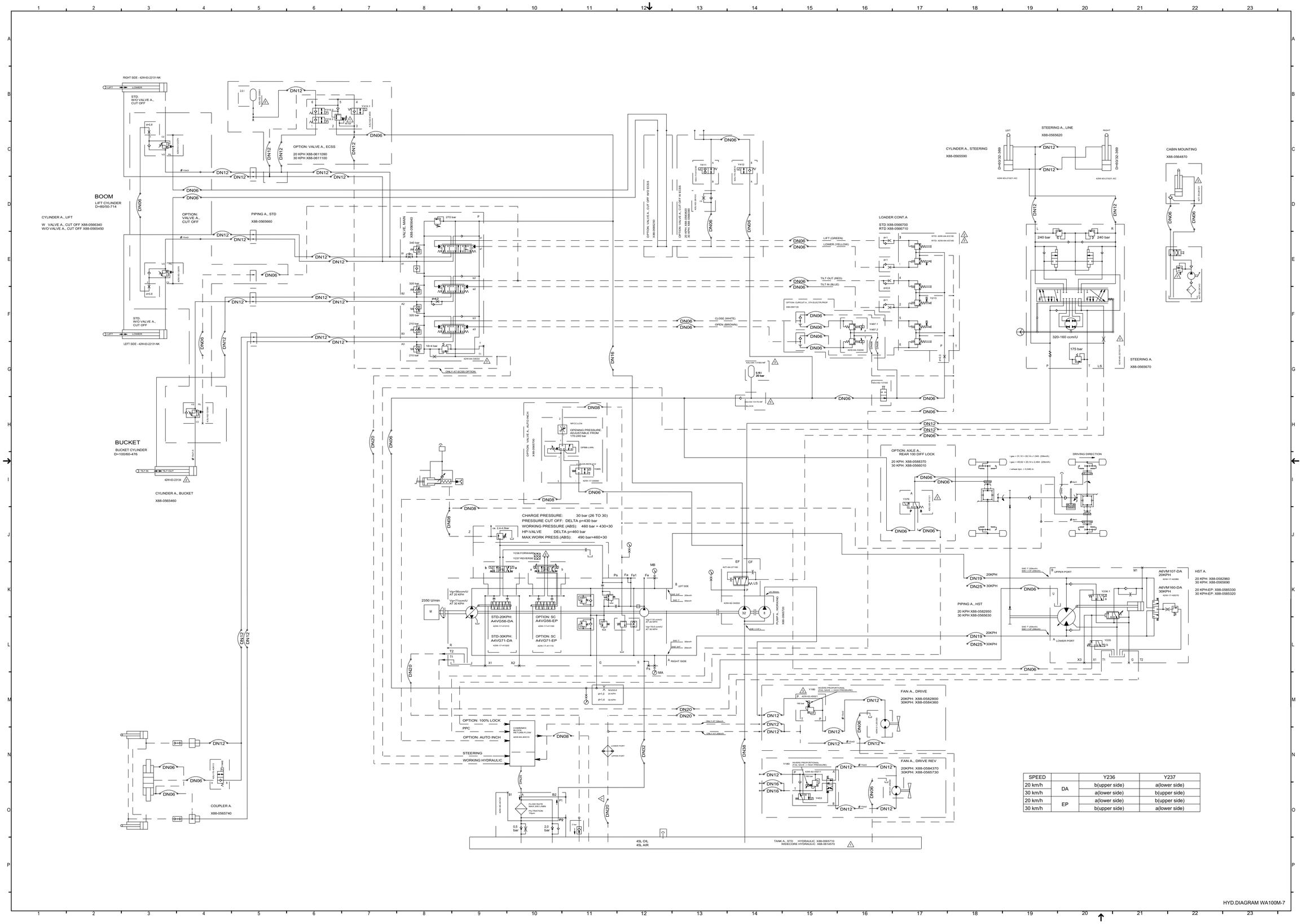
90 OTHERS

Blank for technical reason

Hydraulic circuit diagram – WA80M-7

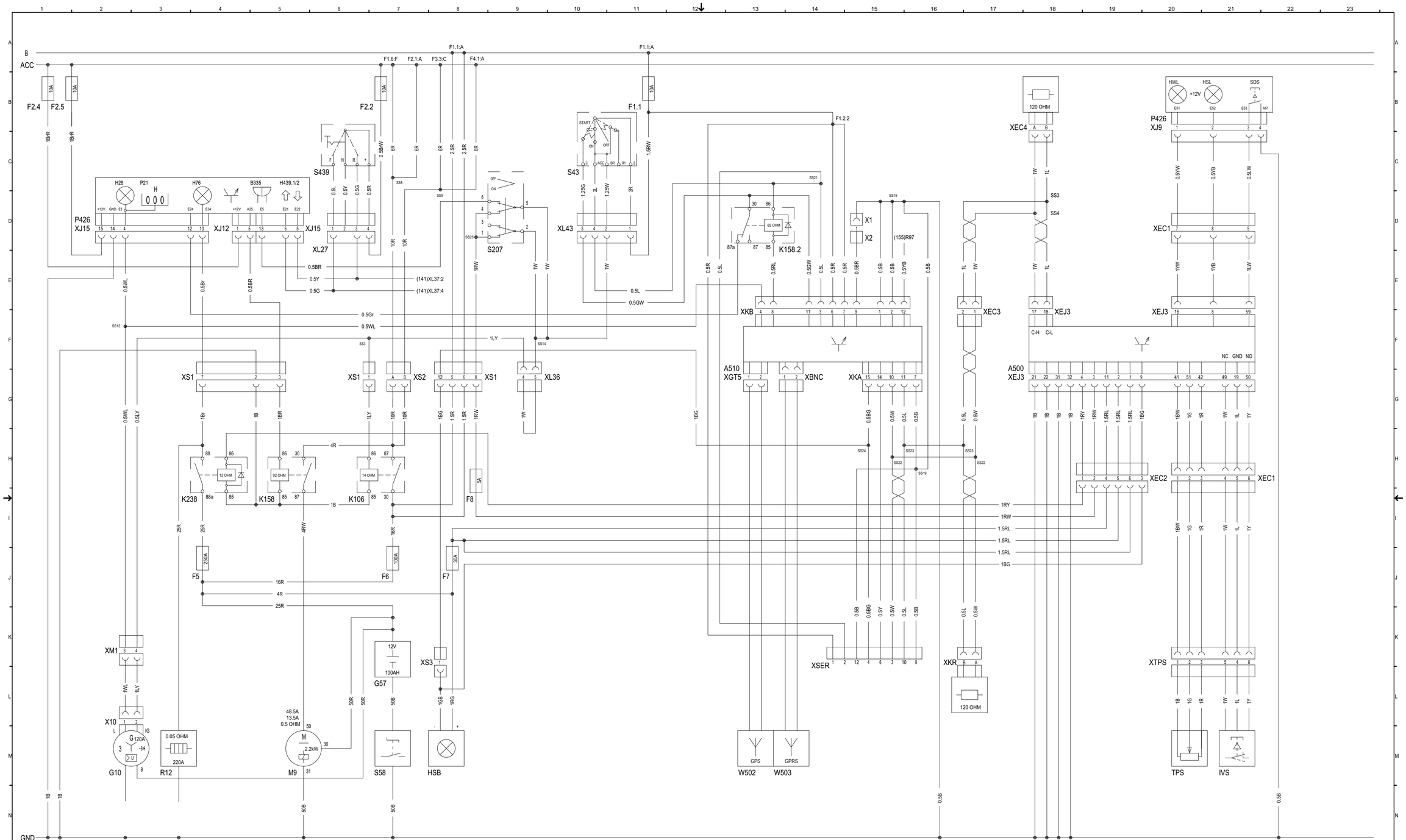


Hydraulic circuit diagram – WA100M-7



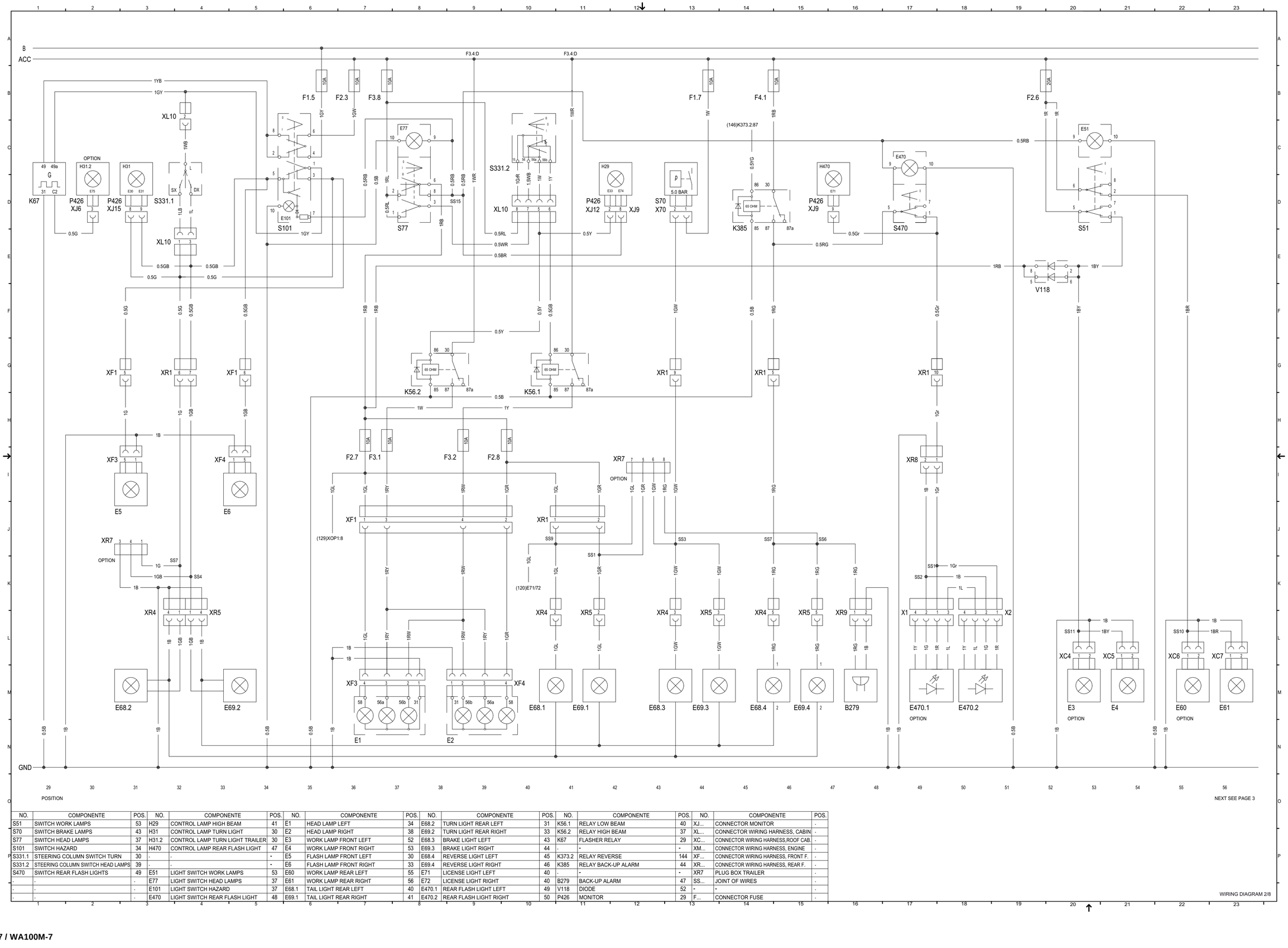
SPEED		Y236	Y237
20 km/h	DA	b(upper side)	a(lower side)
30 km/h		a(lower side)	b(upper side)
20 km/h	EP	a(lower side)	b(upper side)
30 km/h		b(upper side)	a(lower side)

Wiring diagram 1/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
S43	KEY SWITCH	12	H28	CONTROL LAMP ALTERNATOR	2	G10	ALTERNATOR	2	XL...	CONNECTOR WIRING HARNESS, CABIN	-	XEC...	CONNECTOR WIRING HARNESS, ENGINE C.	-	A500	ENGINE CONTROLLER	21
S58	BATTERY MAIN SWITCH	8	H76	CONTROL LAMP AIR PREHEATER ENGINE	4	G57	BATTERY	8	XM...	CONNECTOR WIRING HARNESS, ENGINE	-	XTPS	CONNECTOR THROTTLE PEDAL	24	A510	KOMTRAX CONTROLLER	15
S207	SECONDARY ENGINE STOP SWITCH	10	H439.1	CONTROL LAMP FORWARD	6	.	.	-	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-	-	.	17	-	.	.
S439	SWITCH DRIVE DIRECTION	6	H439.2	CONTROL LAMP REVERSE	6	B335	BUZZER MONITOR	5	XJ...	CONNECTOR MONITOR	-	-	.	-	-	.	.
SDS	PUSH BOTTON SWITCH ENGINE FAULT	26	.	.	-	.	.	-	XS...	CONNECTOR CASE, RELAY	-	-	.	-	-	.	.
.	.	-	HSL	"STOP" LAMP ENGINE CONTROLLER	25	M9	STARTER MOTOR	6	XR...	CONNECTOR WIRING HARNESS, REAR F.	-	TPS	THROTTLE POSITION SENSOR	25	-	.	.
K106	RELAY BATTERY	7	HSB	"SYSTEM BUSY" LAMP	9	.	.	-	XSER	SERVICE CONNECTOR	17	IVS	IDLE VALITATION SWITCH	26	P21	SERVICE METER	3
K158	RELAY STARTER MOTOR	5	HWL	"WARNING" LAMP ENGINE CONTROLLER	25	.	.	-	SS...	JOINT OF WIRES	.	-	.	-	P426	MONITOR	2
K158.2	RELAY KOMTRAX	16	.	.	.	R12	AIR PREHEATER ENGINE	3	XEJ...	CONNECTOR ENGINE CONTROLLER	.	W502	ANTENNA GPS	15	-	.	.
K238	RELAY AIR PREHEATER ENGINE	4	.	.	.	R97	SENSOR FUEL LEVEL	19	XK...	CONNECTOR KOMTRAX	.	W503	ANTENNA GPRS	16	F...	FUSE	.

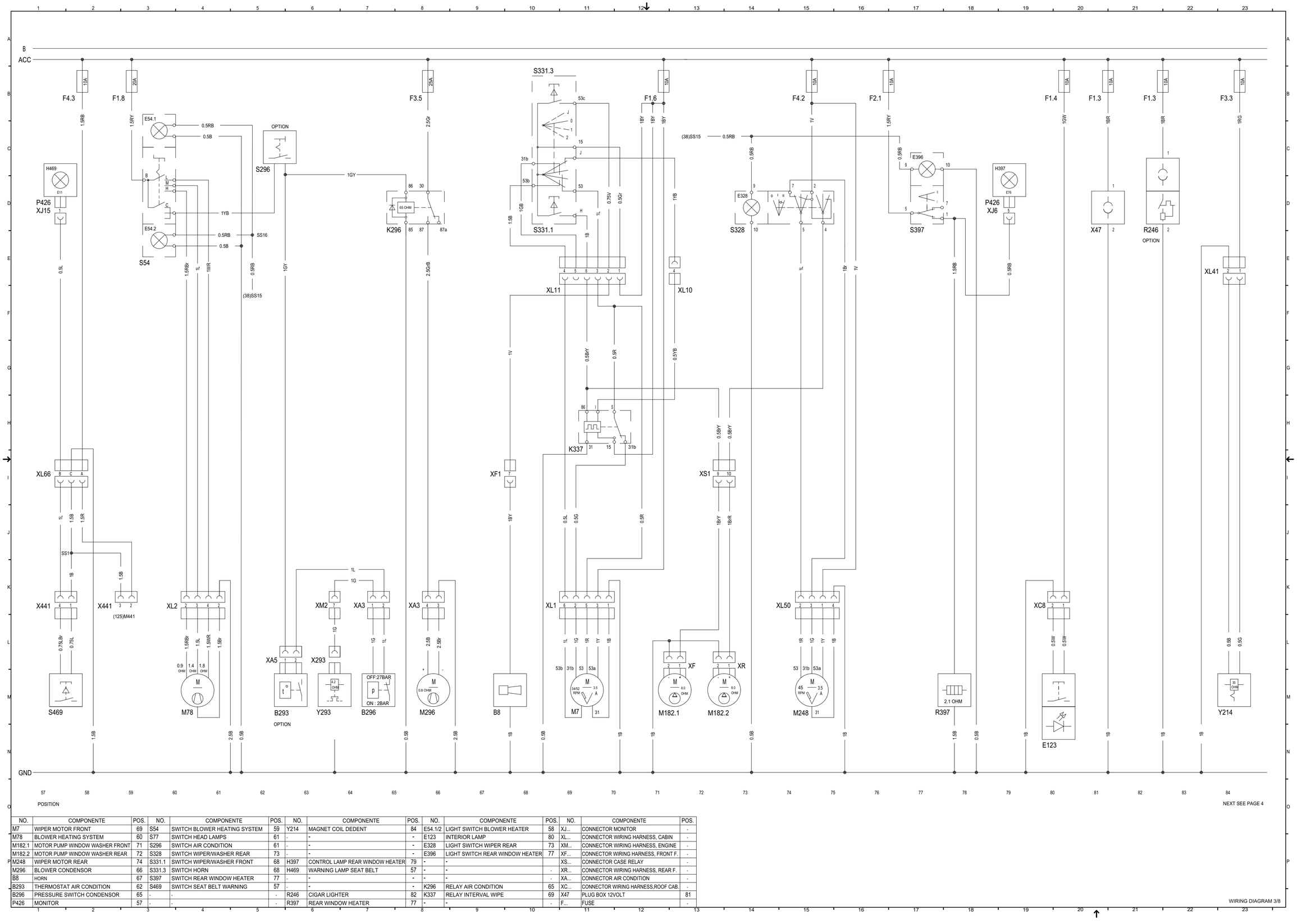
Wiring diagram 2/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
S51	SWITCH WORK LAMPS	53	H29	CONTROL LAMP HIGH BEAM	41	E1	HEAD LAMP LEFT	34	E68.2	TURN LIGHT REAR LEFT	31	K56.1	RELAY LOW BEAM	40	XJ...	CONNECTOR MONITOR	-
S70	SWITCH BRAKE LAMPS	43	H31	CONTROL LAMP TURN LIGHT	30	E2	HEAD LAMP RIGHT	38	E69.2	TURN LIGHT REAR RIGHT	33	K56.2	RELAY HIGH BEAM	37	XL...	CONNECTOR WIRING HARNESS, CABIN	-
S77	SWITCH HEAD LAMPS	37	H31.2	CONTROL LAMP TURN LIGHT TRAILER	30	E3	WORK LAMP FRONT LEFT	52	E68.3	BRAKE LIGHT LEFT	43	K67	FLASHER RELAY	29	XC...	CONNECTOR WIRING HARNESS,ROOF CAB.	-
S101	SWITCH HAZARD	34	H470	CONTROL LAMP REAR FLASH LIGHT	47	E4	WORK LAMP FRONT RIGHT	53	E69.3	BRAKE LIGHT RIGHT	44	-	-	-	XM...	CONNECTOR WIRING HARNESS, ENGINE	-
S331.1	STEERING COLUMN SWITCH TURN	30	-	-	-	E5	FLASH LAMP FRONT LEFT	30	E68.4	REVERSE LIGHT LEFT	45	K373.2	RELAY REVERSE	144	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-
S331.2	STEERING COLUMN SWITCH HEAD LAMPS	39	-	-	-	E6	FLASH LAMP FRONT RIGHT	33	E69.4	REVERSE LIGHT RIGHT	46	K385	RELAY BACK-UP ALARM	44	XR...	CONNECTOR WIRING HARNESS, REAR F.	-
S470	SWITCH REAR FLASH LIGHTS	49	E51	LIGHT SWITCH WORK LAMPS	53	E60	WORK LAMP REAR LEFT	55	E71	LICENSE LIGHT LEFT	40	-	-	-	XR7	PLUG BOX TRAILER	-
-	-	-	E77	LIGHT SWITCH HEAD LAMPS	37	E61	WORK LAMP REAR RIGHT	56	E72	LICENSE LIGHT RIGHT	40	B279	BACK-UP ALARM	47	SS...	JOINT OF WIRES	-
-	-	-	E101	LIGHT SWITCH HAZARD	37	E68.1	TAIL LIGHT REAR LEFT	40	E470.1	REAR FLASH LIGHT LEFT	49	V118	DIODE	52	-	-	-
-	-	-	E470	LIGHT SWITCH REAR FLASH LIGHT	48	E69.1	TAIL LIGHT REAR RIGHT	41	E470.2	REAR FLASH LIGHT RIGHT	50	P426	MONITOR	29	F...	CONNECTOR FUSE	-

WIRING DIAGRAM 2/8

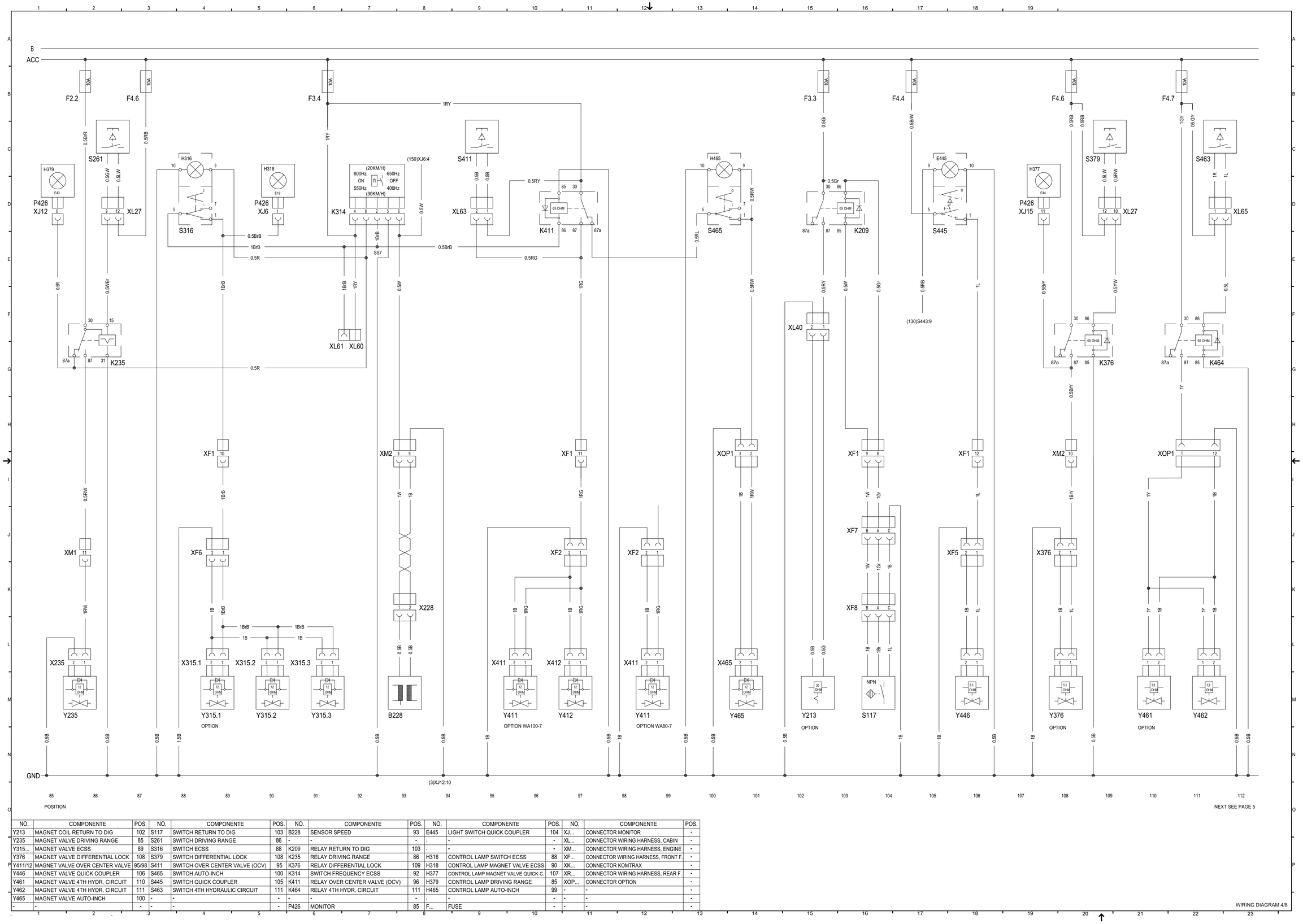
Wiring diagram 3/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
M7	WIPER MOTOR FRONT	69	S54	SWITCH BLOWER HEATING SYSTEM	59	Y214	MAGNET COIL DEDENT	84	E54.1/2	LIGHT SWITCH BLOWER HEATER	58	XJ...	CONNECTOR MONITOR	-
M78	BLOWER HEATING SYSTEM	60	S77	SWITCH HEAD LAMPS	61	-	-	-	E123	INTERIOR LAMP	80	XL...	CONNECTOR WIRING HARNESS, CABIN	-
M182.1	MOTOR PUMP WINDOW WASHER FRONT	71	S296	SWITCH AIR CONDITION	61	-	-	-	E328	LIGHT SWITCH WIPER REAR	73	XM...	CONNECTOR WIRING HARNESS, ENGINE	-
M182.2	MOTOR PUMP WINDOW WASHER REAR	72	S328	SWITCH WIPER/WASHER REAR	73	-	-	-	E396	LIGHT SWITCH REAR WINDOW HEATER	77	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-
M248	WIPER MOTOR REAR	74	S331.1	SWITCH WIPER/WASHER FRONT	68	H397	CONTROL LAMP REAR WINDOW HEATER	79	-	-		XS...	CONNECTOR CASE RELAY	-
M296	BLOWER CONDENSOR	66	S331.3	SWITCH HORN	68	H469	WARNING LAMP SEAT BELT	57	-	-	-	XR...	CONNECTOR WIRING HARNESS, REAR F.	-
B8	HORN	67	S397	SWITCH REAR WINDOW HEATER	77	-	-	-	-	-	-	XA...	CONNECTOR AIR CONDITION	-
B293	THERMOSTAT AIR CONDITION	62	S469	SWITCH SEAT BELT WARNING	57	-	-	-	K296	RELAY AIR CONDITION	65	XC...	CONNECTOR WIRING HARNESS,ROOF CAB.	-
B296	PRESSURE SWITCH CONDENSOR	65	-	-	-	R246	CIGAR LIGHTER	82	K337	RELAY INTERVAL WIPE	69	X47	PLUG BOX 12VOLT	81
P426	MONITOR	57	-	-	-	R397	REAR WINDOW HEATER	77	-	-	-	F...	FUSE	-

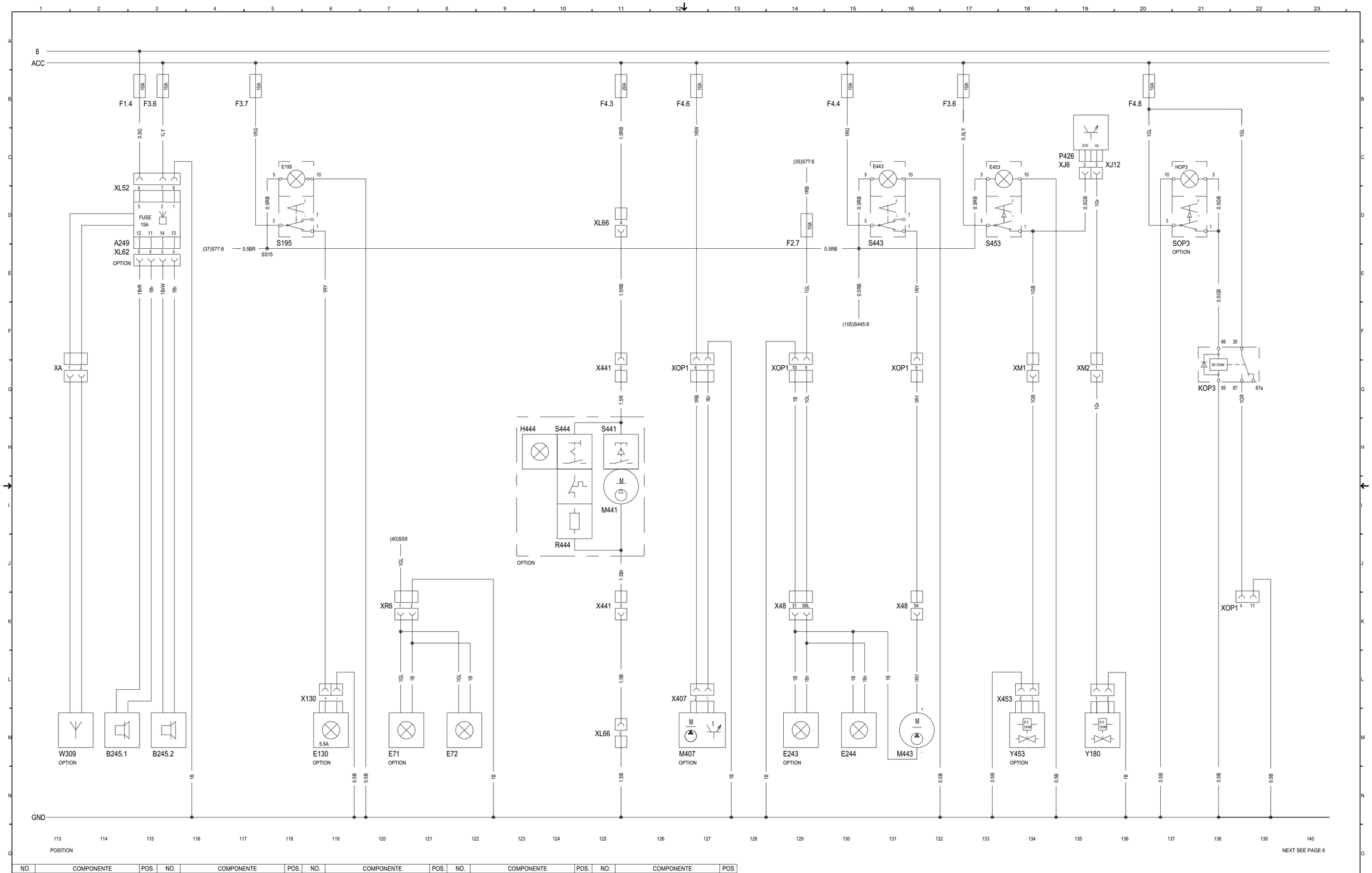
WIRING DIAGRAM 3/8

Wiring diagram 4/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
Y213	MAGNET COIL RETURN TO DIG	102	S117	SWITCH RETURN TO DIG	103	B228	SENSOR SPEED	93	E445	LIGHT SWITCH QUICK COUPLER	104	XJ...	CONNECTOR MONITOR	-
Y235	MAGNET VALVE DRIVING RANGE	85	S261	SWITCH DRIVING RANGE	86	-	-	-	.	-	-	XL...	CONNECTOR WIRING HARNESS, CABIN	-
Y315...	MAGNET VALVE ECSS	89	S316	SWITCH ECSS	88	K209	RELAY RETURN TO DIG	103	-	-	-	XM...	CONNECTOR WIRING HARNESS, ENGINE	-
Y376	MAGNET VALVE DIFFERENTIAL LOCK	108	S379	SWITCH DIFFERENTIAL LOCK	108	K235	RELAY DRIVING RANGE	86	H316	CONTROL LAMP SWITCH ECSS	88	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-
Y411/12	MAGNET VALVE OVER CENTER VALVE	95/98	S411	SWITCH OVER CENTER VALVE (OCV)	95	K376	RELAY DIFFERENTIAL LOCK	109	H318	CONTROL LAMP MAGNET VALVE ECSS	90	XK...	CONNECTOR KOMTRAX	-
Y446	MAGNET VALVE QUICK COUPLER	106	S465	SWITCH AUTO-INCH	100	K314	SWITCH FREQUENCY ECSS	92	H377	CONTROL LAMP MAGNET VALVE QUICK C.	107	XR...	CONNECTOR WIRING HARNESS, REAR F.	-
Y461	MAGNET VALVE 4TH HYDR. CIRCUIT	110	S445	SWITCH QUICK COUPLER	105	K411	RELAY OVER CENTER VALVE (OCV)	96	H379	CONTROL LAMP DRIVING RANGE	85	XOP...	CONNECTOR OPTION	-
Y462	MAGNET VALVE 4TH HYDR. CIRCUIT	111	S463	SWITCH 4TH HYDRAULIC CIRCUIT	111	K464	RELAY 4TH HYDR. CIRCUIT	111	H465	CONTROL LAMP AUTO-INCH	99	-	-	-
Y465	MAGNET VALVE AUTO-INCH	100	-	-	-	-	-	-	.	-	-	-	-	-
-	-	-	-	-	-	P426	MONITOR	85	F...	FUSE	-	-	-	-

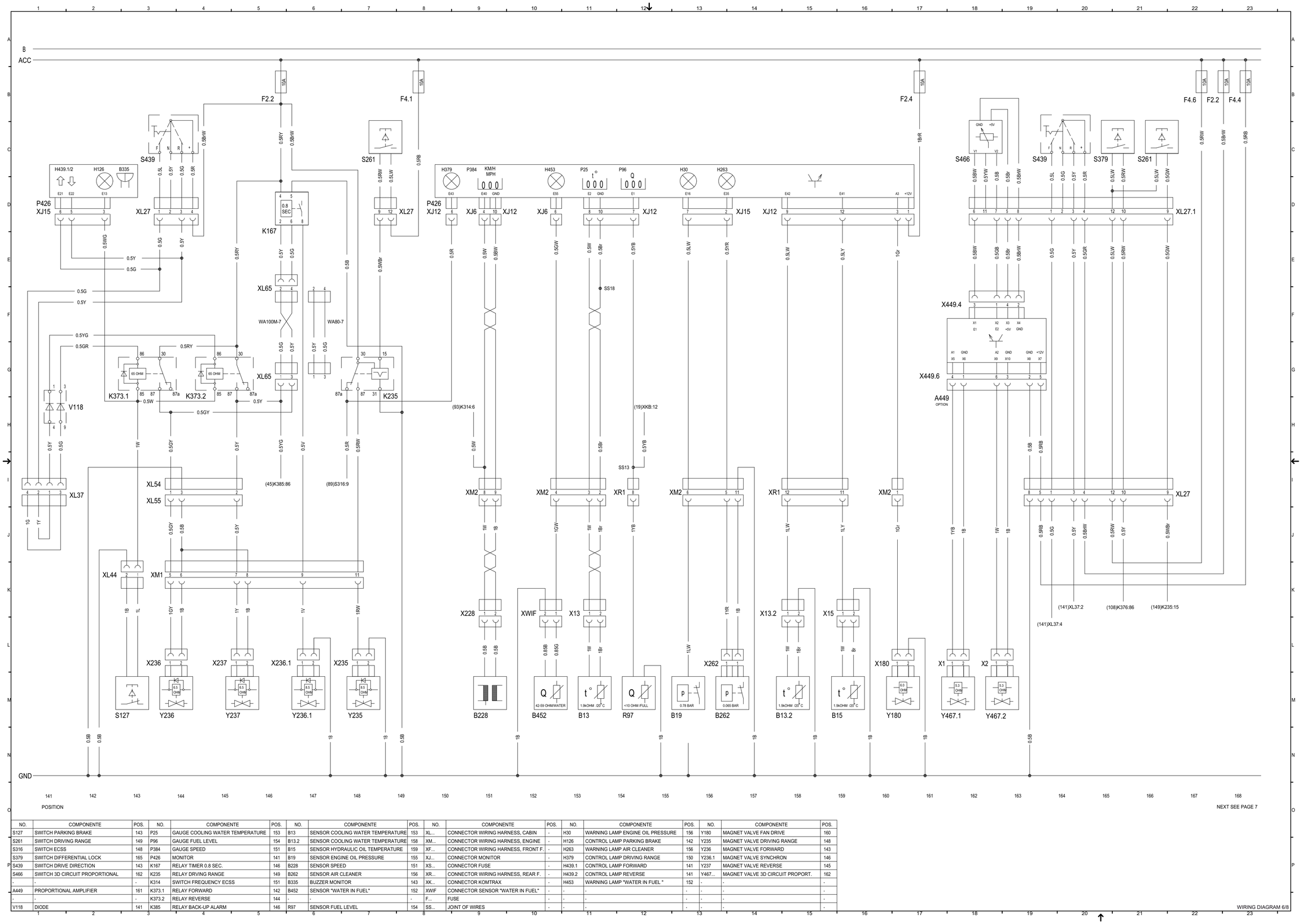
Wiring diagram 5/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
R444	SEAT HEATER	124	Y180	MAGNET VALVE FAN DRIVE	135	H444	CONTROL LAMP SEAT HEATER	123	E71	LICENCE LAMP LEFT	120	XJ...	CONNECTOR MONITOR	-
	.	-	Y453	MAGNET VALVE RESERVIBLE FAN	134	HOP3	CONTROL LAMP OPTION 3	137	E72	LICENCE LAMP RIGHT	121	XL...	CONNECTOR WIRING HARNESS, CABIN	-
KOP3	RELAY OPTION	138	SOP3	SWITCH OPTION 3	137	-	-	-	E130	ROTATING BEACON	118	XM...	CONNECTOR WIRING HARNESS, ENGINE	-
-	-	-	S77	SWITCH HEAD LAMPS	116	-	-	-	E195	LIGHT SWITCH ROTATING BEACON	118	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-
-	-	-	S195	SWITCH ROTATING BEACON	118	B245.1	LOUDSPEAKER LEFT	114	E243	POSITION LAMP SWEEPER LEFT	129	XO...	CONNECTOR OPTION	-
A249	CAR RADIO	114	S441	SWITCH SEAT AIR SUSPENSION	125	B245.2	LOUDSPEAKER RIGHT	115	E244	POSITION LAMP SWEEPER RIGHT	130	XR...	CONNECTOR WIRING HARNESS, REAR F.	-
W309	ANTENNA	113	S443	SWITCH SWEEPER SPRAY	130	-	-	-	E443	CONTROL LAMP SWEEPER	130	XA	CONNECTOR ANTENNA	-
-	-	-	S444	SWITCH SEAT HEATER	124	M407	CENTRAL LUBRICATION	126	E453	LIGHT SWITCH REVERSIBLE FAN	133	-	-	-
P426	MONITOR	135	S445	SWITCH QUICK COUPLER	130	M441	COMPRESSOR SEAT	125	-	-	-	-	-	-
-	-	-	S453	SWITCH RESERVIBLE FAN	133	M443	PUMP SWEEPER	131	F...	FUSE	-	-	-	-

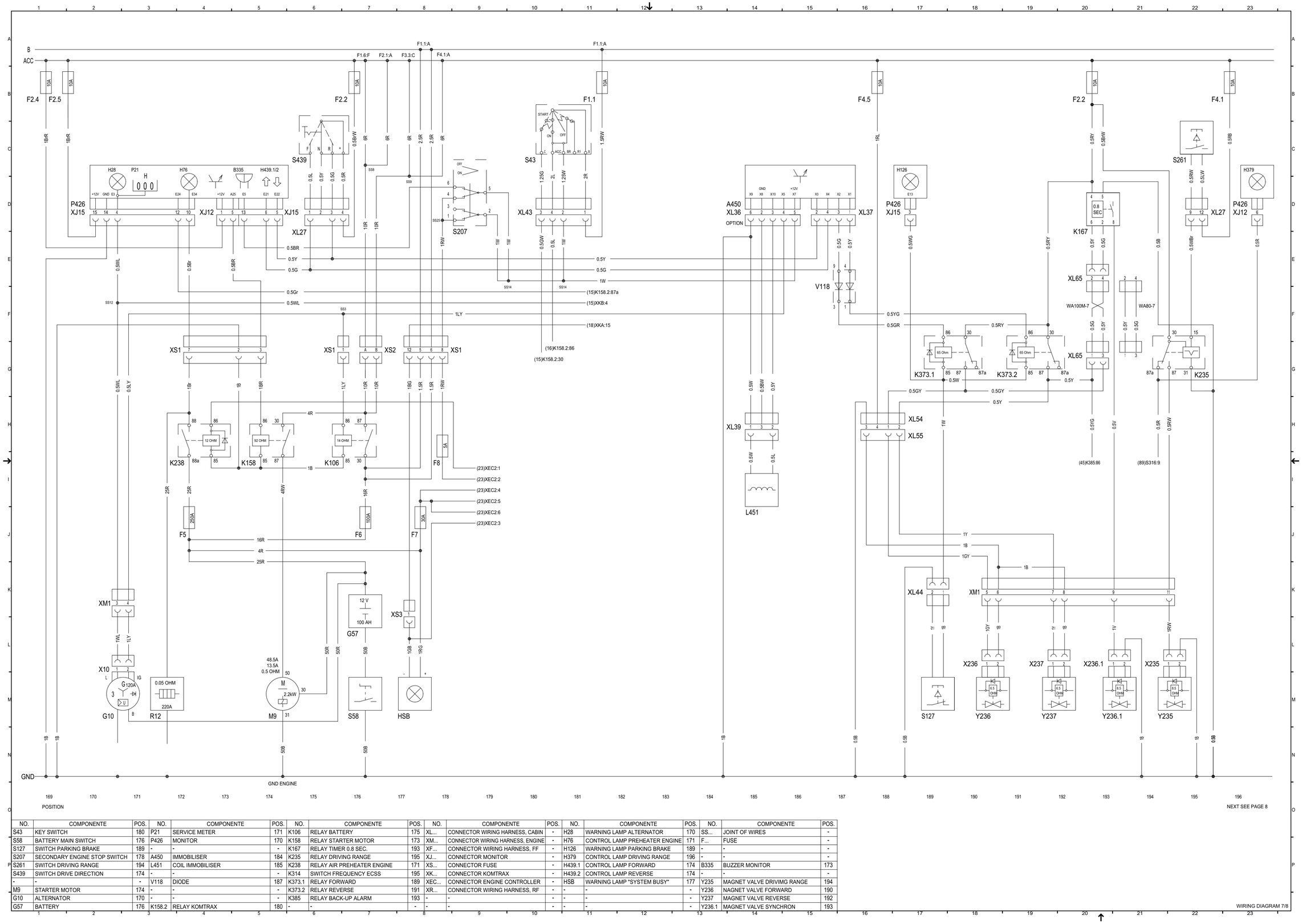
WIRING DIAGRAM 5/8

Wiring diagram 6/8 – WA80M-7, WA100M-7



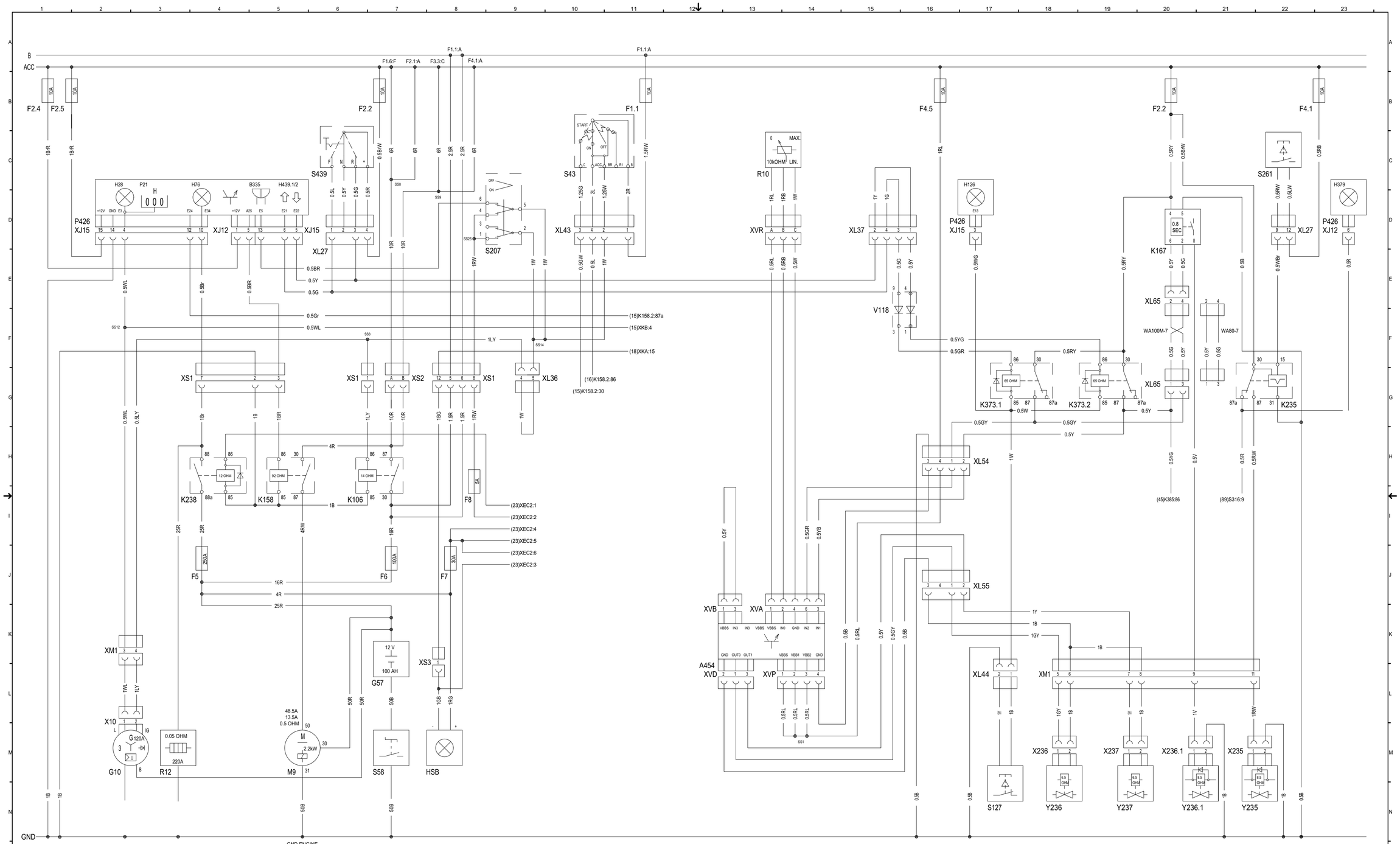
NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
S127	SWITCH PARKING BRAKE	143	P25	GAUGE COOLING WATER TEMPERATURE	153	B13	SENSOR COOLING WATER TEMPERATURE	153	XL...	CONNECTOR WIRING HARNESS, CABIN	-	H30	WARNING LAMP ENGINE OIL PRESSURE	156	Y180	MAGNET VALVE FAN DRIVE	160
S261	SWITCH DRIVING RANGE	149	P96	GAUGE FUEL LEVEL	154	B13.2	SENSOR COOLING WATER TEMPERATURE	158	XM...	CONNECTOR WIRING HARNESS, ENGINE	-	H126	CONTROL LAMP PARKING BRAKE	142	Y235	MAGNET VALVE DRIVING RANGE	148
S316	SWITCH ECSS	148	P384	GAUGE SPEED	151	B15	SENSOR HYDRAULIC OIL TEMPERATURE	159	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-	H263	WARNING LAMP AIR CLEANER	156	Y236	MAGNET VALVE FORWARD	143
S379	SWITCH DIFFERENTIAL LOCK	165	P426	MONITOR	141	B19	SENSOR ENGINE OIL PRESSURE	155	XJ...	CONNECTOR MONITOR	-	H379	CONTROL LAMP DRIVING RANGE	150	Y236.1	MAGNET VALVE SYNCHRON	146
S439	SWITCH DRIVE DIRECTION	143	K167	RELAY TIMER 0.8 SEC.	146	B228	SENSOR SPEED	151	XS...	CONNECTOR FUSE	-	H439.1	CONTROL LAMP FORWARD	141	Y237	MAGNET VALVE REVERSE	145
S466	SWITCH 3D CIRCUIT PROPORTIONAL	162	K235	RELAY DRVING RANGE	149	B262	SENSOR AIR CLEANER	156	XR...	CONNECTOR WIRING HARNESS, REAR F.	-	H439.2	CONTROL LAMP REVERSE	141	Y467...	MAGNET VALVE 3D CIRCUIT PROPORT.	162
-	-	-	K314	SWITCH FREQUENCY ECSS	151	B335	BUZZER MONITOR	143	XK...	CONNECTOR KOMTRAX	-	H453	WARNING LAMP "WATER IN FUEL "	152	-	-	-
A449	PROPORTIONAL AMPLIFIER	161	K373.1	RELAY FORWARD	142	B452	SENSOR "WATER IN FUEL"	152	XWIF	CONNECTOR SENSOR "WATER IN FUEL"	-	-	-	-	-	-	-
-	-	-	K373.2	RELAY REVERSE	144	-	-	-	F...	FUSE	-	-	-	-	-	-	-
V118	DIODE	141	K385	RELAY BACK-UP ALARM	146	R97	SENSOR FUEL LEVEL	154	SS...	JOINT OF WIRES	-	-	-	-	-	-	-

Wiring diagram 7/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
S43	KEY SWITCH	180	P21	SERVICE METER	171	K106	RELAY BATTERY	175	XL...	CONNECTOR WIRING HARNESS, CABIN	-	H28	WARNING LAMP ALTERNATOR	170	SS...	JOINT OF WIRES	-
S58	BATTERY MAIN SWITCH	176	P426	MONITOR	170	K158	RELAY STARTER MOTOR	173	XM...	CONNECTOR WIRING HARNESS, ENGINE	-	H76	CONTROL LAMP PREHEATER ENGINE	171	F...	FUSE	-
S127	SWITCH PARKING BRAKE	189	-	-	-	K167	RELAY TIMER 0.8 SEC.	193	XF...	CONNECTOR WIRING HARNESS, FF	-	H126	WARNING LAMP PARKING BRAKE	189	-	-	-
S207	SECONDARY ENGINE STOP SWITCH	178	A450	IMMOBILISER	184	K235	RELAY DRIVING RANGE	195	XJ...	CONNECTOR MONITOR	-	H379	CONTROL LAMP DRIVING RANGE	196	-	-	-
S261	SWITCH DRIVING RANGE	194	L451	COIL IMMOBILISER	185	K238	RELAY AIR PREHEATER ENGINE	171	XS...	CONNECTOR FUSE	-	H439.1	CONTROL LAMP FORWARD	174	B335	BUZZER MONITOR	173
S439	SWITCH DRIVE DIRECTION	174	-	-	-	K314	SWITCH FREQUENCY ECSS	195	XK...	CONNECTOR KOMTRAX	-	H439.2	CONTROL LAMP REVERSE	174	-	-	-
-	-	-	V118	DIODE	187	K373.1	RELAY FORWARD	189	XEC...	CONNECTOR ENGINE CONTROLLER	-	HSB	WARNING LAMP "SYSTEM BUSY"	177	Y235	MAGNET VALVE DRIVIMG RANGE	194
M9	STARTER MOTOR	174	-	-	-	K373.2	RELAY REVERSE	191	XR...	CONNECTOR WIRING HARNESS, RF	-	-	-	-	Y236	NAGNET VALVE FORWARD	190
G10	ALTERNATOR	170	-	-	-	K385	RELAY BACK-UP ALARM	193	-	-	-	-	-	-	Y237	MAGNET VALVE REVERSE	192
G57	BATTERY	176	K158.2	RELAY KOMTRAX	180	-	-	-	-	-	-	-	-	-	Y236.1	MAGNET VALVE SYNCHRON	193

Wiring diagram 8/8 – WA80M-7, WA100M-7



NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.	NO.	COMPONENTE	POS.
S43	KEY SWITCH	208	P21	SERVICE METER	198	K106	RELAY BATTERY	203	XL...	CONNECTOR WIRING HARNESS, CABIN	-	H28	WARNING LAMP ALTERNATOR	198	Y235	MAGNET VALVE DRIVING RANGE	222
S58	BATTERY MAIN SWITCH	204	P426	MONITOR	197	K158	RELAY STARTER MOTOR	201	XM...	CONNECTOR WIRING HARNESS, ENGINE	-	H76	WARNING LAMP AIR PREHEATER ENGINE	199	Y236	MAGNET VALVE FORWARD	218
S127	SWITCH PARKING BRAKE	217	-	-	-	K167	RELAY TIMER 0.8 SEC.	221	XF...	CONNECTOR WIRING HARNESS, FRONT F.	-	H126	WARNING LAMP PARKING BRAKE	216	Y236.1	MAGNET VALVE SYNCHRON	221
S207	SECONDARY ENGINE STOP SWITCH	206	-	-	-	K235	RELAY DRIVING RANGE	223	XJ...	CONNECTOR MONITOR	-	H379	CONTR0L LAMP DRIVING RANGE	224	Y237	MAGNET VALVE REVERSE	219
S261	SWITCH DRIVING RANGE	222	-	-	-	K314	SWITCH FREQUENCY ECSS	222	XS...	CONNECTOR FUSE	-	H439.1	CONTROL LAMP FORWARD	202	-	-	-
S439	SWITCH DRIVE DIRECTION	202	-	-	-	K238	RELAY AIR PREHEATER ENGINE	199	XV...	CONNECTOR WIRING HARNESS, SPEED	-	H439.2	CONTROL LAMP REVERSE	202	-	-	-
			-	-	-	K373.1	RELAY PARKING BRAKE FORWARD	217	XEC...	CONNECTOR CONTROLLER ENGINE	-	-	-	-	-	-	-
G10	ALTERNATOR	198	-	-	-	K373.2	RELAY PARKING BRAKE REVERSE	219	XK...	CONNETOR KOMTRAX	-	-	-	-	-	-	-
G57	BATTERY	204	R10	POTENTIOMETER SPEED CONTROL	212	K385	RELAY BACK-UP ALARM	220	-	-	-	-	-	-	SS...	JOINT OF WIRES	-
M9	STARTER MOTOR	202	R12	AIR PREHEATER ENGINE	199	-	-	-	-	-	-	A454	CONTROLLER SPEED	211	V118	DIODE	214

COLOUR	SYMBOL
WHITE	W
BLACK	B
RED	R
YELLOW	Y
GREEN	G
BLUE	L
BROWN	Br
LIGHT GREEN	Lg
GREY	Gr
PINK	P
LIGHT BLUE	Sb
ORANGE	O
VIOLET	V

WIRING DIAGRAM 8/8

SHOP MANUAL

ENGINE

95E-6 SERIES

Model Serial Number

95E-6 SERIES

00 Index and foreword

Index

Foreword, safety and general information *(ALL-0370-001-A-00-A)*

Important safety notice *(ALL-1120-012-A-01-A)*

(Rev. 2012/10)

- Appropriate servicing and repair are extremely important to ensure safe operation of the machine. The shop manual describes the effective and safe servicing and repair methods recommended by Komatsu. Some of these methods require the use of the special tools designed by Komatsu for the specific purpose.
- The symbol mark ⚠ is used for such matters that require special cautions during the work. The work indicated by the caution mark should be performed according to the instructions with special attention to the cautions. Should hazardous situation occur or be anticipated during such work, be sure to keep safe first and take every necessary measure.

General precautions

⚠ **Inappropriate handling causes an extreme danger. Read and understand what is described in the operation and maintenance manual before operating the machine. Read and understand what is described in this manual before starting the work.**

- Before performing any greasing or repairs, read all the safety labels stuck to the machine. For the locations of the safety labels and detailed explanation of precautions, see the operation and maintenance manual.
- Locate a place in the repair workshop to keep the 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, water or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.
- When performing any work, always wear the safety shoes and helmet. Do not wear loose work cloths, or clothes with buttons missing.
  1. Always wear the protective eyeglasses when hitting parts with a hammer.
  2. Always wear the protective eyeglasses when grinding parts with a grinder, etc.
- When performing any work with two or more workers, always agree on the working procedure before starting. While working, always keep conversations of the work between your fellow workers and your self on any step of the work. During the work, hang the warning tag of "UNDER WORKING" in the operator's compartment.
- Only qualified workers must perform the work and operation which require license or qualification.
- Keep the tools in good condition. And learn the correct way to use the tools, and use the proper ones among them. Before starting the work, thoroughly check the tools, lift truck, service vehicle, etc.
- If welding repairs is required, always have a trained and experienced welder with good knowledge of welding perform the work. When performing welding work, always wear welding gloves, apron, shielding goggles, cap, etc.
- Before starting work, warm up your body thoroughly to start work under good condition.
- Avoid continuing work for long hours and take rests with proper intervals to keep your body in good condition. Take a rest in a specified safe place.

Safety points

1	Good arrangement
2	Correct work clothes
3	Observance of work standard
4	Practice of making and checking signals
5	Prohibition of operation and handling by unlicensed workers
6	Safety check before starting work
7	Wearing protective goggles (for cleaning or grinding work)
8	Wearing shielding goggles and protectors (for welding work)
9	Good physical condition and preparation
10	Precautions against work which you are not used to or you are used to too much

Preparation

- Before adding oil or making any repairs, place the machine on a firm and level ground, and apply the parking brake and chock the wheels or tracks to prevent the machine from moving.
- Before starting work, lower the work equipment (blade, ripper, bucket, etc.) to the ground. If it is not possible to lower the equipment to the ground, insert the lock pin or use blocks to prevent the work equipment from falling. And be sure to lock all the work equipment control levers and hang a warning tag on them.
- When performing the disassembling or assembling work, support the machine securely with blocks, jacks, or stands before starting the work.
- Remove all of mud and oil from the steps or other places used to get on and off the machine completely. Always use the handrails, ladders of

steps when getting on or off the machine. Never jump on or off the machine. When the scaffold is not provided, use steps or stepladder to secure your footing.

Precautions during work

- For the machine equipped with the battery disconnect switch, check that the system operating lamp is turned off before starting the work. Then, turn the battery disconnect switch to OFF (○) position and remove the switch key. For the machine not equipped with the battery disconnect switch, remove the cable from the battery before starting the work. Be sure to remove the negative end (-) of the battery cable first.
- Release the remaining pressure in the circuits completely before the work when the parts in the circuits of oil, fuel, coolant and air are disconnected or removed. When the cap of the oil filter, drain plug or oil pressure pickup plug is removed, loose them slowly to prevent the oil from spurting out.
- When removing or installing the checking plug or the piping in the fuel circuit, wait 30 seconds or longer after the engine is shut down and start the work after the remaining pressure is released from the fuel circuit.
- Immediately after the engine is shut down, the coolant and oil in the circuits are hot. Be careful not to get scalded by the hot coolant and oil. Start the work after checking that the coolant and oil are cooled down sufficiently.
- Start the work after the engine is shut down. Be sure to shut down the engine when working on or around the rotating parts in particular. When checking the machine without shutting down the engine (measuring oil pressure, rotational speed, oil or coolant temperature), take extreme care not to get caught in the rotating parts or the working equipment.
- The hoist or crane must be used to sling the components weighing 25 kg or heavier. Check the slings (wire rope, nylon sling, chain and hook) for damage before the work. Use the slings with ample capacity and install them to the proper places. Operate the hoist or crane slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
- When removing the part which is under internal pressure or reaction force of the spring, always leave 2 bolts in diagonal positions. Loosen those 2 bolts gradually and alternately and release the pressure, then, remove the part.
- When removing the part, be careful not to break or damage the electrical wiring. The damaged wiring may cause electrical fires.
- When removing piping, prevent the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it off immediately. Fuel or oil on the floor can cause you to slip and can even cause fires.
- As a general rule, do not use gasoline to wash parts. Do not use gasoline to clean the electrical parts, in particular.
- Reinstall the parts removed to their original places. Replace the damaged parts and the parts which must not be used with new ones. When installing the hoses and wiring harnesses, be careful that they are not damaged by contacting with other parts when the machine is operated.
- When connecting the high pressure hoses and tubes, make sure that they are not twisted. The damaged high pressure hoses and tubes are very dangerous when they are installed. So, be extremely careful when connecting the high pressure pipings. In addition, check that their connections are correct.
- When assembling or installing the parts, be sure to tighten the bolts to the specified torque. When installing the protective parts such as guards, or the parts which vibrate violently or rotate at high speeds, be sure to check that they are installed correctly.
- When aligning 2 holes, never insert your fingers or hand into the holes. Align the holes with care so that your fingers are not caught in the hole.
- When measuring hydraulic pressure, check that the measuring tools are correctly installed.
- Pay attention to safety when removing and installing the tracks of the track type machines. When removing the track, it separates suddenly. The workers should not stand at either end of the track.
- If the engine is operated for a long time in a closed place which is not ventilated well, you may suffer from gas poisoning. Accordingly, open the windows and doors to ventilate the place well.

Precautions for slinging work and making signals

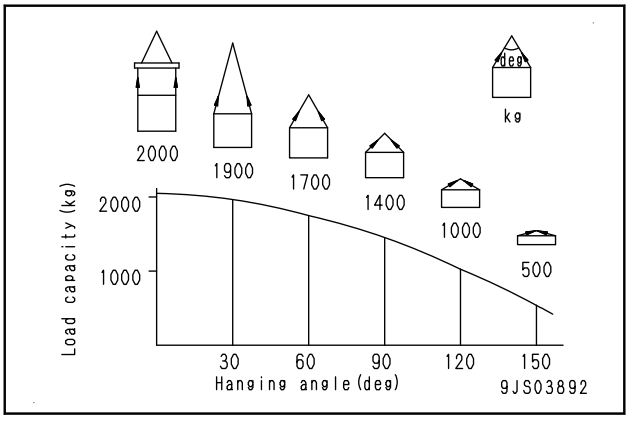
- Only one appointed worker must make signals and co-worker must communicate with each other frequently. The appointed signaler must make specified signals clearly at the place where the signaler is well seen from the operator's seat and where the signaler can see the working condition easily. The signaler must always stand in front of the load and guide the operator safely.
  1. Do not stand under the load.
  2. Do not step on the load.
- Check the slings before starting sling work.

- Keep putting on the gloves during sling work. (Put on the leather gloves, if available.)
- Measure the weight of the load by the eye and check its center of gravity.
- Use the proper sling according to the weight of the load and method of slinging. If too thick wire ropes are used to sling a light load, the load may slip and fall.
- Do not sling a load with 1 wire rope only. If do so, the load may rotate or the sling gets loose and the sling may slip off. Install 2 or more wire ropes symmetrically.

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

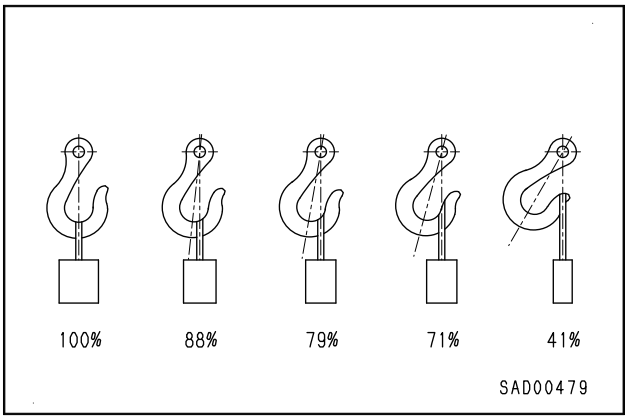
- Hanging angle must be 60 degrees or smaller as a rule.
- When hanging a heavy load (25kg or heavier), the hanging angle of the rope must be narrower than that of the hook.

★ When slinging a load with 2 ropes or more, the larger the hanging angle is, the larger the tension of each rope. The figure bellow shows the variation of allowable load in kg when hoisting is made with 2 ropes, each of which is allowed to sling up to 9.8 kN {1,000kg} a load vertically, at various hanging angles. When the 2 ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight is reduced to 1000 kg when the 2 ropes make a hanging angle of 120 degrees. If the two ropes sling a 2000 kg load at a hanging angle of 150 degrees, each rope is subjected to a force as large as 4000 kg.



- When installing wire ropes to an angular load, apply pads to protect the wire ropes. If the load is slippery, apply proper material to prevent the wire rope from slipping.
- Use the specified eye bolts and fix wire ropes, chains, etc. to them with shackles, etc.
- Apply wire ropes to the middle part of the hook.

★ Slinging near the tip of the hook may cause the rope to slip off the hook during hoisting. The strength of the hook is maximum at its central part.



- Do not use twisted or kinked wire ropes.
- When slinging up a load, observe the following.
  1. Wind up the rope slowly until the wire rope tensions. When putting your hands on the wire ropes, do not grasp them but press them down from above. If you grasp them, your fingers may be caught.
  2. After the wire ropes are stretched, stop the crane and check the condition of the slung load, wire ropes, and pads.
  3. If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
  4. Do not lift up the load at an angle.
- When lowering a load, pay attention to the following.
  1. When lifting down a load, stop it temporarily at 30 cm above the floor, and then lower it slowly.
  2. Check that the load is stable, and then remove the sling.
  3. Remove kinks and dirt from the wire ropes and chains used for the sling work, and put them in the specified place.

Precautions for using mobile crane

★ Read the Operation and Maintenance Manual of the crane carefully in advance and operate the crane safely.

Precautions for using overhead traveling crane

⚠ The hoist or crane must be used to sling the components weighing 25 kg or heavier. A part weighing 25 kg or heavier in "disassembly and assembly" section is indicated with the symbol of ⬚.

- Before starting work, check the wire ropes, brake, clutch, controller, rails, over winding prevention device, ground fault circuit interrupter for electric shock prevention, crane collision prevention device, and energizing warning lamp, and check the following safety items.
- Observe the signals for sling work.
- Operate the hoist at a safe place.
- Be sure to check the directions of the direction indication plate (north, south, east and west) and the operating button.
- Do not sling a load at an angle. Do not move the crane while the slung load is swinging.
- Do not raise or lower a load while the crane is moving longitudinally or laterally.
- Do not drag a sling.
- When lifting up a load, stop it just after it leaves the ground and check safety, and then lift it up.
- Consider the travel route in advance and lift up a load to a safe height.
- Place the control switch in a position where it will not be an obstacle to work and passage.
- After operating the hoist, do not swing the control switch.
- Remember the position of the main switch so that you can turn off the power immediately in an emergency.
- Shut down the main switch when the hoist stops because of a blackout. When turning on a switch which is turned OFF by the ground fault circuit interrupter for electric shock prevention, check that the devices related to that switch are not in operating condition.
- If you find an obstacle around the hoist, stop the operation.
- After finishing the work, stop the hoist at the specified position and raise the hook to at least 2 meters above the floor. Do not leave the sling attached to the hook.

Selecting wire ropes

- Select adequate ropes depending on the weight of the parts to be hoisted, referring to the table below

Wire rope (JIS G3525, 6 x 37 - Type A)

(Standard Z twist wire ropes without galvanizing)

Nominal diameter of rope	Allowable load	
mm	kN	ton
10	8.8	0.9
12	12.7	1.3
14	17.3	1.7
16	22.6	2.3
18	28.6	2.9
20	35.3	3.6
25	55.3	5.6
30	79.6	8.1
40	141.6	14.4
50	221.6	22.6
60	318.3	32.4

★ The allowable load is calculated as one sixth of the breaking load of the rope to be used (safety coefficient: 6).

Precautions for disconnecting and connecting hoses and tubes in air conditioner circuit

Disconnection

⚠ **When replacing the air conditioner unit, air conditioner compressor, condenser or receiver drier, etc., collect the refrigerant (air conditioner gas: R134a) from the air conditioner circuit before disconnecting the air conditioner hoses.**

★ Ask a qualified person for collecting, adding and filling operations of the refrigerant (air conditioner gas: R134a). (Only registered persons can work.)

★ Never release the refrigerant (air conditioner gas: R134a) to the atmosphere.

⚠ **If refrigerant gas (air conditioner gas: R134a) gets in your eyes, you may lose your sight. And if it touches your skin, you may suffer from frostbite. Put on protective eyeglasses, gloves and working clothes with long sleeves while collecting the refrigerant or filling the air conditioner circuit with the refrigerant.**

- When loosening the nuts fixing air conditioner hoses and tubes, be sure to use 2 wrenches; use one wrench to fix and use the other one to loosen the nut.

Connection

- When installing the hose for the air conditioner circuit, take care not to allow invasion of dirt, dusts and water into the hose.
- Check that the O-rings are fitted to the joints when connecting the air conditioner piping.
- Once an O-ring is used, it is deformed and deteriorated. Accordingly, do not reuse it.
- When removing the O-rings, use a soft tool so that the piping is not damaged.
- Check that the O-ring is not damaged or deteriorated.
- Apply compressor oil for refrigerant (R134a) to the O-ring.

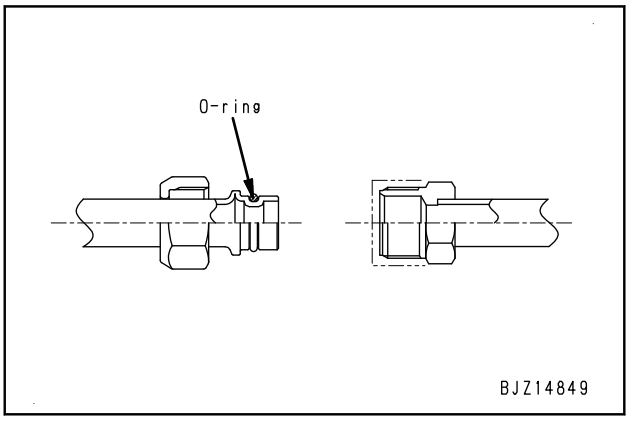
  ★ However, do not apply oil to the threaded portion of a bolt, nut or union.

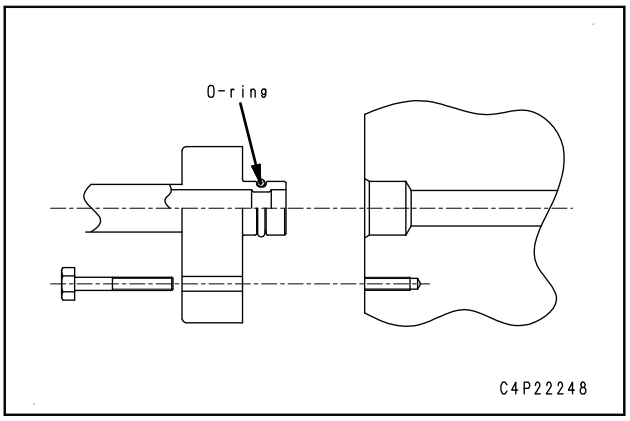
Manufacturer	Part name
DENSO	ND-OIL8
VALEO THERMAL SYSTEMS	ZXL100PG (equivalent to PAG46)
SANDEN	SP-10

- When tightening nuts of the air conditioner hoses and tubes, be sure to use 2 wrenches. Use one wrench to fix and tighten the nut with the other wrench to the specified torque (Use a torque wrench for tightening).

★ Example of fitting of O-ring

- An O-ring is fitted to every joint of the air conditioner piping.

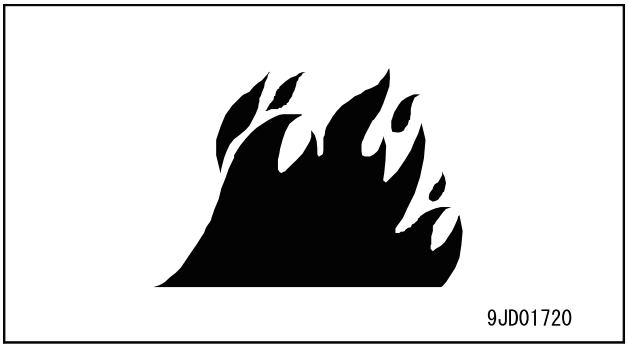


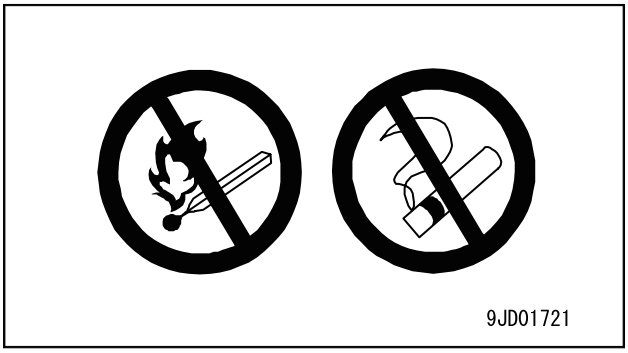


For tightening torques, see "Others", "Precautions for disconnection and connection of air conditioner piping".

Precautions to prevent fire *(ALL-0000-17B-K-03-A)*

- **Fire caused by fuel, oil, coolant or window washer fluid**
  Do not bring any flame or fire close to flammable substances such as fuel, oil, coolant or window washer fluid.There is danger that they may catch fire. Always observe the following.
  - Do not smoke or use any flame near fuel or other flammable substances.
  - Shut down the engine before adding fuel.
  - Do not leave the machine when adding fuel or oil.
  - Tighten all the fuel and oil caps securely.
  - Be careful not to spill fuel on overheated surfaces or on parts of the electrical system.
  - After adding fuel or oil, wipe up any spilled fuel or oil.
  - Put greasy rags and other flammable materials into a safe container to maintain safety at the workplace.
  - When washing parts with oil, use a non-flammable oil. Do not use diesel oil or gasoline.There is danger that they may catch fire.
  - Do not weld or use a cutting torch to cut any pipes or tubes that contain flammable liquids.
  - Determine well-ventilated areas for storing oil and fuel. Keep the oil and fuel in the specified place and do not allow unauthorized persons to enter.
  - When performing grinding or welding work on the machine, move any flammable materials to a safe place before starting.





- **Fire caused by accumulation or attachment of flammable material**
  - Remove any dry leaves, chips, pieces of paper, coal dust, or any other flammable materials accumulated or attached to or around the engine exhaust manifold, muffler, or battery, or on the undercovers.
  - To prevent fires from being caught, remove any flammable materials such as dry leaves, chips, pieces of paper, coal dust, or any other flammable materials accumulated around the cooling system (radiator, oil cooler) or on the undercover.
- **Fire coming from electric wiring**
  Short circuits in the electrical system can cause fire. Always observe the following.
  - Keep all the electric wiring connections clean and securely tightened.
  - Check the wiring every day for looseness or damage. Reconnect any loose connectors or refasten wiring clamps. Repair or replace any damaged wiring.
- **Fire caused by piping**
  Check that all the clamps for the hoses and tubes, guards, and cushions are securely fixed in position.
  If they are loose, they may vibrate during operation and rub against other parts.There is danger that this may lead to damage to the hoses and cause high-pressure oil to spurt out, leading to fire and serious personal injury or death.
- **Fire around the machine due to highly heated exhaust gas**
  This machine is equipped with KDPF (Komatsu Diesel Particulate Filter).
  KDPF is a system for purifying soot in exhaust gas.Its exhaust gas discharged during purification process (regeneration) can be at higher temperature than that from existing models. Do not bring any flammable material close to the outlet of the exhaust pipe.
  - When there are thatched houses, dry leaves or pieces of paper near the work site, set the system to disable the regeneration before starting work to prevent fire hazards due to highly heated exhaust gas.
    See the operation and maintenance manual for the setting procedure.
- **Explosion caused by lighting equipment**
  - When checking fuel, oil, battery electrolyte, or coolant, always use lighting equipment with anti-explosion specifications.
  - When taking the electrical power for the lighting equipment from the machine itself, follow the instructions in the operation and maintenance manual.

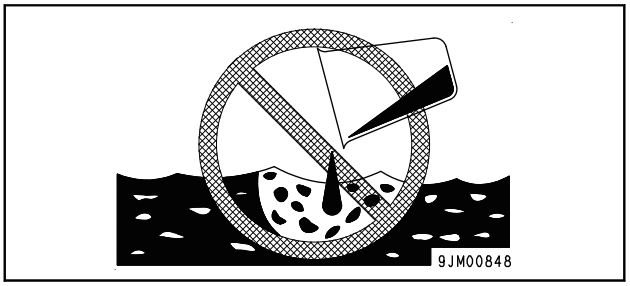
Action if fire occurs *(ALL-0000-17A-K-01-A)*

- Turn the starting switch to OFF position to stop the engine.
- Use the handrails and steps to get off the machine.
- Do not jump off the machine. You may fall or suffer serious injury.
- The fume generated by a fire contains harmful materials which have a bad influence on a human body when they are sucked.
  Don't breathe a fume.
- After a fire, there may be harmful compounds left. If it touches your skin it may have a bad influence on your body.
  Be sure to wear rubber gloves when handle the materials left after the fire.
  The material of the gloves, which is recommended is polychloroprene (Neoprene) or polyvinyl chloride (in the lower temperature environment).
  When wearing cotton-work-gloves, wear rubber gloves under them.

Dispose of waste materials *(ALL-0000-99A-K-02-A)*

To prevent pollution, pay full attention to the way to dispose of waste materials.

- Always put the oil and coolant drained from the machine in containers. Never drain the oil and coolant directly onto the ground or dump into the sewage system, rivers, the sea, or lakes.
- Observe the related laws and regulations when disposing of harmful objects such as oil, fuel, coolant, solvent, filters, and batteries.



Some kinds of rubber and plastics may produce poisonous gas harmful to human body when they are burned.

- As for rubber, plastics, or parts (hoses, cables, and wiring harnesses, etc.) which contain those materials, ask the industrial waste treatment firms for their disposals in accordance with the local regulations.

How to read the shop manual *(ALL-0320-010-A-03-A)*

(Rev. 2012/10)

- Some attachments and optional parts described in this shop manual may not be arranged for certain areas. Contact your Komatsu distributor if one or some of them are required.
- Materials and specifications are subject to change without notice.
- The shop manuals are available for "Machine part" and "Engine part". For the engine, see the shop manual for the same model of the engine as the one which is mounted on the machine.

Composition of shop manual

- This shop manual describes the technical information required for the services performed in a workshop. The shop manual is divided into the following chapters for the convenience of use.

00. Index and foreword

- This section includes the index, foreword, safety and basic information.

01. Specification

- This section explains the specifications of the machine.

10. Structure and function

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

20. Standard value table

- The standard values for a new machine and trouble shooting are described. This standard value table is used for testing and adjusting, and determining a failure at troubleshooting.

50. Disassembly and assembly

- This section explains the procedures for removing, installing, disassembling, and assembling each part or component and the special tools for the works as well as precautions for doing them safely. In addition, tightening torque, and quantity and weight of coating material, oil, grease, and coolant required for the works are also explained.

60. Maintenance standard

- This section describes the maintenance standard values for each component. This section gives the criterion values for each component and required remedy at disassembly or maintenance.

Symbol

Important safety and quality portions are marked with the following symbols so that the shop manual is used practically.

Symbol	Item	Remarks
	Safety	The special safety precautions required for performing work are described.
★	Caution	The special technical precautions or other precautions for preserving standards required when performing work are described
	Weight	The weight of part or component and the cautions required when selecting hoisting wire or when working posture is important are indicated.
	Tightening torque	The tightening torques that require special attention during assembly work are indicated.
	Coat	The places to be coated with adhesives, grease, etc. during assembling are indicated.
	Oil, coolant	The places where oil, coolant, etc. must be added and the quantity to be added are indicated.
	Drain	Places where oil, coolant, etc. must be drained and the quantity to be drained are indicated.

Unit

- In this shop manual, the units are indicated with International System of units (SI).
- For reference, Gravitational System of units which is used to be used is indicated in parentheses of { }.

Explanation of terms for maintenance standard *(ALL-0330-006-A-01-A)*

(Rev. 2012/10)

- The chapter of maintenance standard shows judgement criteria to determine the products to be replaced or to be reused. The judgement criteria are described by using the following terms.

Standard dimension and tolerance

- To be accurate, the finished dimension of a part is slightly different from one to another.
- The finished dimension of a part specifies the allowable difference from the standard dimension which is set first.
- The dimension set as the standard is called the standard dimension and the range of difference from this standard dimension is called the "tolerance".
- An indication example of a standard dimension and tolerance is shown in the following table. (The standard dimension is entered on the left side and the tolerance is entered with a positive or negative symbol on the right side)

Example:

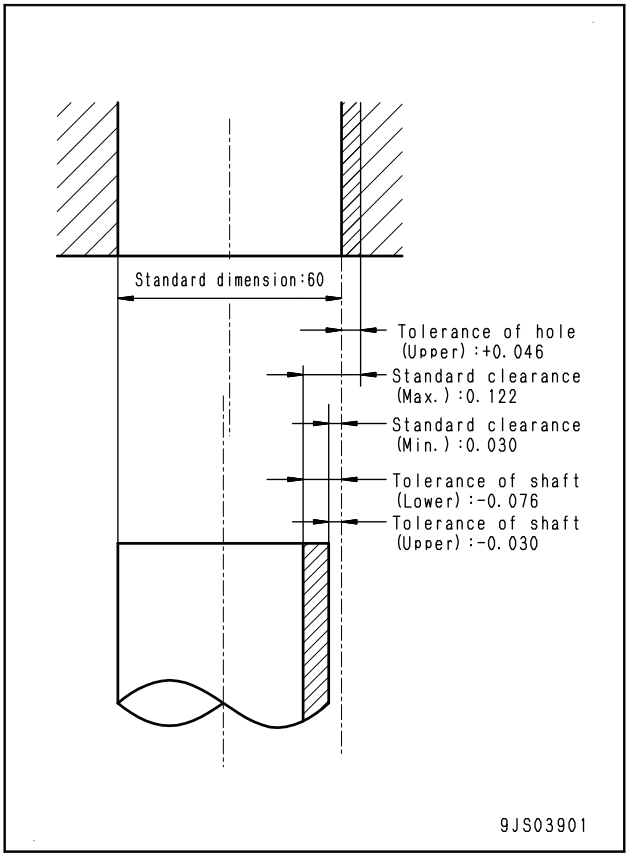
Standard dimension	Tolerance
120	-0.022 -0.126

- The tolerance may be indicated in the text and a table as "standard dimension (upper limit of tolerance/lower limit of tolerance)." Example: 120(-0.022/-0.126)
- Usually, the dimension of a hole and the dimension of a shaft to be inserted into the hole are indicated by the same standard dimension and different tolerances of the hole and shaft. The tightness of fit is decided by the tolerance.
- An indication example of a shaft and hole is shown in the following table. (The standard dimension is entered on the left side and the tolerance of the shaft is entered with a positive or negative symbol at the center and that of the hole on the right side)

Standard dimension	Tolerance	
	Shaft	Hole
60	-0.030 -0.076	+0.046 0

Standard clearance and standard value

- The clearance made when new parts are assembled is called the standard clearance, which is indicated by the range from the minimum clearance to the maximum clearance.
- When some parts are repaired, the clearance is generally adjusted to the standard clearance.
- The values indicating performance and function of new products or equivalent are called the "standard value", which is indicated by a range or a target value.
- When some parts are repaired, the value of performance/function is set to the standard value.



Standard interference

- When the diameter of a hole of a part shown in the given standard dimension and tolerance table is smaller than that of the shaft to be inserted, the difference between those diameters is called the "interference".
- Subtract the maximum dimension of the hole from the minimum dimension of the shaft and call it (A). Subtract the minimum dimension of the hole from the maximum dimension of the shaft and call it (B). The range between (A) and (B) is the "standard interference".
- After repairing or replacing some parts, measure the dimension of their hole and shaft and check that the interference is in the standard range.

Repair limit and allowable value or allowable dimension

- The dimensions of parts change because of the wear or deformation while they are used. When the dimension changes exceeding certain value,

the parts can not be used any longer. This value is called "repair limit".
- If a part is worn to the repair limit, it must be replaced or repaired.
- The performance and function of the products lower while they are used. When the value of the performance and function lowers exceeding a certain limit and it influences the operation etc., this value is called the allowable value or allowable dimension.
- A product whose dimension is out of the allowable value, must be repaired. However, since the allowable values are generally estimated through various tests or experiences in most cases, the judgement must be made in consideration of the operating condition and customer's requirement.

Allowable clearance
- Parts can be used until the clearance between them is increased to a certain limit. The limit at which those parts cannot be used is called the "allowable clearance".
- If the clearance between the parts exceeds the allowable clearance, they must be replaced or repaired.

Allowable interference
- The allowable maximum interference between the hole of a part and the shaft of another part to be assembled is called the "allowable interference".
- The allowable interference shows the repair limit of the part of smaller tolerance.
- The parts whose interferences are out of the allowable interference must be replaced or repaired.

Handling equipment of fuel system devices *(PC-AD00-2A4-K-00-A)*

(Rev. 2012/01)

- The common rail fuel injection system (CRI) consists of more precise parts than the parts used in the conventional fuel injection pump and nozzle. If foreign material enters this system, it may cause a failure. Use special care to prevent entry of the foreign material when servicing the fuel system.

Use care for working environment

- Avoid filter change or repairing the machine in rain or high winds, or at places where there is a lot of dust.

Sealing openings

- Plug the pipes and the openings of the components which are removed with the caps, tapes, vinyl bags, etc. to prevent foreign material from entering. Never perform repair works under the condition that the openings are left as they are or plugged with cloths as foreign material may enter or environment may be polluted by the oil leaked. Do not discard the waste oil somewhere or other. Hand it over to your customer for disposal, or dispose it by yourself.

How to clean parts when dirt is stuck

- If any dirt or dust sticks the parts of the fuel system, clean it off thoroughly with clean fuel.

Precautions for replacing fuel filter cartridge

- Be sure to use the Komatsu genuine fuel filter cartridge.
- The common rail fuel injection system (CRI) consists of more precise parts than the parts used in the conventional fuel injection pump and nozzle. In order to prevent foreign material from entering this system, the filter employs a specially high performance of filter element. If a filter element other than the genuine one is used, the fuel system may have a failure. Accordingly, never use such a filter element.

Handling of intake system parts *(PC220-A900-2A4-K-00-A)*

(Rev.2012/01)

- The Komatsu Variable Geometry Turbocharger (KVGT) consists of more precise parts (variable mechanism) than the parts used in the conventional turbocharger. If foreign material enters this system, it may cause a failure. Use special care to prevent entry of the foreign material when servicing the air intake system.

Be careful of working environment

- Avoid the repair work of the machine in rain or strong wind or at the places where there is a lot of dust.

Sealing openings

- Plug the pipes and the openings of the components which are removed, with the caps, tapes, vinyl bags, etc. to prevent foreign material from entering. Never perform repair works under the condition that the openings are left open or plugged with rag since foreign material may enter.

Handling of hydraulic equipment *(ALL-C000-2A4-P-01-A)*

(Rev. 2012/10)

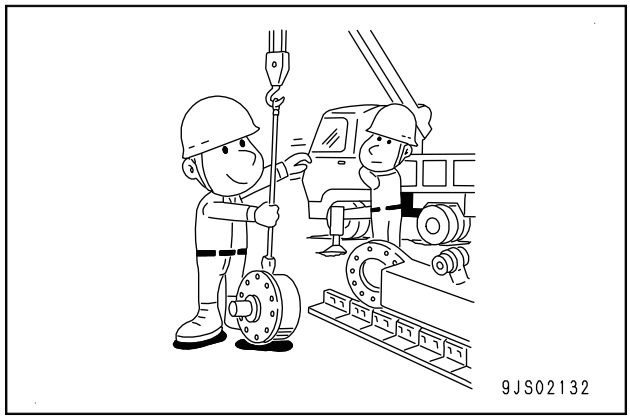
- With the increase in pressure and precision of the hydraulic components, the most common cause of a failure is dirt (foreign material) in the hydraulic circuit. Therefore, the special care must be taken when adding hydraulic oil,or when disassembling or assembling the hydraulic components.

Be careful of working environment

- Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or at places where there is a lot of dust.

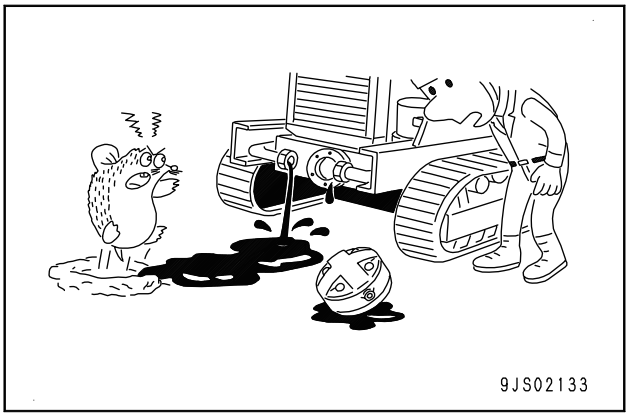
Disassembly and maintenance work in the field

- When disassembly or maintenance work of the hydraulic is performed in the field, there is danger of dust entering the components. It is also difficult to check the performance of the components after repairs, so it is desirable to use the component exchange service. The disassembly and assembly of the hydraulic components must be performed in the specially arranged dustproof workshop and the performance test of the components must be performed with the special testing equipment.



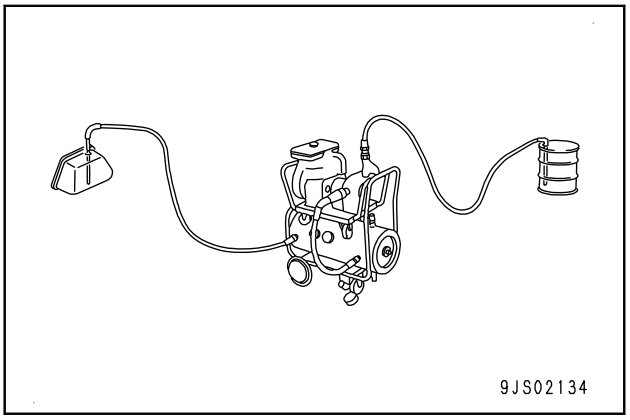
Plugging of opening (prevention of flowing out of oil)

- Plug the pipes and the openings of the components which are removed (when plugs are not prepared, seal with caps, tapes, vinyl bags, etc.) to prevent entry of foreign material and flowing out of oil. Never leave the openings of the pipes and hoses without being covered or plugged with cloth as foreign material may enter them or environment may be polluted by the oil leaked. Do not discard the waste oil somewhere or other. Hand it over to your customer for disposal, or dispose it by yourself.



Preventing intrusion of foreign materials during refilling operations.

- Care must be taken when adding hydraulic oil so that foreign material does not enter. Keep the oil filler port and the area around it, oil supply pump and oil container clean. If an oil cleaning device is used, it is possible to remove the dirt that is collected during storage. It is a surer means.

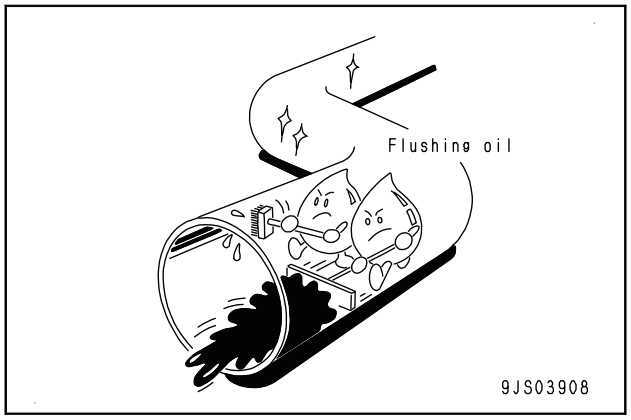


Replacing hydraulic oil while its temperature is high

- When the hydraulic oil is warm, it flows easily. In addition, sludge can also be drained from the circuit together with the oil. So, it is better to change the hydraulic oil while it is warm. When changing the hydraulic oil, the old oil must be drained as much as possible. (Drain the oil not only from the hydraulic tank, but also from the filter housing and the drain plug hole in the circuit.) If the old oil is left in the system, the contaminant and sludge in the oil mix with the new oil and shorten the life of the new hydraulic oil.

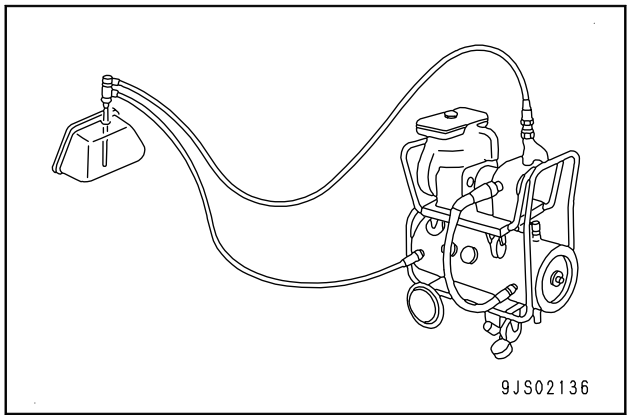
Flushing operations

- After disassembling the equipment or when changing the hydraulic oil with new one, flush the system to remove the contaminant and sludge left in the hydraulic circuit as well as the oil which includes them. Normally, flushing is performed twice. Primary flushing is performed by use of the flushing oil and the secondary flushing is performed by use of the specified hydraulic oil.



Cleaning operations

- After repairing the hydraulic equipment (pump, control valve, etc.) or when the machine is in operation, perform oil cleaning to remove the sludge or contaminant in the hydraulic oil circuit. The oil cleaning equipment can remove the ultra fine (approximately 3 μm) particles that the filter built in the hydraulic equipment can not remove. So, it is an extremely effective device.



Method of disconnecting and connecting of push-pull type coupler *(ALL-C930-001-P-00-A)*

(Rev. 2012/01)

⚠ Loosen the oil filler cap of the hydraulic tank slowly to release the remaining pressure in the hydraulic tank.

⚠ Even if the remaining pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil container.

Type 1 *(ALL-C930-925-P-01-A)*

Disconnection

1. Hold adapter (1) and push hose joint (2) into mating adapter (3). (Fig. 1)
   - ★ It can be pushed in by approximately 3.5mm.
   - ★ Do not hold rubber cap portion (4).
2. While pushing hose joint (2) into adapter (3), push rubber cap (4) against adapter (3) until "click" is heard. (Fig. 2)
3. Hold hose adapter (1) or hose (5) and pull it out. (Fig. 3)
   - ★ Since some hydraulic oil flows out, prepare an oil container.

Fig. 1

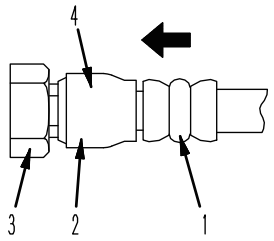


Fig. 2

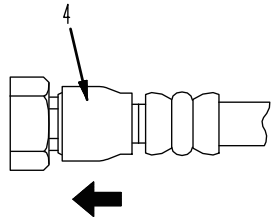
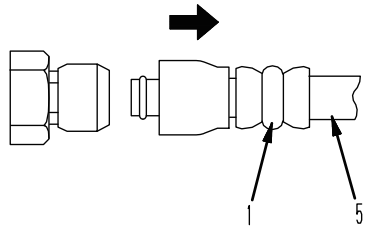


Fig. 3



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Connection

1. Hold hose adapter (1) or hose (5) and insert it in mating adapter (3) aligning them with each other. (Fig. 4)
   - ★ Do not hold rubber cap part (4).
2. After inserting the hose fitting in the adapter on the other side perfectly, pull it back to check the connecting condition. (Fig. 4)
   - ★ When the hose fitting is pulled back, the rubber cap will move toward the hose, however, it is not a problem.

Fig. 4

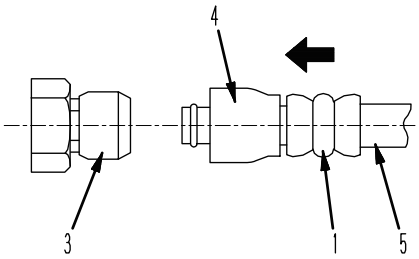
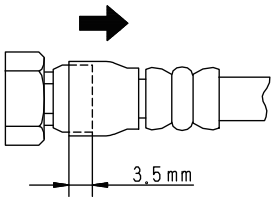


Fig. 5



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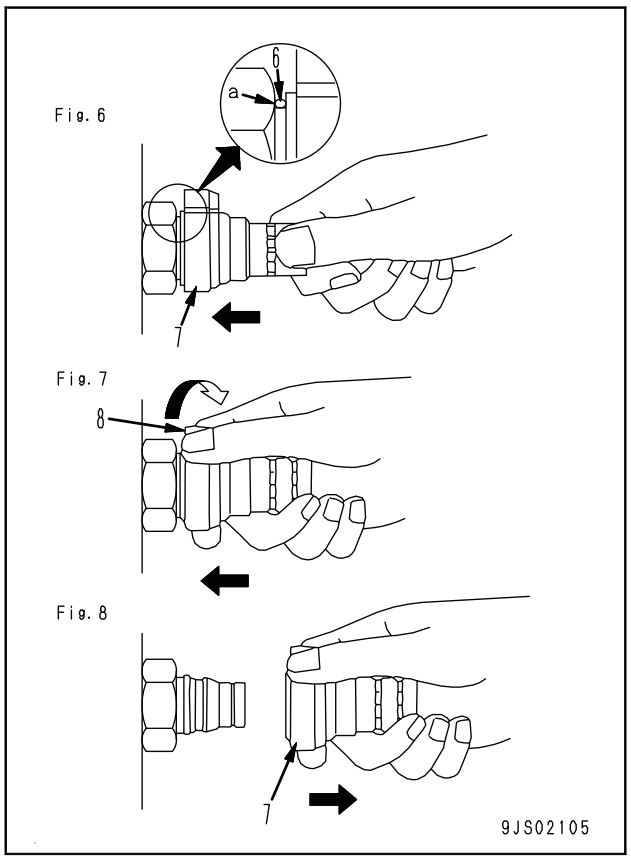
Type 2 *(ALL-C930-925-P-02-A)*

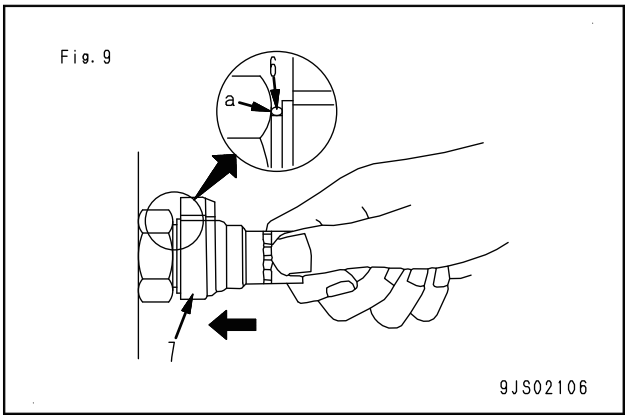
Disconnection

1. While holding the fitting, push body (7) in straight until sliding prevention ring (6) hits contact surface (a) at the hexagonal part on the male side. (Fig. 6)
2. While keeping the condition of Step 1, turn lever (8) to the right (clockwise). (Fig. 7)
3. While keeping the conditions of Steps 1 and 2, pull out whole body (7) to disconnect it. (Fig. 8)



Connection

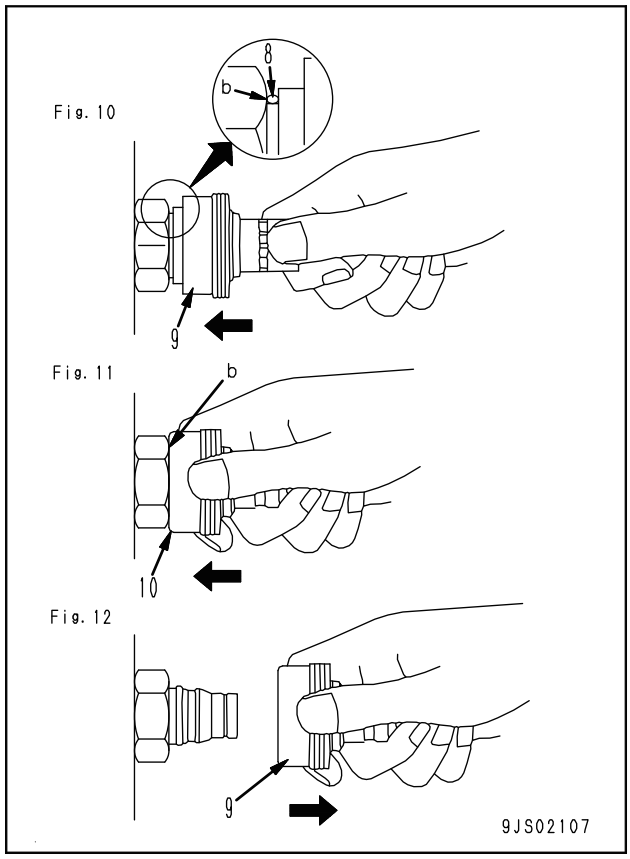
1. While holding the fitting, push body (7) in straight until sliding prevention ring (6) hits contact surface (a) at the hexagonal part on the male side to connect it. (Fig. 9)



Type 3 *(ALL-C930-925-P-03-A)*

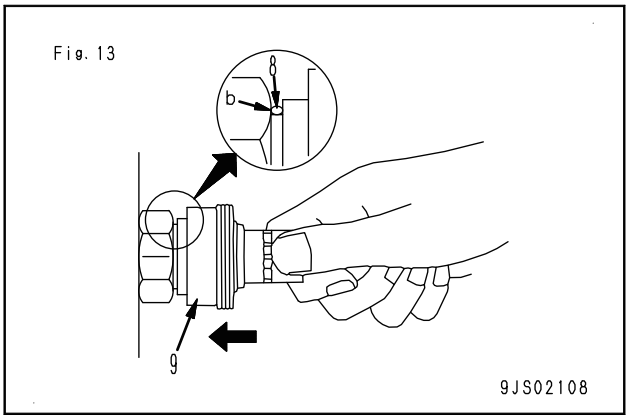
Disconnection

1. While holding the fitting, push body (9) in straight until sliding prevention ring (8) hits contact surface (b) at the hexagonal portion on the male side. (Fig. 10)
2. While keeping the condition of Step 1, push cover (10) straight until it hits contact surface (b) of the hexagonal portion on the male side. (Fig. 11)
3. While keeping the conditions of Steps 1 and 2, pull out whole body (9) to disconnect it. (Fig. 12)



Connection

1. While holding the fitting, push body (9) in straight until sliding prevention ring (8) hits contact surface (a) at the hexagonal portion on the male side to connect them. (Fig. 13)



Handling of electrical equipment *(ALL-E000-2A4-P-01-A)*

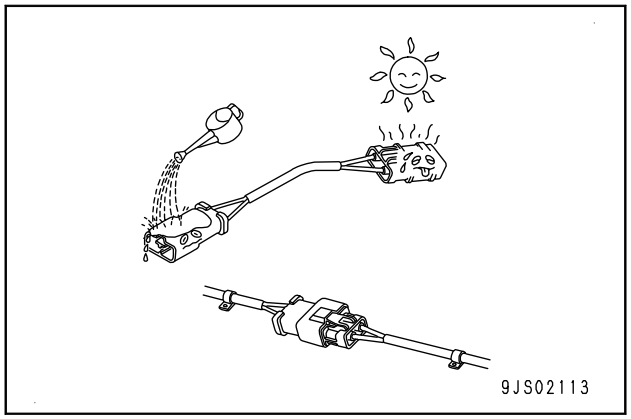
(Rev. 2012/11)

- To maintain the performance of the machine over a long period, and to prevent failures or troubles before they occur, correct "operation", "maintenance and inspection" "troubleshooting", and "repairs" must be performed. This section deals particularly with correct repair procedures for mechatronics components and is aimed at improving the quality of repairs. For this purpose, it describes the working procedures in "Handling of electrical equipment".

Precautions for handling electric equipment

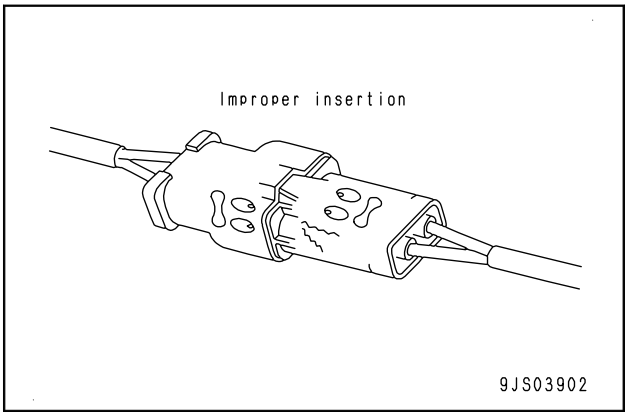
Handling wiring harnesses and connectors

- Wiring harnesses consist of wires connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wires.
- 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 the wiring harnesses.



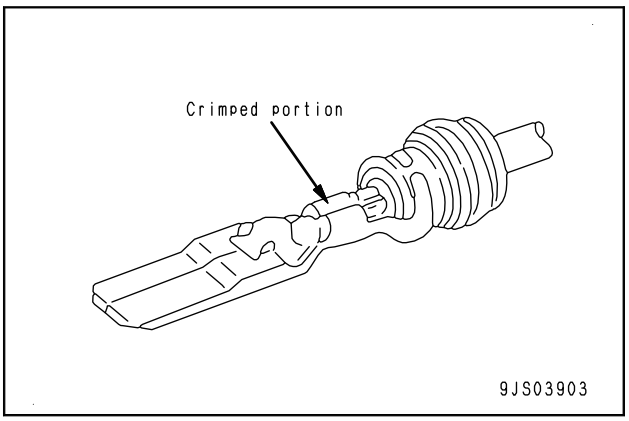
Main failures occurring in wiring harness
Defective contact of connectors (defective contact between male and female connectors)

- Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector,or because one or both of connectors are deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces. The corroded or oxidized contact surfaces may become shiny again (and contact may become normal) by connecting and disconnecting the connectors approximately 10 times.



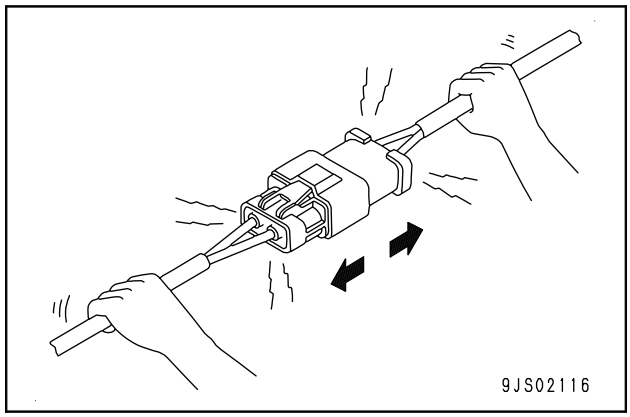
Defective crimping or soldering of connectors

- The pins of the male and female connectors are attached to wires by crimping or soldering. If excessive force is applied to the wire, the joining area may become loose, which may result in a defective connection or breakage.



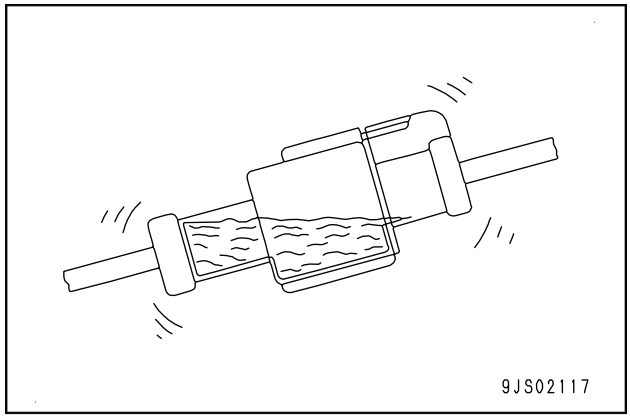
Disconnections in wiring

- If the wiring harness is pulled to disconnect the connector, or the components are lifted with a crane while the wiring harness is still connected, or a heavy object hits the wiring harness, the crimping of the connector may separate, or the soldering may be damaged, or the wiring harness may be broken.



High-pressure water entering 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. Accordingly, take care not to spray water over the connector.
  The connector is designed to prevent water from entering, but once water does enter, it is difficult to drain it. 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.



Entry of water, mud or dirt when disconnecting a connector

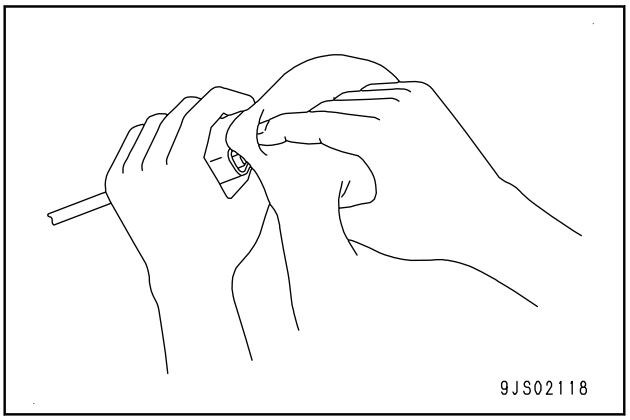
- If any water, mud or dirt is stuck to the outside surface of a connector, it can enter inside the connector when the connector is disconnected. Before disconnecting the connector, wipe off any stuck water or dirt by using a piece of dry cloth or blow it with compressed air.

Oil, mud or dirt stuck to connector

- If any oil or grease is stuck to the connector and an oil film is formed on the mating surface of the male and female pins, the oil prevents electricity from passing through, resulting in defective contact. If any oil or grease, mud or dirt is stuck to the connector, wipe it off with a dry cloth or blow it with compressed air and spray it with electrical contact restorer.

  ★ When wiping the joint portion of the connector, be careful not to apply excessive force or deform the pins.

  ★ If there is oil or water in the compressed air, it causes the contacts to become dirtier. So, remove the oil and water from the compressed air completely before cleaning the connector with the compressed air.

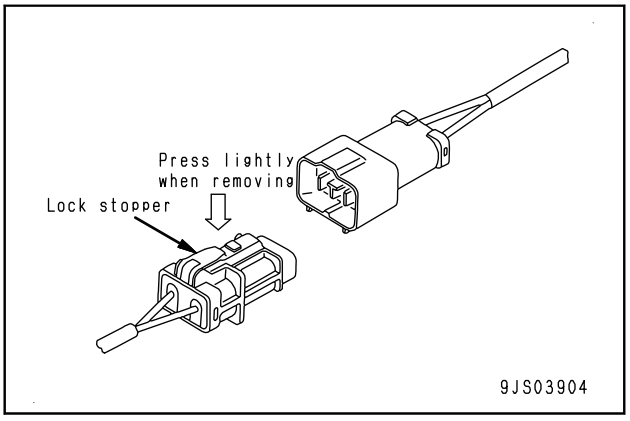


Removing, installing, and drying connectors and wiring harnesses

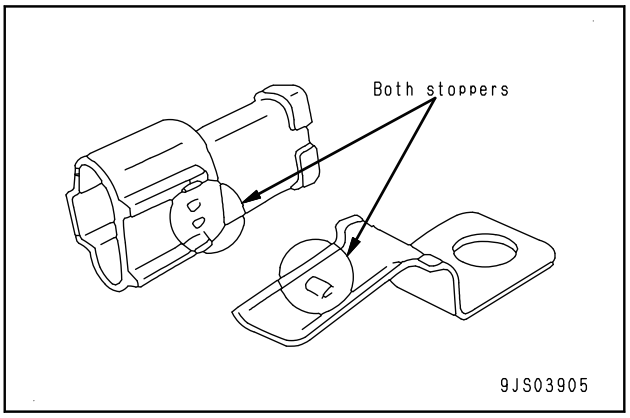
Disconnecting connectors

1. Hold the connectors when disconnecting.
   - Disconnect connectors by holding the connector bodies. For the connectors held by a screw, loosen the screw fully, then hold the male and female connectors with each hand respectively and pull them apart horizontally. For the connectors with lock stopper, press down the stopper with your thumb and pull the connectors apart.

     ★ Never pull the connector with one hand.

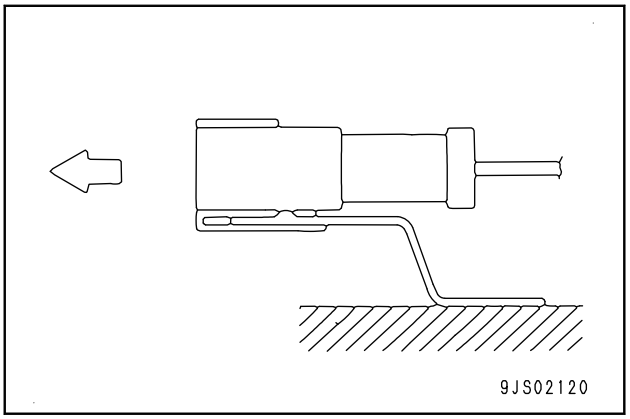


2. When removing from clips
   - Both of the connector and clip have stoppers, which are engaged with each other when the connector is connected.



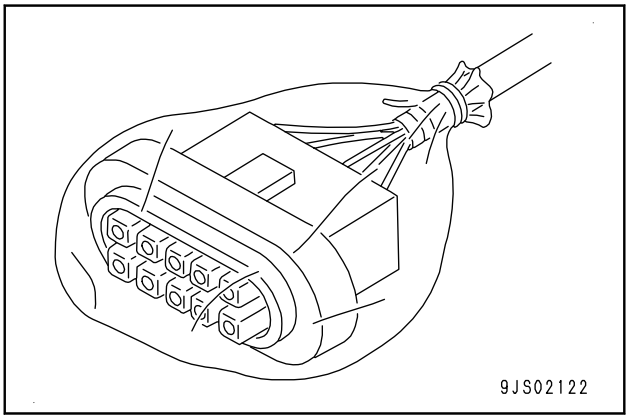
- When removing a connector from a clip, pull the connector in a parallel direction to the clip for removing stoppers.

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



3. Action to take after removing connectors
   - After removing the connector, cover it with the vinyl bag to prevent entry of dust, dirt,oil or water in the contact portion.

     ★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.

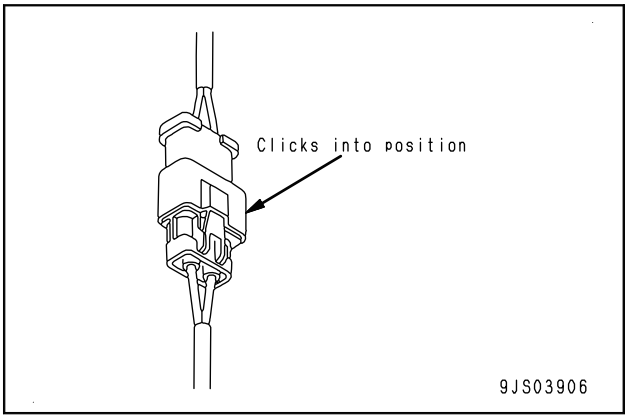


Connecting connectors

1. Check the connector visually.
   - Check that there is no oil, dirt or water stick to the connector pins (joint portion).
   - Check that the connector pins are free from deformation, defective contact, corrosion, or damage.
   - Check that external surfaces of the connectors are free from damage or breakage.

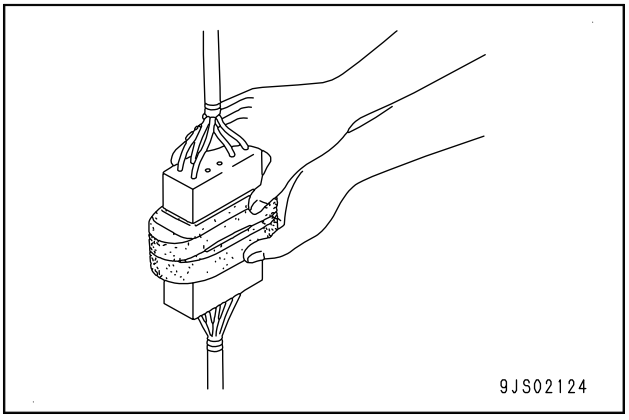
   ★ If any oil, water or dirt is stuck to the connector, wipe it off with a dry cloth. If any water is inside the connector, warm the connector and the inside of the wiring harness with a dryer. But be careful not to make it too hot as it causes short circuit.

   ★ If there is any damage or breakage, replace the connector.
2. Fix the connector securely.
   - Align the connectors correctly, and fit them securely. For the connectors with the lock stopper, push in the connectors until "click" is heard.

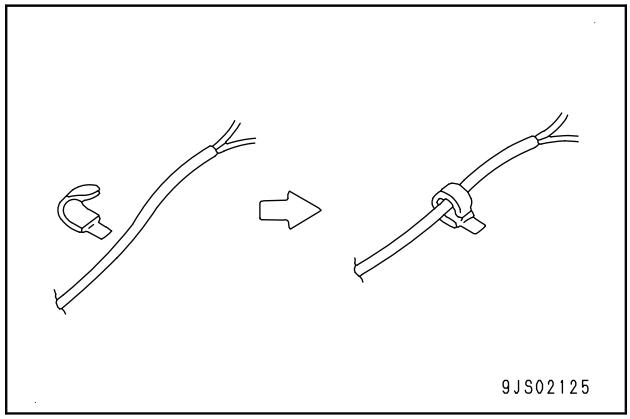


3. Correct the protrusion of the boot and misalignment of the wiring harness
   - For connectors fitted with the boot, correct any extrusion of the boot. In addition, if the wiring harness or the clamp is out of the position, put it in its original position.

     ★ If the connector cannot be corrected easily, remove the clamp and adjust the position.



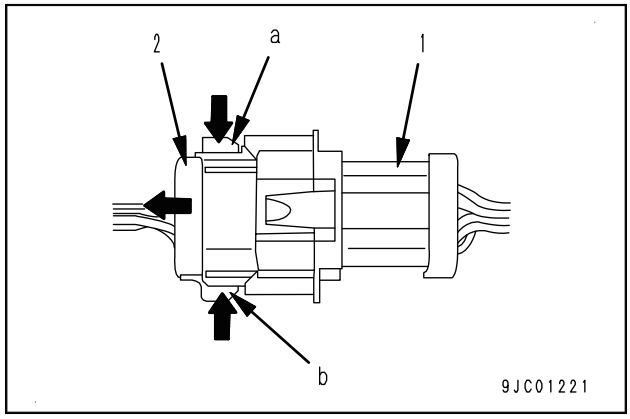
- If the connector clamp is removed, be sure to return it to its original position. And check that it is securely installed.



Handling of Deutsch connector (DT8-pin, DT12-pin)

Disconnection

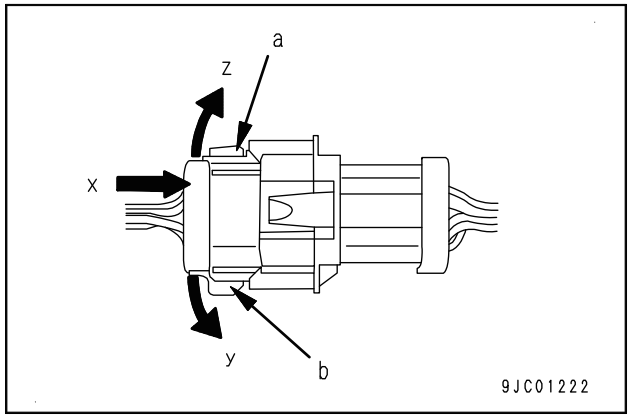
1. While pressing locks (a) and (b) from each side respectively, pull out female connector (2).



Connection

1. Push in female connector (2) horizontally until the lock clicks. (Arrow: x)
2. Since locks (a) and (b) may not be set completely, push in female connector (2) with curving movement until the locks are set normally. (Arrow: x, y, and z)

   ★ Lock (a) in the figure is pulled down (not set completely), and lock (b) is set completely.

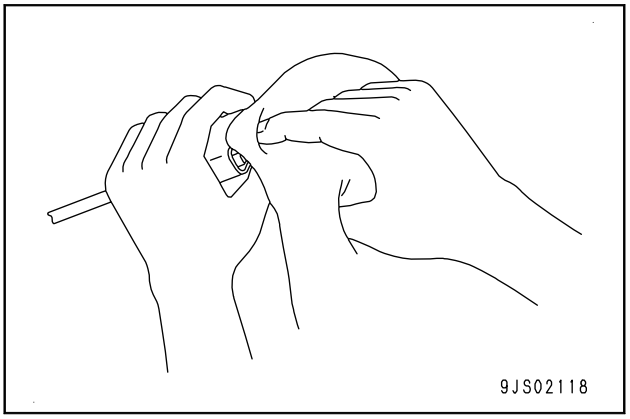


Drying wiring harness

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

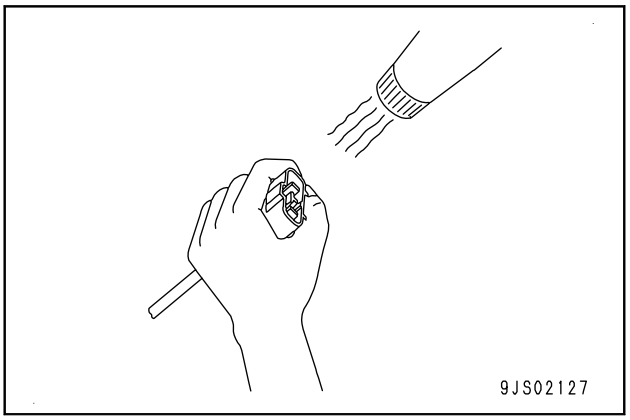
1. Disconnect the connector and wipe off the water with a dry cloth.

   ★ If the connector is to be blown with dry compressed air, there is a risk that oil in the air may cause defective contact of the conditioner, remove oil and water in the air before starting air blow.



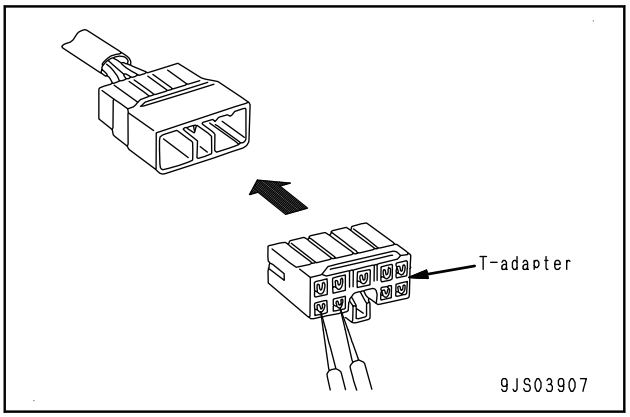
2. Dry the inside of the connector with a dryer. If water gets inside the connector, use a dryer to dry the connector.

   ★ Hot air from the dryer can be used, but regulate the time to use hot air in order to prevent the connector or related parts from becoming too hot, as it causes deformation or damage to the connector.



3. Perform a continuity test on the connector. After drying, leave the wiring harness disconnected and perform a continuity test to check for any short circuits between pins caused by water.

   ★ After the connector is completely dried, blow the contact restorer and reassemble them.



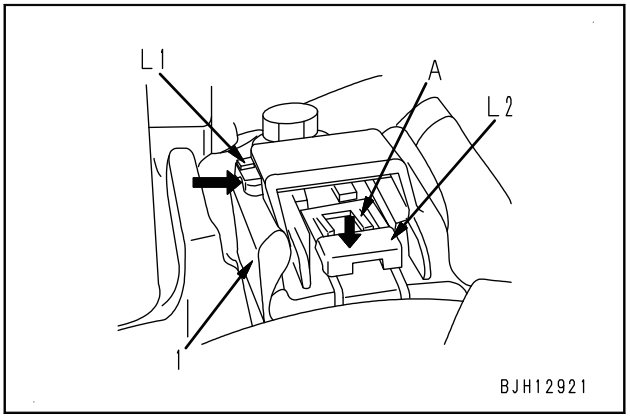
Handling of connectors used on engine

Slide, lock type
(FRAMATOME-3, FRAMATOME-2)

Disconnection

1. Slide lock (L1) to the right.
2. While pressing lock (L2), pull out connector (1) toward you.

   ★ In the case that even if lock (L2) is pressed, connector (1) cannot be pulled out toward you unless part A floats, float part A with a small flat-head screwdriver while pressing lock (L2), and then pull out connector (1) toward you.



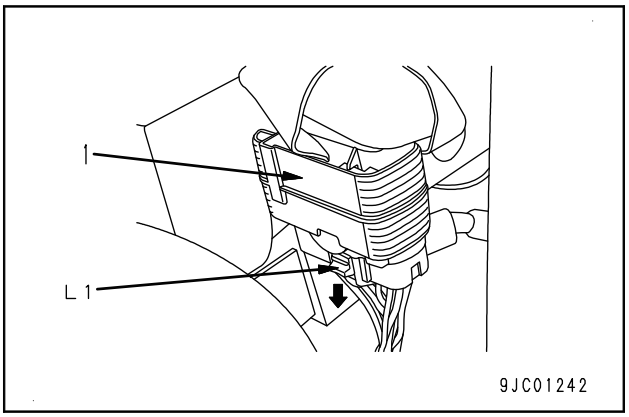
Connection

1. Insert the connector securely until a click is heard.

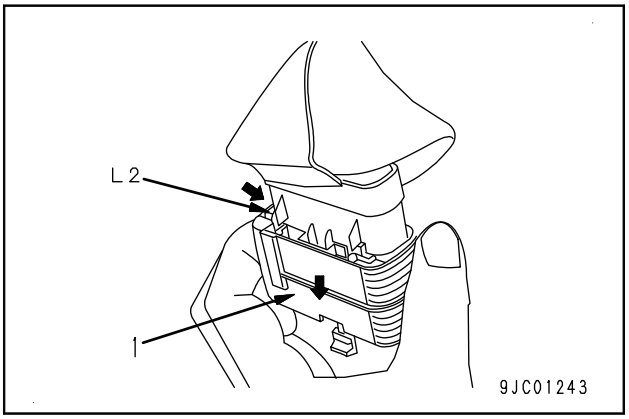
(FRAMATOME-24)

Disconnection

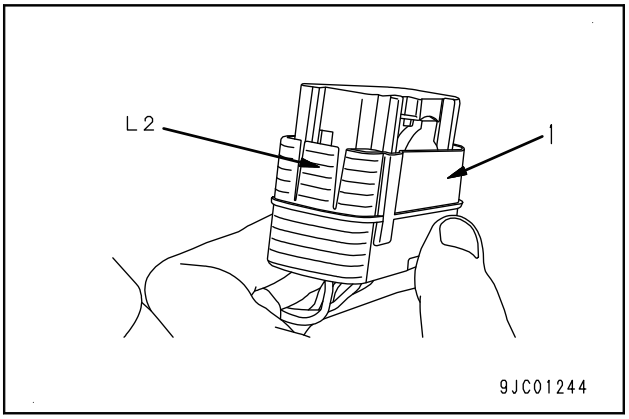
1. Slide down lock (red) (L1).



2. While pressing lock (L2), pull out connector (1).



★ Lock (L2) is located in the back of connector (1).



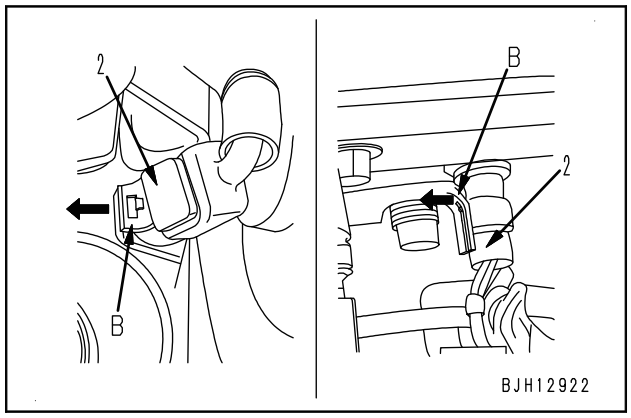
Connection

1. Insert the connector securely until a click is heard.

Pull lock type
(PACKARD-2)

Disconnection

1. Disconnect the connector (2) by pulling lock (B) (on the wiring harness side) of connector (2) outward.



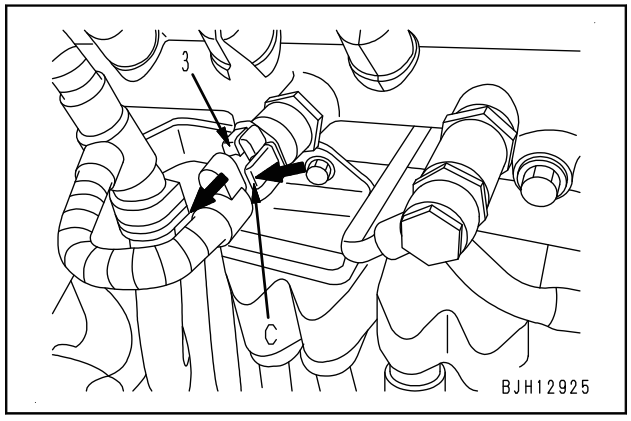
Connection

1. Insert the connector securely until a click is heard.

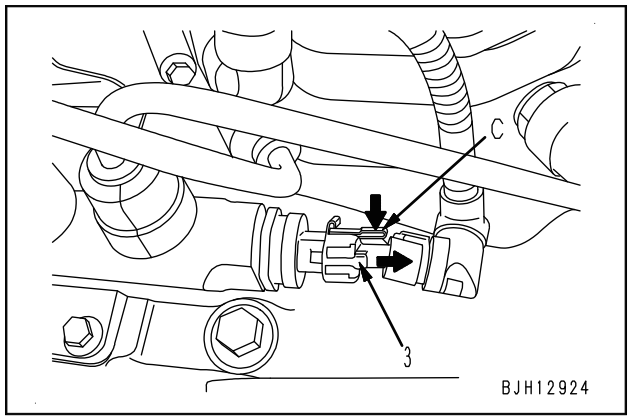
Push lock type
(BOSCH-3)

Disconnection

1. While pressing lock (C), pull out connector (3) in the direction of the arrow.
   - 114 series

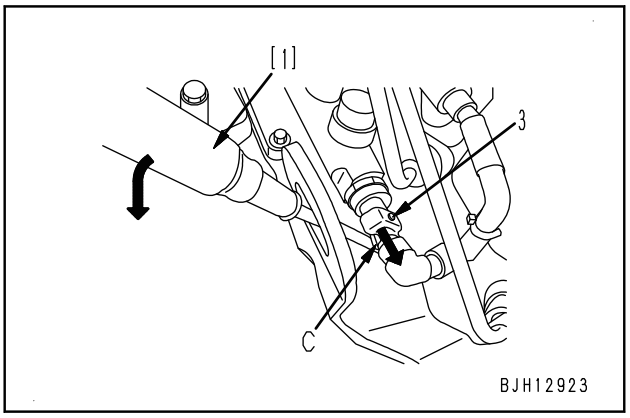


   - 107 series



★ If the lock is located on the underside, use flat-head screwdriver [1] since you cannot insert your fingers.

While pushing up lock (C) of the connector with flat-head screwdriver [1], pull out connector (3) in the direction of the arrow.



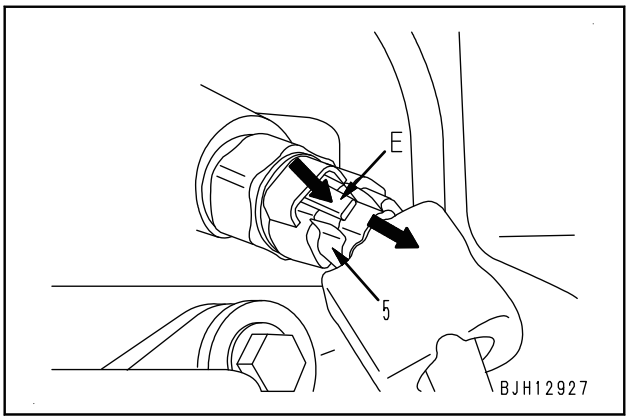
Connection

1. Insert the connector securely until a click is heard.

(AMP-3)

Disconnection

1. While pressing lock (E), pull out connector (5) in the direction of the arrow.



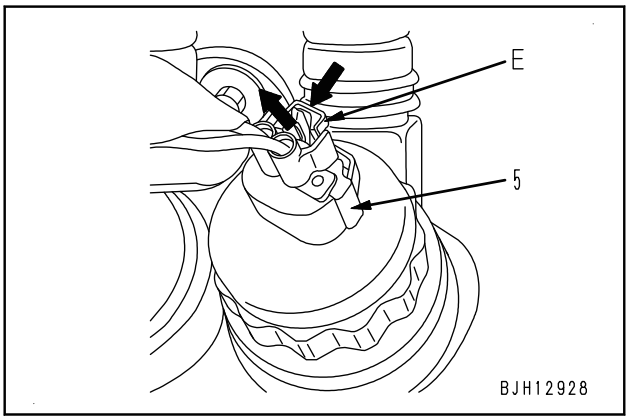
Connection

1. Insert the connector securely until a click is heard.

(SUMITOMO-2)

Disconnection

1. While pressing lock (E), pull out connector (5) in the direction of the arrow.



Connection

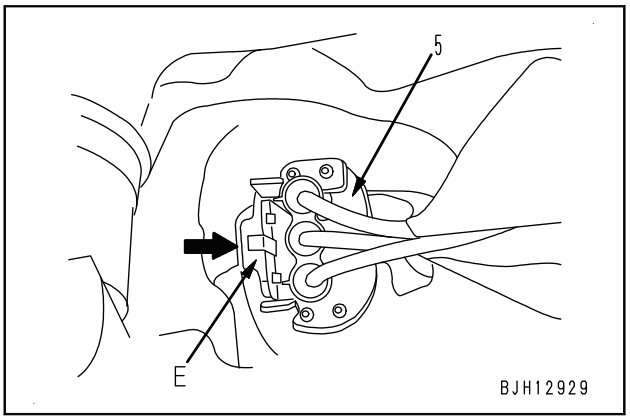
1. Insert the connector securely until a click is heard.

(SUMITOMO-3)

Disconnection

1. While pressing lock (E), pull out connector (5) in the direction of the arrow.

   ★ Pull the connector straight up.



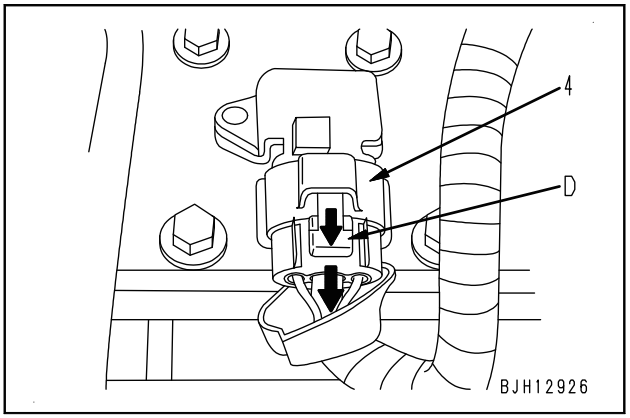
Connection

1. Insert the connector securely until a click is heard.

(SUMITOMO-4)

Disconnection

1. While pressing lock (D), pull out connector (4) in the direction of the arrow.



Connection

1. Insert the connector securely until a click is heard.

Turn-housing type (Round green connector) (CANNON-4)

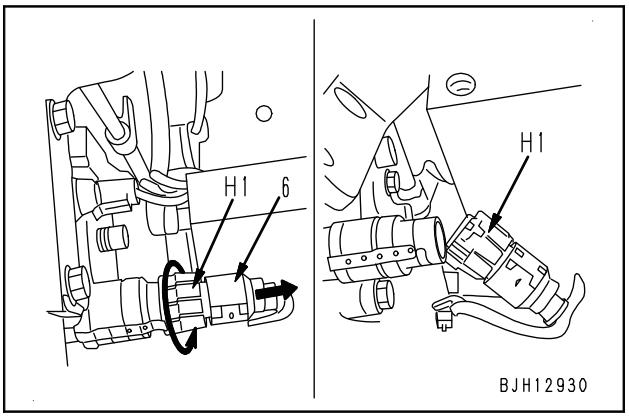
Disconnection

1. Turn housing (H1) in the direction of the arrow.

   ★ Unlock the connector by turning housing (H1). When the lock is release the housing is felt tight to turn.

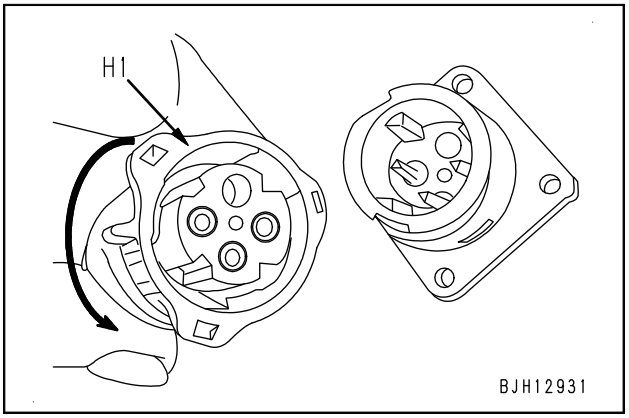
2. Pull out housing (H1) in the direction of the arrow.

   ★ Housing (H1) is left on the wiring harness side.



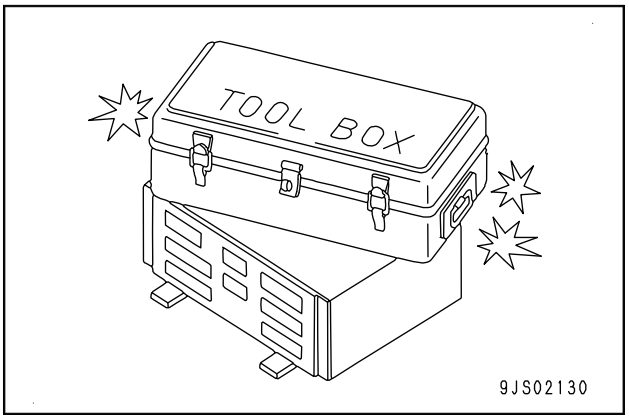
Connection

1. Insert the connector to the end while aligning its grove to the other.
2. Turn housing (H1) in the direction of the arrow until it "clicks".



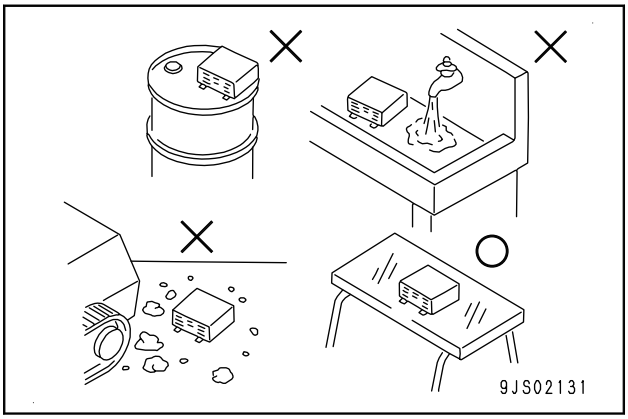
Handling controller

- The electronic circuits for control including the microcomputers are assembled in the controller. These electronic circuits in the controller must be handled with care as they control the machine.
- Do not place objects on top of the controller.



- Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts.
- During rainy weather, do not leave the controller in a place where it is exposed to rain.
- Do not place the controller on oil, water, or soil, or in a place that can be heated to a high

temperature even for a short period of time.
(Place it on a suitable dry stand.)



- Precautions when performing arc welding
  When performing arc welding on the machine body, disconnect all the wiring harness connectors connected to the controller. Put the arc welding ground to the place close to the welding point.

Precautions for troubleshooting electrical circuits

- Be sure to turn the starting switch to the "OFF" position before disconnecting or connecting the connectors.
- Before performing troubleshooting, check all the related connectors for loose connection.
  - ★ Check the related connectors for their performance by disconnecting and connecting them several times.
- Be sure to connect all the disconnected connectors before proceeding to the next step.
  - ★ If the starting switch is turned to the "ON" position with the connectors disconnected, the failure which is not related to the part which is actually failed.
- When performing the troubleshooting for the circuit (measurement of voltage, resistance, continuity, current, etc.), shake the related wiring harnesses and connectors several times and check that the multimeter reading does not change.
  - ★ If there is any value change on the multimeter, there may be a defective contact in the circuit.

How to read electric wire code *(ALL-E500-030-P-00-A)*

(Rev. 2012/10)

- In the electrical circuit diagram, material, thickness and color of each electric wire are indicated by symbols. The wire code is helpful in understanding the electrical circuit diagram.

Example) AEX 0.85 L: Indicates blue, heat-resistant, low-voltage wire for automobile, having nominal No. of 0.85

AEX	Indicates type of wire by symbol. Type, symbol, and material of wire are shown in Table 1. (Since the use of AV and AVS wires depends on size (nominal No.), their symbols are not indicated on the diagram.)
0.85	Indicates size of wire by nominal No. Size (Nominal No.) is shown in Table 2.
L	Indicates color of wire by color code. Color codes are shown in Table 3.

Type, symbol, and material

- AV and AVS are different in thickness and outside diameter of the coating. CAVC has a circular compressed conductor. It differs from AV and AVS in the outside diameter of conductor and thickness of the coating. And AEX is similar to AV in thickness and outside diameter of the coating but different from AV and AVS in material of the coating.

(Table 1)

Type	Sym-bol	Conductor material	Insulator material	Temperature range (°C) in use	Example of use
Low-voltage wire for automobile	AV	Annealed copper for electric appliance	Soft polyvinyl chloride	-30 to +60	For large current wiring (nominal No. 5 and above)
Thin-cover low-voltage wire for automobile (Type 1)	AVS				General wiring (nominal No. 3 and lower)
Thin-cover low-voltage wire for automobile (Type 2)	CAVS				For mid- to small-size excavators (nominal No. 1.25 and lower)
Heat-resistant low-voltage wire for automobile	AEX		Heat-resistant cross linked polyethylene	-50 to +110	General wiring for extremely cold weather specification Wiring at high ambient temperature place

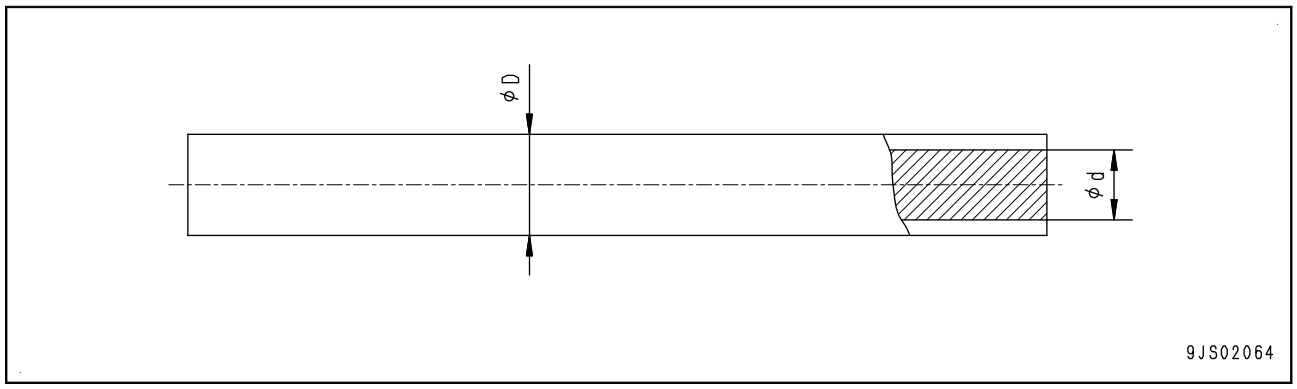
Dimensions
(Table 2)

Nominal No.			0.5f	(0.5)	0.75f	(0.85)	1.25f	(1.25)	2f	2	3f	3	5
Conductor		Number of strands/ Diameter of strand	20/ 0.18	7/0.32	30/ 0.18	11/ 0.32	50/ 0.18	16/ 0.32	37/ 0.26	26/ 0.32	58/ 0.26	41/ 0.32	65/ 0.32
		Cross-sectional area (mm^2)	0.51	0.56	0.76	0.88	1.27	1.29	1.96	2.09	3.08	3.30	5.23
		d (approx.)	1.0		1.2		1.5		1.9	1.9	2.3	2.4	3.0
Coating D	AVS	Standard	2.0		2.2		2.5		2.9	2.9	3.5	3.6	—
	AV	Standard	—		—		—		—	—	—	—	4.6
	AEX	Standard	2.0		2.2		2.7		3.0	3.1	—	3.8	4.6

Nominal No.			8	15	20	30	40	50	60	85	100
Conductor		Number of strands/ Diameter of strand	50/0.45	84/0.45	41/0.80	70/0.80	85/0.80	108/ 0.80	127/ 0.80	169/ 0.80	217/ 0.80
		Cross-sectional area (mm^2)	7.95	13.36	20.61	35.19	42.73	54.29	63.84	84.96	109.1
		d (approx.)	3.7	4.8	6.0	8.0	8.6	9.8	10.4	12.0	13.6
Coating D	AVS	Standard	—	—	—	—	—	—	—	—	—
	AV	Standard	5.5	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6
	AEX	Standard	5.3	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6

Nominal No.			0.5f	0.5	0.75f	0.85	1.25f	1.25
Conductor		Number of strands/ Diameter of strand	—	7/round compression	—	11/round compression	—	16/round compression
		Cross-sectional area (mm^2)	—	0.56	—	0.88	—	1.29
		d (approx.)	—	0.9	—	1.1	—	1.4
Coating D	CAVS	Standard	—	1.6	—	1.8	—	2.1

★ "f" of nominal No. denotes "flexible".



Color codes table
(Table 3)

Color Code	Color of wire	Color Code	Color of wire
B	Black	LgW	Light green & White
Br	Brown	LgY	Light green & Yellow
BrB	Brown & Black	LR	Blue & Red
BrR	Brown & Red	LW	Blue & White
BrW	Brown & White	LY	Blue & Yellow
BrY	Brown & Yellow	O	Orange
Ch	Charcoal	P	Pink
Dg	Dark green	R	Red
G	Green	RB	Red & Black
GB	Green & Black	RG	Red & Green
GL	Green & Blue	RL	Red & Blue
Gr	Gray	RW	Red & White
GR	Green & Red	RY	Red & Yellow
GW	Green & White	Sb	Sky Blue
GY	Green & Yellow	Y	Yellow
L	Blue	YB	Yellow & Black
LB	Blue & Black	YG	Yellow & Green
Lg	Light green	YL	Yellow & Blue
LgB	Light green & Black	YR	Yellow & Red
LgR	Light green & Red	YW	Yellow & White

★ Remarks: In a color code consisting of 2 colors, the first color is the color of the background and the second color is the color of the marking.

Examples)

GW means that the background is "Green" and marking is "White".

Types of circuits and color codes

Type of wire		AVS, AV, CAVS						AEX	
Type of circuit	Charge	R	WG	—	—	—	—	R	—
	Ground	B	—	—	—	—	—	B	—
	Start	R	—	—	—	—	—	R	—
	Light	RW	RB	RY	RG	RL	—	D	—
	Instrument	Y	YR	YB	YG	YL	YW	Y	Gr
	Signal	G	GW	GR	GY	GB	GL	G	Br
	Others	L	LW	LR	LY	LB	—	L	—
		Br	BrW	BrR	BrY	BrB	—	—	—
		Lg	LgR	LgY	LgB	LgW	—	—	—
		O	—	—	—	—	—	—	—
		Gr	—	—	—	—	—	—	—
		P	—	—	—	—	—	—	—
		Sb	—	—	—	—	—	—	—
		Dg	—	—	—	—	—	—	—
		Ch	—	—	—	—	—	—	—

Precautions when performing operation *(ALL-1160-927-A-00-A)*

(Rev. 2012/11)

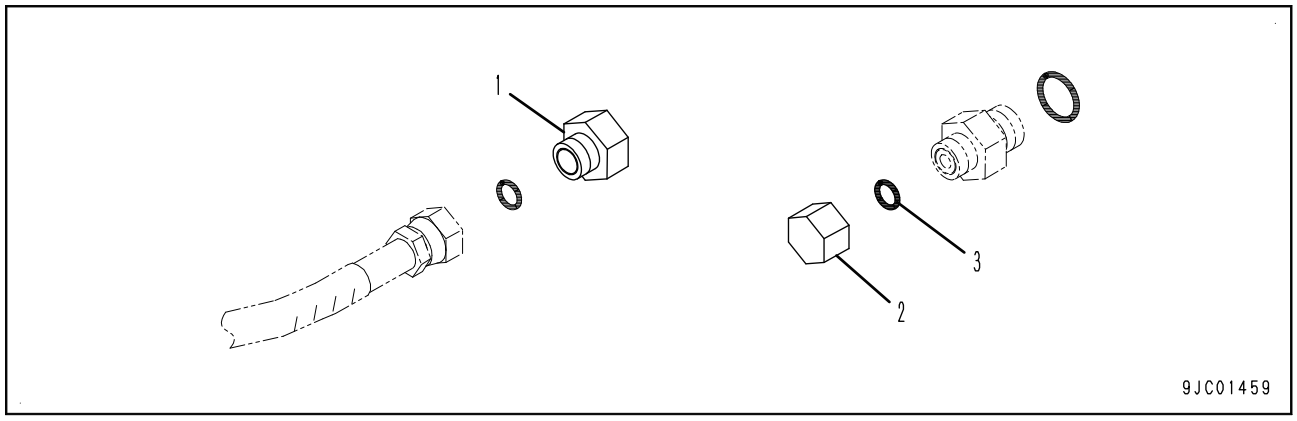
- When performing "testing and adjusting" of the machine, "removal and installation" and "disassembly and assembly" of the components, observe the following general cautions.

Precautions for removal and disassembly work

- If the cooling water contains coolant, dispose of it correctly as chemicals. Do not drain it to the sewage rashly.
- After disconnecting the hoses or tubes, plug them to prevent dirt or dust from entering.
- When draining oil, prepare a container with sufficient capacity.
- Check the match marks which indicate the installing position, and put match marks on the places where they seem necessary before removal of the components 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. Do not pull the wires.
- Attach the tags to wires and hoses to show their installing positions to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep them in a safe place.
- When hoisting the components, prepare the slings with sufficient strength.
- When using forcing screws to remove any component, tighten the forcing screws uniformly and alternately.
- Before removing any component, clean the surrounding area and cover the component to prevent any foreign material from entering after removal.
- After disconnecting the piping or removing a pipe joint, install the following plugs.

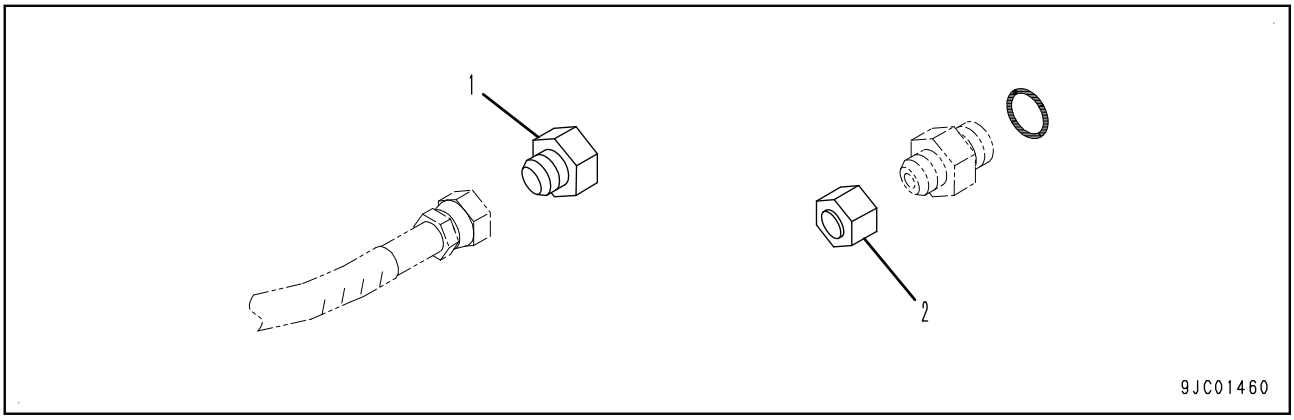
★ The O-rings in the table are emergency parts used for disassembly or transportation of the machine.
When assembling, confirm the part numbers in the parts book and use the parts conforming to the using condition.

Disconnection of face seal type hoses and tubes



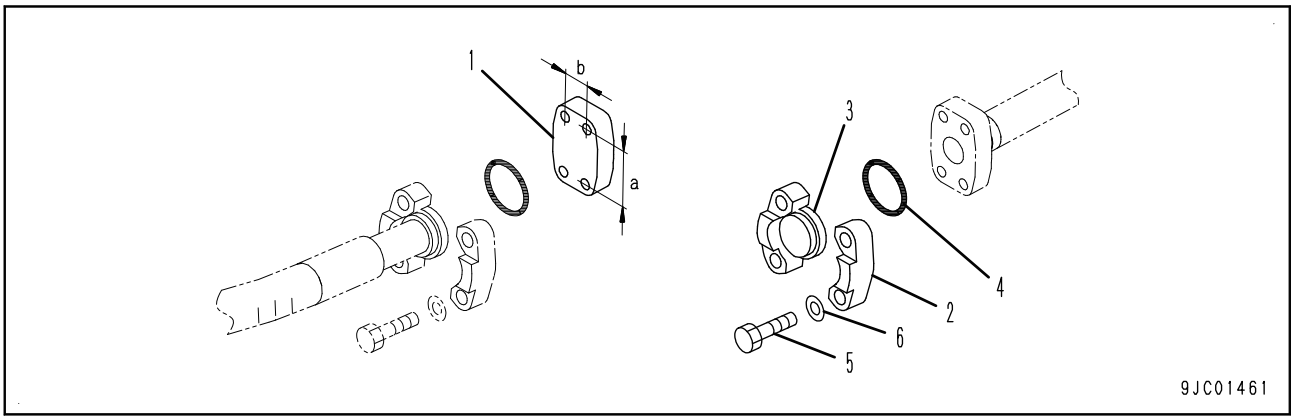
Nominal No.	Hose side	Pipe joint side	O-ring (3)
	Plug (1)	Nut (2)	
02	07376-70210	02789-00210	02896-11008
03	07376-70315	02789-00315	02896-11009
04	07376-70422	02789-00422	02896-11012
05	07376-70522	02789-00522	02896-11015
06	07376-70628	02789-00628	02896-11018

Disconnection of taper seal type hoses and tubes



Nominal No.	Hose side	Pipe joint side
	Plug (1)	Nut (2)
02	07376-50210	07222-00210
03	07376-50315	07222-00312
04	07376-50422	07222-00414
05	07376-50522	07222-00515
06	07376-50628	07222-00616
10	07376-51034	07222-01018
12	07376-51234	07222-01219
14	07376-51443	07222-01422

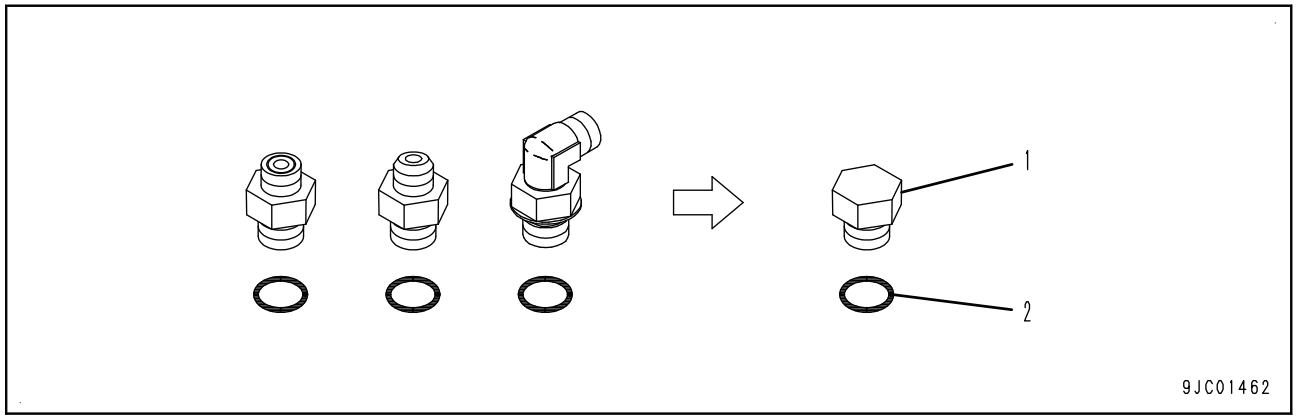
Disconnection of split flange type hoses and tubes



No-minal No.	Bolt pitch (mm)		Hose side	Tube side		O-ring (4)	Bolt (5)	Washer (6)
	a	b	Flange (1)	Split flange (2)	Sleeve head (3)			
04	38.1	17.5	07379-00400	07371-30400	07378-10400	07000-12021	01010-80825	01643-50823
05	42.9	19.8	07379-00500	07371-30500	07378-10500	07000-13022	01010-80830	01643-50823
06	47.6	22.2	07379-00640	07371-30640	07378-10600	07000-13025	07372-51035	01643-51032
10	52.4	26.2	07379-01044	07371-31049	07378-11000	07000-13032	07372-51035	01643-51032
12	58.7	30.2	07379-01250	07371-31255	07378-11200	07000-13038	07372-51035	01643-51032
	66.7	31.8	07379-01260	07371-51260	07378-11210	07000-13038	01010-81245	01643-51232
14	69.9	35.8	07379-01460	07371-31465	07378-11400	07000-13048	07372-51240	01643-51232

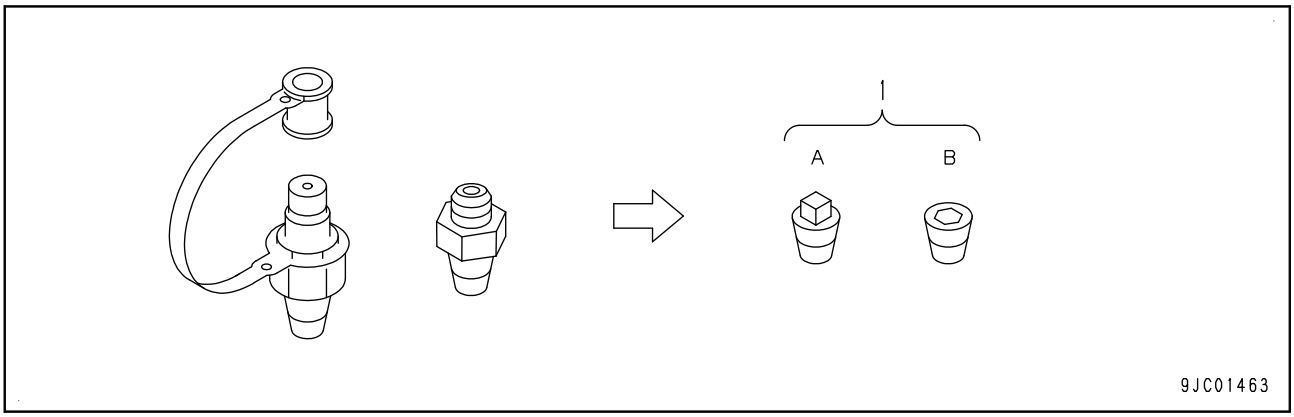
Nominal No.	Bolt pitch (mm)		Hose side	Tube side		O-ring (4)	Bolt (5)	Washer (6)
	a	b	Flange (1)	Split flange (2)	Sleeve head (3)			
	79.4	36.5	07379-01470	07371-51470	07378-11410	07000-13048	01010-81455	01643-31445
20	77.8	42.8	07379-02071	07371-32076	07378-12000	07000-12060	07372-51240	01643-51232
	96.8	44.5	07379-02080	07371-52080	07378-12010	07000-12060	01010-81865	01643-31845
24	88.9	50.8	07379-02484	07371-12484	07378-12400	07000-12070	07372-51240	01643-51232
30	106.4	62	07379-03010	07371-13010	07378-13000	07000-12085	07372-51650	01643-51645
34	120.6	69.8	07379-03411	07371-13411	07378-13400	07000-12100	07372-51650	01643-51645
40	130.2	77.8	07379-04012	07371-14012	07378-14000	07000-12110	07372-51650	01643-51645
50	152.4	92	07379-05011	07371-15011	07378-15000	07000-12135	07372-51655	01643-51645

Removal of pipe joints of O-ring boss type



Nominal No.	Plug (1)	O-ring (2)
08	07040-10807	07002-10823
10	07040-11007	07002-11023
12	07040-11209	07002-11223
14	07040-11409	07002-11423
16	07040-11612	07002-11623
18	07040-11812	07002-11823
20	07040-12012	07002-12034
24	07040-12412	07002-12434
30	07041-13012	07002-13034
33	07040-13316	07002-13334
36	07041-13612	07002-13634
42	07040-14220	07002-14234
52	07040-15223	07002-15234

Removal of pipe joints of taper pipe thread type



Nominal No.	Nominal thread size	Plug (1)	
		Square head type (A)	Hexagonal socket head (B)
01	R1/8	07042-00108	07043-00108
02	R1/4	07042-00211	07043-00211
03	R3/8	07042-00312	07043-00312
04	R1/2	07042-00415	07043-00415
06	R3/4	07042-00617	07043-00617
10	R1	07042-01019	07043-01019
12	R1 1/4	07042-01222	07043-01222
14	R1 1/2	07042-01422	07043-01422
20	R2	07042-02026	07043-02026

Precautions for installation and assembly work

- Tighten the bolts and nuts (sleeve nuts) to the specified torque (KES), unless otherwise specified.
- Install the hoses without twist and interference, and securely fasten the clamps located in-between if they are.
- Replace all of the gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pins and lock plates securely.
- When applying adhesive, clean and degrease the part, and apply 2 to 3 drops of adhesive to the threaded portion.
- When applying liquid gasket, clean and degrease the surface, and apply it uniformly after making sure that the surface is free from dirt or damage.
- Clean all of the parts, and repair any damage, dents, burrs, or rust found on them.
- Coat the rotating parts and sliding parts with engine oil.
- Coat the surfaces of the press-fitting parts with molybdenum disulfide lubricant (LM-P).
- After installing the snap ring, check that the snap ring is settled in the ring groove completely.
- When connecting wiring harness connectors, clean the connectors to remove oil, dirt, or water, then connect them securely.
- Use the eye bolts with no fatigue and deformation and screw them in securely. Match the directions of the eyes and the hook.
- When installing split flanges, tighten the bolts uniformly and alternately to prevent excessive tightening on one side.
- As a rule, apply liquid gasket (LG-5) or liquid sealant (LS-2) to the threaded portion of each taper male screws which receives pressure.
  However, if the threaded portion is difficult to degrease, you may use a seal tape.
- When winding a seal tape onto a right-handed taper male screw, wind it clockwise in the advancing direction of the threads, seeing from the screw end and starting at the third thread.

  ★ If you wind the seal tape in the opposite direction, it becomes loose and comes off or its end part is pushed out, and that can cause oil leakage.

★ When the hydraulic cylinder is used for the first time after reassembly of the hydraulic equipment such as the hydraulic cylinder, pump, etc. and piping after removing them for repair, be sure to perform air bleeding of the hydraulic circuit according to the following procedure.

1. Start and run the engine at low idle.
2. Repeat the operation to extend and retract each cylinder of the work equipment to approximately 100 mm before the stroke end 4 to 5 times.
3. Operate the hydraulic cylinder 3 to 4 times to the end of its stroke.

★ After the completion of repair and when operating the machine which is stored long term, perform the air bleeding with the same procedure as the one described above.

Precautions at the time of completing work
Refilling of coolant, oil and grease

- When the coolant is drained, tighten the drain valve securely, then refill the coolant reservoir with the coolant Komatsu recommends to the specified level. Start the engine to circulate the coolant in the piping, and add the coolant to the specified level again.
- When the hydraulic components are removed and installed, refill the oil reservoir with the oil Komatsu recommends to the specified level. Start the engine to circulate the oil in the piping, and add the oil to the specified level again.
- If the hydraulic piping or hydraulic equipment is removed, be sure to bleed air from the system after rebuilding the parts, by referring to "Testing and adjusting".
- Supply the specified amount of grease to the work equipment parts.

Testing installed condition of cylinder heads and manifolds

- Check the cylinder head and intake and exhaust manifold mountings for looseness.
- If any bolt is loose, retighten it.

★ For the tightening torques, see the "Disassembly and assembly".

Testing of engine piping for damage and looseness

Intake and exhaust system	Check the piping for damage, the mounting bolts and nuts for looseness, and the joints for air suction and exhaust gas leakage. If any part is loosely installed or damaged, retighten the bolts or repair the parts.
Cooling system	Check the piping for damage, the mounting bolts and nuts for looseness, and the joints for water leakage. If any part is loosely installed or damaged, retighten the bolts or repair the parts.
Fuel system	Check the piping for damage, the mounting bolts and nuts for looseness, and the joints for fuel leakage. If any part is loosely installed or damaged, retighten the bolts or repair the parts.

Check of KDPF or muffler and exhaust pipe for damage and looseness

- Visually check the KDPF or muffler, exhaust pipe and their mounting parts for a crack and damage. If any part is damaged, replace it.
- Check the mounting bolts, nuts, and clamps of the KDPF or muffler, exhaust pipe and their mounting parts for looseness.
  If any part is loosely installed, retighten the bolts.

Check of KDPF or muffler function

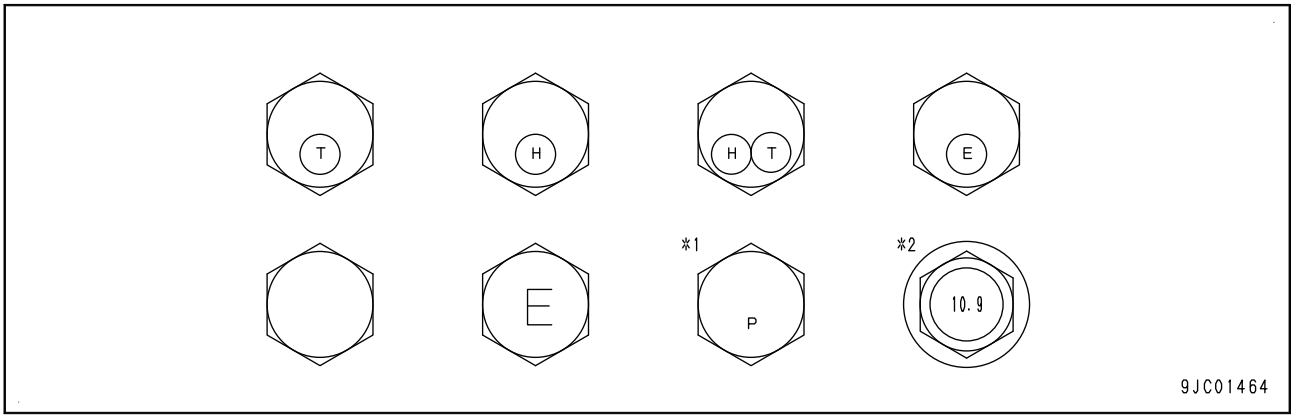
- Check the KDPF or the muffler for unusual noise comparing to the noise when they are new.
  If any unusual noise is heard, repair KDPF or muffler, referring to "Troubleshooting" and "Disassembly and assembly".

Standard tightening torque table *(ALL-M140-03B-P-01-A)*

(Rev. 2012/10)

Table of tightening torque for bolts and nuts

Unless otherwise specified, tighten the metric bolts and nuts to the torque shown in the table below.

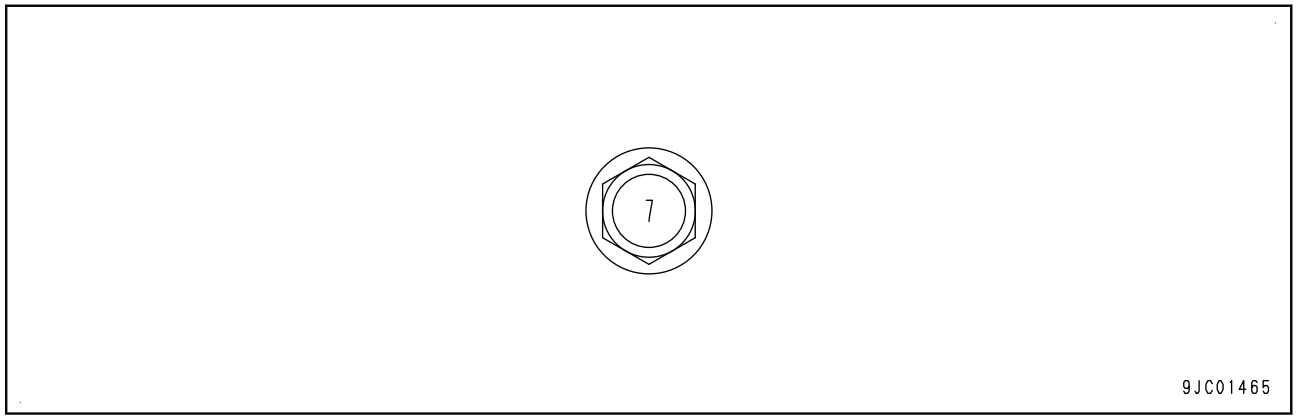


Thread diameter (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})
6	10 (*2) 10	11.8 to 14.7 {1.2 to 1.5}
8	13 (*2) 12	27 to 34 {2.8 to 3.5}
10	17 (*1, *2) 14	59 to 74 {6.0 to 7.5}
12	19 (*1, *2) 17	98 to 123 {10.0 to 12.5}
14	22	157 to 196 {16 to 20}
16	24 (*1) 22	245 to 309 {25 to 31.5}
18	27	343 to 427 {35 to 43.5}
20	30	490 to 608 {50 to 62}
22	32	662 to 829 {67.5 to 84.5}
24	36	824 to 1,030 {84 to 105}
27	41	1,180 to 1,470 {120 to 150}
30	46	1,520 to 1,910 {155 to 195}
33	50	1,960 to 2,450 {200 to 250}
36	55	2,450 to 3,040 {250 to 310}
39	60	2,890 to 3,630 {295 to 370}

*1: Split flange bolt.

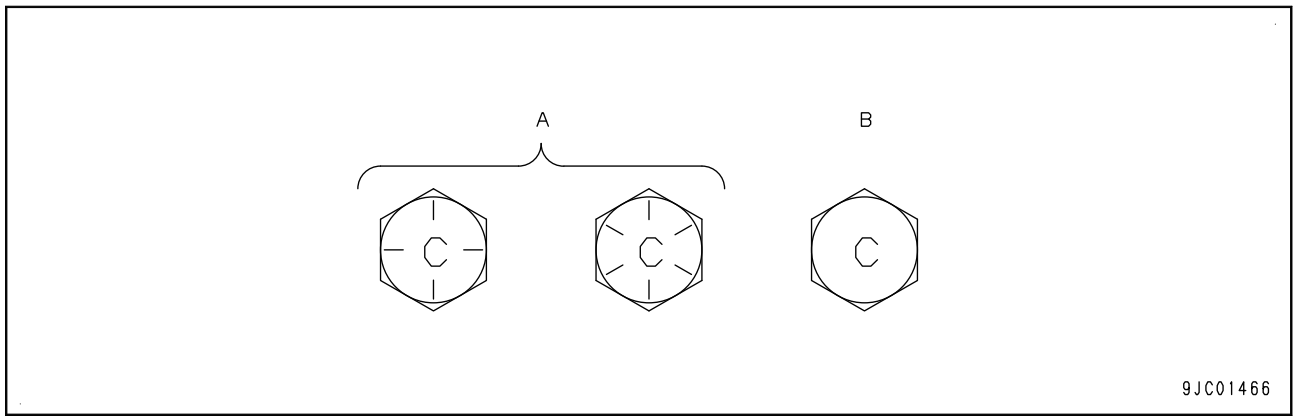
*2: Flanged bolt.

★ Tighten the following flanged bolt on which "7" is stamped on its top to the tightening torque shown in the following table.



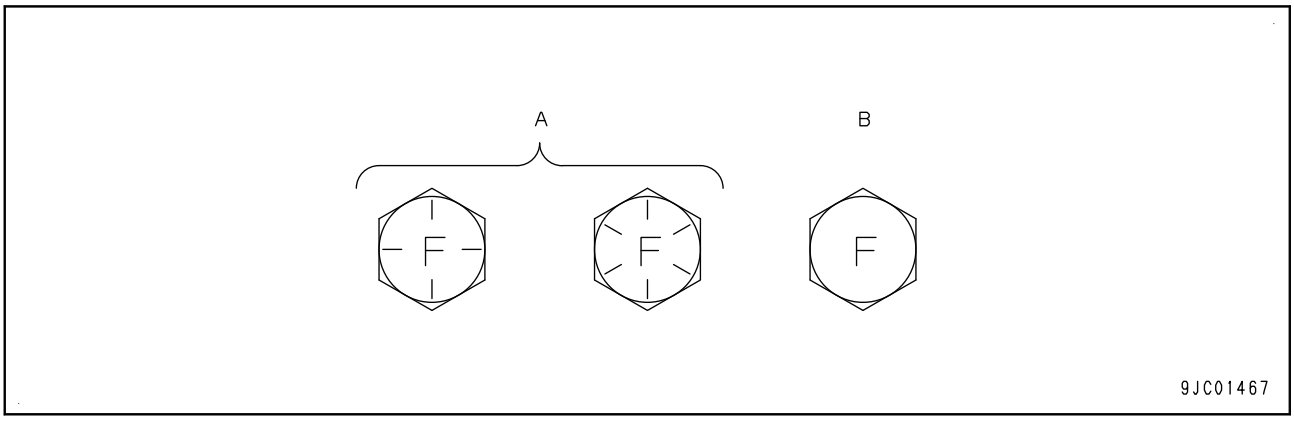
Thread diameter (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})
6	10	5.9 to 9.8 {0.6 to 1.0}
8	12	13.7 to 23.5 {1.4 to 2.4}
10	14	34.3 to 46.1 {3.5 to 4.7}
12	17	74.5 to 90.2 {7.6 to 9.2}

Unless otherwise specified, tighten the unified coarse threaded bolts and nuts to the torque shown in the table below.



Type of bolt	A		B	
Nominal No. - threads per inch, type of thread	Tightening torque (Nm {kgm})		Tightening torque (Nm {kgm})	
	Range	Target	Range	Target
1/4-20UNC	9.8 to 14.7 {1 to 1.5}	12.7 {1.3}	2.9 to 3.9 {0.3 to 0.4}	3.43 {0.35}
5/16-18UNC	24.5 to 34.3 {2.5 to 3.5}	29.4 {3}	6.9 to 8.8 {0.7 to 0.9}	7.8 {0.8}
3/8-16UNC	44.1 to 58.8 {4.5 to 6}	52.0 {5.3}	9.8 to 14.7 {1 to 1.5}	11.8 {1.2}
7/16-14UNC	73.5 to 98.1 {7.5 to 10}	86.3 {8.8}	19.6 to 24.5 {2 to 2.5}	21.6 {2.2}
1/2-13UNC	108 to 147 {11 to 15}	127 {13}	29.4 to 39.2 {3 to 4}	34.3 {3.5}
9/16-12UNC	157 to 216 {16 to 22}	186 {19}	44.1 to 58.8 {4.5 to 6}	51.0 {5.2}
5/8-11UNC	226 to 294 {23 to 30}	265 {27}	63.7 to 83.4 {6.5 to 8.5}	68.6 {7}
3/4-10UNC	392 to 530 {40 to 54}	461 {47}	108 to 147 {11 to 15}	127 {13}
7/8-9UNC	637 to 853 {65 to 87}	745 {76}	177 to 235 {18 to 24}	206 {21}
1-8UNC	883 to 1,196 {90 to 122}	1,040 {106}	245 to 333 {25 to 34}	284 {29}
1 1/8-7UNC	1,187 to 1,608 {121 to 164}	1,393 {142}	333 to 451 {34 to 46}	392 {40}
1 1/4-7UNC	1,598 to 2,157 {163 to 220}	1,873 {191}	451 to 608 {46 to 62}	530 {54}
1 1/2-6UNC	2,354 to 3,177 {240 to 324}	2,765 {282}	657 to 892 {67 to 91}	775 {79}

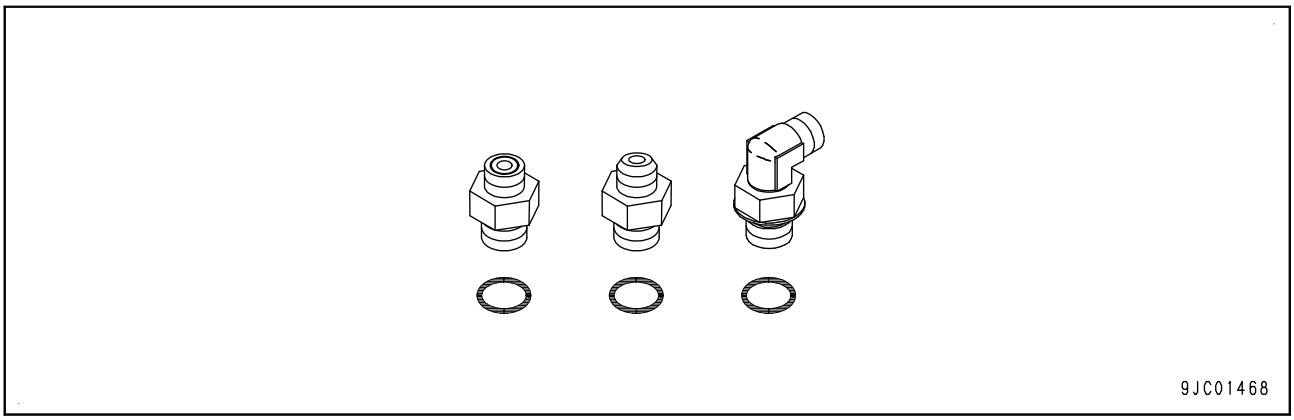
Unless otherwise specified, tighten the unified fine threaded bolts and nuts to the torque shown in the table below.



Type of bolt	A		B	
Nominal No. - threads per inch, type of thread	Tightening torque (Nm {kgm})		Tightening torque (Nm {kgm})	
	Range	Target	Range	Target
1/4-28UNF	14.7 to 19.6 {1.5 to 2}	17.7 {1.8}	3.9 to 4.9 {0.4 to 0.5}	4.41 {0.45}
5/16-24UNF	34.3 to 39.2 {3.5 to 4}	37.3 {3.8}	7.8 to 9.8 {0.8 to 1}	8.8 {0.9}
3/8-24UNF	53.9 to 68.6 {5.5 to 7}	61.8 {6.3}	14.7 to 19.6 {1.5 to 2}	16.7 {1.7}
7/16-20UNF	83.4 to 108 {8.5 to 11}	96.1 {9.8}	24.5 to 29.4 {2.5 to 3}	26.5 {2.7}
1/2-20UNF	127 to 167 {13 to 17}	147 {15}	34.3 to 49.0 {3.5 to 5}	41.2 {4.2}
9/16-18UNF	186 to 245 {19 to 25}	216 {22}	49.0 to 68.6 {5 to 7}	58.6 {6}
5/8-18UNF	255 to 343 {26 to 35}	294 {30}	73.5 to 98.1 {7.5 to 10}	83.4 {8.5}
3/4-16UNF	441 to 598 {45 to 61}	520 {53}	127 to 167 {13 to 17}	147 {15}
7/8-14UNF	716 to 961 {73 to 98}	843 {86}	196 to 265 {20 to 27}	226 {23}
1-14UNF	1,020 to 1,373 {104 to 140}	1,196 {122}	284 to 382 {29 to 39}	333 {34}
1 1/8-12UNF	1,353 to 1,844 {138 to 188}	1,598 {163}	382 to 520 {39 to 53}	451 {46}
1 1/4-12UNF	1,804 to 2,432 {184 to 248}	2,118 {216}	510 to 686 {52 to 70}	598 {61}
1 1/2-12UNF	2,707 to 3,658 {276 to 373}	3,177 {324}	765 to 1,030 {78 to 105}	892 {91}

Table of tightening torque for O-ring boss piping joints

★ Unless otherwise specified, tighten the pipe joint for O-ring boss to the torque shown in the table below.

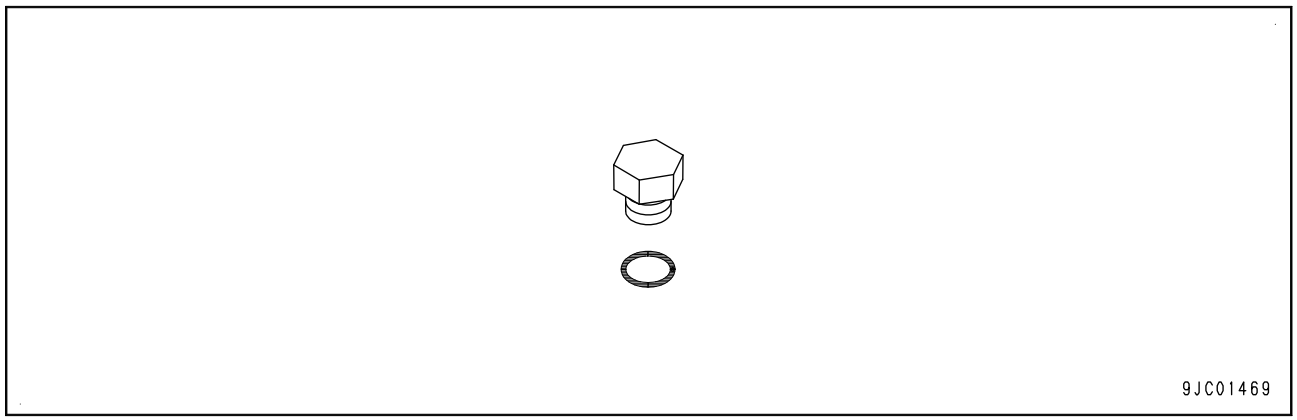


Nominal No.	Thread diameter (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})	
			Range	Target
02	14	Varies depending on type of connector.	35 to 63 {3.5 to 6.5}	44 {4.5}
—	18		59 to 98 {6.0 to 10.0}	78 {8.0}
03, 04	20		84 to 132 {8.5 to 13.5}	103 {10.5}
05, 06	24		128 to 186 {13.0 to 19.0}	157 {16.0}

Nominal No.	Thread diameter (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})	
			Range	Target
10, 12	33		363 to 480 {37.0 to 49.0}	422 {43.0}
14	42		746 to 1,010 {76.0 to 103}	883 {90.0}

Table of tightening torque for O-ring boss plugs

★ Unless otherwise specified, tighten the plug for O-ring boss to the torque shown in the table below.

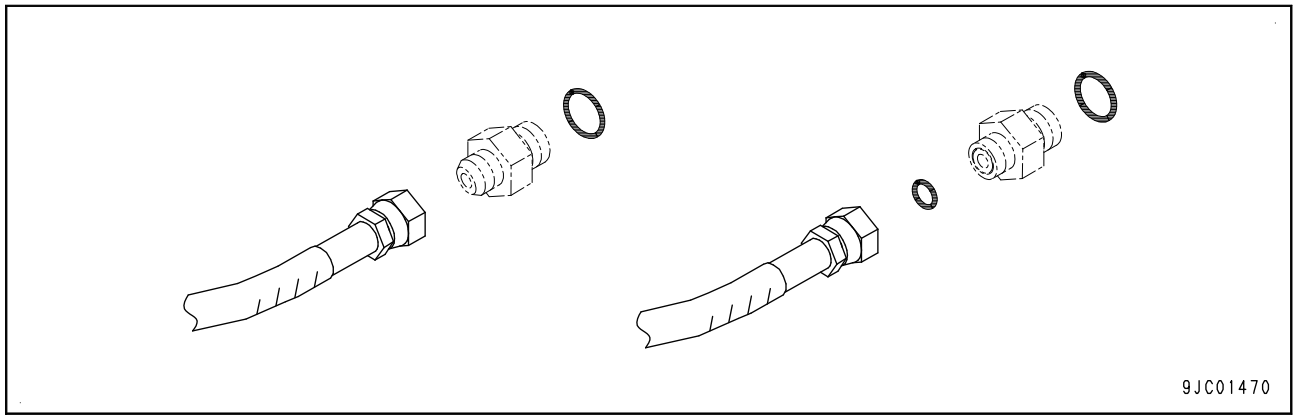


Nominal No.	Thread diameter (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})	
			Range	Target
08	8	14	5.88 to 8.82 {0.6 to 0.9}	7.35 {0.75}
10	10	17	9.8 to 12.74 {1.0 to 1.3}	11.27 {1.15}
12	12	19	14.7 to 19.6 {1.5 to 2.0}	17.64 {1.8}
14	14	22	19.6 to 24.5 {2.0 to 2.5}	22.54 {2.3}
16	16	24	24.5 to 34.3 {2.5 to 3.5}	29.4 {3.0}
18	18	27	34.3 to 44.1 {3.5 to 4.5}	39.2 {4.0}
20	20	30	44.1 to 53.9 {4.5 to 5.5}	49.0 {5.0}
24	24	32	58.8 to 78.4 {6.0 to 8.0}	68.6 {7.0}
30	30	32	93.1 to 122.5 {9.5 to 12.5}	107.8 {11.0}
33	33	—	107.8 to 147.0 {11.0 to 15.0}	127.4 {13.0}
36	36	36	127.4 to 176.4 {13.0 to 18.0}	151.9 {15.5}
42	42	—	181.3 to 240.1 {18.5 to 24.5}	210.7 {21.5}
52	52	—	274.4 to 367.5 {28.0 to 37.5}	323.4 {33.0}

Table of tightening torque for hose (taper seal type and face seal type)

★ Unless otherwise specified, tighten the hose fittings (taper seal type and face seal type) to the torque shown in the table below.

★ The table is applied to the threads coated with engine oil (wet threads)

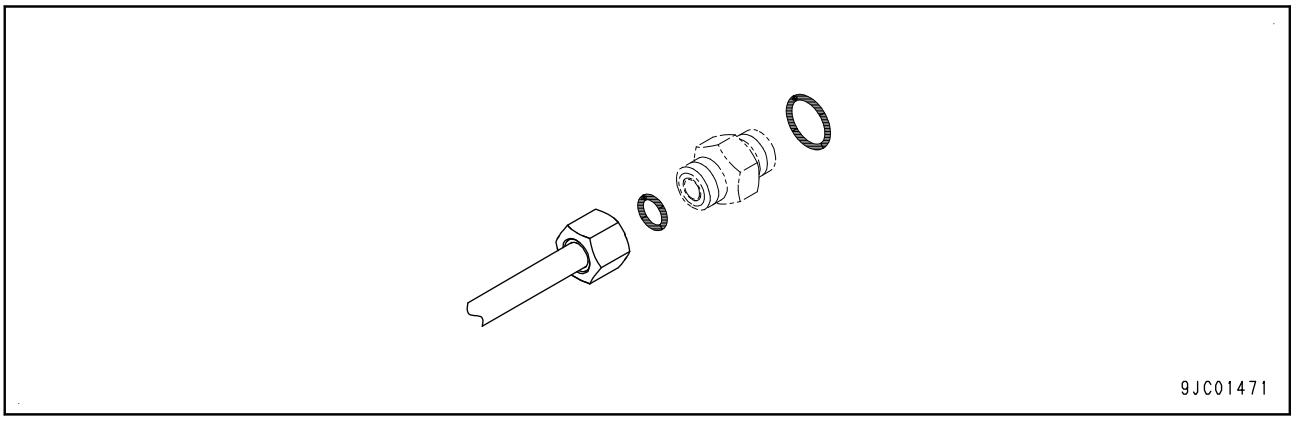


Nominal No. of hose	Width across flats (mm)	Tightening torque (Nm {kgm})		Taper seal	Face seal	
		Range	Target	Thread size (mm)	Nominal No. - threads per inch, type of thread	Thread root diameter (mm) (reference)
02	19	34 to 54 {3.5 to 5.5}	44 {4.5}	—	9/16-18UN	14.3
		34 to 63 {3.5 to 6.5}	44 {4.5}	14	—	—
03	22	54 to 93 {5.5 to 9.5}	74 {7.5}	—	11/16-16UN	17.5
	24	59 to 98 {6.0 to 10.0}	78 {8.0}	18	—	—
04	27	84 to 132 {8.5 to 13.5}	103 {10.5}	22	13/16-16UN	20.6
05	32	128 to 186 {13.0 to 19.0}	157 {16.0}	24	1 -14UNS	25.4
06	36	177 to 245 {18.0 to 25.0}	216 {22.0}	30	1 3/16-12UN	30.2
(10)	41	177 to 245 {18.0 to 25.0}	216 {22.0}	33	—	—
(12)	46	197 to 294 {20.0 to 30.0}	245 {25.0}	36	—	—
(14)	55	246 to 343 {25.0 to 35.0}	294 {30.0}	42	—	—

Table of tightening torque for face seal joints

★ The tightening torque table below applies to the seal joint (sleeve nut type)

★ The table is applied to the threads coated with engine oil (wet threads).



Outer diameter of pipe (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})		Face seal	
		Range	Target	Nominal No. - threads per inch, type of thread	Thread root diameter (mm) (reference)
8	19	14 to 16 {1.4 to 1.6}	15 {1.5}	9/16-18UN	14.3
10	22	24 to 27 {2.4 to 2.7}	25.5 {2.6}	11/16-16UN	17.5
12	24 {27}	43 to 47 {4.4 to 4.8}	45 {4.6}	13/16-16UN	20.6
15 {16}	30 {32}	60 to 68 {6.1 to 6.8}	64 {6.5}	1 -14UNS	25.4
22 {20}	36	90 to 95 {9.2 to 9.7}	92.5 {9.4}	1 3/16-12UN	30.2

Reference: The face seal joint of the dimension in ( ) is also used, depending on the specification.

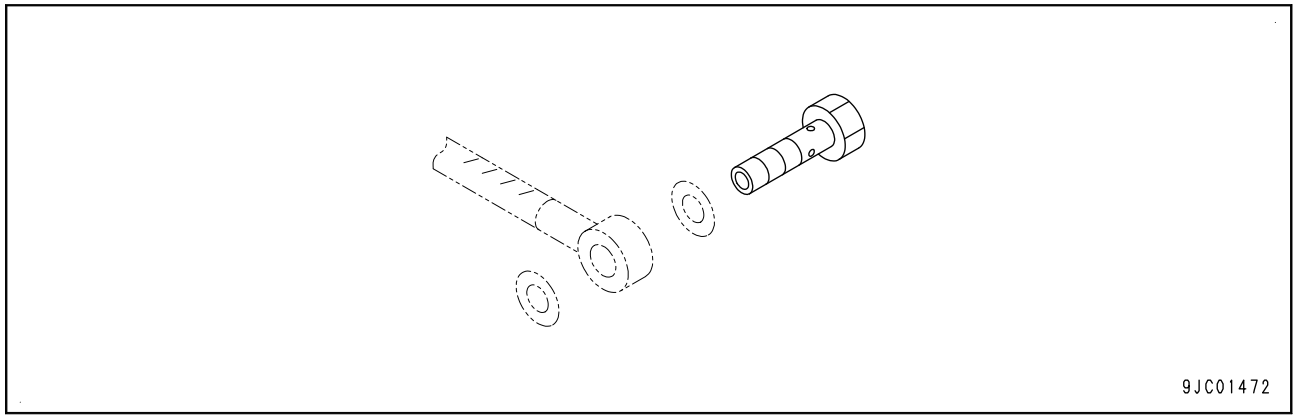
Tightening torque table for bolts and nuts on 102,107 and 114 series engines

★ Unless otherwise specified, tighten the metric threads bolts and nuts used on the 102, 107 and 114 series engines to the torques shown in the table below.

Thread diameter (mm)	Tightening torque (Nm {kgm})
6	10 ± 2 {1.02 ± 0.20}
8	24 ± 4 {2.45 ± 0.41}
10	43 ± 6 {4.38 ± 0.61}
12	77 ± 12 {7.85 ± 1.22}
14	—

Tightening torque table for 102, 107, and 114 series engines (joint bolts)

★ Unless otherwise specified, tighten the metric joint bolts used on the 102, 107, and 114 series engines to the torque shown in the table below.



Thread diameter (mm)	Tightening torque (Nm {kgm})
6	8 ± 2 {0.81 ± 0.20}
8	10 ± 2 {1.02 ± 0.20}
10	12 ± 2 {1.22 ± 0.20}
12	24 ± 4 {2.45 ± 0.41}
14	36 ± 5 {3.67 ± 0.51}

Tightening torque table for tapered screws on 102,107, and 114 series engines (National taper pipe thread (NPT))

★ Unless otherwise specified, tighten the National taper pipe threaded (NPT) screws used on the 102, 107, and 114 series engines to the torques shown in the table below.

Material of female screw	In cast iron or steel	In aluminum
Nominal thread size	Tightening torque (Nm {kgm})	Tightening torque (Nm {kgm})
1/16	15 ± 2 {1.53 ± 0.20}	5 ± 1 {0.51 ± 0.10}
1/8	20 ± 2 {2.04 ± 0.20	15 ± 2 {1.53 ± 0.20}
1/4	25 ± 3 {2.55 ± 0.31}	20 ± 2 {2.04 ± 0.20}
3/8	35 ± 4 {3.57 ± 0.41}	25 ± 3 {2.55 ± 0.31}
1/2	55 ± 6 {5.61 ± 0.61}	35 ± 4 {3.57 ± 0.41}
3/4	75 ± 8 {7.65 ± 0.82}	45 ± 5 {4.59 ± 0.51}

List of abbreviation *(ALL-0360-005-A-00-A)*

(Rev. 2013/03)

- This list of abbreviations includes the abbreviations used in the text of the shop manual for parts, components, and functions whose meaning is not immediately clear. The spelling is given in full with an outline of the meaning.
- Abbreviations that are used in general society may not be included.
- Special abbreviations which appear infrequently are noted in the text (marked with ★).
- This list of abbreviations consists of 2 parts. The first part is a list of the abbreviations used in the text of the manual, and the second part is a list of the abbreviations used in the circuit diagrams.

List of abbreviations used in the shop manual

Abbreviation	Actual word spelled out	Purpose of use (major applicable machine (*), or equipment/device)	Explanation
ABS	Anti-skid Brake System	Travel and brake (HD, HM)	With this function, when the tires skid (wheels stop rotating), the brakes are released, and when the wheels start to rotate, the brakes are applied again.
AISS	Automatic Idling Setting System	Engine	This function automatically sets the idle speed.
AJSS	Advanced Joystick Steering System	Steering (WA)	A lever is used to perform the steering operations instead of a steering wheel. Moreover, it shifts gear and changes direction (FORWARD or REVERSE).
ARAC	Automatic Retarder Accelerator Control	Travel and brake (HD, HM)	When the accelerator pedal is released while the machine is traveling downhill, this function automatically applies the retarder with a constant braking force.
ARSC	Automatic Retarder Speed Control	Travel and brake (HD, HM)	When the accelerator pedal is released while the machine is traveling downhill, this function automatically applies the retarder to ensure that the machine speed does not accelerate above the speed set by the operator.
ASR	Automatic Spin Regulator	Travel and brake (HD, HM)	When the tires spin on soft ground surfaces, this function automatically uses the optimum braking force to drive both wheels.
ATT	Attachment	Work equipment	A device that can be fixed onto a machine in order to enable it to do different jobs.
BCV	Brake cooling oil control valve	Brake (HD)	When the retarder is not being used, this valve bypasses part of the brake cooling oil to reduce the load on the hydraulic pump.
CAN	Controller Area Network	Communication and electronic control	One of communication standards that is used in the network on the machine.
CDR	Crankcase Depression Regulator	Engine	A regulator valve which is installed to KCCV ventilator. It is written as CDR valve and it is not used independently.
CLSS	Closed-center Load Sensing System	Hydraulic system	This system can simultaneously actuate multiple actuators regardless of the load (provides better combined operation than O.L. S.S.).
CRI	Common Rail Injection	Engine	Engine controller electronically controls supply pump, common rail, and injector. This function maintains optimum fuel injection amount and fuel injection timing.
ECM	Electronic Control Module	Electronic control system	Electronic control device uses the signals from the sensors on the machine. This signal indicates the optimum actuation to the actuators. (Same as E.C.U.)

Abbreviation	Actual word spelled out	Purpose of use (major applicable machine (*), or equipment/device)	Explanation
ECMV	Electronic Control Modulation Valve	Transmission (D, HD, WA, etc.)	Proportional electromagnetic valve that gradually increases oil pressure to engage clutch and reduces transmission shock.
ECSS	Electronically Controlled Suspension System	Travel (WA)	This system ensures smooth high-speed travel by absorbing vibration of machine during travel with hydraulic spring effect of accumulator.
ECU	Electronic Control Unit	Electronic control system	Electronic control device uses the signals from the sensors on the machine. This signal indicates the optimum actuation to the actuators. (Same as E.C.M.)
EGR	Exhaust Gas Recirculation	Engine	This function recirculates part of exhaust gas to combustion chamber in order to reduce combustion temperature, controls emission of NOx.
EMMS	Equipment Management Monitoring System	Machine monitor	This system allows data (filter, oil replacement interval, malfunctions on machine, failure code, and failure history) from each sensor on the machine to be checked on the monitor.
EPC	Electromagnetic Proportional Control	Hydraulic system	This mechanism allows actuators to be operated in proportion to the current supplied.
FOPS	Falling Object Protective Structure	Cab and canopy	This structure protects the operator's head from falling objects. (Falling Object Protective Structure) This performance is standardized as ISO 3449.
F-N-R	Forward-Neutral-Reverse	Operation	Forward-Neutral-Reverse
GNSS	Global Navigation Satellite System	Communication	A general term for positioning system using satellites such as GPS, GALILEO, etc.
GPS	Global Positioning System	Communication (KOMTRAX, KOMTRAX Plus)	This system uses satellites to determine the current location on the earth.
HSS	Hydrostatic Steering System	Steering (D)	This function uses a combination of hydraulic motor and bevel shaft to control difference in travel speed of right and left tracks. Accordingly machine can turn without using steering clutch.
HST	Hydro Static Transmission	Transmission (D, WA)	This function uses a combination of hydraulic pump and hydraulic motor to shift the speed range steplessly without using gears.
ICT	Information and Communication Technology	Intelligent Machine Control	A general term for the engineering and its socially applied technology of information processing and communication.
IMA	Inlet Metering Actuator	Engine	This valve is installed at inlet port of pump, and it adjusts fuel intake amount in order to control fuel discharge of supply pump. Same as I.M.V.
IMU	Inertial Measurement Unit	Intelligent Machine Control	This is a device to detect the angular velocity and acceleration of the 3 axes that control motions.
IMV	Inlet Metering Valve	Engine	This valve is installed at inlet port of pump, and it adjusts fuel intake amount in order to control fuel discharge of supply pump. Same as I.M.V. (I.M.A.)
KCCV	Komatsu Closed Crankcase Ventilation	Engine	This mechanism separates oil in blowby gas and returns it to the intake side to afterburn it there. It primarily consists of filters.

Abbreviation	Actual word spelled out	Purpose of use (major applicable machine (*), or equipment/device)	Explanation
KCSF	Komatsu Catalyzed Soot Filter	Engine	This filter captures soot in exhaust gas. It is built in to KDPF.
KDOC	Komatsu Diesel Oxidation Catalyst	Engine	The catalyst used for purifying exhaust gas. This is built in KDPF or assembled with the muffler.
KDPF	Komatsu Diesel Particulate Filter	Engine	This component is used to purify the exhaust gas. KDOC (catalyst) and KCSF (filter to capture soot) are built-in it. It is installed in place of the conventional muffler.
KTCS	Komatsu Traction Control System	Travel and brake (HM system)	This function recovers the drive force of the wheels by braking automatically with the optimum force and at the same time activates the inter-axle differential lock when the wheels idle while the machine travels on the soft ground road.
KVGT	Komatsu Variable Geometry Turbocharger	Engine	The turbocharger on which the cross-section area of the exhaust passage is made variable.
LCD	Liquid Crystal Display	Machine monitor	Image display equipment such as a monitor which assembles in the liquid crystal element.
LED	Light Emitting Diode	Electronic parts	It refers to semiconductor element that emits light when the voltage is applied in forward direction.
LIN	Local Interconnect Network	Communication and electronic control	One of communication standards that is used in the network on the machine
LS	Load Sensing	Hydraulic system	Function that detects differential pressure of pump and controls discharge amount corresponding to load.
LVDS	Low Voltage Differential Signaling	Communication and electronic control	One of communication standards that is used in the network on the machine
MAF	Mass Air Flow	Engine	This indicates engine intake air flow.It is not used independently but it is used as combined with sensor.Mass air flow sensor can be called as MAF sensor.
MMS	Multimedia Messaging Service	Communication	Service that allows transmission and reception of short messages consisting of characters or voice or images between cell phones.
NC	Normally Closed	Electric and hydraulic systems	Device actuated to open electric or hydraulic circuits that are normally closed if not actuated.
NO	Normally Open	Electric and hydraulic systems	Device actuated to close electric or hydraulic circuits that are normally open if not actuated.
OLSS	Open-center Load Sensing System	Hydraulic system	Hydraulic system that can operate multiple actuators at the same time, regardless of the load.
PC	Pressure Compensation	Hydraulic system	A function used to correct oil pressure.
PCCS	Palm command control system	Steering (D)	System in which a controller instantly analyses data from each lever, pedal, and dial, and performs optimum electronic control of the engine and transmission.
PCV	Pre-stroke Control Valve	Engine	This valve is installed at inlet port of pump and it adjusts fuel intake amount in order to control fuel discharge amount of supply pump.

Abbreviation	Actual word spelled out	Purpose of use (major applicable machine (*), or equipment/device)	Explanation
PPC	Proportional Pressure Control	Hydraulic system	Used for controlling proportional pressure. This system moves actuators in proportion to the oil pressure.
PPM	Piston Pump and Motor	Hydraulic system (D, PC, etc.)	Piston pump and motor.
PTO	Power Take Off	Power transmission	Power take-offmechanism
PTP	Power Tilt and power Pitch dozer	Work equipment (D)	This function performs hydraulic control of the tilt and pitch of the bulldozer blade.
ROPS	Roll-Over Protective Structure	Cab and canopy	If a machine tips over, this structure protects the operator with the seat belt fastened from being crushed. (Operator Protective Structure When Tipping) This performance is standardized as ISO 3471.
SI	Le Systeme International d' Unites (International unit system)	Unit	Abbreviation for the "International System of Units". It is the universal unit system and "a single unit for a single quantity" is the basic principle applied.
SOL	Solenoid	Electric system	It refers to an actuator consisting of a solenoid and an iron core that is moved by the magnetic force when the solenoid is energized.
TWV	2-Way Valve	Hydraulic and electric systems	Solenoid valve that switches over direction of flow.
	Variable Flow Turbocharger	Engine	Turbocharger variable in route of exhaust passage.

*1: Code for applicable machine family

D: Bulldozer

HD: Dump truck

HM: Articulated dump truck

PC: Hydraulic excavator

WA: Wheel loader

List of abbreviations used in the circuit diagrams

Abbreviation	Actual word spelled out
A/C	Air Conditioner
A/D	Analogue-to-Digital
A/M	Air Mix Damper
ACC	Accessory
ADD	Additional
AUX	Auxiliary
BR	Battery Relay
CW	Clockwise
CCW	Counter Clockwise
ECU	Electronic Control Unit
ECM	Electronic Control Module
ENG	Engine
EXGND	External Ground
F.G.	Frame Ground
GND	Ground
IMA	Inlet Metering Actuator
NC	No Connection

Abbreviation	Actual word spelled out
S/T	Steering
STRG	
SIG	Signal
SOL	Solenoid
STD	Standard
OPT	Option
OP	
PRESS	Pressure
SPEC	Specification
SW	Switch
TEMP	Temperature
T/C	Torque Converter
T/M	Transmission

Conversion table *(ALL-2150-931-A-00-A)*

(Rev. 2012/10)

Method of using the conversion table

- The unit conversion table enables the simple conversion in the figures between the different units. For further details of the method of use of the conversion table, see the examples given below.

Example: Method of using the conversion table to convert a unit from millimeters to inches

Conversion of 55 mm into inches

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

Conversion of 550 mm into inches

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

Millimeters to inches

(B)

1 mm = 0.03937 in

	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
						(C)				
(A) 50	1.969	2.008	2.017	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	2.847	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

	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	2.847	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

Kilograms to pounds

1 kg = 2.2046 lb

	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

ℓ to U.S. Gallons

1 ℓ = 0.2642 U.S.Gal

	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

ℓ to U.K. Gallons

1 ℓ = 0.21997 U.K.Gal

	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

	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/cm^2 to lb/in^{22}

1 kg/cm^2 = 14.2233 lb/in^{22}

	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	1,010	1,024	1,038	1,053	1,067	1,081	1,095	1,109	1,124
80	1,138	1,152	1,166	1,181	1,195	1,209	1,223	1,237	1,252	1,266
90	1,280	1,294	1,309	1,323	1,337	1,351	1,365	1,380	1,394	1,408
100	1,422	1,437	1,451	1,465	1,479	1,493	1,508	1,522	1,536	1,550
110	1,565	1,579	1,593	1,607	1,621	1,636	1,650	1,664	1,678	1,693
120	1,707	1,721	1,735	1,749	1,764	1,778	1,792	1,806	1,821	1,835
130	1,849	1,863	1,877	1,892	1,906	1,920	1,934	1,949	1,963	1,977
140	1,991	2,005	2,020	2,034	2,048	2,062	2,077	2,091	2,105	2,119
150	2,134	2,148	2,162	2,176	2,190	2,205	2,219	2,233	2,247	2,262
160	2,276	2,290	2,304	2,318	2,333	2,347	2,361	2,375	2,389	2,404
170	2,418	2,432	2,446	2,460	2,475	2,489	2,503	2,518	2,532	2,546
180	2,560	2,574	2,589	2,603	2,617	2,631	2,646	2,660	2,674	2,688
190	2,702	2,717	2,731	2,745	2,759	2,773	2,788	2,802	2,816	2,830
200	2,845	2,859	2,873	2,887	2,901	2,916	2,930	2,944	2,958	2,973
210	2,987	3,001	3,015	3,030	3,044	3,058	3,072	3,086	3,101	3,115
220	3,129	3,143	3,158	3,172	3,186	3,200	3,214	3,229	3,243	3,257
230	3,271	3,286	3,300	3,314	3,328	3,343	3,357	3,371	3,385	3,399
240	3,414	3,428	3,442	3,456	3,470	3,485	3,499	3,513	3,527	3,542

Temperature
Conversion of Fahrenheit to Celsius

- A simple way to convert a Fahrenheit temperature reading into a Celsius temperature reading or vice versa is to see the number in the center column of the following table. The figures on the following table show the temperatures in both Fahrenheit and Celsius.
- When converting from Fahrenheit to Celsius degrees, consider the center column to be a table of Fahrenheit temperatures and read the corresponding Celsius temperature in the column at the left.
- When converting from Celsius to Fahrenheit degrees, consider the center column to be a table of Celsius 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	177.8
-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

SHOP MANUAL

ENGINE

95E-6 SERIES

Model Serial Number

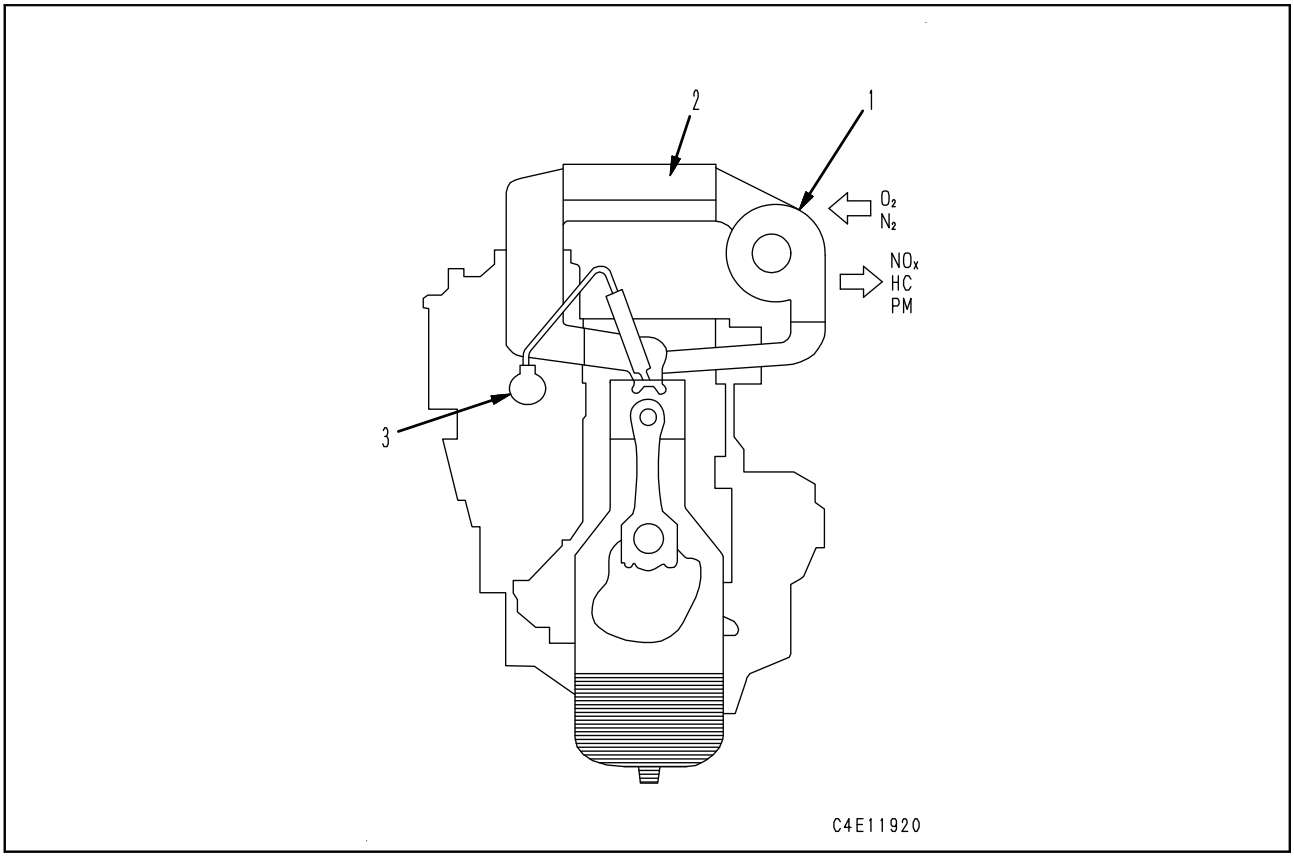
95E-6 SERIES

01 Specification

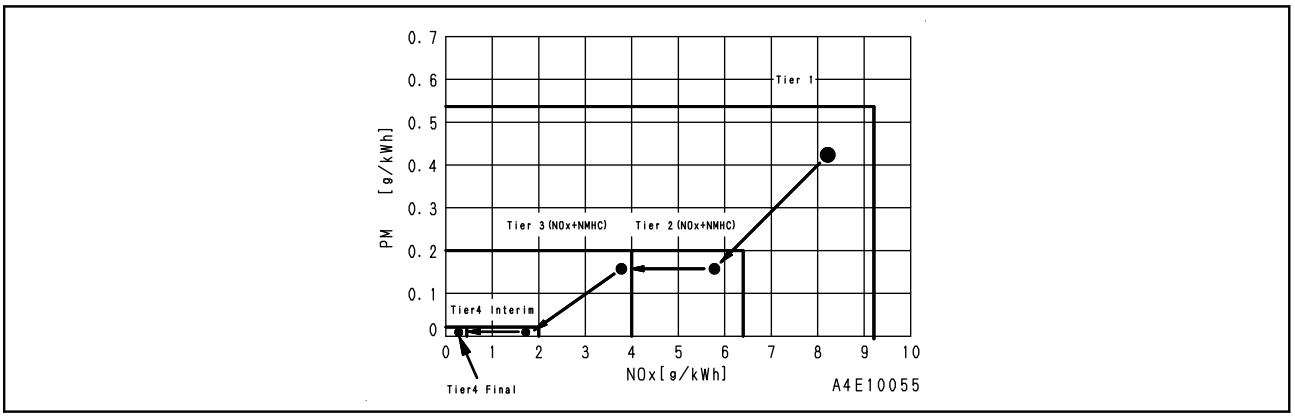
Table of contents *(ALL-0310-002-A-00-A)*

General information *(ALL-0000-001-A-00-A)*

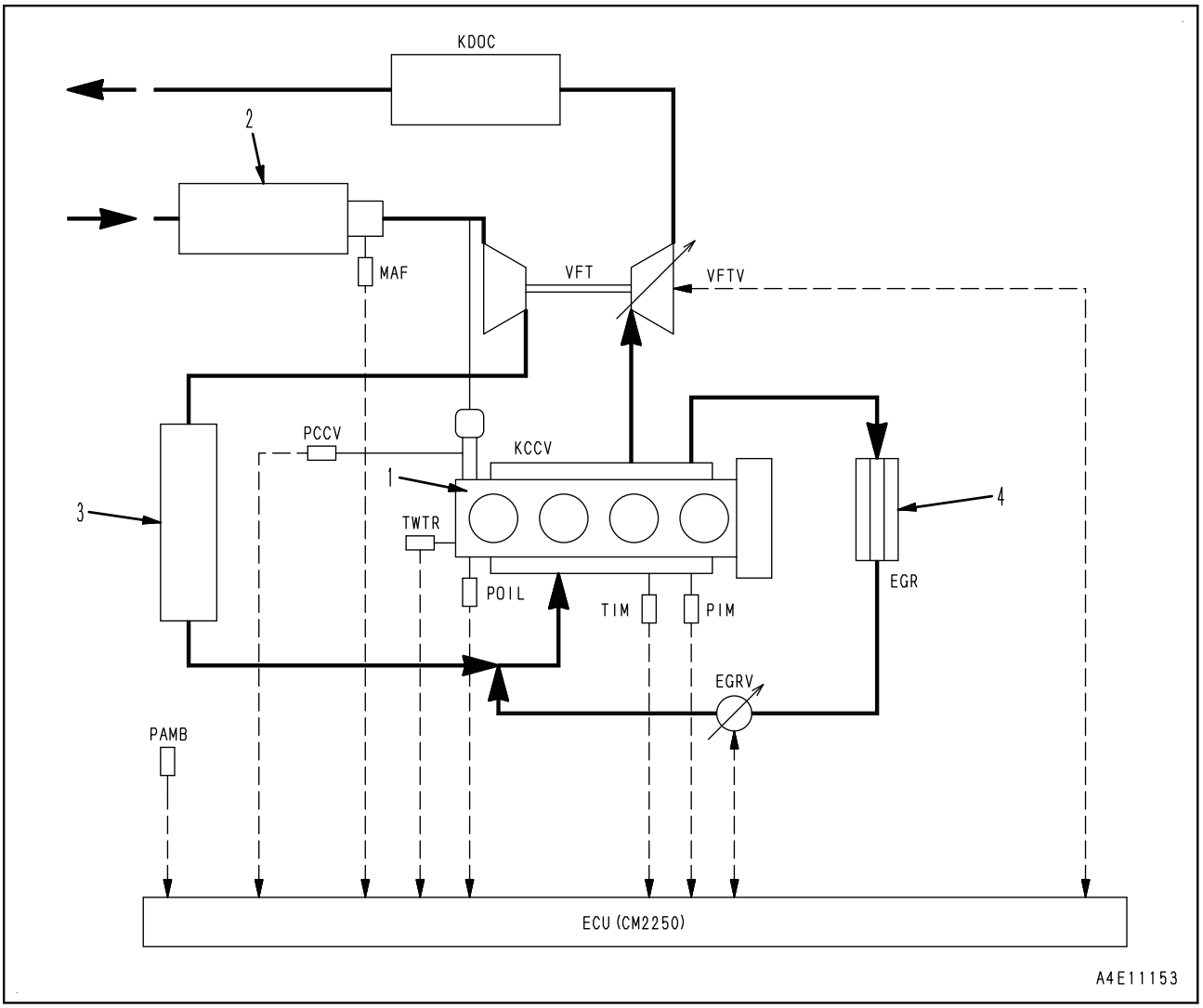
Exhaust gas regulation *(ENG-A000-017-K-00-A)*



- The 3 main diesel engine emissions that adversely impact the human body and the environment are the following:
  1. NOx (nitrogen oxides): causes breathing problems and acid rain
  2. HC (hydrocarbons): causes photochemical smog
  3. PM (particulates in air such as soot): causes cancer and breathing problems
- NOx are produced when the nitrogen (N_2) in air reacts with oxygen (O_2) at high temperatures. These substances are produced when a diesel engine combustion takes place with too much air (nitrogen). To reduce NOx, it is necessary to lower the combustion temperature in the cylinder to suppress the oxidation of N (nitrogen). Therefore, an air-cooled aftercooler (2) is used for lowering the temperature of the air from turbocharger (1).
- HC is the main component of fuel. HC in the blowby gas holds the most part of hazardous materials emitted from a diesel engine, however, this has been released into the air.
- Incomplete combustion produces HC and also PM, which are solid particles adhering to soot, etc. Generally, there is a antinomy relation between NOx and PM (trying to reduce either results in increase of the other). To reduce PM, combustion has been improved by using common rail (3), microparticulating the fuel spray by using an electronically controlled high-pressure fuel injection system, reducing the injection period, and optimizing the injection timing.
- Emission regulations are established in Japan, US, and various regions in Europe. The history of the USA regulations from the 1st (Tier 1) to 4th (Tier 4) is traced in the following table. (Transition of USA EPA(*1) emission regulations, for engine rated horsepowers 130 kW to 560 kW)
  The horizontal axis shows the NOx + NMHC(*2) level, and the vertical axis shows the PM level. In the 4th (Tier 4) regulation, both the NOx + NMHC and PM standards are tightened to levels approx. 1/7 of the 3rd (Tier 3) regulation. This 4th regulation is referred to as "Tier 4 regulation"(*3).
  *1: United States Environmental Protection Agency
  *2: General term for hydrocarbons (HC) that have a high photochemical reactivity.
  *3: There are 2 stages in Tier 4. The 1st stage is referred to as "Tier 4 Interim", for which actions are taken this time. The 2nd stage is referred to as "Tier 4 Final".



Actions taken to meet the Tier 4 regulation *(ENG95-A000-018-K-00-A)*



1. Engine
2. Air cleaner
3. Air-cooled aftercooler
4. EGR cooler

ECU (CM2250): Engine controller
EGRV: EGR valve control actuator (electric)
KDOC: Oxidation catalyst muffler
KCCV: Blowby reductor

MAF: Mass air flow and temperature sensor

PAMB: Ambient pressure sensor

PCCV: Crankcase pressure sensor

PIM: Intake manifold pressure sensor

POIL: Oil pressure switch

TIM: Intake manifold temperature sensor

TWTR: Coolant temperature sensor

VFTV: Variable Flow Turbocharger control actuator (electric)

- Tier4 is improved mainly over Tier3 in the following points.
  1. Employment of EGR (Exhaust Gas Recirculation) cooler (4) (reduction of NOx)
  2. Increase of intake air quantity in low engine speed range by changing turbocharger speed (reduction of PM)
  3. Oxygen concentration control by EGR ratio control corresponding to operating condition attained by employing high-precision EGR valve (EGRV), mass air flow and temperature sensor (MAF), and engine controller, and by sensing condition of each part of EGR circuit (reduction of NOx and PM)
  4. Fine spraying of injected fuel by increasing common rail pressure and fuel injection pressure (reduction of PM)
  5. Internal circulation of blowby gas by employing blowby reductor (KCCV) (reduction of HC)
  6. Employment of oxidation catalyst (KDOC) muffler (reduction of HC and PM)
  7. Control of characteristic dispersion of injectors with engine controller (CM2250) (reduction of NOx, PM, and HC)
  8. Automatic control of fuel injection and turbocharger by recognizing high altitude with ambient pressure sensor (PAMB) (reduction of NOx and PM at high altitude)
  9. Employment of cylinder head having 4 valves (for each cylinder) (reduction of PM and fuel consumption)
  10. Improvement of piston combustion chamber (reduction of NOx, PM, and fuel consumption)

  *: PM (soot and other particulate matter), NOx (nitrogen oxides), HC (hydrocarbon)

Specifications

Applicable machines

Engine	Engine serial No.	Machine model	
SAA4D95LE-6		WA80M-7 WA100M-7	Wheel loader

Specifications

Applicable machines: WA80M-7

Engine model			SAA4D95LE-6
No. of cylinders - bore x stroke		mm	4 - 95 x 115
Piston displacement		ℓ {cc}	3.260 {3,260}
Firing order		-	1 - 2 - 4 - 3
Dimensions	Overall length	mm	717.8
	Overall width	mm	731.3
	Overall heigh	mm	1,254
Performance	Rated horsepower (Gross)	kW {HP}/min $^{-1}$ {rpm}	52.0 {69.7} / 2,200 {2,200}
	Max. torque (Gross)	Nm {kgm}/min^{-1} {rpm}	266 {27.1} / 1,600 {1,600}
	Max. speed with no load (high idle speed)	min^{-1} {rpm}	2,520 ± 50 {2,520 ± 50}
	Min. speed with no load (low idle speed)	min^{-1} {rpm}	900 ± 25 {900 ± 25}
	Fuel consumption rate at rated horsepower	g/kWh {g/HPh}	232 {171}
Dry weight		kg	380
Fuel injection system		-	High-pressure common rail type
Fuel injection system control		-	Electronic control system
Lubricating oil capacity (refill capacity)		ℓ	12.5 {11.5}
Coolant capacity		ℓ	(Engine only 5.5)
Alternator		-	12V, 120A
Starting motor		-	12V, 2.2 kW
Turbocharger			TD04M4t

Applicable machine: WA100M-7

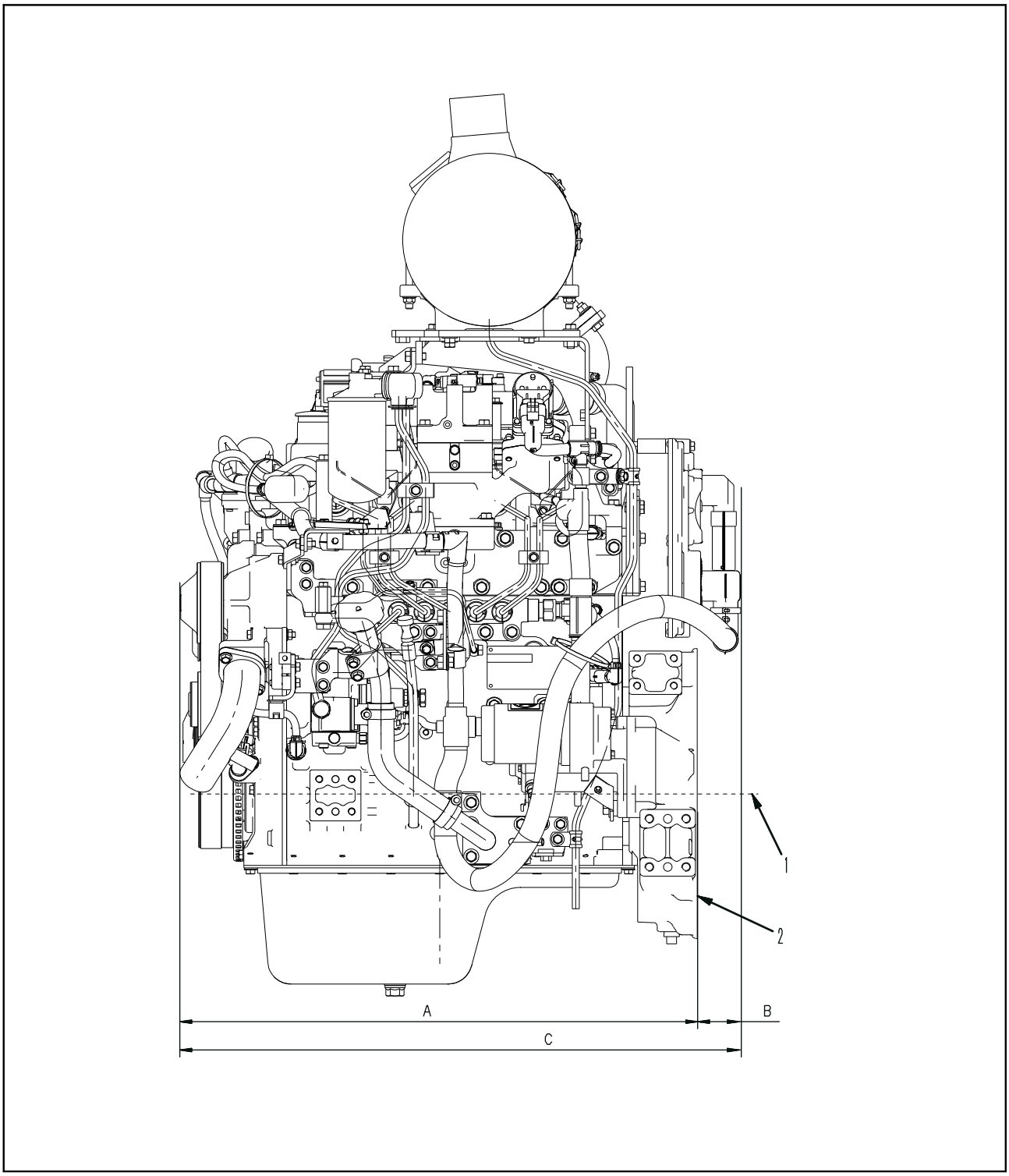
Engine model			SAA4D95LE-6
No. of cylinders - bore x stroke		mm	4 - 95 x 115
Piston displacement		ℓ {cc}	3.260 {3,260}
Firing order		-	1 - 2 - 4 - 3
Dimensions	Overall length	mm	717.8
	Overall width	mm	731.3
	Overall height	mm	1,254
Performance	Rated horsepower (Gross)	kW {HP}/min $^{-1}$ {rpm}	62.2 {88.8} / 2,350 {2,350}
	Max. torque (Gross)	Nm {kgm}/min^{-1} {rpm}	320{32.7} / 1,600 {1,600}
	Max. speed with no load (high idle speed)	min^{-1} {rpm}	2,650 ± 50 {2,650 ± 50}
	Min. speed with no load (low idle speed)	min^{-1} {rpm}	900 ± 25{900 ± 25}
	Fuel consumption rate at rated horsepower	g/kWh {g/HPh}	236 {176}
Dry weight		kg	380
Fuel injection system		-	High-pressure common rail type
Fuel injection system control		-	Electronic control system
Lubricating oil capacity (refill capacity)		ℓ	12.5 {11.5}
Coolant capacity		ℓ	(Engine only 5.5)
Alternator		-	12V, 120A
Starting motor		-	12V, 2.2 kW
Turbocharger		-	TD04M4t

General view

Applicable machines: WA80M-7

Left side

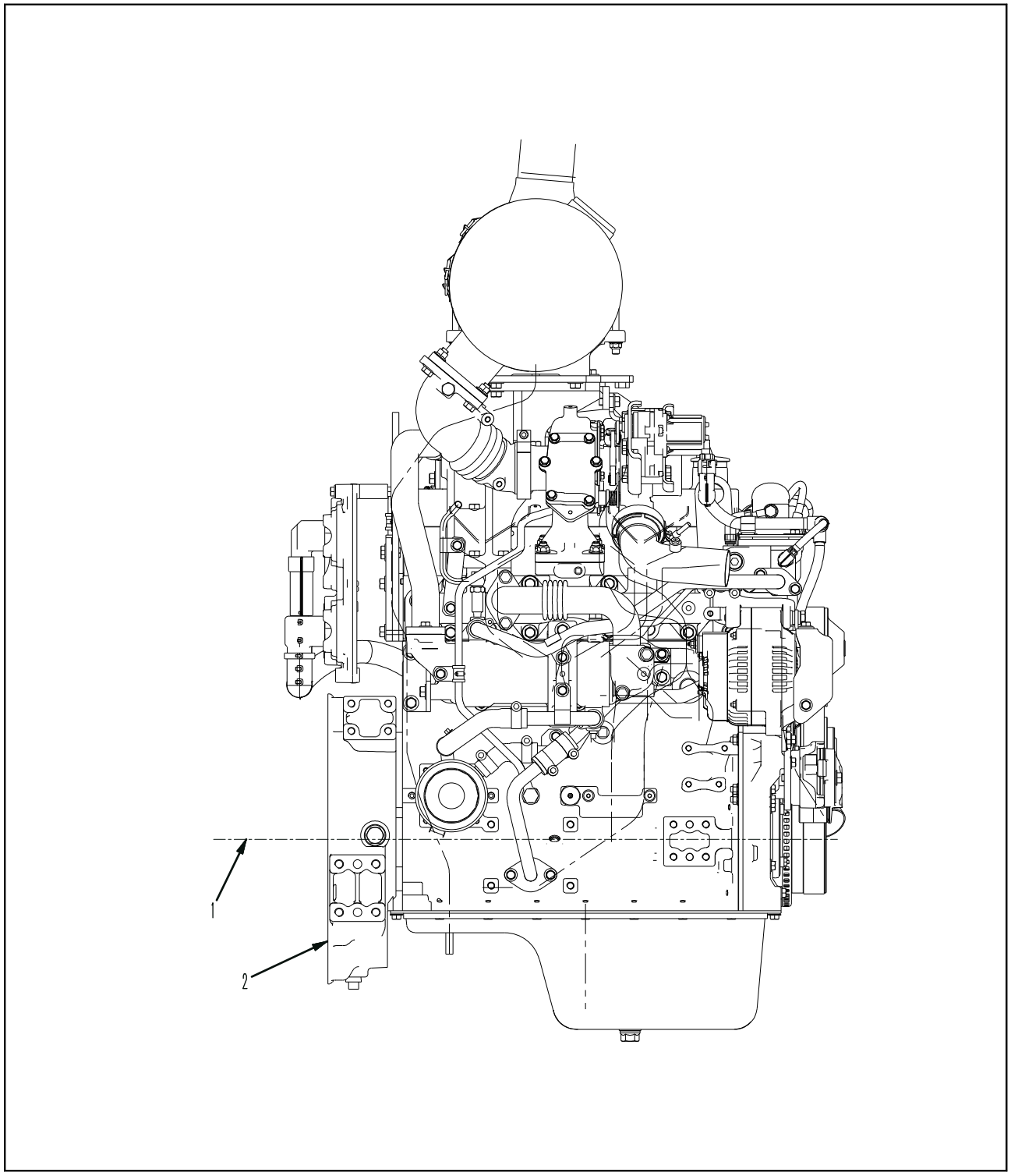
★ The shape is subject to machine models.



1. Center of crankshaft
2. Rear side of flywheel housing

Right side

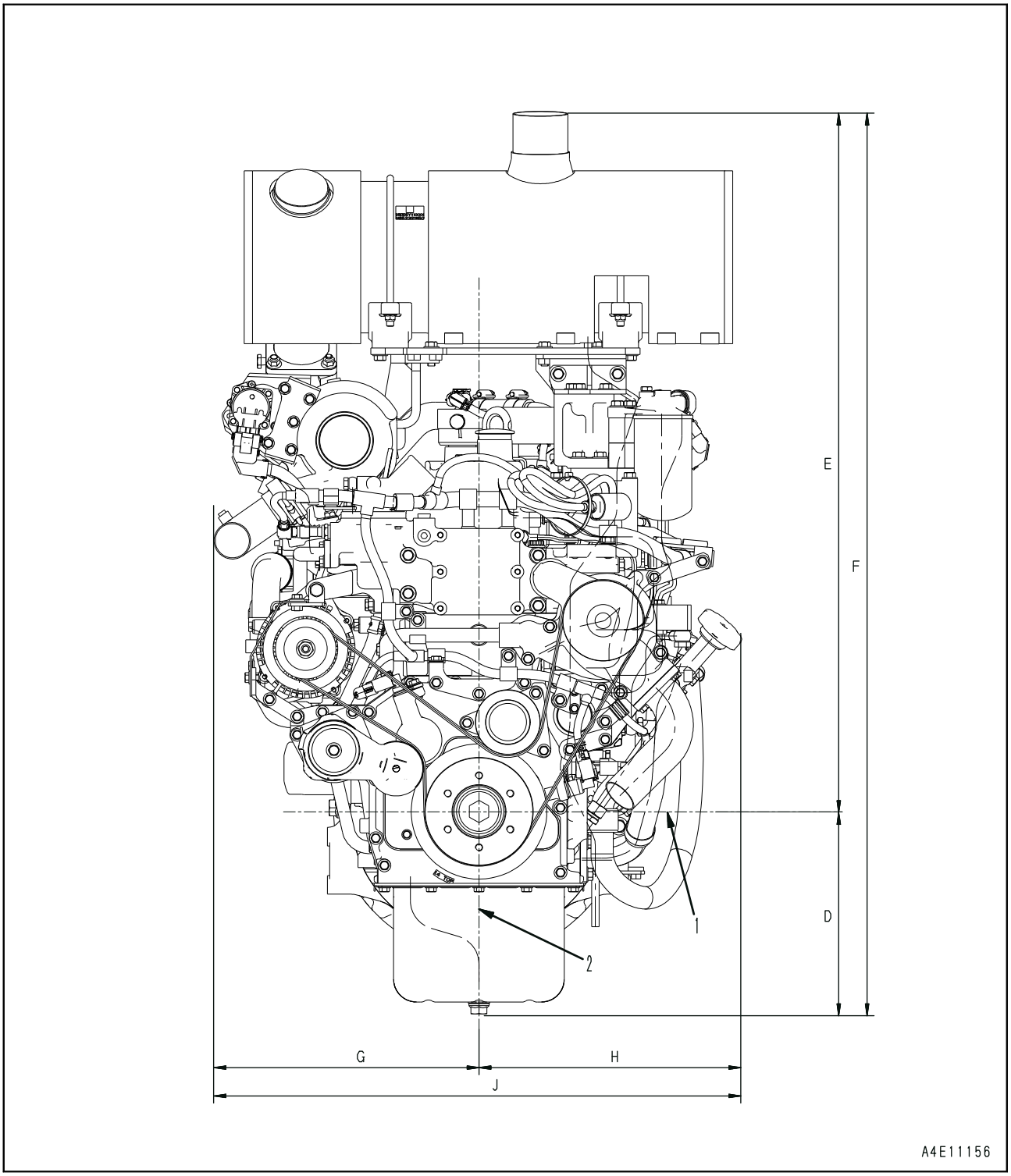
★ The shape is subject to machine models.



1. Center of crankshaft
2. Rear side of flywheel housing

Front side

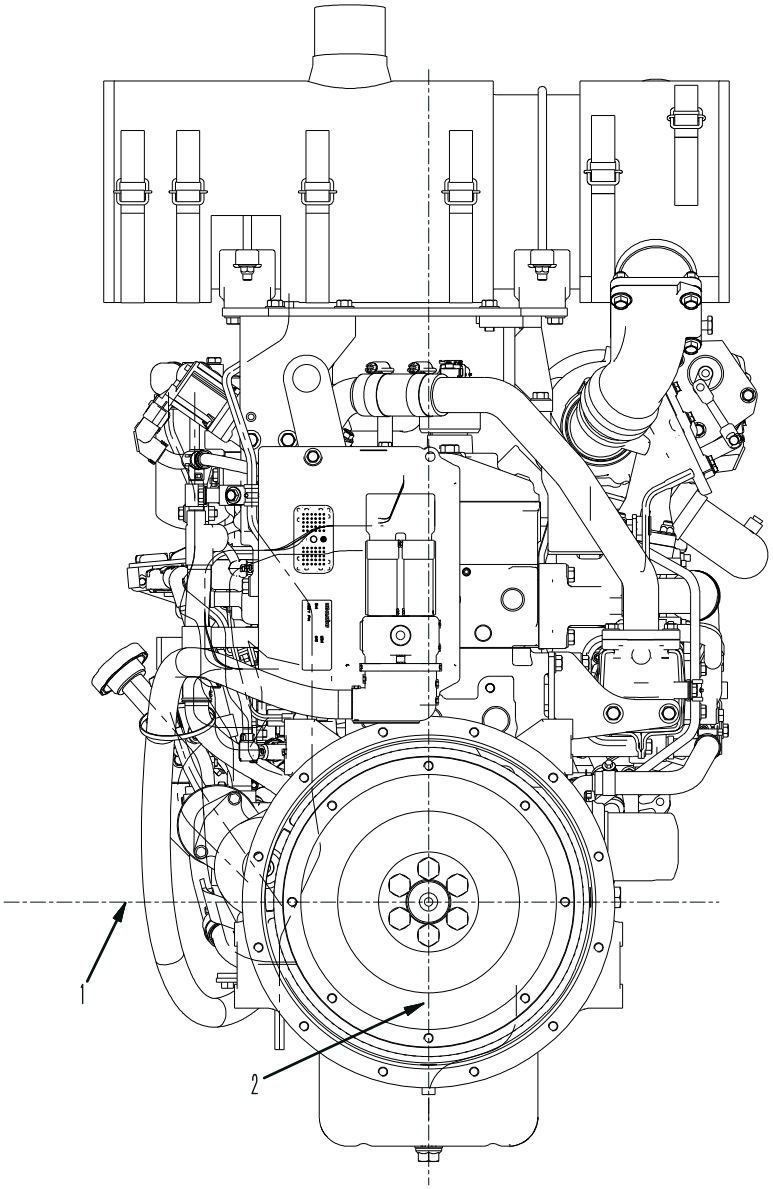
★ The shape is subject to machine models.



1. Center of crankshaft
2. Center of cylinder

Rear side

★ The shape is subject to machine models.

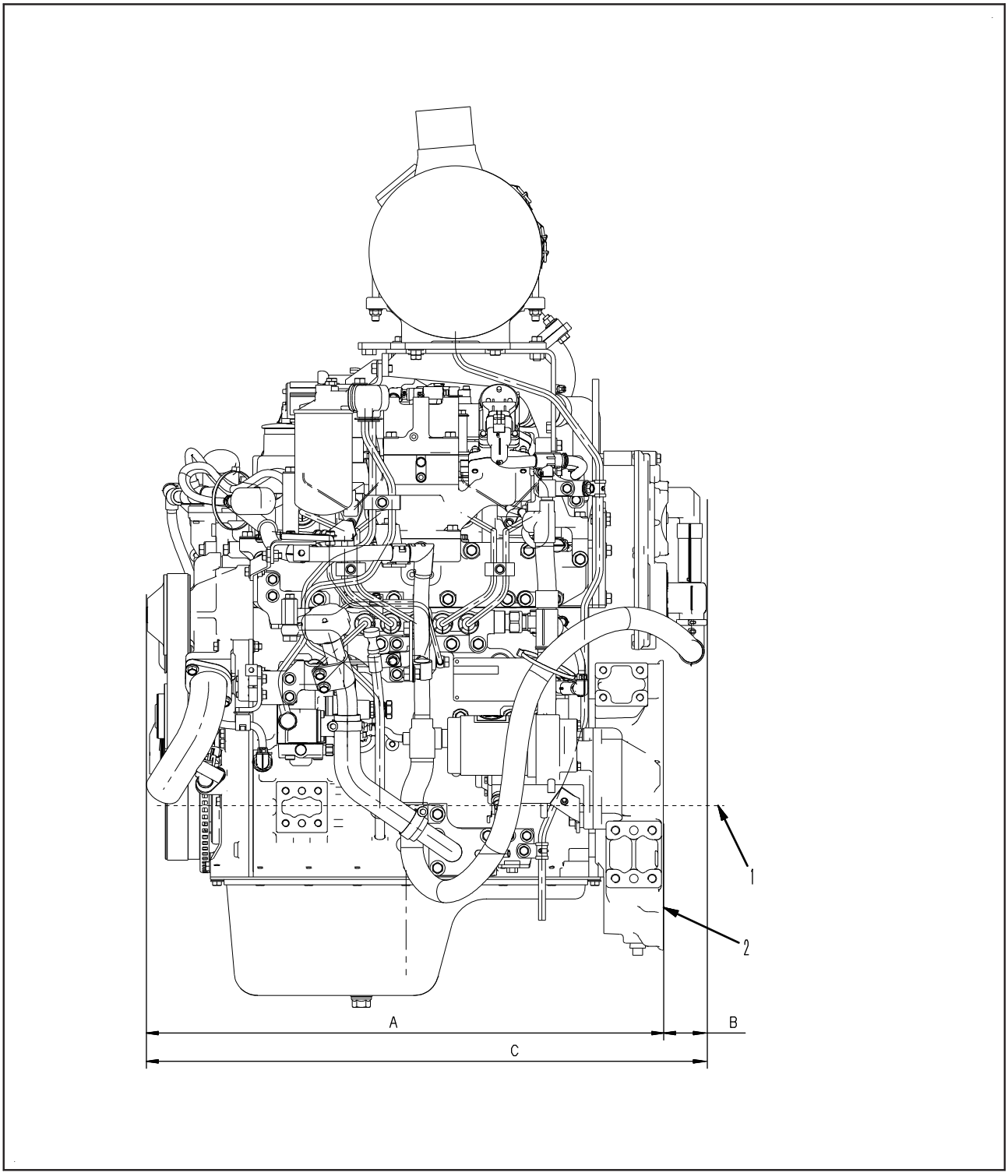


1. Center of crankshaft
2. Center of cylinder

Applicable machine: WA100M-7

Left side

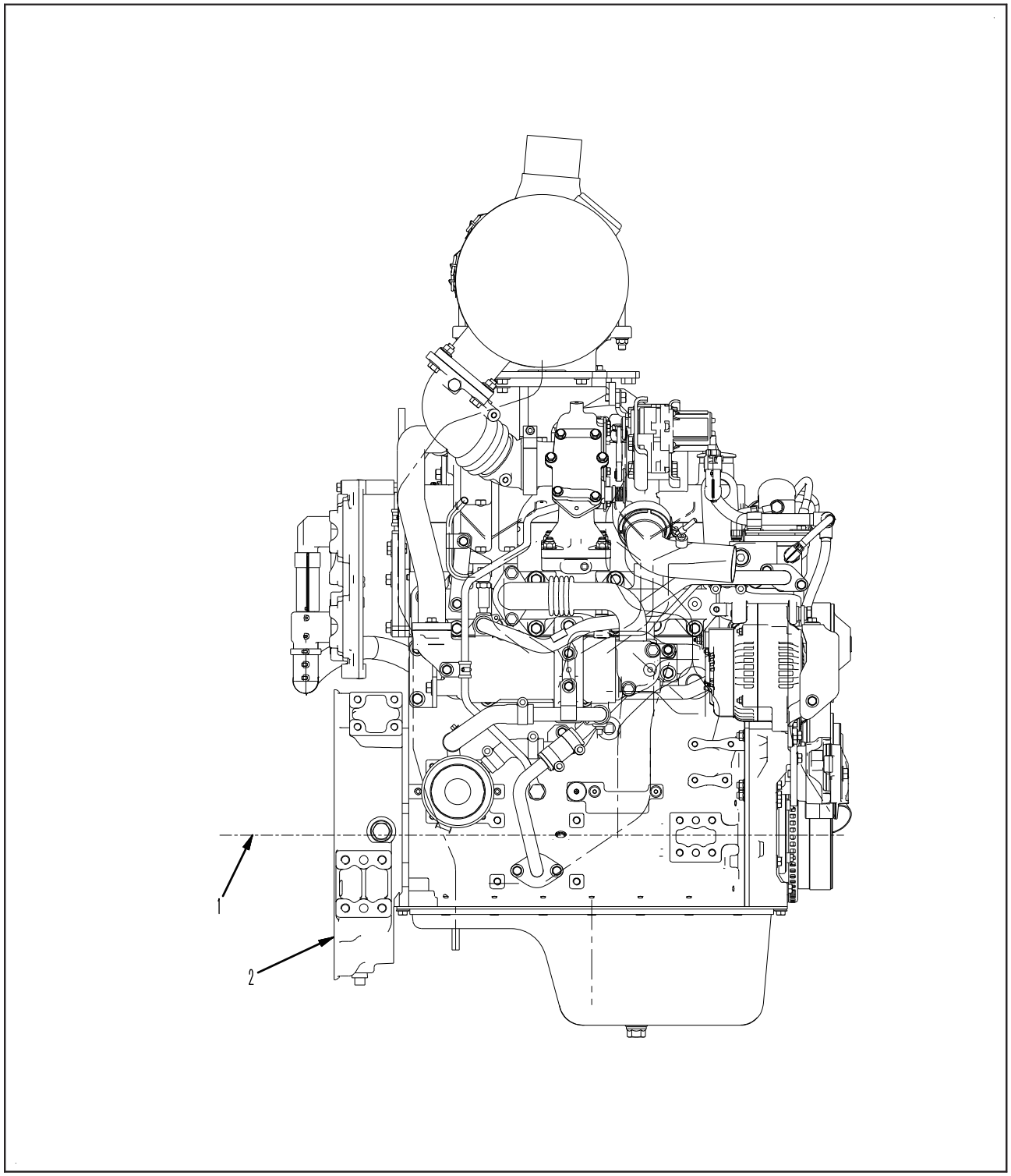
★ The shape is subject to machine models.



1. Center of crankshaft
2. Rear side of flywheel housing

Right side

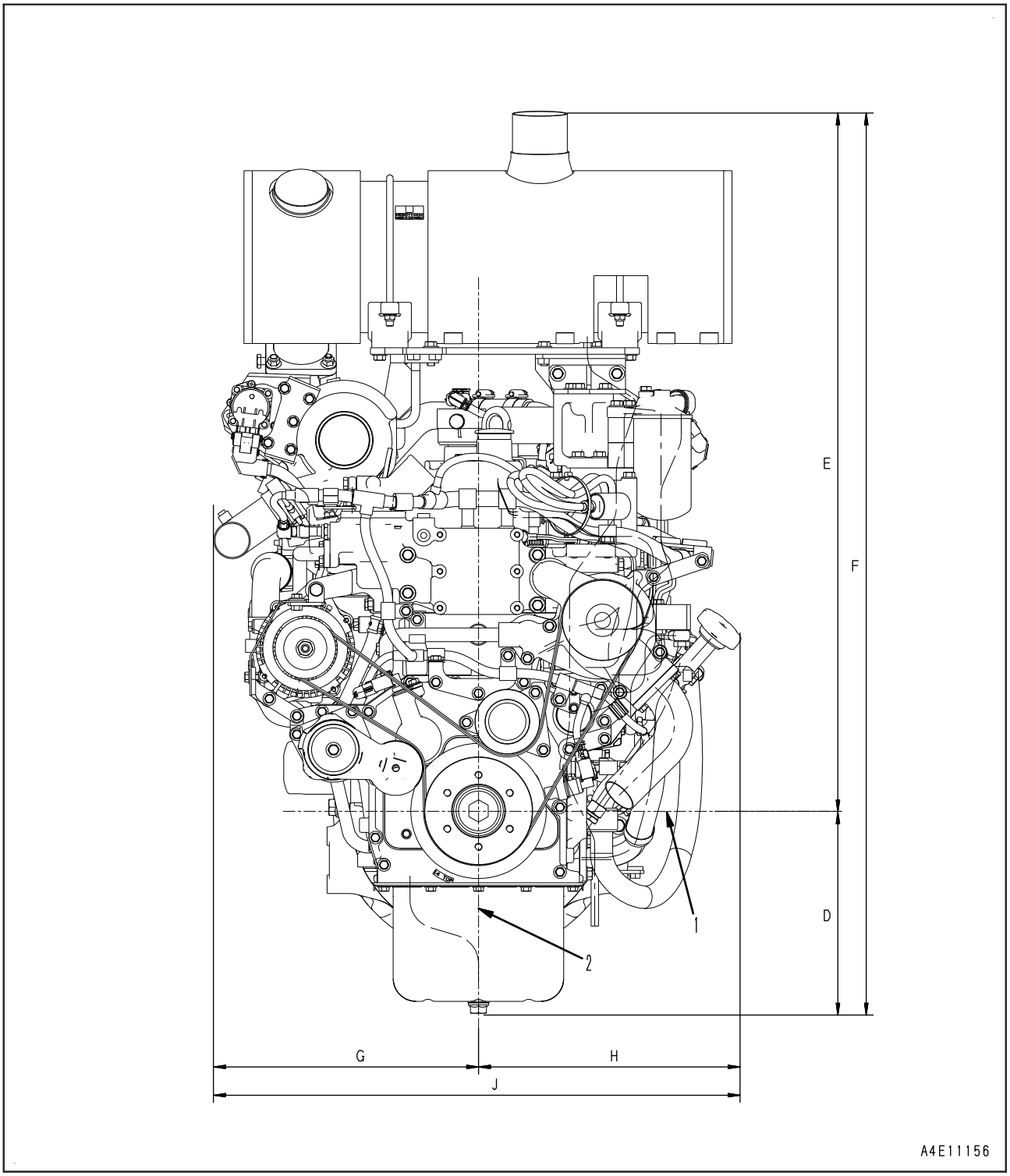
★ The shape is subject to machine models.



1. Center of crankshaft
2. Rear side of flywheel housing

Front side

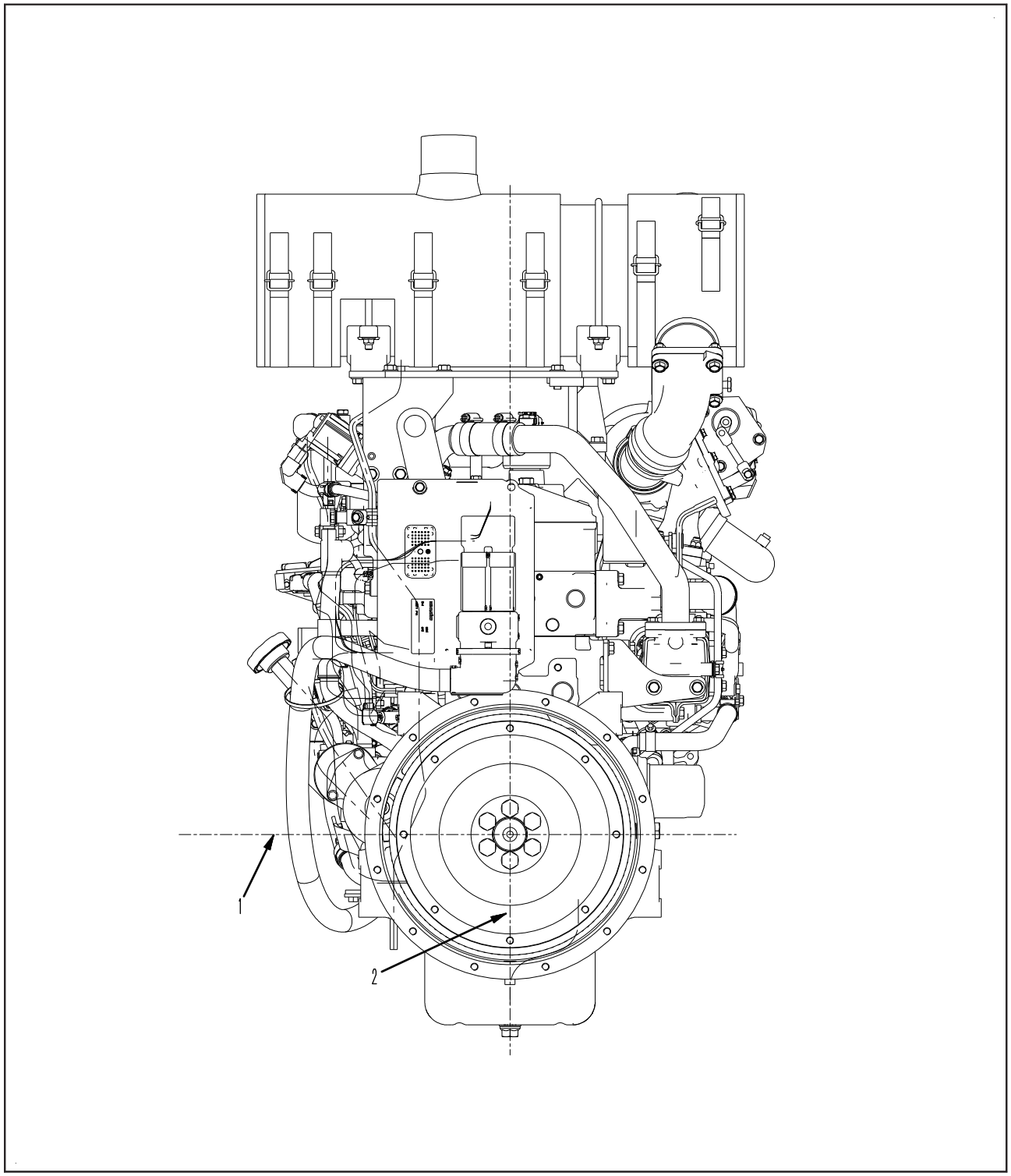
★ The shape is subject to machine models.



1. Center of crankshaft
2. Center of cylinder

Rear side

★ The shape is subject to machine models.



1. Center of crankshaft
2. Center of cylinder

Dimensions table

★ These dimensions are given for reference when the engine is set on a test bench.

Unit: mm

Engine	Machine model	Dimension of each part								
		A	B	C	D	E	F	G	H	J
SAA4D95LE-6	WA80M-7 WA100M-7	717,8	—	717,8	972.6	281	1,254	367	369.3	731.3

Weight table

Unit: kg

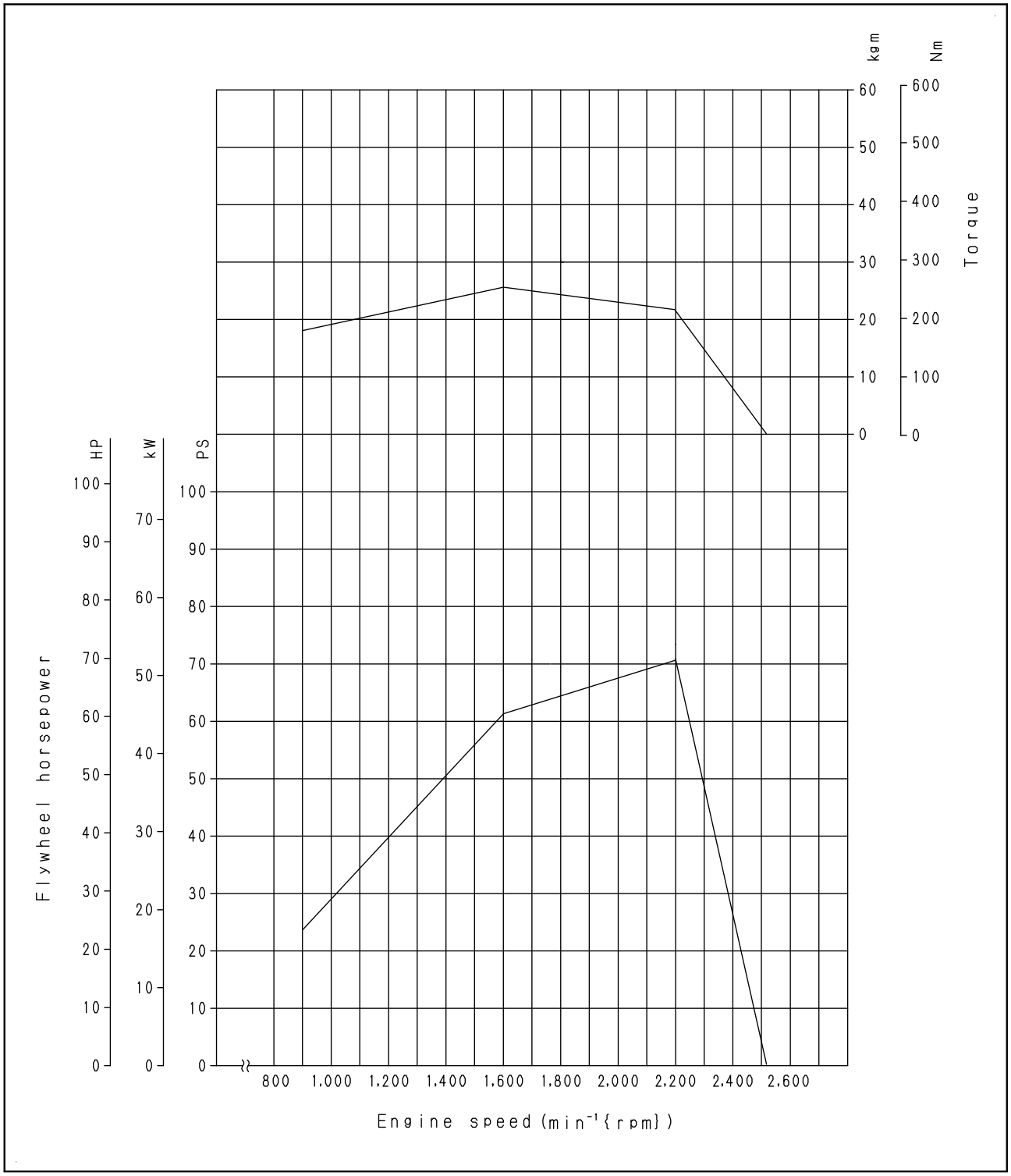
No.	Item	Main parts	SAA4D95LE-6
1	Turbocharger	TD04M4t	9.5
2	Cylinder head assembly	Cylinder head, valve, valve spring	31.8
3	Cylinder block assembly	Cylinder block Main metal block Cylinder liner	71
4	Gear case (front cover)		2.8
5	Oil pan		4.4
6	Flywheel assembly	Flywheel Ring gear	18
7	Flywheel housing		4.9
8	Crankshaft assembly	Crankshaft Crank gear	26.1
9	Camshaft assembly	Camshaft, cam gear, thrust plate	5.2
10	Piston and connecting rod assembly	Piston, piston ring, piston pin, connecting rod	2.4 x 4
11	Oil pump		0.6
12	Supply pump		4.0
13	Water pump		7.0
14	Alternator	12V, 120A	6.3
15	Starting motor	12V, 2.2kW	6
16	Air compressor		—
17	Aftercooler assembly		—

Engine performance curve

Applicable machines: WA80M-7

Rated horsepower: 52.0 ± 2 . 6 kW { 69.7 ± 3.5 HP } / 2,200 min

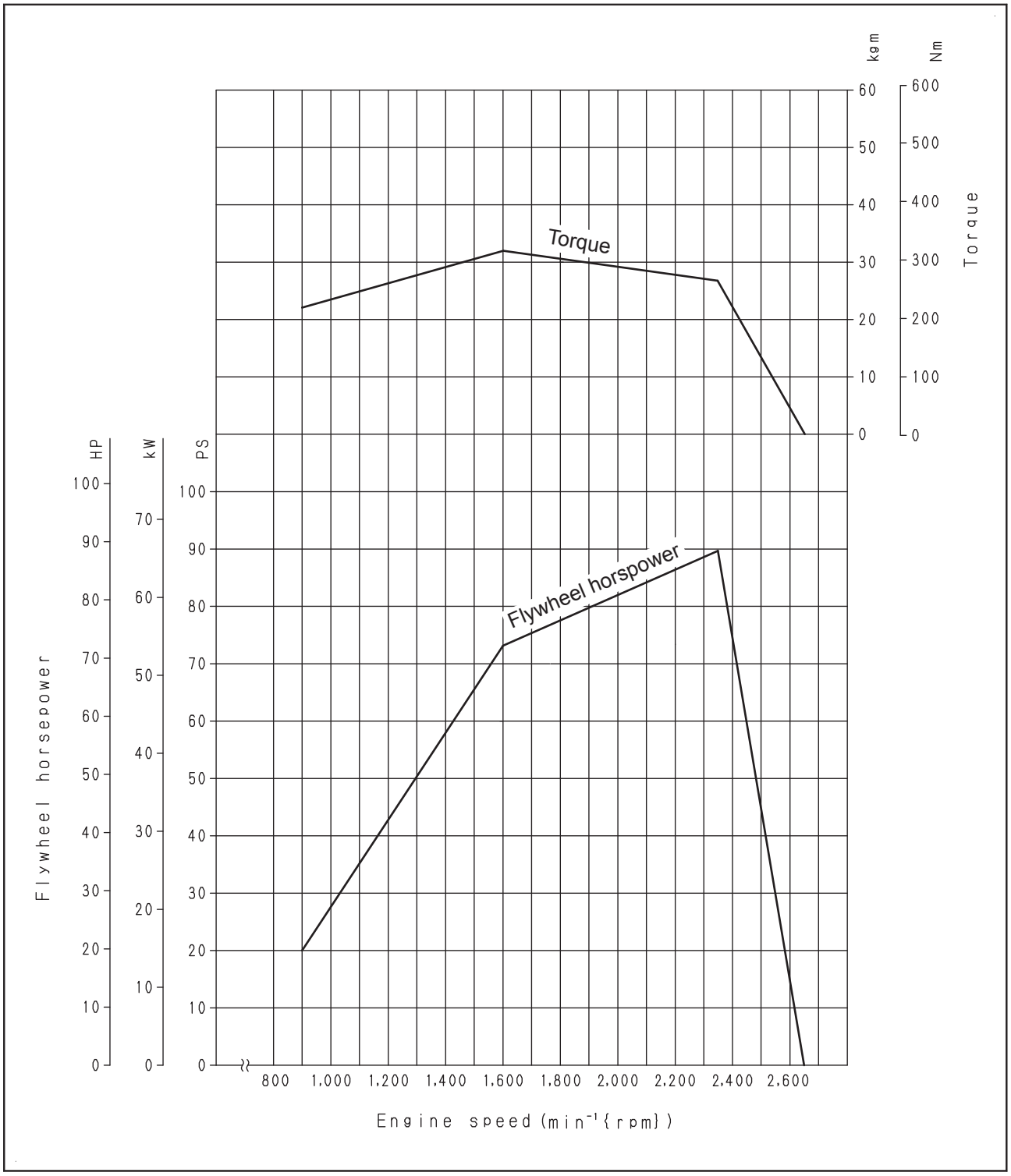
Maximum torque: 266 ± 13 Nm { 27.1 ± 1.4 kgm } / 1,600 min



Applicable machine: WA100M-7

Rated horsepower: 66.2 ± 3.3 kW {88.8 ± 4.4 HP} / 2,350 min

Maximum torque: 320± 16 Nm {32.7 ± 1.6 kgm} / 1 , 600 min



SHOP MANUAL

ENGINE

95E-6 SERIES

Model Serial Number

95E-6 SERIES

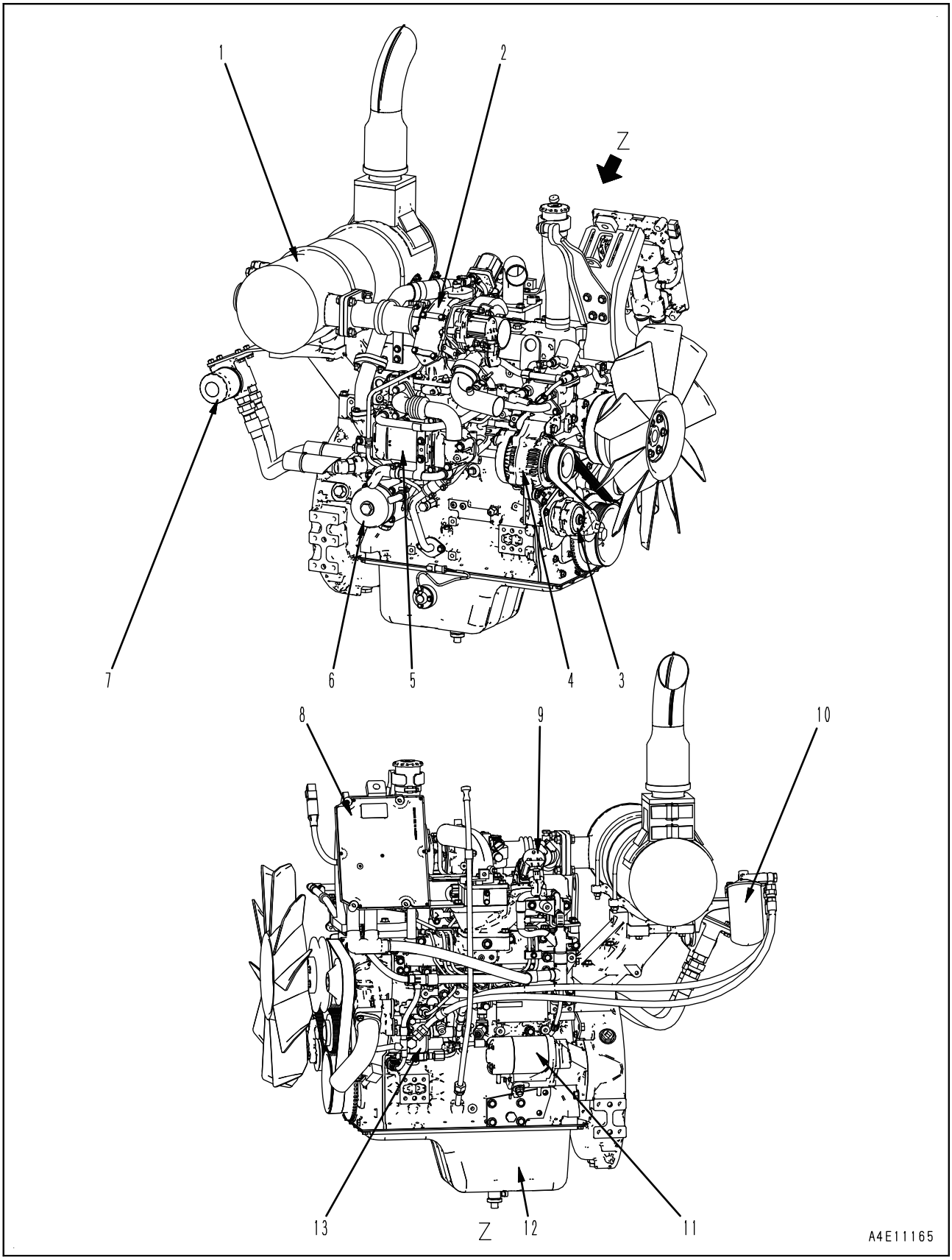
10 Structure and function

Table of contents

Components layout *(ALL-A000-001-K-04-A)*

Components layout drawing *(ENG95-A000-04D-K-00-A)*

★ The shape is subject to machine models.

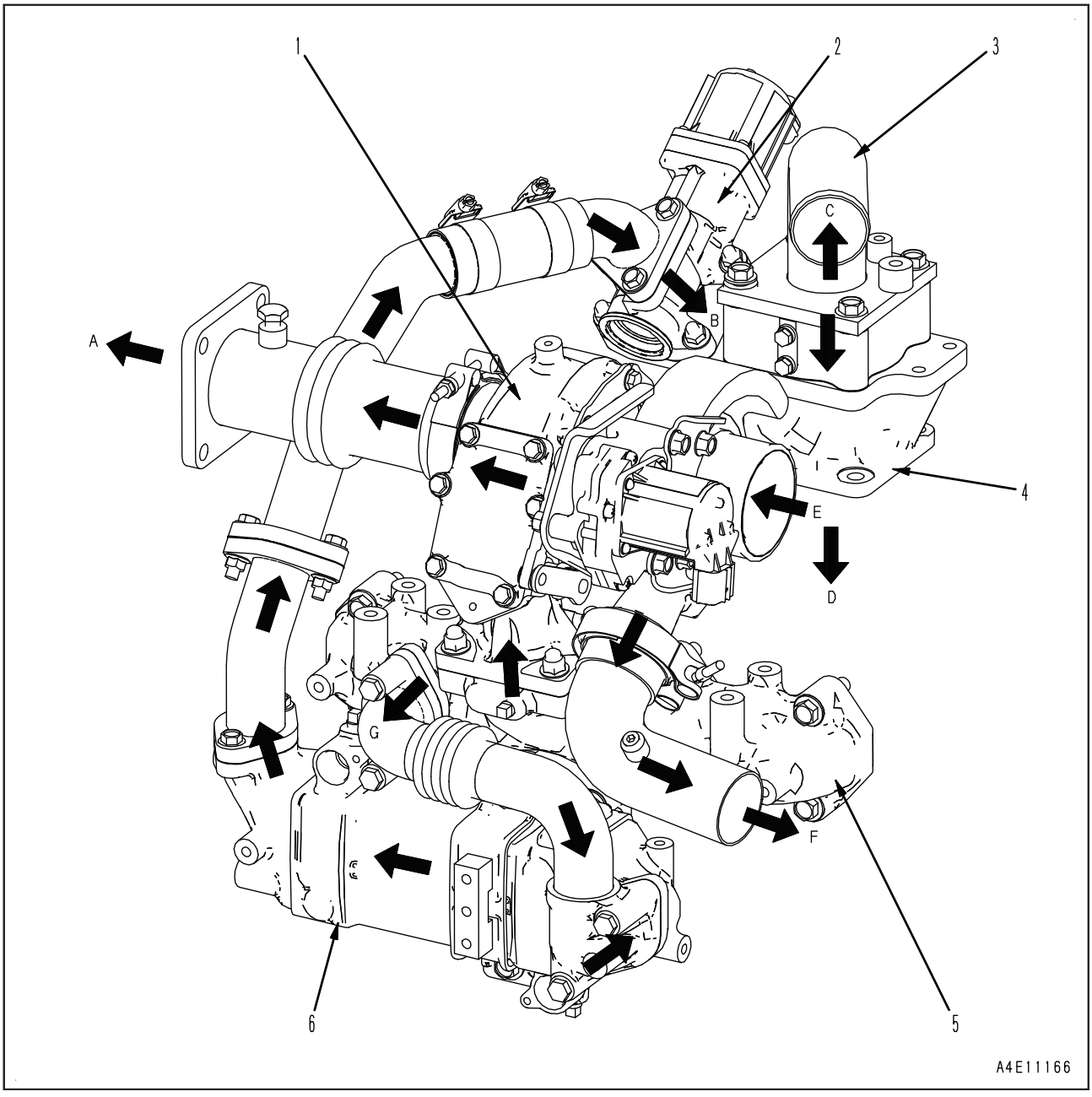


1. KDOC muffler
2. Turbocharger
3. Auto-tensioner
4. Alternator
5. EGR cooler
6. Oil cooler
7. Engine oil filter
8. Engine controller
9. EGR valve
10. Fuel filter
11. Starting motor
12. Oil pan
13. Supply pump

Intake and exhaust system parts

Intake and exhaust system layout drawing

★ The shape is subject to machine models.



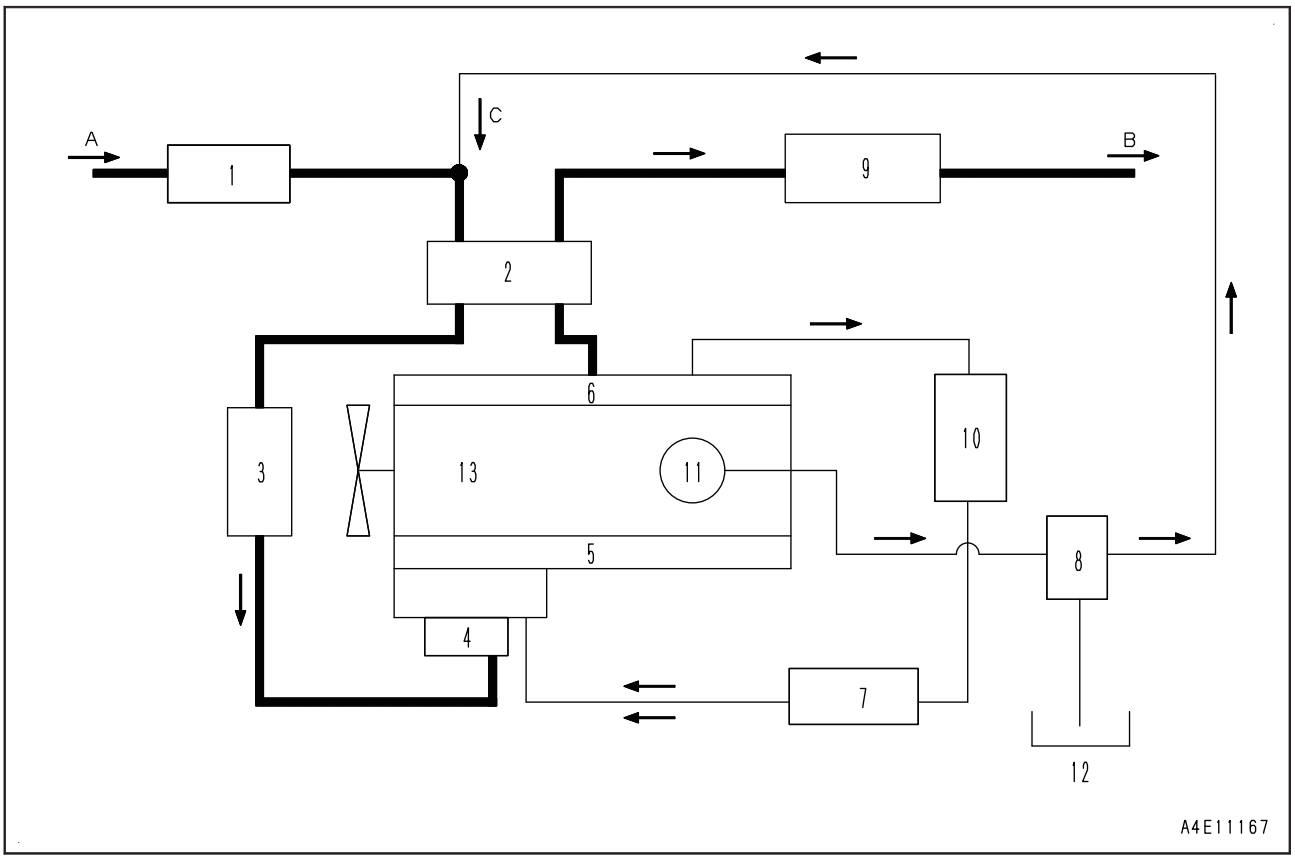
1. Turbocharger
2. EGR valve
3. Air intake connector
4. Mixing connector
5. Exhaust manifold
6. EGR cooler

A: To KDOC muffler
B: From EGR valve
C: From aftercooler
D: To air intake manifold
E: From air cleaner

F: To aftercooler

G: From exhaust manifold

Intake and exhaust system circuit diagram



1. Air cleaner
2. Turbocharger
3. Air-cooled aftercooler
4. Intake air heater
5. Air intake manifold
6. Exhaust manifold
7. EGR valve
8. KCCV ventilator
9. KDOC muffler
10. EGR cooler
11. Breather
12. Engine oil pan
13. Engine

A: From atmosphere

B: To atmosphere

C: From KCCV

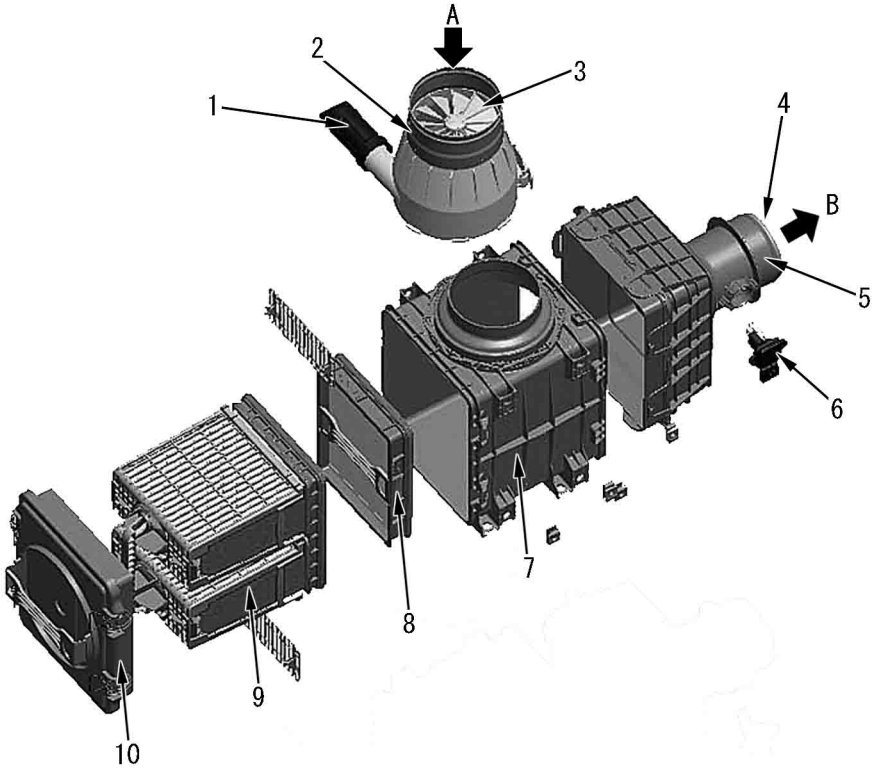
Function

- The engine employs the turbocharger (Variable Flow Turbocharger), EGR system (EGR valve and EGR cooler) which recirculates a part of the exhaust gas into the combustion chamber to control generation of NOx, KDOC (KOMATSU Diesel Oxidation Catalyst), and KCCV (KOMATSU Closed Crankcase Ventilation) system which recirculates the blowby gas.
- The engine requires clean air to maintain its performance. Ifi t takes in dirt or dust, it is damaged and its performance is lowered.
- Air is sucked into the engine through air cleaner (1), turbocharger (2), and air-cooled aftercooler (3).

- If the turbocharger takes in foreign material, it may be damaged seriously since it has a variable mechanism which is not installed to the conventional turbocharger. Accordingly, the turbocharger always requires a high quality air cleaner. Therefore, clean or replace the air cleaner element according to the procedure described in the Operation and Maintenance Manual while taking care that foreign material does not enter it.
- The intake air is sucked into the compressor side turbocharger (2) through air cleaner (1). The air turbocharged by turbocharger (2) is cooled by air-cooled aftercooler (3). Then, the air is sucked into the cylinders through intake manifold (5) and used for combustion.
- The exhaust gas flows through exhaust manifold (6) to the turbine of turbocharger (2) and drives the turbine impeller by using its energy.
- The engine controller outputs signals to the EGR system so that EGR valve (7) opens properly according to the engine load to realize both clean exhaust gas and low fuel consumption.
- If EGR valve (7) opens, a part of the exhaust gas (EGR gas) flows from exhaust manifold (6) into the EGR cooler through the EGR piping.
- The exhaust gas cooled by EGR cooler (10) flows through EGR vale (7), merges with the intake air, and flows into intake manifold (5).
- KDOC muffler (9) is installed to meet the emission regulations and composed of KDOC (oxidation catalyst) and muffler.
- SOF (Soluble Organic Fraction) in PM (Particulate Matter) contained in the exhaust gas from the engine is oxidized to reduce the PM and clean the exhaust gas.

Air cleaner *(ENG95-A910-041-K-00-A)*

★ The shape is subject to machine models.



APE11168

1. Vacuator valve
2. Pre-cleaner
3. Inlet
4. Outlet
5. Outlet cover
6. MAF sensor
7. Body
8. Secondary element
9. Primary element
10. Cover

A: Air intake inlet

B: Air intake outlet

Features

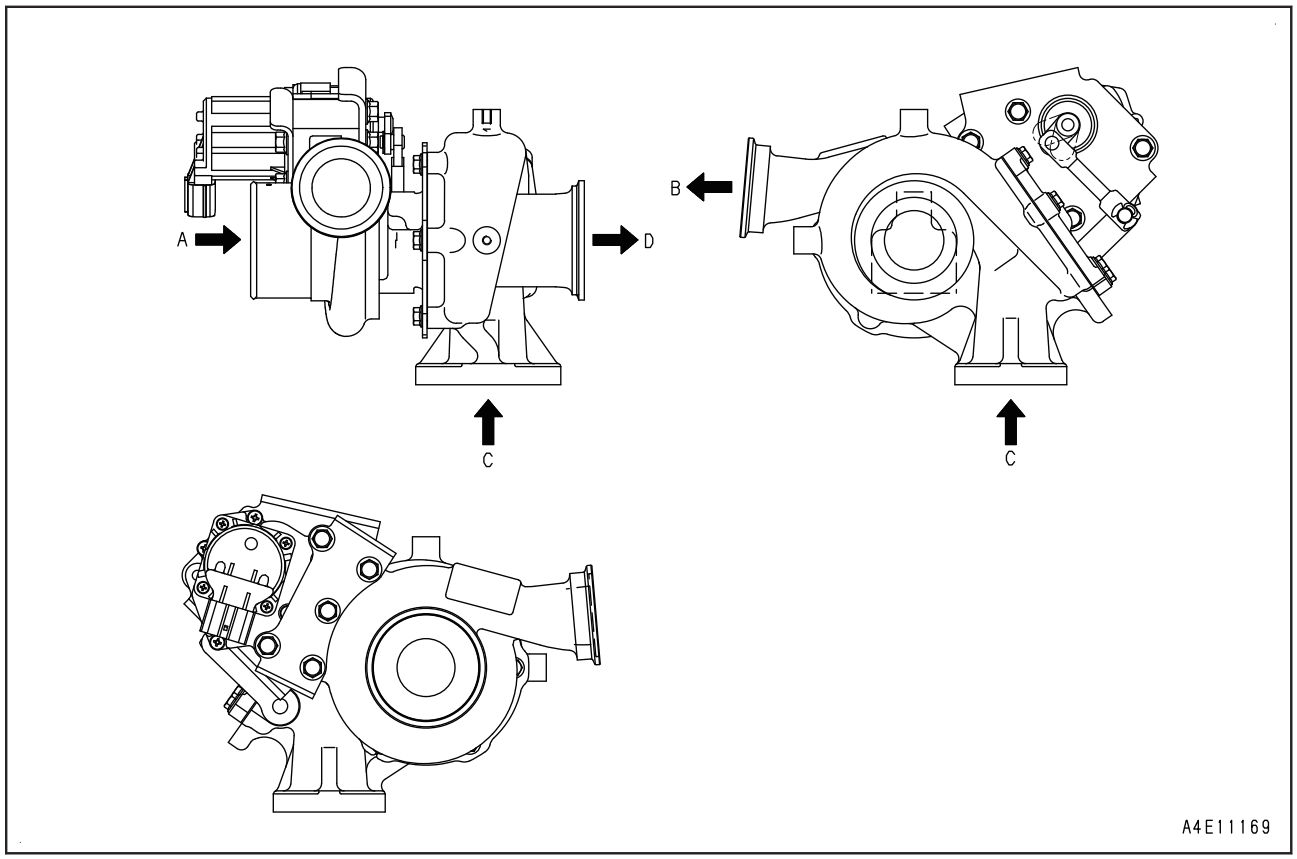
- Since the intake air does not swirl largely or make a U-turn, the intake resistance is low.
- Orifice of the element and the outlet straighten the flow effectively to stabilize the MAF sensor output.
- Since the body is rectangular, it makes dead volume decrease when mounted on the machine.

Operation *(ENG95-A910-044-K-00-A)*

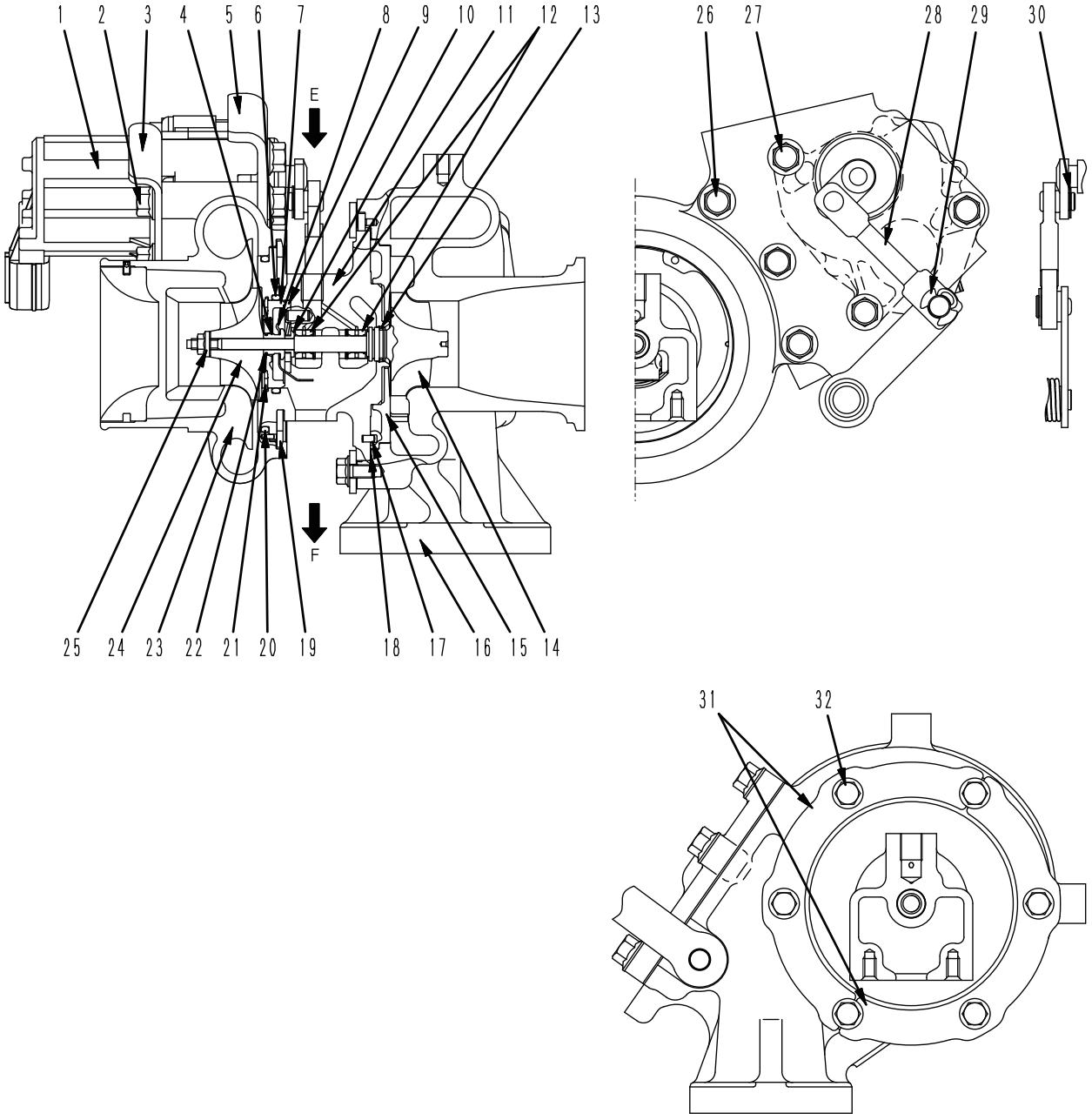
- Air containing dust is sucked in from inlet (3) and the dust is separated by centrifugal force of pre-cleaner (2).
- Furthermore, the dust is removed 99.9% or more by primary element (9) and the clean air is sucked into the engine through secondary element (8) and outlet (4).
- On the other hand, the dust and water separated by pre-cleaner (2) swirl along the inside wall of pre-cleaner (2), jump into vacuator valve (1), and go out automatically.

Turbocharger (Variable Flow Turbocharger)

★ The shape is subject to machine models.



A: Air intake inlet
B: Air intake outlet
C: Exhaust inlet
D: Exhaust outlet



1. Turbocharger motor
2. Flange bolt
3. Bracket
4. Thrust sleeve

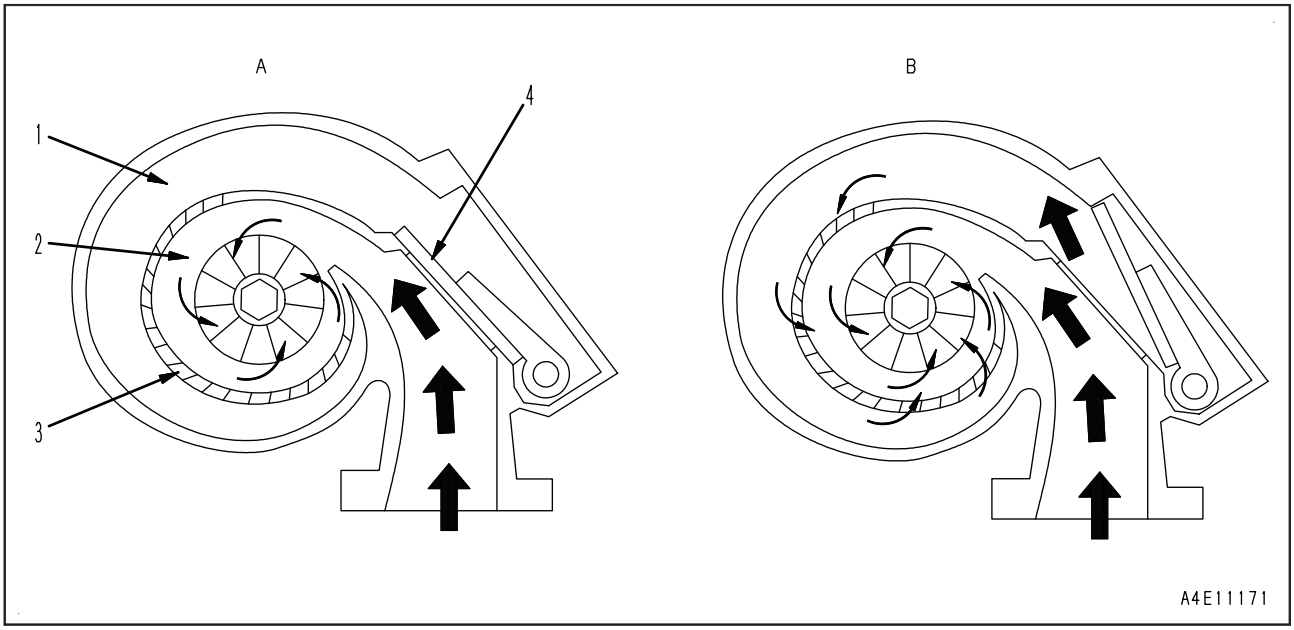
5. Bracket
6. O-ring
7. Insert
8. Oil deflector
9. Thrust bearing
10. Thrust ring
11. Bearing housing
12. Bearing
13. Piston ring
14. Turbine wheel
15. Turbine insert
16. Turbine housing assembly
17. Pin
18. Seal ring
19. Snap ring
20. O-ring
21. Snap ring
22. Piston ring
23. Compressor cover assembly
24. Compressor wheel
25. Lock nut
26. Flange bolt
27. Flange bolt
28. Connector assembly
29. Snap ring
30. Snap ring
31. Lock plate
32. Flange bolt

E: Oil inlet
F: Oil outlet

Specifications

Model: TD04M4t
Applicable exhaust temperature: Max. 700°C (turbine inlet)
Rotation direction: Clockwise (seen from intake air inlet)

Operation



1. Large scroll
2. Small scroll
3. Fixed vane
4. Flow control valve

A: When flow control valve is fully closed (small flow rate)

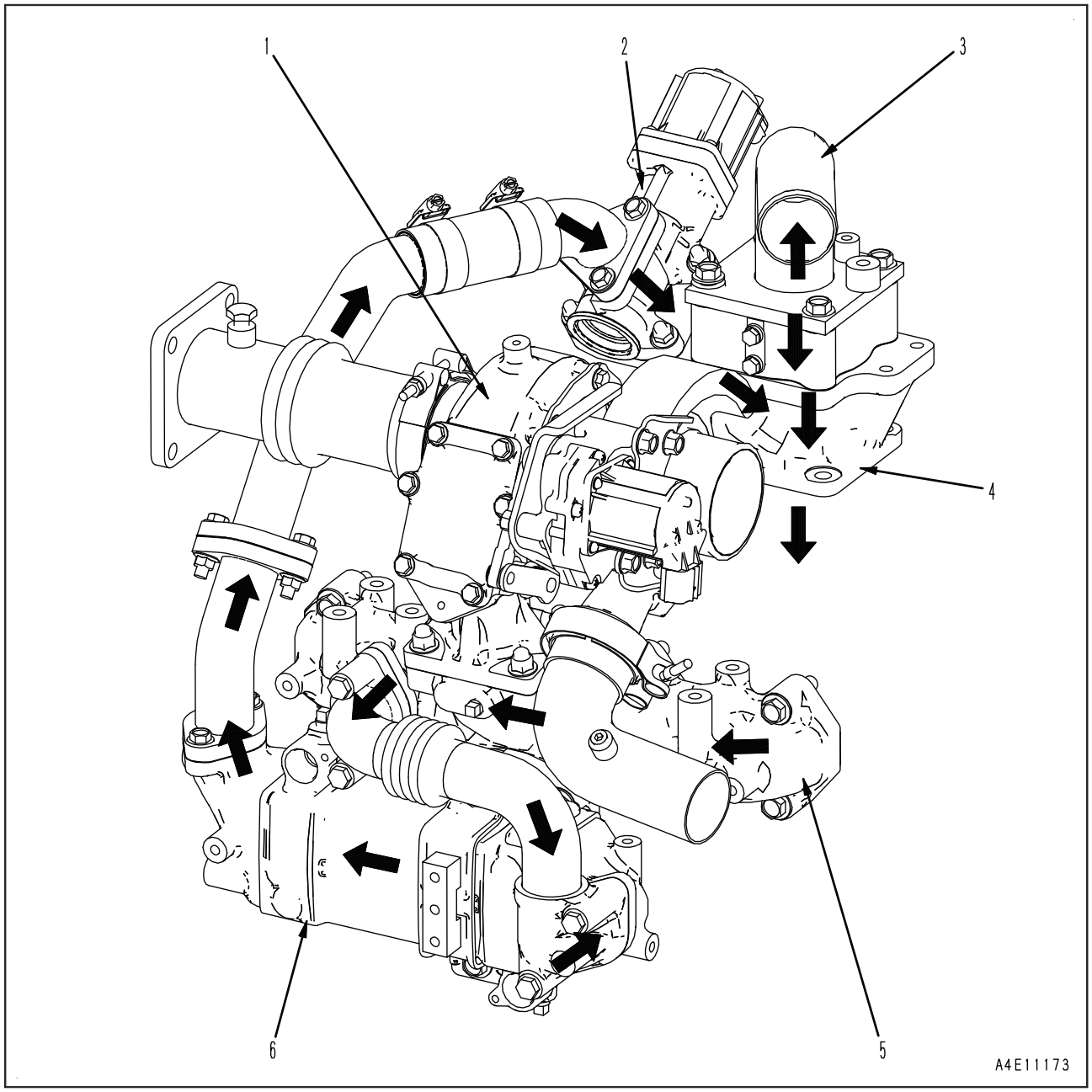
B: When flow control valve is fully open (large flow rate)

- The turbine housing of the turbocharger consists ofl arge scroll (1) and small scroll (2).
- Fixed vane (3) is installed between large scroll (1) and small scroll (2) for flow rectification.
- The flow rate into large scroll (1) side is controlled by opening or closing the flow control valve (4).
- The position of the flow control valve (4) is controlled by the actuator which is driven by the command from the engine controller.

EGR system piping drawing

★ EGR: Abbreviation for Exhaust Gas Recirculation

★ The shape is subject to machine models.



1. Turbocharger
2. EGR valve
3. Intake air connector
4. Mixing connector
5. Exhaust manifold
6. EGR cooler

Function

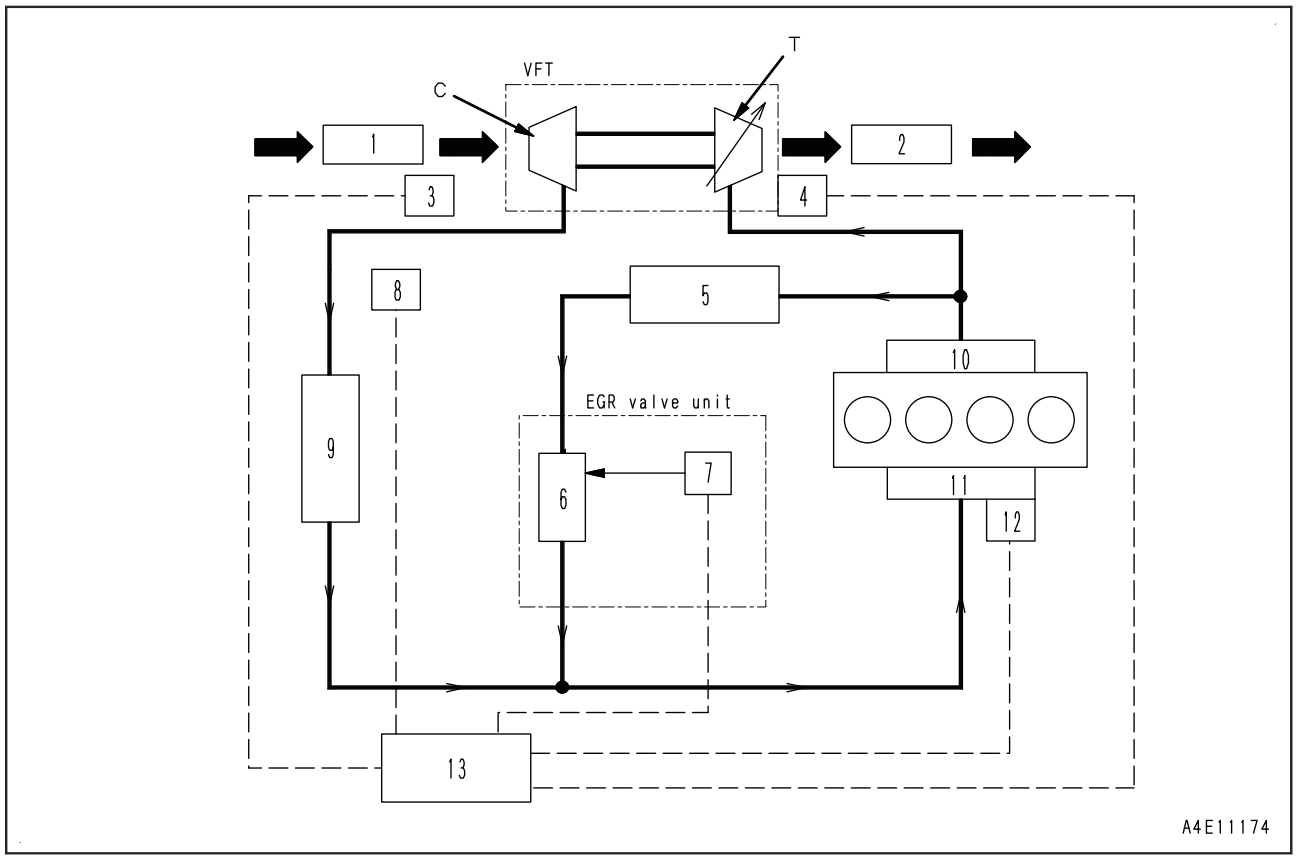
- EGR valve (driven with electric motor)
  Controls the gas flow from exhaust side to intake side. Since the exhaust pressure is higher than the boost pressure, the exhaust gas flows into the intake side.
- EGR cooler

Cools the exhaust gas.
The engine coolant is used for cooling.

- Intake air connector
  Returns the air from the air-cooled aftercooler and the exhaust gas from the EGR valve to the intake side.
- Sensors
  Control the EGR according to the operating condition.
  Troubleshoot the system.
- Control each part of the EGR circuit and control the EGR rate according to the operating condition to clean the exhaust gas constantly.
- Monitor the condition of the EGR circuit and perform troubleshooting to prevent a serious failure.

EGR system circuit diagram

★ EGR: Abbreviation for Exhaust Gas Recirculation



1. Air cleaner
2. KDOC muffler
3. Mass air flow and temperature sensor (MAF)
4. Electric actuator (Turbocharger)
5. EGR cooler
6. EGR valve
7. Electric actuator (EGR valve)
8. Ambient pressure sensor
9. Aftercooler
10. Exhaust manifold
11. Air intake manifold
12. Charge (boost) pressure and temperature sensor
13. Engine controller

C: Blower impeller

T: Turbine impeller

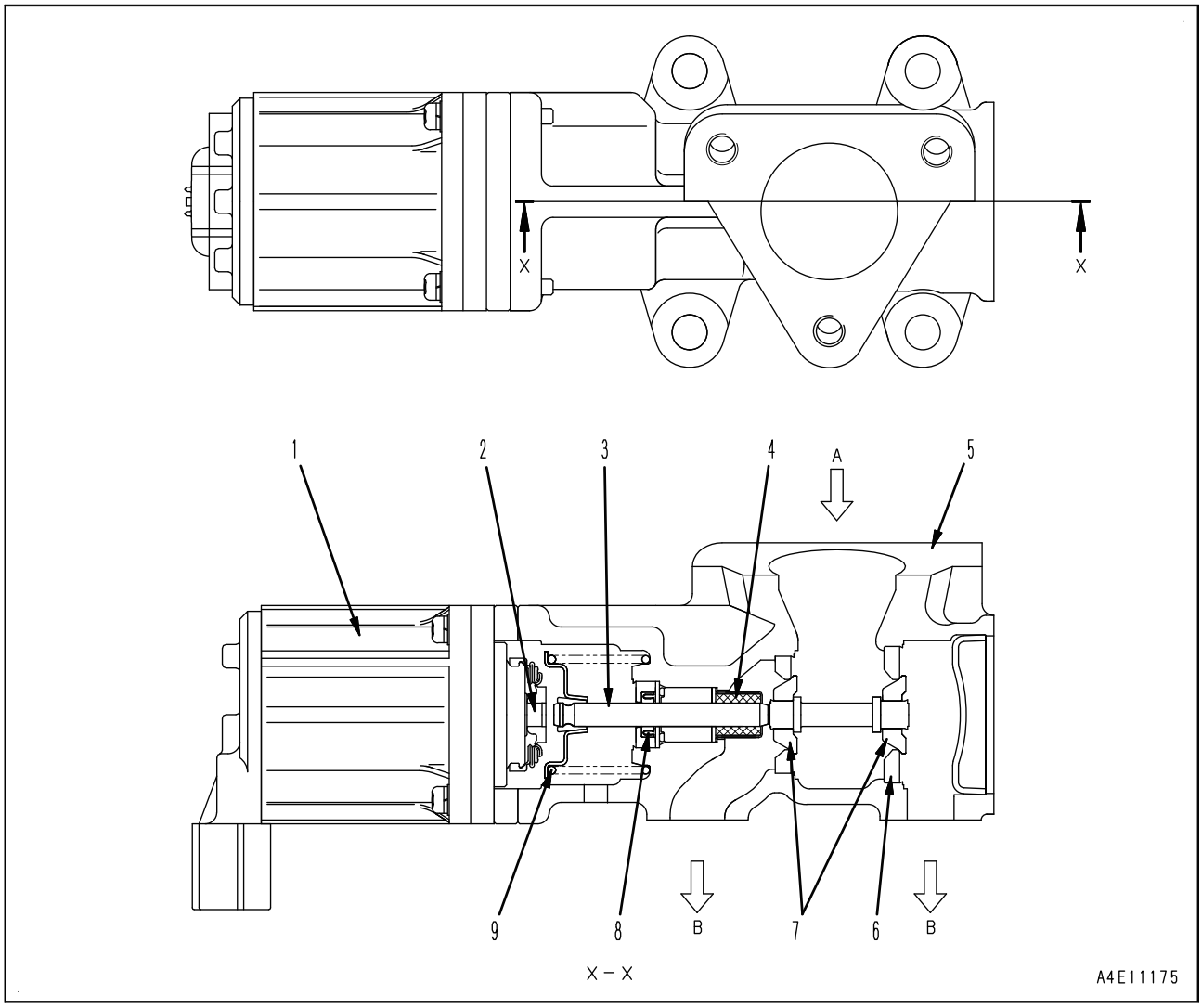
Operation

- The engine controller outputs signals so that EGR valve (6) opens properly according to the engine load to realize both clean exhaust gas and low fuel consumption.
- If EGR valve (6) opens, a part of the exhaust gas (EGR gas) flows from exhaust manifold (10) into EGR cooler (5) through the EGR piping.
- The exhaust gas cooled by EGR cooler (5) flows through EGR valve (6), merges with the intake air in the air intake connector, and flows into intake manifold (11).

EGR valve *(ENG95-A9K1-041-K-00-A)*

★ EGR: Abbreviation for Exhaust Gas Recirculation

★ The shape is subject to machine models.



1. DC motor assembly (brushless motor with built-in position sensor)
2. DC motor shaft
3. Rod
4. Filter
5. Housing
6. Valve seat
7. Valve
8. Seal
9. Spring

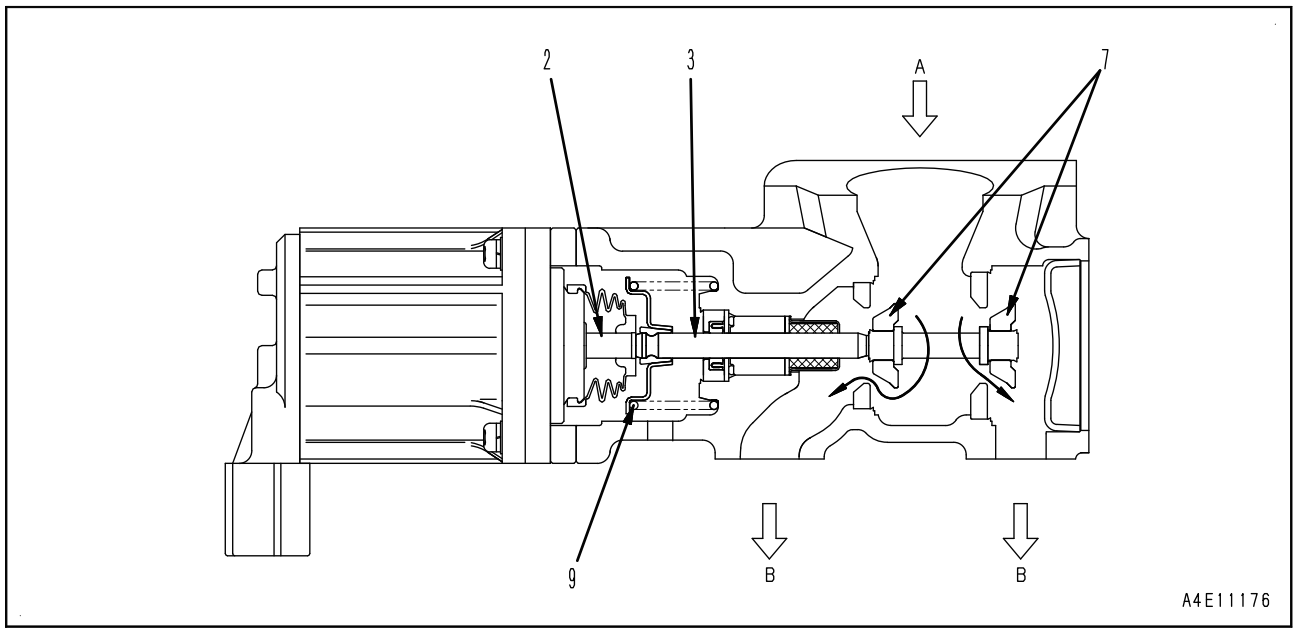
A: EGR gas inlet (from EGR cooler)

B: EGR gas outlet (to intake manifold)

Structure

- Small-sized EGR valve driven with a DC motor.
- The DC motor has a position sensor in it to sense the valve position.
- Since 2 valves are combined to cancel the EGR gas pressure, the operating effort is small.

Operation *(ENG95-A9K1-044-K-00-A)*



A: EGR gas inlet (from EGR cooler)

B: EGR gas outlet (to air intake manifold)

- DC motor shaft (2) of the DC motor converts rotary motion into linear motion. Accordingly, valve (7) is opened or closed by turning the motor.

Open valve: The DC motor is turned and DC motor shaft (2) is pushed out to push rod (3) and open valve (7).

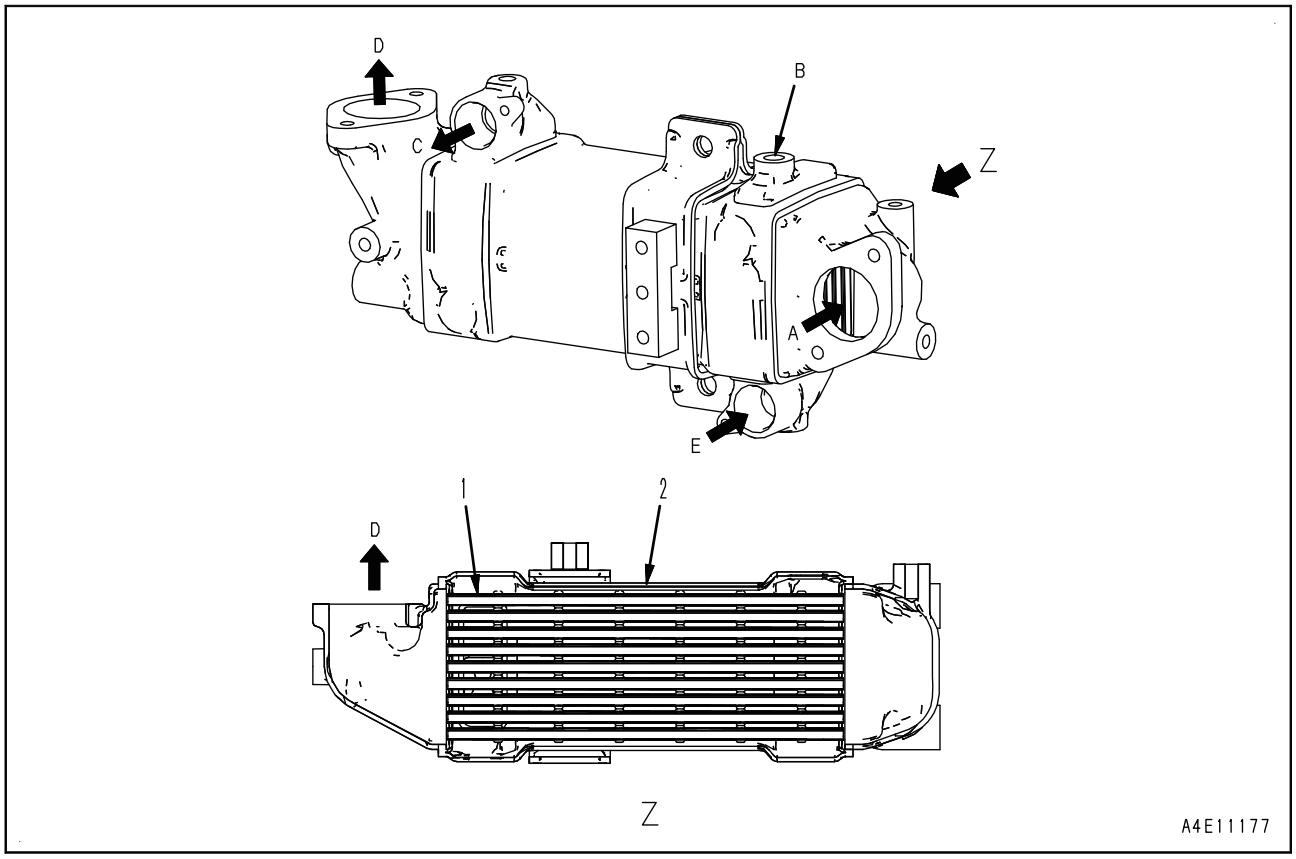
When valve (7) opens, the EGR gas flows into the air intake manifold.

Close valve: The DC motor is turned in reverse and DC motor shaft (2) is pulled in, then rod (3) is pushed back by spring (9) and valve (7) closes.

EGR cooler *(ENG95-A9L0-041-K-00-A)*

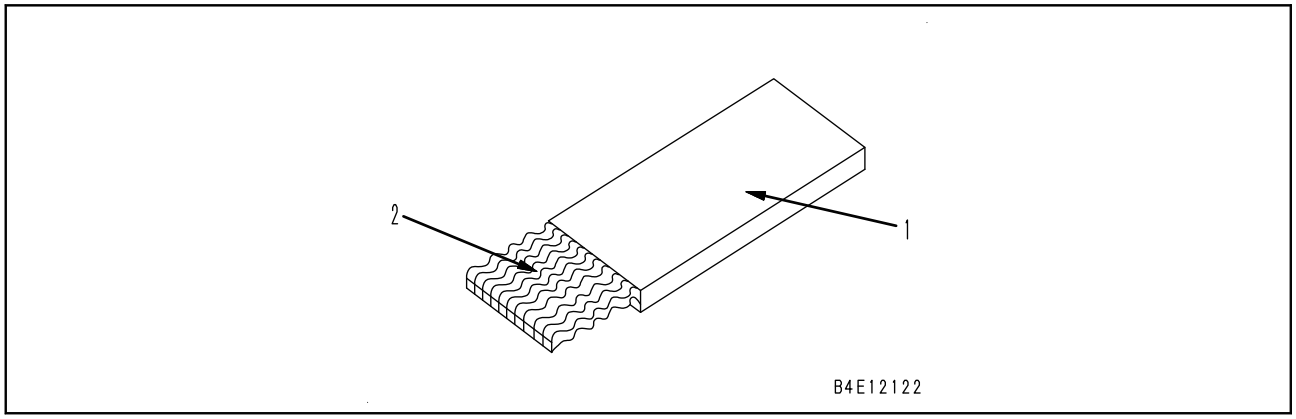
★ EGR: Abbreviation for Exhaust Gas Recirculation

★ The shape is subject to machine models.



1. Tube
2. Shell

A: EGR gas inlet
B: Air vent
C: Coolant outlet
D: EGR gas outlet
E: Coolant inlet



1. Flat tube
2. Inner fin

Operation *(ENG95-A9L0-044-K-00-A)*

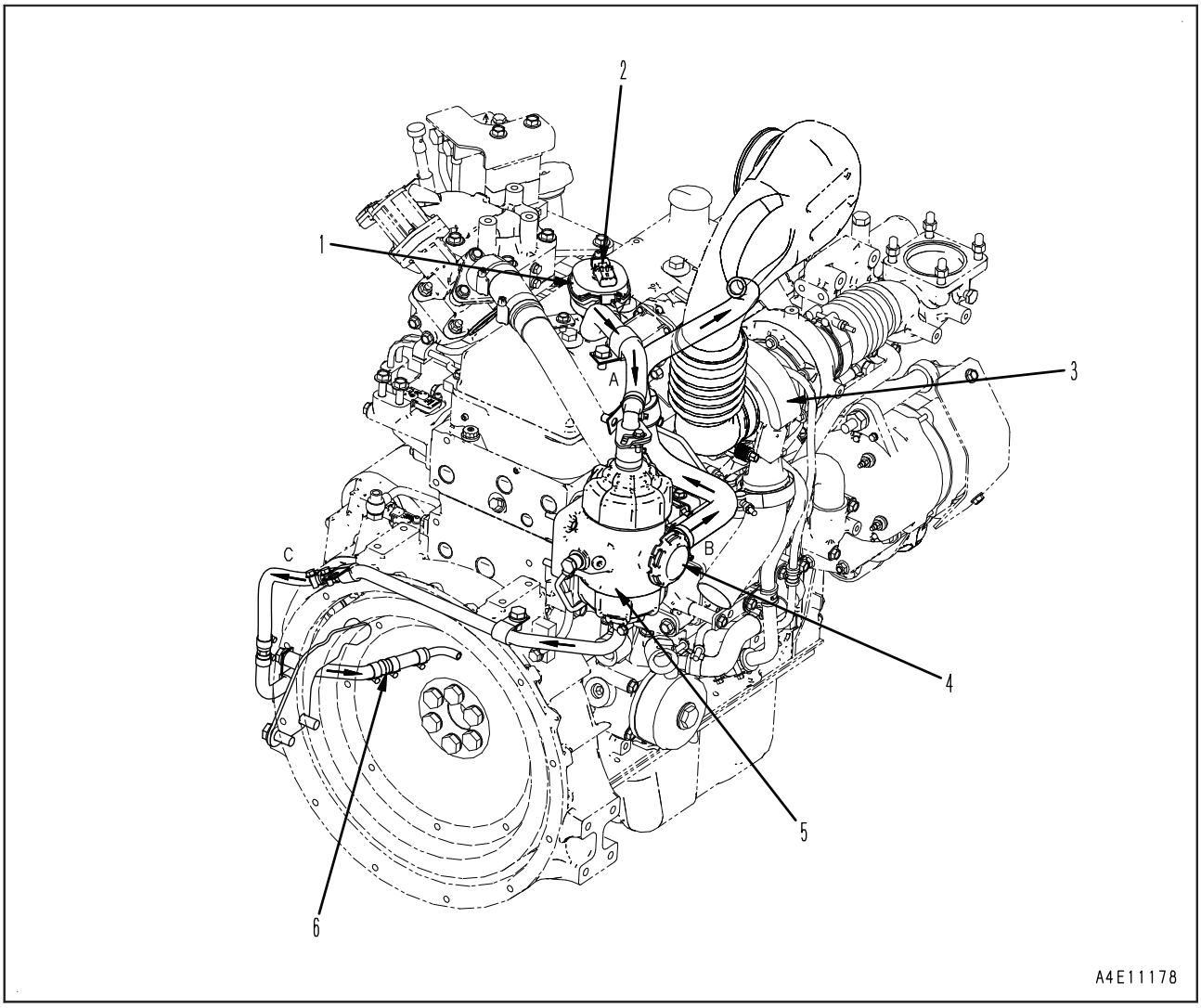
- The EGR gas enters from (A) and flows through 9 flat tubes (1).

- Coolant enters from (E) and flows around flat tube (1) in the shell and then goes out from (C).
- The EGR gas is effectively cooled by flat tubes (1) with inner fins (2) and flows out from EGR gas outlet (D).

KCCV layout drawing

★ KCCV: Abbreviation for KOMATSU Closed Crankcase Ventilation

★ The shape is subject to machine models.



1. Breather
2. Crankcase pressure sensor
3. Turbocharger
4. CDR valve
5. KCCV ventilator
6. Check valve

A: Blowby gas (from breather)

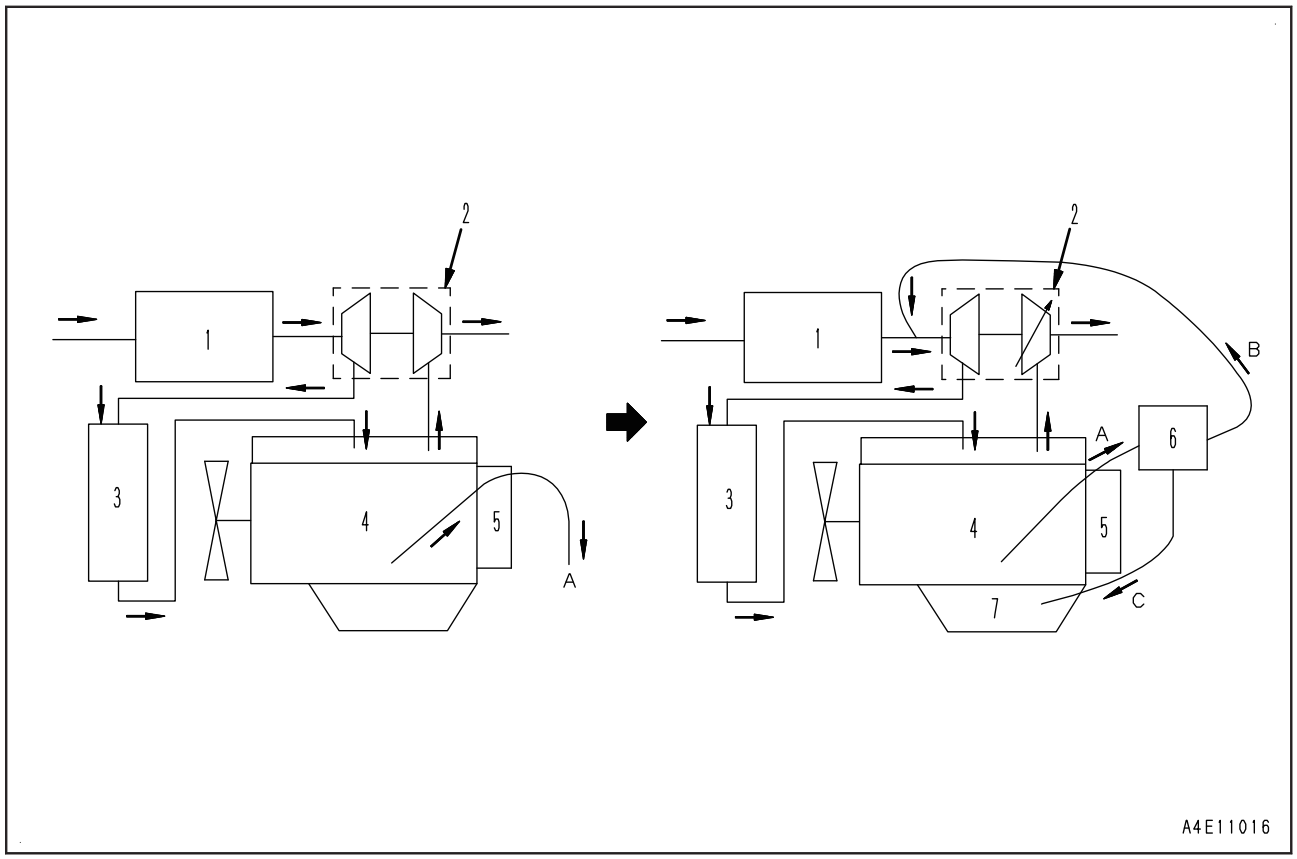
B: Blowby gas from which engine oil was removed (to Turbocharger)

C: Engine oil from which blowby gas was removed (to oil pan)

- In the past, blowby gas (A) was discharged into the atmosphere as it was. Since the emission regulations has become strict and blowby gas must be controlled now, the blowby gas intake recirculation system is employed.
- Blowby gas (A) contains ingredients of the engine oil. If it is recirculated to turbocharger (3) as it is, it causes the following problems. To prevent this, a filter is installed to KCCV ventilator (5) to remove the engine oil.
  1. Lowering of performance of turbocharger and aftercooler caused by sticking engine oil
  2. Abnormal combustion in engine
  3. Malfunction of each sensor caused by sticking engine oil

Operation

★ The left side of the following figure shows the traditional flow of blowby gas that has been discharged to the atmosphere. The right side shows the flow of blowby gas recirculated to the intake system by the KCCV ventilator.



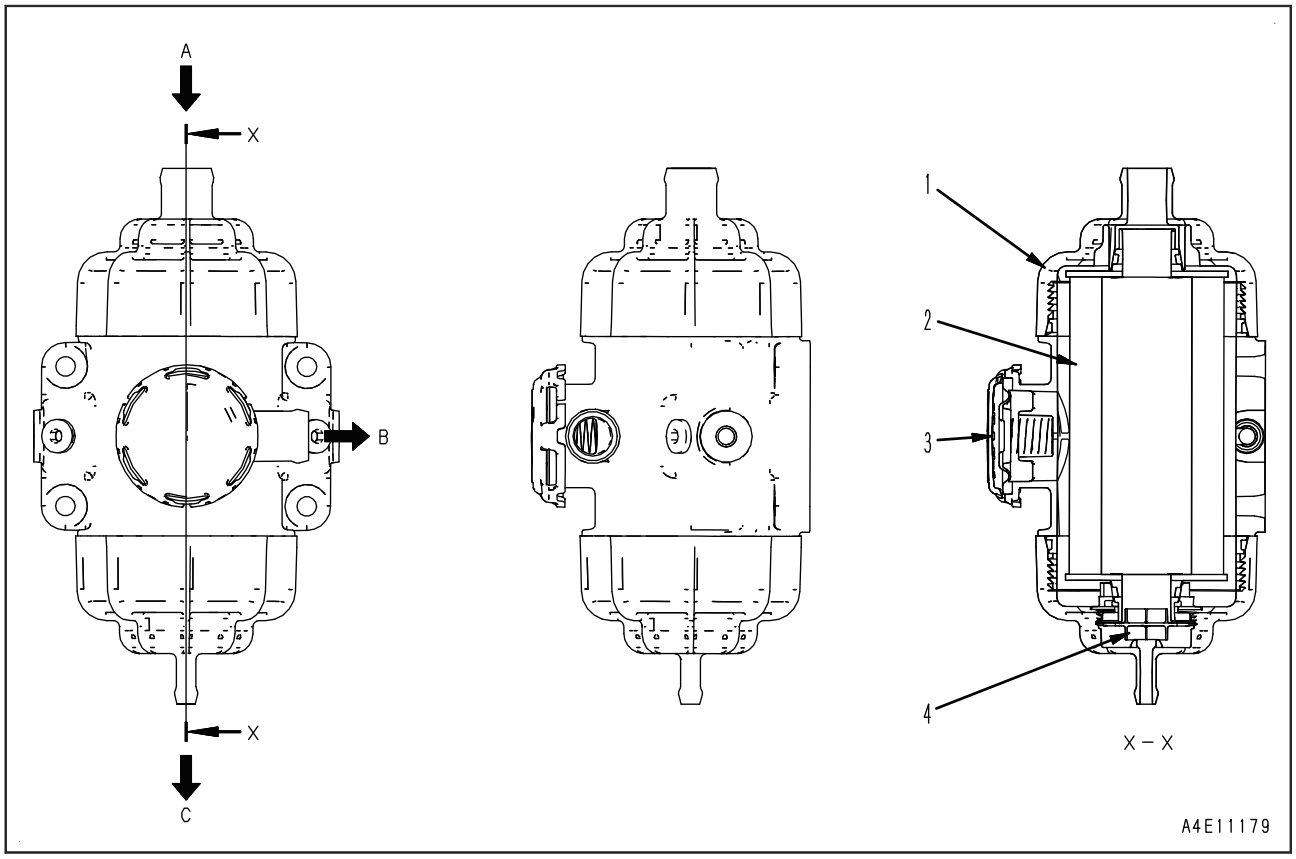
1. Air cleaner
2. Turbocharger
3. Aftercooler
4. Cylinder block (crankcase)
5. Breather
6. KCCV ventilator
7. Oil pan

- Engine oil is removed from blowby gas (A) in cylinder block (4) by the filter in KCCV ventilator (6), and then the cleaned gas (B) is recirculated to the intake side of the turbocharger.
- Removed engine oil (C) flows through a check valve and falls to the oil pan.

KCCV ventilator

★ KCCV: Abbreviation for KOMATSU Closed Crankcase Ventilation

★ The shape is subject to machine models.



1. Case
2. Filter
3. CDR valve
4. Relief valve

A: Blowby gas inlet (from breather)

B: Blowby gas outlet (to turbocharger intake side)

C: Oil drain port (to oil pan)

Function

- If the blowby gas is returned to the intake side of the turbocharger, the crankcase pressure becomes negative and dust may be sucked in through the crankshaft seal. To prevent this, the blowby pressure is controlled by using the CDR valve (regulator valve) and crankcase pressure sensor.
- If the filter of the KCCV ventilator is clogged, the crankcase pressure increases to cause oil leakage. To prevent this, the crankcase pressure sensor (installed separately) senses clogging of the filter.
- There are 2 types of the filter; one is the top load type (taken out upward) and the other is the bottom load type (taken out downward).

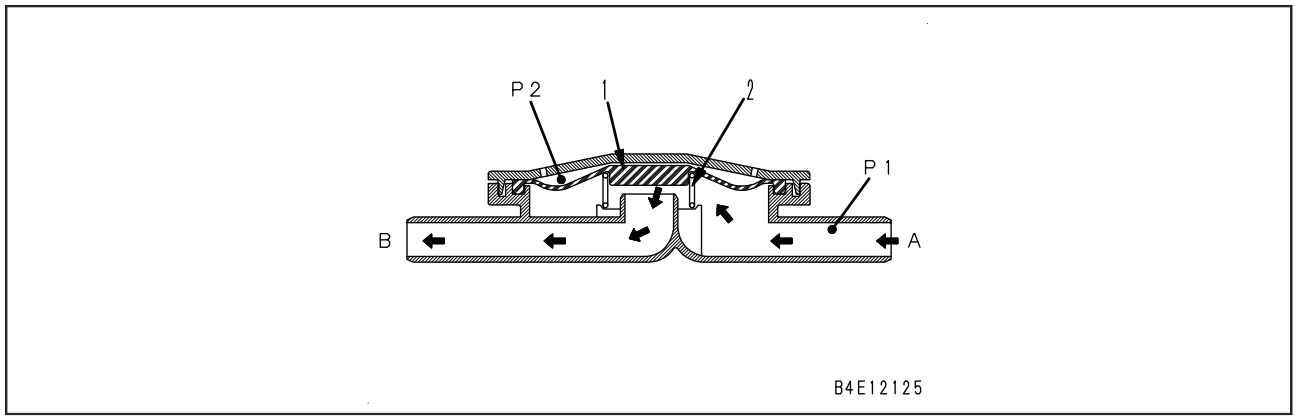
Operation

- Blowby gas enters (A) and engine oil mist is separated when it flows through filter (2).
- The separated oil flows along the case wall to oil drain port (C), and then flows into the oil pan.
- When the crankcase pressure becomes negative, the CDR valve operates to prevent the crankcase pressure from becoming excessively negative.
- The crankcase pressure sensor senses the blowby gas pressure (crankcase pressure).
- If the engine controller judges from the value sensed by the crankcase pressure sensor that the filter is clogged, it displays failure code CA555 and then displays CA556 if the pressure increases further.

- Relief valve (4) is installed inside case (1) and operates to protect the KCCV ventilator and engine when filter (2) is blocked.

CDR valve

★ CDR: Abbreviation for Crankcase Depression Regulator



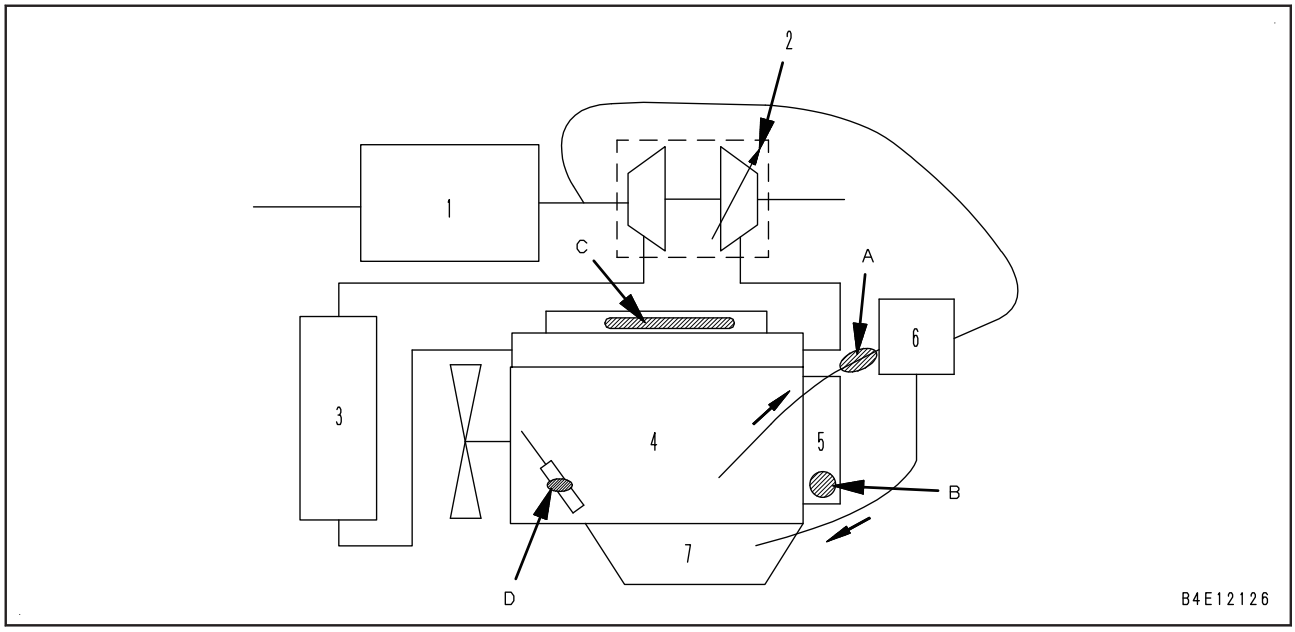
1. Diaphragm
2. Spring

A: Crankcase side

B: Turbocharger side (intake side)

- The CDR valve is a regulator valve which prevents excessive negative crankcase pressure (P1).
- Normally, diaphragm (1) is pushed up by spring (2) and blowby gas flows from crankcase side (A) to turbocharger side (intake side) (B).
- When intake air flow at the turbocharger side (intake side) (B) increases and crankcase pressure (P1) decreases, force of spring (2) yields to ambient pressure (P2). The diaphragm shuts the passage and temporarily blocks the flow.
- Then, when blowby gas accumulates in the crankcase and pressure (P1) recovers, the diaphragm is pushed up again and blowby gas starts to flow again.

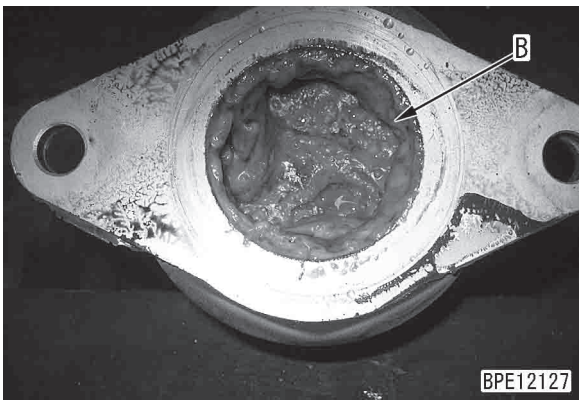
Forming of condensed water and emulsion

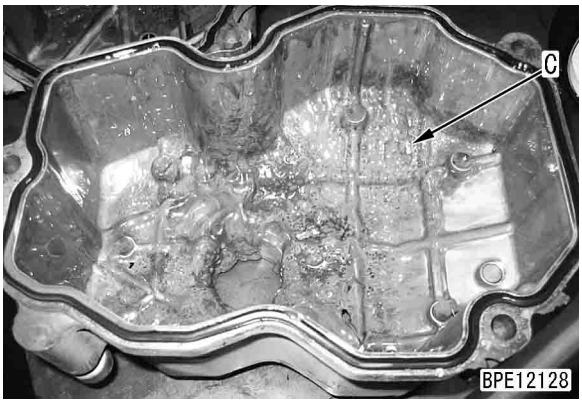


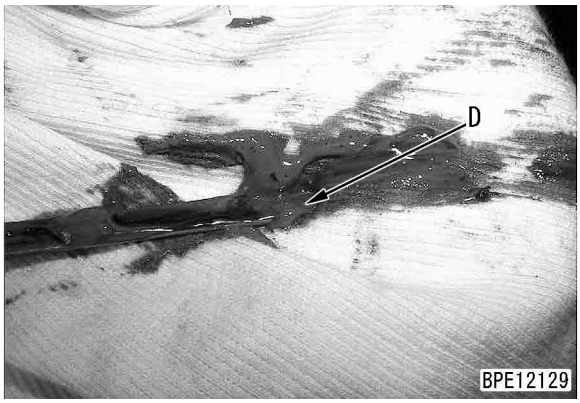
1. Air cleaner
2. Turbocharger
3. Aftercooler
4. Engine
5. Breather
6. KCCV ventilator
7. Oil pan

Outline

- If operating the engine with low load while the ambient temperature is low, the moisture in the blowby gas is not vaporized but condensed and returned to oil pan (7) through KCCV ventilator (6). Its flow is as follows;
  1. The moisture in the blowby gas is condensed in KCCV piping (A).
  2. The condensed water flows into the oil pan through the drain circuit.
  3. The water is vaporized inside the oil pan.
  4. When the water is condensed again at a place in the engine where the temperature is relatively low, it is mixed with the oil and white solid material is generated. This solid material is called mayonnaise sludge (*).
  *: Emulsion made of oil and water which looks like mayonnaise.
  5. The temperature of each part does not increase because ofl ow-load operation and the mayonnaise sludge is piled up.
- The mayonnaise sludge is generated at inside of breather (B), back of head cover (C), level gauge (D), etc. where temperature is low and water is condensed easily.





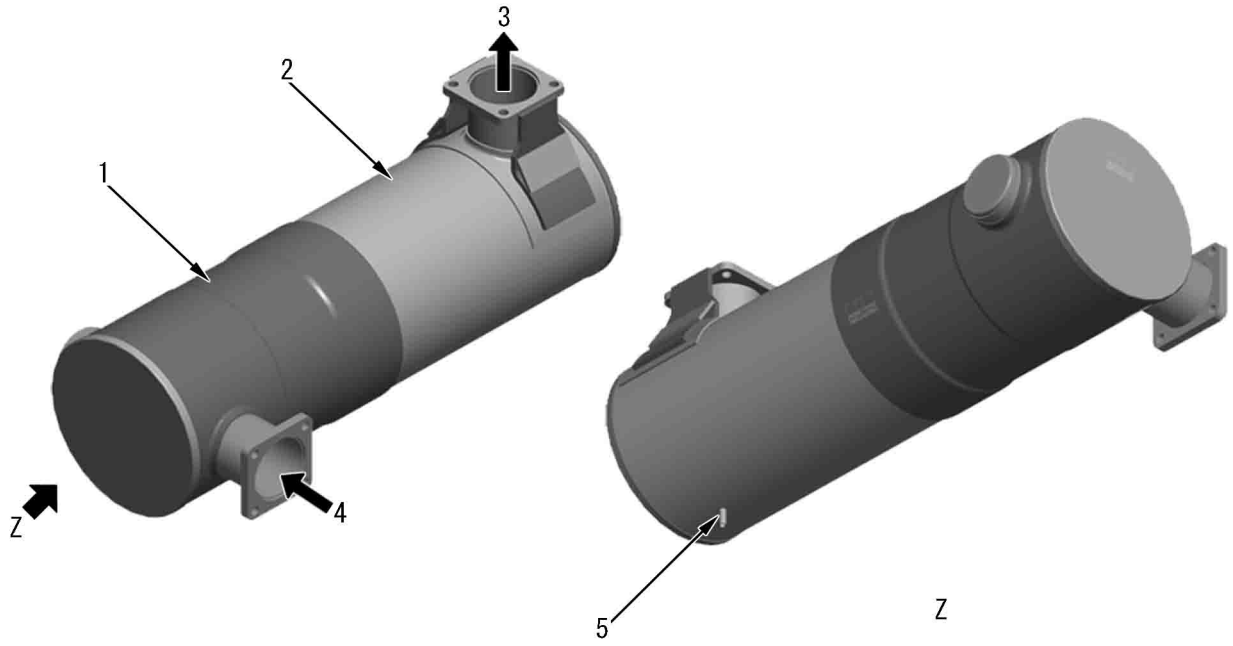


- If the operation is increased and the engine oil temperature increases, the mayonnaise sludge disappears.
- Mixing of the mayonnaise sludge into the oil is not a problem. However, if it mixes into the engine coolant, find out the cause of coolant leakage.

KDOC muffler *(ENG95-A9H2-041-K-00-A)*

★ KDOC: Abbreviation for Komatsu Diesel Oxidation Catalyst

★ The shape is subject to machine models.



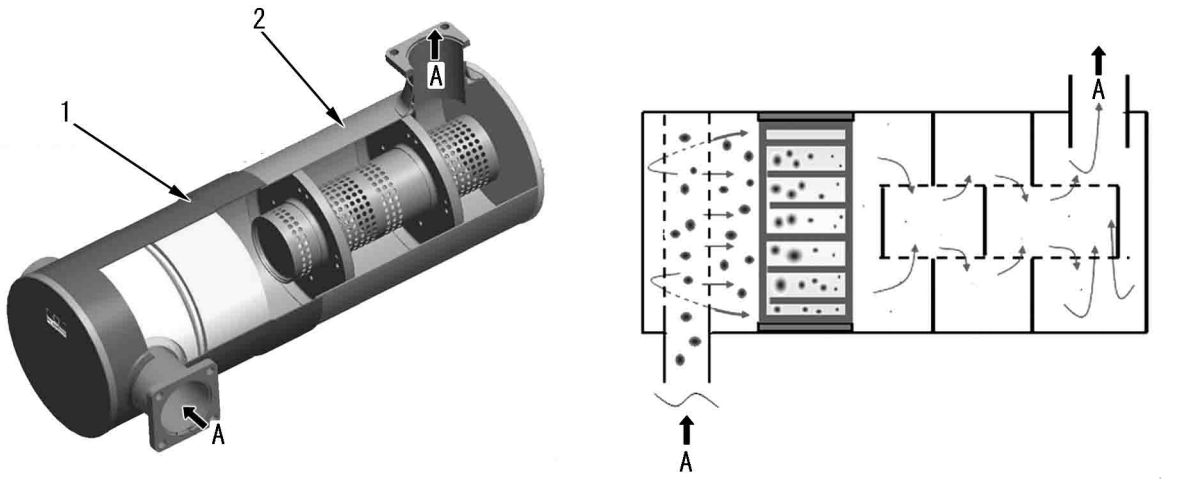
APE11180

1. DOC unit
2. Silencer unit
3. Exhaust gas outlet piping
4. Exhaust gas inlet piping
5. Drain piping

Structure

- The KDOC muffler consists of inlet piping (4) to lead in the exhaust gas from the engine, DOC unit (1) to store the oxidation catalyst, silencer unit (2) having silencing function and containing a "dam" to prevent rain water from flowing into the DOC unit from exhaust gas outlet piping, outlet piping (3) to discharge the exhaust gas, and drain piping (5) to drain water from the silencer unit. Those components are welded together into one unit.
- DOC unit (1) consists of ceramic honeycomb with oxidation catalyst.
- The ceramic honeycomb is protected with a mat made of special fibers to prevent breakage of the ceramic under the vibrations from the engine and chassis.

Function *(ENG95-A9H2-042-K-00-A)*



APE11181

A: Flow of exhaust gas

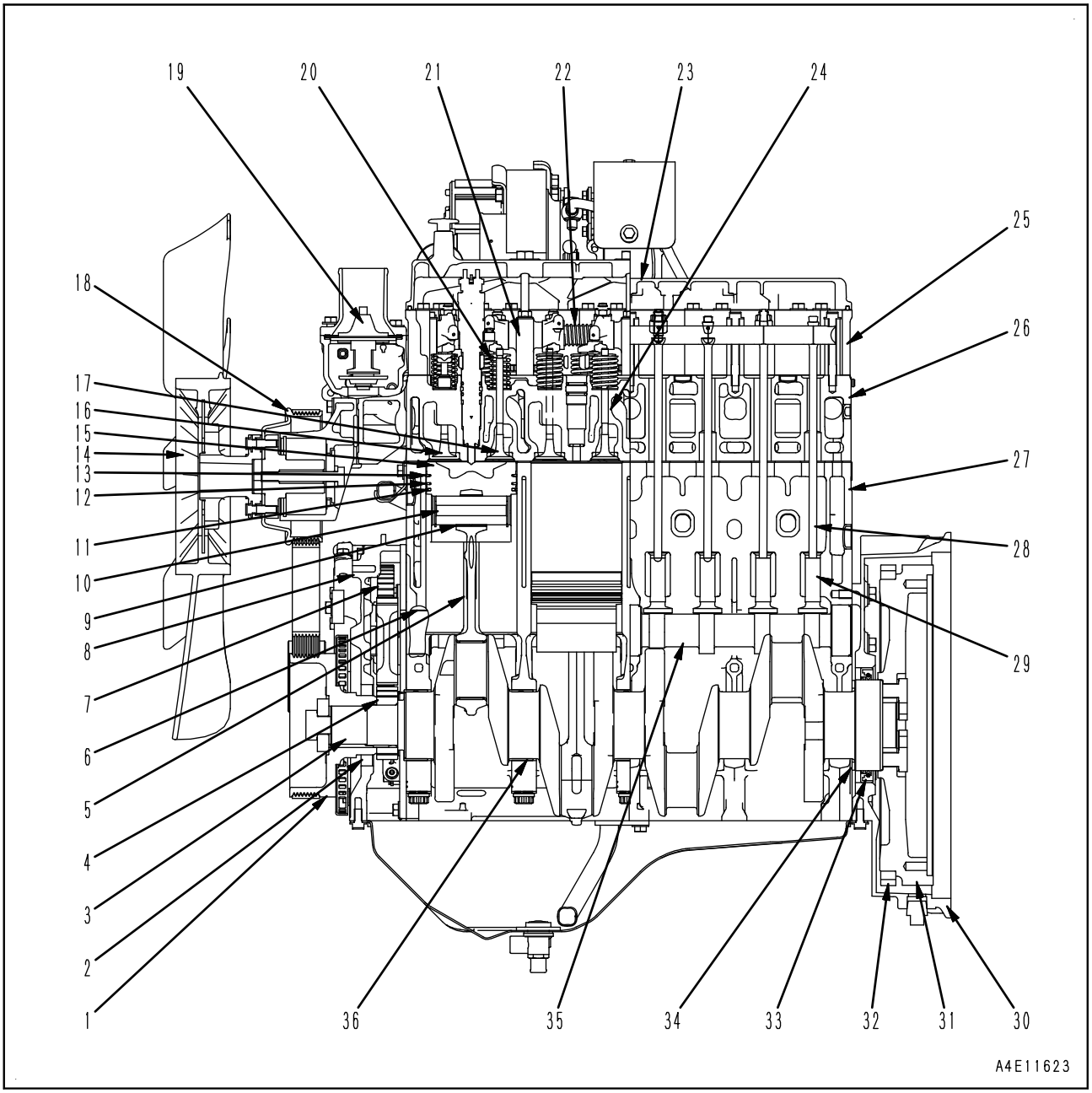
1. DOC unit

2. Silencer unit

- The KDOC muffler is installed to meet the latest very severe emission regulations. It oxidizes SOF (soluble organic fraction in minute particle in exhaust gas), HC (hydrocarbon not combusted), and CO (carbon monoxide) contained in the engine exhaust gas to clean the exhaust gas. It also has a silencer to reduce the exhaust noise.
- Function of DOC unit
  (1) Oxidization of SOF (soluble organic fraction)
  (2) Oxidization of HC (hydrocarbon)
  (3) Oxidization of CO (carbon monoxide)
- Function of silencer unit
  Reduction of exhaust noise

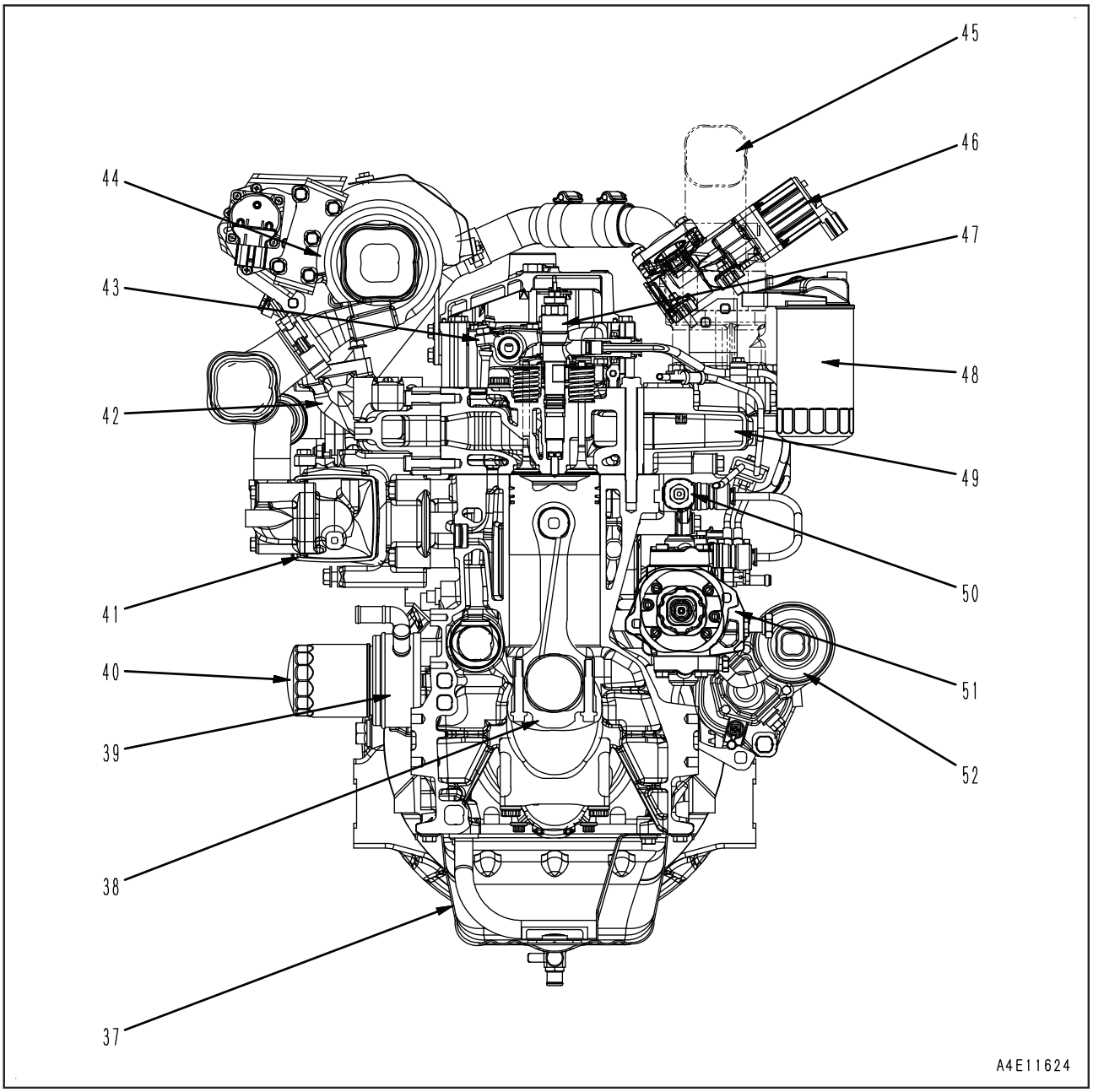
Engine main body parts *(ENG95-R402-041-K-00-A)*

General structure *(ENG95-A000-041-K-00-A)*



1. Crank pulley
2. Front seal
3. Crankshaft
4. Crank gear
5. Connecting rod
6. Camshaft bushing
7. Cam gear
8. Front cover
9. Connecting rod bushing
10. Piston pin
11. Oil ring
12. Second ring

13. Top ring
14. Fan
15. Piston
16. Air intake valve
17. Exhaust valve
18. Fan pulley
19. Thermostat
20. Valve spring
21. Rocker arm bracket
22. Rocker arm spring
23. Head cover
24. Valve guide
25. Rocker housing
26. Cylinder head
27. Cylinder block
28. Push rod
29. Tappet
30. Flywheel housing
31. Flywheel
32. Ring gear
33. Rear seal
34. Thrust bearing
35. Camshaft
36. Main bearing

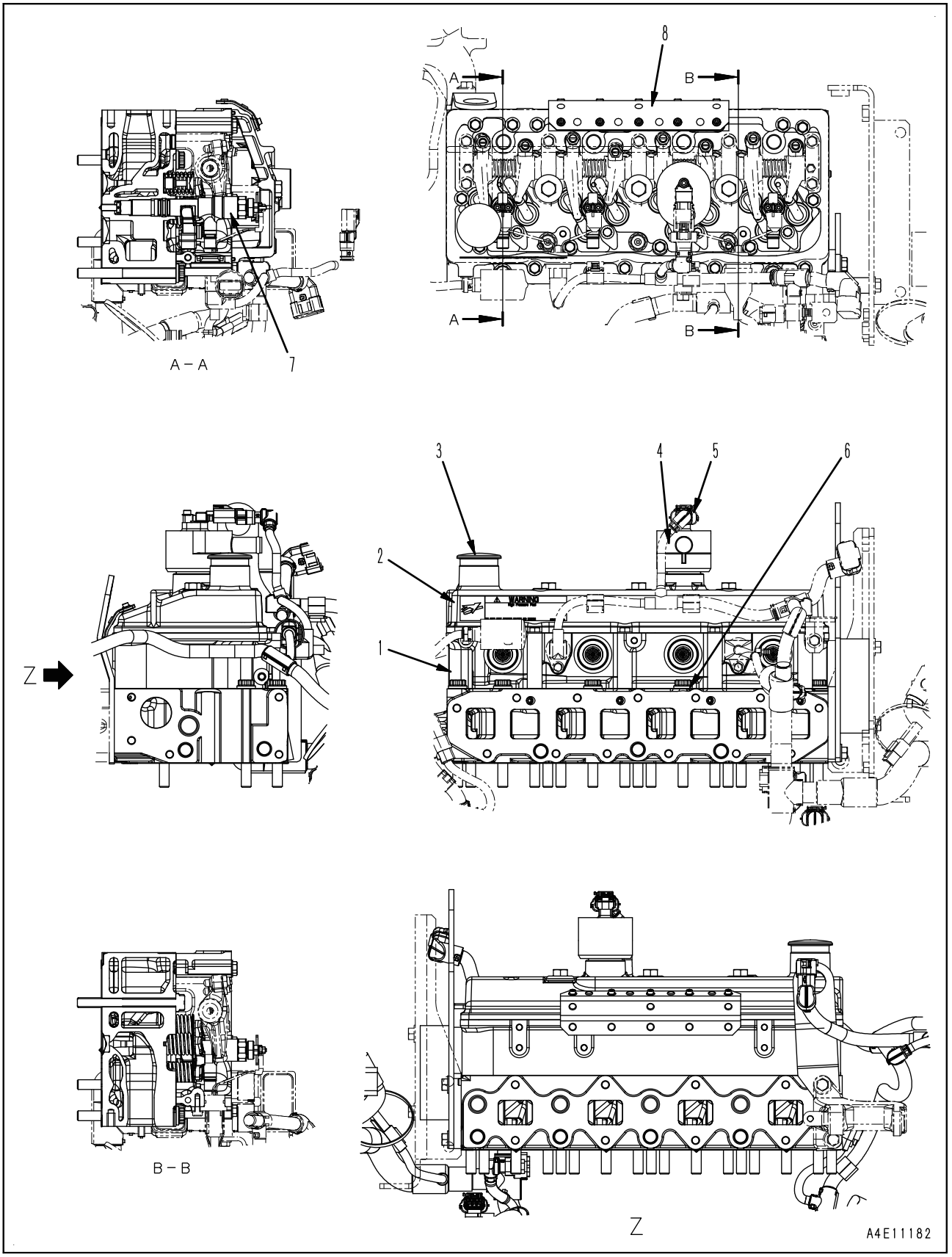


37. Oil pan
38. Connecting rod cap
39. Oil cooler
40. Oil filter
41. EGR cooler
42. Exhaust manifold
43. Rocker arm
44. Turbocharger
45. Intake air connector
46. EGR valve
47. Injector
48. Fuel filter
49. Air intake manifold
50. Common rail pressure

51. Supply pump
52. Starting motor

Cylinder head *(ENG95-A100-041-K-00-A)*

★ The shape is subject to machine models.



1. Cylinder head
2. Cylinder head cover

3. Oil filler cap
4. Breather
5. Crankcase internal pressure sensor
6. Head bolt
7. Injector assembly
8. Heat insulation cover

Specifications *(ENG95-A100-030-K-00-A)*

Cylinder head
- Direct fuel injection type
- Unit type
- 4 valves (per cylinder)

Valve seat
- Intake side: Valve seat insert press-fitted
- Exhaust side: Valve seat insert press-fitted

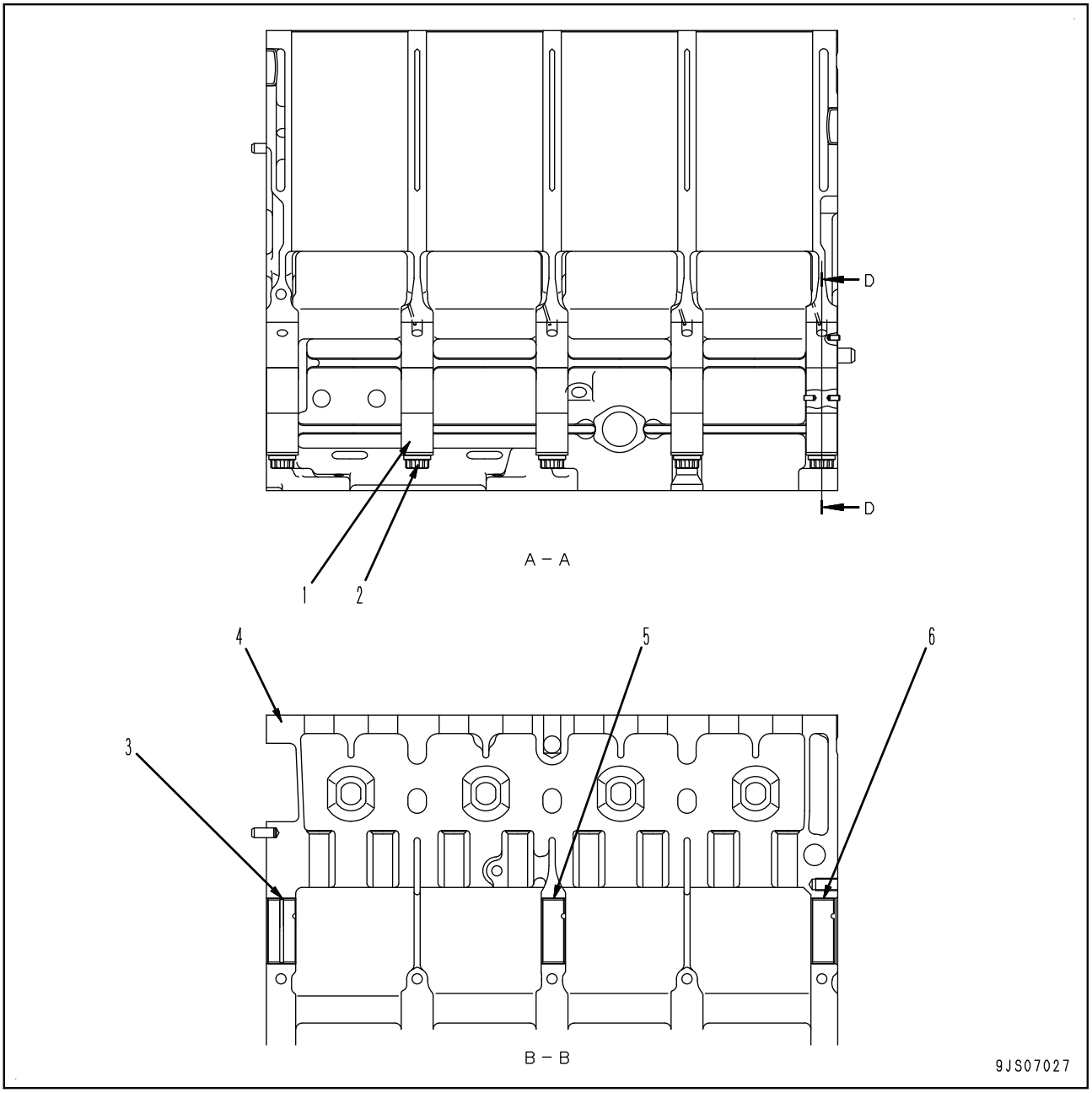
Injector assembly
- Head cover installed inside
- Installation: Dry type (without sleeve)

Center injection (installed to center of cylinder)

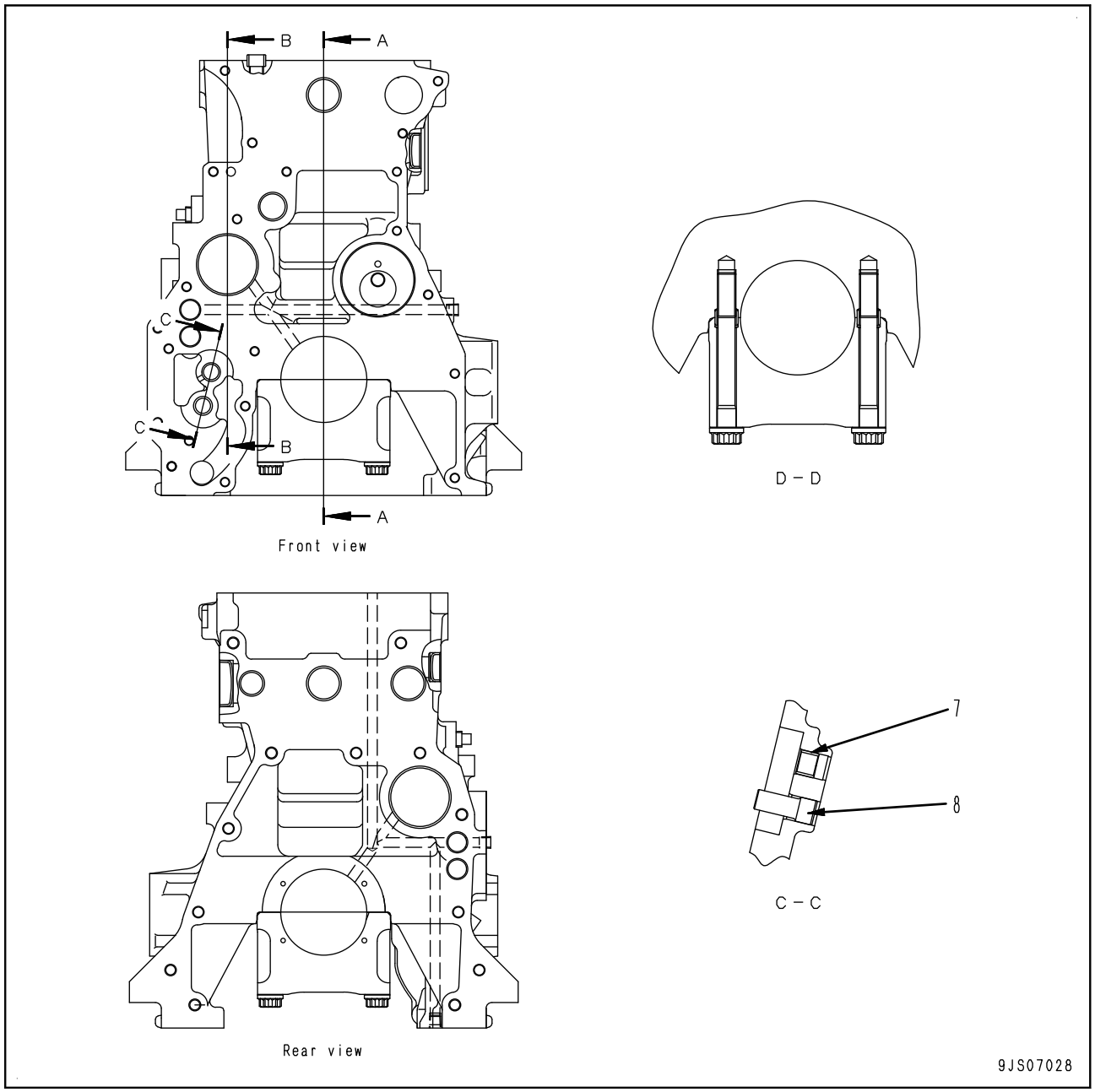
Head cover
- Float mount type

Cylinder block *(ENG95-A300-041-K-00-A)*

★ The shape is subject to machine models.



1. Main bearing cap
2. Main bearing cap bolt
3. Cam bushing (journal No.1)
4. Cylinder block
5. Cam bushing (journal No.2)
6. Cam bushing (journal No.3)



7. Oil pump drive shaft bushing
8. Oil pump driven shaft

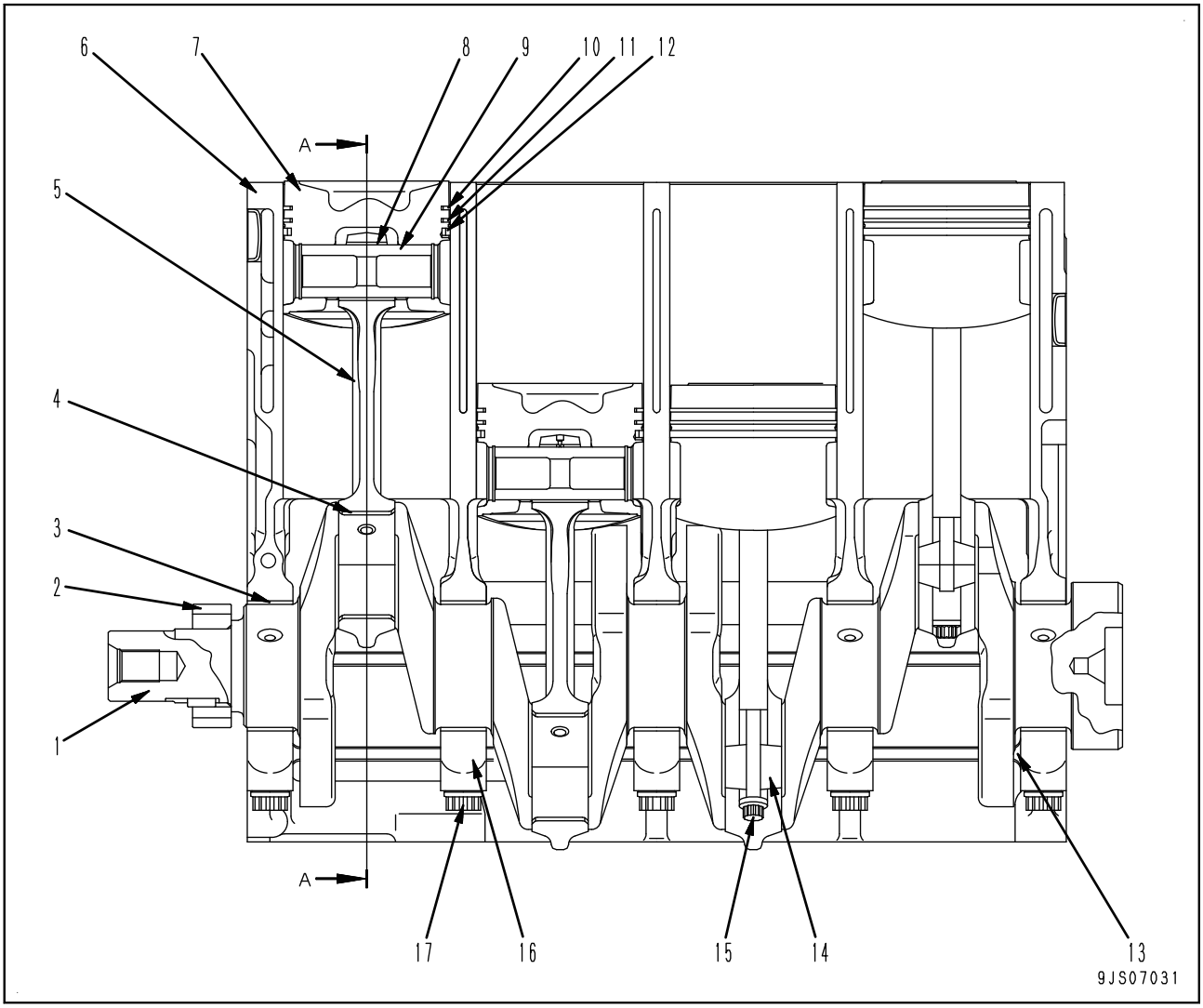
Specifications *(ENG95-A300-030-K-00-A)*

Cylinder block
- Crankshaft: 5 bearings
- Camshaft: 3 bearings

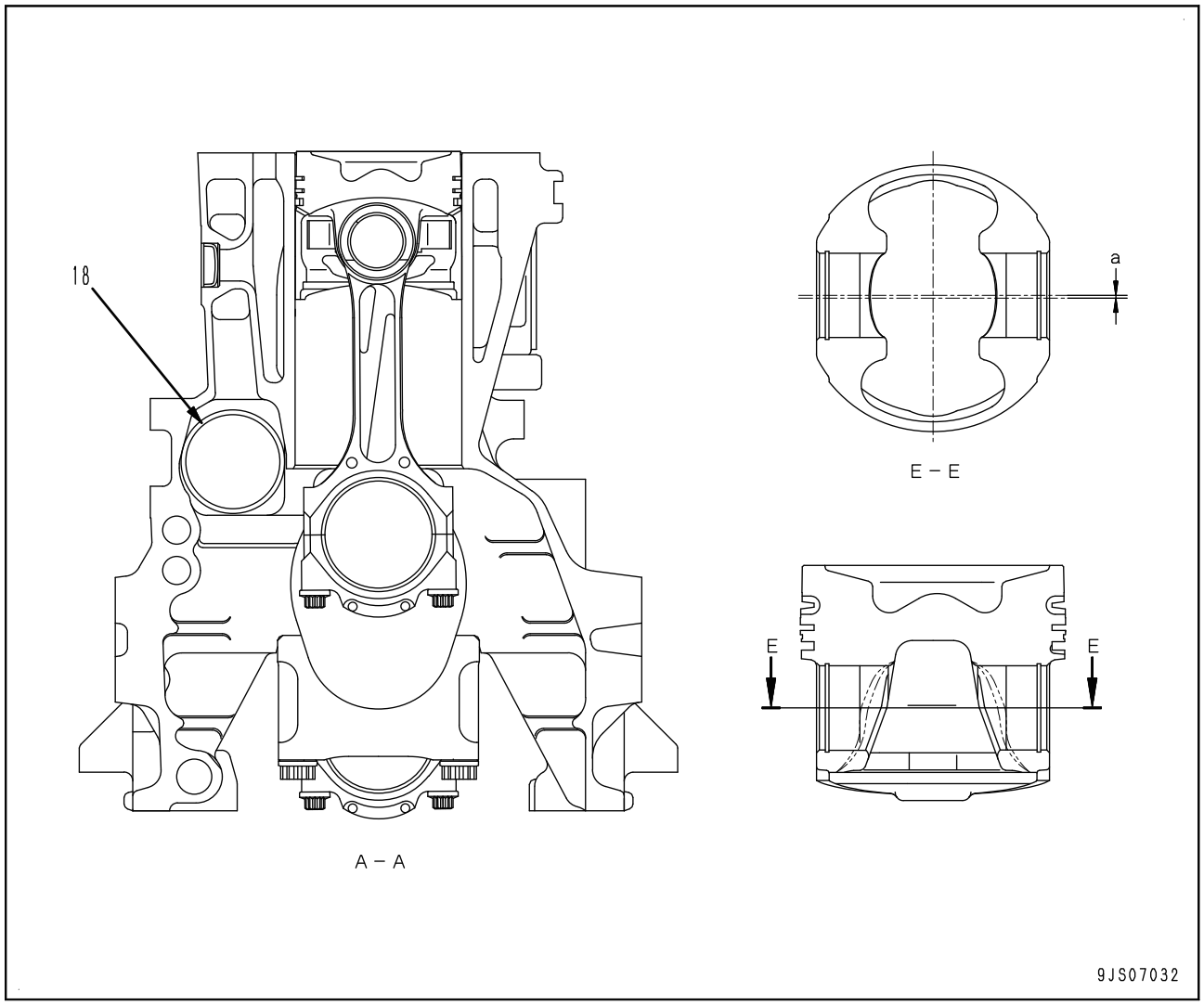
Cylinder
- Without liner
- Machining of inside: Honing

Main moving parts *(ENG95-R403-041-K-00-A)*

★ The shape is subject to machine models.



1. Crankshaft
2. Crank gear (number of teeth: 26)
3. Main bearing
4. Connecting rod bearing
5. Connecting rod
6. Cylinder block
7. Piston
8. Connecting rod bushing
9. Piston pin
10. Top ring
11. Second ring
12. Oil ring
13. Thrust bearing
14. Connecting rod cap
15. Connecting rod cap bolt
16. Main bearing cap
17. Main bearing cap bolt



18. Camshaft bushing

a: Offset

Specifications *(ENG95-R403-030-K-00-A)*

Crankshaft

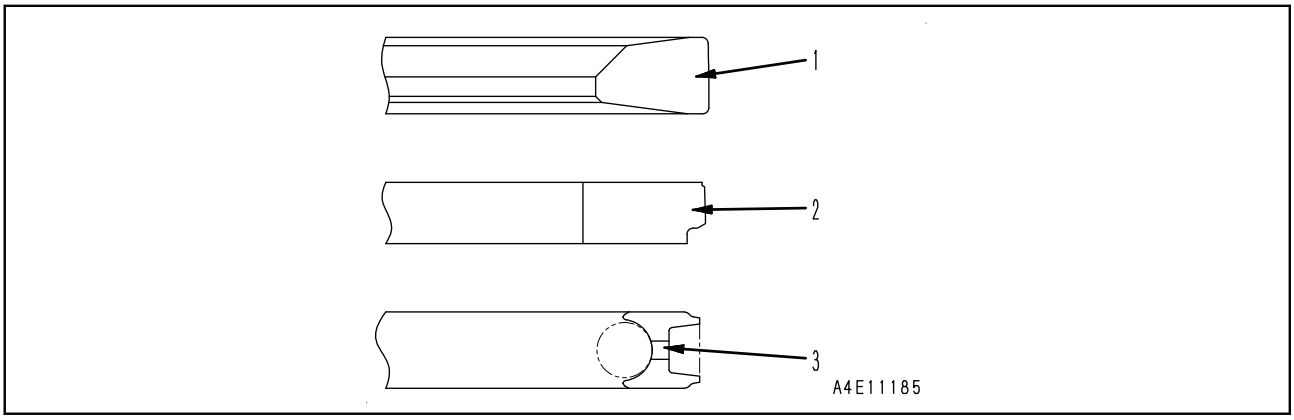
- Closed die forging

Piston

- 2-stage combustion chamber for direct fuel injection
- Center of piston pin hole is offset by 1.0 mm

(for vibration reduction)

Piston ring

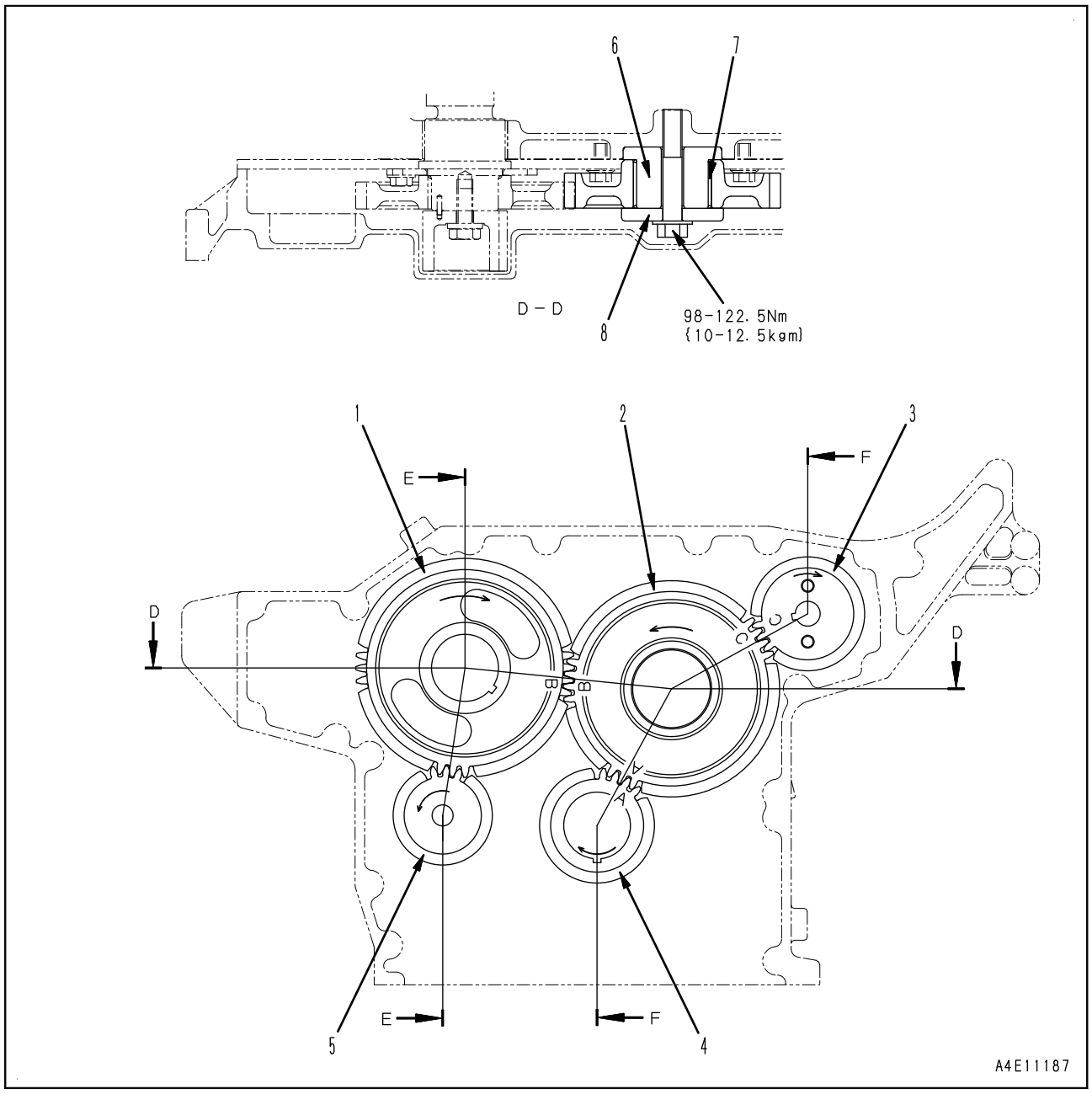


Top ring (1): Keystone, inner cut, barrel face, and hard chrome plating on both sides
Second ring (2): Flat, taper face, undercut, and hard chrome plating
Oil ring (3): With coil expander, nitriding

Timing gear *(ENG95-A5A0-041-K-00-A)*

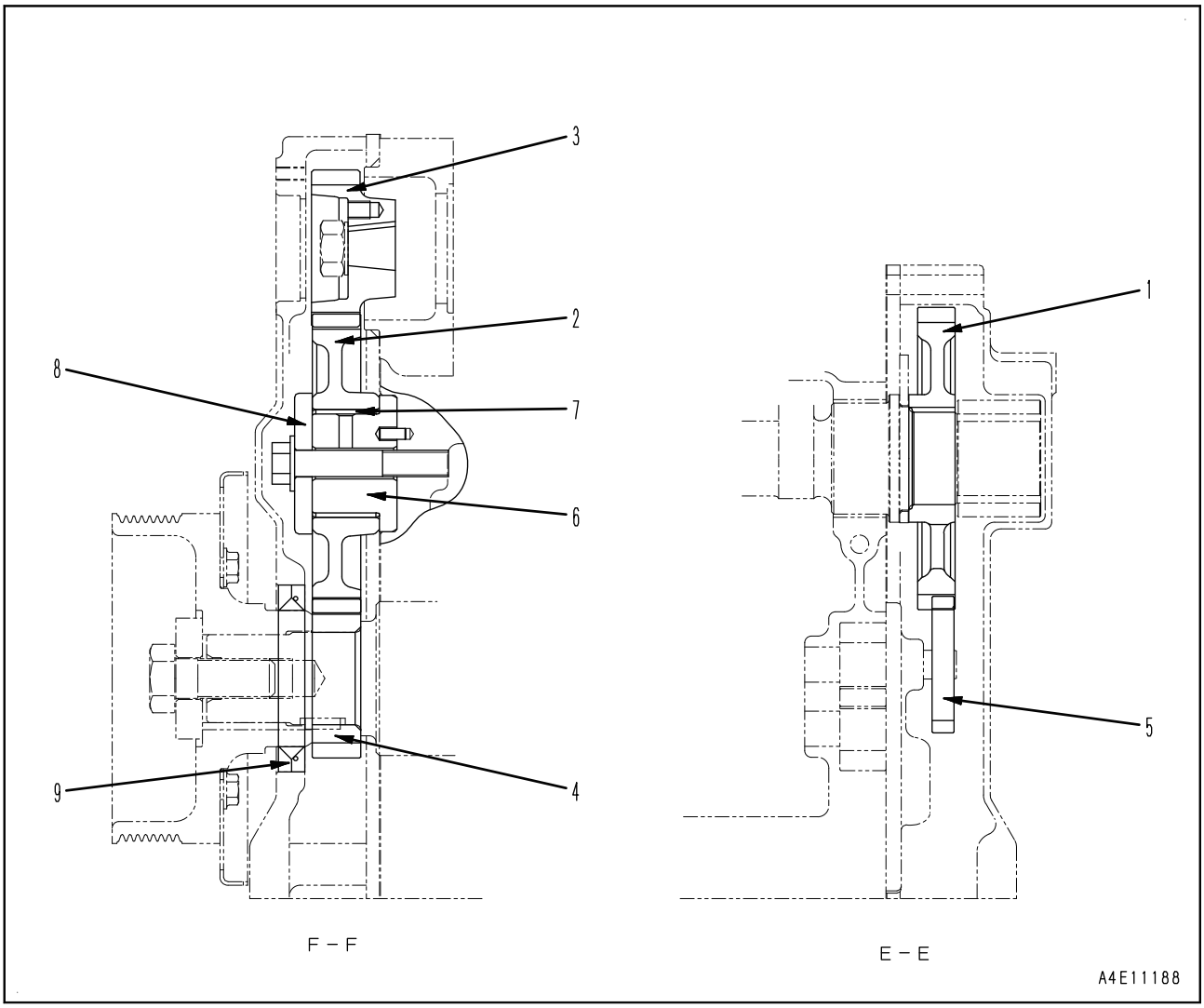
★ The shape is subject to machine models.

Without front PTO (spur gear)



A, B, C: Matchmarks of gears

1. Cam gear (number of teeth: 52)
2. Idler gear (number of teeth: 52)
3. Supply pump drive gear (number of teeth: 26)
4. Crank gear (number of teeth: 26)
5. Oil pump drive gear (number of teeth: 22)
6. Shaft
7. Bushing
8. Thrust plate



1. Cam gear (number of teeth: 52)
2. Idler gear (number of teeth: 52)
3. Supply pump drive gear (number of teeth: 26)
4. Crank gear (number of teeth: 26)
5. Oil pump drive gear (number of teeth: 22)
6. Shaft
7. Bushing
8. Thrust plate
9. Front seal

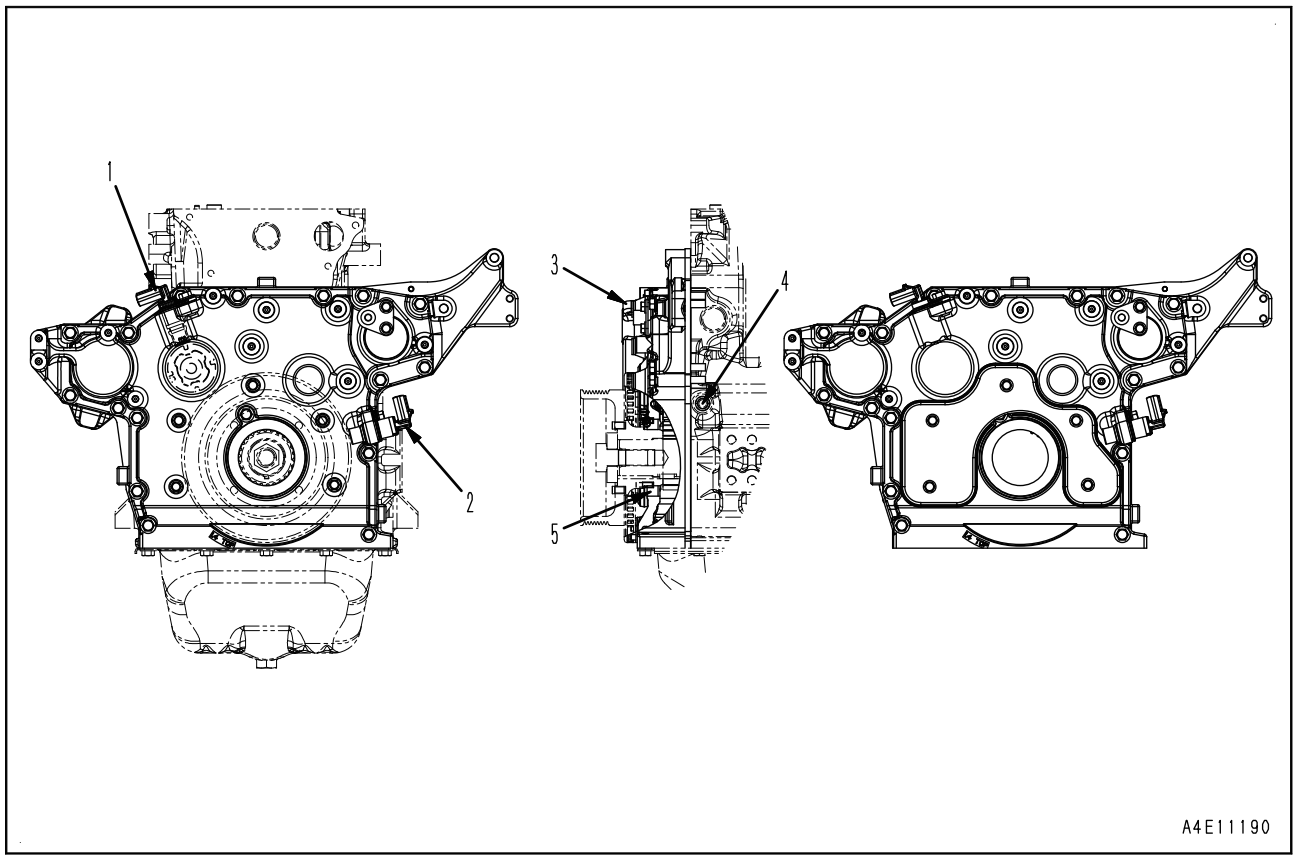
Specifications *(ENG95-A5A0-030-K-00-A)*

Front seal

- Single lip with dust seal

Front cover *(ENG95-A5B2-041-K-00-A)*

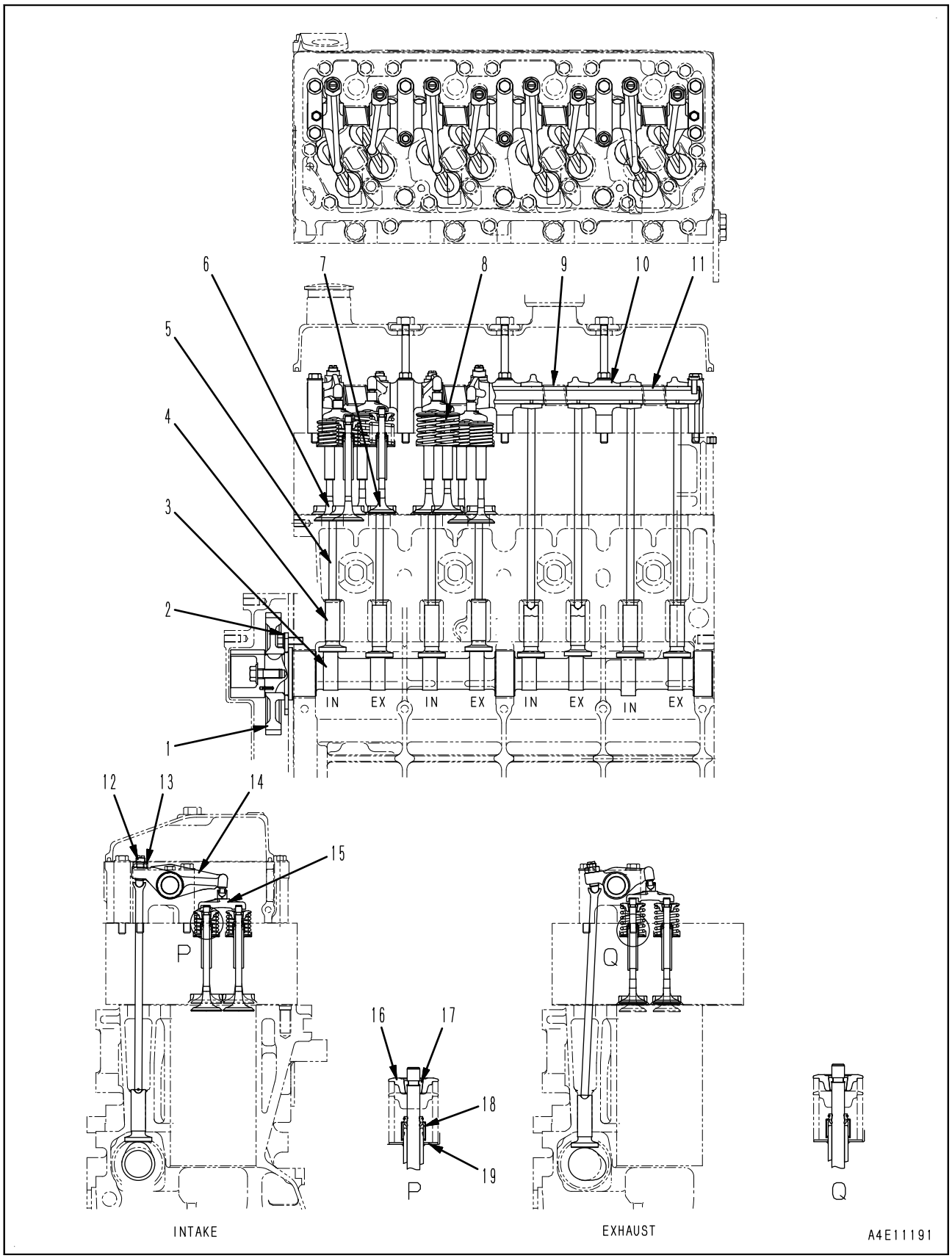
★ The shape is subject to machine models.



1. Bkup (cam) speed sensor mounting hole
2. Ne (crank) speed sensor mounting hole
3. Front gear housing
4. Engine oil pressure switch mounting hole
5. Front seal

Valve system *(ENG95-A700-041-K-00-A)*

★ The shape is subject to machine models.



1. Cam gear (number of teeth: 52)
2. Thrust plate

3. Camshaft
4. Tappet
5. Push rod
6. Intake valve
7. Exhaust valve
8. Valve spring
9. Rocker arm spring
10. Rocker arm bracket
11. Rocker arm shaft
12. Adjustment screw
13. Lock nut
14. Rocker arm
15. Crosshead
16. Spring seat
17. Valve cotter
18. Valve seal
19. Spring seat

Specifications

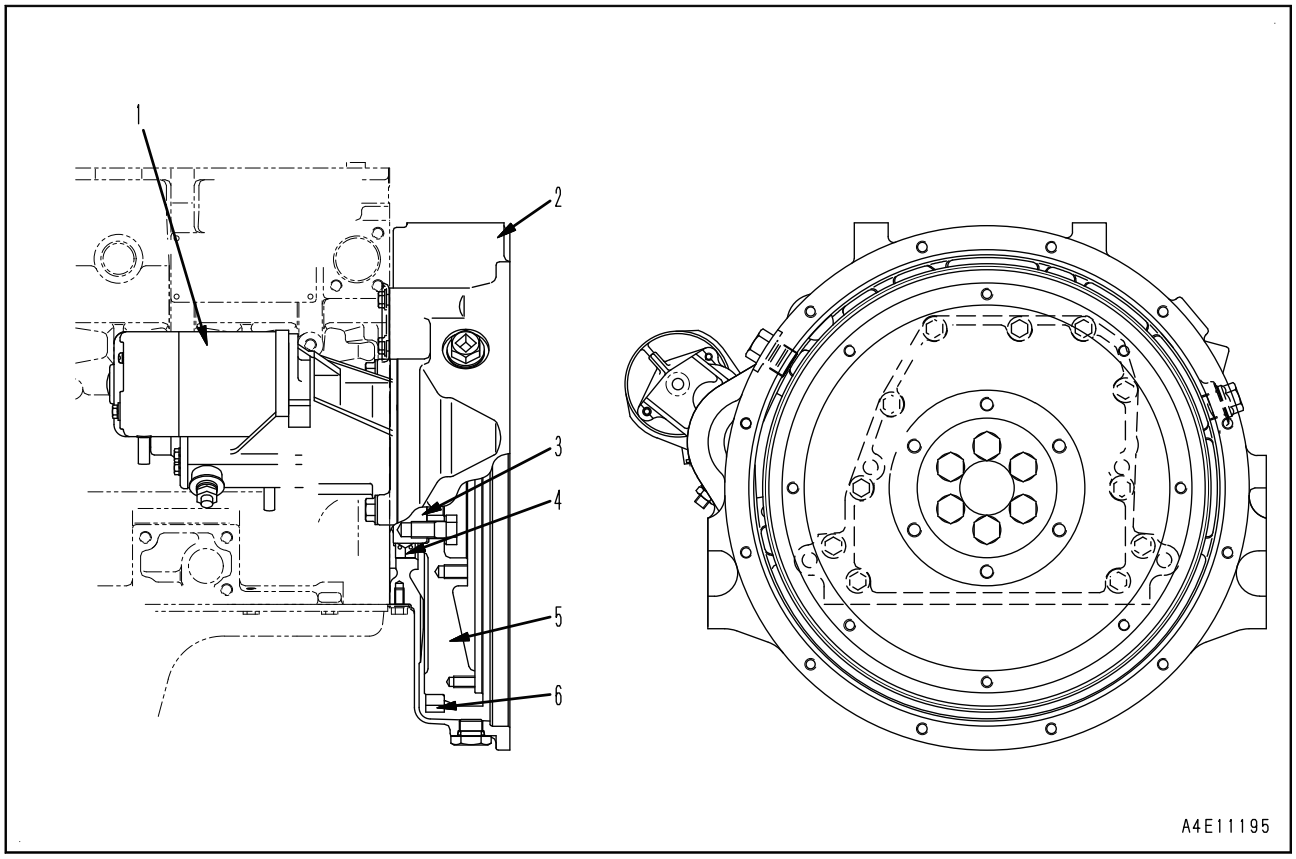
Valve lift

- Intake valve: 8.5 mm
- Exhaust valve: 9.1 mm

Flywheel and flywheel housing *(ENG95-A560-041-K-00-A)*

Without rear PTO

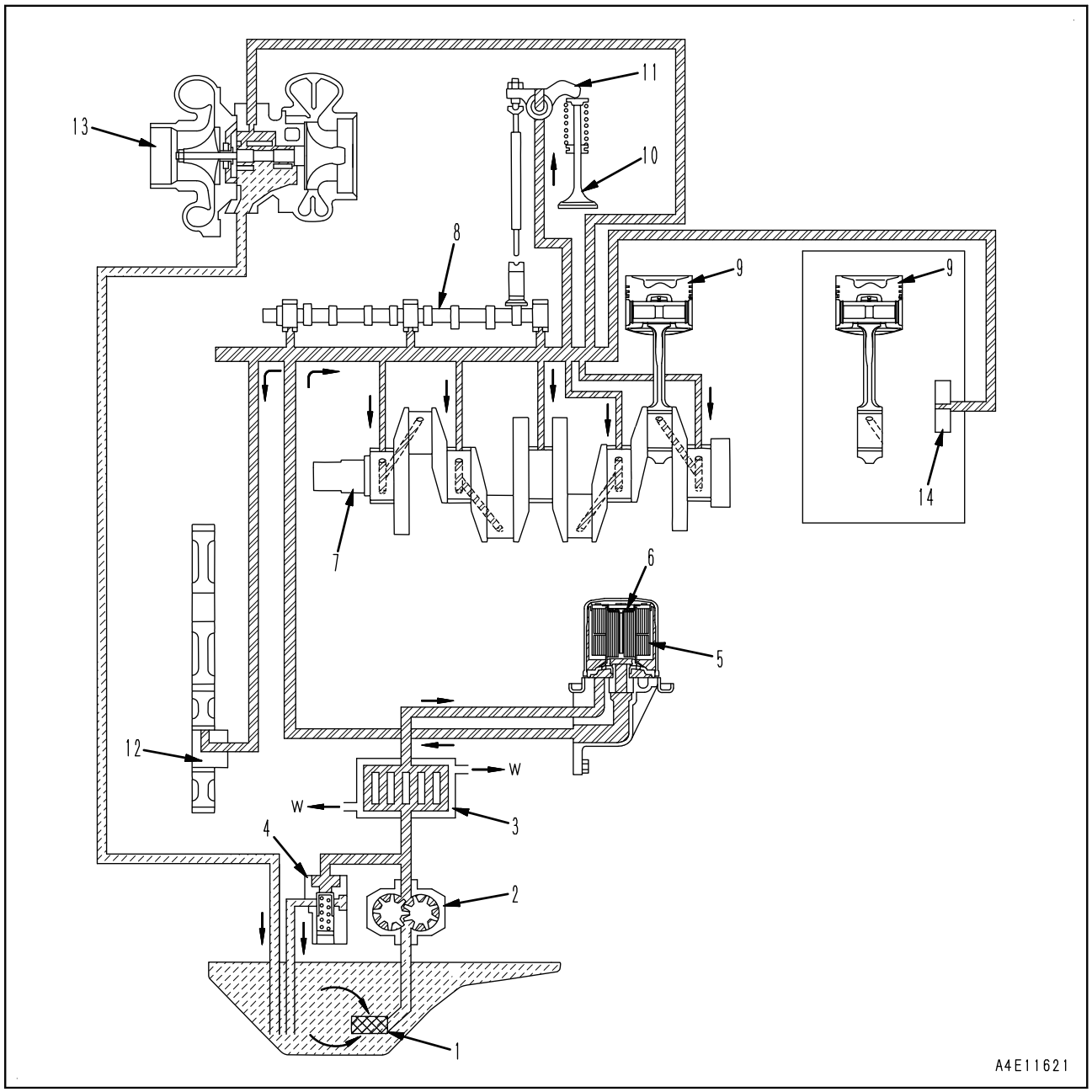
★ The shape is subject to machine models.



1. Starting motor
2. Flywheel housing
3. Crankshaft
4. Rear seal (For wet type: Double lip)
5. Flywheel
6. Ring gear (number of teeth: 127)

Lubrication system *(ENG107-AB00-001-K-00-A)*

Lubrication system chart *(ENG95-AB00-052-K-00-A)*

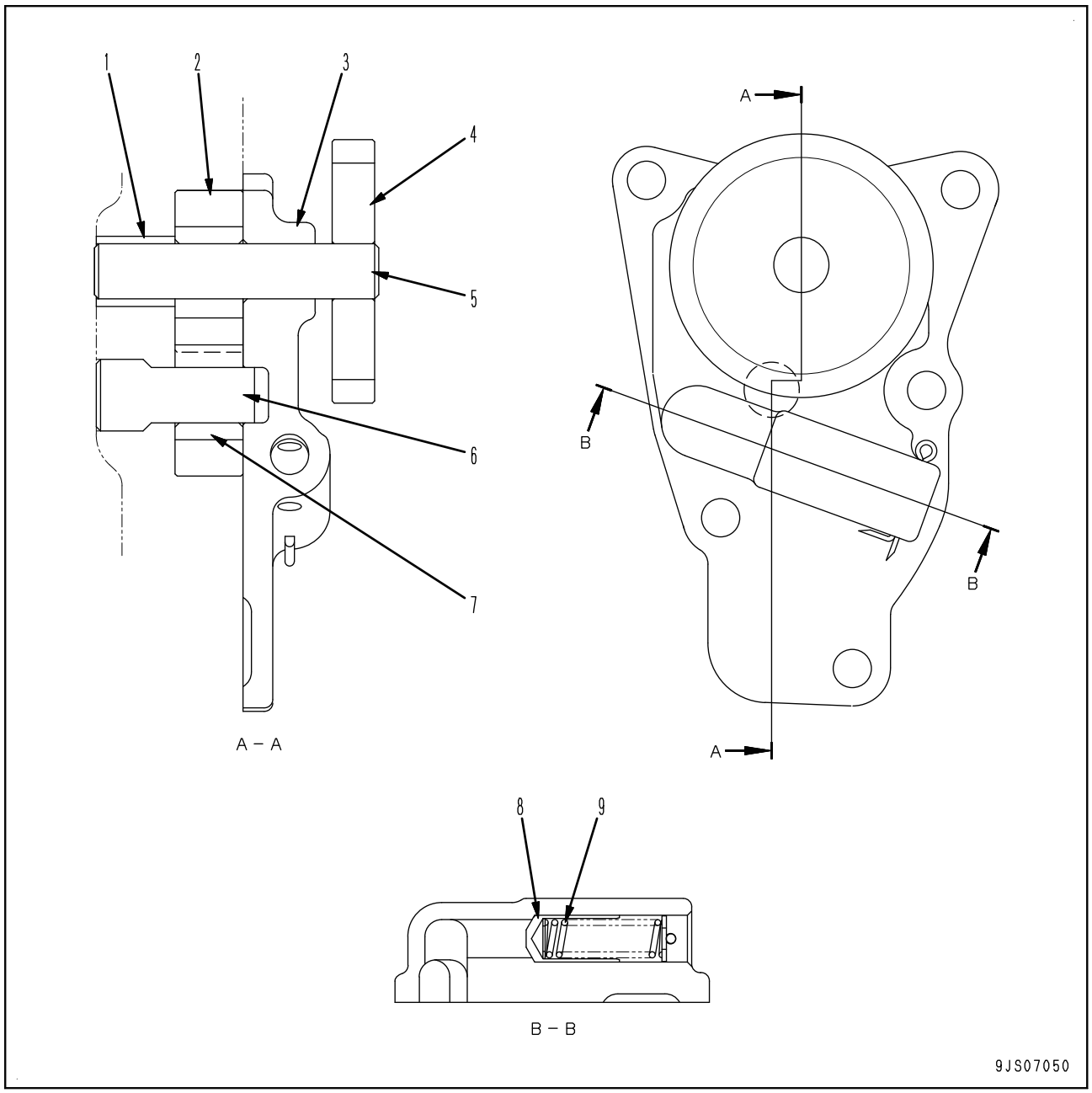


1. Oil strainer
2. Oil pump
3. Oil cooler
4. Regulator valve
5. Oil filter
6. Safety valve
7. Crankshaft
8. Camshaft
9. Piston
10. Intake and exhaust valves
11. Rocker arm
12. Timing gear

13. Turbocharger
14. Piston cooling

Oil pump *(ENG95-AB50-041-K-00-A)*

★ The shape is subject to machine models.



1. Bushing
2. Drive gear (number of teeth: 7)
3. Pump cover
4. Pump drive gear (number of teeth: 22)
5. Drive shaft
6. Driven shaft
7. Driven gear (number of teeth: 7)
8. Regulator valve
9. Valve spring

Specifications *(ENG95-AB50-030-K-00-A)*

Oil pump

- Type: Gear pump

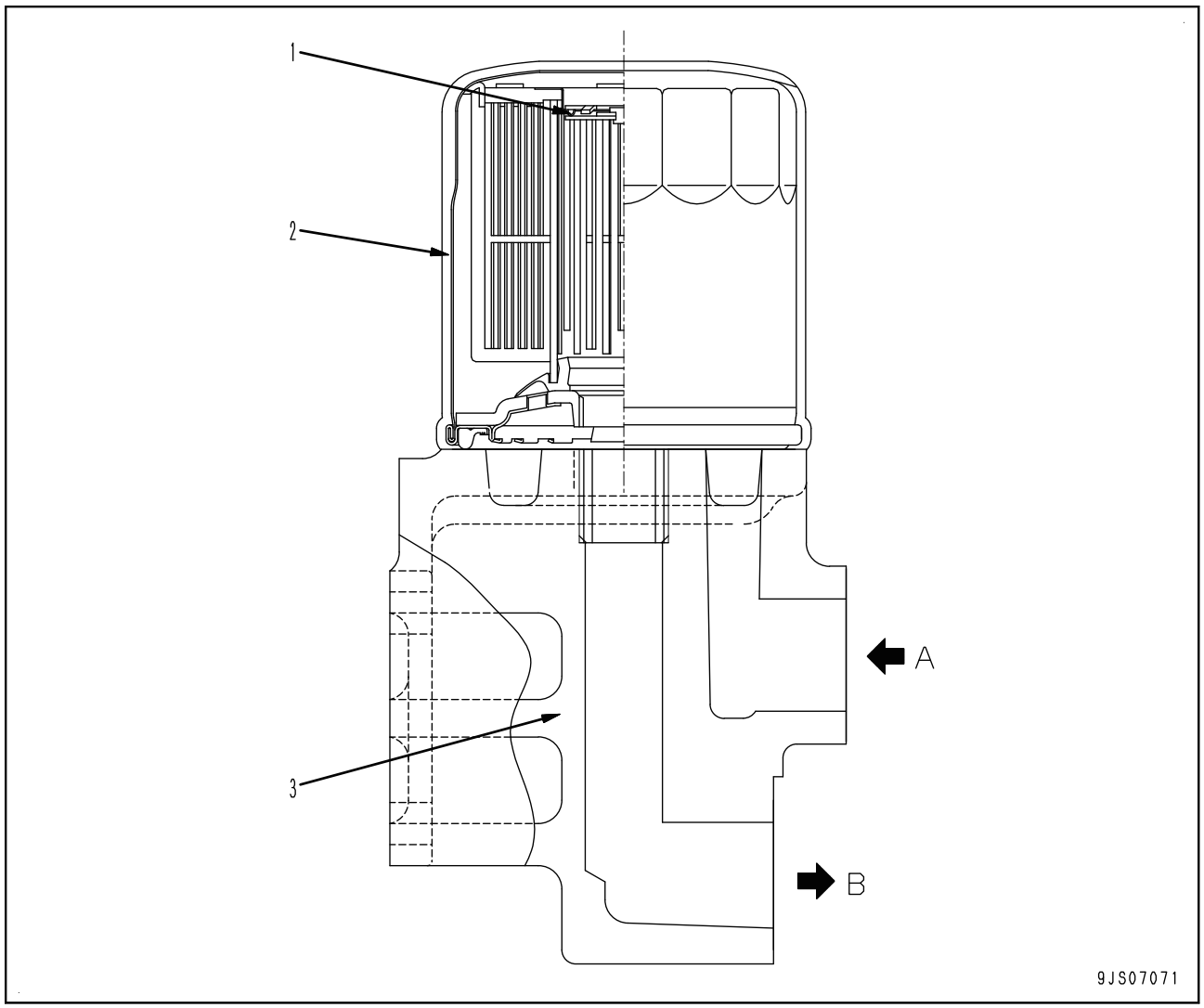
- Speed: Engine speed x 1.182

Regulator valve

- Operating pressure: 588 ± 49 kPa {6 ± 0.5 kg/cm^2}

Oil filter *(ENG95-ABC0-041-K-00-A)*

★ The shape is subject to machine models.



1. Relief valve
2. Cartridge
3. Bracket

A: Oil inlet

B: Oil outlet

Specifications

Relief valve

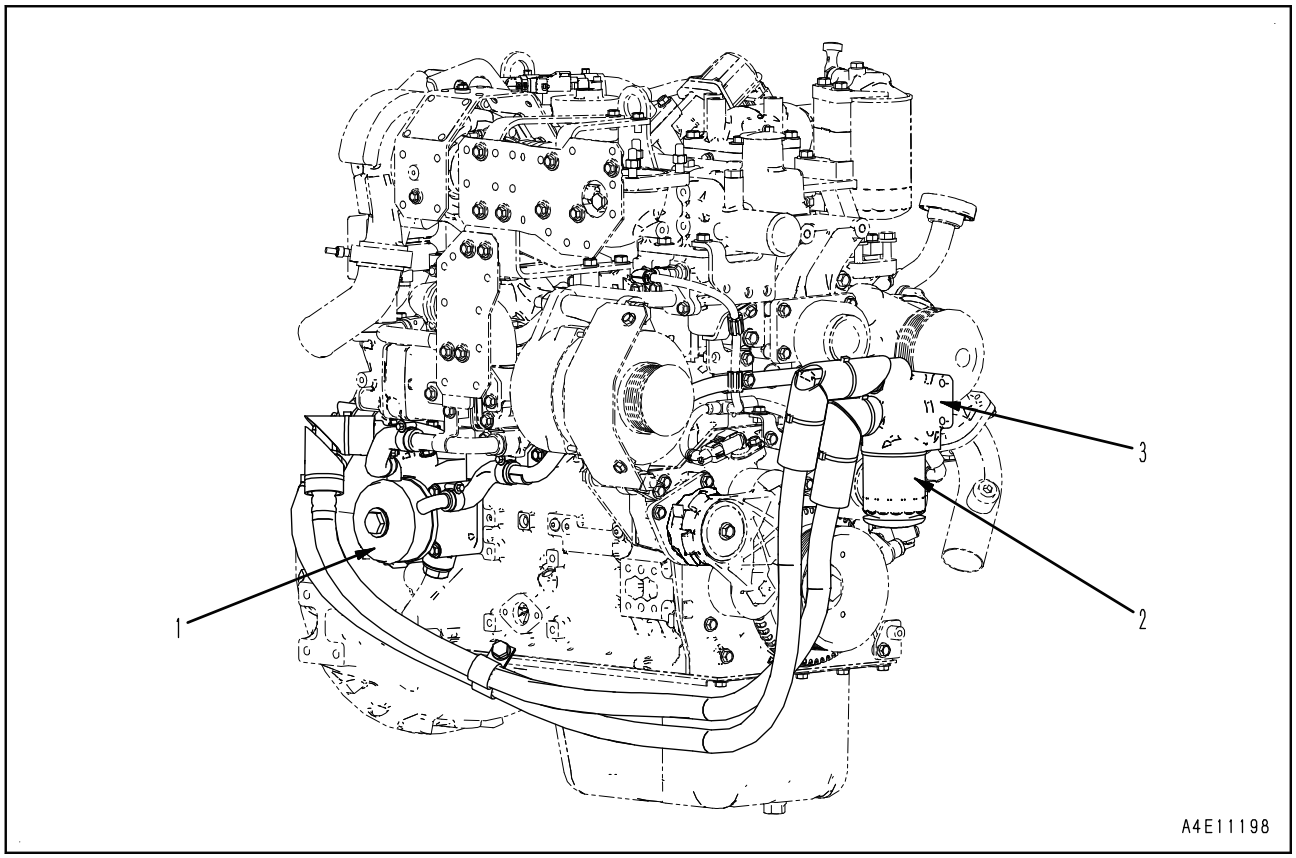
- Cracking pressure: 100 ± 20 kPa {1 ± 0.2 kg/cm^2}

Function *(ENG107-ABC0-042-K-00-A)*

- During the engine lubrication process, impurities such as carbon, sludge, and wear particles will mix in the engine oil. The filter removes these impurities.
- A safety valve is provided to bypass the engine oil when the filter gets clogged.
- To make filter cartridge replacement easier, this is remotely mounted on some machines.

Oil filter mounting *(ENG95-H324-041-K-00-A)*

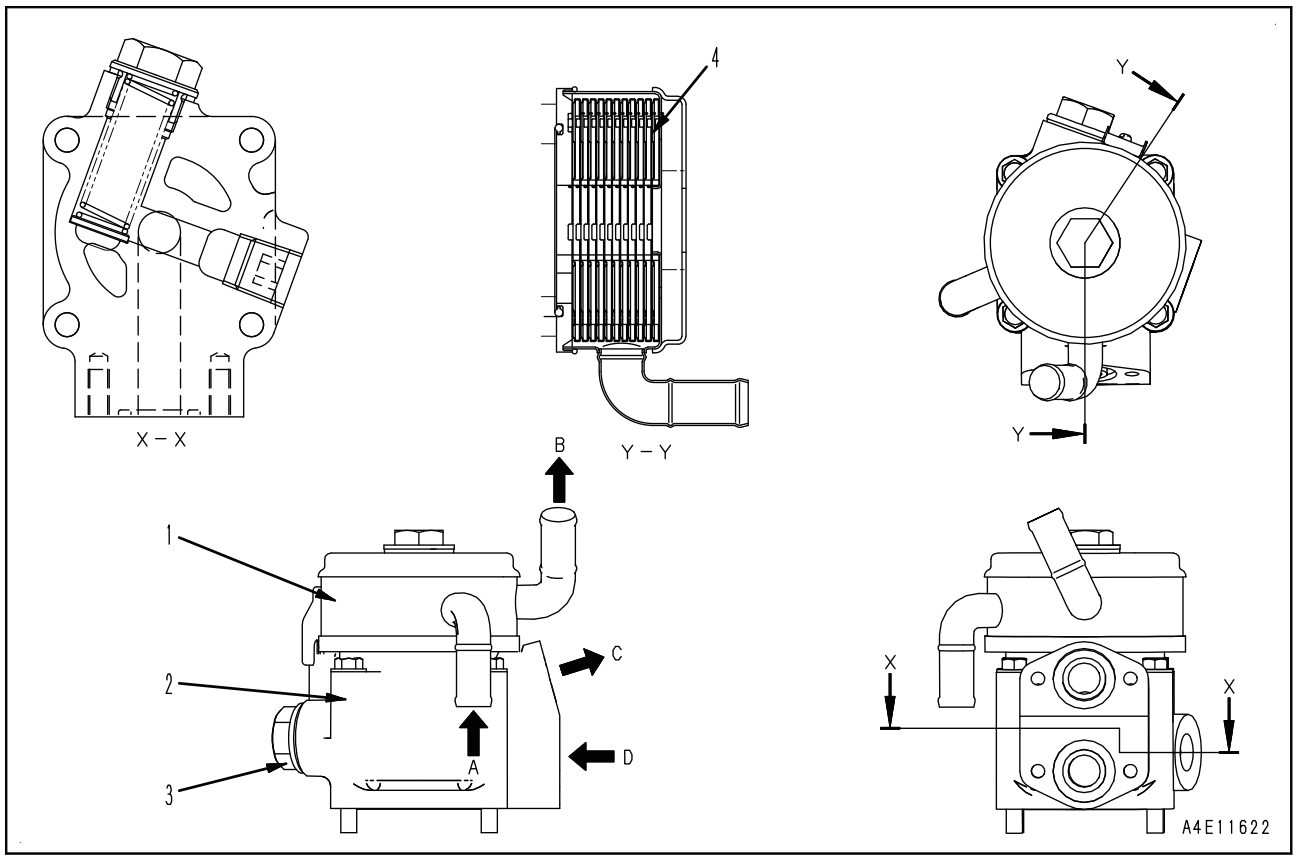
★ The shape is subject to machine models.



1. Oil cooler
2. Cartridge
3. Bracket

Oil cooler *(ENG95-B810-041-K-00-A)*

★ The shape is subject to machine models.



1. Oil cooler
2. Adapter
3. Safety valve
4. Oil cooler core assembly

A: Coolant inlet
B: Coolant outlet
C: Oil outlet
D: Oil inlet

Specifications *(ENG95-B810-030-K-00-A)*

Oil cooler

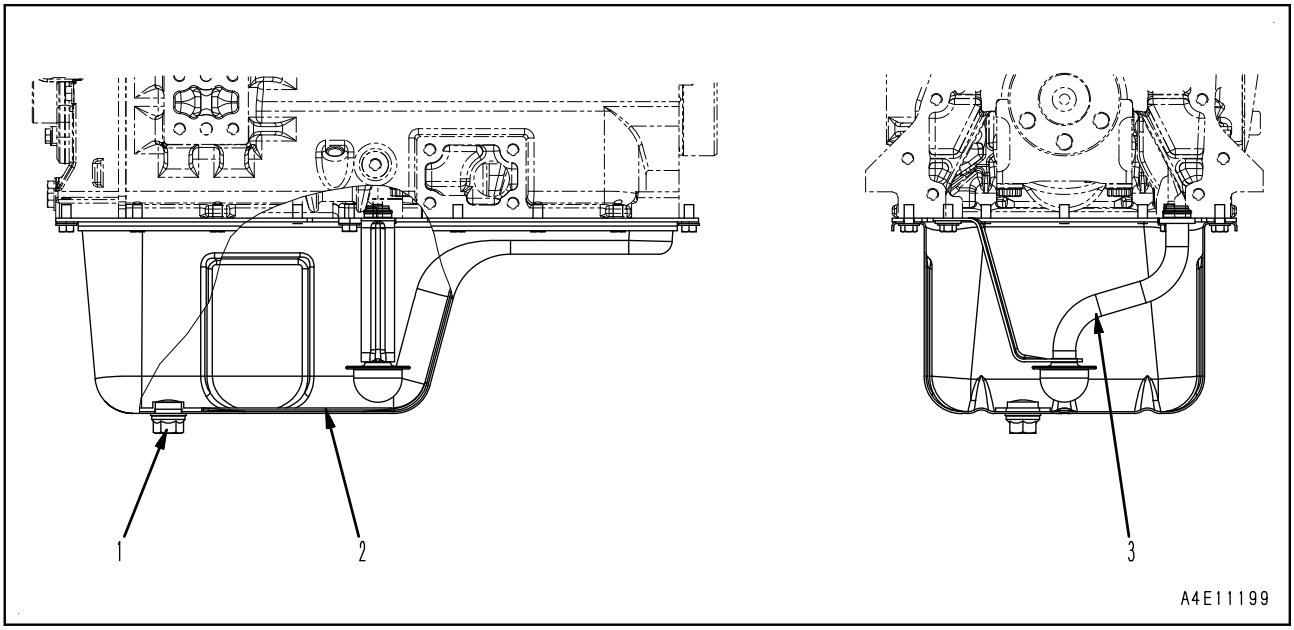
- Type of core: Water-cooled multiple disc
- Number of core layers: 11

Function *(ENG95-B810-042-K-00-A)*

- This is installed between the oil pump and oil filter circuit to cool the engine oil which lubricates the inside of the engine.

Oil pan *(ENG95-AB20-041-K-00-A)*

★ The shape is subject to machine models.

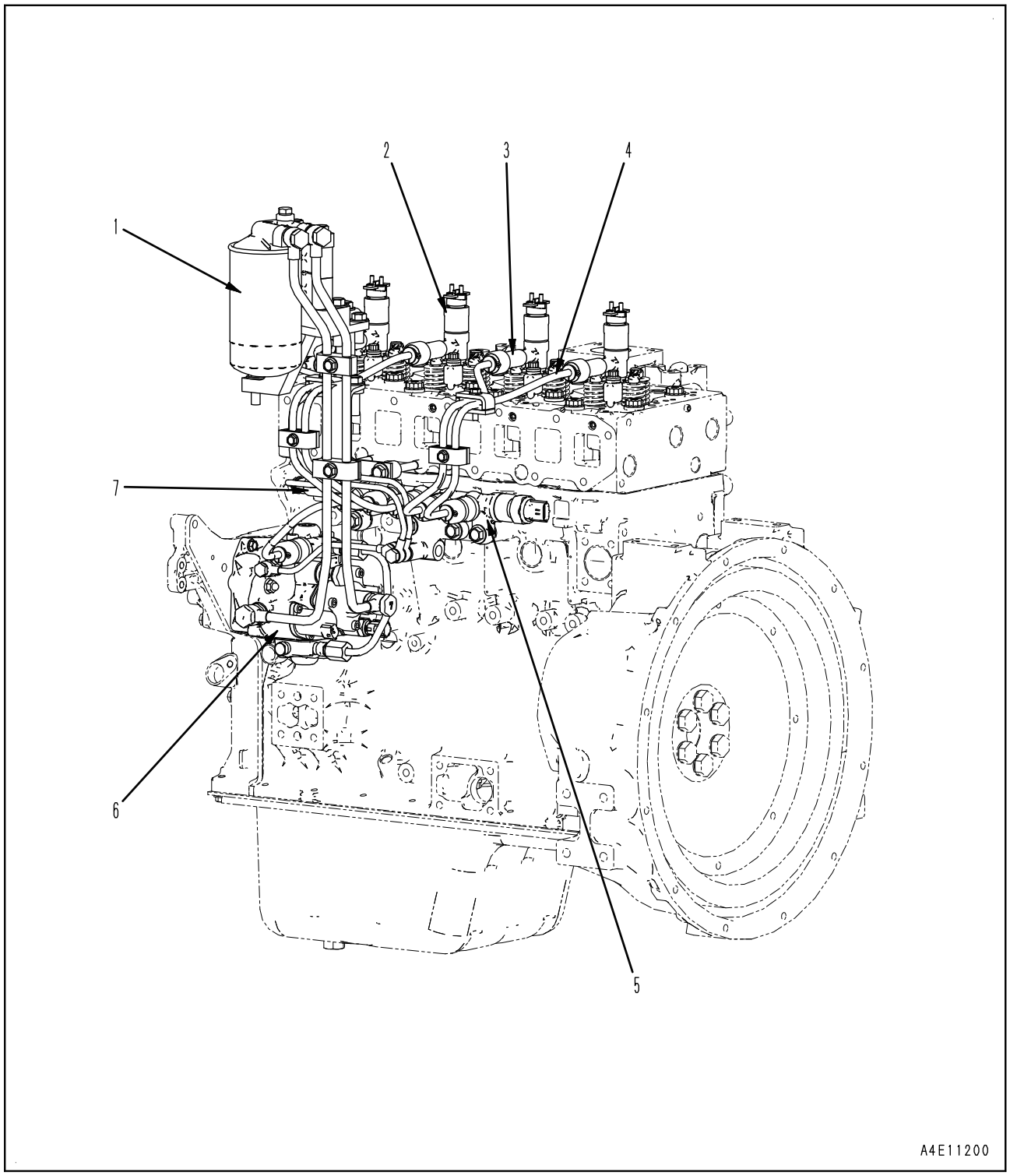


1. Drain plug
2. Oil pan
3. Oil suction pipe (with strainer)

Fuel system *(ENG107-AD00-001-K-00-A)*

Fuel system parts layout drawing *(ENG95-AD00-04D-K-00-A)*

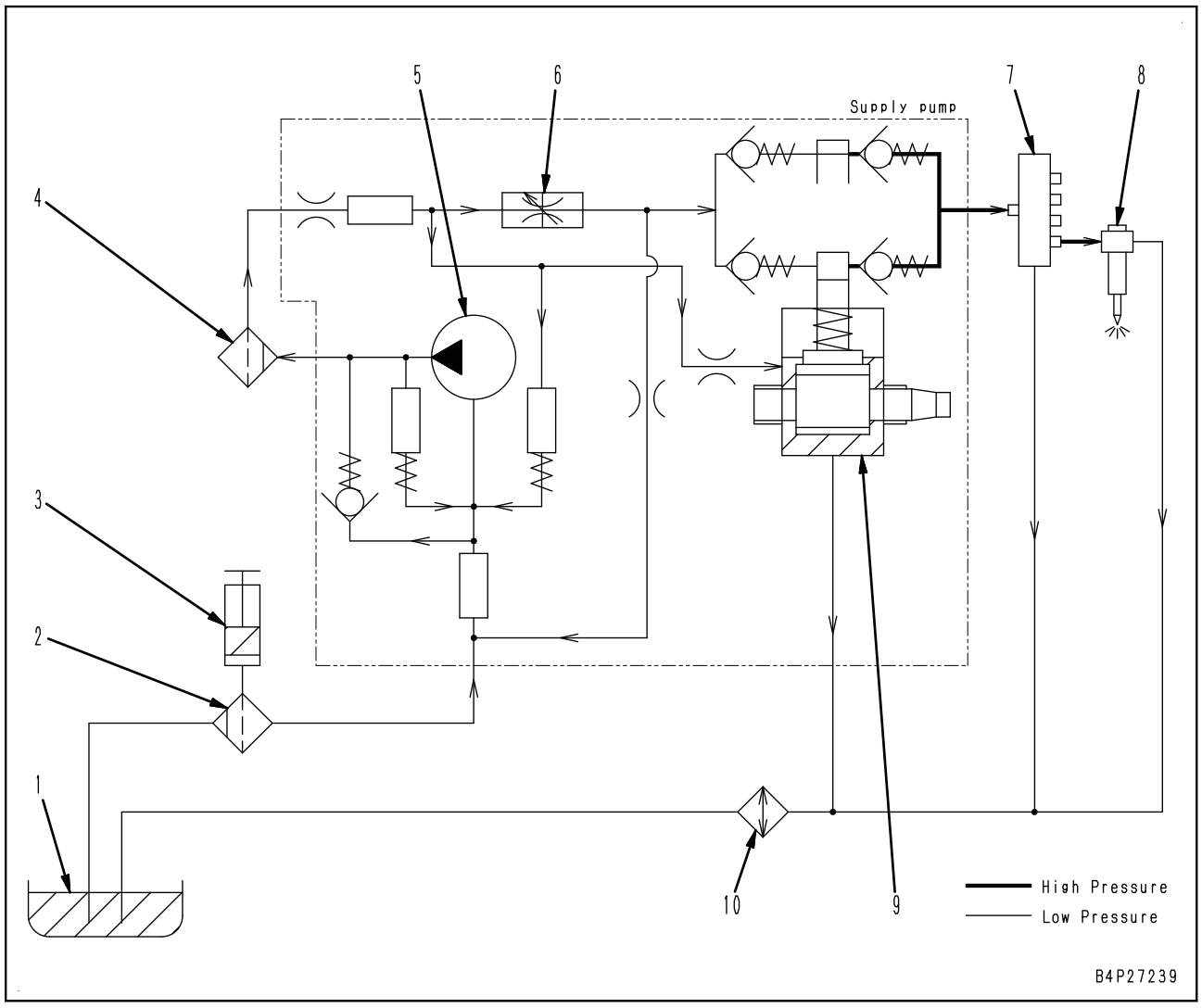
★ The shape is subject to machine models.



1. Main filter
2. Injector
3. Inlet connector
4. High-pressure pipe
5. Common rail

6. Supply pump
7. Pressure limiter valve

Fuel system circuit diagram *(ENG95-AD00-052-K-00-A)*



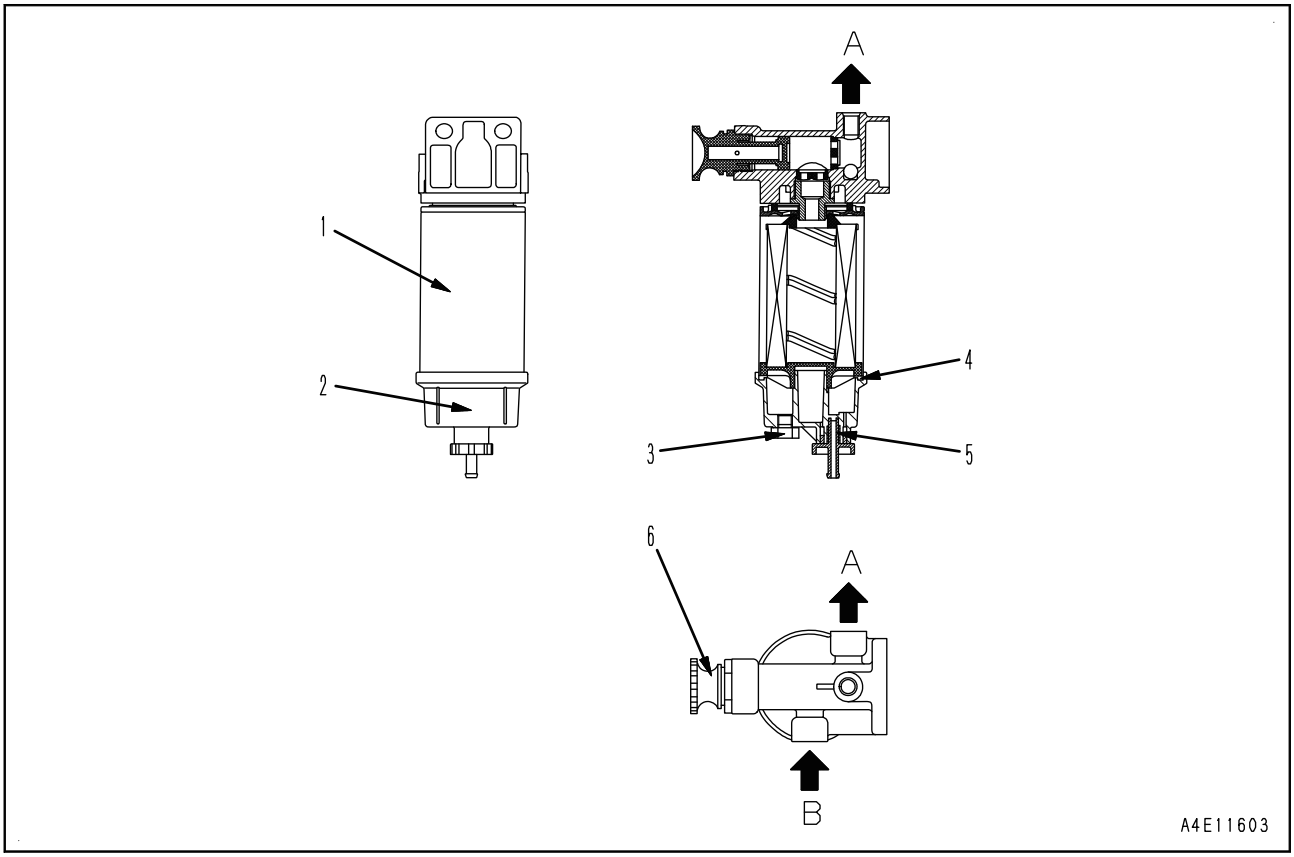
1. Fuel tank
2. Prefilter
3. Priming pump
4. Prefilter
5. Feed pump
6. SCV (Suction control valve)
7. Common rail pressure
8. Injector
9. Supply pump
10. Fuel cooler (may not installed to some machine models)

Operation *(ENG95-AD00-044-K-00-A)*

- The fuel system is a high-pressure common rail system controlled electronically. The high-pressure common rail system consists of 4 main components.
- Those components are feed pump (low-pressure fuel pump) (5), supply pump (high-pressure fuel pump) (9), common rail (7), and injector (8).
- The fuel system uses injector (8) driven with a solenoid.
- Engine controller (EC) controls fuel supply rate and timing to injector (8) by driving the solenoid in each injector (8).
- The fuel supply rate and timing are controlled precisely by controlling the solenoid electronically.

Prefilter *(ENG95-AEA0-041-K-00-A)*

★ The shape is subject to machine models.



1. Filter cartridge
2. Clear bowl
3. Plug
4. O-ring
5. Drain valve
6. Hand primer (priming pump)

A: Fuel outlet

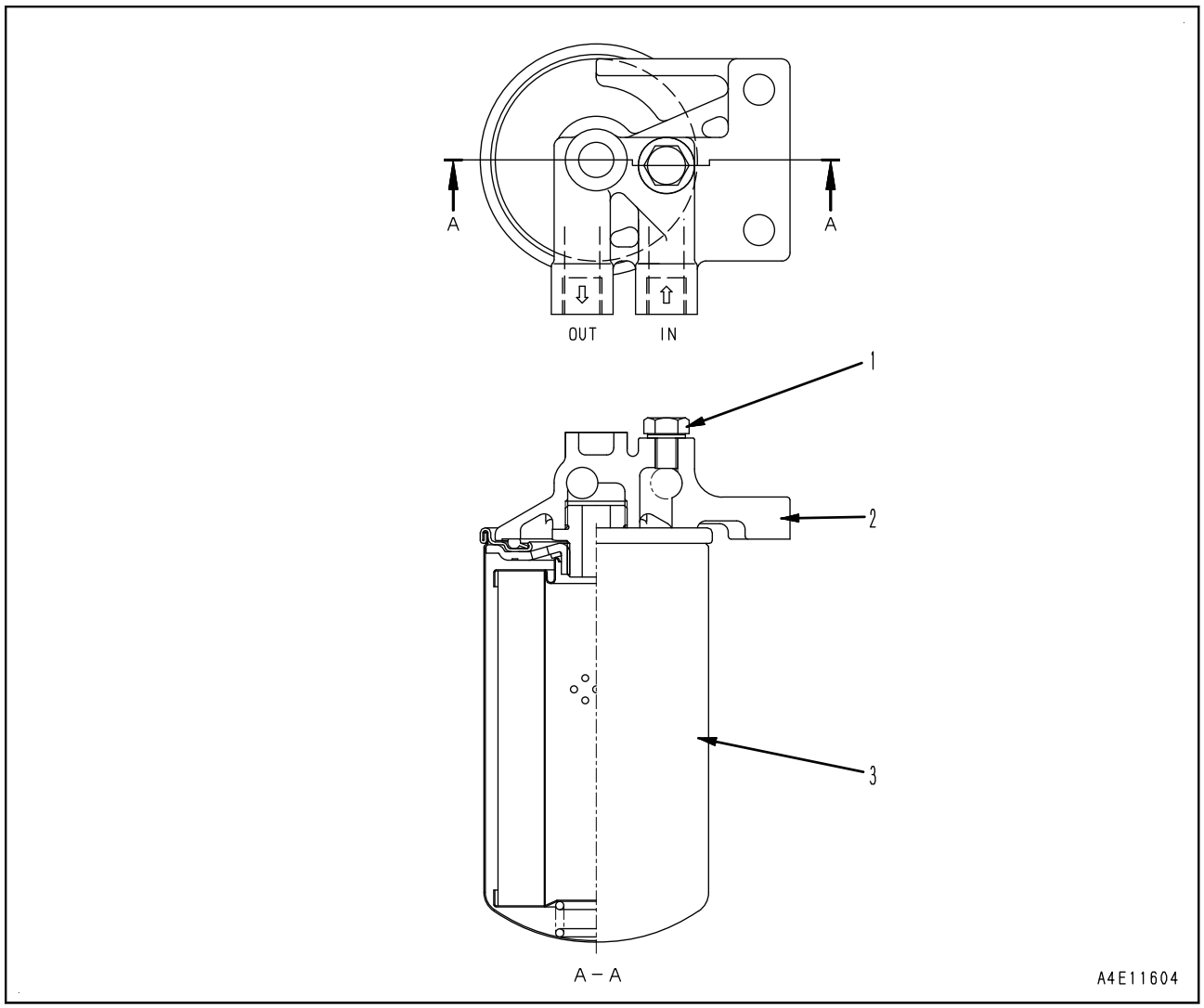
B: Fuel inlet

Function *(ENG95-AEA0-042-K-00-A)*

- Fuel flows from the fuel tank to the supply pump through the prefilter
- The prefilter is a fuel filter having a water separator to separate water accumulated in the filter.

Main filter *(ENG95-AED0-041-K-00-A)*

★ The shape is subject to machine models.

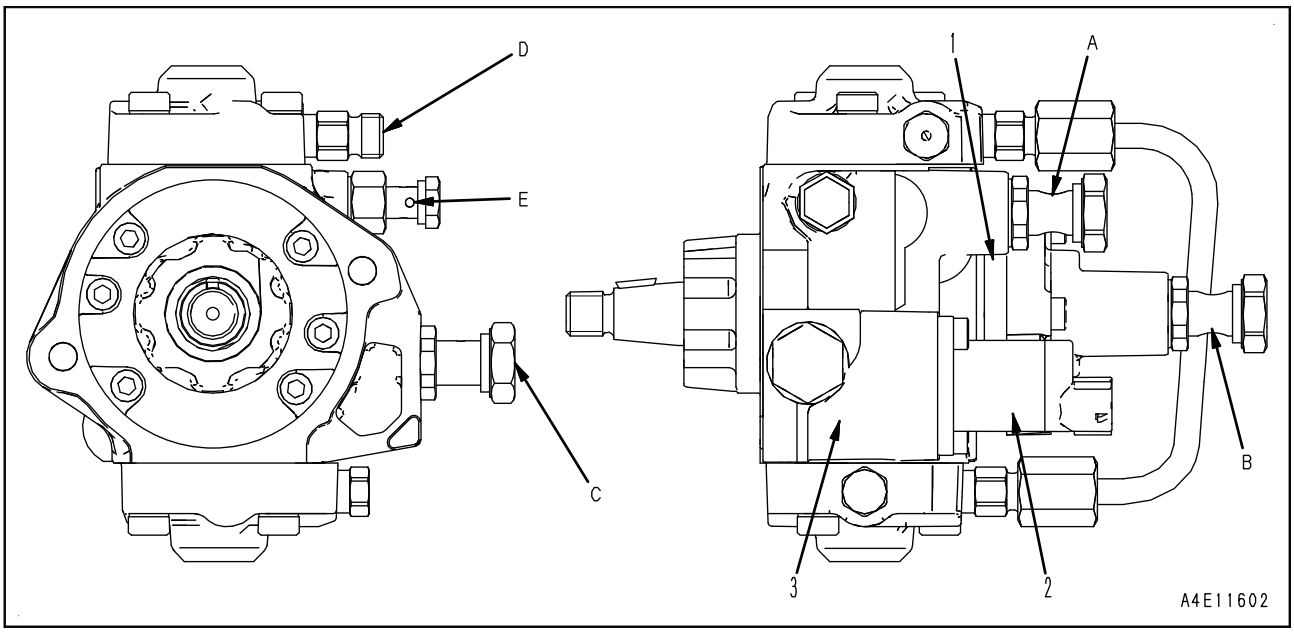


1. Plug
2. Filter head
3. Cartridge

Function *(ENG107-AED0-042-K-00-A)*

- Fuel from the feed pump (low-pressure pump) flows through the main filter to the supply pump (high-pressure pump).
- The main filter removes impurities from the fuel.
- To make cartridge replacement easier, this is remotely mounted on some machines.

Supply pump *(ENG95-AD70-041-K-00-A)*



1. Feed pump
2. SCV (Suction control valve)
3. Supply pump

A: Fuel inlet (from fuel tank)

B: Fuel outlet (to fuel filter)

C: Fuel inlet (from fuel filter)

D: Fuel outlet (to common rail)

E: Overflow

Specifications *(ENG95-AD70-030-K-00-A)*

Supply pump

- Model: HP3 manufactured by DENSO
- Lubrication method: Lubrication with fuel

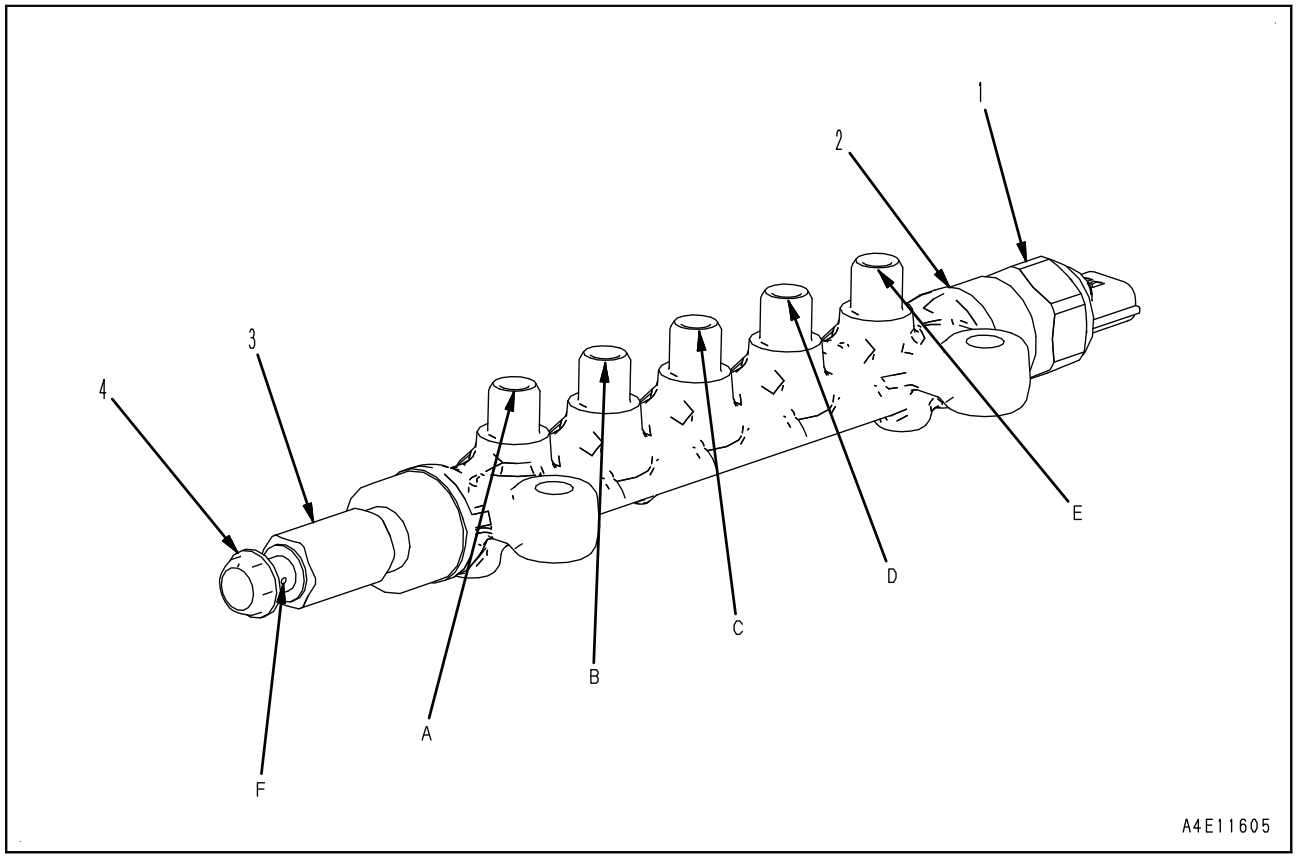
Governor

- Type: Electronic control

Function *(ENG107-AD70-042-K-00-A)*

- The supply pump consists of a feed pump (low-pressure pump) and a supply pump (high-pressure pump) is driven by the power from the camshaft.
- The feed pump (low-pressure pump) supplies fuel to the main filter.
- The supply pump (high-pressure pump) sends fuel to the common rail.

Common rail *(ENG95-AE21-041-K-00-A)*



1. Common rail pressure sensor
2. Common rail pressure
3. Pressure limiter
4. Hollow screw

A: From supply pump

B: To No.1 injector

C: To No.2 injector

D: To No.3 injector

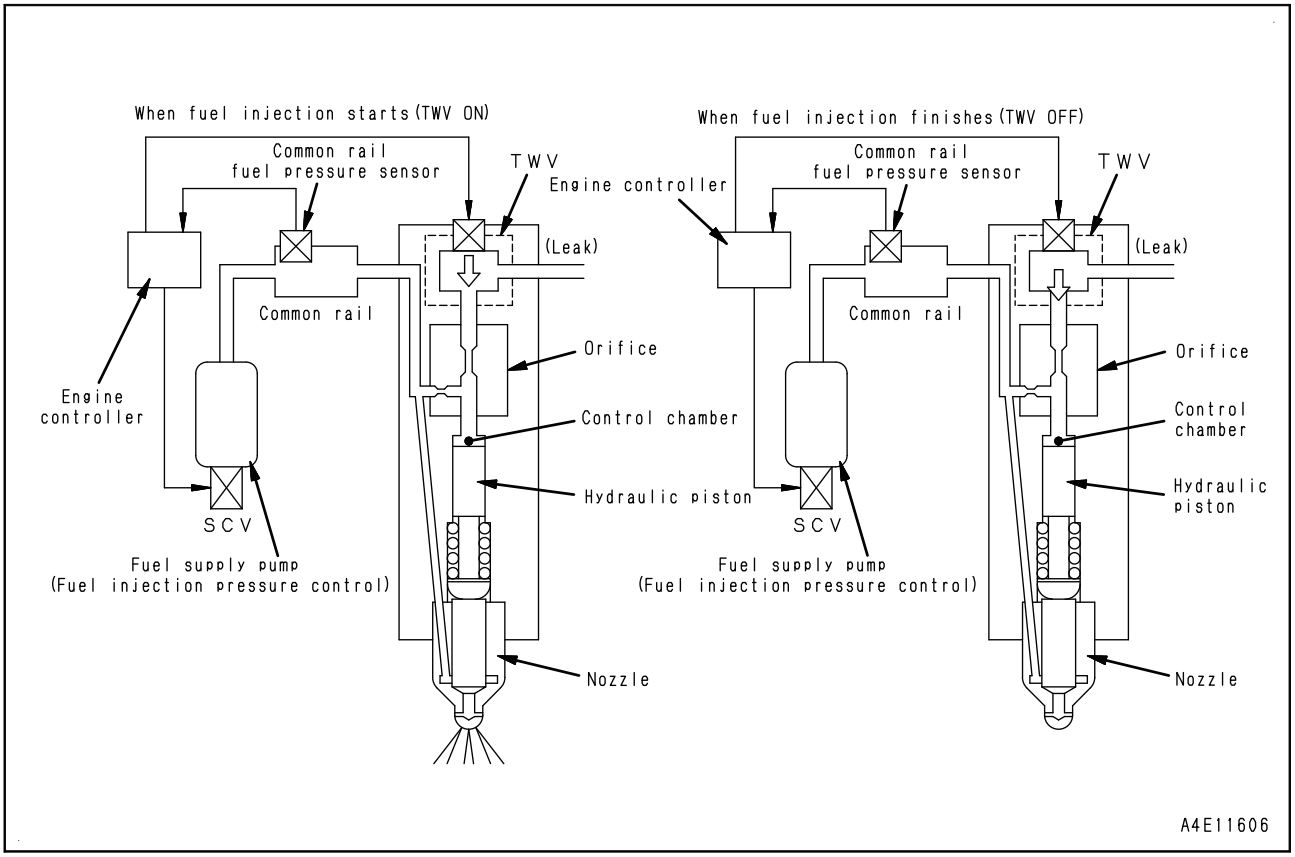
E: To No.4 injector

F: Fuel outlet when limiter opens

Structure

- Common rail (2) distributes the high-pressure fuel generated by the high pressure pump to the injectors of the cylinders.
- Common rail (2) is equipped with common rail pressure sensor (1), HP connection (B to E), and pressure limiter (3).
- The fuel injection pipes are connected to HP connections (B to E) to send the high-pressure fuel to the injectors.
- The piping of pressure limiter (3) returns to the fuel tank.

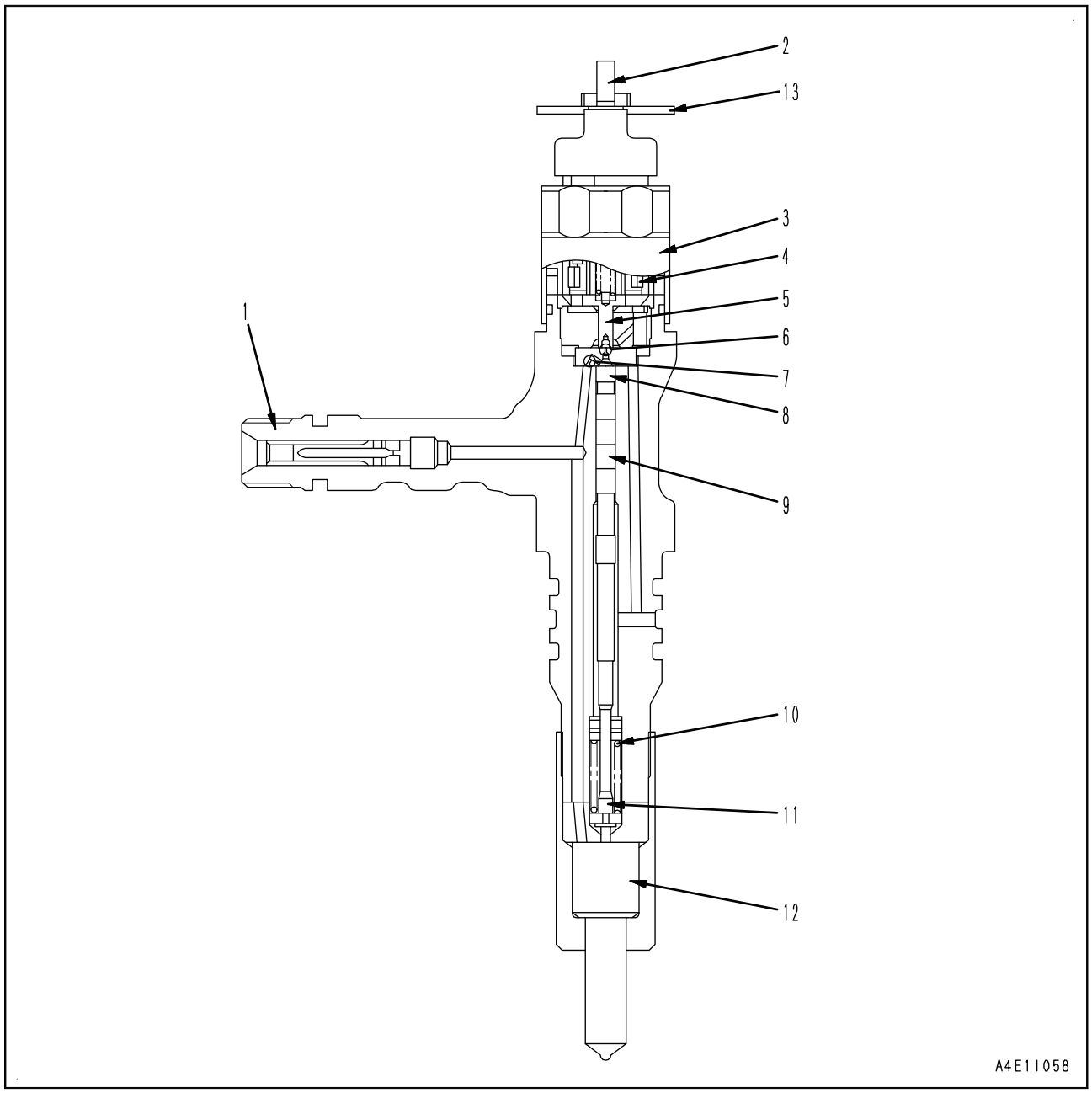
Injector *(ENG95-AE60-04A-K-00-A)*



Function *(ENG125-AE60-042-K-00-A)*

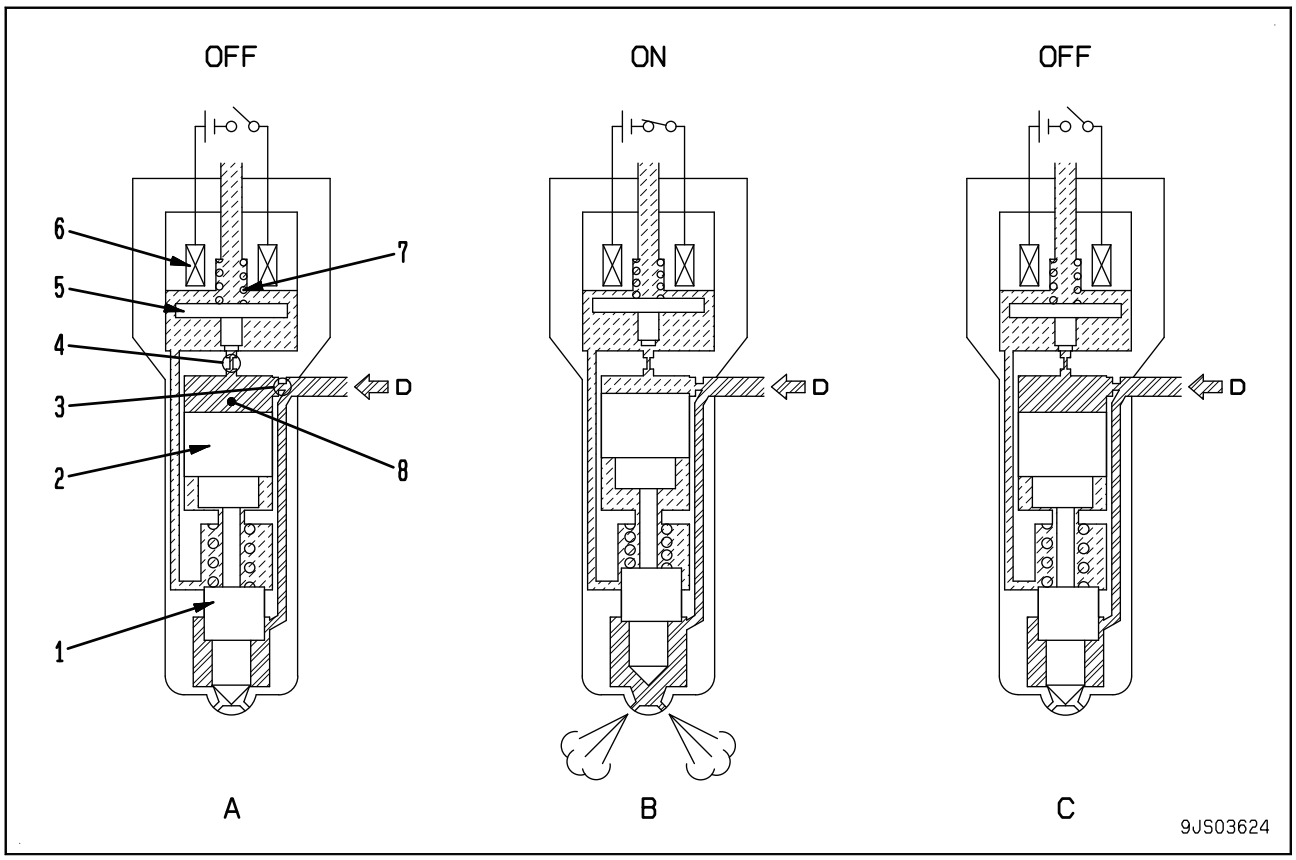
- The function of the injector is to inject the high-pressure fuel from the common rail into each combustion chamber of the engine in the optimum timing, by the optimum quantity, at the optimum injection rate, and under the optimum spray condition while referencing signals from engine controller.
- The TWV (2-way solenoid valve) controls the start and finish of fuel injection by controlling the pressure in the control chamber.
- The orifice restricts the nozzle valve opening speed to control the fuel injection rate.
- The hydraulic piston transmits the force generated by the pressure in the control chamber to the needle valve of the nozzle.
- The nozzle has the function of atomizing fuel.

Structure *(ENG125-AE60-041-K-00-A)*



1. Inlet connector
2. Terminal
3. Upper body
4. Solenoid
5. Valve body
6. Orifice (OUT)
7. Orifice (IN)
8. Pressure control chamber
9. Control piston
10. Spring
11. Pressure pin
12. Nozzle assembly
13. QR code tab

- The injector consists of the traditional nozzle section, orifice to control the fuel injection rate, hydraulic piston, and 2-way solenoid valve.



A: When fuel is not injected
B: When fuel injection is started
C: When fuel injection is finished
D: From common rail
1. Nozzle
2. Control piston
3. Orifice (IN)
4. Orifice (OUT)
5. Valve body
6. Solenoid
7. Spring
8. Pressure control chamber

Specifications *(ENG95-AE60-030-K-00-A)*

- Model: G3 manufactured by DENSO

Operation *(ENG125-AE60-044-K-00-A)*

1) When fuel is not injected (A)

- When solenoid (6) is not energized, valve body (5) is pushed down by spring (7).
- Since the high-pressure fuel is applied from the common rail to pressure control chamber (8), nozzle (1) is closed and the fuel is not injected.

2) When fuel injection is started (B)

- When solenoid (6) is energized, valve body (5) is pulled up by the electromagnetic force and the fuel passage opens.
- Since the fuel in pressure control chamber (8) flows out through orifices (3) and (4), nozzle (1) rises and fuel injection pump starts.

- The fuel injection rate is gradually increased by the function of orifices (3) and (4).
- If energization of solenoid (6) is continued, injection rate is set to the maximum.

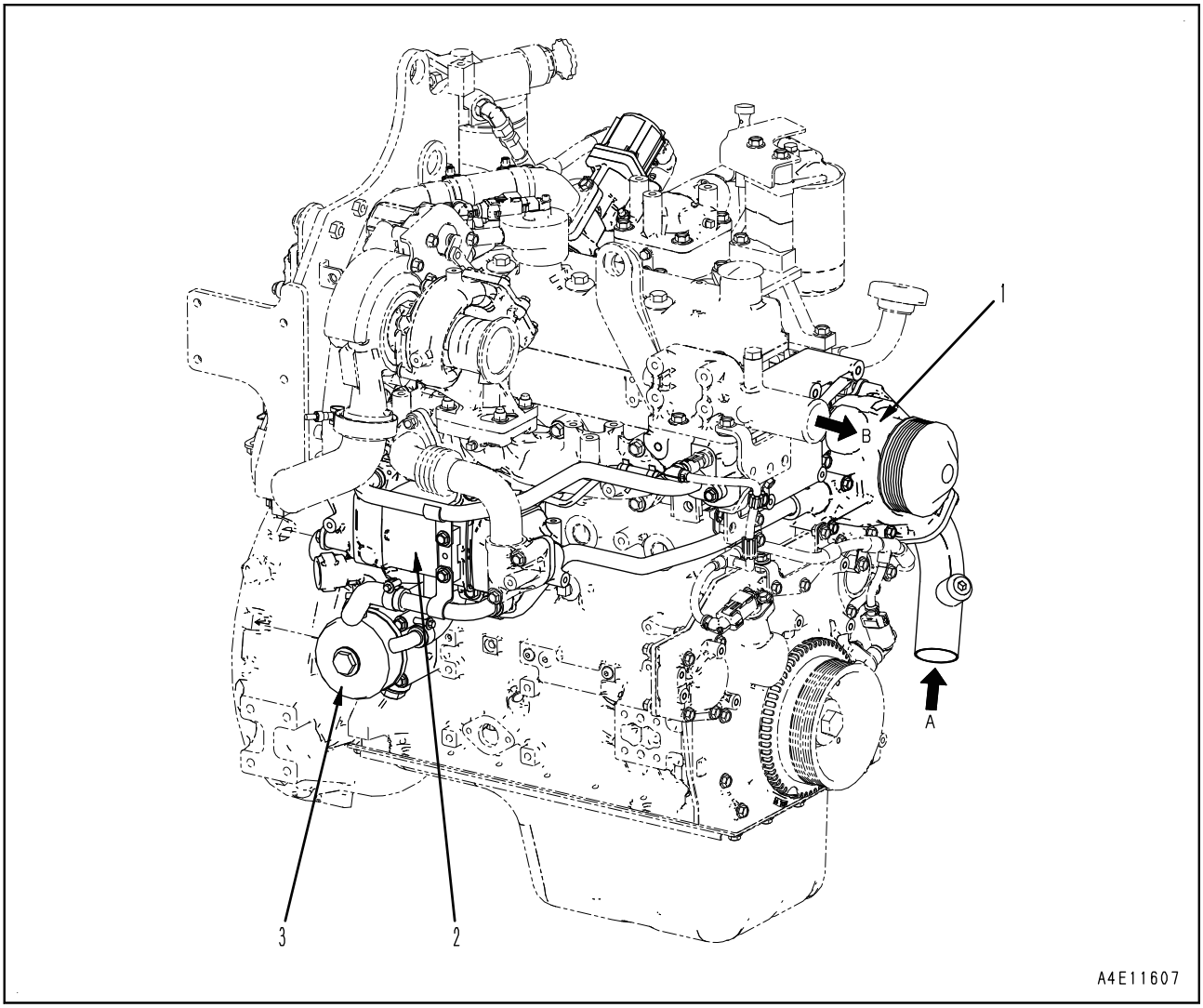
3) When fuel injection is finished (C)

- When solenoid (6) is de-energized, valve body (5) is lowered by spring (7) and the fuel passage is closed.
- At this time, the high-pressure fuel in the common rail is applied to pressure control chamber (8) suddenly and nozzle (1) is closed quickly, fuel injection is finished sharply.

Cooling system *(ENG107-B110-001-K-00-A)*

Cooling system parts layout drawing *(ENG95-B110-04D-K-00-A)*

★ The shape is subject to machine models.

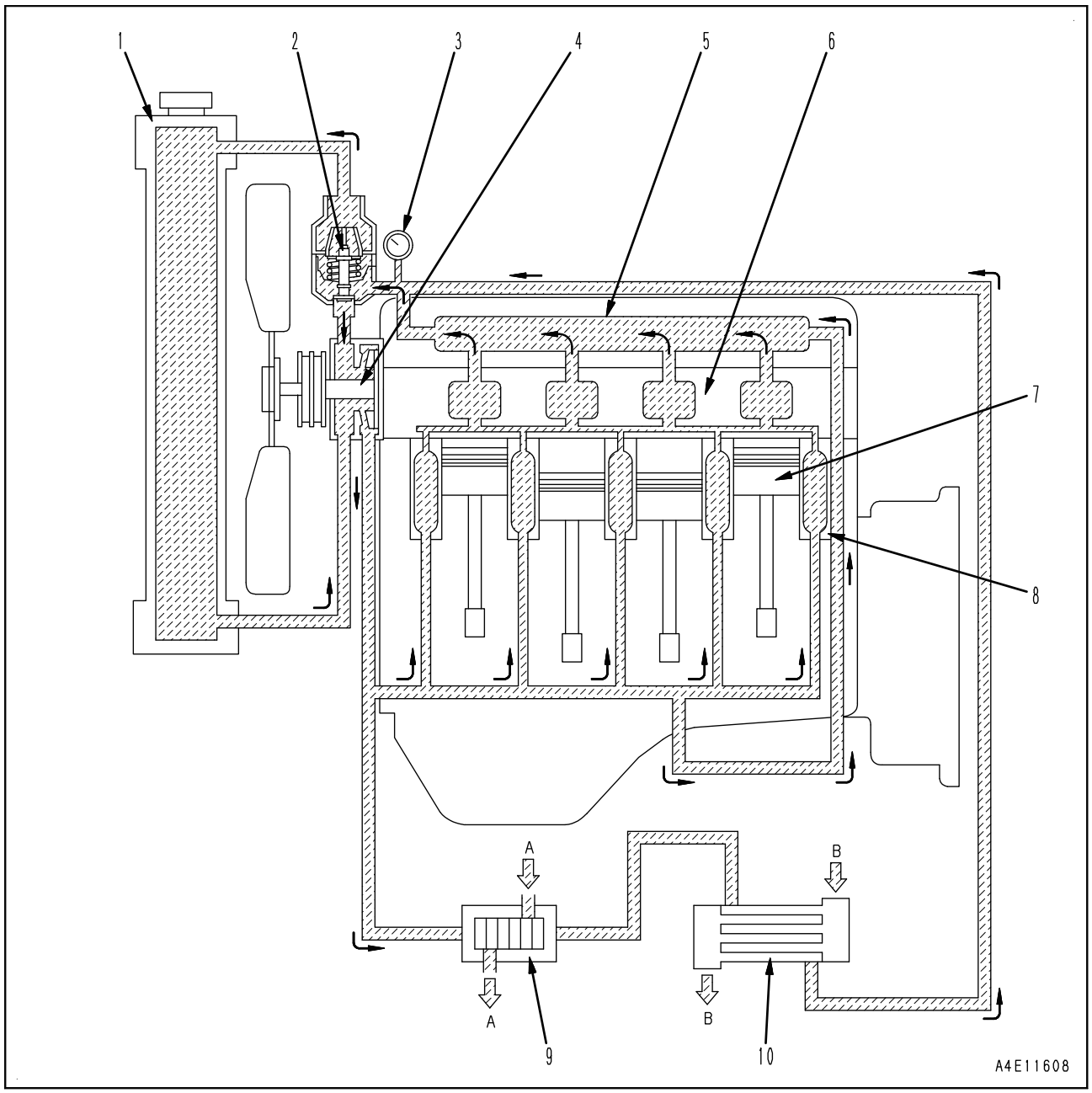


1. Water pump
2. EGR cooler
3. Oil cooler

A: From radiator

B: To radiator

Cooling system chart *(ENG95-B110-052-K-00-A)*



1. Radiator
2. Thermostat
3. Coolant temperature gauge
4. Water pump
5. Water manifold
6. Cylinder head
7. Piston
8. Cylinder block
9. Oil cooler
10. EGR cooler

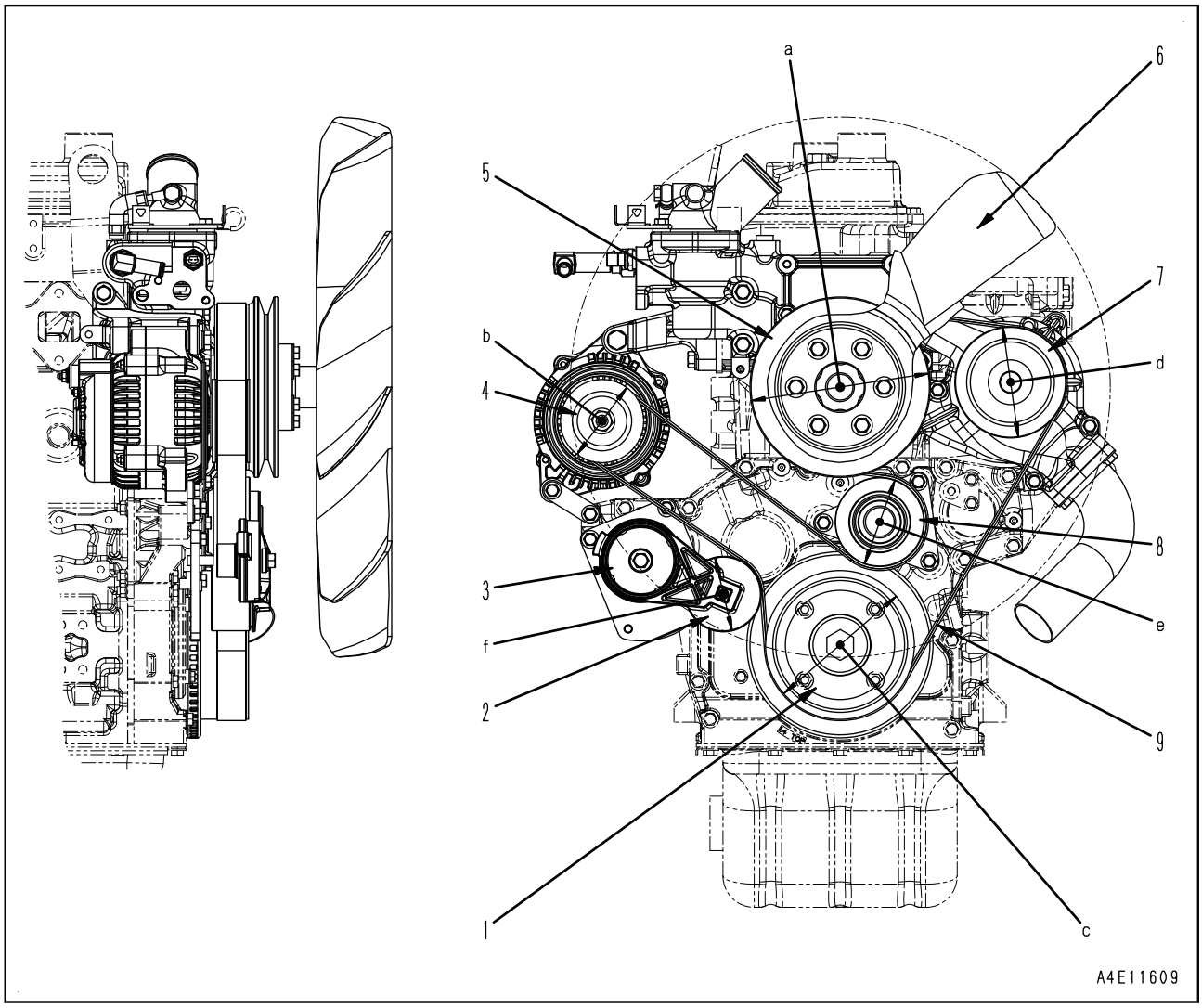
A: Oil inlet/outlet

B: Exhaust gas inlet/outlet

Drive pulley *(ENG107-B110-041-K-00-A)*

Fan drive *(ENG95-B400-041-K-00-A)*

★ The shape is subject to machine models.



1. Crank pulley
2. Tension pulley
3. Auto-tensioner
4. Alternator
5. Fan pulley
6. Fan
7. Water pump
8. Idler
9. V-belt

a, b, c, d, e, f: Outside diameter of pulley

- Auto-tensioner (3) adjusts and maintains the tension of V-belt (9) automatically by using tension pulley (2).

Specifications

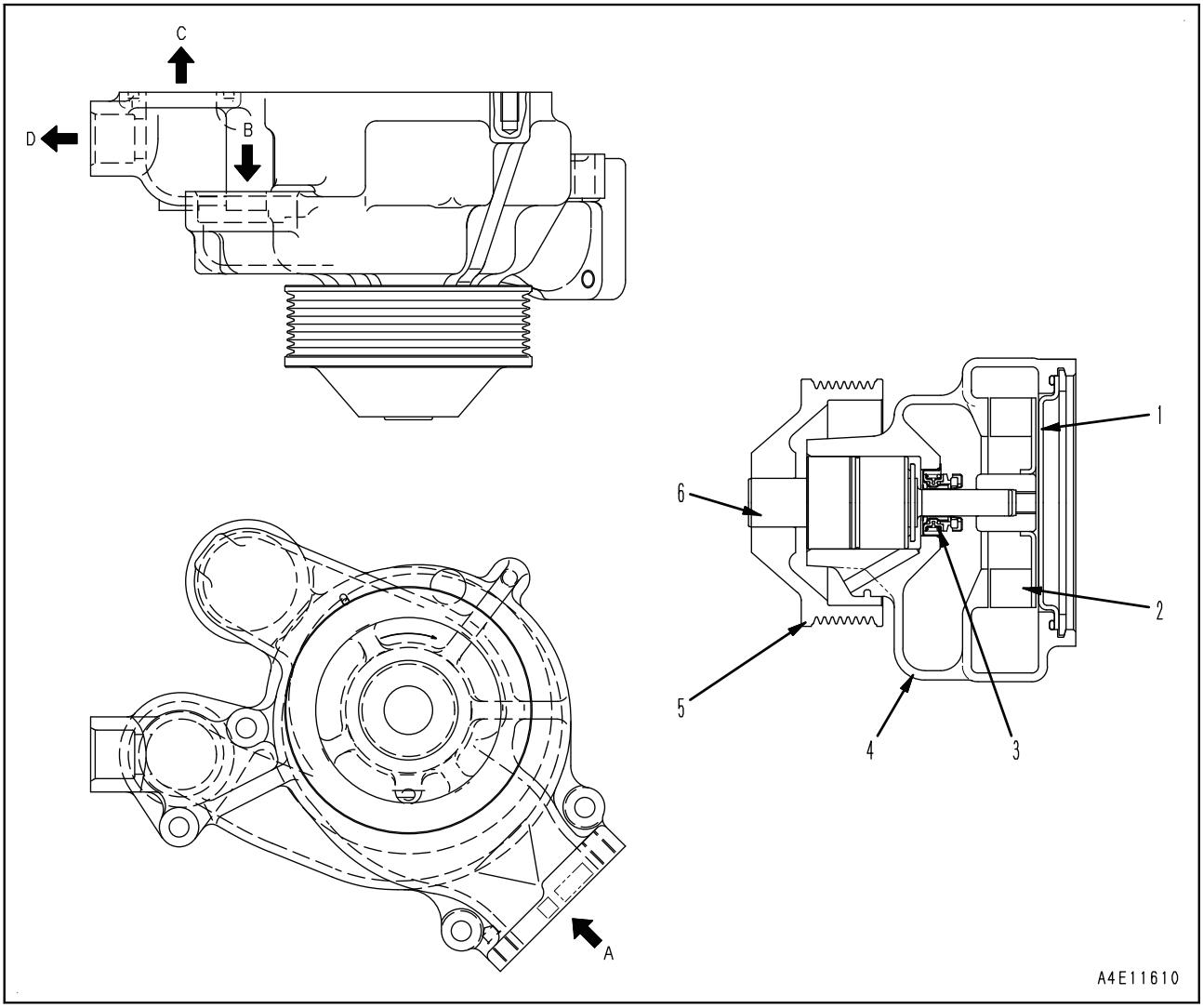
Outside diameter of pulley

Unit: mm

Machine model	a (Fan) (Idler)	b (Alternator)	c (Crank pulley)	d (Water pump)	e (Idler)	f (Tensioner)
WA80M-7	—	77.5	148	110	90	74
WA100M-7	—	77.5	148	110	90	74

Water pump *(ENG95-BA10-041-K-00-A)*

★ The shape is subject to machine models.



1. Plate
2. Impeller
3. Water seal
4. Pump body
5. Pulley
6. Drive shaft

A: Coolant inlet (from radiator)
B: Coolant inlet (from thermostat)
C: Coolant outlet (to inside of engine)
D: Coolant outlet (to oil cooler and EGR cooler)

Specifications *(ENG95-BA10-030-K-00-A)*

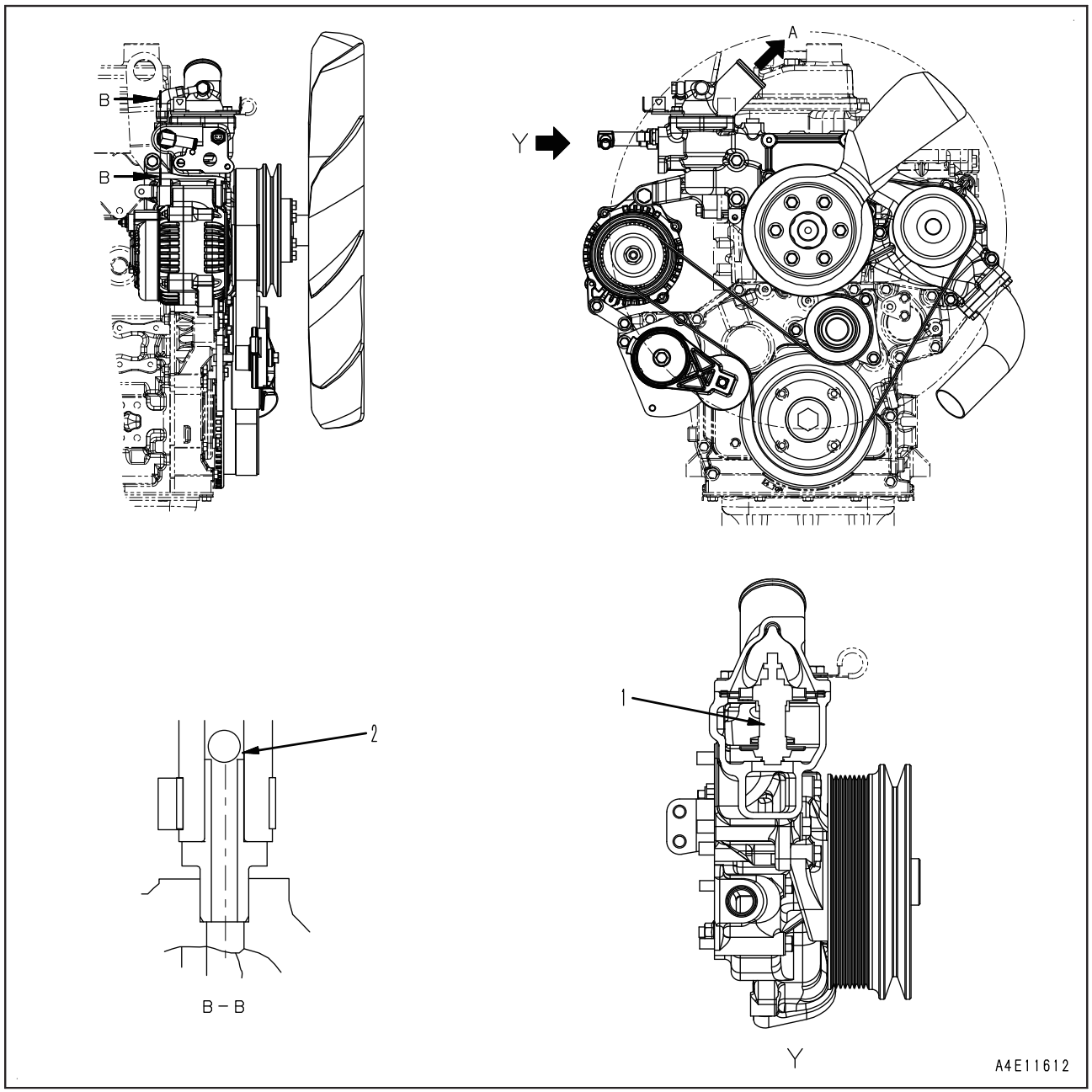
- Type: Centrifugal, V-belt driven

Function *(ENG107-BA10-042-K-00-A)*

- The water pump circulates coolant through the entire engine to prevent engine from overheating.
- Engine power is transmitted to the pulley via a fan belt to drive the impeller.

Thermostat and jiggle valve

★ The shape is subject to machine models.

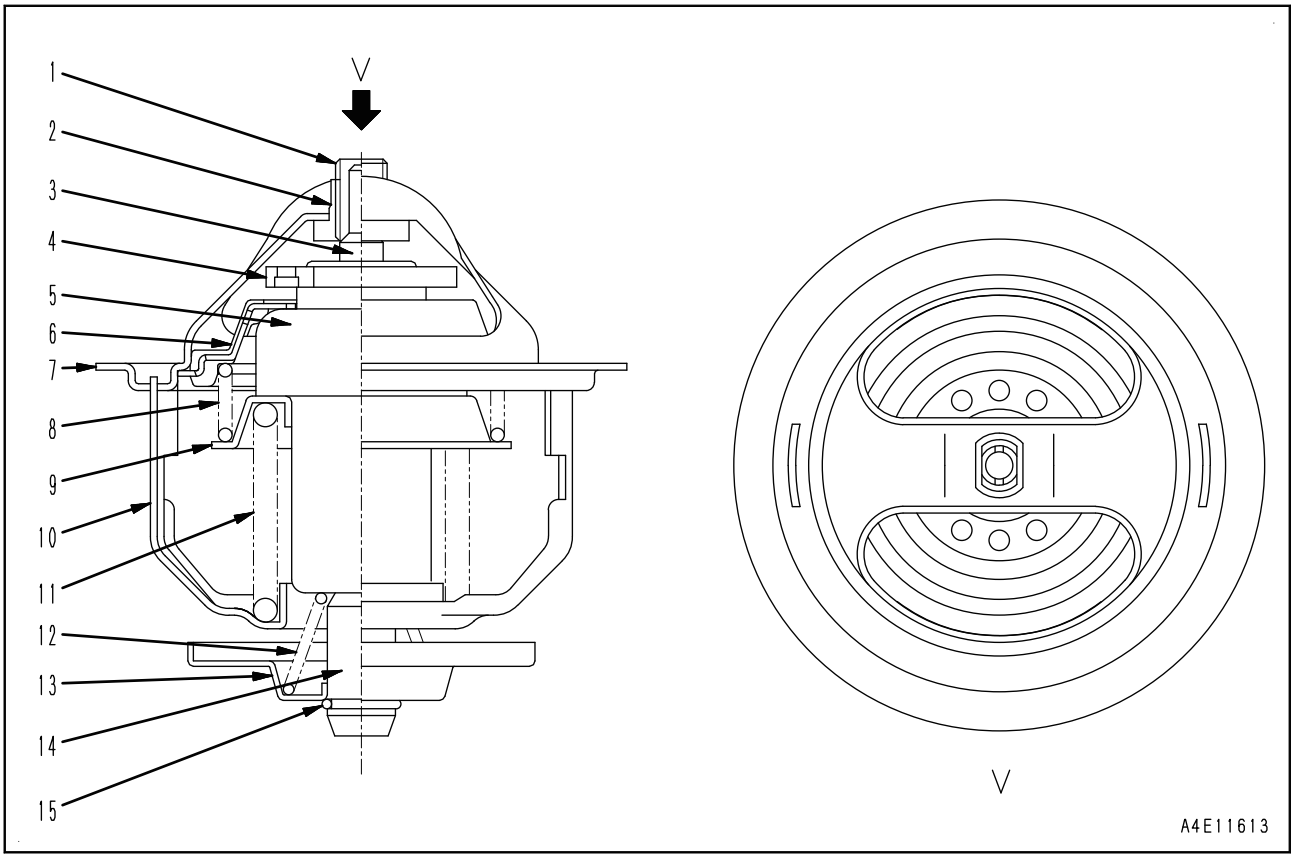


1. Thermostat (2-stage valve)
2. Orifice

A: To radiator

Function of orifice
Orifice(2) discharges bubbles (air) in the coolant passage which prevent cooling of the engine from the engine side.

Thermostat (2-stage valve)

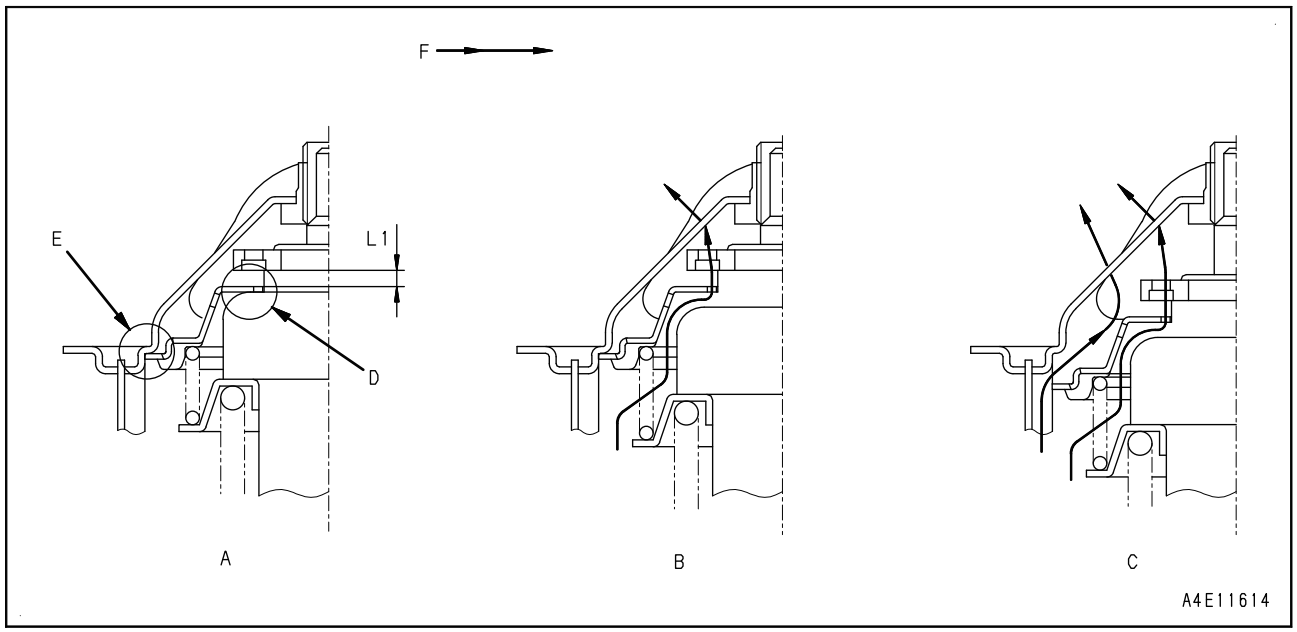


1. Adjustment tools
2. Stopper
3. Piston
4. Valve holder
5. Pellet
6. Valve
7. Seat
8. Spring
9. Support
10. Mounting frame
11. Spring
12. Spring
13. Bypass valve
14. Bypass shaft
15. Wiring

Specifications *(ENG95-BA30-030-K-00-A)*

- Open temperature: 76 ± 2°C (primary valve)
  83 ± 2°C (secondary valve)
- Full open temperature: 95°C
- Valve lift: Min. 10 mm

Operation *(ENG95-BA30-044-K-00-A)*



A: Valve closed

B: Primary valve open

C: Secondary valve open

D: Open part of primary valve

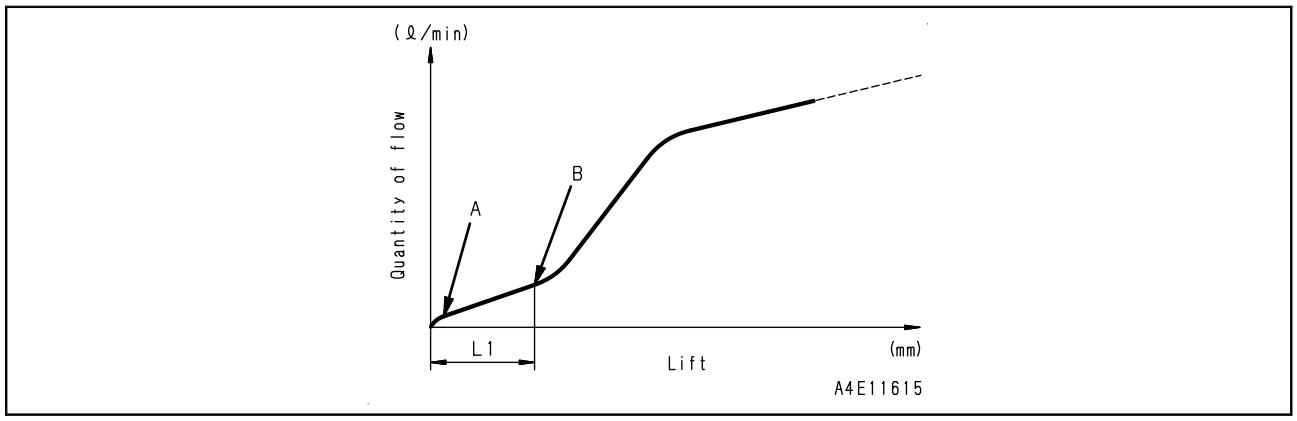
E: Open part of secondary valve

F: Flow direction of coolant

L1: Lift

1. Valve closed (A)
   A valve mechanism of small diameter is formed at part (D) in the above figure. When it is closed, it is seated (closed) on the shoulder of the caulked part of the pellet.
2. Primary valve open (B)
   The coolant exceeds the set temperature and the piston starts to extend.
   At this time, the valve of small diameter at part D in the above figure opens first and the coolant flows through it into the radiator side.
3. Secondary valve open (C)
   If the coolant temperature increases further and the lift exceeds (L1), part (D) in the above figure touches the holder and starts to open the valve at part (E)
   Since the coolant has been flowing into the radiator through the primary valve, the coolant pressure is not affected much at this time.

Flow characteristics (reference graph)



A: Primary valve open

B: Secondary valve open

L: Lift

Q: Flow rate

The coolant flows as shown in the above lift-flow characteristics (reference graph). The flow change gradient low when the lift is low.

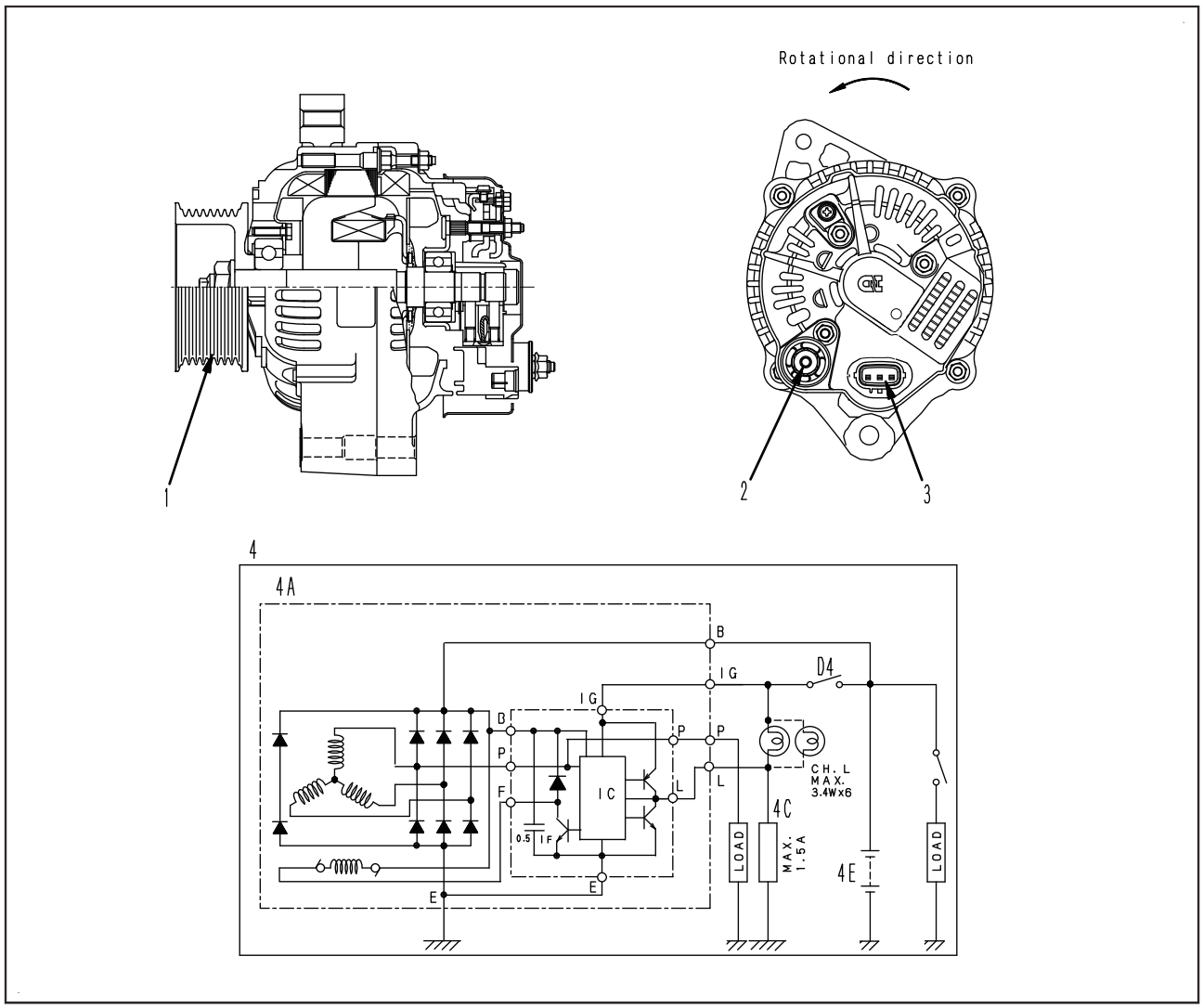
Accordingly, the flow rate fluctuation caused by hunting is reduced when the valve is open, and the thermal shock to the engine is reduced.

Electrical equipment

Alternator

Alternator with built-in regulator (Open type, 120A)

★ The shape is subject to machine models.



1. Alternator pulley
2. Terminal B
3. Connector
4. Internal electrical circuit diagram

4A. Alternator assembly
4B. Regulator
4C. Terminal L load
4D. Starting switch
4E. Battery

Specifications

Engine	Machine model	Type	Specification	Pulley		Weight (kg)
				Number of stage	Outside diameter (mm)	
SAA4D95LE-6	WA80M-7 WA100M-7	Open type, manufactured by DENSO	12V, 120A	Poly V-ribbed with 8 ribs	77.5	6.3

Blank for technical reason

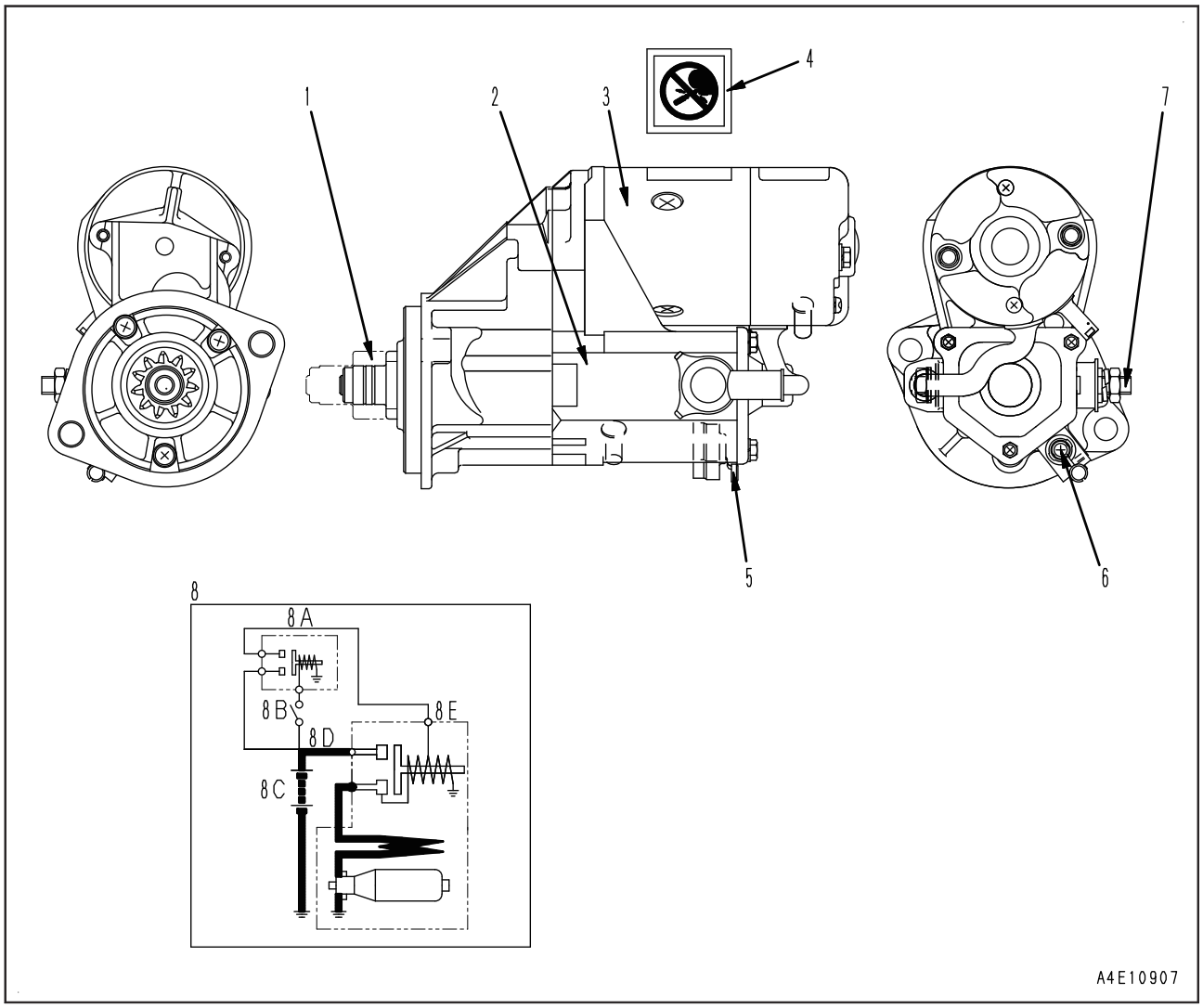
Blank for technical reason

Blank for technical reason

Starting motor

For 2.2kW

★ The shape is subject to machine models.



1. Pinion gear
2. Magnetic switch
3. Starting motor assembly
4. Caution plate for prohibiting to start by short-circuiting
5. Cover to prevent starting by short-circuiting
6. 50 (terminal C)
7. 30 (terminal B)
8. Internal wiring diagram
   - 8A. Relay
   - 8B. Starting switch
   - 8C. Battery
   - 8D. 30 (terminal B)
   - 8E. 50 (terminal C)

Engine	Machine model	Type	Specification	Number of pinion teeth	Weight (kg)
SAA4D95LE-6	WA80M-7 WA100M-7	Drip proof type manufactured by NIHON DENSO	12V, 2.2 kW	9	6.0

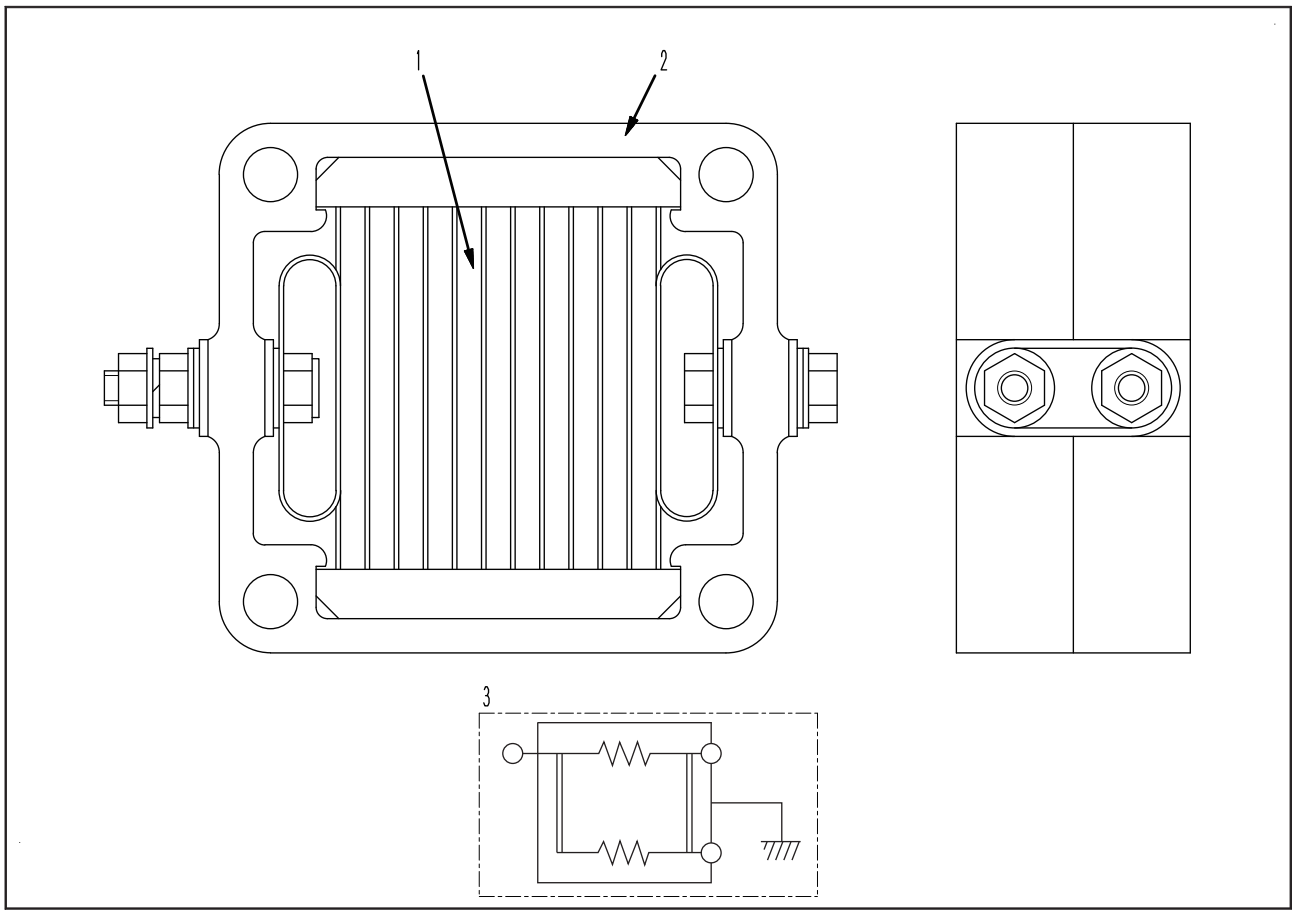
Blank for technical reason

Blank for technical reason

Blank for technical reason

Intake air heater *(ENG95-AM51-041-K-00-A)*

★ The shape is subject to machine models.



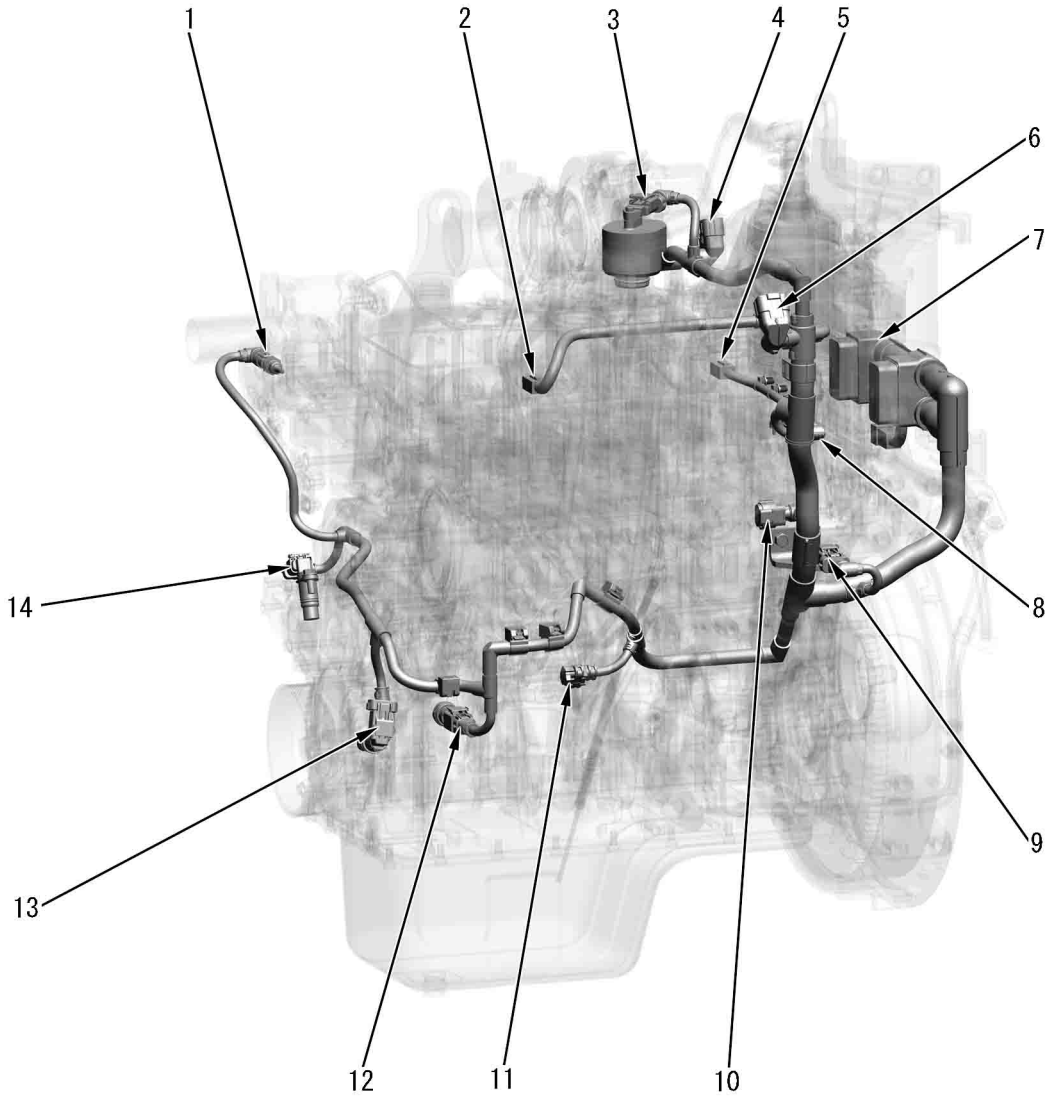
1. Heater coil
2. Housing
3. Internal wiring diagram

Specifications

- Type of heater: Electric intake air heater (ribbon heater)
- Rated voltage: 12 V (DC)
- Load current: 220 A

Engine harness

★ The shape is subject to machine models.

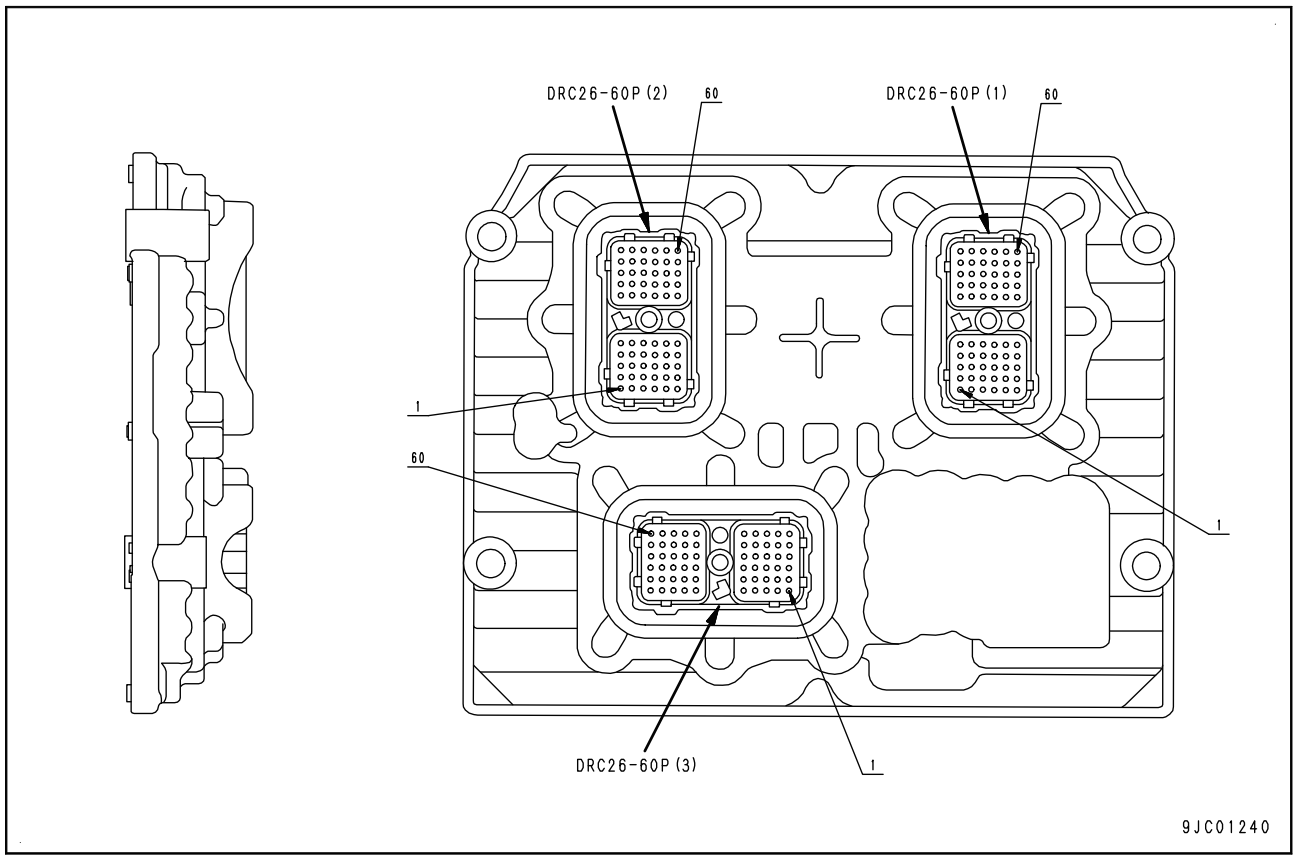


APE11616

1. To coolant temperature sensor
2. To injector (No.1, 2) wiring harness
3. To crankcase pressure sensor
4. To turbocharger
5. To injector (No.3, 4) wiring harness
6. To EGR valve
7. To engine controller
8. To charge (boost) pressure and temperature sensor
9. To ambient pressure sensor
10. To common rail pressure sensor
11. To supply pump SCV
12. To engine oil pressure switch

13. To Ne (crank) speed sensor
14. To Bkup (cam) speed sensor

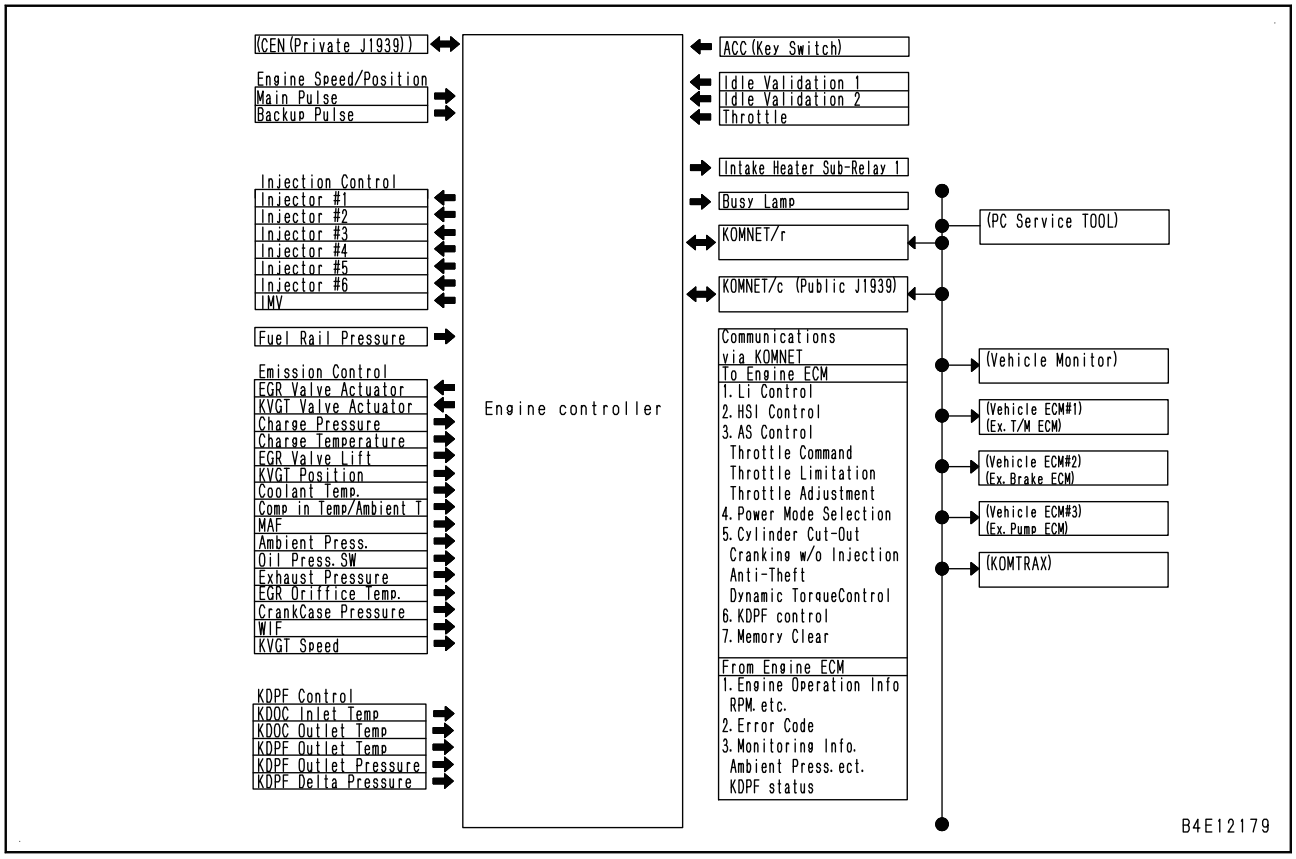
Engine controller *(PC220-AP70-041-K-00-A)*



Function *(ENG95-AP70-042-K-00-A)*

- Engine controller (CM2250) developed by cooperation between KOMATSU and CUMMINS is employed.
- The engine controller calculates the signals input from the sensors installed to various parts and outputs signals to control the engine properly.
- The engine controller holds the information of other controllers mounted on the machine in common through the network (CAN) and controls the engine and machine properly.
- The engine controller is installed through rubber vibration isolators to reduce vibrations.

Engine controller system diagram *(ENG107-AP70-052-K-00-A)*



Input and output signals of engine controller *(ENG95-AP70-03C-K-00-A)*

- The symbols in the signal category column of the input/output signal table are as follows.

A: Power supply

B: Input

C: Ground/Shield/Return

D: Output

E: Communication

DRC26-60P(1)[ECM J1(CN-CE01)]

Pin No.	Signal name	Signal category
1	(*1)	—
2	(*1)	—
3	Crankcase pressure sensor	B
4	(*1)	—
5	Charge temperature sensor	B
6	Intake temperature MAF sensor	B
7	(*1)	—
8	CAN_B (+) (KOMNET/r)	E
9	Bkup (camshaft) speed sensor (+)	B
10	(*1)	—
11	(*1)	—
12	(*1)	—
13	GND	C
14	Coolant temperature sensor	B
15	Charge pressure sensor	B
16	Ambient pressure sensor	B
17	(*1)	—

Pin No.	Signal name	Signal category
18	CAN_B (-) (KOMNET/r)	E
19	(*1)	—
20	(*1)	—
21	Sensor power supply (12 V)	A
22	GND	C
23	Mass air flow (MAF) sensor	B
24	(*1)	—
25	(*1)	—
26	Ne (crankshaft) speed sensor (+)	B
27	(*1)	—
28	(*1)	—
29	(*1)	—
30	SCV (+)	D
31	Engine oil pressure switch	B
32	(*1)	—
33	(*1)	—
34	(*1)	—
35	(*1)	—
36	Sensor power supply (5 V)	A
37	NE (crankshaft) speed sensor (-)	C
38	(*1)	—
39	(*1)	—
40	SCV (-)	C
41	(*1)	—
42	(*1)	—
43	(*1)	—
44	Injector #3 (+)	D
45	Injector #2 (+)	D
46	Injector #4 (+)	D
47	(*1)	—
48	Injector #1 (+)	D
49	(*1)	—
50	(*1)	—
51	(*1)	—
52	(*1)	—
53	(*1)	—
54	Injector #3 (-)	C
55	Injector #2 (-)	C
56	Injector #4 (-)	C
57	(*1)	—
58	Injector #1 (-)	C
59	GND	C
60	Sensor power supply (5 V)	A

*1: Never connect these pins. Malfunctions or failures may occur.

DRC26-60P(2)[ECM J2(CN-CE02)]

Pin No.	Signal name	Signal category
1	Turbocharger motor (V)	B
2	Turbocharger motor (U)	B
3	EGR valve motor (W)	B
4	EGR valve motor (V)	B
5	EGR valve motor (U)	B

Pin No.	Signal name	Signal category
6	(*1)	—
7	(*1)	—
8	(*1)	—
9	(*1)	—
10	(*1)	—
11	Turbocharger motor	B
12	(*1)	—
13	(*1)	—
14	(*1)	—
15	(*1)	—
16	(*1)	—
17	(*1)	—
18	GND	C
19	(*1)	—
20	(*1)	—
21	GND	C
22	(*1)	—
23	(*1)	—
24	CAN_B (+)	E
25	CAN_B (-)	E
26	(*1)	—
27	(*1)	—
28	(*1)	—
29	(*1)	—
30	Sensor power supply (5 V)	A
31	Sensor power supply (5 V)	A
32	(*1)	—
33	(*1)	—
34	(*1)	—
35	(*1)	—
36	(*1)	—
37	(*1)	—
38	(*1)	—
39	(*1)	—
40	(*1)	—
41	EGR valve sensor (V)	D
42	EGR valve sensor (W)	D
43	Turbocharger sensor (V)	D
44	Common rail pressure sensor	B
45	(*1)	—
46	(*1)	—
47	GND	C
48	(*1)	—
49	(*1)	—
50	(*1)	—
51	EGR valve sensor (U)	D
52	Turbocharger sensor (U)	D
53	Turbocharger sensor (W)	D
54	(*1)	—
55	Common rail pressure sensor	B
56	(*1)	—
57	(*1)	—

Pin No.	Signal name	Signal category
58	(*1)	—
59	(*1)	—
60	(*1)	—

*1: Never connect these pins. Malfunctions or failures may occur.

DRC26-60P(3)[CN-CE03]

Pin No.	Signal name	Signal category
1	Continuous power supply (24 V)	A
2	Continuous power supply (24 V)	A
3	Starting switch ACC signal	B
4	Electrical intake air heater relay (+)	D
5	(*1)	—
6	(*1)	—
7	(*1)	—
8	(*1)	—
9	System operating lamp	D
10	(*1)	—
11	Continuous power supply (24 V)	A
12	Continuous power supply (24 V)	A
13	GND	C
14	(*1)	—
15	(*1)	—
16	(*1)	—
17	CAN_A (+) (KOMNET/c)	E
18	CAN_A (-) (KOMNET/c)	E
19	GND	C
20	(*1)	—
21	GND	C
22	GND	C
23	(*1)	—
24	(*1)	—
25	(*1)	—
26	(*1)	—
27	(*1)	—
28	(*1)	—
29	(*1)	—
30	(*1)	—
31	GND	C
32	GND	C
33	(*1)	—
34	(*1)	—
35	(*1)	—
36	(*1)	—
37	(*1)	—
38	(*1)	—
39	(*1)	—
40	(*1)	—
41	GND	C
42	Sensor power supply (5 V)	A
43	GND	C
44	(*1)	—
45	(*1)	—

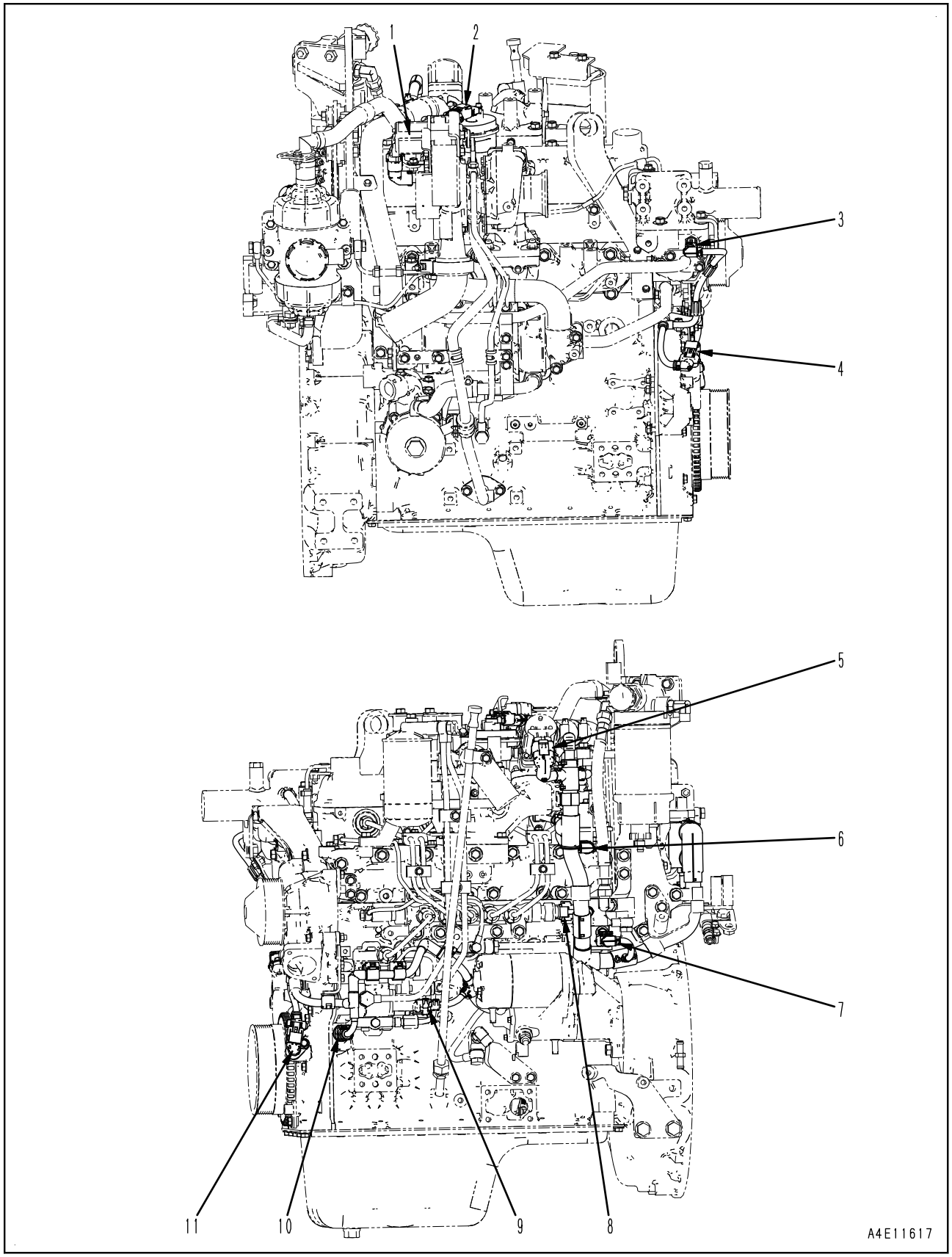
Pin No.	Signal name	Signal category
46	(*1)	—
47	(*1)	—
48	(*1)	—
49	Idle validation signal 1	B
50	Idle validation signal 2	B
51	Throttle signal	B
52	Sensor power supply (5 V)	A
53	(*1)	—
54	(*1)	—
55	(*1)	—
56	(*1)	—
57	(*1)	—
58	(*1)	—
59	(*1)	—
60	(*1)	—

*1: Never connect these pins. Malfunctions or failures may occur.

Sensor *(ALL-E700-001-P-00-A)*

Sensors layout drawing *(ENG95-AK50-04D-K-00-A)*

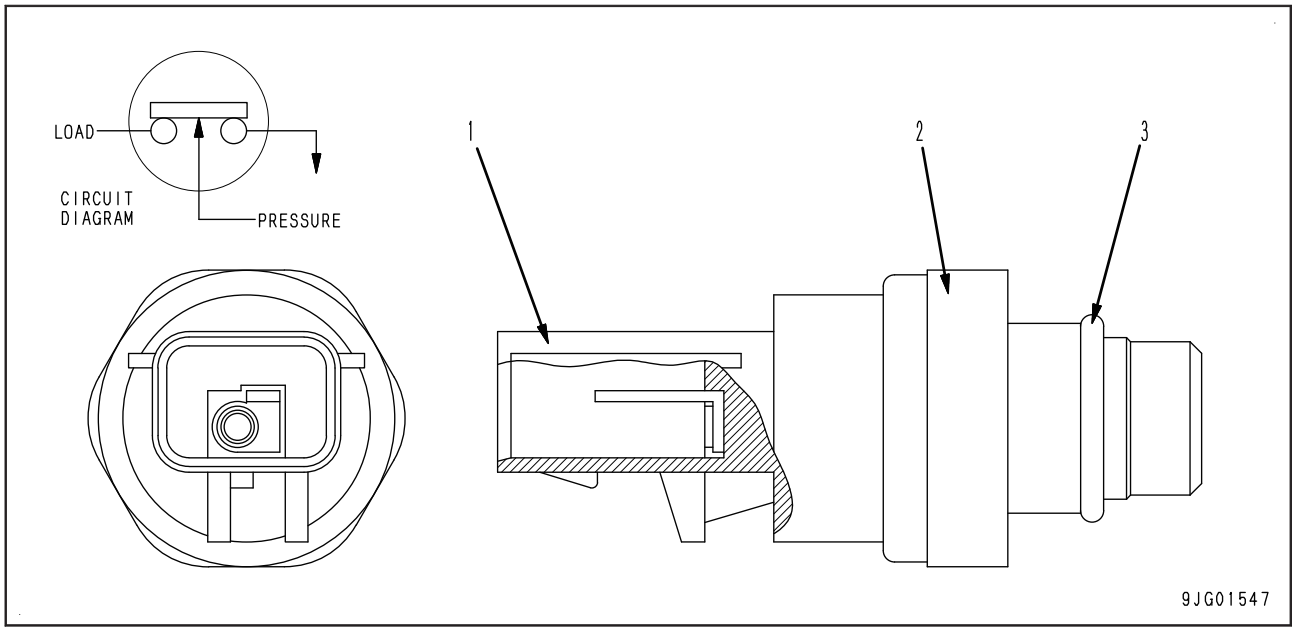
★ The shape is subject to machine models.



List of sensors

No.	Sensors	Connector label name
1	Turbocharger motor (with built-in position sensor)	
2	Crankcase pressure sensor	CCV
3	Coolant temperature sensor	TWTR
4	Bkup (camshaft) speed sensor	CAM
5	EGR valve motor (with built-in position sensor)	EGR/V
6	Charge (boost) pressure and temperature sensor	TMAP (PITM)
7	Ambient pressure sensor	PAMB
8	Common rail pressure sensor	PFUEL
9	Suction control valve	SCV
10	Engine oil pressure switch	POIL
11	Ne (crankshaft) speed sensor	NE
—	Mass air flow and temperature sensor	MAF

Engine oil pressure switch

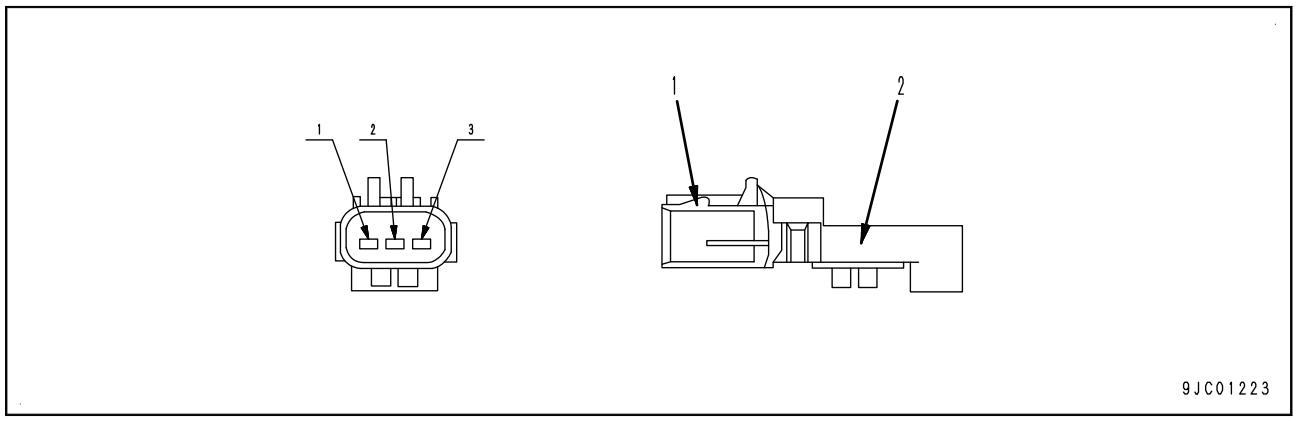


1. Connector
2. Sensor
3. O-ring

Specifications
Contact type: Normally closed

Function
- This oil pressure sensor is installed to the cylinder block, senses the engine oil pressure, and turns "ON" when the engine oil pressure decreases below the specified pressure.

Ambient pressure sensor *(ENG-AAP2-041-K-00-A)*

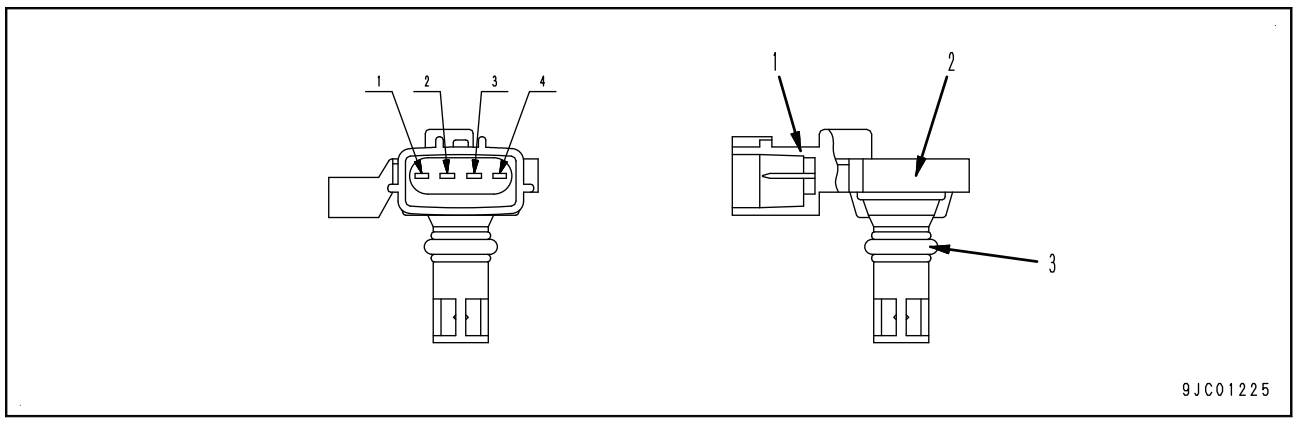


1. Connector
2. Sensor

Function *(ENG95-AAP2-042-K-00-A)*

- This sensor is installed to the bracket on the side of the cylinder block, senses the ambient pressure, and outputs it as a variable voltage.

Charge (boost) pressure and temperature sensor *(ENG-AAM7-041-K-00-A)*



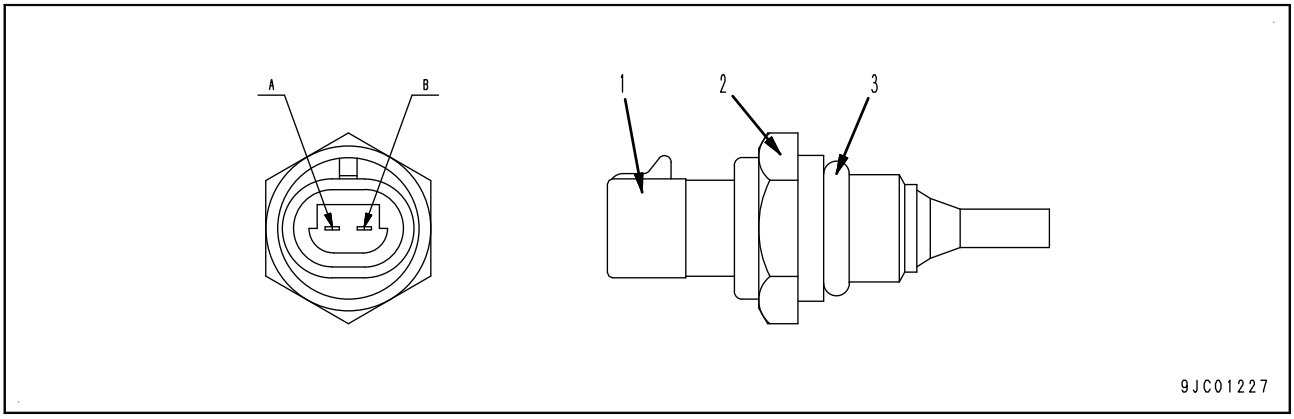
1. Connector
2. Sensor
3. O-ring

Function *(ENG95-AAM7-042-K-00-A)*

- This sensor is installed to the engine intake manifold. It detects the engine intake air pressure and its temperature, and outputs signals as a variable voltage for pressure, and as variable resistance for temperature.

★ "Charge pressure and temperature" are the engine intake air pressure and temperature of a turbocharged engine. These are also referred to as "boost pressure and temperature" or "intake air pressure and temperature".

Coolant temperature sensor *(ENG-BA87-041-K-00-A)*

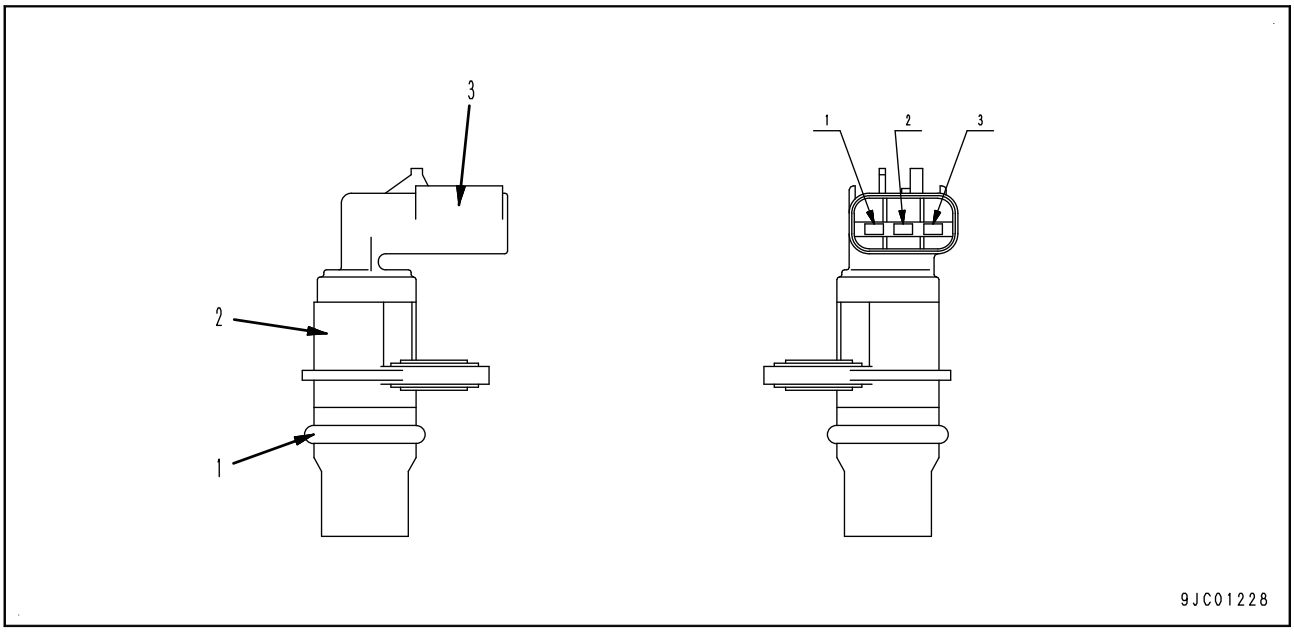


1. Connector
2. Sensor
3. O-ring

Function *(ENG95-BA87-042-K-00-A)*

- This sensor is installed to the thermostat housing of the engine, senses temperature change, and outputs it as a resistance change signal.

Ne (crankshaft) speed sensor *(ENG-AG42-041-K-00-A)*

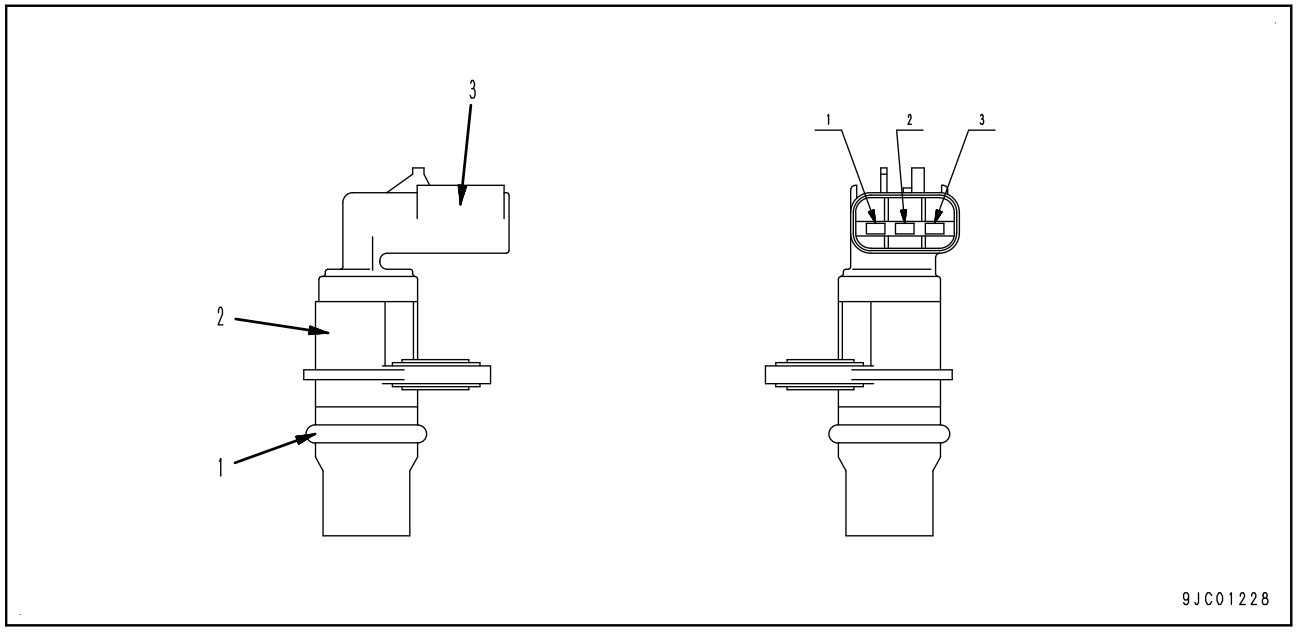


1. O-ring
2. Sensor
3. Connector

Function *(ENG-AG42-042-K-00-A)*

- This sensor, installed to the crankshaft pulley on the engine front cover, outputs the pulse voltage due to the gear rotation.

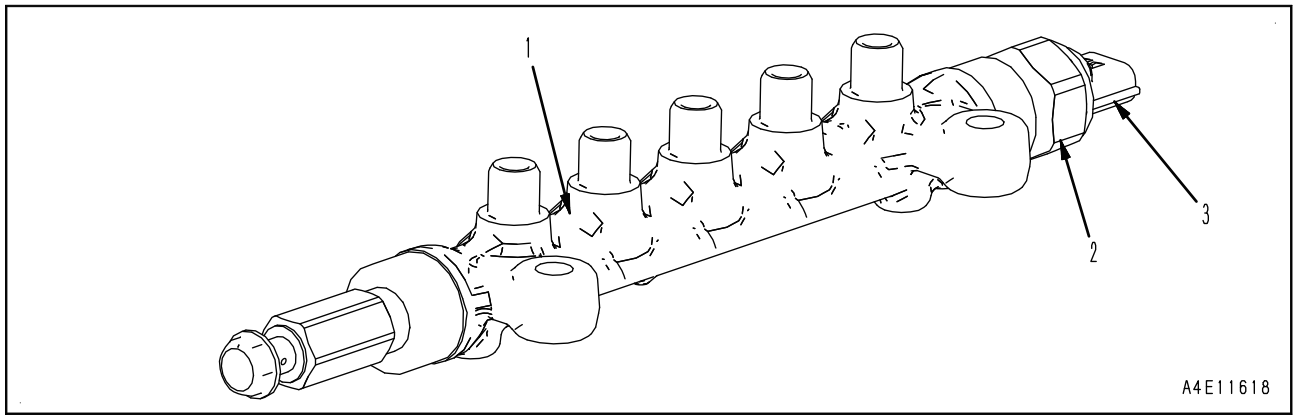
Bkup (camshaft) speed sensor *(ENG-AG62-041-K-00-A)*



1. O-ring
2. Sensor
3. Connector

Function *(ENG95-AG62-042-K-00-A)*

Common rail pressure sensor *(ENG95-AE28-041-K-00-A)*

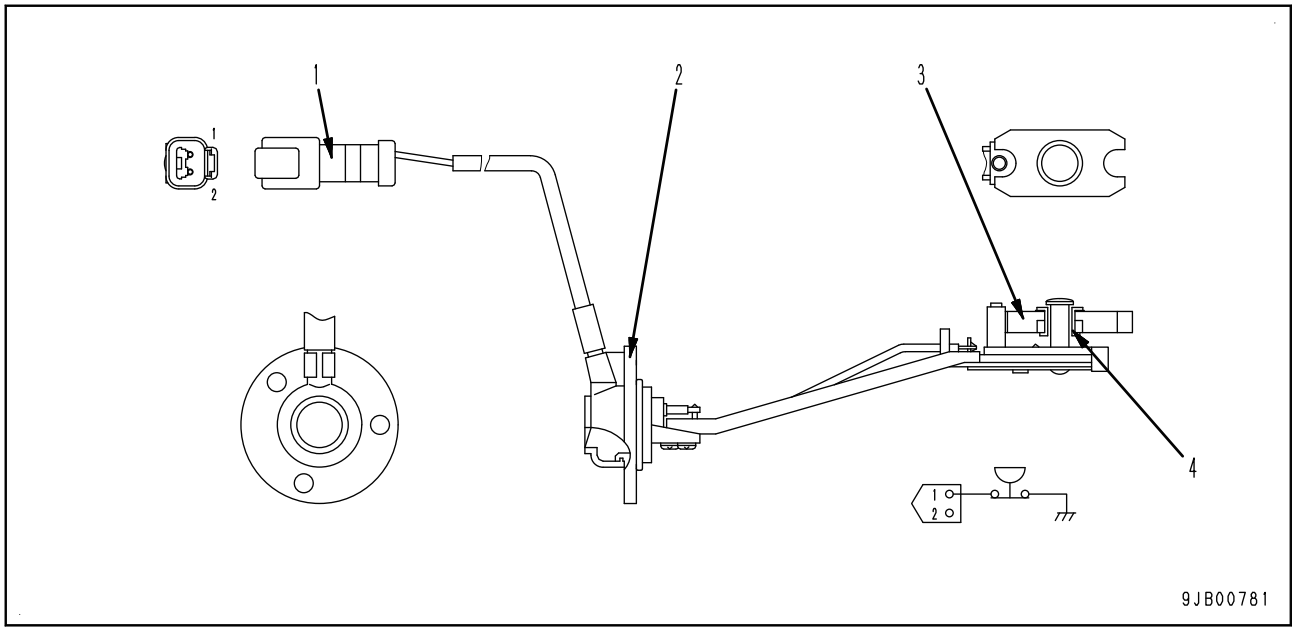


1. Common rail pressure
2. Sensor
3. Connector

Function *(ENG-AE28-042-K-00-A)*

- This sensor, installed to the common rail in the engine, detects the fuel pressure to output the corresponding variable voltage.

Engine oil level sensor *(ENG-AB45-041-K-00-A)*

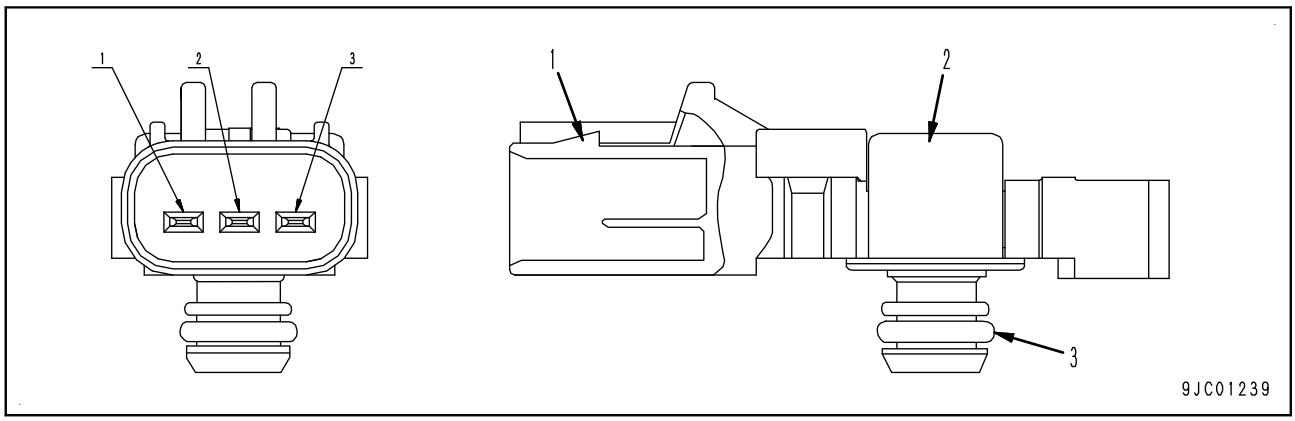


1. Connector
2. Bracket
3. Float
4. Switch

Function *(ENG-AB45-042-K-00-A)*

- This sensor, installed on the side face of the oil pan, turns "OFF" by the lowered float, if the oil level becomes lower than specified.

Crankcase pressure sensor *(ENG-A18C-041-K-00-A)*

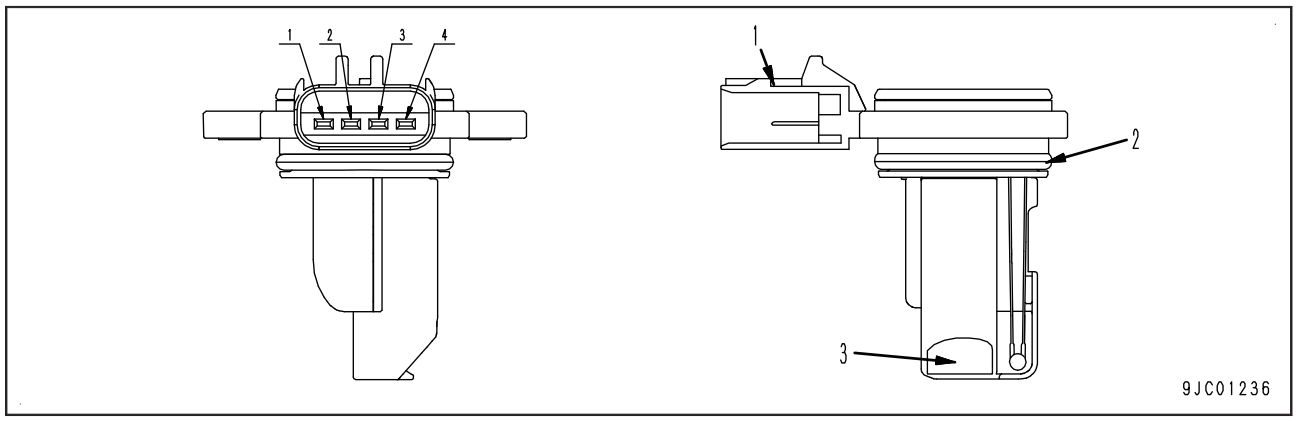


1. Connector
2. Sensor
3. O-ring

Function *(ENG95-A18C-042-K-00-A)*

- This sensor is installed to the breather top, senses the crankcase pressure (blowby pressure), and outputs it as a variable voltage.

Mass air flow and temperature sensor



1. Connector
2. O-ring
3. Sensor

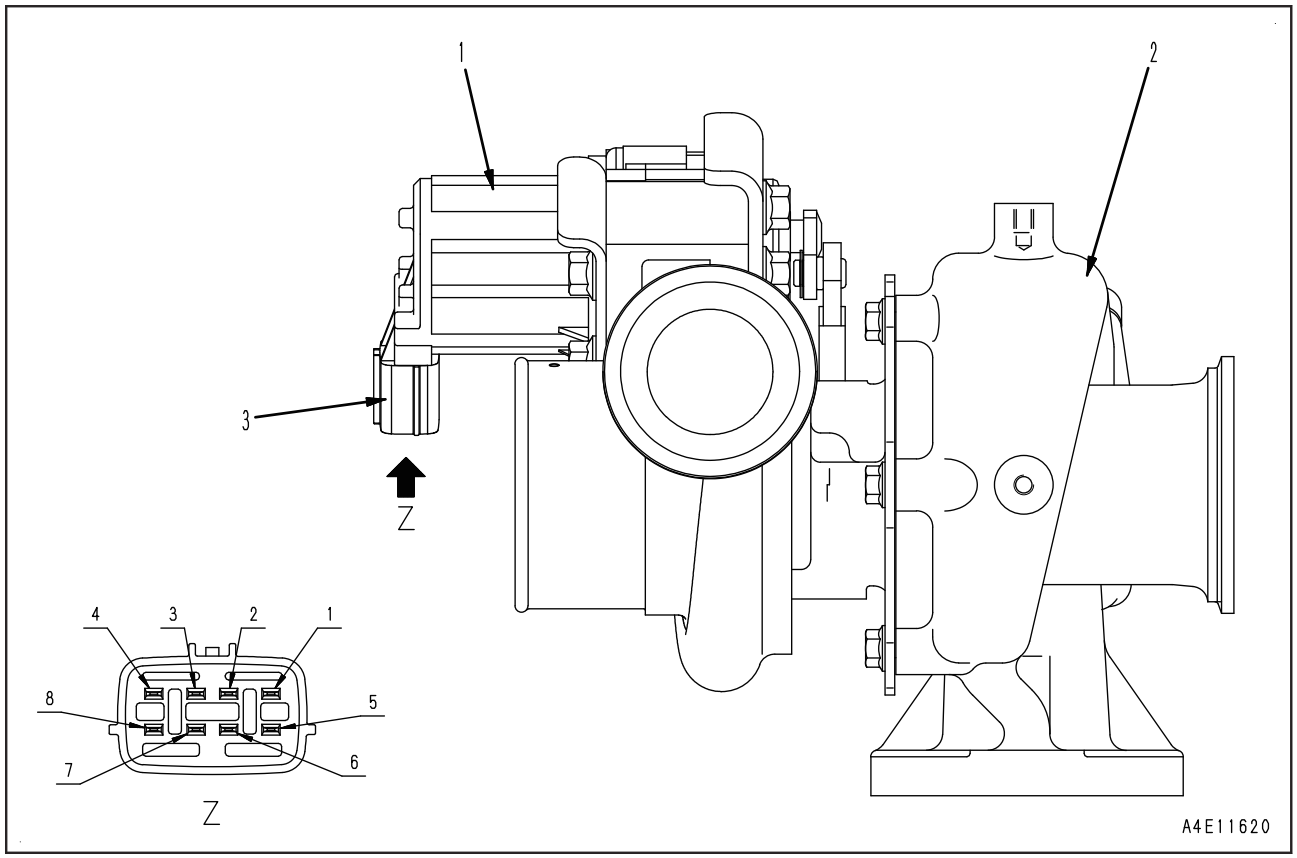
Function

- This sensor is installed to the outlet side of air cleaner, converts the variations ofi ntake air flow and temperature into the resistance variation, and outputs the corresponding signals.

★ The "MAF (Mass Air Flow)" means the "intake air flow".

Turbocharger motor (with built-in position sensor)

★ The shape is subject to machine models.



1. Turbocharger motor (brushless motor with built-in position sensor)
2. Turbine part

3. Connector

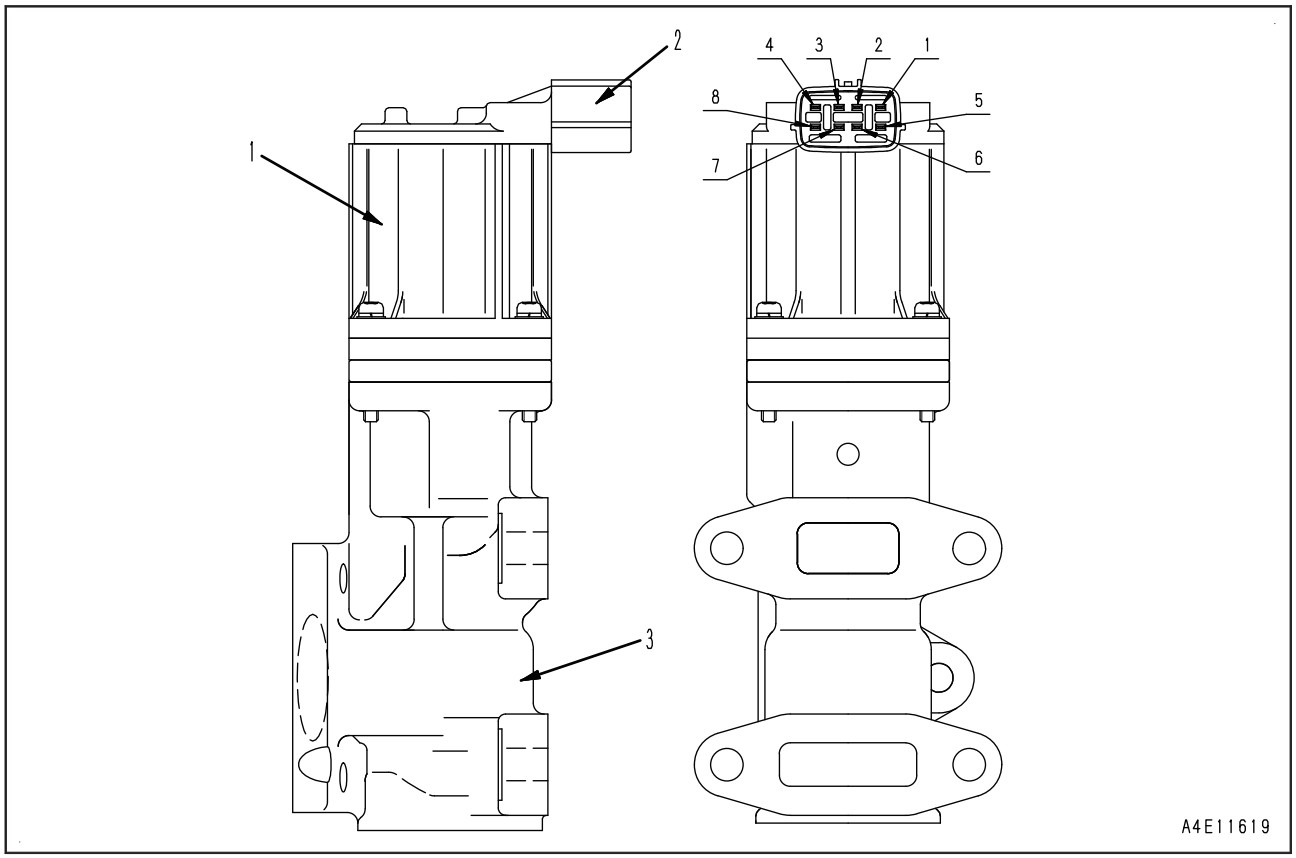
Function

- Controls the flow control valve with a DC motor.
- The turbocharger motor has a position sensor in it to sense the valve position.

EGR valve (with built-in position sensor)

★ EGR: Abbreviation for Exhaust Gas Recirculation

★ The shape is subject to machine models.



1. EGR valve motor (with built-in position sensor)
2. Connector
3. Body

Function

- Small-sized EGR valve driven with a DC motor.
- The EGR valve motor has a position sensor in it to sense the valve position.

SHOP MANUAL

ENGINE

95E-6 SERIES

Model Serial Number

95E-6 SERIES

20 Standard value tables

Table of contents

Standard service value table

Standard value table for engine

Applicable machines: WA80M-7

Performance

Engine				SAA4D95LE −6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Engine speed	• Coolant temperature: 75 to 94 °C	High idle	rpm	2,520 ± 50	2,520 ± 50
		Low idle		900± 25	900± 25

Air intake and exhaust system

Engine				SAA4D95LE −6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Air intake resistance	Whole speed range		kPa {mmH $_2$O}	Max. 3.73 {380}	Max. 7.47 {762}
Boost pressure	At rated horsepower		kPa {mmHg}	-	-
Exhaust gas temperature	Whole speed range (20 °C)		°C	Max. 650	Max. 700
Exhaust gas color	• Coolant temperature: 75 to 94 °C • After kept for 5 seconds at normal condition	Exhaust pipe outlet	Bosch index	Max. 0.5	Max. 2.0
Valve clearance	Intake valve		mm	0.35	-
	Exhaust valve			0.50	-

Main body

Engine			SAA4D95LE −6	
Item	Measurement condition	Unit	Standard value for new machine	Repair limit
Compression pressure	Engine oil temperature: 40 to 60 °C Engine speed: 200 to 250 rpm	MPa {kg/cm^2}	Min. 2.9 {30}	Min. 2.0 {20}
Blowby pressure	At rated horsepower (when KCCV is disconnected)	kPa {mmH$_2$O}	Max. 0.98 {100}	Max. 1.47 {150}

Standard value table for engine

Applicable machines: WA100M-7

Performance

Engine				SAA4D95LE −6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Engine speed	• Coolant temperature: 75 to 94 °C	High idle	rpm	2,650 ± 50	2,650 ± 50
		Low idle		900± 25	900± 25

Air intake and exhaust system

Engine				SAA4D95LE −6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Air intake resistance	Whole speed range		kPa {mmH $_2$O}	Max. 3.73 {380}	Max. 7.47 {762}
Boost pressure	At rated horsepower		kPa {mmHg}	-	-
Exhaust gas temperature	Whole speed range (20 °C)		°C	Max. 650	Max. 700
Exhaust gas color	• Coolant temperature: 75 to 94 °C • After kept for 5 seconds at normal condition	Exhaust pipe outlet	Bosch index	Max. 0.5	Max. 2.0
Valve clearance	Intake valve		mm	0.35	-
	Exhaust valve			0.50	-

Main body

Engine			SAA4D95LE −6	
Item	Measurement condition	Unit	Standard value for new machine	Repair limit
Compression pressure	Engine oil temperature: 40 to 60 °C Engine speed: 200 to 250 rpm	MPa {kg/cm^2}	Min. 2.9 {30}	Min. 2.0 {20}
Blowby pressure	At rated horsepower (when KCCV is disconnected)	kPa {mmH$_2$O}	Max. 0.98 {100}	Max. 1.47 {150}

Lubrication system

Engine				SAA4D95LE −6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Oil pressure	At rated horsepower Engine oil temperature: Min. 80 °C	EOS5W30-LA EOS5W40-LA EO10W30-LA EO15W40-LA	MPa {kg/cm^2}	0.29 to 0.69 {3.0 to 7.0}	Min. 0.21 {2.1}
	At low idle Engine oil temperature: Min. 80 °C			Min. 0.15 {1.5}	Min. 0.13 {1.3}
Oil temperature	Whole speed range (inside oil pan)		°C	90 to 110	Max. 120
Oil consumption	At continuous rated horsepower Ratio to fuel consumption		%	Max. 0.15	Max. 0.3

Cooling system

Engine			SAA4D95LE −6	
Item	Measurement condition	Unit	Standard value for new machine	Repair limit
Tension of alternator and fan belt	Deflection when pressed with finger force of 98 N {10 kg}	mm	Automatic adjustment (auto-tensioner)	Automatic adjustment (auto-tensioner)

Running-in standard and performance test standard

Applicable machines: WA80M-7

Running-in standard

Engine		SAA4D95LE-6				
Item		Procedure				
		1	2	3	4	5
Running time	min.	2	10	2	3	3
Engine speed	rpm	900	900	1,200	1,600	2,200
Dynamometer load	N {kg}	0 {0}	98 {10}	147 {15}	245 {25}	315{32}
Output	kW {HP}	0 {0}	8.1 {10.8}	13.2 {17.7}	29.4 {39.4}	52.0 {69.7}

★ The dynamometer load in this table shows the value when the dynamometer arm is 716 mm long.

Performance test standard

Engine		SAA4D95LE-6			
Test item		Rated horsepower	Max. torque	Max. speed with no load	Min. speed with no load
Specification value (Gross)	-	52.0 kW/2,200 rpm {69.7 HP/2,200 rpm}	266 Nm/1,600 rpm {27.1 kgm/1,600 rpm}	2,520 ± 50 rpm	900 ± 25rpm
Engine speed	rpm	2,200 ± 5	1,600 ± 100	-	-
Dynamometer load	N {kg}	299 to 331 {30.5 to 33.8}	352 to 390 {35.4 to 39.8}	-	-
Output (Gross)	kW {HP}	49.4 to 54.6 {66.2 to 73.2}	-	-	-
Torque (Gross)	Nm {kgm}	-	253to 279 {25.8 to 28.5}	-	-
Fuel consumption	sec/200 cc	-	-	-	-
Coolant temperature	°C	75 to 94	75 to 94	75 to 94	75 to 94
Lubricating oil temperature	°C	90 to 120	90 to 120	90 to 120	90 to 120
Lubricating oil pressure	kPa {kg/cm²}	340 to 690 {3.5 to 7.0}	-	-	Min. 150 {Min. 1.5}
Exhaust temperature	°C	Max. 640	Max. 670	-	-

★ This table shows the standard values obtained by using the JIS correction coefficients.

★ This table shows the standard values when the air cleaner and the KDOC are installed and no load is applied to the alternator.

★ The dynamometer load in this table shows the value when the dynamometer arm is 716 mm long.

★ Use ASTM No. 1 or No. 2 diesel fuel as fuel.

★ Use EO15W40-LA as lubricating oil.

Running-in standard and performance test standard

Applicable machines: WA100M-7

Running-in standard

Engine		SAA4D95LE-6				
Item		Procedure				
		1	2	3	4	5
Running time	min.	2	10	2	3	3
Engine speed	rpm	900	900	1,200	1,600	2,350
Dynamometer load	N {kg}	0 {0}	98 {10}	147 {15}	245 {25}	375{38}
Output	kW {HP}	0 {0}	8.1 {10.8}	13.2 {17.7}	29.4 {39.4}	66.2 {88.8}

★ The dynamometer load in this table shows the value when the dynamometer arm is 716 mm long.

Performance test standard

Engine		SAA4D95LE-6			
Test item		Rated horsepower	Max. torque	Max. speed with no load	Min. speed with no load
Specification value (Gross)	-	66.2 kW/2,350 rpm {88.8 HP/2,350 rpm}	320 Nm/1,600 rpm {32.7 kgm/1,600 rpm}	2,650 ± 50 rpm	900 ± 25rpm
Engine speed	rpm	2,350 ± 5	1,600 ± 100	-	-
Dynamometer load	N {kg}	357 to 394 {36.4 to 40.2}	425 to 470 {43.4to 47.9}	-	-
Output (Gross)	kW {HP}	62.9 to 69.3 {84.4 to 93.2}	-	-	-
Torque (Gross)	Nm {kgm}	-	304 to 336 {31.0 to 34.3}	-	-
Fuel consumption	sec/200 cc	-	-	-	-
Coolant temperature	°C	75 to 94	75 to 94	75 to 94	75 to 94
Lubricating oil temperature	°C	90 to 120	90 to 120	90 to 120	90 to 120
Lubricating oil pressure	kPa {kg/cm^2}	340 to 690 {3.5 to 7.0}	-	-	Min. 150 {Min. 1.5}
Exhaust temperature	°C	Max. 640	Max. 670	-	-

★ This table shows the standard values obtained by using the JIS correction coefficients.

★ This table shows the standard values when the air cleaner and the KDOC are installed and no load is applied to the alternator.

★ The dynamometer load in this table shows the value when the dynamometer arm is 716 mm long.

★ Use ASTM No. 1 or No. 2 diesel fuel as fuel.

★ Use EO15W40-LA as lubricating oil.

SHOP MANUAL

ENGINE

95E-6 SERIES

Model Serial Number

95E-6 SERIES

50 Disassembly and assembly

Table of contents *(ALL-0310-002-A-00-A)*

Related information on disassembly and assembly *(ALL-3851-001-A-00-A)*

How to read this manual *(ALL-0320-011-A-00-A)*

(Rev.2013.05)

Removal and installation of □□□□ assembly
Special tools

- The special tools required for removal and installation work are described in the list as symbols such as A1, ..., X1. Part number, part name, necessity, and quantity are described.
- Mark used in the column of necessity are explained below.
  ■: Tools are not substituted, must always be equipped (used).
  ●: Tools extremely useful if available or tools that can be substituted with commercially available tools.
- For details and the sketches of the special tools, see "Special tool list" and "Sketches of special tools."

Removal

- In "Removal" section, the work procedures, precautions and know-how to do the work, and the amount of oil and coolant to be drained are described.
- The general tools required for "Removal" are listed as [1], [2], ..., without description of part number, part name, and quantity.
- Marks used in "Removal" section are explained below.

⚠ : This mark shows safety-related precautions which must be followed when performing the work.

★ : This mark gives knowledge or precautions when performing the work.

[*1]: This mark indicates that knowledge or precautions for the assembly installation work are given in the "Installation" section.


: This mark shows the amount of oil or coolant to be drained.


: This mark shows the weight of the part or equipment.

Installation

- The work procedure of "Installation" is in the reversed order to removal unless otherwise specified.
- For knowledge and precautions required for "Installation", a [*1] mark is assigned to the "Removal" work procedure to indicate the work item of the installation knowledge or precaution.
- The general tools required for "Installation" are listed as [1], [2], ..., without description of part number, part name, and quantity.
- Marks used in "Installation" section are explained below.

⚠ : This mark shows safety-related precautions which must be followed when performing the work.

★ : This mark gives knowledge or precautions when performing the work.


: This mark shows the weight of the part or equipment.


: This mark shows a specific coating agent to be used.


: This mark shows the specified tightening torque.


: This mark shows the amount of oil or coolant to be added.

- **For details of oil or coolant to be added after installation, see Specification "Table of fuel, coolant and lubricants".**

Disassembly and assembly of □□□□ assembly
Special tools

- The special tools required for disassembly and assembly work are described in the list as symbols such as A1, ..., X1. Part number, part name, necessity, and quantity are described.
- Mark used in the column of necessity are explained below.
  ■: Tools are not substituted, must always be equipped (used).
  ●: Tools extremely useful if available or tools that can be substituted with commercially available tools.
- For details and the sketches of the special tools, see "Special tool list" and "Sketches of special tools."

Disassembly

- "Disassembly" describes the work procedure as well as the precautions, knowledge, and drain amounts of oil and coolant required for the work.
- The general tools required for "Disassembly" are listed as [1], [2], ..., without description of part number, part name, and quantity.

- Marks used in the section of "Disassembly" are explained below.

⚠ : This mark shows safety-related precautions which must be followed when performing the work.

★ : This mark gives knowledge or precautions when performing the work.

: This mark shows the amount of oil or coolant to be drained.

: This mark shows the weight of the part or equipment.

Assembly

- "Assembly" describes the work procedure as well as the precautions, knowledge, and drain amounts of oil and water required for the work.
- The general tools required for "Assembly" are listed as [1], [2], ..., without description of part number, part name, and quantity.
- Marks used in the section of "Assembly" are explained below.

⚠ : This mark shows safety-related precautions which must be followed when performing the work.

★ : This mark gives knowledge or precautions when performing the work.

: This mark shows the weight of the part or equipment.

: This mark shows a specific coating agent to be used.

: This mark shows the specified tightening torque.

: This mark shows the amount of oil or coolant to be added.

- **For details of oil or coolant to be added after installation, see Specification "Table of fuel, coolant and lubricants".**

Coating materials list *(ALL-3540-071-A-00-A)*

(Rev.2012.11)

★ The coating materials such as adhesives, liquid gasket, and grease used for disassembly and assembly are listed below.

★ For coating materials not listed below, use the equivalent of products shown in this manual.

Adhesive

Komatsu code	Part No.	Capacity	Container	Main features and applications
LT-1A	790-129-9030	150 g	Tube	• Use to prevent rubber gaskets, rubber cushions, and cork plugs from coming out.
LT-1B	790-129-9050	20 g (contained 2 pieces)	Polyethylene container	• Use for plastic (except polyethylene, polypropylene, tetrafluoroethylene and vinyl chloride), rubber, metal, and non-metal parts which require immediate and strong adhesion.
LT-2	790-129–9180	50 g	Polyethylene container	• Features: Resistance to heat and chemicals • Use to prevent bolts and plugs from coming loose and as sealant.
LT-3	790-129-9060 Set of adhesive and hardener	Adhesive: 1 kg Hardener: 500 g	Can	• Use to bond and seal metal, glass and plastics.
LT-4	790-129-9040	250 g	Polyethylene container	• Use to seal plugs for blank holes.
Holts MH705	790-129-9120	75 g	Tube	• Heat-resistant seal used to repair engines
ThreeBond 1735	790-129-9140	50 g	Polyethylene container	• Instantaneous adhesive • Curing time: From 5 sec. to 3 min. • Use mainly to bond metals, rubbers, plastics, and woods.
Aron Alpha 201	790-129-9130	2 g (contained 5 pieces)	Polyethylene container	• Instantaneous adhesive • Quick-curing type (max. strength is obtained after 30 minutes) • Use mainly to bond rubbers, plastics, and metals.
Loctite 499	428-99-80070	20 cc	Tube	• General-purpose instantaneous adhesive with excellent resistance to heat and impact • Use on the bushing mounting faces of axle supports.
Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	• Features: Resistance to heat and chemicals • Use to bond high-temperature fit parts.

Liquid gasket

Komatsu code	Part No.	Capacity	Container	Main features and applications
LG-5 ThreeBond 1110F	790-129-9080	1 kg	Polyethylene container	• Use to seal various threaded parts, pipe joints, and flanges. • Use to seal taper plugs, elbows, and nipples for hydraulic piping.
LG-6 ThreeBond 1215	790-129-9160	250 g	Tube	• Features: Silicon-based heat and cold-resistant sealant. • Use to seal flange surface and threaded parts. • Use to seal oil pan, final drive case, etc.
LG-7 ThreeBond 1207C	790-129-9170	150 g	Tube	• Features: Silicon-based quick-curing sealant • Use to seal flywheel housing, intake manifold, oil pan, thermostat housing, etc.
LG-8 ThreeBond 1207B	419-15-18131	100 g	Tube	• Features: Silicon-based heat, vibration, and shock-resistant sealant. • Use to seal transfer case, etc.
LG-9 ThreeBond 1206D	790-129-9310	200 g	Tube	• Use for rough surfaces such as the circle gear top seal which is not clamped by bolts, gaps in the weld which must be caulked, etc. • Can be coated with paint.
LG-10 ThreeBond 1206E	790-129-9320	200 g	Tube	• Use as lubricant or sealant when the radiator hoses are put on. • Can be coated with paint.
LG-11 ThreeBond 1121	790-129-9330	200 g	Tube	• Feature: Can be used together with solid gaskets. • Use for covers of the transmission case and steering case etc.
ThreeBond 1211	790-129-9090	100 g	Tube	• Liquid gasket used to repair engine

Molybdenum disulfide lubricant

Komatsu code	Part No.	Capacity	Container	Main features and applications
LM-P	09940-00040	200 g	Tube	• Use to prevent galling and seizure of press-fitted parts, shrinkage-fitted parts, and threaded parts. • Use to lubricate linkages, bearings, etc.
LM-S	09995-00250	190 g	Can	• Spray type • Thin molybdenum disulfide films are made on metal surfaces to prevent the metals from galling. • Use for the drive shaft splines, needle bearings, various link pins, bolts, etc.

Seizure prevention compound

Komatsu code	Part No.	Capacity	Container	Main features and applications
LC-G NEVER-SEEZ	—	—	Can	• Feature: Seizure and galling prevention compound with metallic super-fine-grain, etc. • Use for the mounting bolt in the high temperature area of the exhaust manifold and the turbocharger, etc.

Grease

Komatsu code	Part No.	Capacity	Container	Main features and applications
G2-LI G0-LI(*) *: For cold districts	SYG2-400LI-A SYGA-16CNLI SYG0-400LI-A (*) SYG0-16CNLI (*)	Various	Various	• Lithium grease with extreme pressure lubrication performance, general purpose type.
Molybdenum disulfide grease LM-G(G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g x 10 400 g x 20 16 kg	Bellows-type container Can	• Use for parts under heavy load. Caution: • Do not use this grease for rolling bearings like swing circle bearings, etc. and spline. • Use this grease for work equipment pins only when installing them, but do not use it afterward.
Hyper white grease G2-T G0-T(*) *: For cold districts	SYG2-400T SYG2-16CNT SYG0-400T(*) SYG0-16CNT(*)	400 g 16 kg	Bellows-type container Can	• Higher seizure resistance, heat resistance, and waterproof than molybdenum disulfide grease • Not conspicuous on machine since color is white.
Biogrease G2-B G2-BT(*) *: For use at high temperature and under high load	SYG2-400B SYGA-16CNB SYG2-400BT(*) SYGA-16CNBT (*)	400 g 16 kg	Bellows-type container Can	• Since this grease is biodegradable in short period, it has less impact on microorganisms, animals, and plants.
G2-S ThreeBond 1855	—	200 g	Tube	• Feature: Silicon-based grease with wider operating temperature range and superior thermal oxidative stability to prevent deterioration of rubber and plastic. • Use for oil seals of the transmission, etc.
G2-U-S ENS grease	427-12-11871	2 kg	Can	• Feature: Urea (organic) grease with heat resistance and long life, inclusion type. • Use for rubber, bearing and oil seal in damper. Caution: Do not mix with lithium grease.

Primer

Komatsu code	Part No.	Capacity	Container	Main features and applications	
Loctite 712	428-99-80080	100 mℓ	Glass container	• Use to accelerate hardening of instantaneous adhesive.	
SUNSTAR Paint Surface Primer 580 SUPER	417-926-3910	20 mℓ	Glass container	For adhered window glass	• Use as primer for cab side. (Effective period: 4 months after manufacture)
SUNSTAR Glass Primer 580 SUPER		20 mℓ	Glass container		• Use as primer for glass side. (Effective period: 4 months after manufacture)
SUNSTAR Paint Surface Primer 435-95	22M-54-27230	20 mℓ	Glass container		• Use as primer for painted cab sheet metal surface. (Effective period: 4 months after manufacture)
SUNSTAR PRIMER 435-41 for glass	22M-54-27240	150 mℓ	Steel can		• Use as primer for black ceramic-coated glass surface and for hard polycarbonate-coated surface. (Effective period: 4 months after manufacture)
SUNSTAR sash primer GP-402	22M-54-27250	20 mℓ	Glass container		• Use as primer for sash (alumite surface treatment). (Effective period: 4 months after manufacture)

Adhesive

Komatsu code	Part No.	Capacity	Container	Main features and applications	
SUNSTAR Penguin Seal 580 SUPER "S" or "W"	417-926-3910	320 mℓ	Polyethy-lene container	For adhered window glass	• Use "S" as adhesive for glass in high temperature months (during summer) and "W" in low temperature months (during winter). (Effective period: 4 months after manufacture)
Sika Japan Sikaflex 256HV	20Y-54-39850	310 mℓ	Cartridge		• Use as adhesive for glass. (Effective period: 6 months after manufacture)
SUNSTAR Penguin Super 560	22M-54-27210	320 mℓ	Ecocart (special container)		• Use as adhesive for glass. (Effective period: 6 months after manufacture)

Caulking material

Komatsu code	Part No.	Capacity	Container	Main features and applications	
SUNSTAR Penguin Seal No.2505	417-926-3920	330 mℓ	Cartridge	For adhered window glass	• Use to seal glass-to-glass joint. (Effective period: 4 months after manufacture)
SEKISUI Silicone Sealant 83	20Y-54-55130	333 mℓ	Cartridge		• Use to seal front window. (Effective period: 6 months after manufacture)
GE TOSHIBA SILICONES TOSSEAL381	22M-54-27220	333 mℓ	Cartridge		• Translucent white seal used for joint seals between glasses (Effective period: 12 months after manufacture)

Special tools list *(ENG95-3530-061-A-00-A)*

★ Tools with part number 79*T-***-**** are not supplied (to be locally manufactured).

★ Necessity

■: Tools are not substituted, must always be equipped (used).

●: Tools extremely useful if available or tools that can be substituted with commercially available tool.

★ New/Redesign

N: Tools with new part numbers, newly developed for this model.

R: Tools, with advanced part numbers, developed by improving existing tools for other models.

Blank: Tools already available for other models that can be used without any modification.

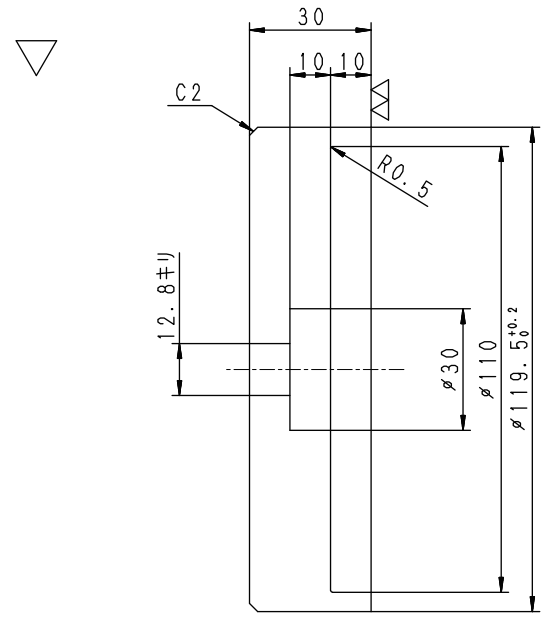
★ Tools marked with ○ in the Sketch column have the sketches. (See "Sketches of special tools")

Work	Sym-bol	Part No.	Part name	Necessity	Q'ty	New/Redesign	Sketch	Contents of work
Disassembly and assembly of engine assembly	A	790-501-2001	Engine repair stand	■	1			
	B	790-901-1250	Bracket	■	1			
Removal and installation of valve cotter	C	795-102-2102	Spring pusher (kit)	●	1			
		795-102-2110	• Handle		1			
		795-102-2150	• Bracket		1			
		795-102-2130	• Bracket		1			
		795-102-2170	• Stud bolt		1			
		01016-50830	• Bolt		1			
		01580-10806	• Nut		2			
Pulling out valve guide	D	795-501-1110	Remover	●	1	N		
Removal and installation of gear of supply pump	E	790-101-3000	Push puller	■	1	N		
Removal and installation of piston ring	F	795-100-2800	Piston ring tool	■	1			
Insertion of piston	G	795-921-1100	Piston holder	■	1			
Press fitting of rear oil seal	H	795T-221-1020	Plate	■	1		○	
		790-101-5401	Push tool (kit)	■	1			
		790-101-5431	• Plate		1			
		790-101-5421	• Grip		1			
		01010-51240	• Bolt		1			
Press fit of front oil seal	J	795T-221-1010	Push tool	■	1		○	
		790-101-5201	Push tool (kit)	■	1			
		790-101-5271	• Plate		1			
		790-101-5221	• Grip		1			
		01010-51225	• Bolt		1			
Press fitting of valve guide	K	795-501-1120	Guide driver	■	1	N		
Press fitting of valve seal	L	795-501-1130	Seal driver	■	1	N		
Adjusting valve clearance	N	795-125-1370	Feeler gauge	●	1			

Sketches of special tools *(ENG95-3531-066-A-00-A)*

Note: Komatsu does not take any responsibility for special tools manufactured according to these sketches.

H: Plate

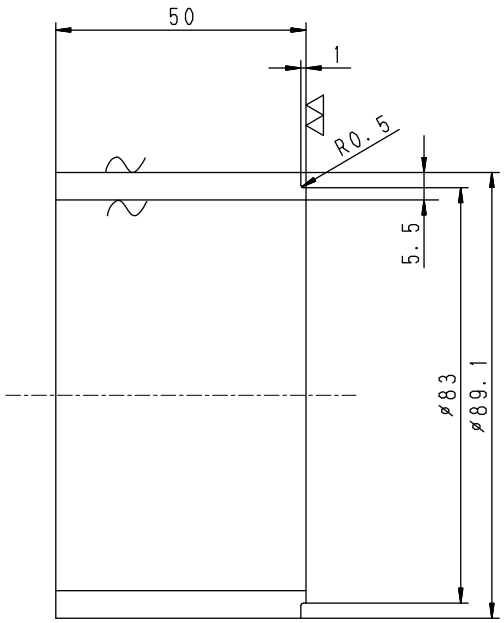


C4E11702

HEAT TREATMENT	MATERIAL
Quenching and tempering of finished products	S45C
PART NAME	Q'TY
PLATE	1
795T-221-1020 △	

指示ナキ角部ハ　C0．5　ニテ面取ルコト。
Chamfer each corner to C0.5, unless otherss otherwise specified.

J: Push tool



C4E11701

HEAT TREATMENT	MATERIAL
-	STKM13A
PART NAME	Q'TY
PUSH TOOL	1
795T-221-1010 △	

指示ナキ角部ハ　C0．5　ニテ面取ルコト。
Chamfer each corner to C0.5, unless otherss otherwise specified.

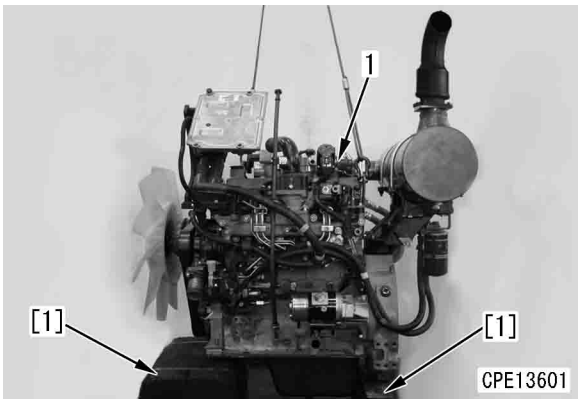
Disassembly and assembly *(ENG107-A000-001-K-00-A)*

General disassembly of engine *(ENG95-A000-530-K-00-A)*

★ Since the shapes, quantity, locations, etc. of the parts are different from the actual machine on which the engine is mounted, check them before starting the work.

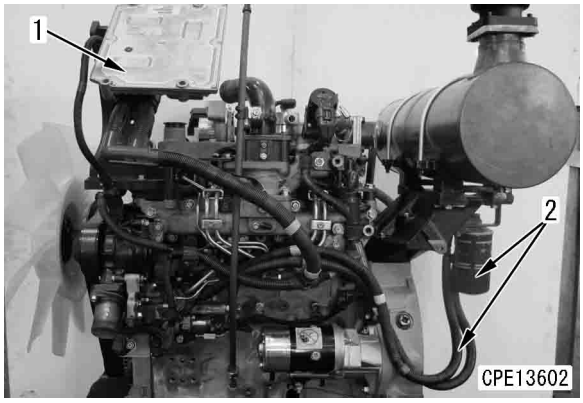
1. Preparation
   Before disassembling the engine, check its parts for cracking, damage, etc. and clean it generally and carefully for accurate inspection of its parts and quick disassembly and assembly.
   ★ Before cleaning the engine, carefully seal the openings or remove electric parts and wiring connectors so that water does not enter them.
2. Setting engine assembly
   1) Set engine assembly (1) on a rigid and stable block [1].
      ★ The weight depends on the machine model it is installed.

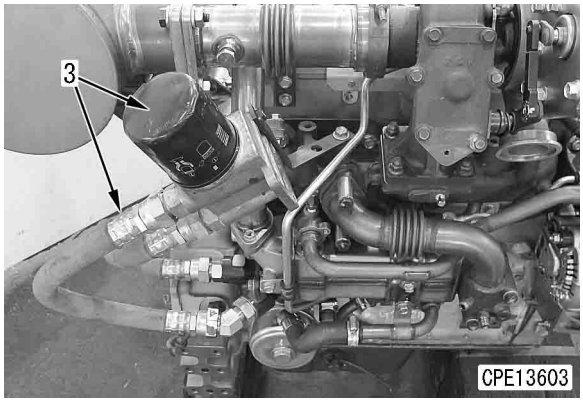
      Engine assembly:
      430 kg



   2) Drain the engine coolant and engine oil.
      ★ The quantity of the oil depends on the applicable machine.

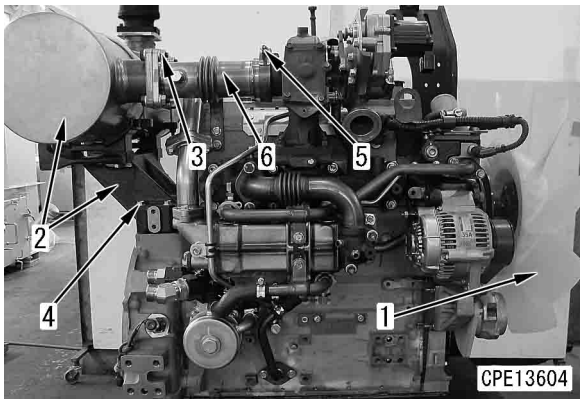
      Engine oil:
      11.5 ℓ
3. Removal of following auxiliaries
   1) Remove engine controller (1).
   2) Remove fuel filter and hose assembly (2).
   3) Remove oil filter and hose assembly (3).

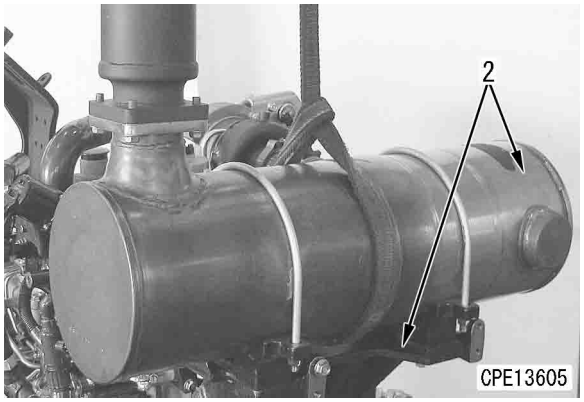




4. Fan and KDOC muffler assembly
   1) Remove fan (1).
   2) Sling KDOC muffler and bracket assembly (2) and remove nuts (3) (4 pieces) and bolts (4) (4 pieces).
      ★ The weight depends on machine it is installed.

      KDOC muffler and bracket assembly:
      45 kg
   3) Remove clamp (5), and remove tube (6).





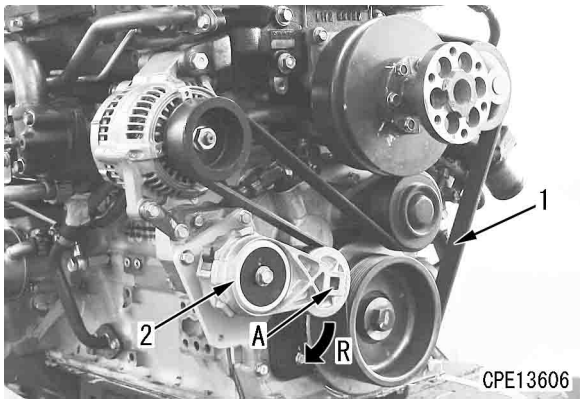
5. Fan belt
   Remove fan belt (1).

   ★ Insert a wrench in the portion A (width across flats: 12.7 mm) of the tensioner assembly (2), and rotate it in the counter-direction (R) to the winding-up direction to decrease fan belt tension, then remove.

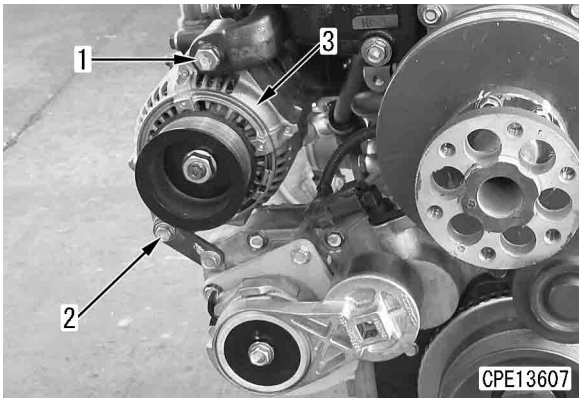
   ⚠ Be sure that the wrench is secured at portion A of tensioner assembly before turning it. (If you try to rotate the wrench before it is securely attached due to the strong spring force of tensioner assembly, the wrench may come offthat is very dangerous.

   ⚠ After removing the fan belt, slowly and carefully restore the tensioner assembly.

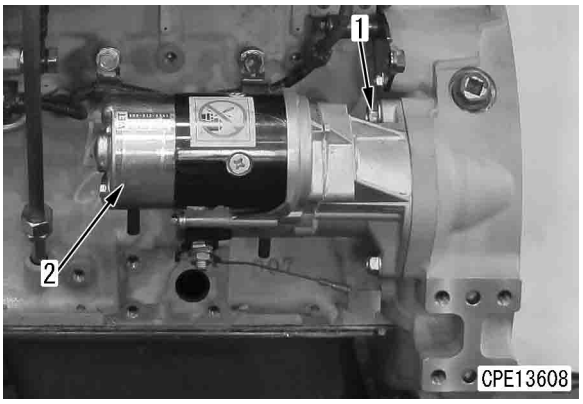
   ⚠ Be careful not to get your fingers caught between the pulley and fan belt during work.



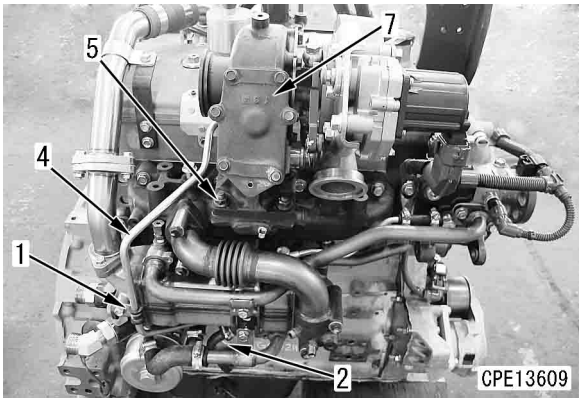
6. Alternator assembly
   Remove mounting bolts (1) and (2), and alternator (3).

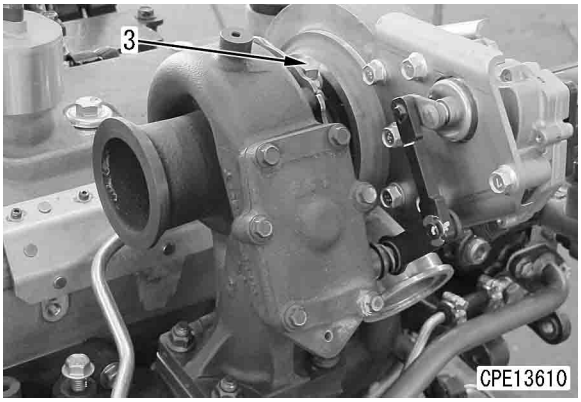


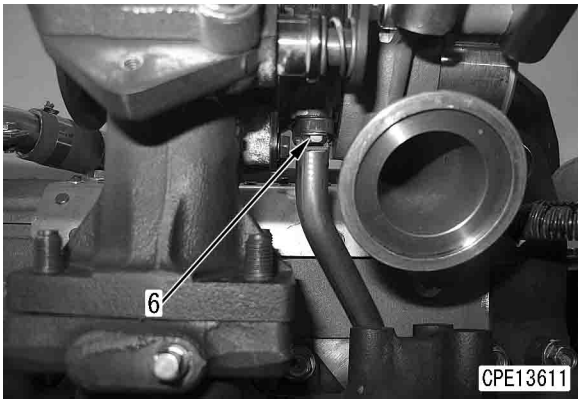
7. Starting motor assembly
   Remove mounting bolts (1) (2 pieces) and starting motor (2).



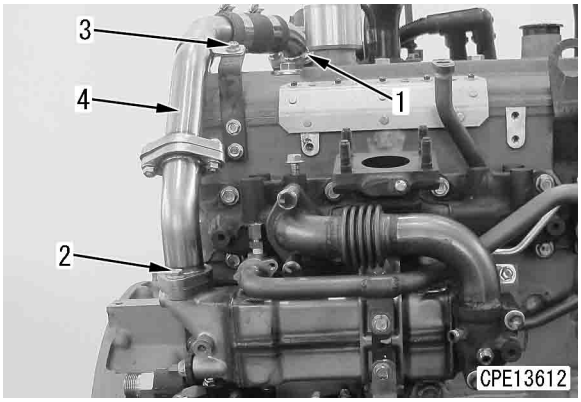
8. Turbocharger assembly
   1) Disconnect tube clamp (1).
   2) Remove mounting bolts (2) and (3), and then remove tube (4).
   3) Remove nuts (5) (4 pieces).
   4) Remove mounting bolt (6) of the lubricating oil drain tube on turbocharger side.
   5) Remove turbocharger assembly (7).

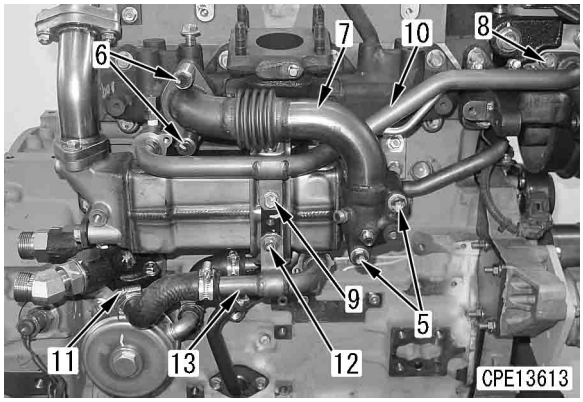


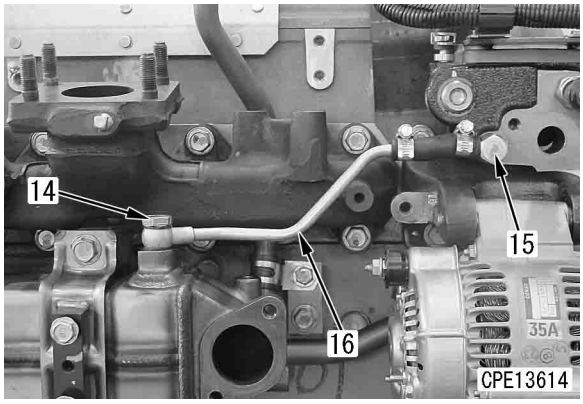




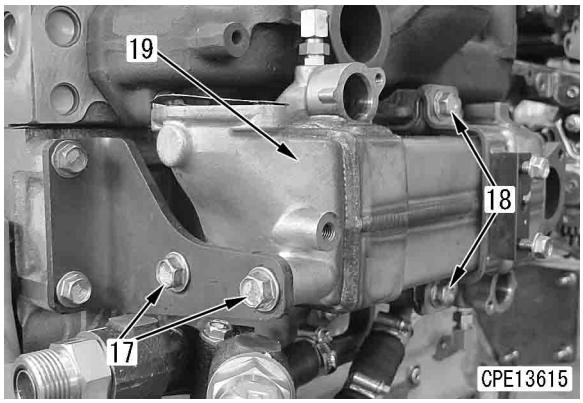
9. EGR cooler assembly
   1) Remove mounting bolts (1) (3 pieces), mounting bolts (2) (2 pieces), and clamping bolt (3). Remove tube (4).
   2) Remove mounting bolts (5) and (6), and then remove tube (7).
   3) Remove mounting bolts (8) (2 pieces), mounting bolt (9), and then remove tube (10).
   4) Remove hose clamp (11), bolt (12), and tube (13).
   5) Remove joint bolts (14) and (15), and then remove tube (16).



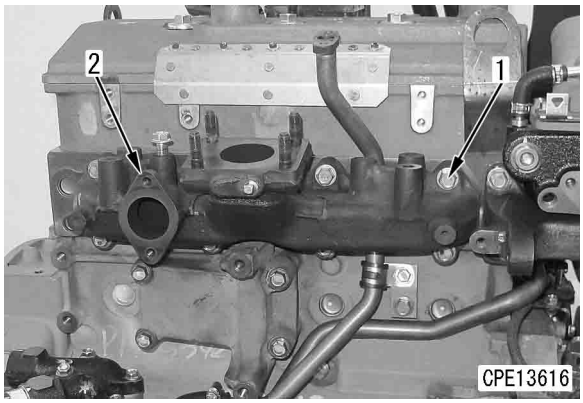




   6) Remove mounting bolts (17) and (18), and remove EGR cooler (19).



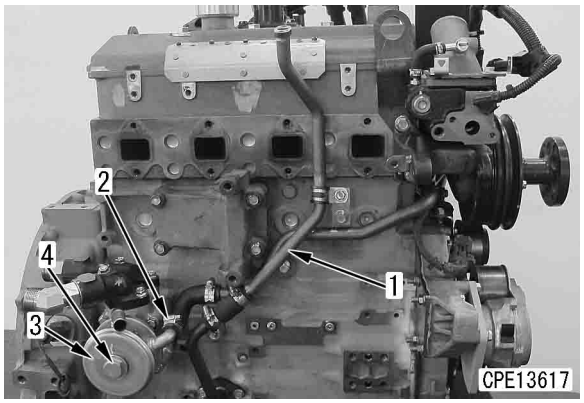
10. Exhaust manifold assembly
    Remove mounting bolts (1) (8 pieces) and exhaust manifold (2).

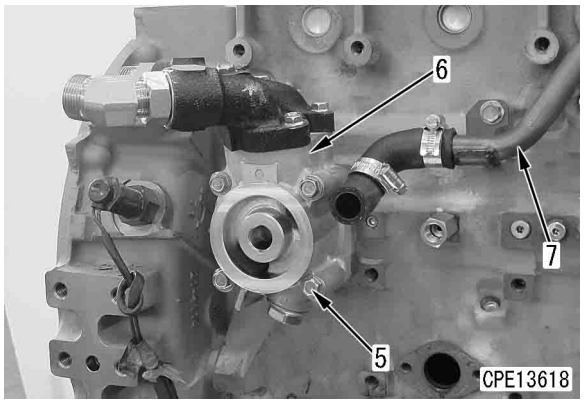


11. Oil cooler and adapter assembly

1) Remove tube (1).
2) Remove hose clamp (2) and remove it from oil cooler (3).
3) Remove mounting bolts (4) and remove oil cooler (3).
4) Remove mounting bolts (5) and adapter assembly (6).

★ Remove tube (7) in advance.



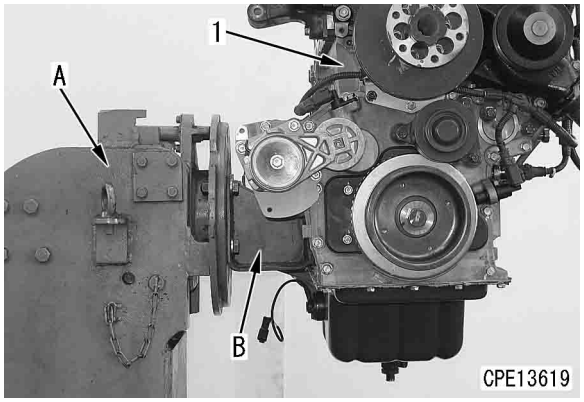


12.Installation to engine repair stand

1) Install engine assembly (1) to tool B.
2) Sling engine assembly (1) together with tool B as a unit, and install it to tool A.

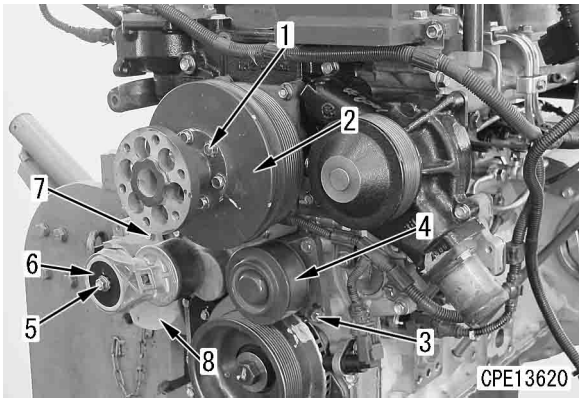
★ The weight depends on the applicable machine model.

Engine assembly:
380 kg



13.Fan pulley, idler pulley and tensioner assembly

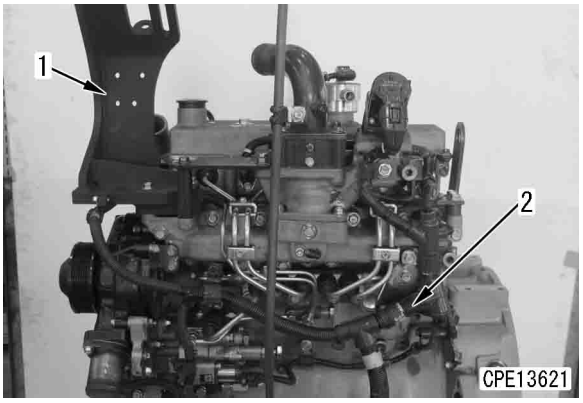
1) Remove mounting bolts (1) (6 pieces), and remove fan pulley assembly (2).
2) Remove mounting bolts (3) (3 pieces), and remove idler pulley assembly (4).
3) Remove mounting bolt (5) and remove tensioner assembly (6).
4) Remove mounting bolts (7) (3 pieces) and remove plate (8).



14.Bracket and wiring harness assembly

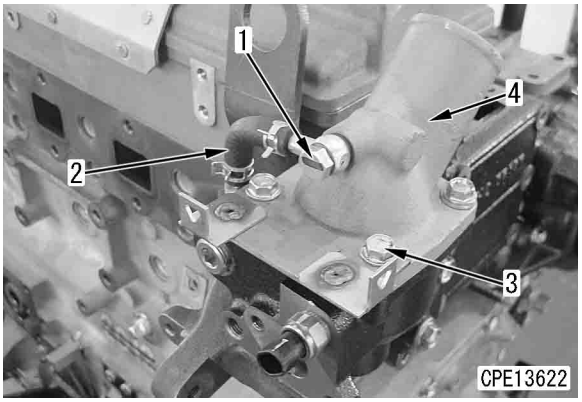
1) Remove bracket (1).
2) Disconnect wiring harness assembly (2).

★ When disconnecting the wiring harness assembly, check the positions of each clamp and connector.

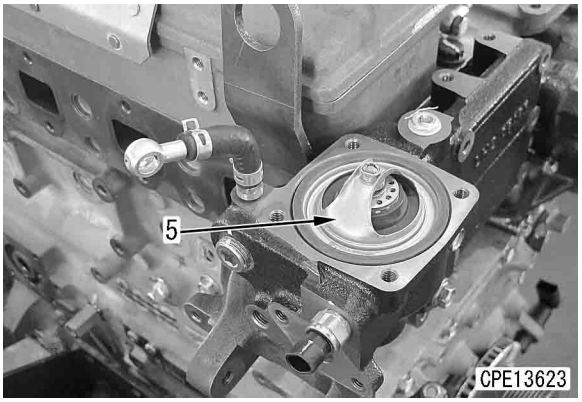


15.Thermostat assembly

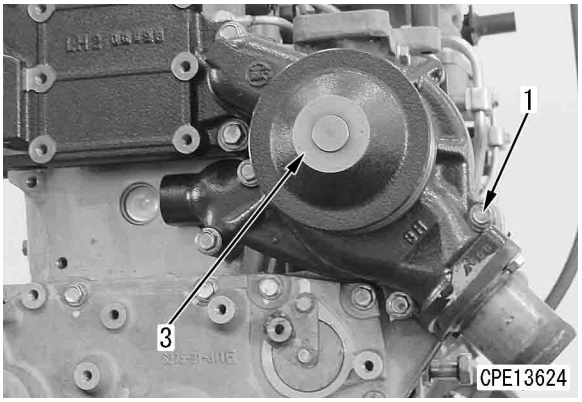
1) Remove joint bolt (1), and disconnect hose (2).
2) Remove mounting bolt (3) and remove coolant outlet connector (4).

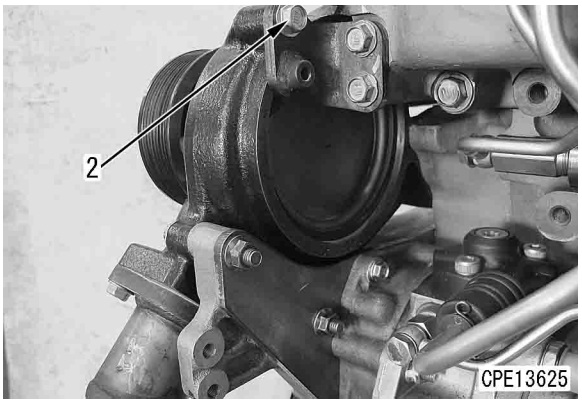


3) Remove thermostat (5).

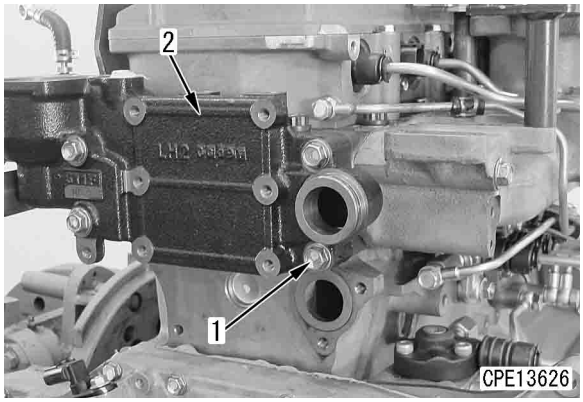


16.Water pump assembly
Remove mounting bolts (1) (4 pieces) and water pump (3).

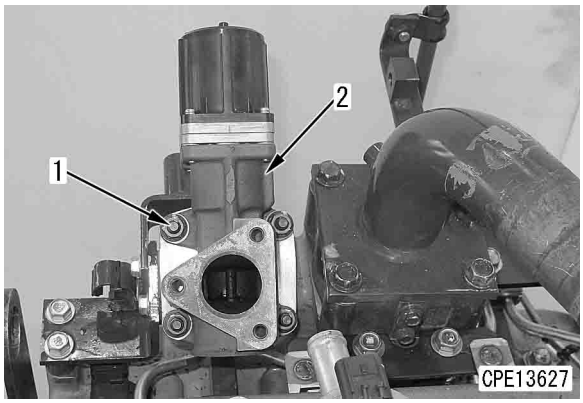




17.Thermostat housing
Remove mounting bolts (1) to remove thermostat housing (2).

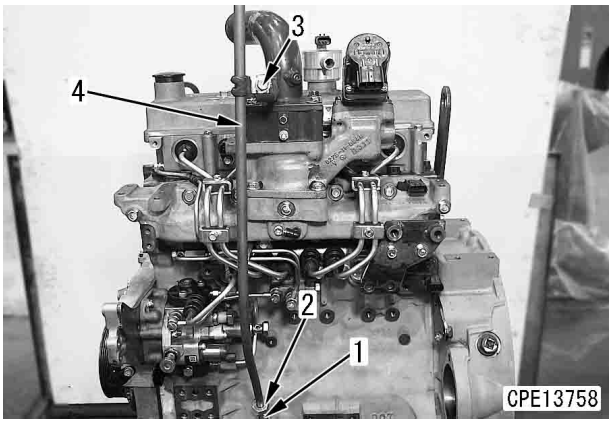


18.EGR valve assembly
Remove mounting bolts (1) (4 pieces) and remove EGR valve assembly (2).



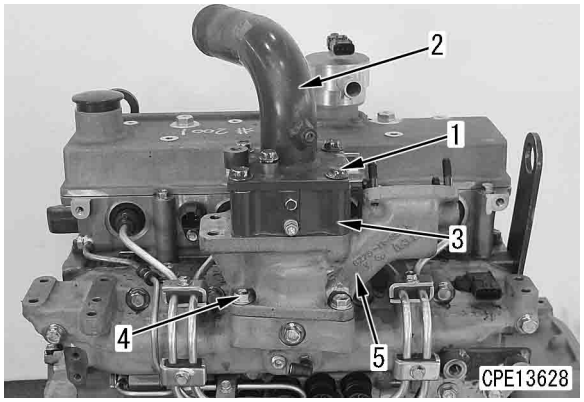
19.Oil filler pipe

1) While fixing guide (1), loosen nut (2).
2) Remove the clamp (3), and remove oil filler pipe (4).



20.Electrical intake air heater and air intake connector

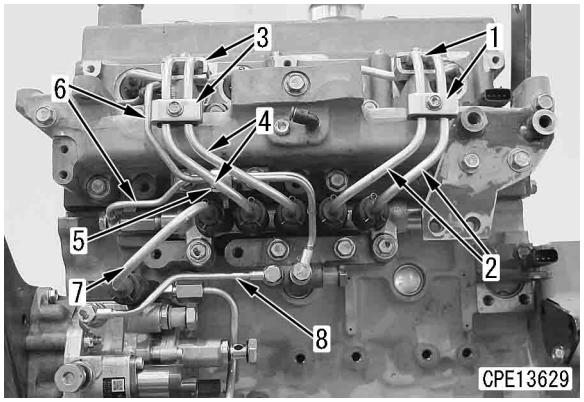
1) Remove mounting bolts (1) and remove tube (2) and intake air heater (3).
2) Remove mounting bolts (4) (4 pieces) and air intake connector (5).



21.Fuel high-pressure pipe

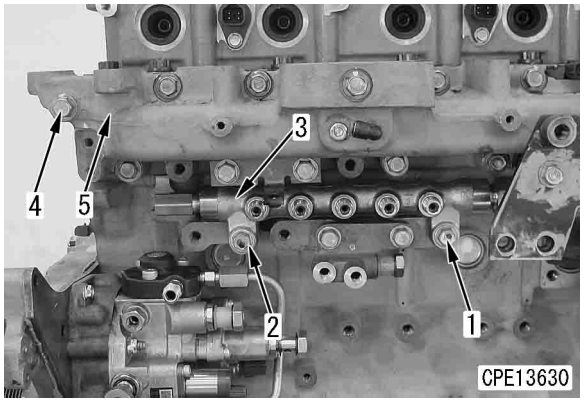
★ When removing the fuel high-pressure pipe, be careful not to apply excessive force to the pipe.

1) Remove tube clamp (1) and disconnect fuel high-pressure pipe (2).
2) Remove tube clamp (3) and disconnect fuel high-pressure pipe (4).
3) Remove tube clamp (5) and disconnect fuel tube (6).
4) Remove high pressure fuel pipe (7) and fuel tube (8).



22.Common rail and intake air manifold

1) Remove mounting bolts (1) and (2), and then remove common rail (3).
2) Remove mounting bolts (4) (13 pieces) and air intake manifold (5).



23.Breather and cylinder head cover

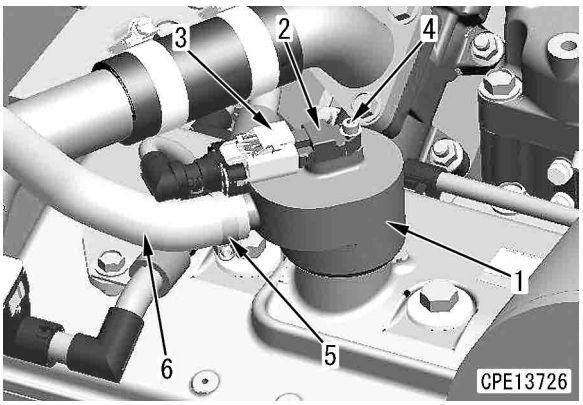
1) Remove breather (1).

★ Clean the periphery of the breather and crank case pressure sensor so that dirt, sand, dust, etc. do not enter in the engine.

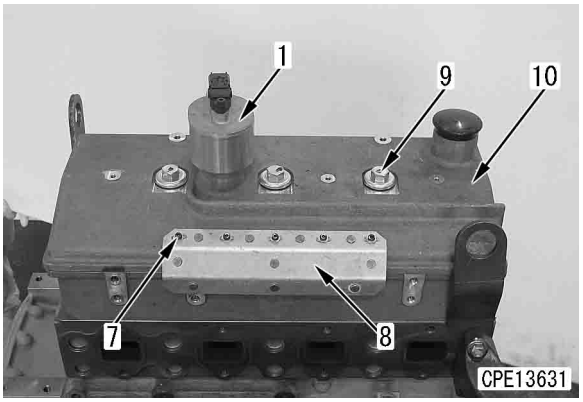
★ When removing the breather only, remove it according to the following procedures.

1] Disconnect connector (3) from crankcase pressure sensor (3).
2] Remove mounting bolt (4) and remove crankcase pressure sensor (2).
3] Loosen clamp (5) and disconnect breather hose (6).
4] Remove breather (1) from the cylinder head cover.

★ Be careful not to remove breather forcibly otherwise O-ring may be damaged.



2) Remove mounting bolt (7) and cover (8).
3) Remove mounting nuts (9) (3 pieces), and remove cylinder head cover (10).



24.Rocker housing

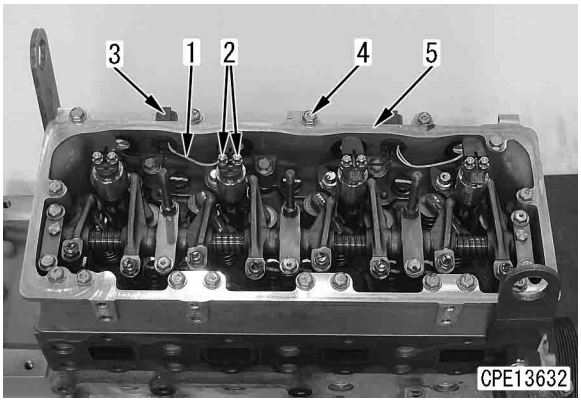
1) Remove nuts (2) (8 pieces) for injector wiring harness (1) from the injectors.

★ Installing position of injector wiring harness

Color of injector wiring harness	Cylinder No.
White	1, 3
Black	2, 4

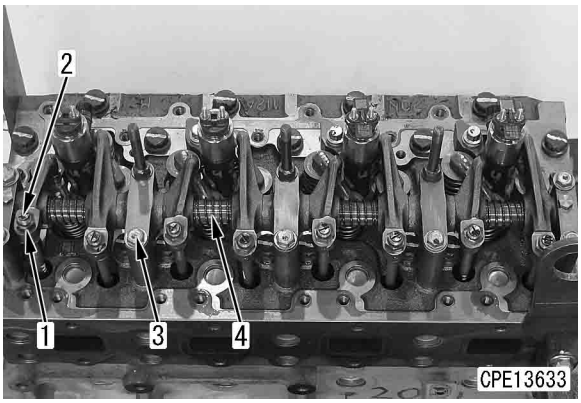
★ Remove injector harness connector (3) (2 pieces) from the rocker housing only when required.

2) Remove mounting bolts (4) (19 pieces) and remove rocker housing (5).



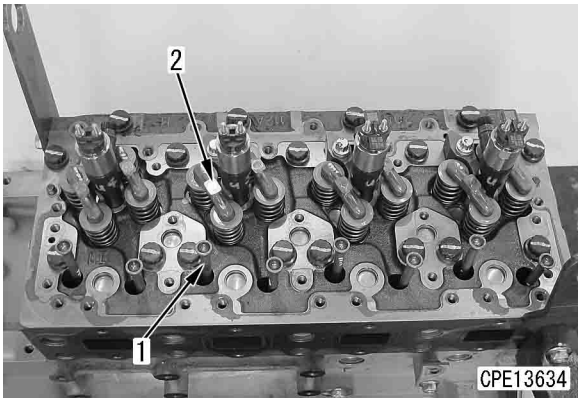
25.Rocker arm assembly

1) Loosen lock nuts (1) (8 pieces) and fully loosen adjustment screws (2) (8 pieces).
2) Remove mounting bolts (3) (10 pieces) and remove rocker arm assembly (4).

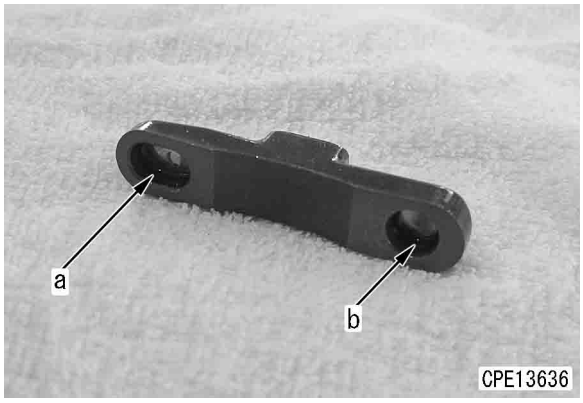


26.Push rod and crosshead

1) Remove push rods (1) (8 pieces).
2) Remove crossheads (2) (8 pieces).



★ Note the mounting position and the shapes of holes (a) and (b). (For reinstallation in the same direction)



27.Injector assembly

1) Remove mounting bolts (1) (4 pieces) and remove injector holders (2) (4 pieces).

★ Always replace this bolt with a new bolt when reassembling, because it is not reusable.

2) Remove injectors (3) (4 pieces).

★ Before removing the injector, record the cylinder number to which the injector is installed and the character string (M) listed on the QR code tab (Q) as a set.

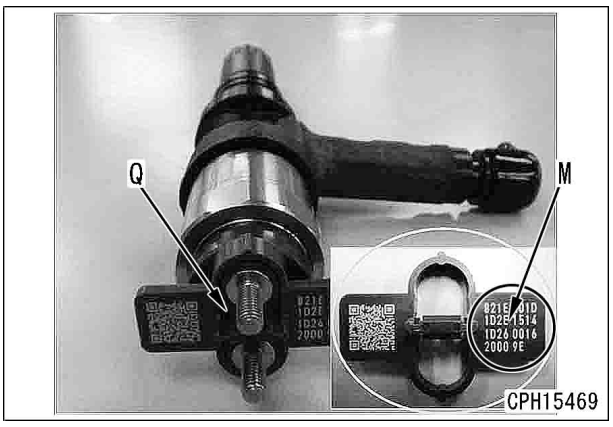
★ Read character string (M) in the order of the arrow shown in the figure.

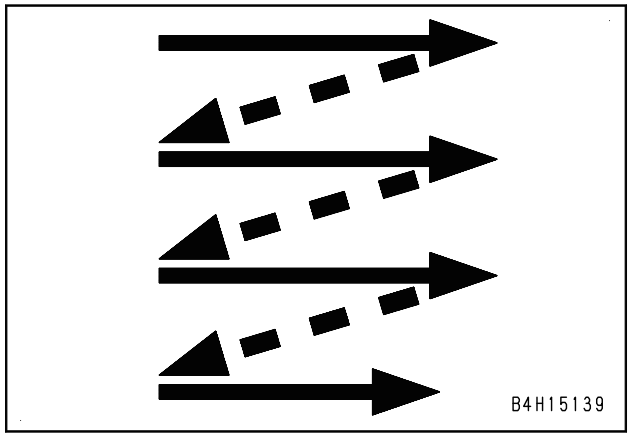
★ Check that the noted character string (M) is correct.

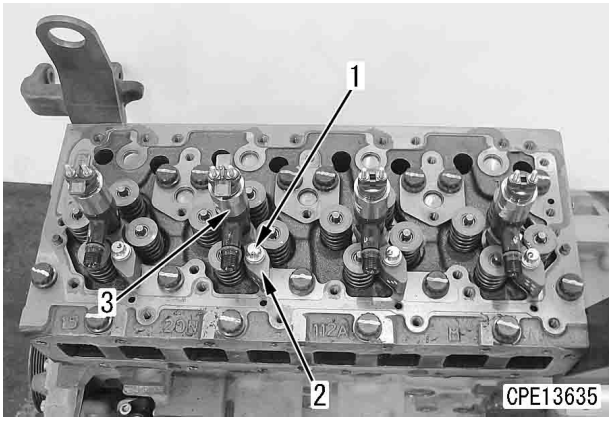
★ Do not remove QR code tab (Q) attached to the injector head.

★ Do not damage QR code tab (Q) attached to the injector head.

(Reference: The QR code or character string indicates the compensation value for fuel injection of the injector, which is specific to each injector.)





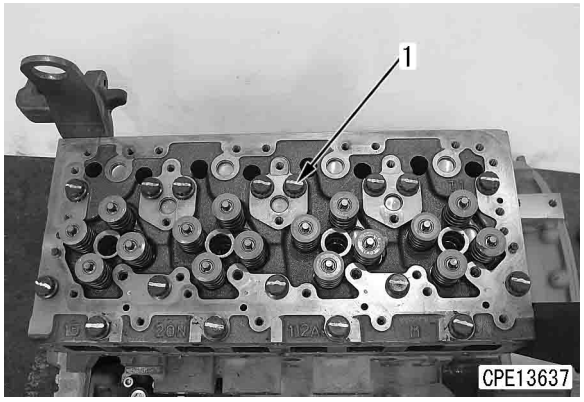


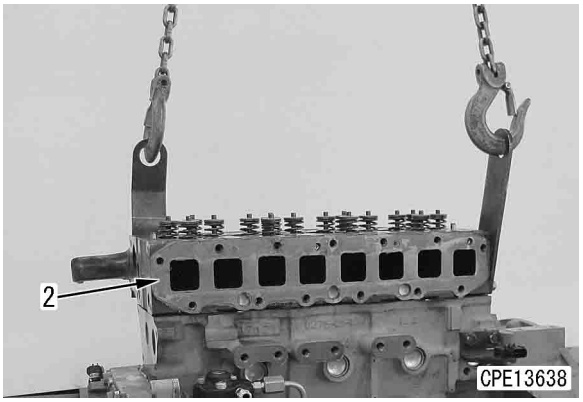
28.Cylinder head assembly

1) Remove mounting bolts (1) (17 pieces), and sling cylinder head assembly (2) and remove it.

Cylinder head assembly: 35 kg

★ Lay a cloth, etc. to prevent damaging the mounting area, and place the cylinder head assembly on the cloth.



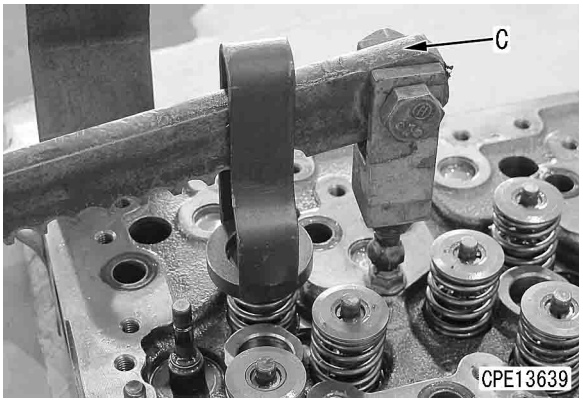


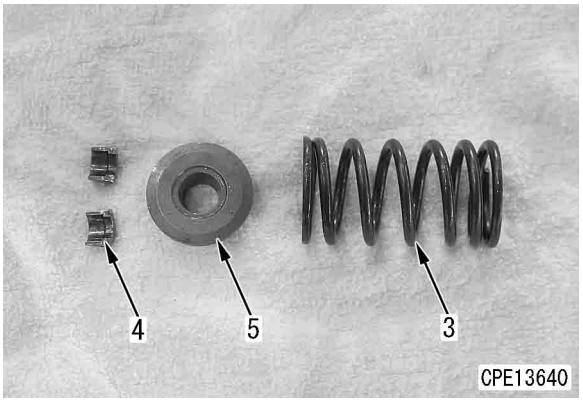
2) Disassemble the cylinder head assembly according to the following procedure.

1] By using tool C, compress the valve spring (3) and remove cotter (4).

2] Loosen tool C slowly and remove valve spring seat (5) and valve spring (3).

★ Remove from all cylinders in the same way.

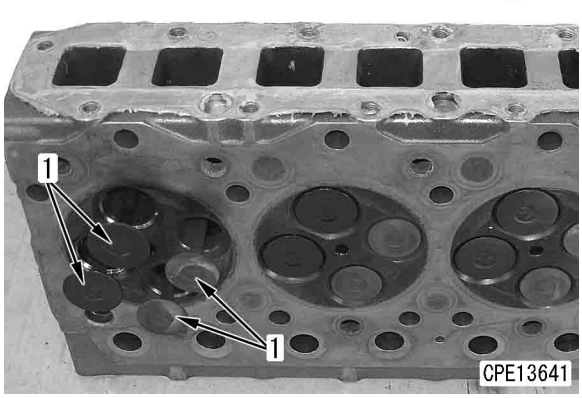




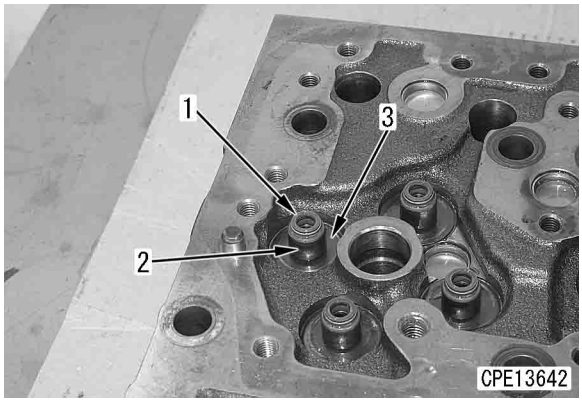
29.Intake, exhaust valves

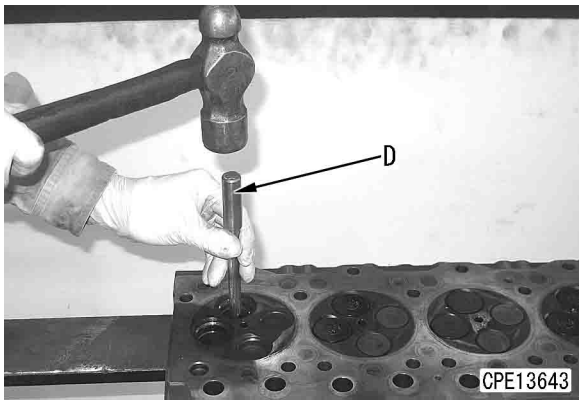
Raise the cylinder head assembly and remove intake and exhaust valves (1) (16 pieces).

★ Put marks on the intake and exhaust valves so that you can find matching cylinder head.

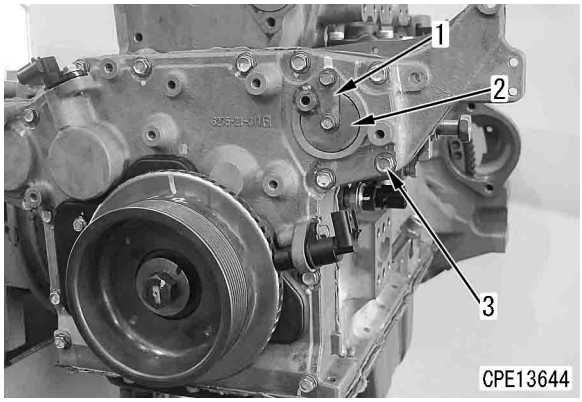


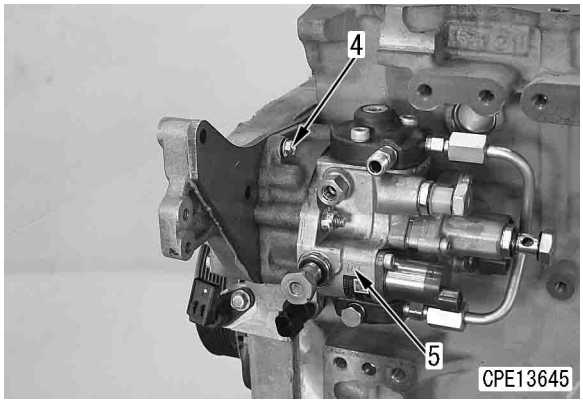
30. Valve guide and valve seals
    1) Remove valve seals (1) (16 pieces).
    2) By using tool D, remove valve guides (2) (16 pieces). (when necessary)
    3) Remove valve spring seats (3) (16 pieces).





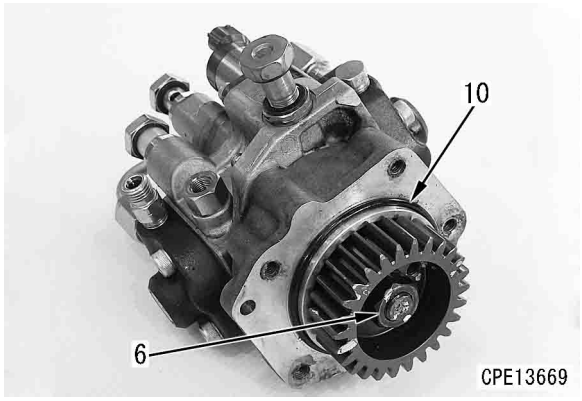
31. Supply pump assembly
    1) Remove plate (1).
    2) Remove the gear cover (2) of the supply pump.
    3) Remove mounting bolts (3) (4 pieces).
    4) Remove mounting bolts (4) and remove supply pump assembly (5).



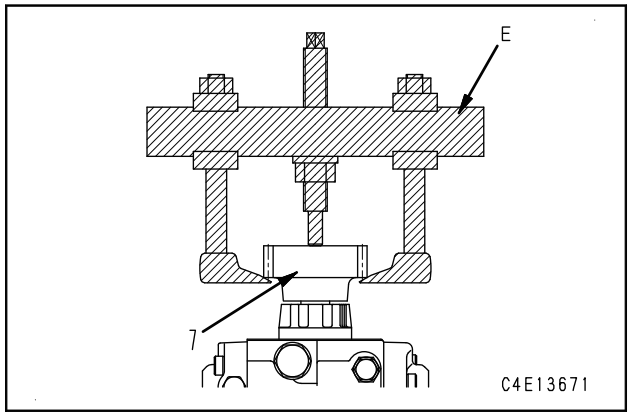


    5) When removing the gear from the supply pump assembly, follow the procedure described below.
        1] Remove O-ring (10).
        2] Loosen nut (6).

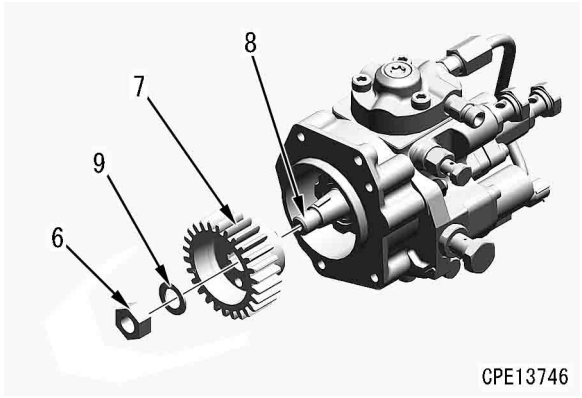
            ★ Do not remove the nut from the shaft.



        3] Install tool E between the flange and gear (7) of the supply pump.

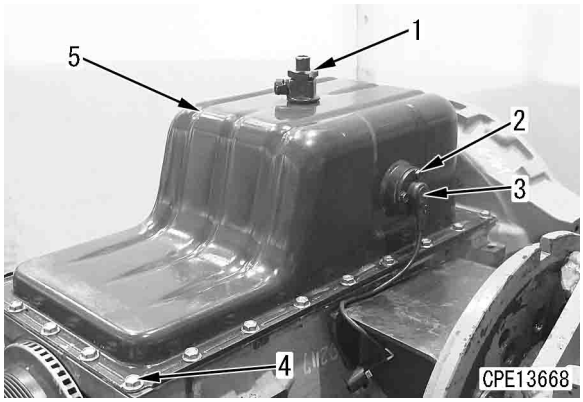


4] Remove nut (6), washer (9) and gear (7) from shaft (8).

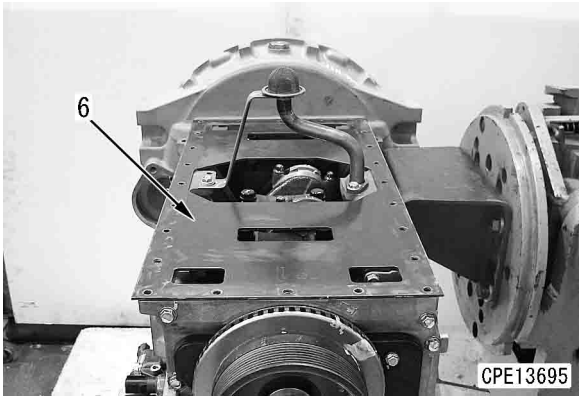


32.Engine oil pan

1) Rotate the engine repair stand to set the oil pan side facing upward.
2) Remove engine oil drain valve (1).
3) Remove mounting bolts (2) (3 pieces) and remove engine oil level sensor (3).
4) Remove mounting bolts (4) (24 pieces) and remove engine oil pan (5).

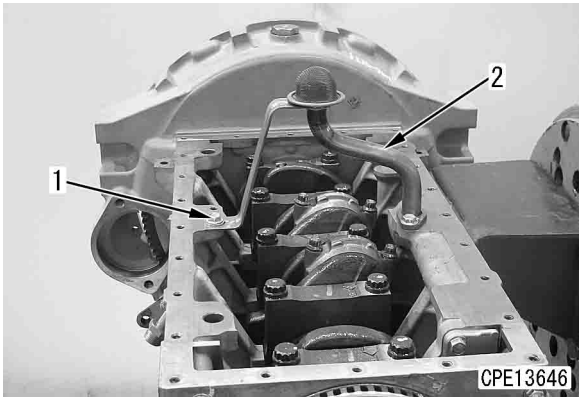


5) Remove under plate (6) from the cylinder block.



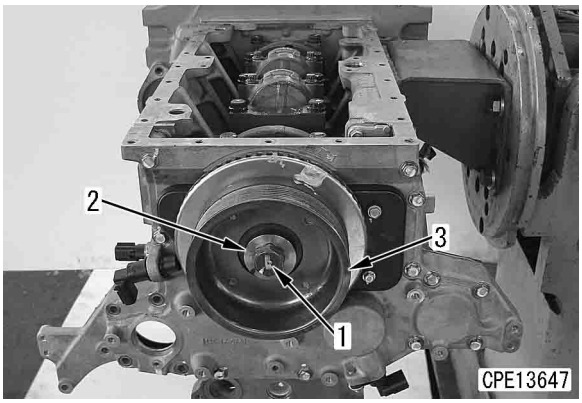
33.Oil suction tube

Remove mounting bolts (1) (2 pieces) and remove oil suction tube (2).



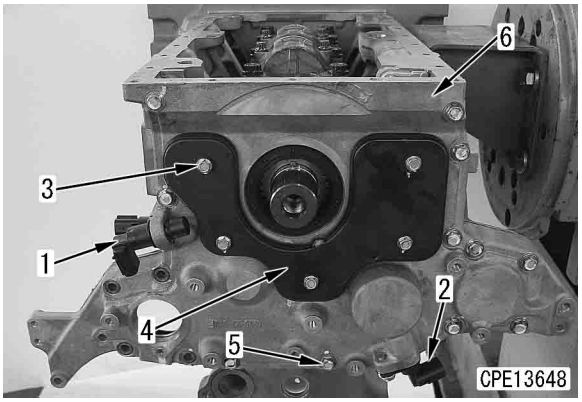
34.Crankshaft pulley

1) Remove mounting bolts (1).
2) Remove plate (2).
3) Remove crankshaft pulley (3).

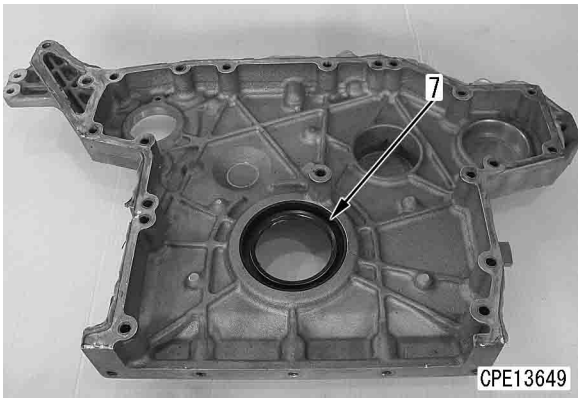


35.Speed sensor and front cover

1) Remove crankshaft speed sensor (NE) (1).
2) Remove camshaft speed sensor (BKUP) (2).
3) Remove mounting bolts (3) (5 pieces) and remove cover (4).
4) Remove mounting bolts (5) (13 pieces) and front cover (6).

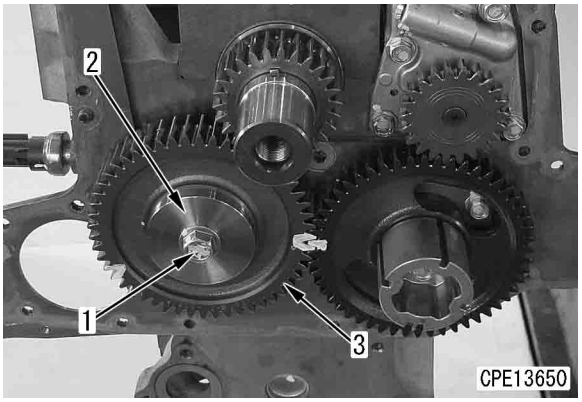


5) Remove front oil seal (7).



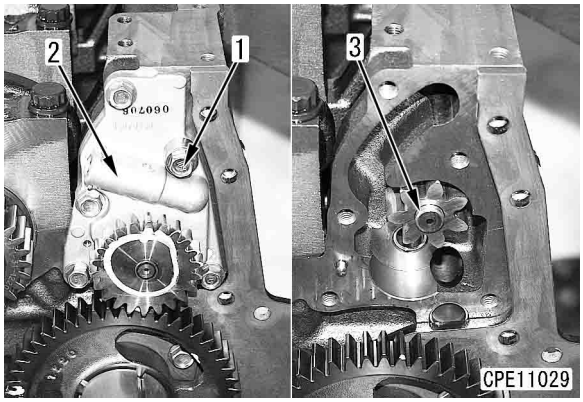
36.Idler gear

Remove mounting bolt (1), washer (2) and remove idler gear (3).



37.Oil pump assembly

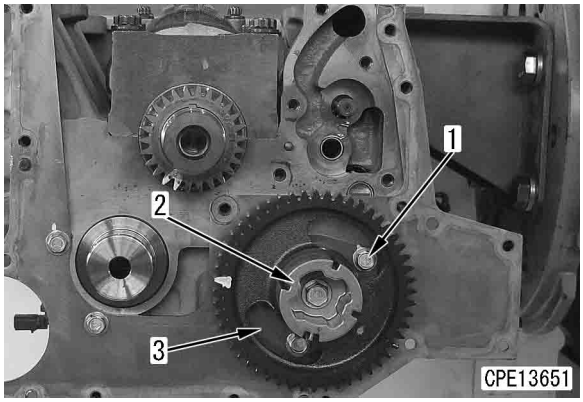
1) Remove mounting bolts (1) (5 pieces) and remove oil pump (2).
2) Remove driven gear (3).



38.Camshaft assembly

1) Remove mounting bolts (1) (2 pieces) through the molded hole of the gear.
2) Pull out camshaft assembly (2) and thrust plate (3) together from the cylinder block.

★ While turning the camshaft slightly, pull it out carefully so that the bushings are not damaged.



39.Flywheel assembly

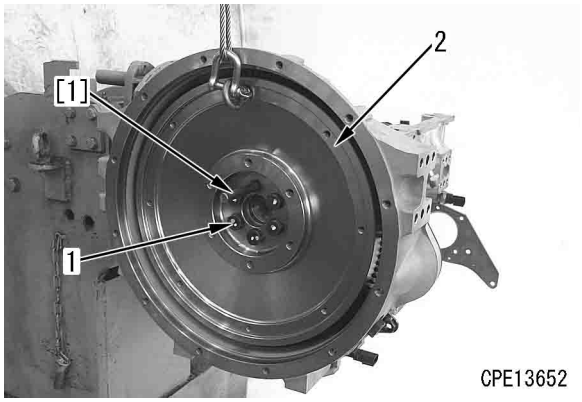
1) Remove mounting bolts (1) (6 pieces).

★ Remove mounting bolt (1 piece)and then install guide bolt [1].

2) Sling flywheel assembly (2), and remove it.

Flywheel assembly: 18 kg

⚠ Be sure to use a guide bolt as the flywheel spigot joint portion is shallow and it may suddenly fall.



40.Flywheel housing

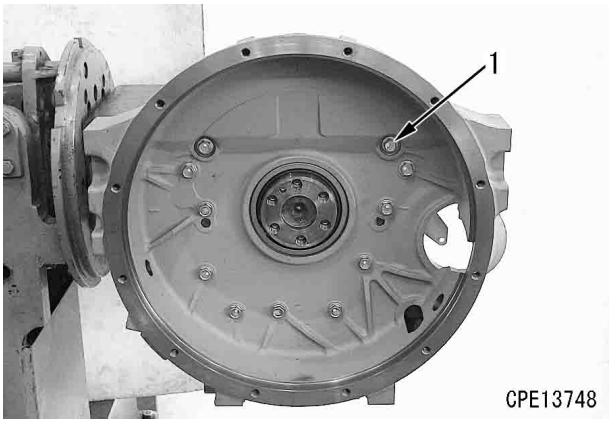
1) Remove mounting bolts (1) (11 pieces) and install guide bolt [1].

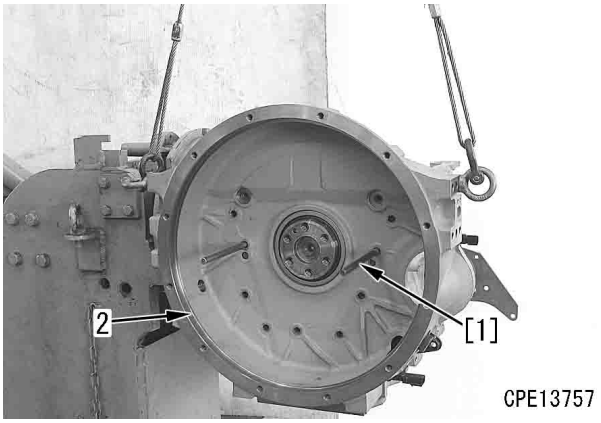
★ Remove mounting bolts (2 pieces) and install guide bolts.

★ Install guide bolts (2 pieces) to prevent damage to the rear oil seal.

2) Sling flywheel housing (2), and remove it horizontally.

Flywheel housing: 4.9 kg



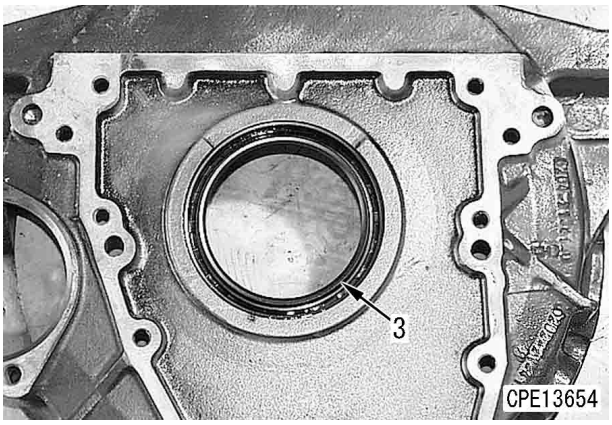


3) Remove rear oil seal (3).

★ Screw a slide hammer, etc. in the metal ring of rear oil seal (3), and pull out the rear oil seal by using the the impact of the slide hammer.

★ Before pulling out the seal, drive the seal inward a little to separate it from the housing for easy removal.

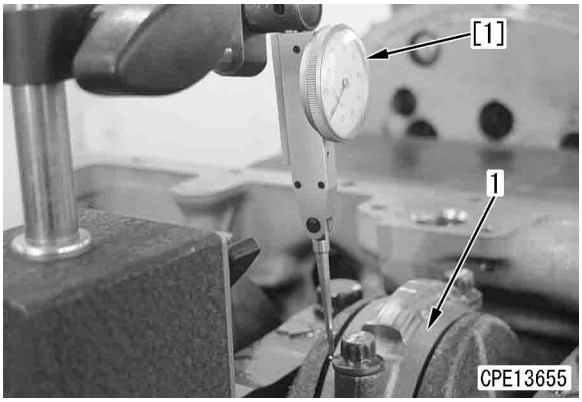
★ Do not use a drill, etc. as metal chips may enter the engine.



41.Piston and connecting rod assembly

1) Measure the side clearance of piston and connecting rod assembly (1) by using dial gauge [1].

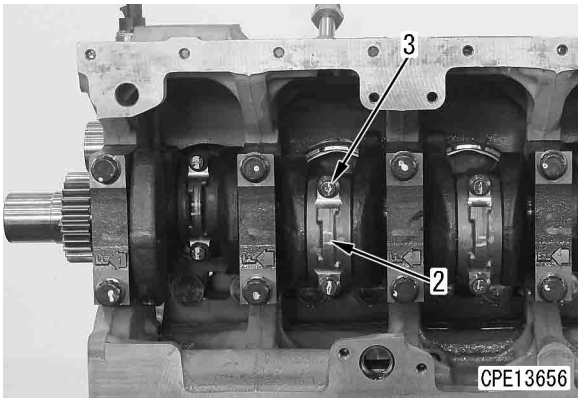
★ Measure the side clearance by moving the piston and the connecting rod assembly in the axial direction of the crankshaft.



2) Rotate the crankshaft and bring the piston to be removed to the bottom dead center position.
3) Rotate the engine repair stand, and set it sideways.
4) Remove mounting bolts (3) (2 pieces) of connecting rod cap (2) of piston and connecting rod assembly (1).
5) Tap connecting rod cap (2) with a plastic hammer, and remove connecting rod cap and connecting rod bearing as a unit.

★ Check that the number stamped on the connecting rod cap matches the cylinder number.

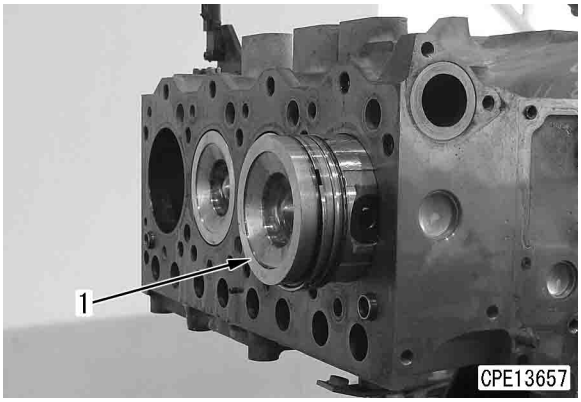
★ If there is no stamped number, stamp a number at the camshaft end.



6) Use a wooden bar from oil pan side to push the piston skirt, support the piston at the cylinder head end, then push more from oil pan side and pull out piston and connecting rod assembly (1).

★ Remove from all cylinders in the same way.

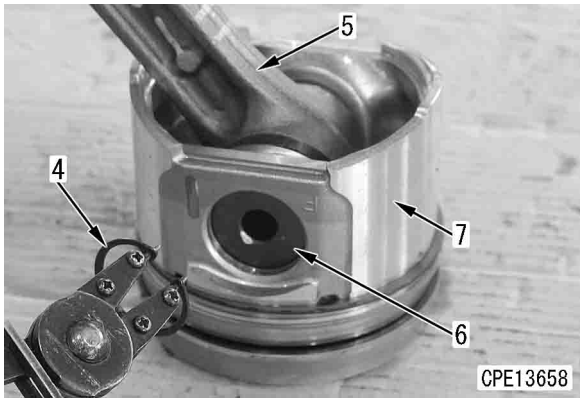
★ Be careful that the sliding surfaces of the pistons, connecting rod bearings, etc. are not damaged.



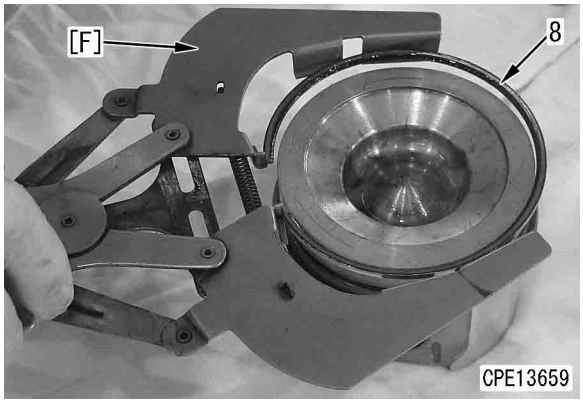
7) Disassemble piston and connecting rod assembly (1) according to the following procedure.

1] Remove snap ring (4).
2] Support connecting rod (5) with your hand, pull out piston pin (6) and disconnect piston (7) from the connecting rod.
3] Remove the snap ring on the opposite side.

★ If the piston pin cannot be pulled out, soak it in hot water, then pull it out.



4] By using tool F, remove piston ring (8) off the piston.

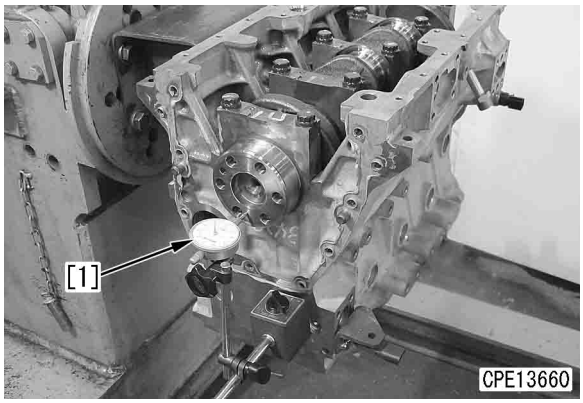


42.Main cap

1) Measuring end play (play in axial direction)

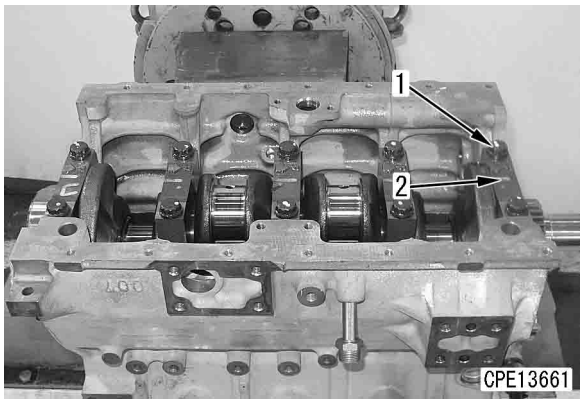
1] Rotate the engine repair stand, and set the oil pan of engine assembly to come upward.
2] Measure the end play of crankshaft by using dial gauge [1].

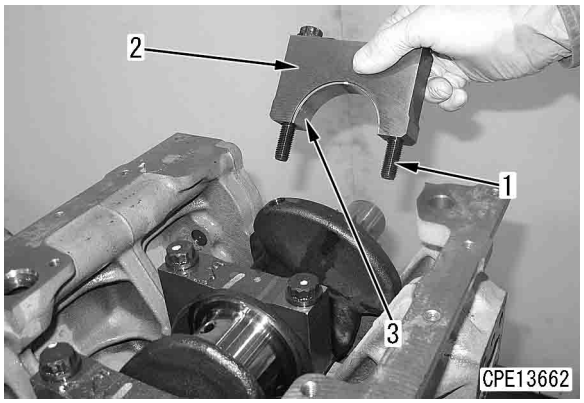
★ The end play measurement is necessary for judging the wear of the thrust bearing and abnormal wear of the crankshaft, so measure it before removing the crankshaft.



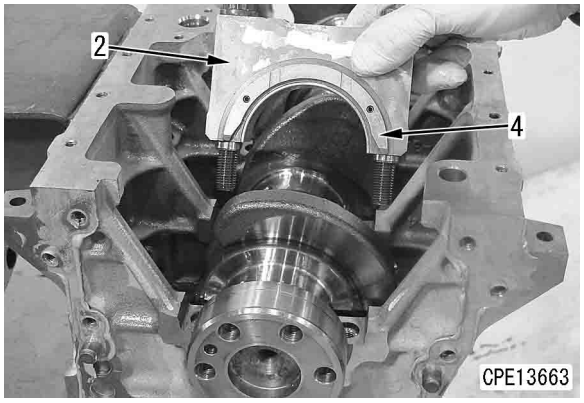
2) Remove mounting bolts (1) (10 pieces) of the main cap, then remove main caps (2) (5 pieces).

★ While wiggling the cap with a mounting bolt inserted into bolt hole in the cap, or by tapping the cap to the left and right with a plastic hammer, remove the cap together with lower bearing (3).





★ Thrust bearings (4) are installed to both surfaces of main cap (2) at the flywheel end, so when removing, note the positions of the bearings.

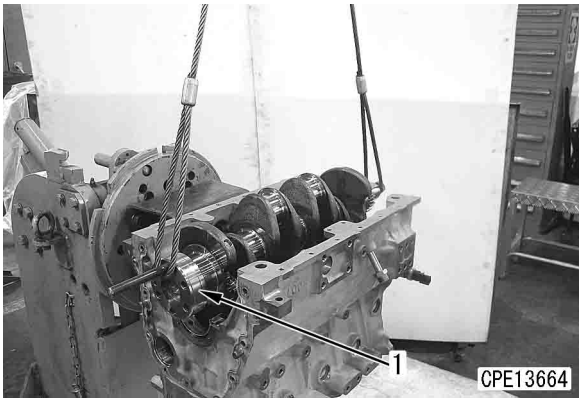


43.Crankshaft assembly

1) Sling crankshaft (1) and remove it.

★ Be careful not to damage the sliding portion of the crankshaft.

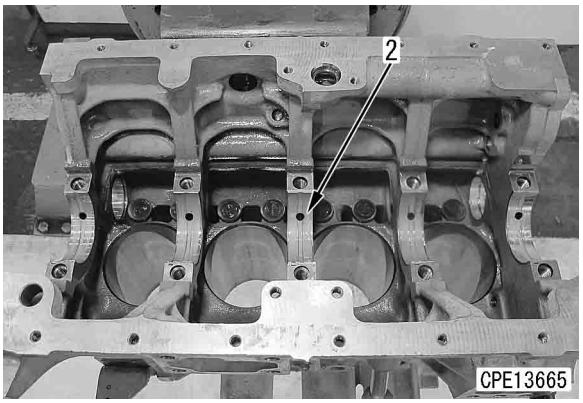
Crankshaft assembly:
30 kg



2) Remove main bearings (2) (5 pieces).

★ Push the end of the bearing down and remove it.

★ Put marks to the main bearings and thrust bearings to indicate their mounting positions, and sort them in a set by main cap number.

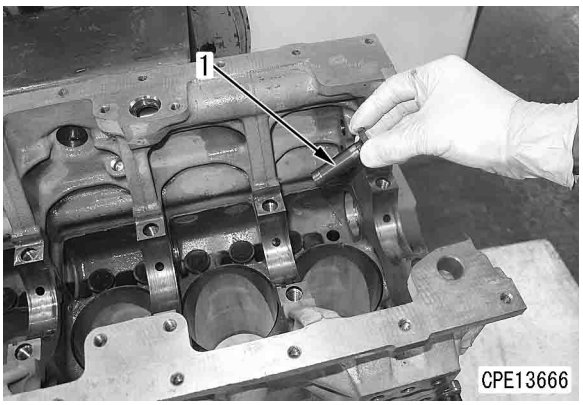


44.Tappet

Remove tappets (1) (8 pieces) from the cylinder block.

★ Check the sliding area of the cam for wear.

★ If wear is found, there is a possibility that the camshaft is worn. Check the camshaft.



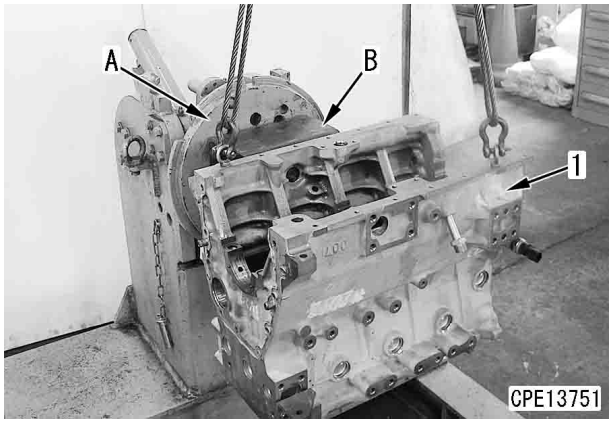
45.Cylinder block assembly

1) Sling cylinder block assembly (1), and remove mounting bolt of tool B.

2) Sling cylinder block assembly (1) and tool B together, and remove them from tool A.

★ Place the cylinder block assembly onto the block, and remove tool B.

Cylinder block assembly:
80 kg



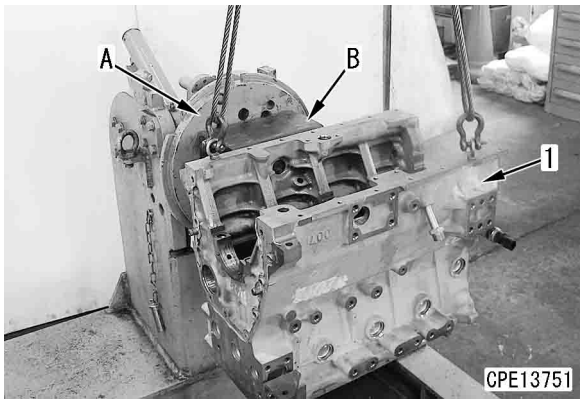
General assembly of engine *(ENG95-A000-710-K-00-A)*

★ Since the shapes, quantity, locations, etc. of the parts are different from the actual machine on which the engine is mounted, check them before starting the work.

★ Clean each part, and check it for dents, damage, blowholes, etc. And assemble the engine after checking that the oil and water paths are not clogged.

1. Cylinder block assembly
   1) Install tool B to cylinder block assembly (1).
   2) Sling cylinder block assembly (1) together with tool B as a unit and install it to tool A.

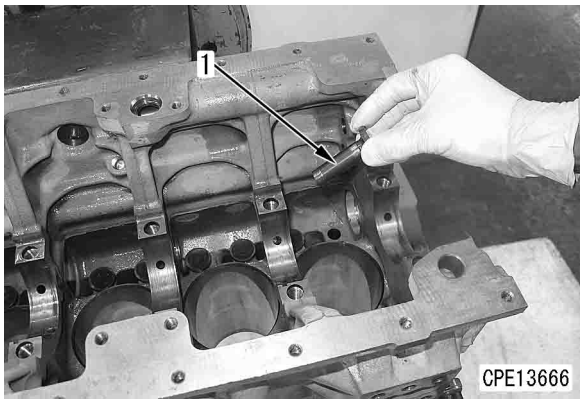
Cylinder block assembly:
80 kg



2. Tappet
   1) Apply engine oil to tappet (1).

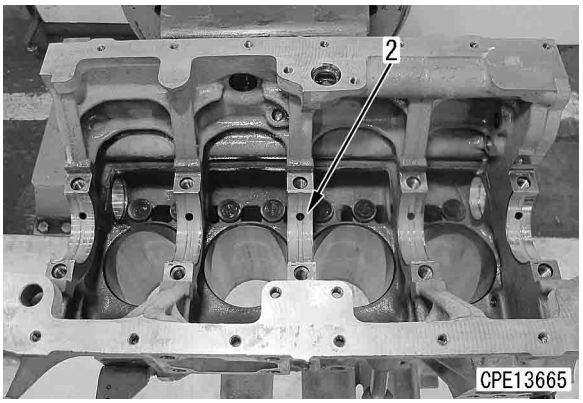
Tappets: Engine oil

   2) Install tappets (1) (8 pieces).



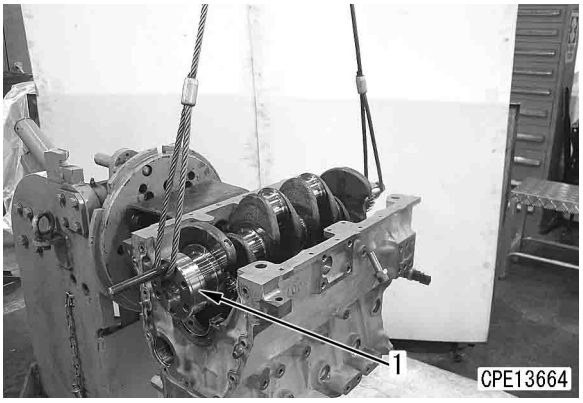
3. Crankshaft assembly
   1) Install main bearing (2).
      ★ Set the protruding portion of the bearing to the notch of the cylinder block.
      ★ Check that no dirt or dust is sticking to the back side of the bearing before assembling.
      ★ Apply engine oil to the inner side of the bearing. However, do not apply it to the back.

Inner side of main bearing:
Engine oil



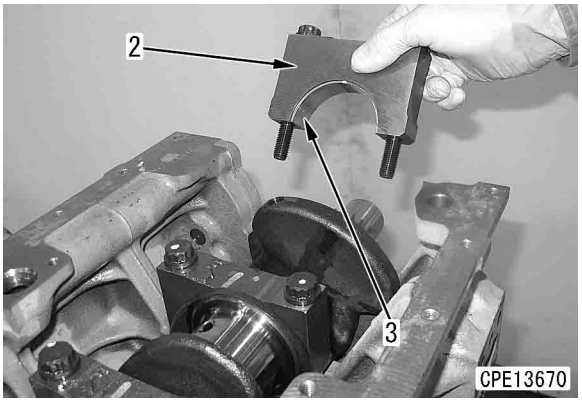
   2) Be careful not to let crankshaft (1) contact the block, and set it carefully on the main bearing.
   (Reference: If the crankshaft gear is replaced, put the crankshaft gear in an electric furnace, heat it for approximately 30 minutes at 190°C maximum, then shrink fit the gear.)

Crankshaft assembly:
30 kg



4. Main cap
   1) Align the notched part of each main cap (2) with lower bearing (3), and install lower bearing (3).
      ★ Check that no foreign material is sticking to the back of the bearing before assembling.
      ★ Apply engine oil to the inner side of the bearing. However, do not apply it to the back.

Inner side of bearing:
Engine oil



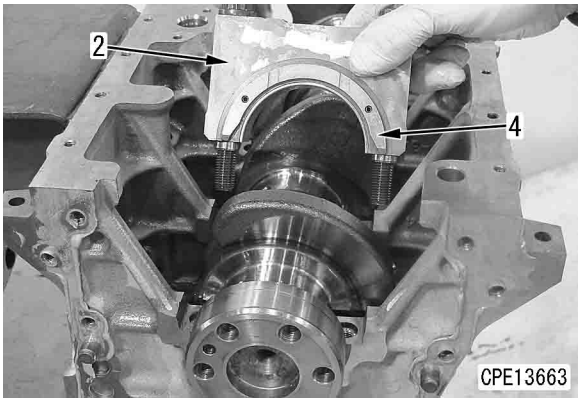
2) Align it with the dowel pin, and install thrust bearing (4) to main cap (2).

★ Install the thrust bearings to the both sides of the main cap.

★ Install the thrust bearing so that the oil grooves face the outside.

★ Apply engine oil to the whole face of the bearing.

Thrust bearing:
Engine oil



3) Fit main cap (2) to cylinder block, then tighten mounting bolts (1).

★ Before tightening the mounting bolts, fit the main cap and cylinder block completely and fasten them with the mounting bolts.

★ Check that the stamped mark on the main cap is the same as the stamped mark on the cylinder block.

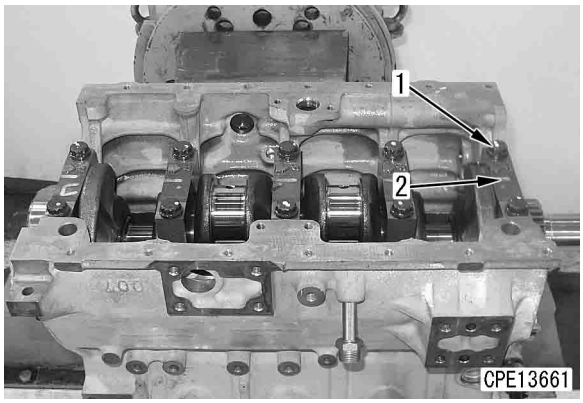
★ Install it so that the embossed arrow points the front side.

★ Be careful not to let the thrust bearing move out of position.

★ Tighten the main cap mounting bolts according to the following procedure by using a torque wrench.

1] Apply engine oil to the threaded portion of the seat surface of the bolt.

Threaded part and seat surface of bolt:
Engine oil

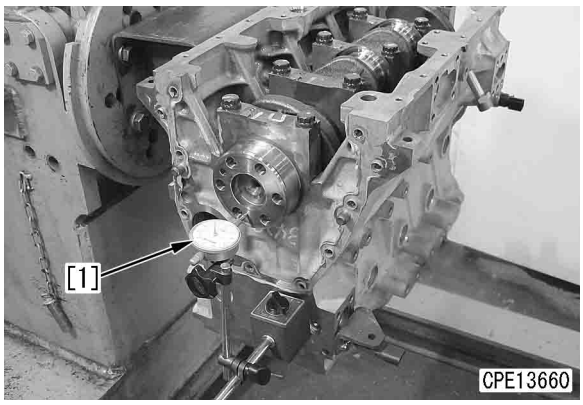


2] Tighten mounting bolts (1) (2 pieces) of each main cap alternately according to the following procedure.

Main cap mounting bolt:
1st time: 107.8 to 117.6 Nm {11.0 to 12.0 kgm}
2nd time: Loosen completely.
3rd time: 127.4 to 137.2 Nm {13.0 to 14.0 kgm}

4) Put the probe of dial gauge [1] to contact the end surface of the crankshaft and move the crankshaft back and forth to measure the end play of the crankshaft.

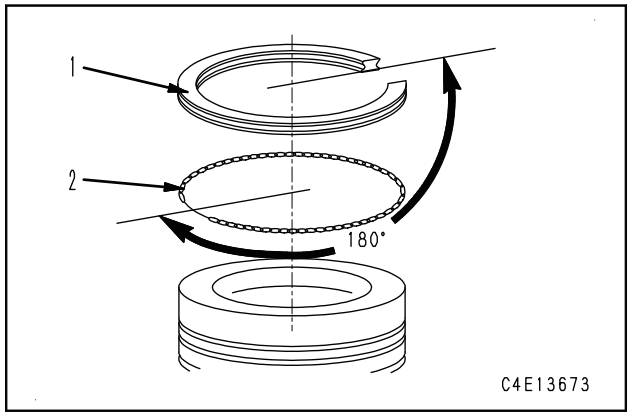
★ End play standard: 0.131 to 0.351 mm



5. Assembly of piston and connecting rod assembly.

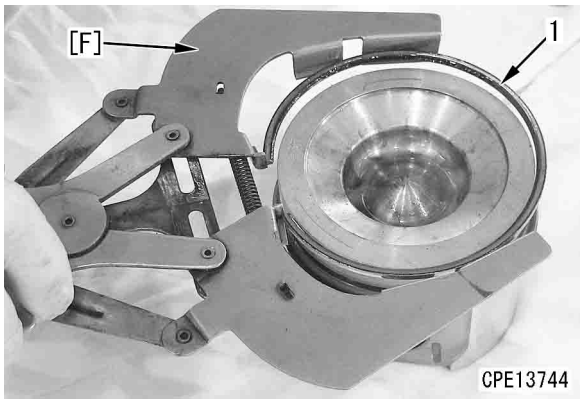
1) Install expander (2) into oil ring (1).

★ Fit oil ring (1) so that its abutment joint is 180 degrees away from the connection of expander (2).



★ Be careful not to damage the piston nor break the ring.

2) Install oil ring (1) to the piston by using tool F.

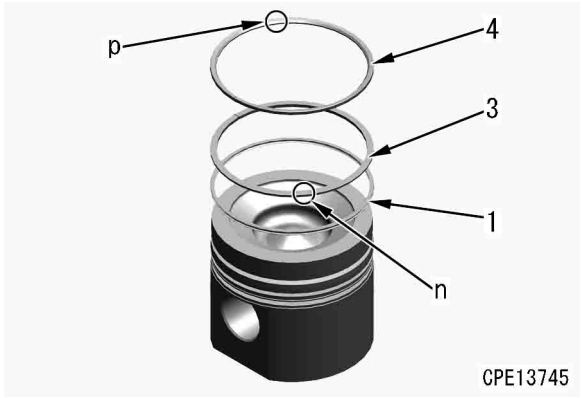


3) Install 2nd ring (3) to the piston by using tool F.

★ Install 2nd ring with the stamping mark "2R" (n) facing up, which is located near the abutment joint.

4) Install top ring (4) to the piston by using tool F.

★ Install top ring with the stamping mark "1R" (p) facing up, which is located near the abutment joint.



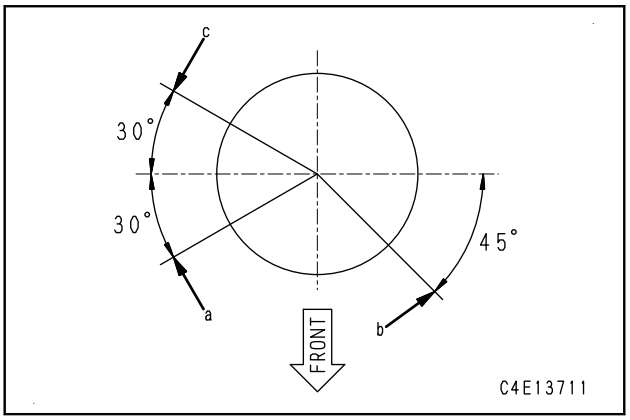
★ Installing position of each ring is shown on the following figure.

FRONT: Indicates the engine front.

(a): Position of oil ring abutment joint

(b): Position of 2nd ring abutment joint

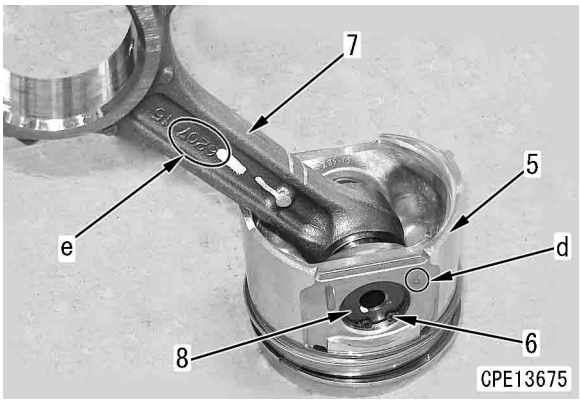
(c): Position of top ring abutment joint



5) Install snap ring (6) on a side of piston (5).

6) Insert connecting rod (7) into piston (5) and install piston pin (8).

★ Face embossed letter "F" (d) on each piston side and punched part number (e) on the connecting rod side to the engine front side when assembled.



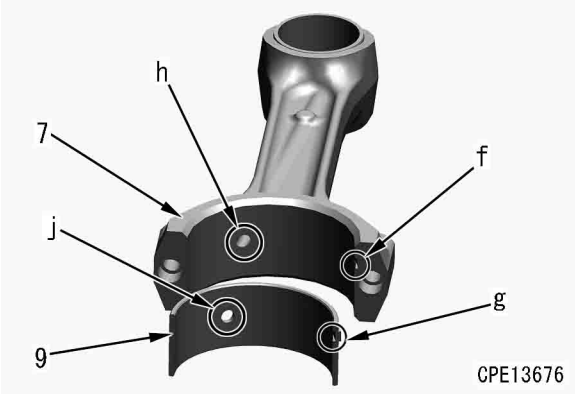
7) Install snap ring on the other side.

★ After installing the snap rings, check that the connecting rod moves smoothly back and forth.

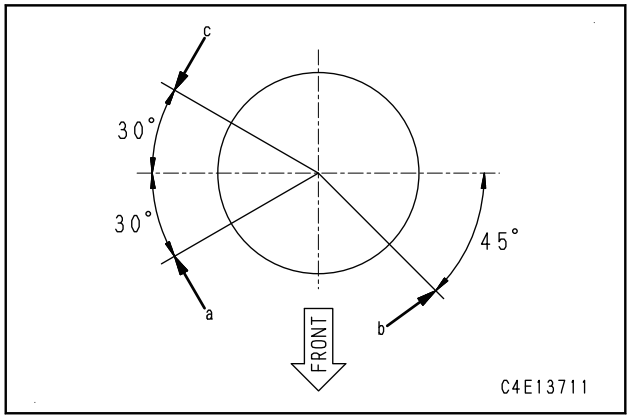
8) Align the notch (f) of connecting rod (7) to protrusion (g) of the upper connecting rod bearing (9), and install upper connecting rod bearing (9) to connecting rod (7).

★ Check that no foreign material is attached to the back of the upper connecting rod bearing.

★ Align oil hole (h) of the connecting rod and oil hole (j) of the upper connecting rod bearing.

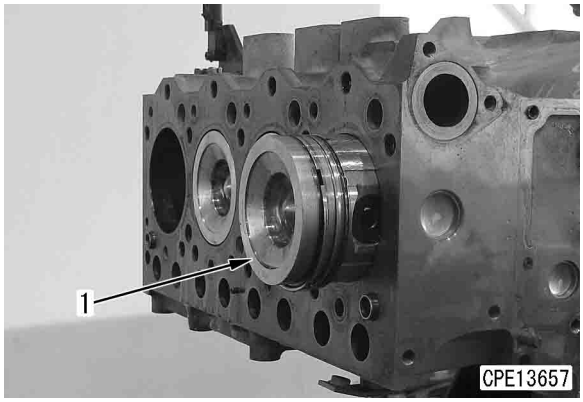


6. Installation of piston and connecting rod assembly
   1) Reverse the cylinder block and set it as the crankshaft becomes vertical.
   2) Check the directions of the abutment joint of the piston rings again.
      FRONT: Indicates the engine front.
      (a): Position of oil ring abutment joint
      (b): Position of 2nd ring abutment joint
      (c): Position of top ring abutment joint

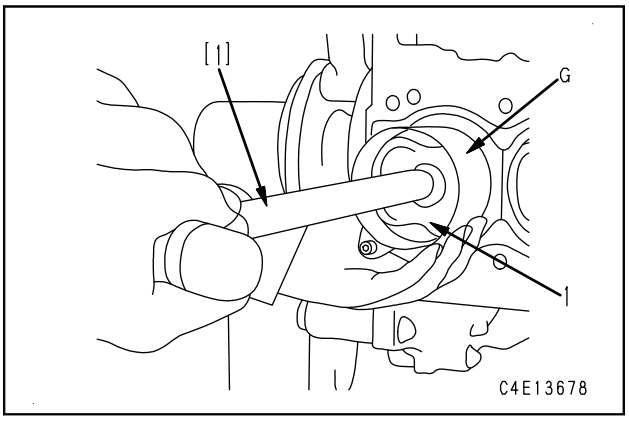


   3) Set the crankshaft for the cylinder block to which the piston and connecting rod assembly (1) are assembled at the bottom dead center .
   4) Install the piston and connecting rod assembly (1) into the cylinder block.
      ★ when inserting, face embossed letter "F" on the piston side to the engine front side.
      ★ Apply engine oil to the inside face of the cylinder, piston rings, and the surface of the connecting rod bearing.

Cylinder inner side, piston ring:
Engine oil



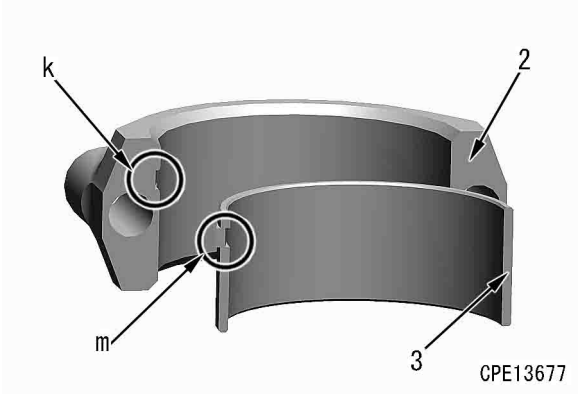
   5) By using tool G, compress the piston rings and push in the piston and head of connecting rod assembly (1) with a wood bar [1], etc.
      ★ When pushing in the piston and connecting rod assembly (1), support the big end of the connecting rod by your hand and guide it to the crank pin so that it is not damaged.



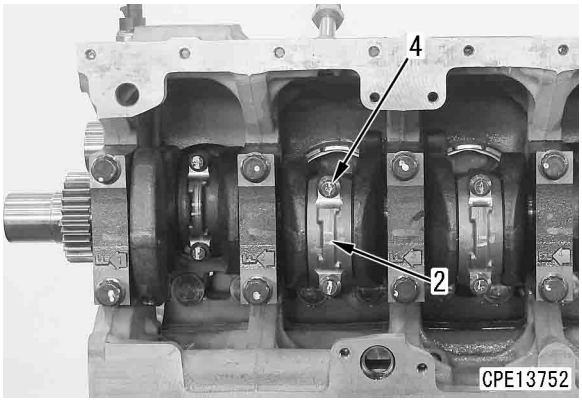
   6) Align the protrusion (m) of lower connecting rod bearing (3) with the notch (k) of the connecting rod cap (2), and install lower connecting rod bearing (3) to connecting rod cap (2)
      ★ Apply engine oil to the inner side of the lower connecting rod bearing.

Inner side of lower connecting rod bearing:
Engine oil

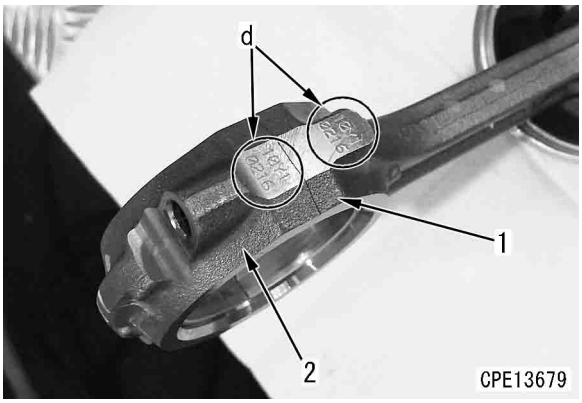
      ★ Check that no foreign material is attached to the back of the lower connecting rod bearing.



7) Install connecting rod cap (2) to the large end of the connecting rod, and tighten mounting bolts (4).



(Reference: Match the identification stamp marks (d) of the large end of connecting rod and the connecting rod cap.)

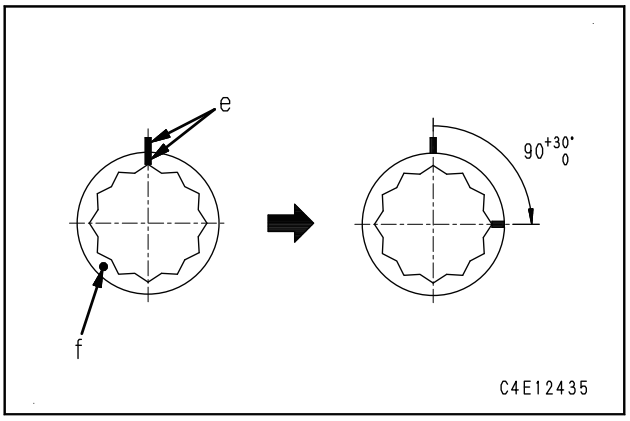


★ Apply engine oil to mounting bolt threads and bolt seat surface.

Threaded part of mounting bolt and bolt seat surface:
Engine oil

Cap mounting bolt:
1st time: Tighten to 39.2 (+1.96/0) Nm {4.0 (+0.2/0) kgm}
2nd time: Put matchmarks (e) on the bolt head and connecting rod seat surface, then tighten the bolts alternately by rotating them 90 degrees (+30 degrees/ 0 degrees).

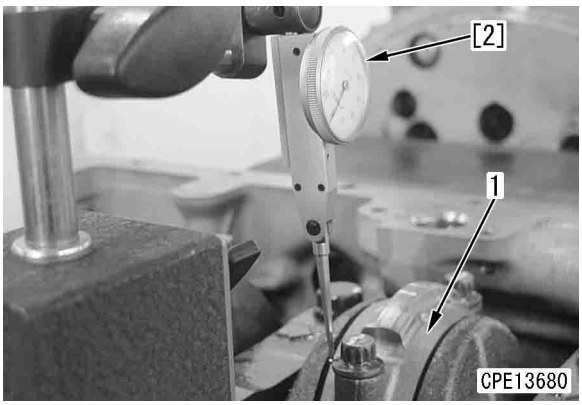
★ The bolt which has 5 punch marks (f) must be replaced without being reused. After tightening, put a punch mark on the bolt head to indicate the number of uses.



8) Rotate the crankshaft to check for smooth rotation.
9) Measure the side clearance of piston and connecting rod assembly (1) with dial gauge [2].

★ Measure the side clearance by moving the piston and the connecting rod assembly in the axial direction of the crankshaft.

★ Side clearance: 0.20 to 0.40 mm

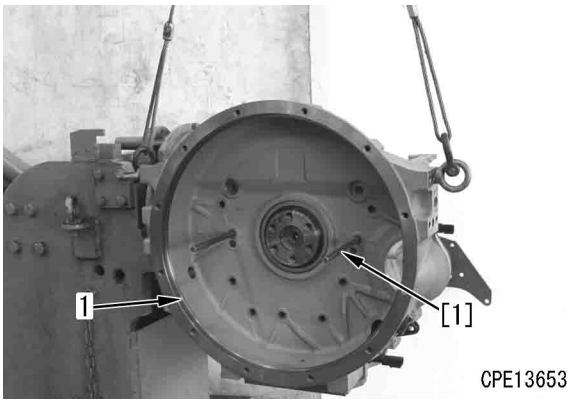


7. Flywheel housing

1) Install guide bolt [1] and install flywheel housing (1).

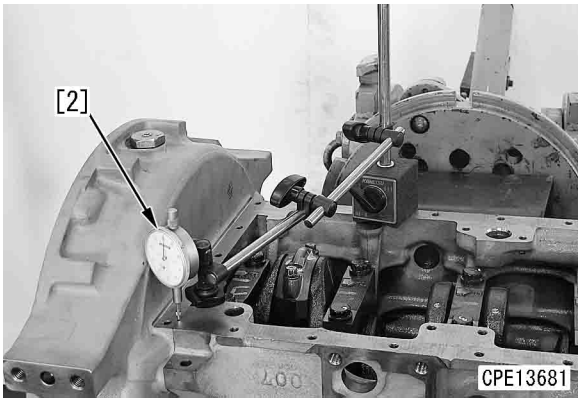
Flywheel mounting surface:
Liquid gasket (LG-7)

Mounting bolt:
58.8 to 73.5 Nm {6.0 to 7.5 kgm}



2) Measure the stepped difference between flywheel housing and the oil pan mounting surface of cylinder block by using dial gauge [2].

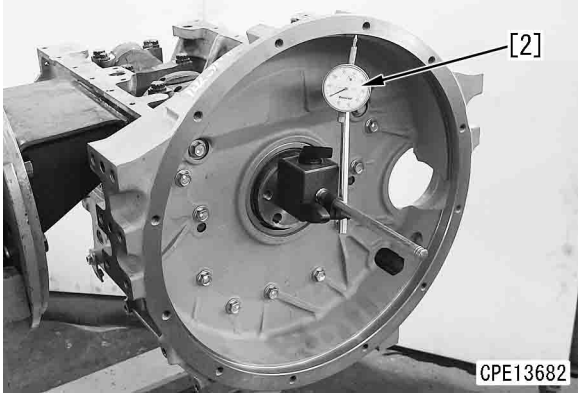
★ Step difference of oil pan mounting surface:
Allowable limit: within 0.15 mm



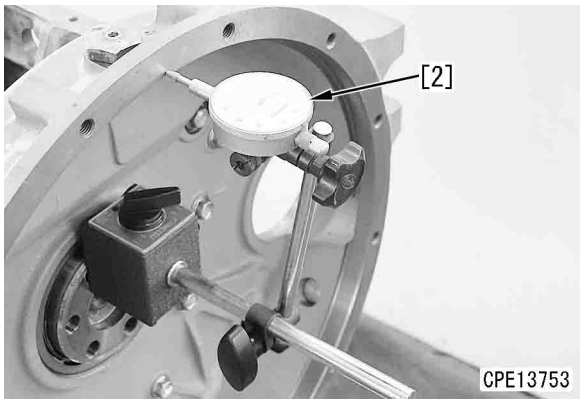
3) Measure the radial runout and face runout of the flywheel housing by using dial gauge [2].

★ Measure the radial runout and the facial runout by rotating the crankshaft.

★ The following figure shows the radial runout.
- Standard value: Max. 0.30 mm



★ The following figure shows the facial runout.
- Standard value: Max. 0.30 mm

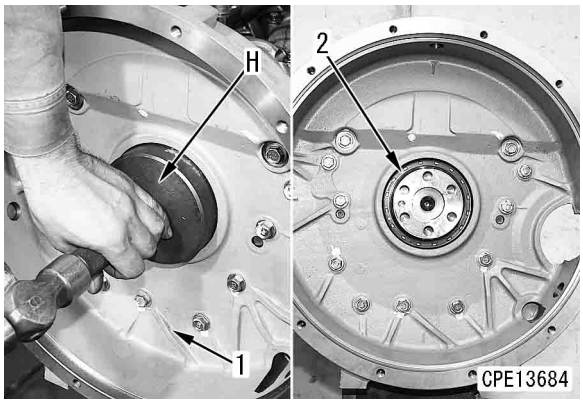


4) After installing flywheel housing (1) to the cylinder block, install rear oil seal (2) by using tool H.

★ When fitting the lip of the rear oil seal to the crankshaft flange, be careful not to apply excessive force to the lip surface.

★ Fill the space between the oil seal lips with grease of approximately 3 cc.

Rear oil seal:
Grease (G2-LI)



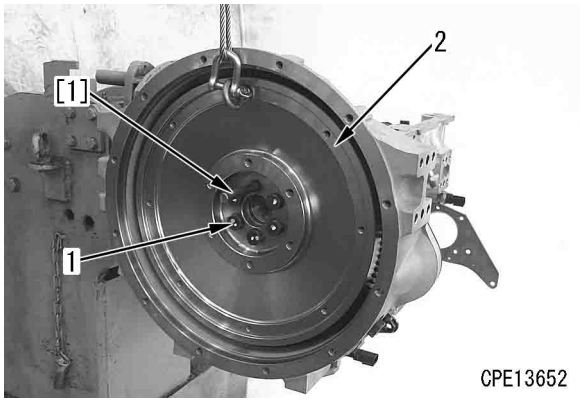
8. Flywheel

1) Install guide bolt [1], install flywheel (2), and tighten them with the mounting bolts (1).

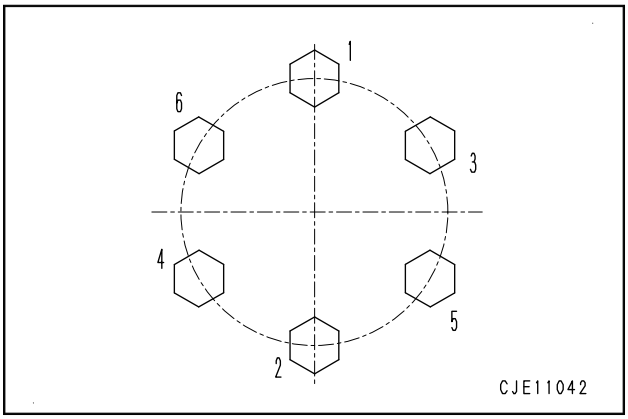
★ Tighten the bolts twice in order according to the following torque.

Mounting bolt threads:
Engine oil

Mounting bolt:
1st time: 58.8 to 117.7 Nm {6.0 to 12.0 kgm}
2nd time: 186.3 to 196.1 Nm {19.0 to 20.0 kgm}



- The following figure shows the tightening order.

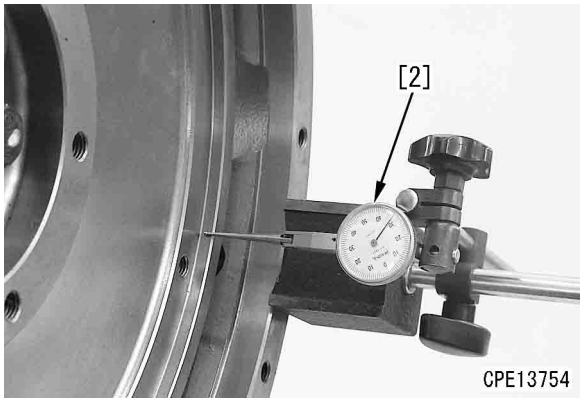


2) Measure the radial runout and face runout of the flywheel by using dial gauge [2].

★ Measure the radial runout and the facial runout by rotating the crankshaft.

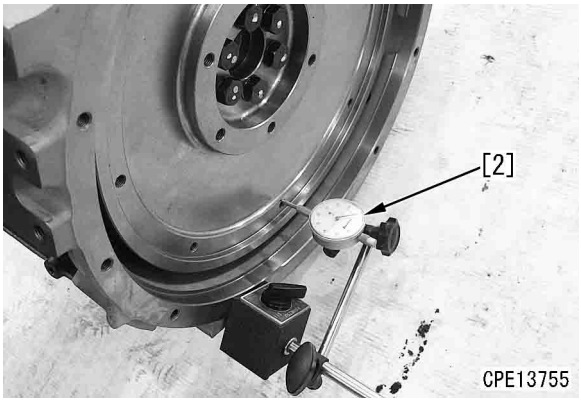
★ The following figure shows the radial runout.

- Standard value: Max. 0.30 mm



★ The following figure shows the facial runout.

- Standard value: Max. 0.30 mm



9. Camshaft assembly

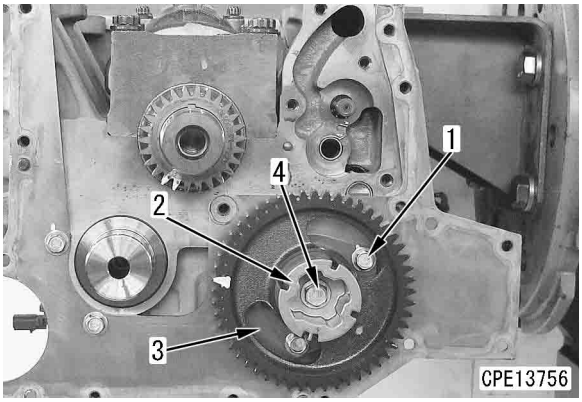
1) Insert camshaft assembly (2) in the cylinder block.

★ When inserting the camshaft, turn it lightly so that the bushings are not damaged.

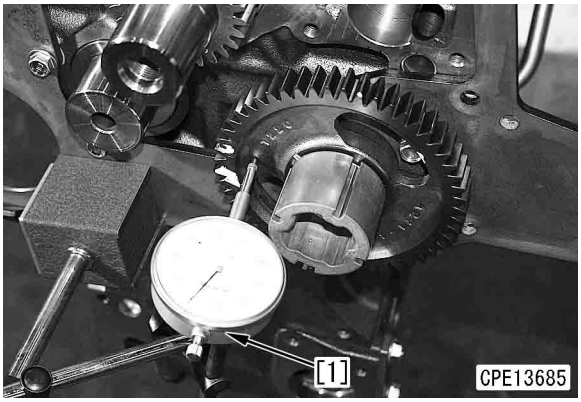
2) Tighten thrust plate (3) with mounting bolt (1) through the molded hole of the gear to fix the camshaft assembly (2) and tighten it with cam ring mounting bolt (4).

Thrust plate mounting bolt (1):
14.7 to 34.3 Nm {1.5 to 3.5 kgm}

Cam ring mounting bolt:
58.8 to 73.5 Nm {6.0 to 7.5 kgm}



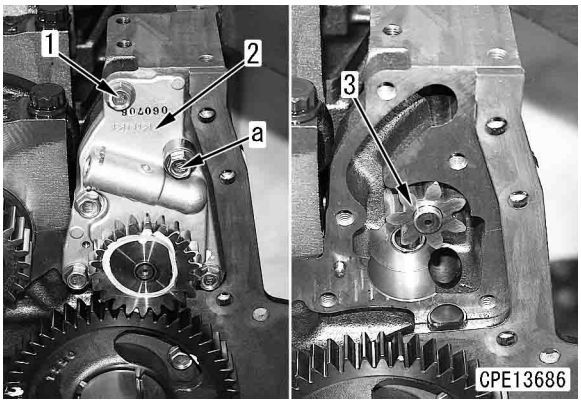
3) Apply dial gauge [1] to the end face of the gear of the camshaft assembly and move the camshaft back and forth to measure the end play.
End play of camshaft: 0.15 to 0.35 mm



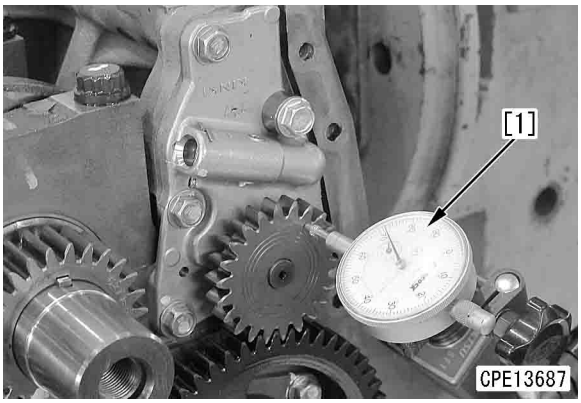
10.Oil pump assembly

1) Install driven gear (3) of the oil pump.
2) Install oil pump (2) and tighten mounting bolts (1).

★ Mounting bolts (a) have spacers.



3) Apply the probe of the dial gauge [1] to the end face of the oil pump gear and move the oil pump gear back and forth to measure the end play.
End play of oil pump gear: 0.02 to 0.07 mm



11.Idler gear

1) Align match marks on each gear and install idler gear (1).

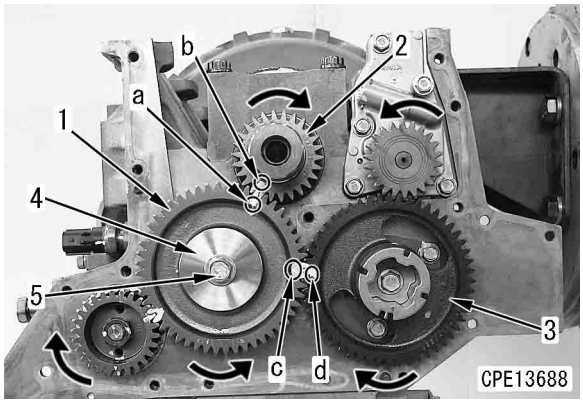
★ How to align the match marks

- Idler gear (1) and crankshaft gear (2): Match stamp mark "A" of gear (a) and stamp mark "A" of gear (b).
- Idler gear (1) and camshaft gear (3): Match stamp mark "B" of gear (c) and stamp mark "B" of gear (d).

2) Install washers (4) and tighten the idler gear mounting bolts (5).

Mounting bolt:
98.0 to 122.5 Nm {10.0 to 12.5 kgm}

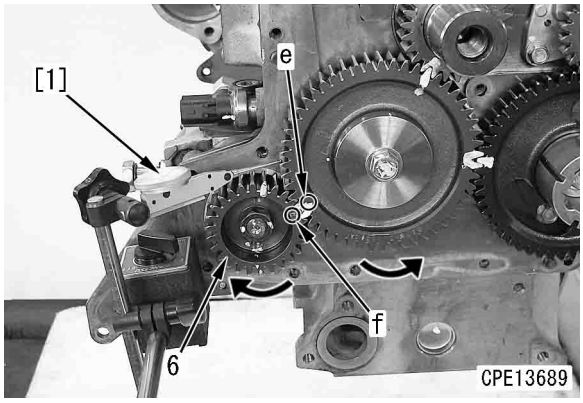
★ Install the washer with its unchamfered face facing the gear.



3) Apply the probe of the dial gauge [1] to the end face of the idler gear and move the idler gear back and forth to measure the end play.
End play of idler gear: 0.03 to 0.09 mm
4) Measuring backlash of each gear
Install supply pump assembly (6) loosely and measure the backlash of each gear by using dial gauge [1].

★ For installation of the supply pump assembly, see "Removal and installation of supply pump".

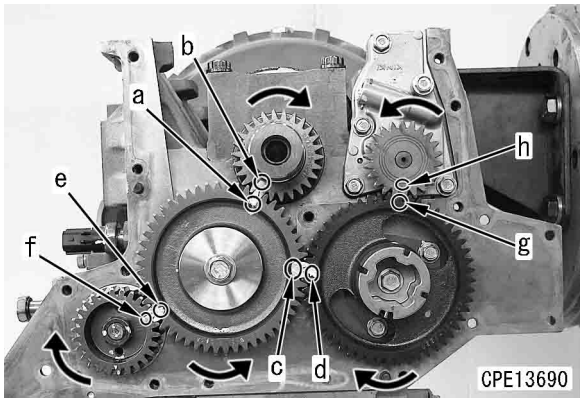
★ When the supply pump assembly is loosely installed, the matchmark of the gear must be matched to stamp mark "C" at part (e) and stamp mark "C" at part (f).



★ When measuring the backlash of each gear, fix the mating gear securely and move the other gear.

- Standard backlash values of each gear

Position	Standard value (mm)
a-b	0.07 to 0.33
c-d	0.09 to 0.36
e-f	0.06 to 0.33
g-h	0.07 to 0.33



12.Front cover

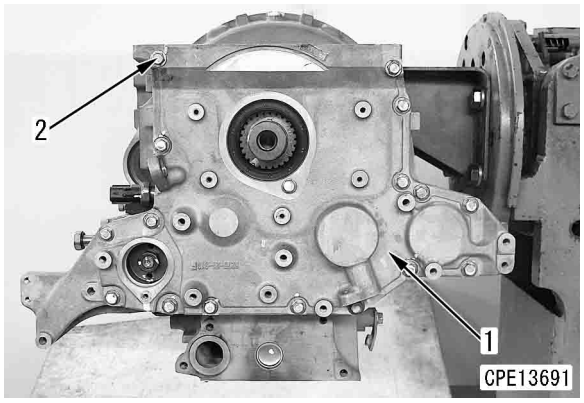
1) Apply the liquid gasket to the mounting surface to the cylinder block.

Front cover:

Liquid gasket (LG-7)

2) Install front cover (1) and fasten it with mounting bolts (2).
3) Measuring level difference at mounting face
Measure the level difference between the front cover (1) and oil pan mounting face of the cylinder block.

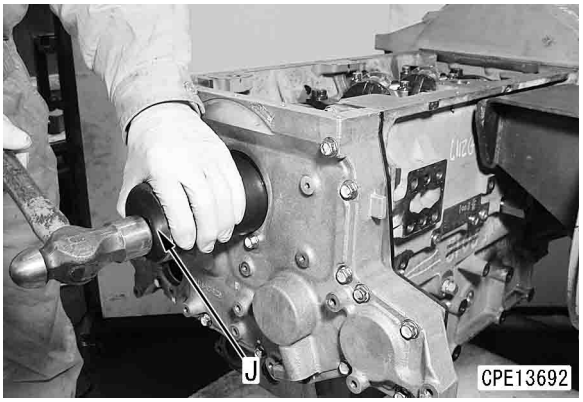
★ Level difference at mounting face: within 0.15 mm or less

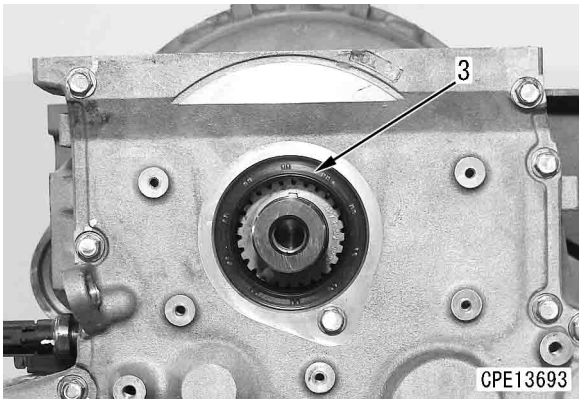


4) By using tool J, install front oil seal (3).
5) After press fitting the front oil seal, fill the space between oil seal lips with approximately 2 cc of grease.

Front oil seal:

Grease (G2-LI)





13.Crankshaft pulley and speed sensor

1) Install cover (1).
2) Install crankshaft pulley (2), setting it to the crankshaft key.
3) Install plate (3) and tighten mounting bolts (4).

Mounting bolt:

343 to 402 Nm {35 to 41 kgm}

4) Install camshaft speed sensor (BKUP) (5) and tighten mounting bolts (6).

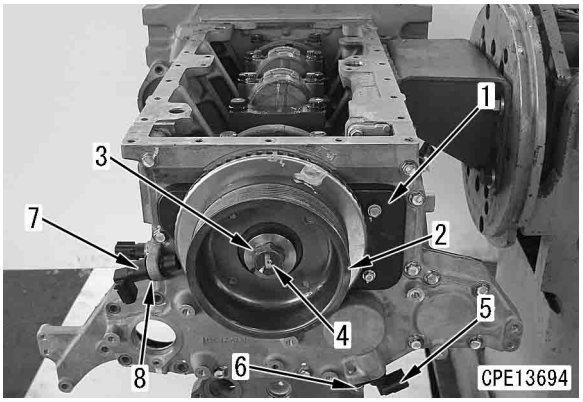
Mounting bolt:

7.0 to 11.0 Nm {0.7 to 1.1 kgm}

5) Install crankshaft speed sensor (NE) (7) and tighten mounting bolts (8).

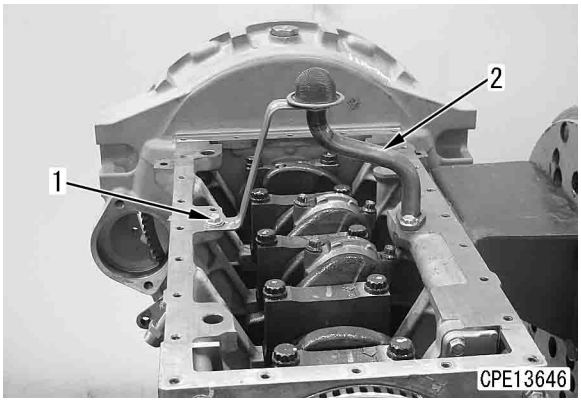
Mounting bolt:

7.0 to 11.0 Nm {0.7 to 1.1 kgm}



14.Oil suction tube

1) Fit the O-ring and install oil suction tube (2) to the cylinder block.
2) Tighten mounting bolts (1).



15.Engine oil pan

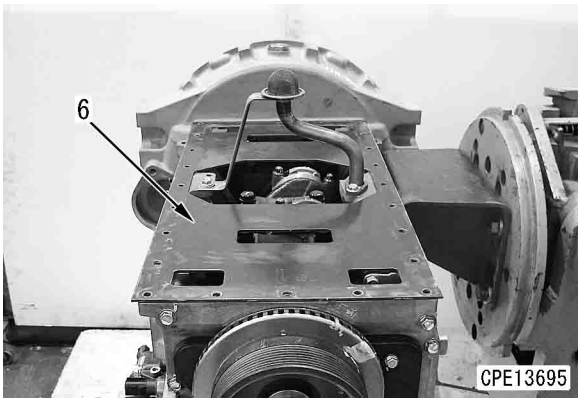
1) Apply the liquid gasket to the contact surfaces of under plate (6) and the cylinder block.

★ Apply the liquid gasket to the under plate side.

Under plate:

Liquid gasket (LG-7)

2) Install under plate (6) to the cylinder block.



3) Apply liquid gasket to the contact surfaces of engine oil pan (5) and the under plate.

★ Apply the liquid gasket to the engine oil pan side.

Engine oil pan:

Liquid gasket (LG-7)

4) Install engine oil pan (5) and tighten mounting bolts (4).

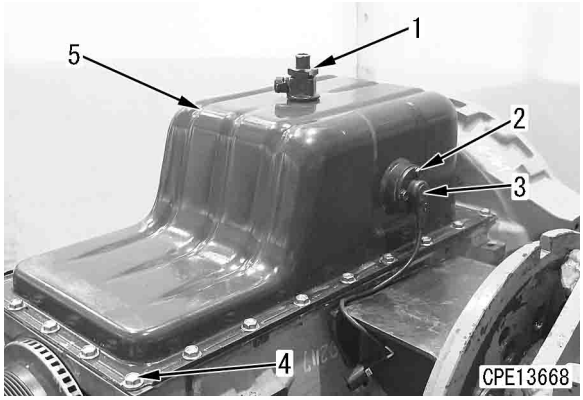
Mounting bolt:

29.4 to 34.3 Nm {3.0 to 3.5 kgm}

5) Install engine oil level sensor (3) and tighten mounting bolts (2).
6) Install engine oil drain valve (1).

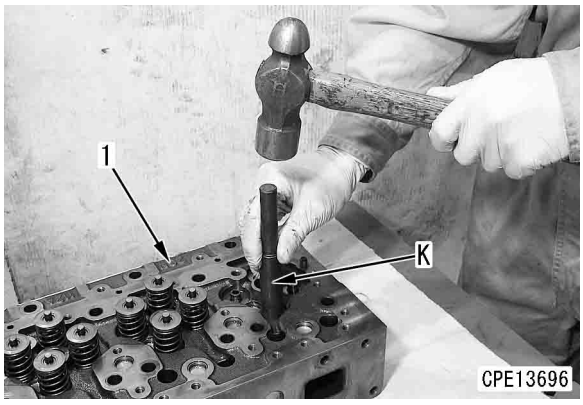
Drain valve:

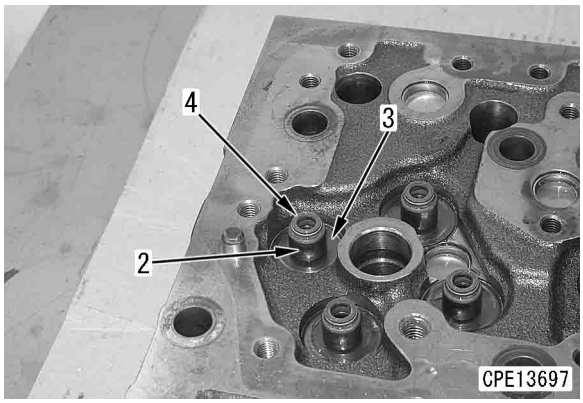
44.1 to 58.8 Nm {4.5 to 6.0 kgm}



16.Cylinder head assembly

1) Assemble the cylinder head according to the following procedure:
   1] By using tool K, install valve guide (2) to cylinder head (1). (when necessary)
   2] Install valve spring seat (3).
   3] By using tool L, Install valve seal (4) to the head of valve guide.



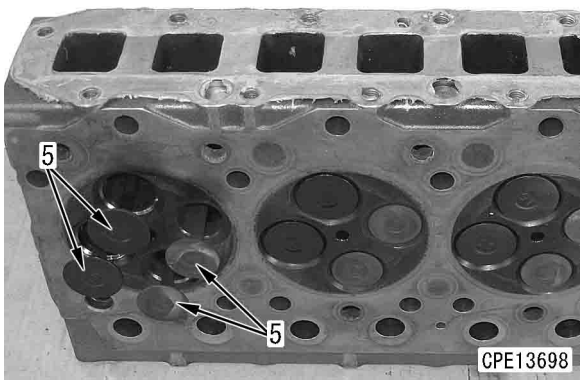


   4] Apply engine oil to the valve stem of intake and exhaust valves (5) and the inner surface of valve guide.

Valve stem and valve guide:

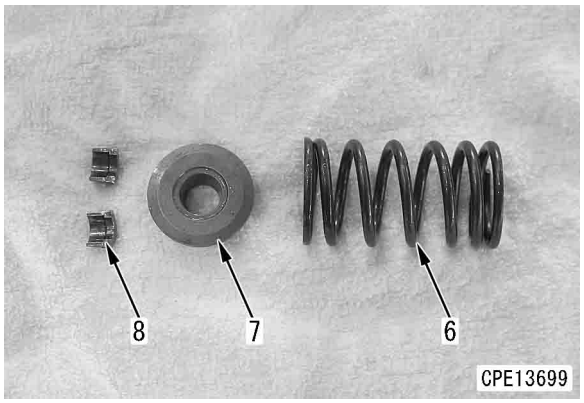
Engine oil

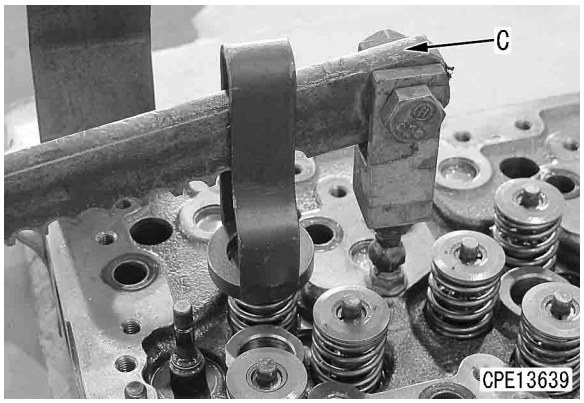
   5] Raise the cylinder head (1) and install intake and exhaust valves (5).

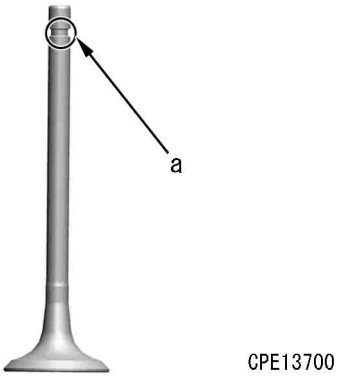


6] Install valve spring (6) and valve spring seat (7).
7] By using tool C, compress valve spring (6), then fit valve cotter (8) into groove (a) on the valve stem.

★ Tap the top end face of the valve stem with a plastic hammer and check that the valve cotter is completely fitted.



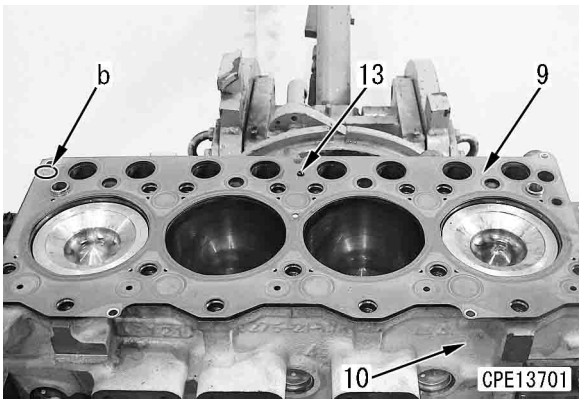




2) Rotate the engine repair stand, and set cylinder block assembly (10) reversely.
3) Check that the cylinder head and the cylinder block mounting face are free from dirt or foreign matter and install cylinder head gasket (9) to cylinder block assembly (10).

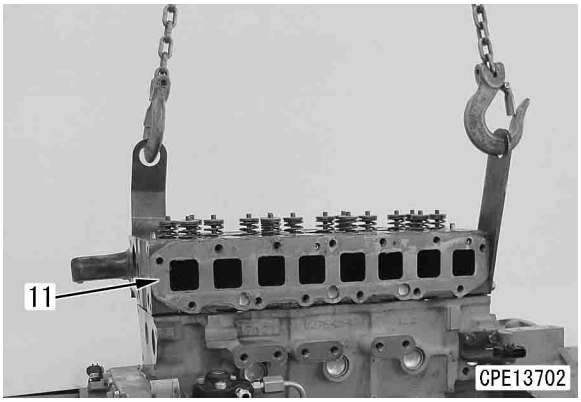
★ Stamp mark "TOP" (b) on the cylinder head gasket must face the upper side when the gasket is installed.

★ Check that the hole of pin (13) to prevent the wrong installation of cylinder head gasket on the upper side of the cylinder block and the hole of cylinder head gasket are matched.



4) Sling cylinder head assembly (11) and install it onto the cylinder block.

Cylinder head assembly:
35 kg

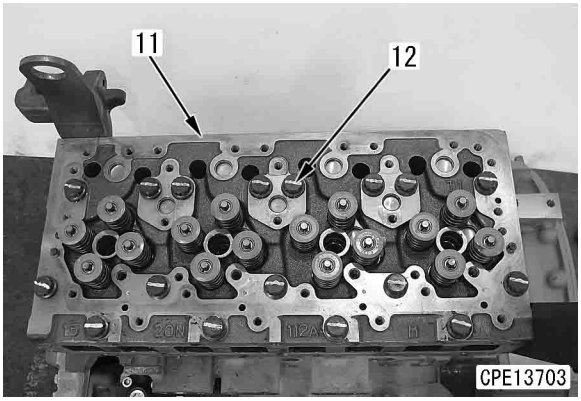


5) Apply molybdenum disulfide lubricant to the threads of cylinder head mounting bolts.

Threaded part of mounting bolt :

Lubricant with molybdenum disulfide (LM-P)

6) Finger tighten the mounting bolt (12) by 2 to 3 threads.



7) Tighten mounting bolt (12) in the order of [1] to [17] in the following figure and with the following procedures.
F: Indicates the engine front.
A: Indicates the engine inlet side.
B: Indicates engine exhaust side.

Cylinder head mounting bolt:

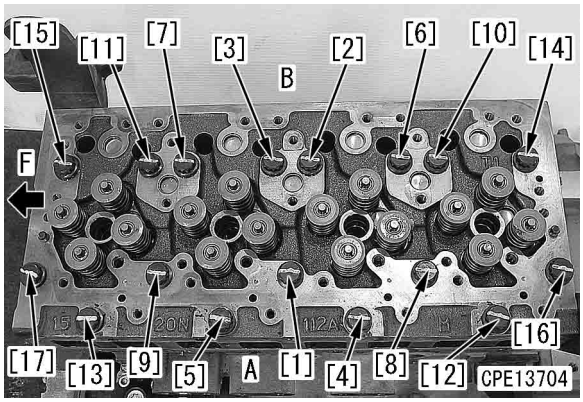
1st time: 68.6 ± 9.8 Nm {7 ± 1 kgm}

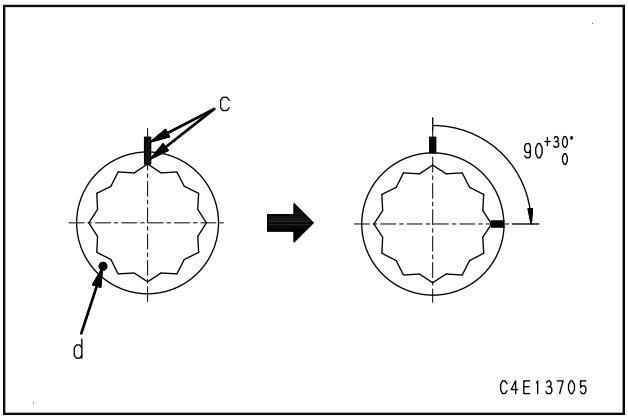
2nd time: 107.8 ± 4.9 Nm {11 ± 0.5 kgm}

3rd time: Put mark (c) on the bolt head and cylinder head, then turn bolt 90 degrees (+30 degrees/ 0 degrees) to tighten.

★ After tightening, put a punch mark (d) on each bolt head to indicate the number of tightening.

★ A bolt which already have 5 punch marks (d) must be replaced without being reused any more.



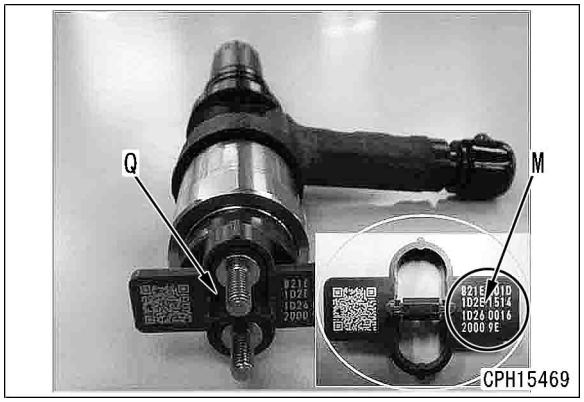


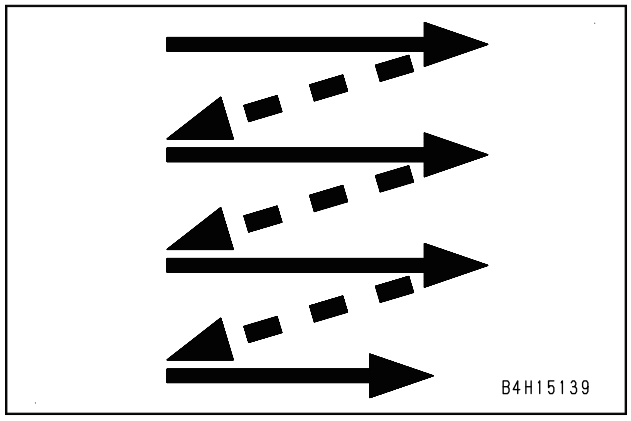
17.Injector assembly

★ When replacing the injector assembly or engine controller assembly, write the character string into the engine controller according to the following procedure. For details, see Testing and adjusting, "Writing offset value when replacing injector and engine controller" in the shop manual for the applicable machine.

- Note the number of cylinder to which a new injector is installed and character string (M) listed on the QR code tab at the top of the injector as a set.
  - ★ Read character string (M) in the order of the arrow shown in the figure.
  - ★ Be sure to check that the noted character string is correct.
- Write the noted character string into the engine controller.
  - ★ Be sure to write the noted character string into the cylinder number column of the cylinder to which the injector is installed.
  - ★ If the offset values are not written correctly, the engine may not operate normally.

    (Reference: The QR code or character string indicates the compensation value for fuel injection of the injector, which is specific to each injector.)





1) Install gasket (2) to injector (1).
2) Fit O-rings (3) and (4) to injector (1).

★ Do not put the O-ring in spill groove (a).

3) Apply engine oil to O-ring (3) and head side inserting hole of injector (1).

O-ring and head side inserting hole:

Engine oil

4) Face the fuel inlet hole of injector (1) to the fuel inlet manifold side, and insert it into the cylinder head while inserting injector holder (5) into (b) part of the injector.

★ Do not let the gasket at the tip of the injector nozzle fall.

5) Tighten the mounting bolt (6) of injector holder (5) lightly.

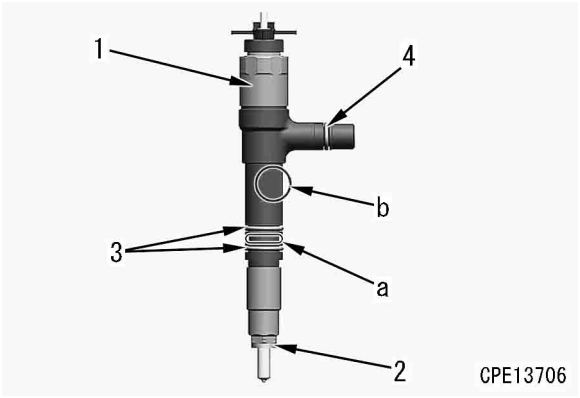
★ Apply Loctite 204 to the threaded part of the mounting bolt.

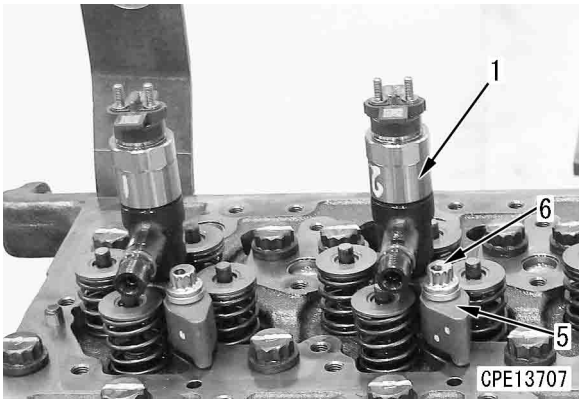
Threaded part:

Liquid adhesive (Loctite No. 204 or equivalent)

★ Be careful not to tighten the bolt too much.

★ Always use a new bolt, because it is not reusable.





18.Push rod and crosshead

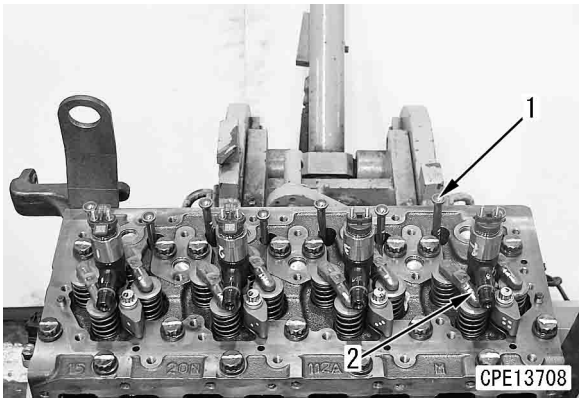
1) Insert push rods (1) in the tappet guides.

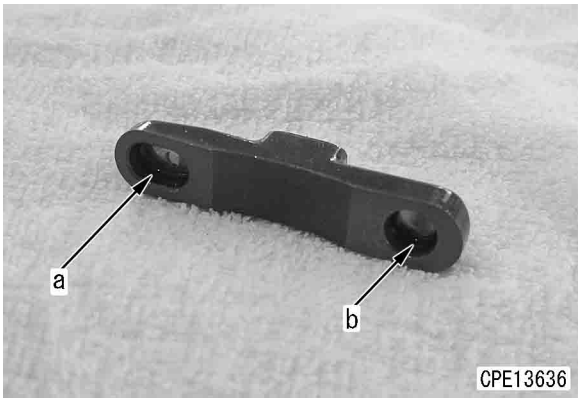
★ The push rods for the intake and exhaust valves are the same.

★ If the push rods are free from defects, install them in the same positions as before.

2) Install crosshead (2).

★ Install the crosshead so that long hole (a) faces the exhaust side and the short hole (b) faces the inlet side.



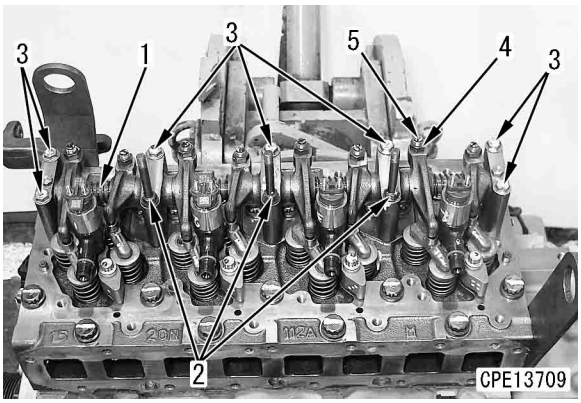


19.Rocker arm assembly

1) Install rocker arm (1).
2) Check that the ball of adjustment screw (5) is fully put into the push rod socket.
3) Tighten rocker arm (1) with stud bolt (2) and mounting bolt (3).

Rocker arm mounting bolt:
19.6 to 29.4 Nm {2.0 to 3.0 kgm}

★ Loosen lock nut (4) and back off adjustment screw (5) by sufficiently.



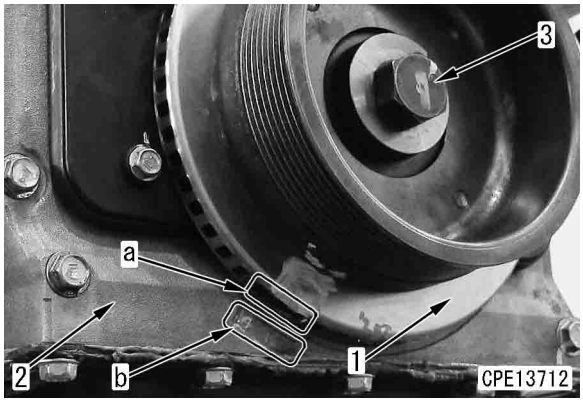
20.Adjusting valve clearance

Adjust the valve clearance according to the following procedure.

1) Rotate the crankshaft forward (clockwise seen from the front) and match notch (a) of plate (1) at the rear of the crankshaft pulley to embossed letters "1.4TOP" (b) on front cover (2).

★ Rotate the crankshaft by holding the crankshaft pulley bolt (3).

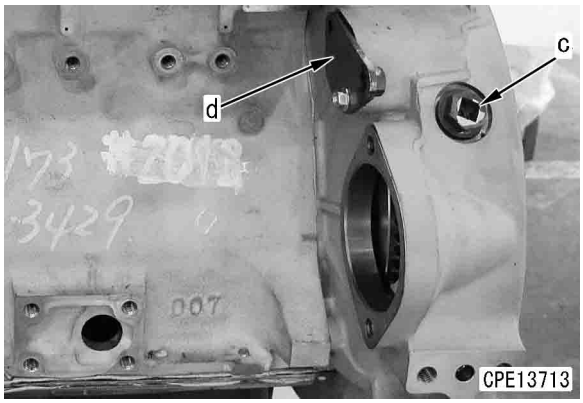
★ Always rotate the crankshaft pulley bolt forward to prevent it from being loosened.



Reference: The cranking can be done by the following way on the some machine models.

- If plug (c) of the flywheel housing is removed, you can check the No.1 cylinder top dead center mark (white paint) on the flywheel side.
- You can install the barring tool for rotating the crankshaft by removing cover (d) of the flywheel housing.

★ For details, see the shop manual for the applicable machine.



★ The air intake and exhaust rocker arm of No. 1 cylinder with the piston at the No. 1 cylinder compression top dead center can be moved by hand by the distance equivalent to the valve clearance. If the rocker arm cannot be moved by your hand, the No. 1 piston is not at its compression top dead center. In that case, rotate the crankshaft one more turn.

2) Adjust the valve clearances marked with ● in the valve arrangement drawing according to the following procedure.

Valve arrangement

Cylinder No.	1	2	3	4
Exhaust valve	●	●	○	○
Intake valve	●	○	●	○

BJE10606

1] With adjustment screw (4) fixed, loosen lock nut (5).
2] Insert tool N into the clearance between rocker arm (6) and crosshead (7).
3] Adjust the valve clearance by using adjustment screw (4).

★ With tool N inserted, turn the adjustment screw until the feeler gauge can move lightly.

★ Adjust the valve clearance to within the following target value.

★ Valve clearance (when cold)

Intake side: 0.35 ± 0.02 mm

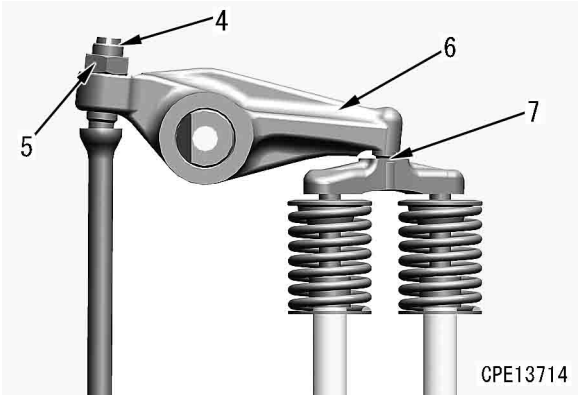
Exhaust side: 0.50 ± 0.02 mm

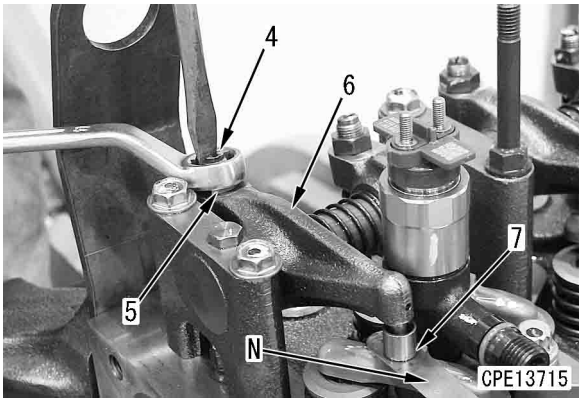
4] With adjustment screw (4) fixed, tighten lock nut (5).

Lock nut:

39.2 to 49.0 Nm {4.0 to 5.0 kgm}

★ After tightening the locknut, check the valve clearance again.





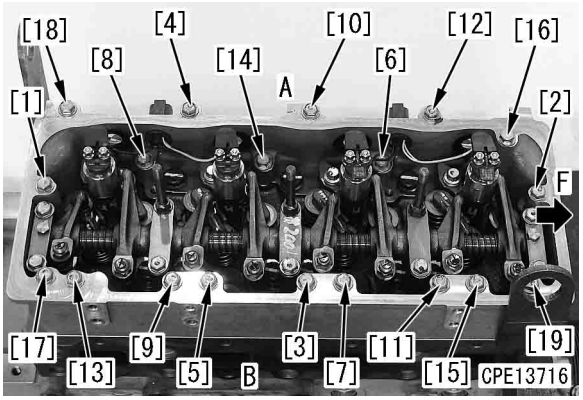
3) Rotate the crankshaft forward by one turn to set the No. 4 piston to the compression top dead center and adjust the valve clearances marked with ○, similarly to the valves marked with ●.
Reference: You may rotate the crankshaft pulley by 180 degrees and adjust the valve clearance for each cylinder with it's piston is set to the compression top dead center. (Firing order: 1-2-4-3)

21.Rocker housing

1) Install rocker housing (1) with mounting bolt (2) tightened in the order of [1] to [19] in the following figure.

Mounting bolt:

27.0 to 34.0 Nm {2.8 to 3.5 kgm}

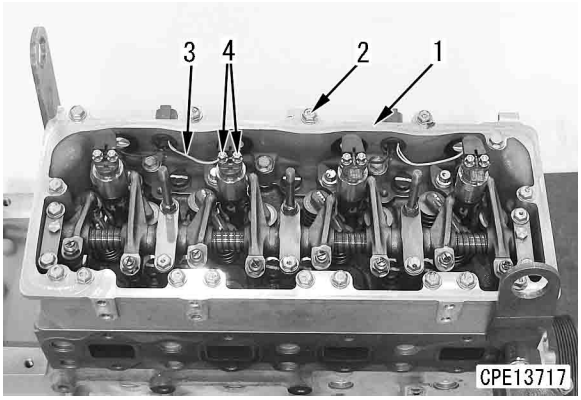


2) Install nut (4) of injector harness (3).

Mounting nut:

2.0 to 2.4 Nm {0.20 to 0.24 kgm}

★ Be careful that the injector harness is not pinched by the tool and rocker housing.



★ Mounting position of injector wiring harness

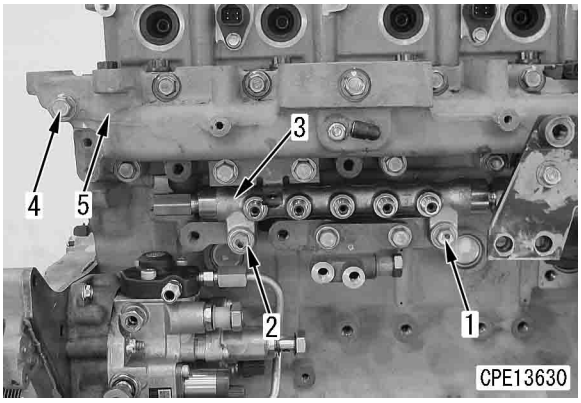
Color of injector wiring harness	Cylinder No.
White	1, 3
Black	2, 4

22.Air intake manifold, common rail

1) Apply liquid gasket to the mounting surface of intake manifold (5) to the cylinder head.

Air intake manifold mounting face:
Liquid gasket (LG-7)

2) Install air intake manifold (5) with mounting bolts (4).
3) Install common rail (3) with mounting bolts (1) and (2).



23.Fuel high-pressure pipe and cylinder head cover

1) Install fuel tube (1) between supply pump and common rail inlet.
2) Install fuel high-pressure pipe (2) loosely between common rail and No.1 and No.2 injectors.
3) Install fuel high-pressure pipe (3) loosely between common rail and No.3 and No.4 injectors.

★ Tighten the mounting bolts of injector holders, which were installed loosely, to the specified torque.

Injector holder mounting bolt:
39.0 to 49.0 Nm {4.0 to 5.0 kgm}

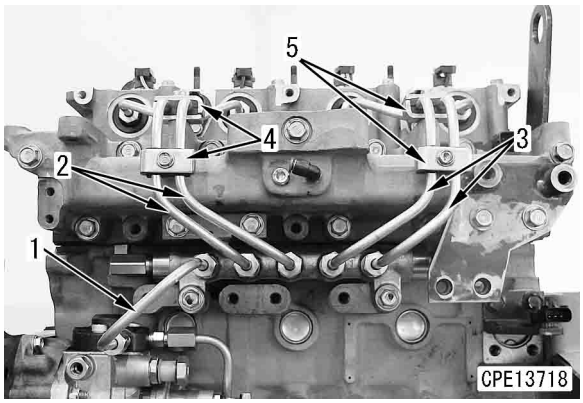
4) Tighten the mounting sleeve nut of the fuel high-pressure pipe on the injector side.

Mounting sleeve nut:
39.0 to 44.0 Nm {4.0 to 4.5 kgm}

5) Tighten the mounting sleeve nut of the fuel high-pressure pipe on the common rail side.

Mounting sleeve nut:
39.0 to 44.0 Nm {4.0 to 4.5 kgm}

6) Install tube clamps (4) and (5).

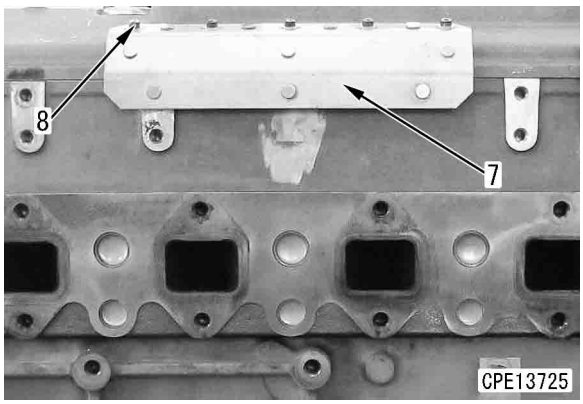


7) Install cylinder head cover (6) to the rocker housing.

Mounting bolt:
7.8 to 9.8 Nm {0.8 to 1.0 kgm}

8) Fasten cover (7) with mounting bolt (8).

Mounting bolt:
3.6 to 4.4 Nm {0.37 to 0.45 kgm}

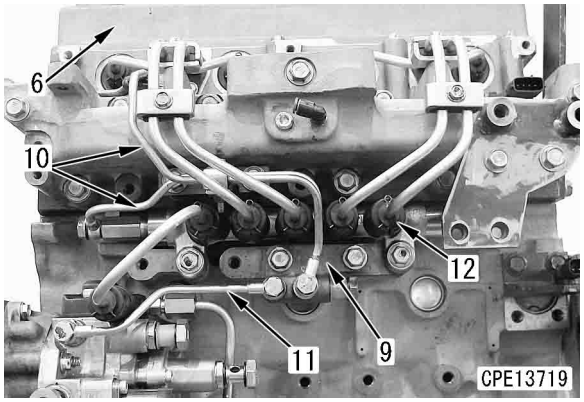


9) Install fuel spray prevention cap (12) to each sleeve nut.

★ Face the slit of the fuel spray prevention cap downward.

★ The fuel spray prevention caps are installed so that fuel will not spout over the high pressure part of the engine and catch fire when it leaks by any chance.

10)Install adapter (9), fuel tubes (10) and (11).



24.Air intake connector, intake air heater and breather

1) Install air intake connector (1) with mounting bolts (2).
2) Install intake air heater (3) and tube (4) with mounting bolts (5).
3) Install breather (6) to the cylinder head according to the following procedure.

★ Check that O-rings (7) and (8) are free from damages such as scratch or flaw.

★ Check that no dirt, sand or dust is attached to the mounting part of the breather.

★ If any O-ring is damaged, replace it with a new one.

1] Apply engine oil to O-rings (7) and (8).

O-ring:

Engine oil

2] Install O-rings (7) and (8) to the breather.
3] Install breather (6) straight to the cylinder head cover assembly.

★ Be careful not to install breather forcibly otherwise O-ring may be damaged.

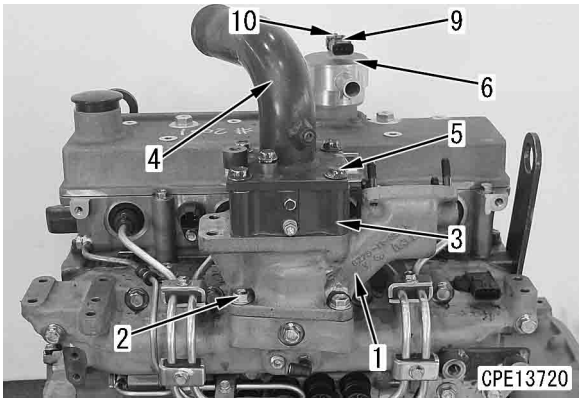
★ When installing the breather, remove crankcase pressure sensor (9) beforehand.

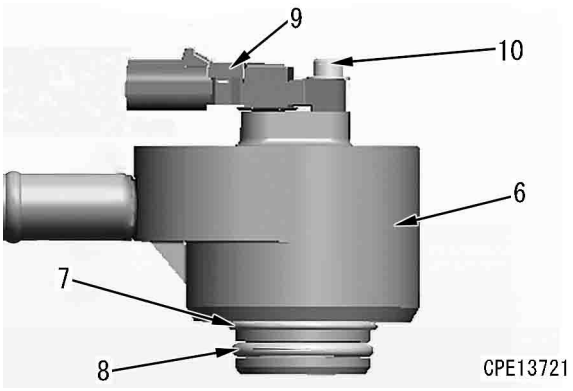
4] Tighten crankcase pressure sensor (9) to breather (6) with hexagonal socket head bolt (10).

★ Check that no dirt, sand or dust is attached to the mounting part of the crankcase pressure sensor.

Hexagonal socket head bolt:

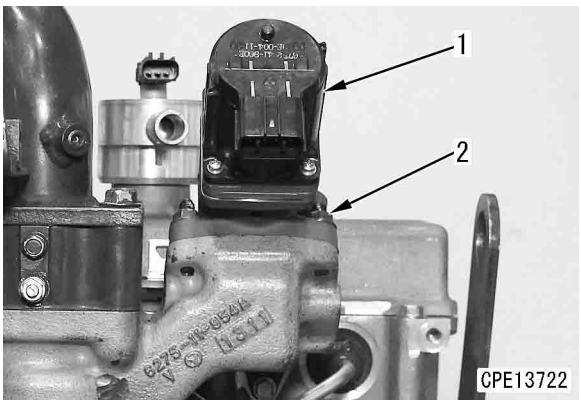
4.0 to 5.0 Nm {0.4 to 0.5 kgm}





25.EGR valve assembly

Install EGR valve assembly (1), and tighten nut (2).



26.Oil filler pipe

1) Apply adhesive to guide (1) and install the guide to the cylinder block.

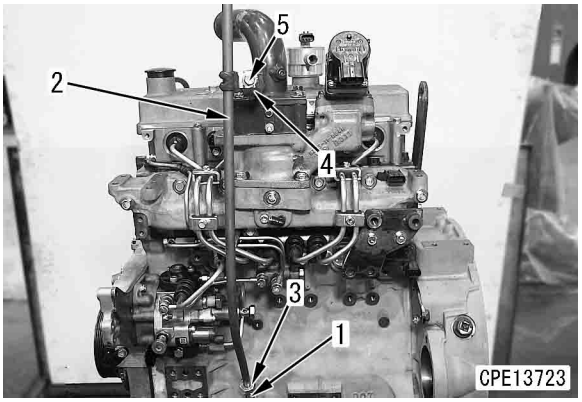
Guide:

Adhesive (LT-2)

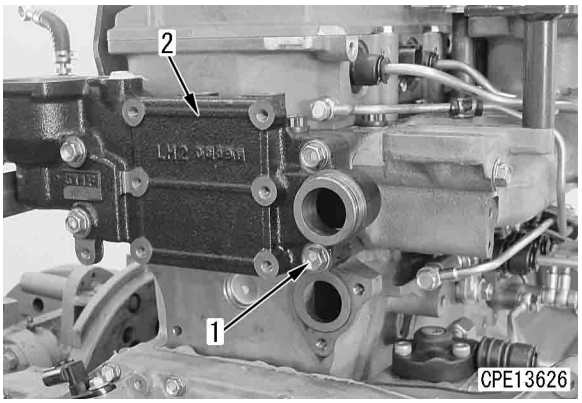
2) Install oil filler pipe (2), and tighten nut (3).

★ Lock the guide when tightening the nut.

3) Install bracket (4) and fix oil filler pipe (2) with clamp (5).

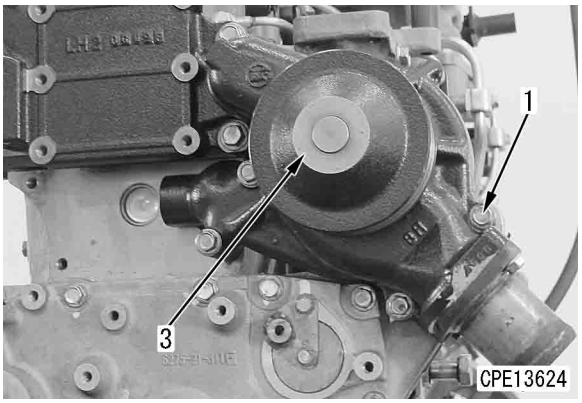


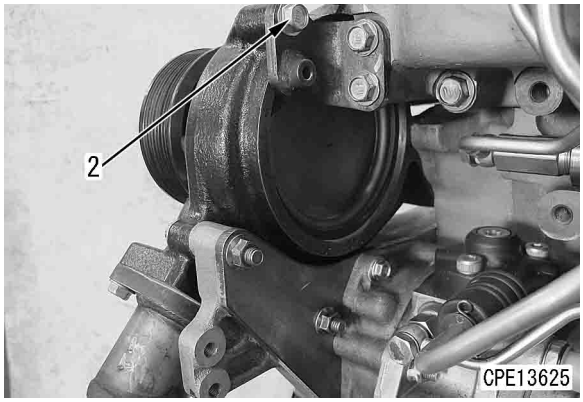
27.Thermostat housing
Install thermostat housing (2), and then tighten mounting bolts (1).



28.Water pump assembly
Install water pump (3) and tighten mounting bolts (1) (4 pieces) and mounting bolt (2).

★ Do not forcibly install it otherwise it may cause scratches or flaws to the O-ring.

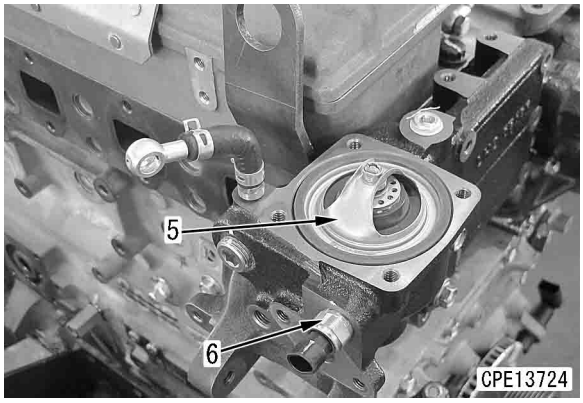




29.Coolant temperature sensor and thermostat
1) Install coolant temperature sensor (6).

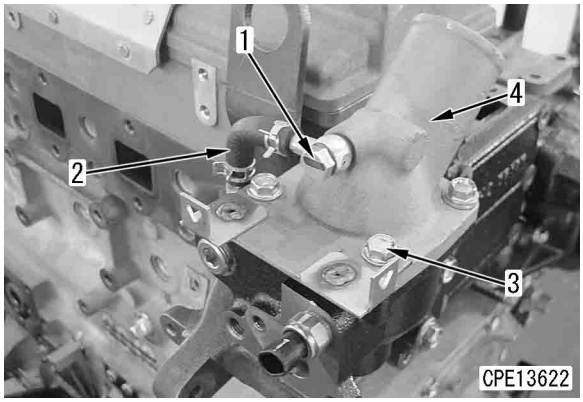
Coolant temperature sensor:
22.5 ± 2.9 Nm {2.3 ± 0.3 kgm}

2) Install thermostat (5).



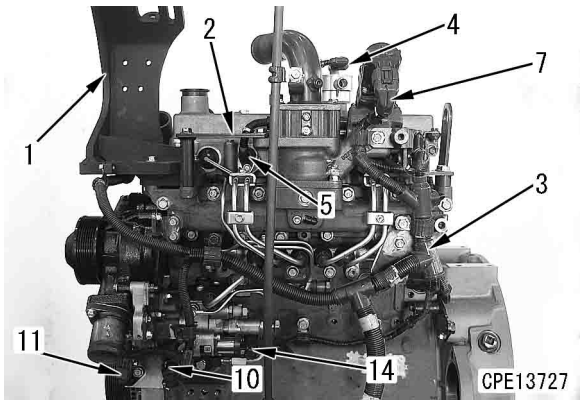
3) Install coolant outlet connector (4) with mounting bolts (3).
4) Install hose (2) and tighten joint bolts (1).

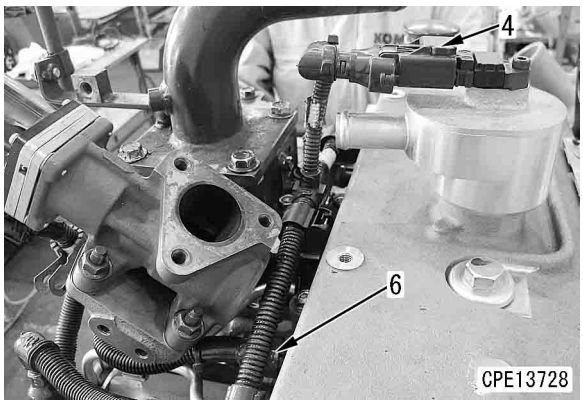
Joint bolt:
9.8 to 12.7 Nm {1.0 to 1.3 kgm}

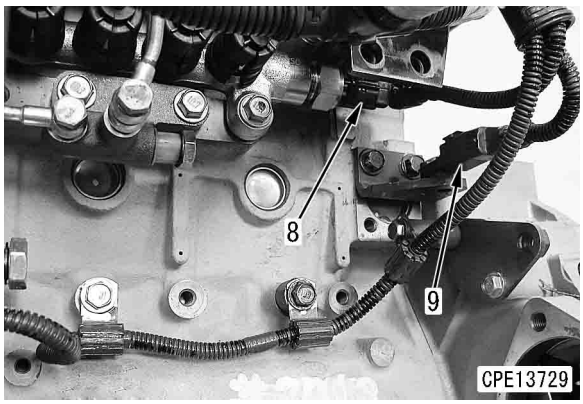


30.Bracket and wiring harness assembly
1) Install brackets (1) and (2).
2) Route wiring harness assembly (3) in specified position, connect the wiring harness connectors to their mating connectors, and then fix it with clamps.
3) Connect the following connectors.

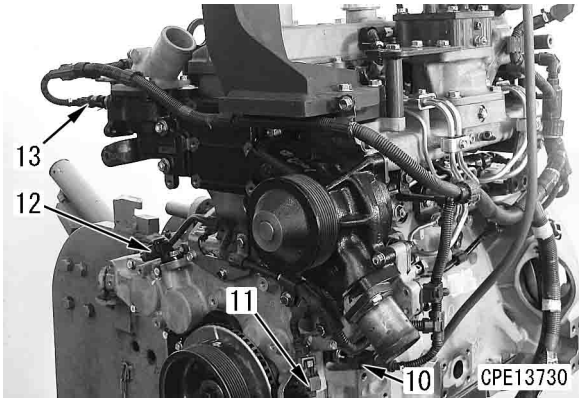
- (4) Crankcase pressure sensor: CCV
- (5) Injector (Nos.1 and 2): CN1
- (6) Injector (Nos.3 and 4): CN2
- (7) EGR valve: EGR/V
- (8) Common rail pressure sensor: PFUEL
- (9) Ambient pressure sensor: EGR/V

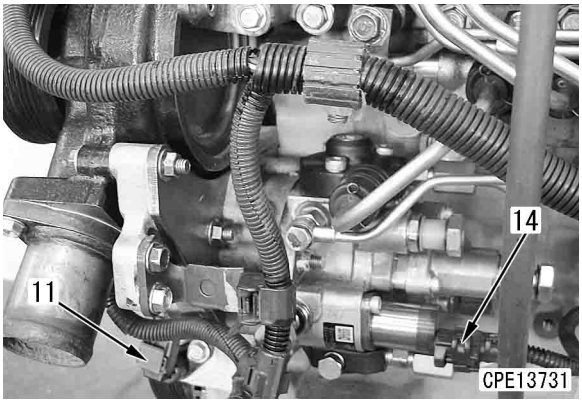






4) Connect the following connectors.
   - (10) Oil pressure switch: POIL
   - (11) Ne (crankshaft) speed sensor: NE
   - (12) BKUP Camshaft speed sensor: CAM
   - (13) Coolant temperature sensor: TWTR
   - (14) Fuel supply pump regulator: SCV

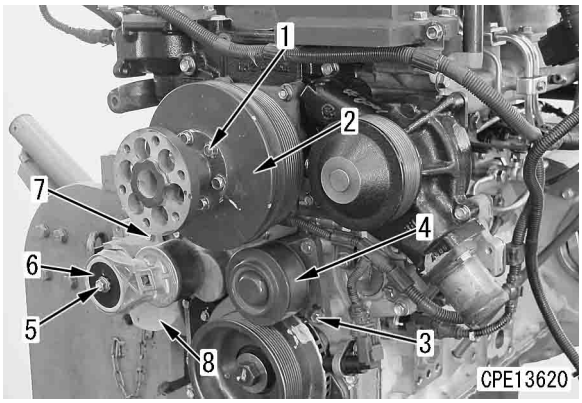




31. Fan pulley, idler pulley and tensioner assembly
   1) Install plate (8) and fasten it with mounting bolts (7).
   2) Install tensioner (6) and fasten it with mounting bolts (5).

      Mounting bolt:

      44.1 to 53.9 Nm {4.5 to 5.5 kgm}
   3) Install idler pulley (4) and fasten it with mounting bolts (3).
   4) Install fan pulley (2) and fasten it with mounting bolts (1).

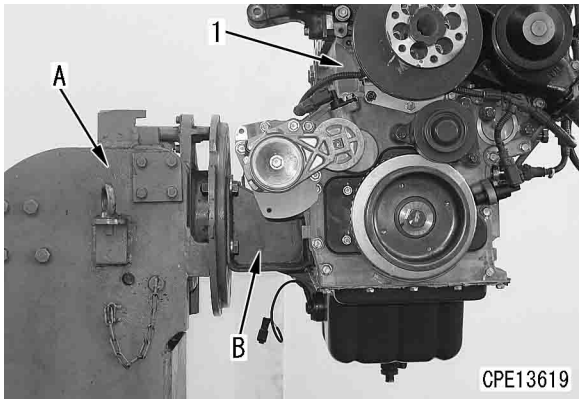


32. Oil cooler and adapter assembly
   1) Sling engine assembly (1) and remove mounting bolt of tool B.
   2) Sling and remove engine assembly (1) and tool B together from tool A.

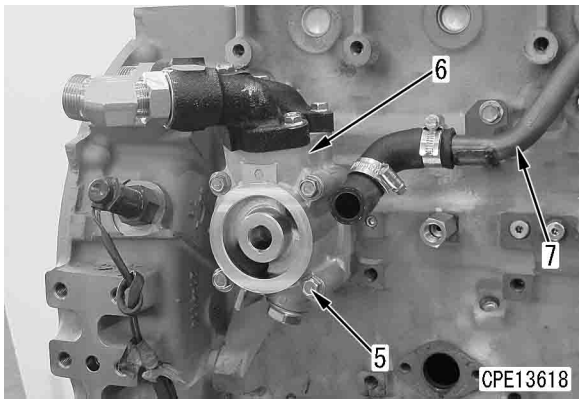
      ★ Place the cylinder assembly onto the block and remove tool B.

★ The weight depends on the applicable machine model.

Engine assembly:
340 kg



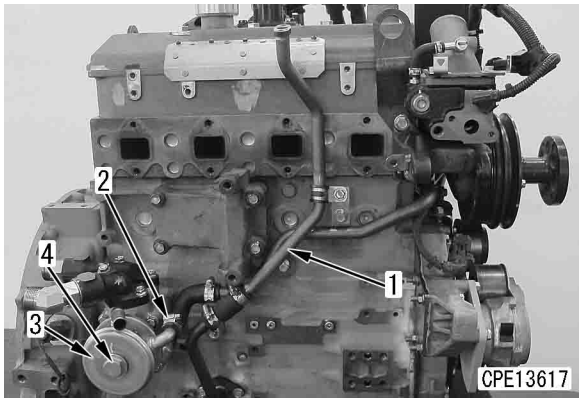
3) Install tube (7).
4) Install adapter assembly (6) and fasten it with mounting bolts (5).



5) Install oil cooler (3) and tighten mounting bolts (4).
6) Install hose (2) between the tubes and fasten it with hose clamp (2).

Mounting bolt:
4.4 ± 0.49 Nm {0.45 ± 0.05 kgm}

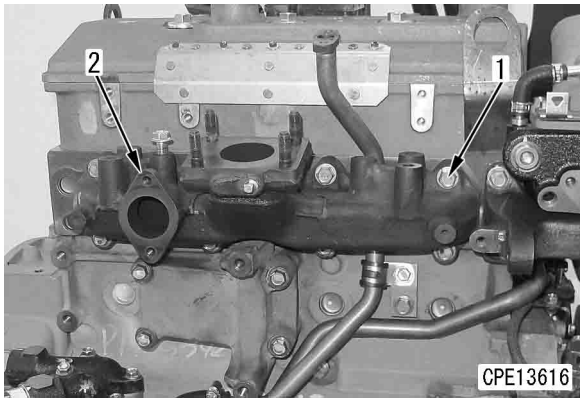
7) Install drain hose (1) of turbocharger lubrication oil.



33.Exhaust manifold assembly

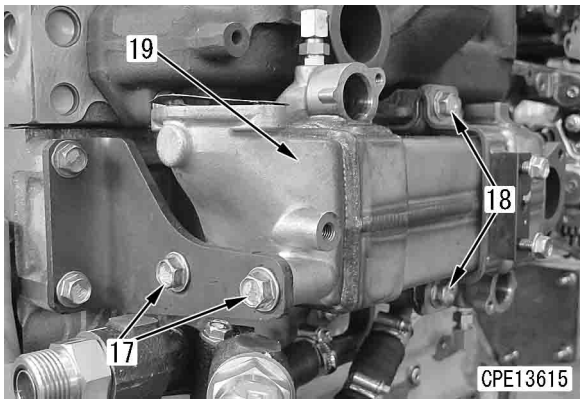
Install exhaust manifold (2) and fasten it with the mounting bolts (1).

Mounting bolt:
34.0 to 54.0 Nm {3.5 to 5.5 kgm}



34.EGR cooler

1) Install EGR cooler (19) and fasten it with mounting bolts (18) and (17).

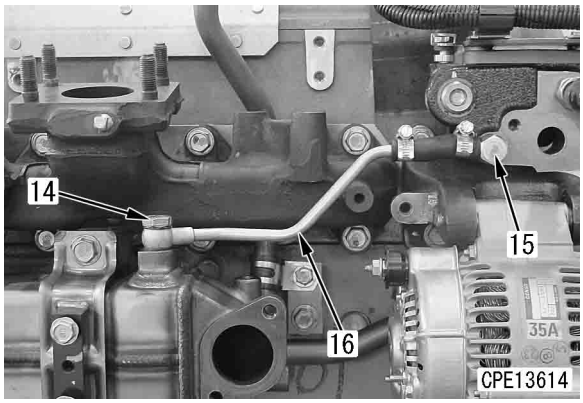


2) Install tube (16) and fasten it with joint bolts (15) and (14).

Joint bolt:
19.6 to 29.4 Nm {2.0 to 3.0 kgm}

★ When installing the hose between the tubes, tighten the hose clamp bolts to the following torque.

Hose clamp:
3.3 ± 0.49 Nm {0.34 ± 0.05 kgm}



3) Install tube (13) and fasten it with bolts (12) and hose clamp (11).

Hose clamp:
4.4 ± 0.49 Nm {0.45 ± 0.05 kgm}

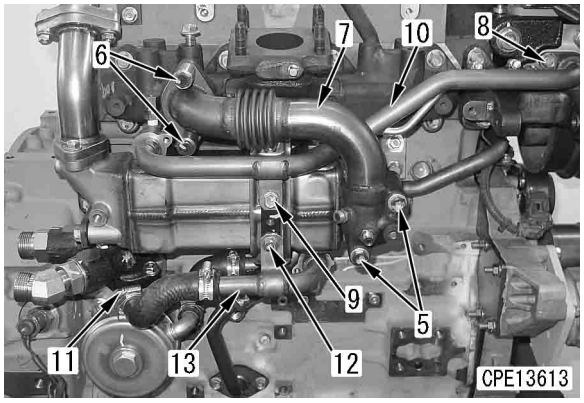
4) Install tube (10) and tighten mounting bolts (9) and (8).
5) Apply molybdenum disulfide lubricant to the threads of mounting bolts (6) and (5) for tube (7).

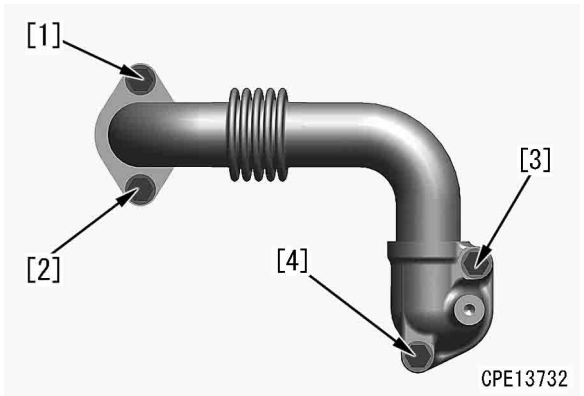
Threaded portion:
Lubricant with molybdenum disulfide (LM-P)

6) Install tube (7) and tighten mounting bolts (6) and (5) in the order of [1] to [4] in the following figure and with the following procedures.

★ Install the gasket to the mounting faces of the both ends of tube.

Mounting bolt:
1st time: 9.8 to 14.7 Nm {1.0 to 1.5 kgm}
2nd time: 24.5 to 29.4 Nm {2.5 to 3.0 kgm}
3rd time: 24.5 to 29.4 Nm {2.5 to 3.0 kgm}(check)





7) Fasten tube (4) with clamping bolts (3) and mounting bolts (2) and (1).

★ When replacing the hose between tubes, install the hose according to the following procedure.

1] Insert hose (21) into tube (4).

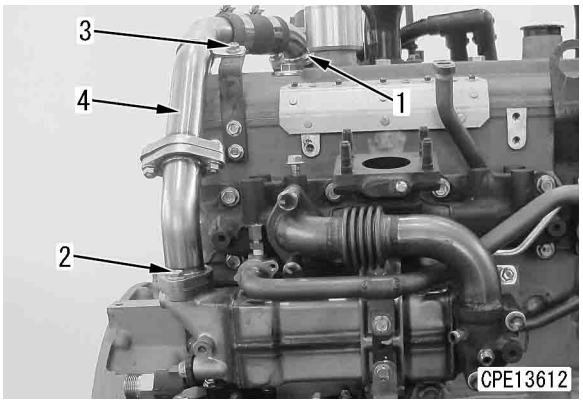
★ Insert the pipe to 45 mm from the end of the pipe.

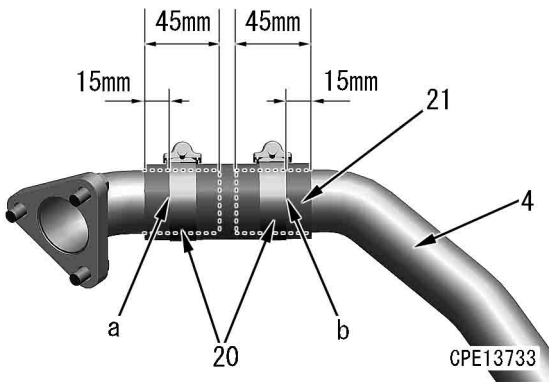
2] Fasten the hose with hose clamp (20).

Hose clamp:
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

★ Install the clamp at 15 mm from the end of the hose.

★ Put the marks to places (a) and (b) where the clamps are to be installed.





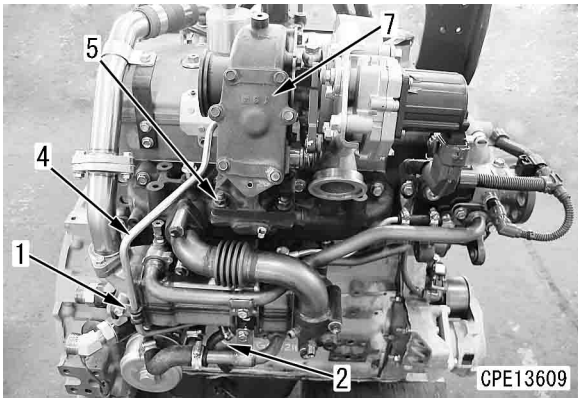
35.Turbocharger assembly

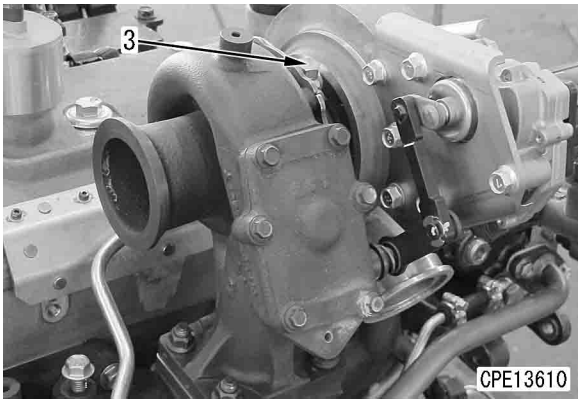
1) Fasten turbocharger assembly (7) with nut (5).

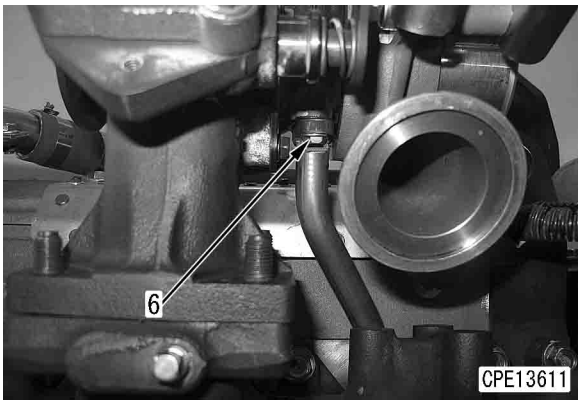
Nut:
29.4 to 44.1 Nm {3.0 to 4.5 kgm}

2) Install the lubricating oil drain tube on turbocharger side. Tighten mounting bolts (6).
3) Install tube (4), tighten joint bolts (3) and (2), and install tube clamp (1).

Joint bolt:
9.8 to 12.7 Nm {1.0 to 1.3 kgm}

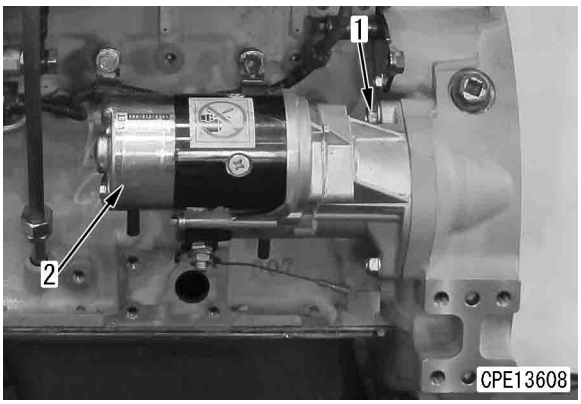






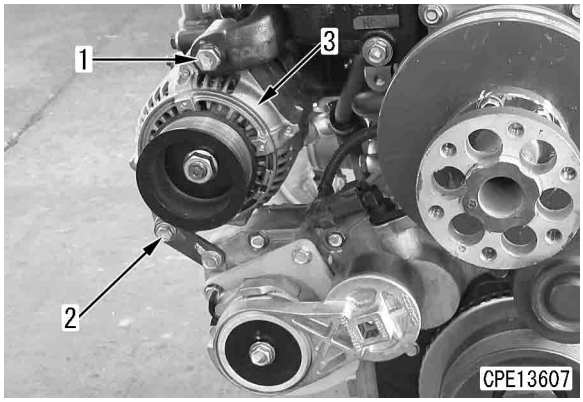
36.Starting motor assembly

Install starting motor (2) and tighten mounting bolts (1).



37.Alternator

Tighten mounting bolts (2) and (1) of alternator (3).



38.Fan belt

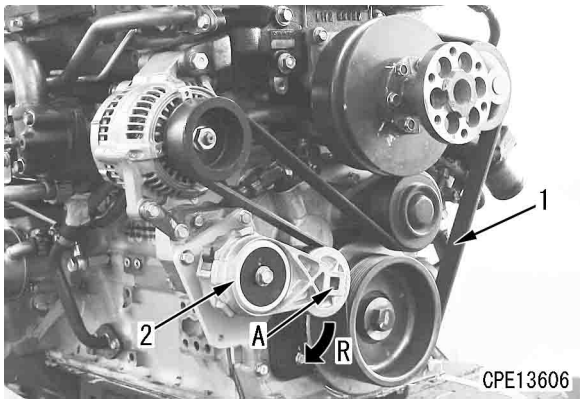
Install fan belt (1).

★ Insert a wrench in the portion A (width across flats: 12.7 mm) of the tensioner assembly (2), and rotate it in the counter-direction (R) to the winding-up direction, then install the fan belt.

⚠ **Be sure that the wrench is secured at portion A of tensioner assembly before turning it. (If you try to rotate the wrench before it is securely attached due to the strong spring force of tensioner assembly, the wrench may come off that is very dangerous.**

⚠ **After installation of the fan belt, restore tensioner assembly slowly with care.**

⚠ **Be careful not to get your fingers caught between the pulley and fan belt during work.**



39.Fan and KDOC muffler

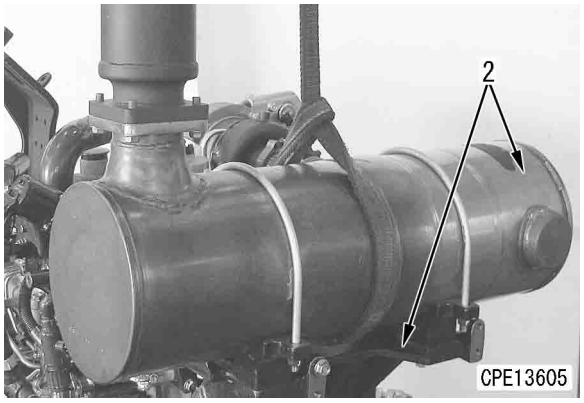
1) Install tube (6) and fasten it with clamp (5).

Clamp:

6.9 to 8.8 Nm {0.7 to 0.9 kgm}

2) Sling KDOC muffler and bracket assembly (2).

KDOC muffler and bracket assembly:
42 kg

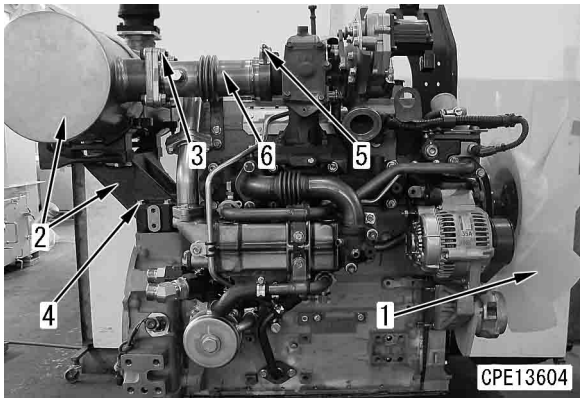


3) Install KDOC muffler and bracket assembly (2) and tighten mounting bolts (4) and mounting nuts (3).

★ Apply molybdenum disulfide lubricant to the mounting bolt side threads of the nuts.

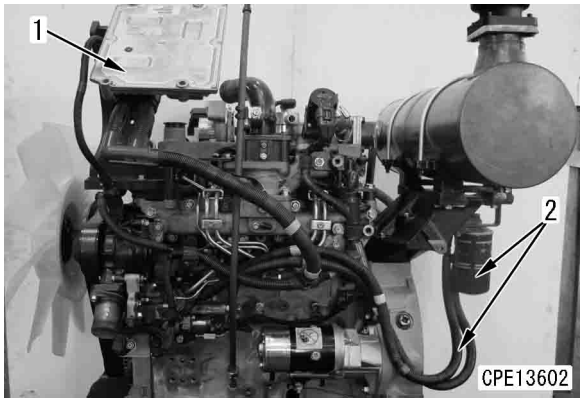
Threaded portion:
Lubricant with molybdenum disulfide (LM-P)

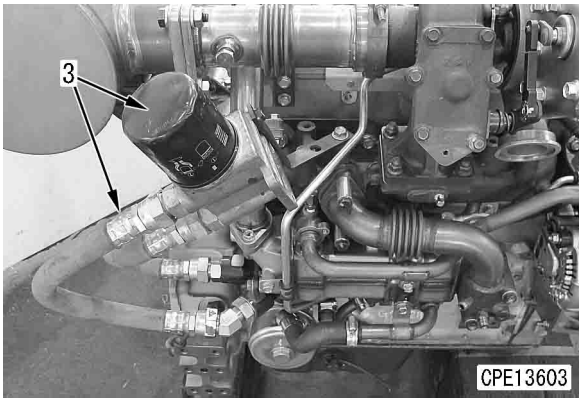
4) Install fan (1).



40. Installation of following auxiliaries

1) Install oil filter and hose assembly (3).
2) Install fuel filter and hose assembly (2).
3) Install engine controller (1).





Removal and installation procedure of supply pump unit alone *(ENG107-AD70-924-K-00-A)*

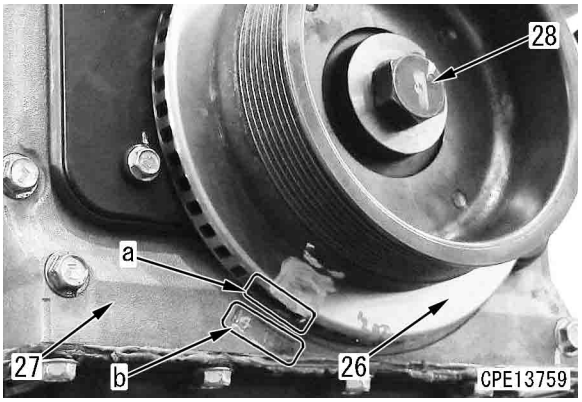
Removal *(ENG95-AD70-520-K-00-A)*

★ Be sure to match the top positions of pistons #1 and #4 in the following procedure before removing.

Rotate the crankshaft forward (clockwise seen from the front) and match notch (a) of plate (26) at the rear of the crankshaft pulley to embossed letters "1.4TOP" (b) on front cover (27).

★ Rotate the crankshaft by holding the crankshaft pulley bolt (28).

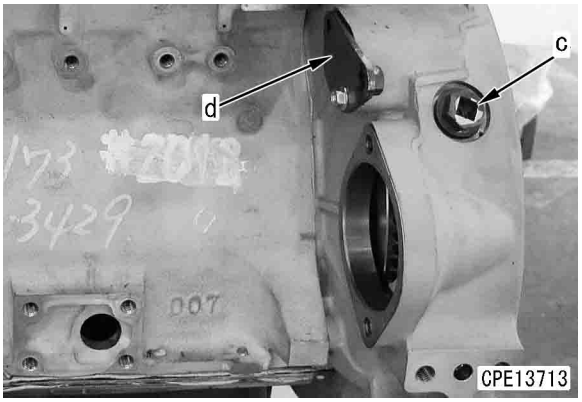
★ Always rotate the crankshaft pulley bolt forward to prevent it from being loosened.



Reference: The cranking can be done by the following way on the some machine models.

- If plug (c) of the flywheel housing is removed, you can check the No.1 cylinder top dead center mark (white paint) on the flywheel side.
- You can install the barring tool for rotating the crankshaft by removing cover (d) of the flywheel housing.

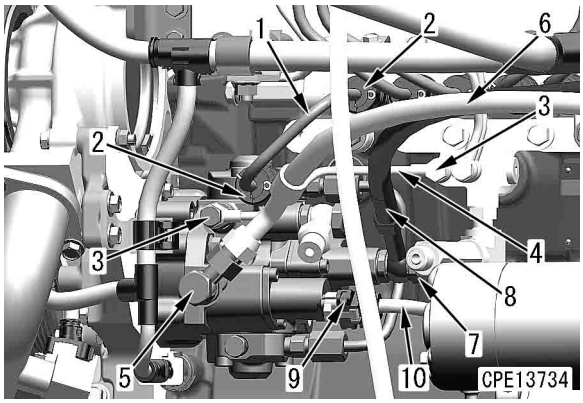
★ For details, see the shop manual for the applicable machine.



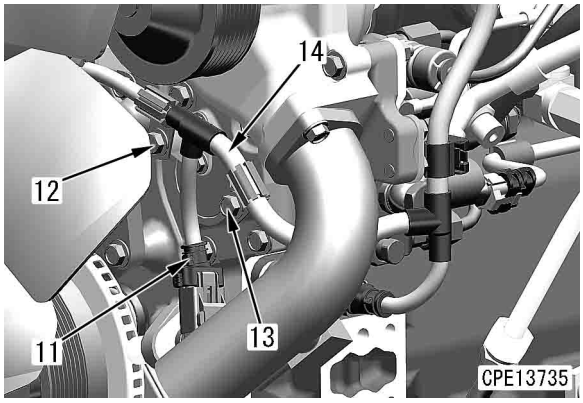
★ The air intake and exhaust rocker arm of No. 1 cylinder with the piston at the No. 1 cylinder compression top dead center can be moved by hand by the distance equivalent to the valve clearance. If the rocker arm cannot be moved by your hand, the No.1 piston is not at its compression top dead center. In that case, rotate the crankshaft one more turn.

1. Remove fuel spray prevention caps (2) (2 pieces) of high-pressure pipes (1). [*1]
2. Loosen sleeve nuts (2) (2 pieces) and remove high-pressure fuel pipes (1). [*2]

   ★ When removing the fuel high-pressure pipe, be careful not to apply excessive force to the pipe.
3. Remove joint bolt (3), and remove fuel tube (4).
4. Remove joint bolt (5), and disconnect fuel hose (6). [*3]
5. Remove joint bolt (7), and disconnect fuel hose (8). [*4]
6. Remove connector (SCV) (9) of the supply pump regulator and disconnect wiring harness (10).

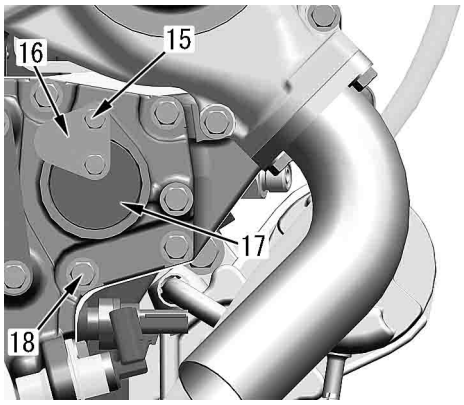


7. Disconnect connector (11) of the NE (crankshaft) speed sensor.
8. Remove bolts (12) and (13) and disconnect wiring harness (14).

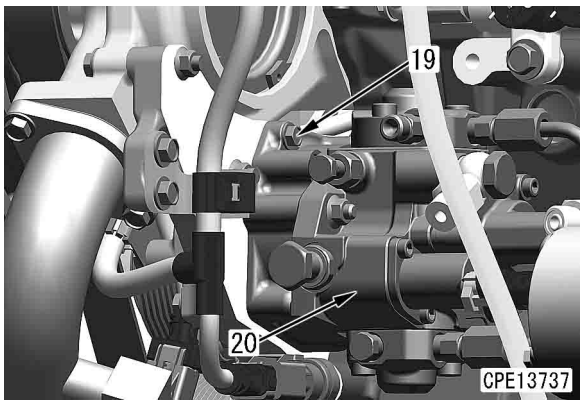


9. Remove mounting bolt (15) to remove plates (16) and (17). [*5]

10.Remove mounting bolts (18) (4 pieces).

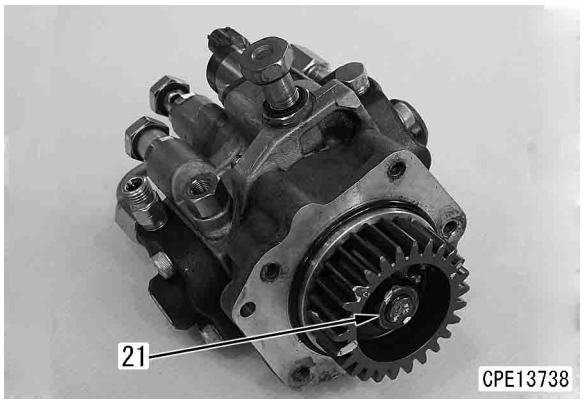


11.Remove mounting bolts (19), and remove supply pump assembly (20) together with the gear. [*6]

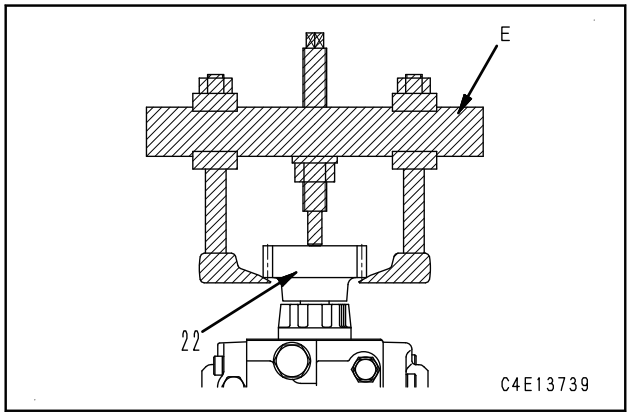


12.Loosen nut (21).

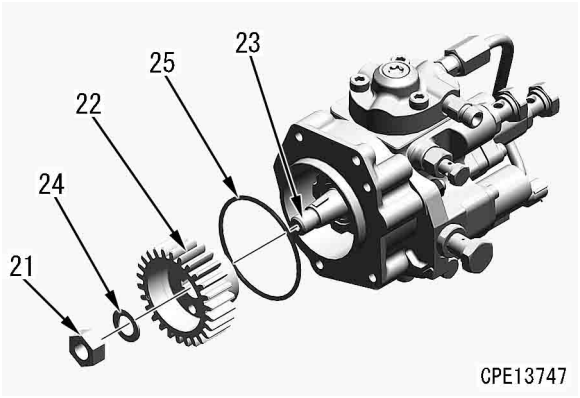
★ Do not remove the nut from the shaft.



13.Install tool E between the flange and gear (22) of the supply pump.



14.Remove nut (21), washer (24), gear (22) and O-ring (25) from shaft (23). [*7]



Installation *(ENG95-AD70-720-K-00-A)*

- Perform installation in the reverse order to removal.

[*1]

★ Face the slit of the fuel spray prevention cap downward.

[*2], [*3], [*4]

- Installation procedures for pipings

1. Install fuel high-pressure pipe (1).

★ When installing the fuel high-pressure pipe, be careful not to apply excessive force to the pipe.

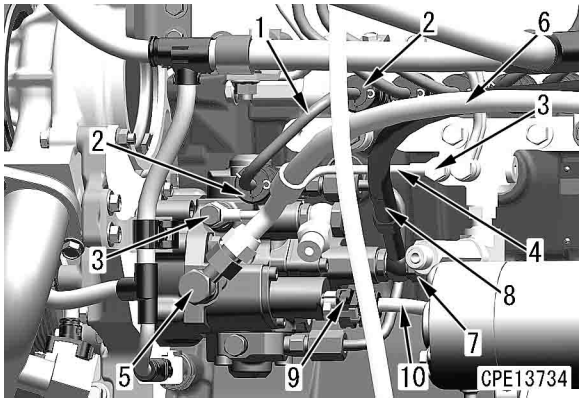
Sleeve nut for fuel high-pressure pipe:
39.0 to 44.0 Nm {4.0 to 4.5 kgm}

2. Install fuel tube (4).
3. Install fuel hose (6).

Joint bolt:
17.6 to 19.6 Nm {1.8 to 2.0 kgm}

4. Install fuel hose (8).

Joint bolt:
17.6 to 19.6 Nm {1.8 to 2.0 kgm}



[*5]

Plate mounting bolt:

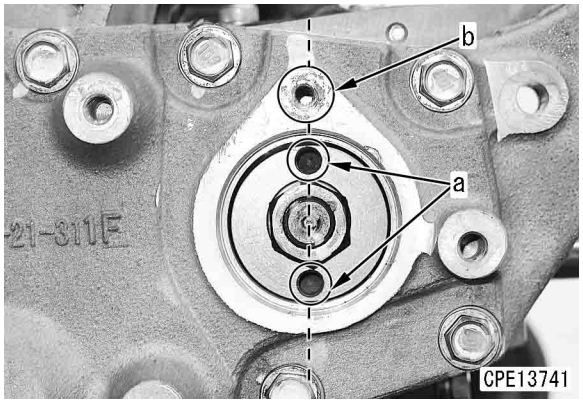
8.8 to 14.7 Nm {0.9 to 1.5 kgm}

[*6]

- Positioning of supply pump gear
  Match the top positions of pistons #1 and #4.

★ When installing the supply pump assembly to the front cover, align straightly the tapped hole (a) of the gear and the tapped hole (b) of the front cover viewing from the engine front .

★ Install it with the stamp mark "C" of the gear facing the idler pulley.



[*7]

Gear mounting nut (21):

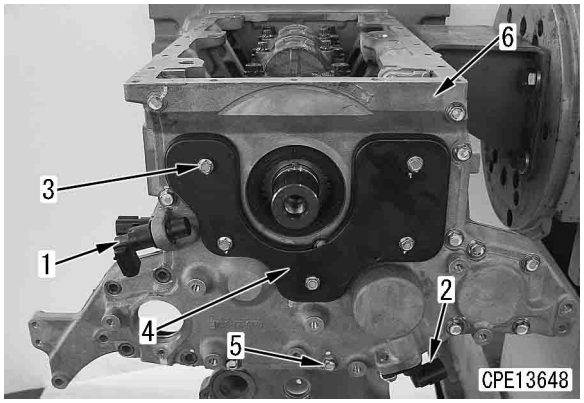
58.8 to 68.6 Nm {6.0 to 7.0 kgm}

Engine front oil seal replacement procedure *(ENG107-A350-924-K-00-A)*

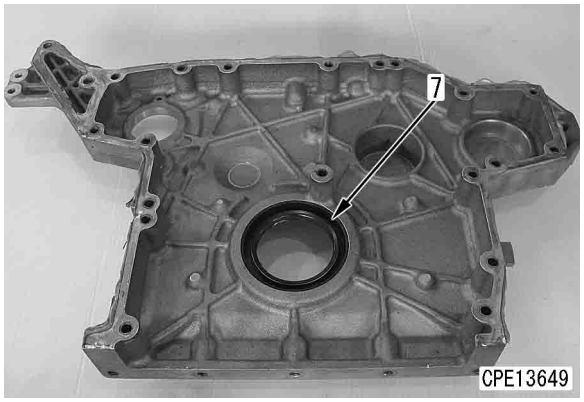
Removal *(ENG95-A350-520-K-00-A)*

★ For the work up to the removal of the crankshaft pulley, see the manual for the machine the engine is installed.

1. Remove crankshaft speed sensor (NE) (1) and camshaft speed sensor (BKUP) (2).
2. Remove mounting bolts (3) (5 pieces) and remove cover (4).
3. Remove mounting bolts (5) (12 pieces) and front cover (6).



4. Remove front oil seal (7).

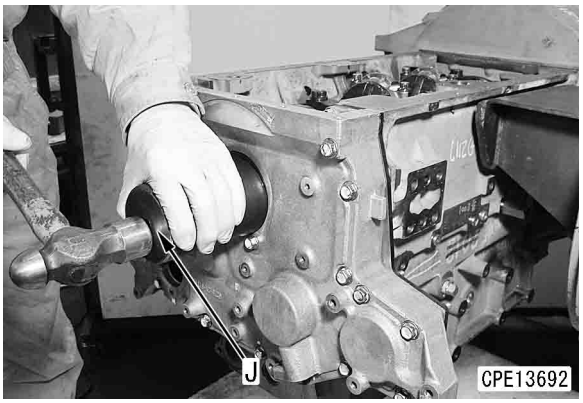


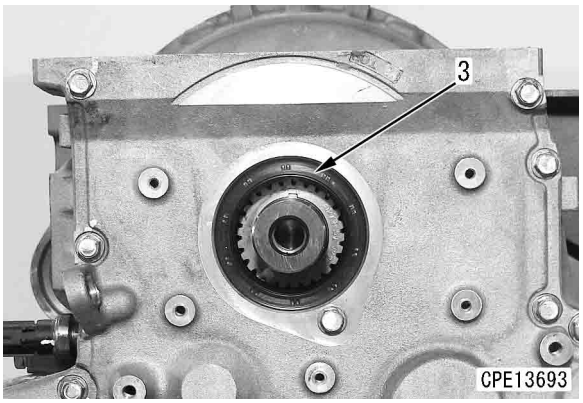
Installation *(ENG95-A350-720-K-00-A)*

★ Before installing the front oil seal, check that the end corner and the lip sliding surface of the crankshaft are free from a flaw, burr, fin, and rust.

1. By using tool J, install front oil seal (3).
2. After press fitting the front oil seal, fill the space between oil seal lips with approximately 2 cc of grease.

Front oil seal:
Grease (G2-LI)





Engine rear oil seal replacement procedure *(ENG107-A510-924-K-00-A)*

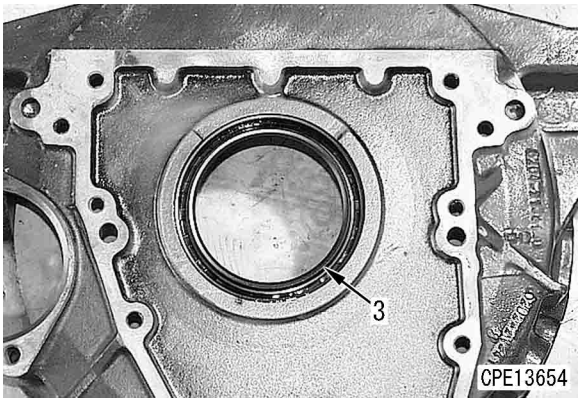
Removal *(ENG95-A510-520-K-00-A)*

★ For the work up to the removal of the flywheel, see the manual for the machine the engine is installed.

Screw a slide hammer, etc. in the metal ring of rear oil seal (2), and pull out the rear oil seal by using the the impact of the slide hammer.

★ Before pulling out the seal, drive the seal inward a little to separate it from the housing for easy removal.

★ Do not use a drill, etc. as metal chips may enter the engine.

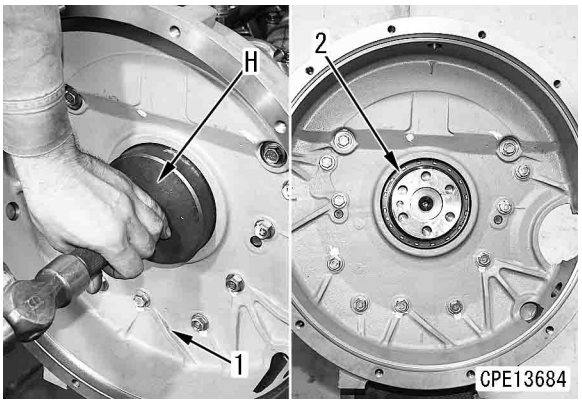


Installation *(ENG95-A510-720-K-00-A)*

★ Before installing the rear oil seal, check that the end corner and the lip sliding surface of the crankshaft are free from a flaw, burr, fin, and rust.

1. Install rear oil seal (2) by using tool H.
2. After press fitting the rear oil seal, fill the space between oil seal lips with approximately 3 cc of grease.

Rear oil seal: Grease (G2-LI)



SHOP MANUAL

ENGINE

95E-6 SERIES

Model Serial Number

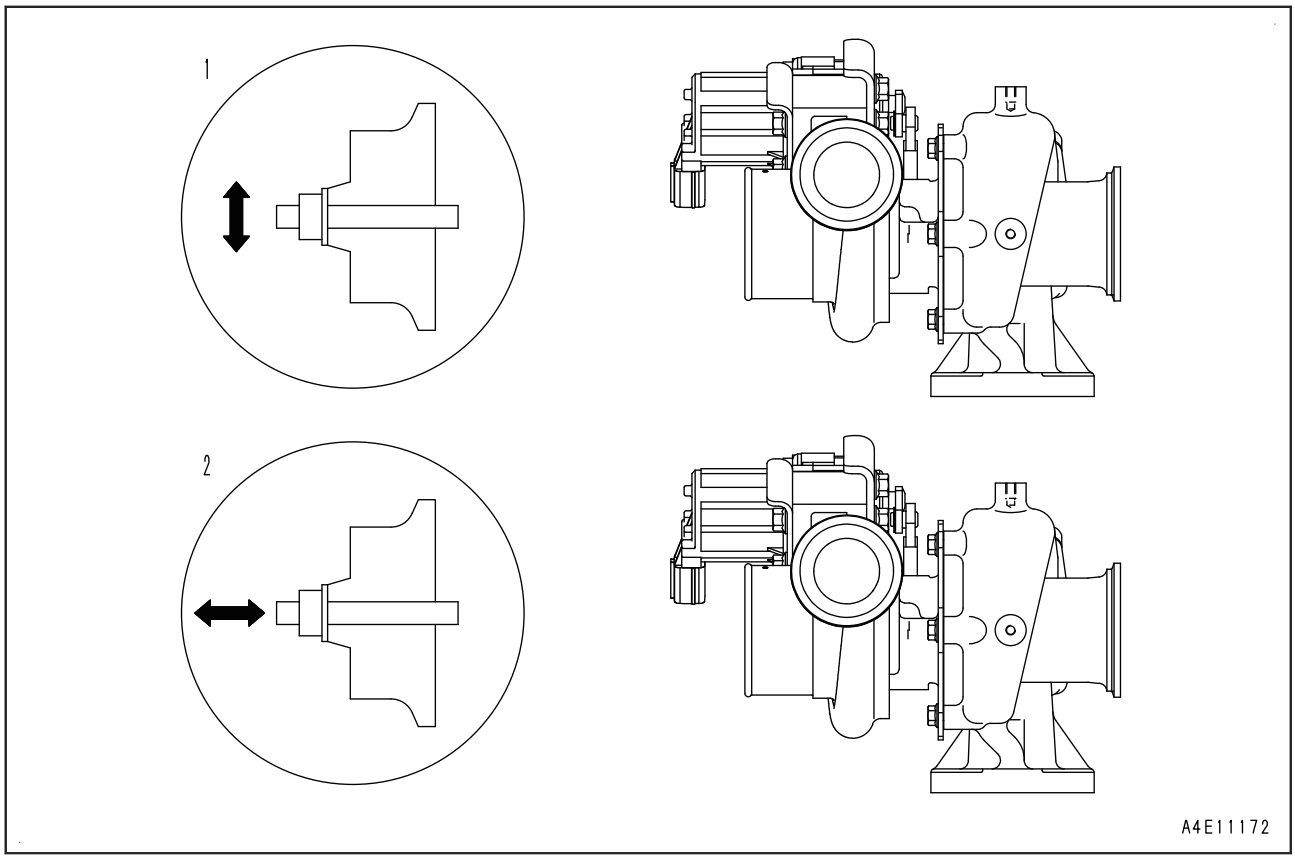
95E-6 SERIES

60 Maintenance standard

Table of contents

Intake and exhaust system parts

Turbocharger (Variable Flow Turbocharger)

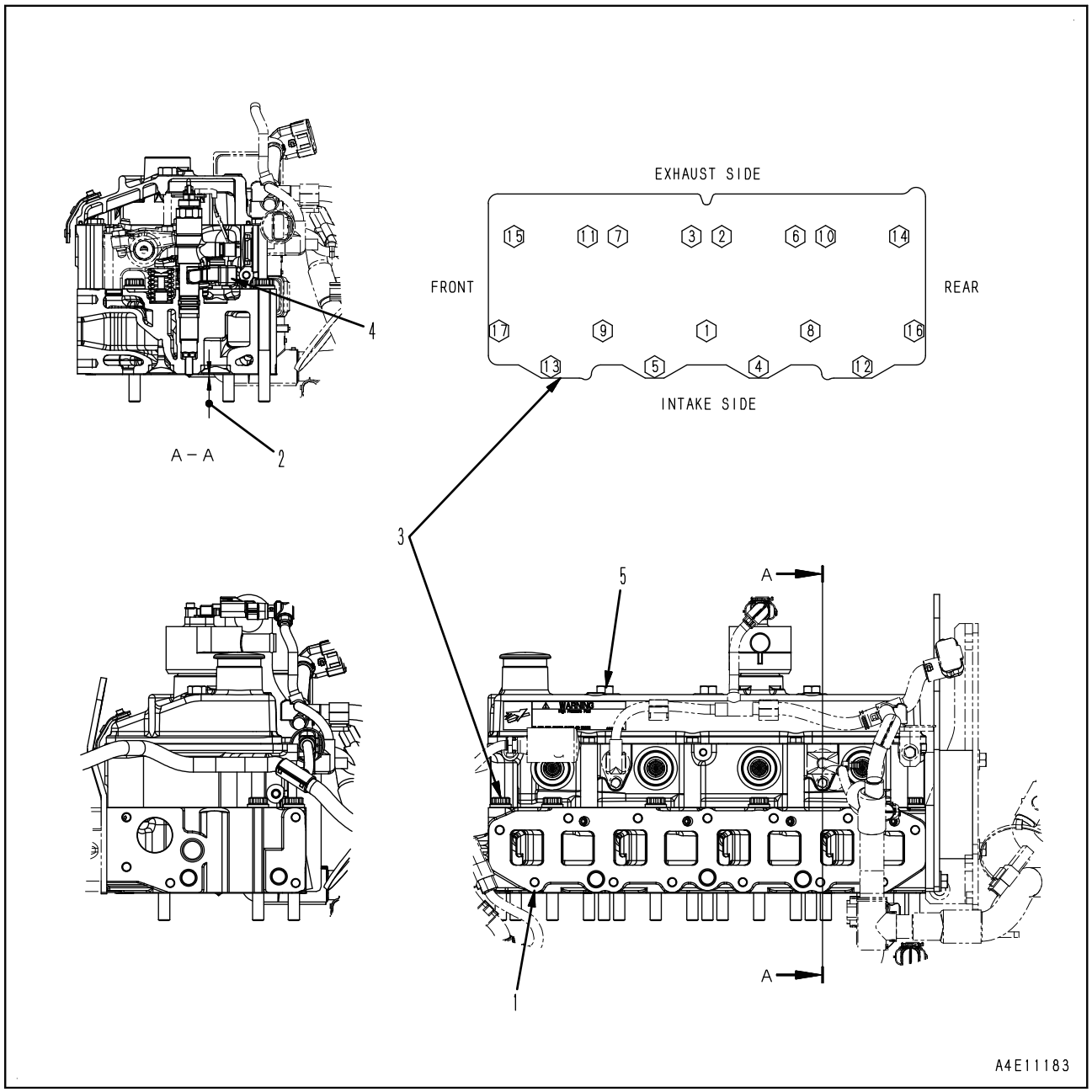


Unit: mm

No.	Item	Criteria		Remedy
1	Radial play (play in radial direction)	When compressor wheel and turbine wheel are pushed lightly with fingers toward housing, neither of them must touch housing.		Replace turbocharger assembly
2	End play (play in axial direction)	Standard	Repair limit	
		0.02 to 0.07 (reference value)	0.103	

Engine main body parts *(ENG107-R402-001-K-00-A)*

Cylinder head *(ENG95-A100-034-K-00-A)*

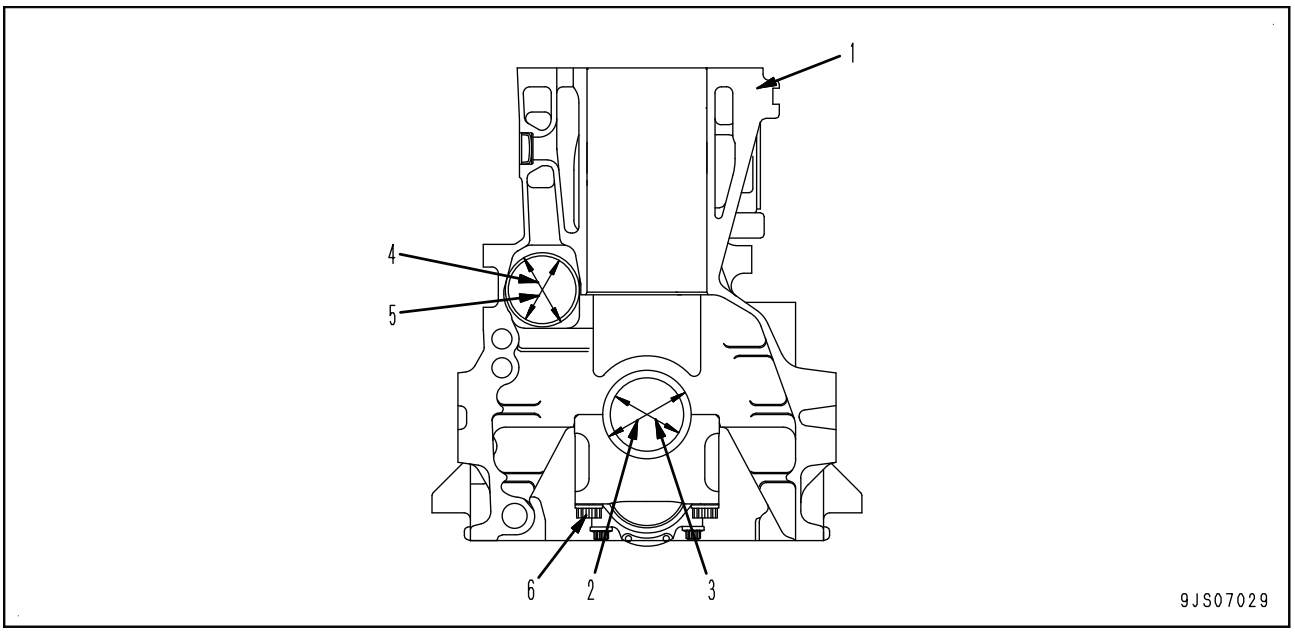


Unit: mm

No.	Item	Criteria			Remedy
1	Distortion of cylinder head mounting face	Tolerance		Repair limit	Repair by grinding or replacement
		0 to 0.05		0 to 0.30	
2	Protrusion of nozzle	Standard		Allowable range	Replace nozzle gasket
		3.53 ± 0.23		3.3 to 3.76	
3	Tightening torque of cylinder head mounting bolt (Apply molybdenum disulfide (LM-P) to seat and threaded part of bolt.)	Procedure	Target (Nm {kgm})	Range (Nm {kgm})	Tighten in the order of Nos. shown in the illustration
		1st time	68.6 {7}	58.8 to 78.5 {6 to 8}	
		2nd time	108 {11}	103 to 113 {10.5 to 11.5}	
		3rd time	Plastic region tightening angle method		
			Retighten 90 degrees	90 (+30 / 0) degrees	
4	Tightening torque of nozzle holder mounting bolt	Target (Nm {kgm})		Range (Nm {kgm})	Tighten
		44 {4.5}		39 to 49 {4 to 5}	
5	Tightening torque of cylinder head cover mounting bolt	8.8 {0.9}		7.8 to 9.8 {0.8 to 1.0}	

*: For assembly procedure, however, see Disassembly and assembly.

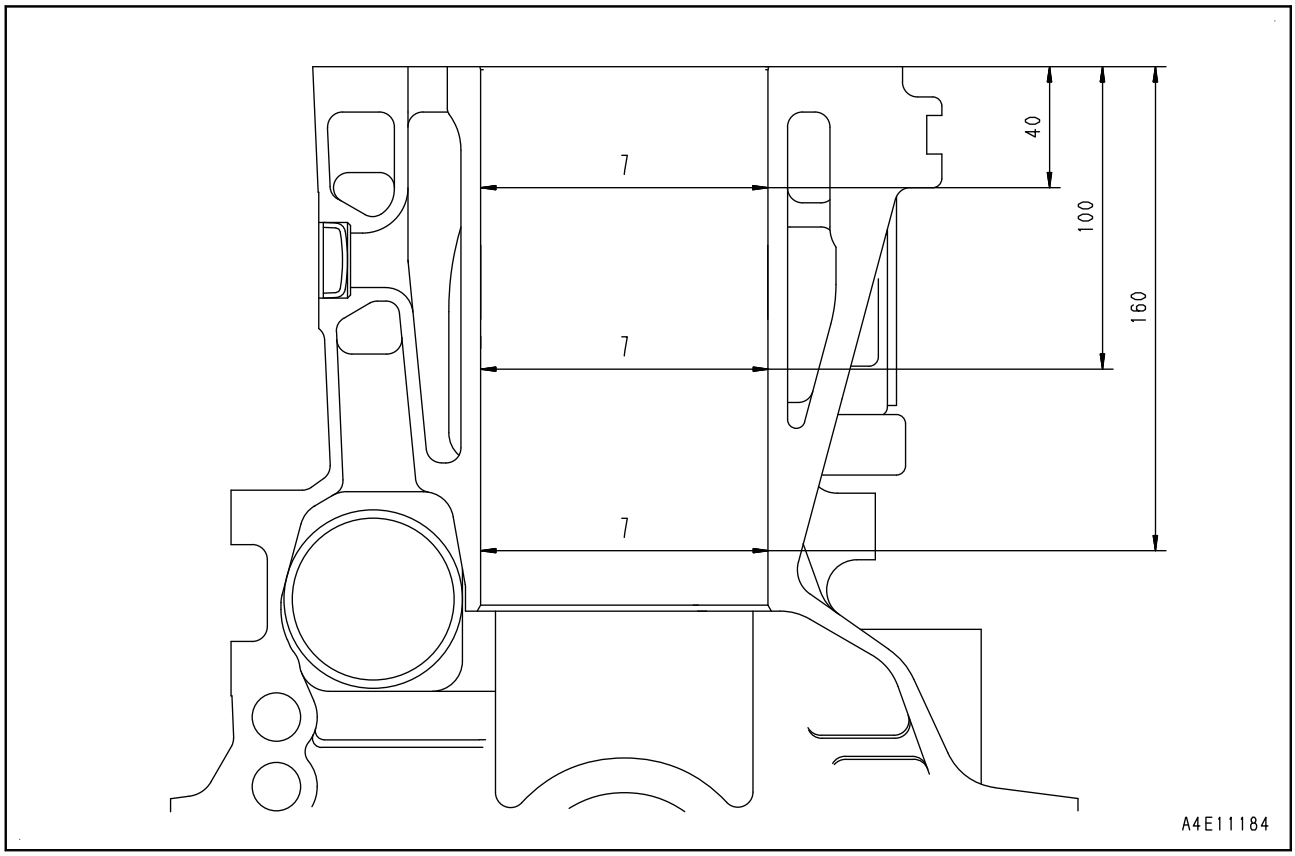
Cylinder block *(ENG95-A300-034-K-00-A)*



Unit: mm

<table>
<tr><th>No.</th><th>Item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Distortion of cylinder head mounting face</td><td colspan="3">Tolerance</td><td colspan="2">Repair limit</td><td rowspan="2">Repair by grinding</td></tr>
<tr><td colspan="3">0 to 0.08</td><td colspan="2">0.15</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Inside diameter of main metal mounting hole</td><td colspan="3">Standard dimension</td><td colspan="2">Tolerance</td><td rowspan="3">Repair or replace cylinder block</td></tr>
<tr><td colspan="3">74.00</td><td colspan="2">+0.019
0</td></tr>
<tr><td colspan="3">• Repair limit of roundness: 0.005</td><td colspan="2">• Repair limit of straightness: 0.010</td></tr>
<tr><td rowspan="6">3</td><td rowspan="6">Inside diameter of main metal</td><td></td><td>Standard dimension</td><td>Tolerance</td><td colspan="2">Repair limit</td><td rowspan="6">Replace main metal</td></tr>
<tr><td>STD</td><td>70.00</td><td rowspan="5">+0.103
+0.058</td><td colspan="2">70.20</td></tr>
<tr><td>0.25 US</td><td>69.75</td><td colspan="2">69.95</td></tr>
<tr><td>0.50 US</td><td>69.50</td><td colspan="2">69.70</td></tr>
<tr><td>0.75 US</td><td>69.25</td><td colspan="2">69.45</td></tr>
<tr><td>1.00 US</td><td>69.00</td><td colspan="2">69.20</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Inside diameter of cam bushing mounting hole</td><td colspan="3">Standard dimension</td><td colspan="2">Tolerance</td><td rowspan="3">Repair or replace cylinder block</td></tr>
<tr><td colspan="3">53.5</td><td colspan="2">+0.030
0</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Inside diameter of cam bushing</td><td colspan="2">Standard dimension</td><td colspan="2">Tolerance</td><td colspan="2">Repair limit</td><td rowspan="2">Replace bushing</td></tr>
<tr><td colspan="2">50.5</td><td colspan="2">+0.030
-0.040</td><td colspan="2">50.60</td></tr>
<tr><td rowspan="5">6</td><td rowspan="5">Tightening torque of main metal cap mounting bolt
(Apply engine oil to threaded part and seat of bolt.)</td><td colspan="2">Procedure</td><td colspan="2">Target (Nm {kgm})</td><td colspan="2">Range (Nm {kgm})</td><td rowspan="5">Tighten</td></tr>
<tr><td colspan="2">1st time</td><td colspan="2">113 {11.5}</td><td colspan="2">108 to 118
{11 to 12}</td></tr>
<tr><td colspan="2">2nd time</td><td colspan="2">0 {0}</td><td colspan="2">Tighten completely</td></tr>
<tr><td colspan="2">3rd time</td><td colspan="2">132 {13.5}</td><td colspan="2">127 to 137
{13 to 14}</td></tr>
</table>

★ US: Undersize

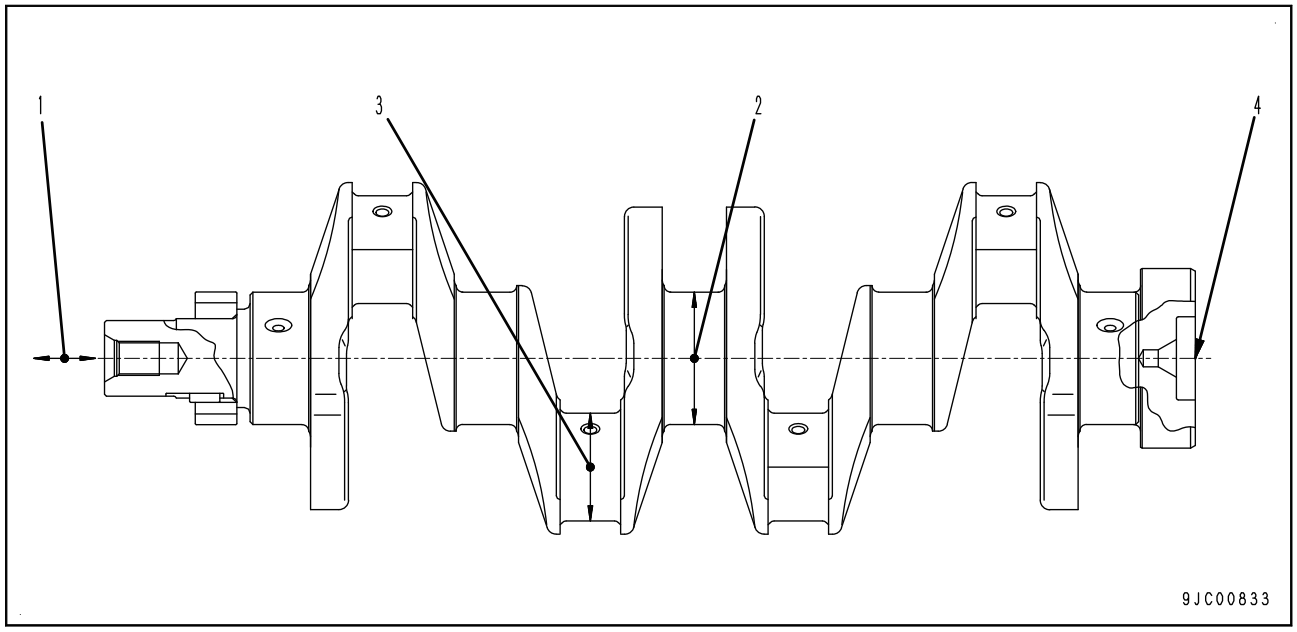


Unit: mm

No.	Item	Criteria				Remedy
7	Inside diameter		Standard dimension	Tolerance	Repair limit	Correct to oversize, install cylinder liner, or replace cylinder block
		STD	95.00	+0.022 0	95.15	
		0.25 OS	95.25		95.40	
		0.50 OS	95.50		95.65	
	Roundness of inside diameter	Repair limit: 0.02				
	Cylindricity of inside diameter	Repair limit: 0.02				
	Procedure of correction to overhaul size	Measure inside diameter at position 40, 100, and 160 from cylinder block top and determine overhaul size from maximum measured value. 1. If inside diameter of cylinder is 95.15 or less, select 0.25 oversize piston. Machine cylinder bore of cylinder block to 95.25 (+0.022/0). 2. If inside diameter of cylinder is 95.16 to 95.40, select 0.50 oversize piston. Machine cylinder bore of cylinder block to 95.50 (+0.022/0). 3. If inside diameter of cylinder is larger than 95.40, perform stepped machining of cylinder block and insert cylinder liner.				(when overhauling) Correct rank mark of cylinder bore on top of cylinder block (S or L)

★ OS: Oversize

Crankshaft *(ENG95-A530-034-K-00-A)*

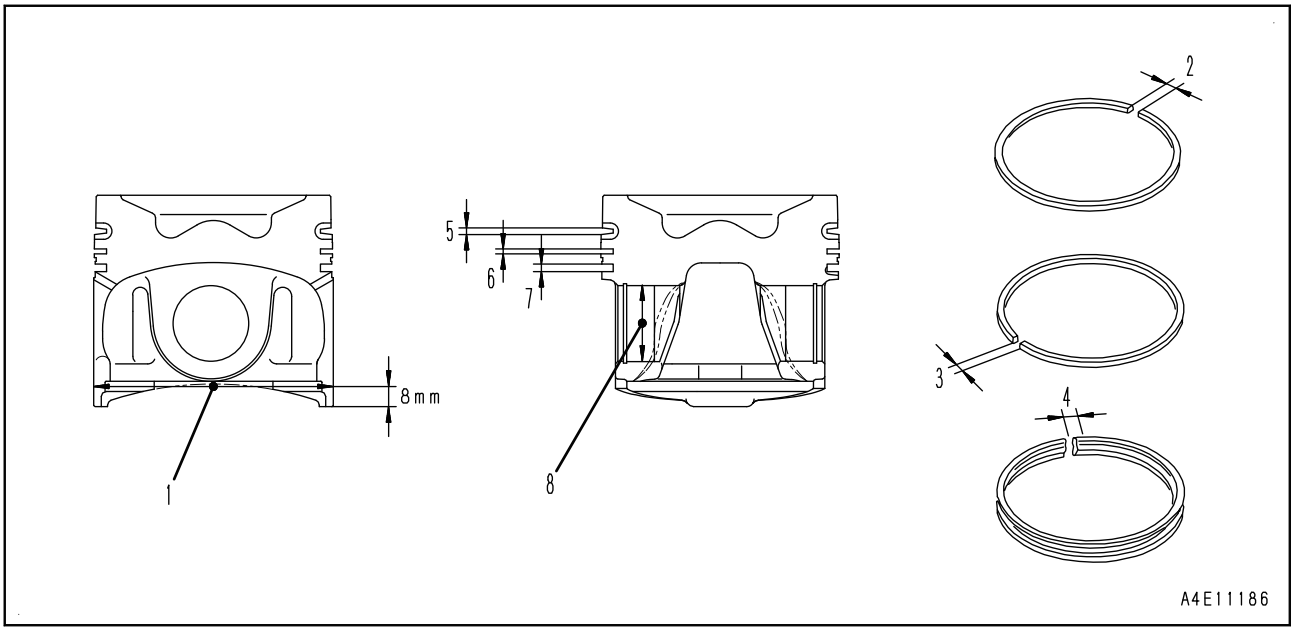


Unit: mm

No.	Item	Criteria				Remedy
1	End play	Standard value		Repair limit		Replace thrust metal or use oversize
		0.131 to 0.351		0.40		
2	Outside diameter of main journal		Standard dimension	Tolerance	Repair limit	Use undersize or replace
		STD	70.00	+0.015 0	69.86	
		0.25 US	69.75		69.61	
		0.50 US	69.50		69.36	
		0.75 US	69.25		69.11	
		1.00 US	69.00		68.86	
	Roundness of main journal	Repair limit: 0.020				
	Clearance in main journal	Standard clearance		Allowable clearance		Replace main metal
		0.043 to 0.103		0.25		
3	Outside diameter of crank pin journal		Standard dimension	Tolerance	Repair limit	Use undersize or replace
		STD	57.00	+0.015 0	56.91	
		0.25 US	56.75		56.66	
		0.50 US	56.50		56.41	
		0.75 US	56.25		56.16	
		1.00 US	56.00		55.91	
	Roundness of crank pin journal	Repair limit: 0.020				
	Clearance in crank pin journal	Standard clearance		Allowable clearance		Replace connecting rod metal
		0.029 to 0.089		0.22		
4	Bend of crankshaft	Repair limit: 0.09 (total indicator reading)				Use undersize or replace

★ US: Undersizes

Piston *(ENG95-A580-034-K-00-A)*



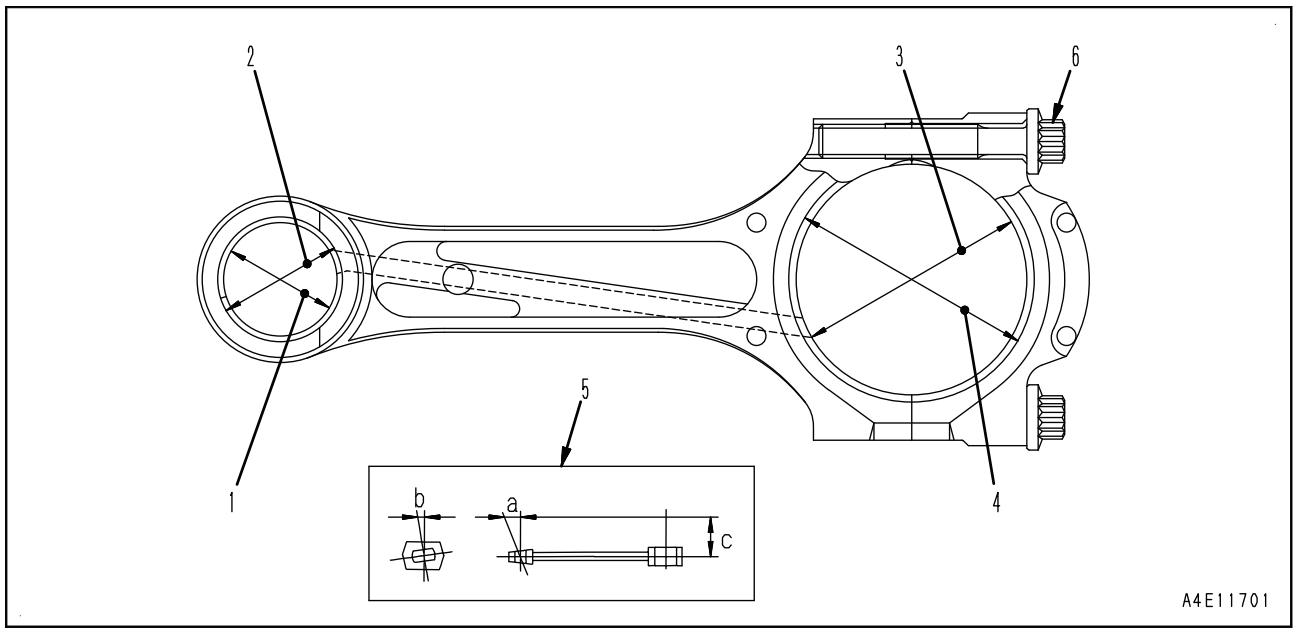
Unit: mm

No.	Item	Criteria						Remedy
1	Outside diameter of piston (perpendicular to boss)		Standard dimension			Repair limit		Replace piston (Only S is supplied)
		STD	94.875			94.86		
		0.25 OS	95.125			95.11		
		0.50 OS	95.375			95.36		
2	Clearance on abutment joint of piston ring	Measuring location	Standard clearance			Allowable clearance		Replace piston ring
		Top ring	0.28 to 0.38			2.0		
3		Second ring	0.40 to 0.50			2.0		
4		Oil ring	0.20 to 0.40			1.5		
5	Clearance between piston ring groove and piston ring	Measuring location	Standard dimension	Tolerance		Standard clearance	Allowable clearance	Replace piston ring or piston
				Ring	Piston			
		Top ring	2.5	-0.01 -0.03	Judge by groove wear gauge (*1)			
6		Second ring	2	-0.01 -0.03	+0.05 +0.03	0.04 to 0.08	0.16	
7		Oil ring	2.5	-0.01 -0.03	+0.04 +0.02	0.03 to 0.07	0.15	
8	Clearance between piston and piston pin	Standard dimension	Tolerance			Standard clearance	Allowable clearance	Replace piston or piston pin
			Shaft	Hole				
		30	0 -0.006	+0.012 +0.004		0.04 to 0.018	0.05	

*1: Part No. of wear gauge 795-901-1130

★ OS: Oversize

Connecting rod *(ENG95-A590-034-K-00-A)*



Unit: mm

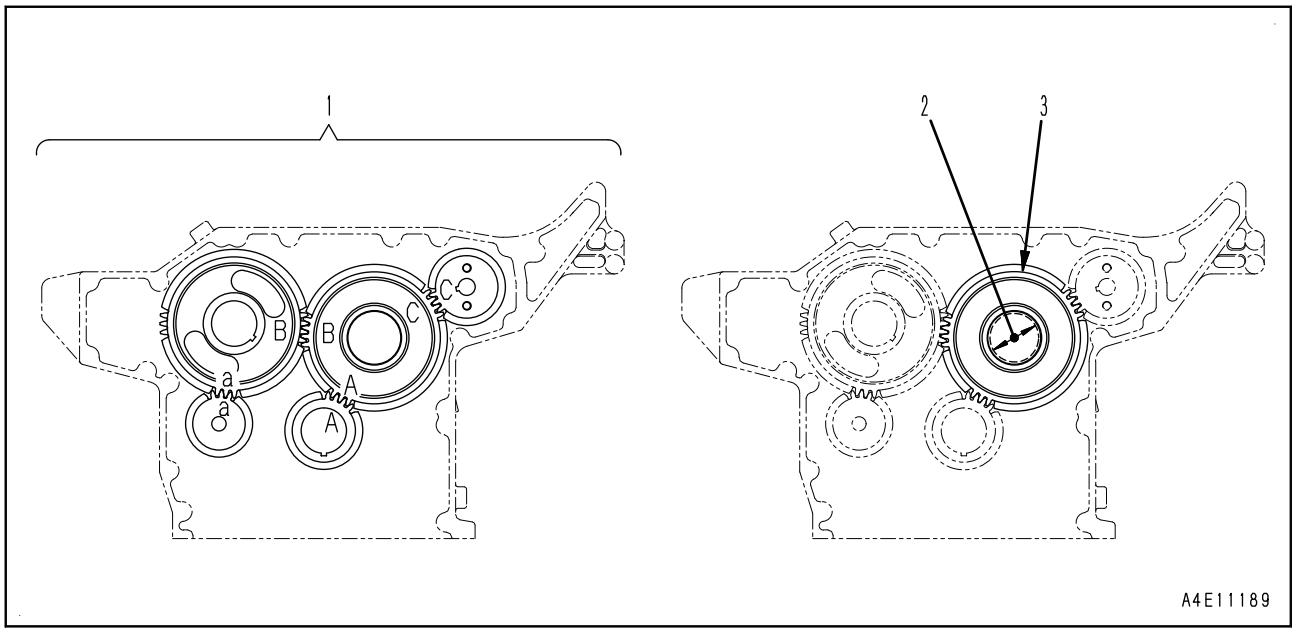
<table>
<tr><th>No.</th><th>Item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between connecting rod and piston pin
(Press fitting, then reaming)</td><td rowspan="2">Standard dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Allowable clearance</td><td rowspan="2">Replace bushing (Spare part is half finished)</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>30</td><td>0
-0.006</td><td>+0.033
+0.020</td><td>0.020 to 0.039</td><td>0.10</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Inside diameter of mounting hole of connecting rod bushing</td><td colspan="3">Standard dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Replace connecting rod</td></tr>
<tr><td colspan="3">33.00</td><td colspan="2">+0.025
0</td></tr>
<tr><td rowspan="6">3</td><td rowspan="6">Inside diameter of connecting rod metal</td><td></td><td colspan="2">Standard dimension</td><td>Tolerance</td><td>Repair limit</td><td rowspan="6">Replace connecting rod metal</td></tr>
<tr><td>STD</td><td colspan="2">57.00</td><td rowspan="5">+0.095
+0.045</td><td>57.20</td></tr>
<tr><td>0.25 US</td><td colspan="2">56.75</td><td>56.95</td></tr>
<tr><td>0.50 US</td><td colspan="2">56.50</td><td>56.70</td></tr>
<tr><td>0.75 US</td><td colspan="2">56.25</td><td>56.45</td></tr>
<tr><td>1.00 US</td><td colspan="2">56.00</td><td>56.20</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Inside diameter of mounting hole of connecting rod metal</td><td colspan="3">Standard dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Replace connecting rod</td></tr>
<tr><td colspan="3">61.00</td><td colspan="2">+0.024
0</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Bend and torsion of connecting rod</td><td>Item</td><td colspan="2">Standard value</td><td colspan="2">Repair limit</td><td rowspan="4">Replace connecting rod</td></tr>
<tr><td>Parallelism (a)</td><td colspan="2">Max. 0.10</td><td colspan="2">0.15</td></tr>
<tr><td>Torsion (b)</td><td colspan="2">Max. 0.30</td><td colspan="2">0.35</td></tr>
<tr><td>Dimension (c)</td><td colspan="2">167</td><td colspan="2">—</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Tightening torque of connecting rod cap mounting bolt
(Apply engine oil to threaded part of bolts and nuts.)</td><td>Procedure</td><td colspan="2">Target (Nm {kgm})</td><td colspan="2">Range (Nm {kgm})</td><td rowspan="4">Tighten</td></tr>
<tr><td>1st time</td><td colspan="2">39 {4}</td><td colspan="2">37 to 41 {3.8 to 4.2}</td></tr>
<tr><td rowspan="2">2nd time</td><td colspan="2">Retighten 90 degrees</td><td colspan="2">90 (+30 / 0) degrees</td></tr>
<tr><td colspan="4">(plastic region tightening angle method)</td></tr>
</table>

★ US: Undersize

★ Make punch mark on connecting rod cap mounting bolt when retightening it. If number of punch marks exceeds 5, replace bolt with a new one.

Timing gear *(ENG95-A5A0-034-K-00-A)*

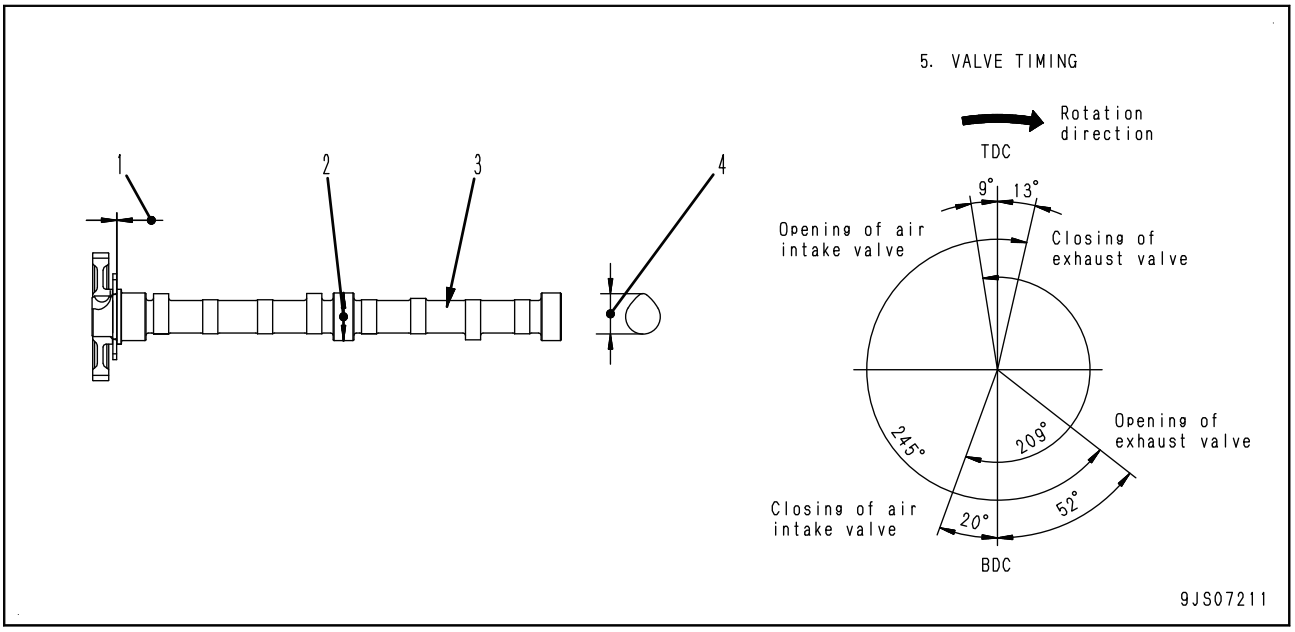
Without front PTO



Unit: mm

No.	Item	Criteria					Remedy
1	Backlash of gear	Position	Check location		Standard	Repair limit	Replace bushing or gear
		A	Crank gear and idler gear		0.07 to 0.33	0.40	
		B	Idler gear and cam gear		0.09 to 0.36		
		C	Idler gear and supply pump gear		0.06 to 0.33		
		a	Cam gear and oil pump gear		0.07 to 0.33		
2	Clearance between idler gear bushing and shaft	Standard dimension	Tolerance		Standard clearance	Allowable clearance	Replace bushing (spare part is half finished) or gear
			Shaft	Hole			
		45	0 -0.016	+0.083 +0.018	0.017 to 0.053	0.10	
3	End play of idler gear	Standard value			Repair limit		Replace idler shaft, thrust plate, or gear
		0.03 to 0.09			0.20		

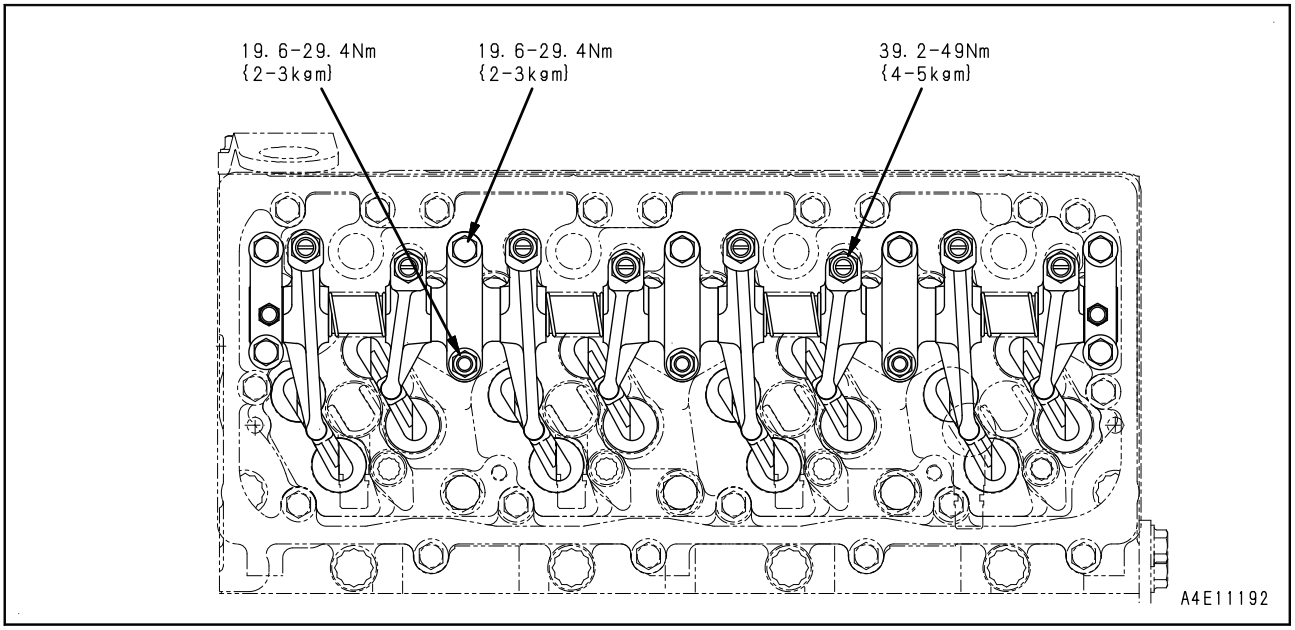
Camshaft *(ENG95-A5G0-034-K-00-A)*



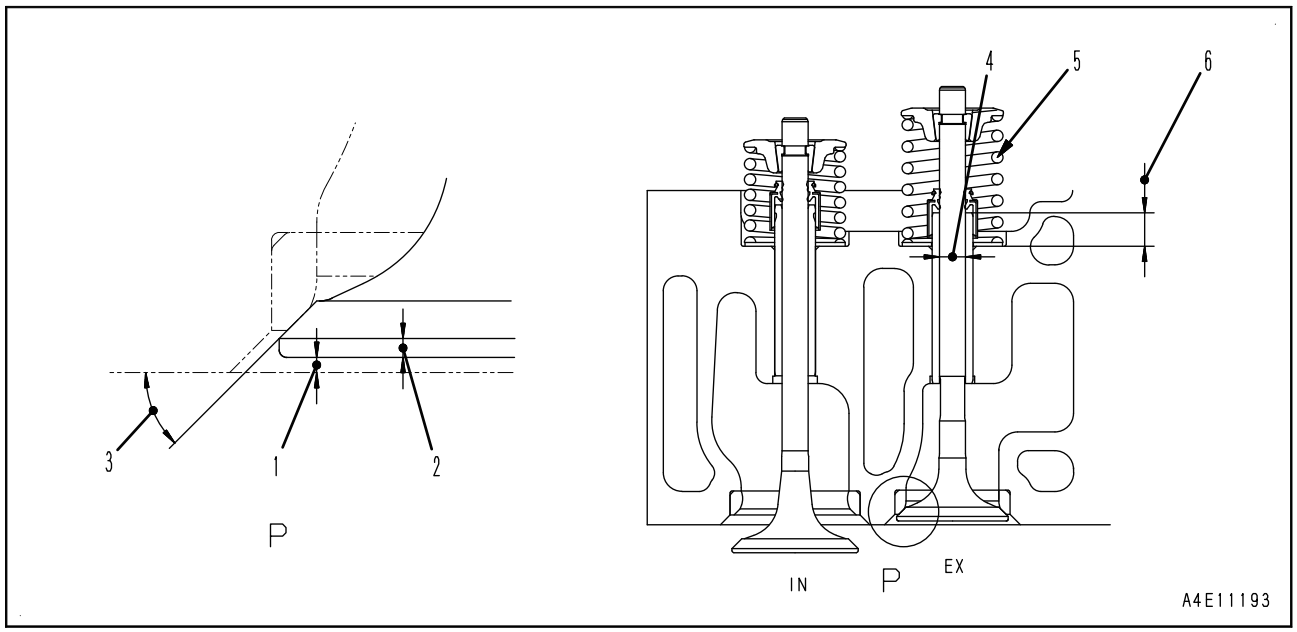
Unit: mm

No.	Item	Criteria						Remedy
1	End play	Standard value			Repair limit			Replace thrust plate
		0.150 to 0.350			0.5			
2	Clearance between cam shaft and bushing	Journal	Standard dimension	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Allowable clearance	Replace bushing
		No. 1 No. 2 No. 3	50.5	-0.080 -0.110	+0.030 -0.040	0.076 to 0.113	0.25	
3	Bend of camshaft	Repair limit: 0.03 (total indicator reading)						Replace
4	Cam height	Standard dimension		Tolerance		Repair limit		
		Intake	41.81	±0.10		41.3		
		Exhaust	42.40			41.8		
5	Valve timing	Valve position	Crank angle		At check (Crank angle when valve lowers 1 mm.)			Bend or wear of valve, camshaft, and push rod Check and repair, or replace
					Standard value		Tolerance	
		Intake open	Before top dead center	9 degrees	After top dead center	8 degrees	±3 degrees	
		Intake closed	After bottom dead center	20 degrees	After bottom dead center	3 degrees		
		Exhaust open	Before bottom dead center	52 degrees	Before bottom dead center	36 degrees		
		Exhaust closed	After top dead center	13 degrees	Before top dead center	12 degrees		

Valve system *(ENG95-A700-034-K-00-A)*



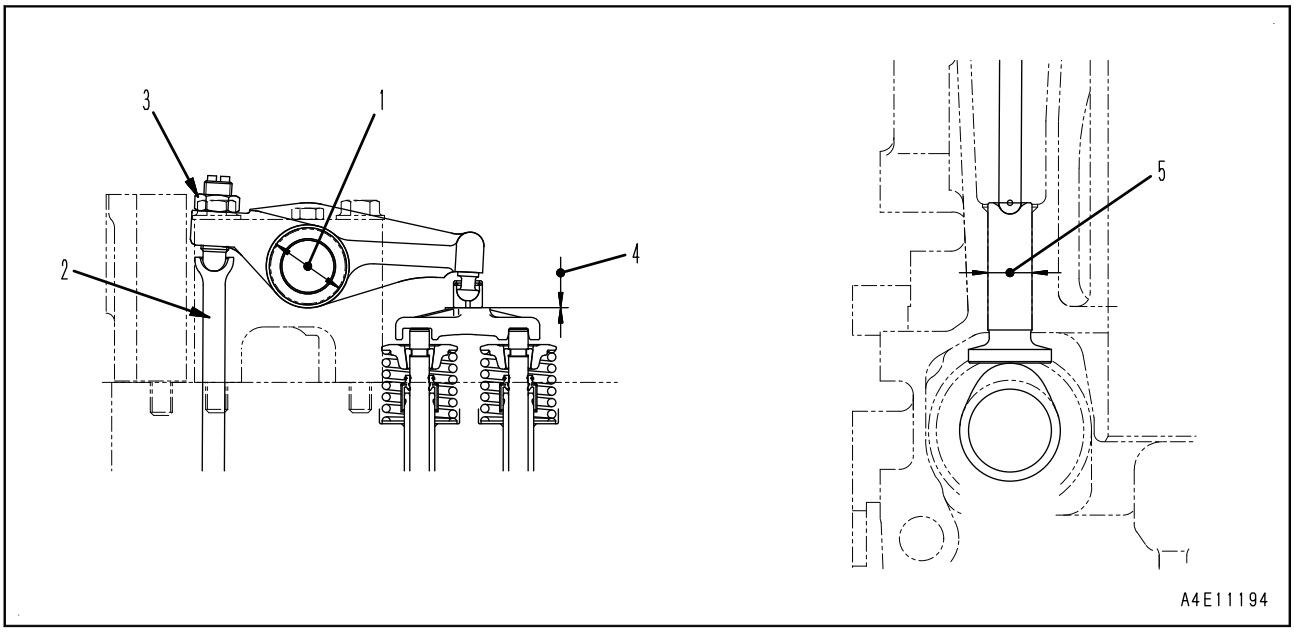
Valve and valve guide *(ENG95-A700-034-K-01-A)*



Unit: mm

No.	Item	Criteria						Remedy
1	Sinking of valve		Tolerance			Repair limit		Replace valve or valve seat
		Intake	1.0 ± 0.18			+2.0		
		Exhaust	1.0 ± 0.18			+2.0		
2	Valve lip thickness	Intake	1.1					Replace
		Exhaust	1.3					
3	Valve seat angle	Standard	Tolerance			Repair limit		Repair or replace valve or valve seat
		45 degrees	±15 minutes			Judge contact condition by vacuum test		
4	Clearance between valve guide and valve stem	Standard dimension		Tolerance		Standard clearance	Allowable clearance	Replace either or both of valve and valve guide
				Shaft	Hole			
		In-take	7	-0.030 -0.045	+0.025 +0.010	0.040 to 0.070	0.20	
		Ex-haust	7	-0.045 -0.060	+0.025 +0.010	0.055 to 0.085	0.20	
5	Free length of valve spring	Part No. (identification)		Standard dimension		Repair limit		Replace
		6275-41-4410 (blue)		49.7		49		
	Load at installed length of valve spring	Part No. (identification)		Installed length	Standard load at installed length N {kg}		Allowable load at installed length N {kg}	
		6275-41-4410 (blue)		34.0	173.3 ± 8.7 {17.7 ± 0.9}		152 {15.5}	
	Squareness of valve spring	Repair limit: 2 degrees						
6	Driving height of valve guide	Standard dimension			Tolerance			Repair
		9			±0.2			

Rocker arm shaft, push rod, and tappet *(ENG95-A770-034-K-00-A)*



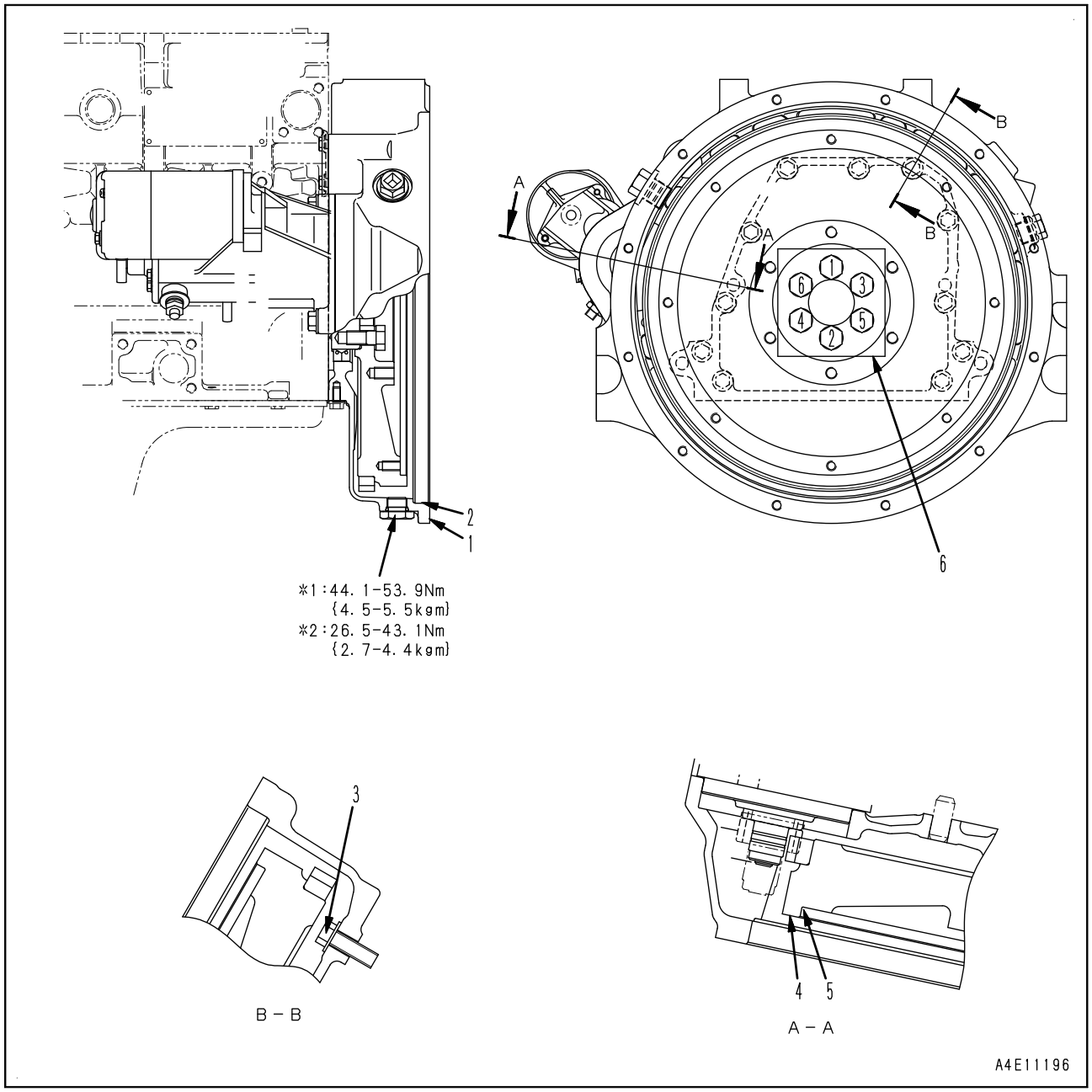
Unit: mm

No.	Item	Criteria			Remedy
1	Outside diameter of rocker arm shaft	Standard dimension	Tolerance		Replace rocker arm shaft
		19	0 -0.020		
	Inside diameter of rocker arm shaft hole	19	+0.030 +0.010		Replace rocker arm
	Clearance between rocker arm shaft and rocker arm	Standard clearance	Allowable clearance		Replace rocker arm or shaft
		0.010 to 0.050	0.12		
	Bend of rocker arm shaft	Repair limit: 0.20 (total indicator reading)			
2	Bend of push rod	Repair limit: 0.30 (total indicator reading)			Replace push rod
3	Tightening torque of rocker arm nut	Target (Nm {kgm})	Range (Nm {kgm})		Tighten
		44 {4.5}	39 to 49 {4 to 5}		
4	Valve clearance (both in warm and cold states)	Valve	Standard	Tolerance	Adjust
		Intake	0.35	±0.02	
		Exhaust	0.50	±0.02	
5	Outside diameter of tappet	Standard dimension	Tolerance		Replace tappet
		16	-0.010 -0.028		
	Inside diameter of tappet hole	16	+0.020 +0.002		Replace cylinder block.
	Clearance between tappet and tappet hole	Standard clearance	Allowable clearance		Replace tappet or cylinder block
		0.012 to 0.048	0.12		

Flywheel and flywheel housing *(ENG95-A560-034-K-00-A)*

Without rear PTO

★ The shape is subject to machine models.



★ 6: The Nos. shown in the illustration indicate the tightening order of the bolts.

*1: Plug

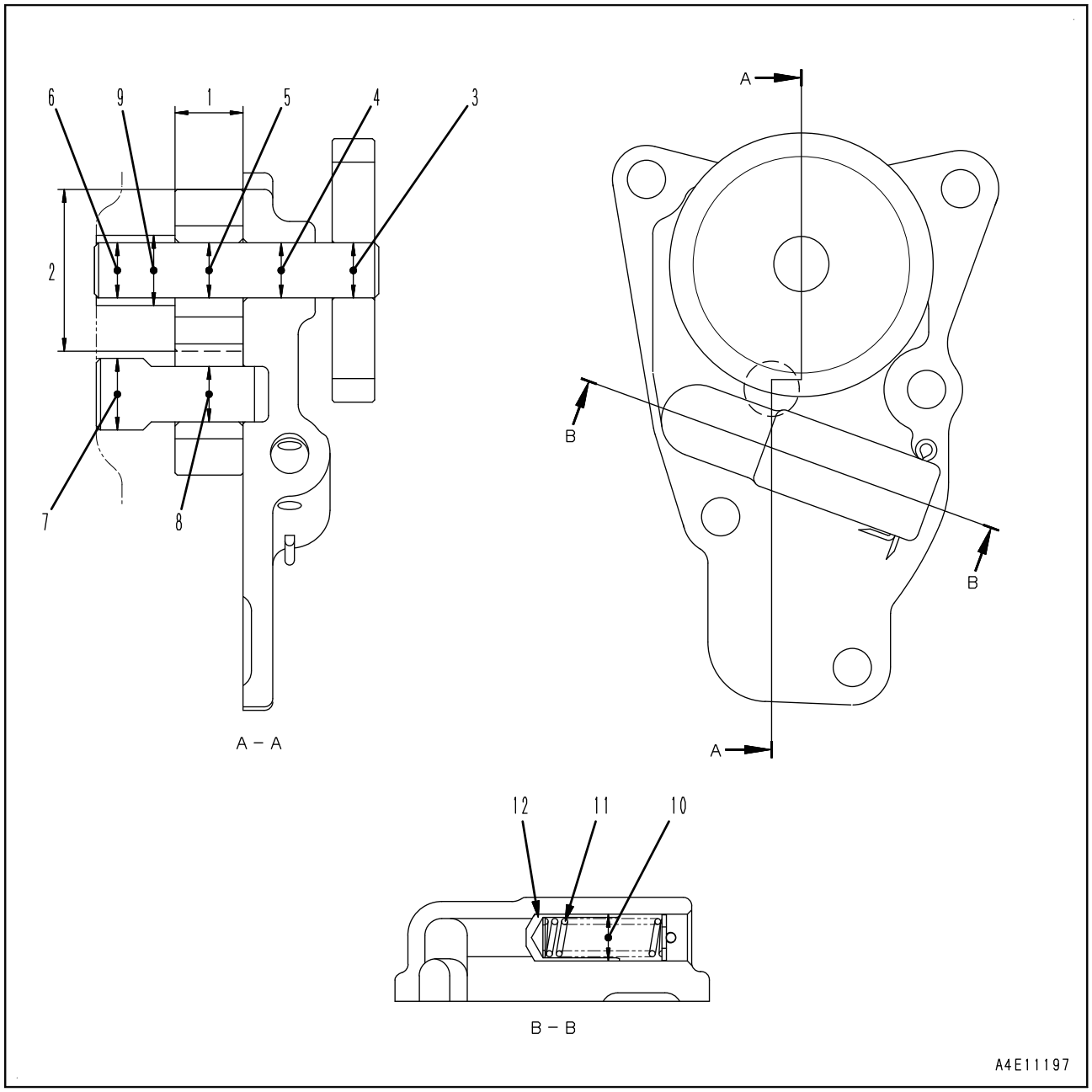
*2: Plug (taper)

Unit: mm

No.	Item	Criteria			Remedy
1	Facial runout of flywheel housing	Repair limit: 0.30			Reassemble or repair
2	Radial runout of flywheel housing	Repair limit: 0.30			
3	Tightening torque of flywheel housing mounting bolt	Target (Nm {kgm})	Range (Nm {kgm})		Tighten
		66.2 {6.75}	58.8 to 73.5 {6.0 to 7.5}		
4	Facial runout of flywheel	Repair limit: 0.35			Reassemble or repair
5	Radial runout of flywheel	Repair limit: 0.30			
6	Tightening torque of flywheel mounting bolt (Apply engine oil to threaded portion of bolt.)	Procedure	Target (Nm {kgm})	Range (Nm {kgm})	Tighten
		1st time	88.3 {9.0}	58.8 to 118 {6.0 to 12.0}	
		2nd time	191 {19.5}	186 to 196 {19 to 20}	

Lubrication system *(ENG107-AB00-001-K-00-A)*

Oil pump *(ENG95-AB50-034-K-00-A)*

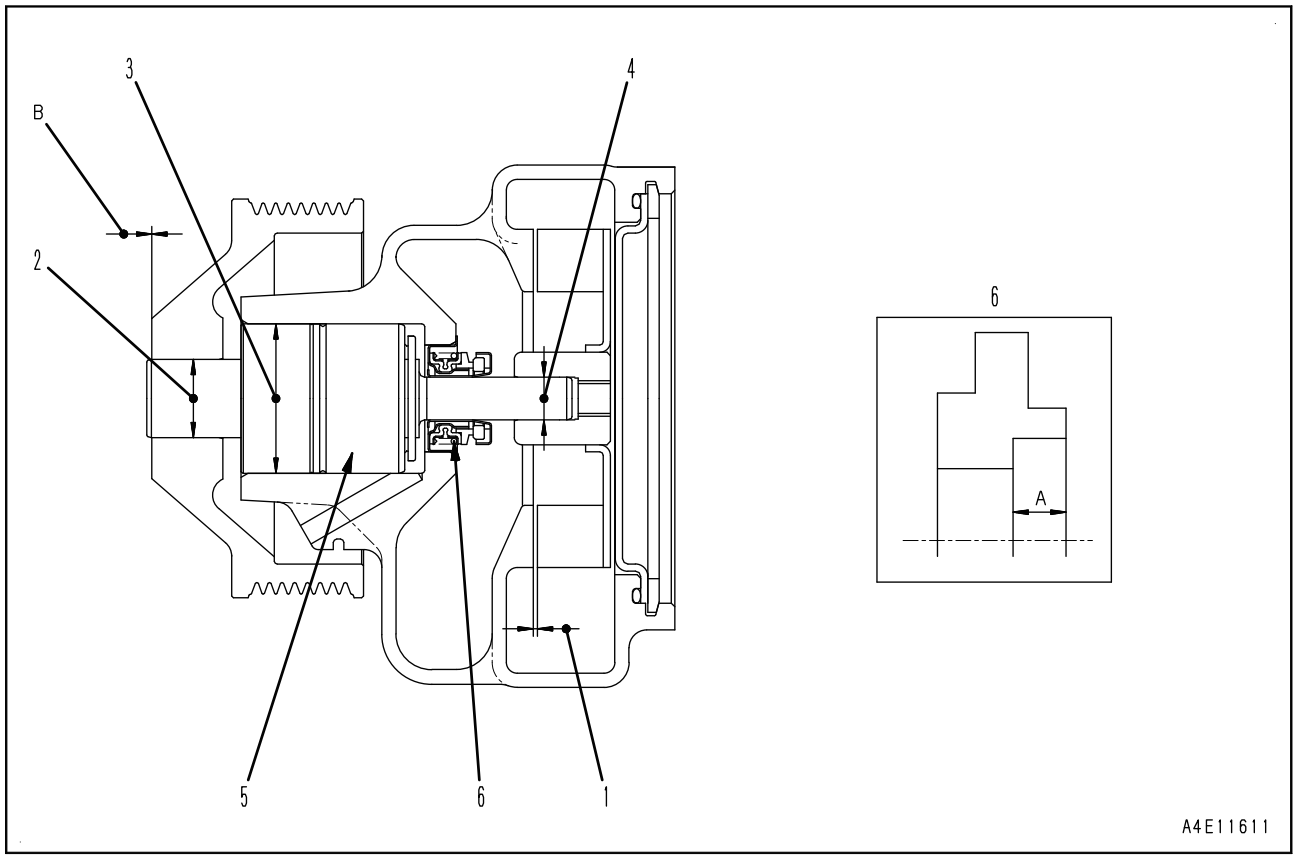


Unit: mm

No.	Item	Criteria					Remedy
1	Pump gear clearance in axial direction	Standard dimension	Tolerance: Gear width	Tolerance: Body width	Standard clearance (end play)	Allowable clearance (end play)	Replace gear
		21	0 -0.016	+0.070 +0.030	0.030 to 0.086	0.10	
2	Pump gear clearance in radial direction	Standard dimension	Tolerance: Outside diameter of gear	Tolerance: Outside diameter of body	Standard clearance	Allowable clearance	
		38	+0.115 +0.065	+0.245 +0.205	0.045 to 0.090	0.13	
3	Interference between pump drive gear and drive shaft	Standard dimension	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Allowable clearance	Replace
		13	-0.024 -0.042	-0.067 -0.085	0.025 to 0.061	—	
4	Clearance between drive shaft and cover	13	-0.024 -0.042	+0.018 0	0.024 to 0.060	—	Replace bushing
5	Interference between pump gear and drive shaft	13	-0.024 -0.042	-0.067 -0.085	0.025 to 0.061	—	Replace
6	Clearance between drive shaft and bushing	13	-0.024 -0.042	+0.048 +0.004	0.028 to 0.090	—	Replace bushing
7	Interference between driven shaft and cylinder block	16	+0.064 +0.046	+0.018 0	0.028 to 0.064	—	Replace cylinder block.
8	Clearance between driven shaft and gear	13	-0.109 -0.127	-0.067 -0.085	0.024 to 0.060	—	Replace shaft or gear
9	Inside diameter of cylinder block for drive shaft bushing	16	+0.087 +0.060	+0.018 0	0.042 to 0.087	—	Replace cylinder block.
10	Clearance between valve and body	Standard dimension	Tolerance: Shaft	Tolerance: Hole	Standard clearance		Replace
		11	-0.050 -0.077	+0.020 -0.020	0.030 to 0.097		
11	Regulator valve spring	Standard dimension: Free length	Standard dimension: Installed length	Standard dimension: Load at installed length	Repair limit: Test length	Repair limit: Test load	Replace
		30.4	27.8	19.7 N {2.0 kg}	23.0	55.9 N {5.7 kg}	
12	Operating pressure of regulator valve	Standard: 0.6 ± 0.05 MPa {6 ± 0.5 kg/cm^2}					Repair or replace spring

Cooling system *(ENG107-B110-001-K-00-A)*

Water pump *(ENG95-B400-034-K-00-A)*



Unit: mm

No.	Item	Criteria				Remedy
1	Clearance in impeller body	Standard clearance: 0.3 to 2.0				Replace
2	Interference between shaft and fan pulley boss	Standard dimension	Tolerance		Standard interference	
			Shaft	Hole		
		22	0 -0.013	-0.066 -0.082	0.053 to 0.082	
3	Interference between shaft and body	42	0 -0.013	-0.025 -0.046	0.012 to 0.046	
4	Interference between shaft and impeller	12	0 -0.013	-0.035 -0.062	0.022 to 0.062	
5	Bend of shaft	Repair limit: Facial runout at face (B) is 0.1				
6	Wear of seal ring of water seal	Repair limit: Dimension (A) is 0				

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