# SHOP MANUAL

# KOMATSU-CUMMINS

# N-855 SERIES

# DIESEL ENGINE

| ENGINE MODEL | APPLICABLE MACHINE |
|---|---|
| N-855-C | PC300-1 |
| | PC300-2 |
| | PC300LC-1 |
| | PC300LC-2 |
| NT-855-C | D80A,E-18 |
| | D85A,E,P-18 |
| | D80F-18 |
| | D95S-2 |
| | PC400-1 |
| | PC400LC-1 |
| | W170-2 |
| | W180-1 |
| NTA-855-C | HD320-2 |
| | HD320-3 |
| | WS16S-2 |
| | WS23-1 |

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## ⚠ IMPORTANT SAFETY NOTICE

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

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

# ⚠ SAFETY

### GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

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

### PREPARATIONS FOR WORK

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

## PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (—) terminal first.
14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
    Replace any damaged 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 operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

# FOREWORD

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

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

**STRUCTURE AND FUNCTION**

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

**TESTING AND ADJUSTING**

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

**DISASSEMBLY AND ASSEMBLY**

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

**MAINTENANCE STANDARD**

This section gives the judgement standards when inspecting disassembled parts.

## NOTICE

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

# HOW TO READ THE SHOP MANUAL

## VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

**Chassis volume:** Issued for every machine model
**Engine volume:** Issued for each engine series
**Electrical volume** :
**Attachments volume** : } Each issued as one volume to cover all models

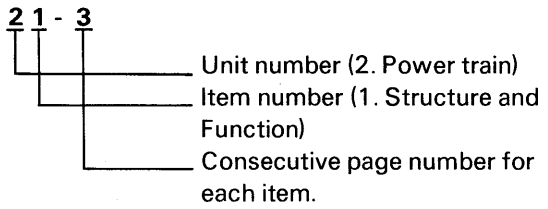
These various volumes are designed to avoid duplicating the same information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes are ready.

## DISTRIBUTION AND UPDATING

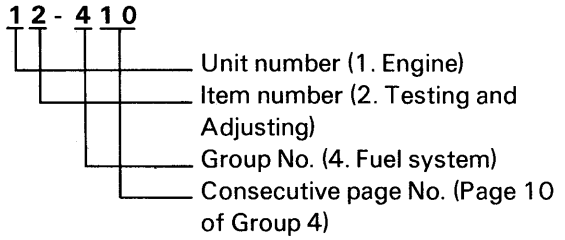
Any additions, amendments or other changes will be sent to KOMATSU distributers. Get the most up-to-date information before you start any work.

## FILING METHOD

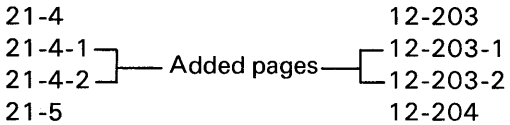
1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
   Example 1 (Chassis volume):




   Example 2 (Engine volume):




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




## REVISED EDITION MARK (①②③····)

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

## REVISIONS

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

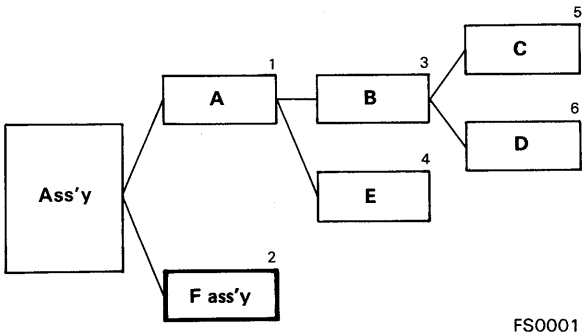
## SYMBOLS

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

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

## NETWORK (Disassembly and assembly relationship drawings)

In the shop manual the following network drawings show relationship between work items and sequence for assembly and disassembly.




FS0001

In this network the sequence of disassembly is marked on the top right of each work item so that handling can be easily understood. For example, when taking **D** of the Ass'y follow the sequence **A** → **B**→ **D**, when removing **E** follow the sequence **A** →**E**.

**F ass'y** indicates a further separate disassembly, and indicates the existence of a previous work network. For assembly the sequence is shown using the same kind of network.

## TROUBLESHOOTING CHART

As shown below, the symptoms relating to a particular trouble are described in the line designated "Problems". The probable cause of the trouble is then marked under the "Causes" column.

Example:
Symptom: Reduced tractive power or slow travel speed.

| Problems | Causes: Oil leaks in torque converter | Air suction in the hydraulic pump | |
|---|---|---|---|
| Torque converter oil pressure gauge shows lower than normal pressure. (normal 3 — 4.8 kg/cm²) | ○ | ○ | ○ |
| Transmission oil pressure gauge shows lower than normal pressure. (normal 20 — 23 kg/cm²) | | ○ | |
| | ○ | | |

## MAINTENANCE STANDARD

### Standard size, Tolerance

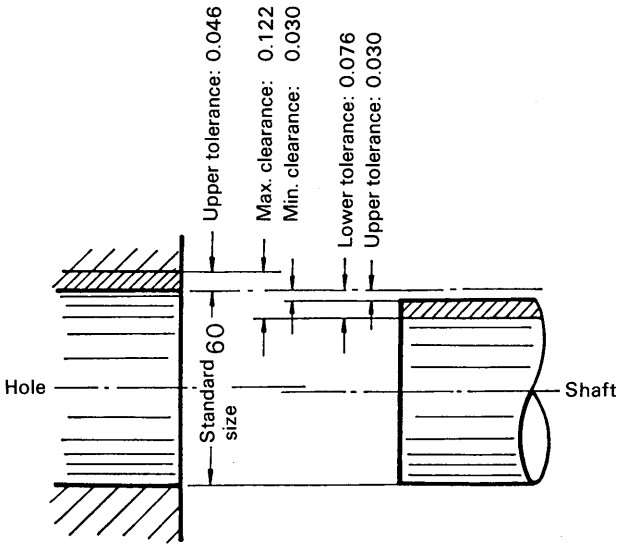
The dimensions of finished parts each differ a little. Therefore, when determining the finished dimensions of parts, a dimension that will be standard is determined provisionally, then the difference allowed from it is indicated. The former is called the standard size, and the latter the tolerance.

The way to show this is by a plus or a minus sign with the tolerance in smaller numerals to the right of the standard size.

Example: $120^{-0.026}_{-0.126}$
(It equals 119.874 — 119.978 mm)

Moreover, when expressing the dimensions of a hole and the shaft that goes inside it, for the sake of convenience, the standard size for the hole and the shaft are usually taken as the same, and the tolerances changed to indicate the tightness of the fit. For example, the fit of a revolving shaft is indicated as follows, and is shown in the drawing.

Hole: $60^{+0.046}_{0}$ Shaft: $60^{-0.030}_{-0.076}$




FS0002

### Standard size

This is the standard value at the time of design.

### Repair limit

This is the limit in dimensions which the part can be used. When parts exceed the repair limit, they must be repaired or replaced as specified.

Example:

Unit: mm

| No. | Check item | Criteria | | Remedy |
|---|---|---|---|---|
| | | Standard size | Repair limit | |
| | | | | |

### Standard clearance

This is the clearance between new parts after assembly. It is recorded as a range between minimum clearance and maximum clearance. The clearance is adjusted to this value.

### Clearance limit

This is the maximum clearance allowed.

When the clearance exceeds the clearance limit, the parts must be repaired or replaced as specified.

Example:

Unit: mm

| No. | Check item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| | | Standard size | Tolerance | | Standard clearance | Clearance limit | |
| | | | Shaft | Hole | | | |
| | | | | | | | |

# PRECAUTIONS FOR DISASSEMBLY AND ASSEMBLY

## 1. PREPARATIONS BEFORE DISASSEMBLY

**1. Washing before taking a machine into the repair shop**

Thoroughly wash the machine to remove sand, mud and dust before taking it into the shop. Taking a dirty machine into the shop will decrease work efficiency, cause damage to parts, and increase the intrusion of dust and dirt into the machine when it is reassembled.

**2. Checking the machine before disassembly**

Before disassembly, study the entire disassembly procedure from beginning to end in the reference materials, and carefully check and record the items listed below. This will help to save unnecessary disassembly and parts costs. It will also give clues on how to prevent recurrence of the trouble.

- Machine model, serial number and service meter reading.
- Reason for disassembly. (Symptoms, locations, and cause of trouble)
- Any dirty air cleaner elements or air leakage.
- Properties of fuel used, clogging of fuel filter elements, water mixed in fuel, and leaky or constricted fuel pipes.
- Oil capacities, dirtiness of oils (viscosity, color, and any impurities), water mixed in oil, oil leakage, and any clogging of oil filter elements.
- Tension of the V-belt and tracks.
- Any damaged parts or loose bolts.

**3. Preparation for disassembly**

Prepare the required facilities, tools, and space for the disassembly work and rack space for storing the disassembled parts. Make sure that they are all clean.

## 2. PRECAUTIONS FOR DISASSEMBLY AND REASSEMBLY

**1. During disassembly**

1) If the disassembly involves draining oil or lubricants, have containers of suitable capacity on hand. Do not spill any oil or lubricants on the floor.
2) Mark the parts clearly to prevent confusion at the time of reassembly.
3) For disassembly of certain designated parts, use only the special tool prescribed for that purpose.
4) When, after removal of fastening nuts and bolts, a part still can not be removed, never force it. Instead, investigate and correct the cause.
5) Maintain disassembled parts in good order for storage, paying special care not to confuse parts that appear similar. Tag them or mark with ink if necessary.
6) Store standard parts such as bolts and nuts with reference to where they are to be used and in a manner that will prevent loss.

**2. During reassembly**

1) Thoroughly clean and examine all parts before reassembly. Repair any scratched or dented surfaces.
   ★ Foreign matter is especially damaging to sliding surfaces, and will greatly decrease their service life.
2) Clean new parts to remove any rust preventative coating.
   **Solvent:** Light oil or trichloroethane
3) Carefully align any match marks provided.
4) Use a press or press-fitting tool to assemble bearings, bushings and oil seals.

**3. Checks and inspections during disassembly/reassembly**

1) During disassembly, watch carefully for evidence of seizing, interference, or improper contact of sliding parts.
2) Measure and record end clearances, gear backlashes, protrusions, and the like during the disassembly/reassembly. Quite often they cannot be measured afterwards.

## 3. DETERGENTS

### 1. Precautions for cleaning

1) Thoroughly clean disassembled parts and group them by unit for storage. Be especially sure to remove sludge from oil holes and pipes.
2) Never use dirty solvents to clean important parts.
3) Take extreme care with special chemical agents. Observe the manufacturer's handling instructions and take measures to prevent the agent from coming into contact with your skin or eyes.

### 2. Selection of detergents

| Parts | Detergents |
|---|---|
| Ordinary parts | Kerosene, light oil, or trichloroethane |
| Finely machined parts (Bearings etc.) | Clean kerosene or neutral dehydrated light oil |
| Large castings (Cylinder head, cylinder block etc.) | Alkaline detergent, PH10 — 12. (Immerse in 50 — 70°C detergent for 5 — 10 minutes. Then rinse thoroughly with water.) |

### 3. Detergents for washing rubber parts (O-rings, oil seals etc.)

| Rubber / Color / Detergents | Nitrile rubber | Ester rubber | Silicon rubber | Fluorine rubber |
|---|---|---|---|---|
| Trichloroethane | ○ | ○ | ○ | ○ |
| Trichloroethylene | ○ | X | X | ○ |
| Gasoline | X | X | X | ○ |
| Thinner | X | X | X | X |
| Light oil | ○ | ○ | X | ○ |
| Steam | ○ | X | ○ | ○ |

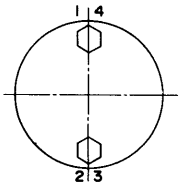
○: Immersion allowed for a short time only
X: Detergent detrimental to rubber

## 4. NUTS AND BOLTS

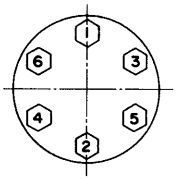
Unless otherwise specified in the DISASSEMBLY AND ASSEMBLY, tighten all bolts to a torque of page 00-29.

1) Use bolts having the exact length required for the parts they are to join.
   If too long, the bolt presses against the bottom of the tapped hole; this pressure makes proper tightening impossible. If too short, the bolt lacks the number of threads necessary to hold the parts together.
2) Tighten each nut and bolt to the specified torque.
3) Tighten bolts evenly and in order.

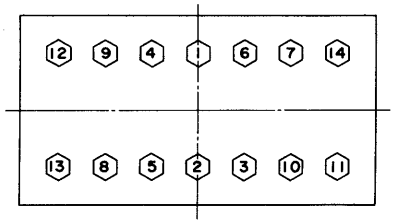
Tighten mutually opposing bolts alternately.




Tighten in turn on opposite sides.




Tighten from the center outwards and on alternate sides.



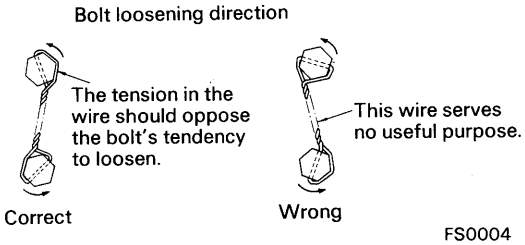

FS0003

4) The Template Method is prescribed for tightening bolts on certain specific parts of the engine.
   The Template Method obtains good fittings of bolts with their seats and of bearings with their races to ensure uniform overall tightening. The bolts are tightened in stages, then loosened, and then tightened once more.

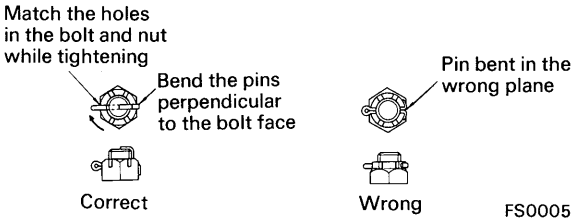
## 5. HANDLING LOCKING DEVICES

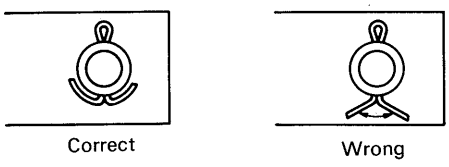
Nuts and bolts which cannot be checked visually from the outside or which are located in vital areas must be firmly locked into position with wires, cotter pins, and lock washers. Never reuse these locking devices.

### 1. Lock wire

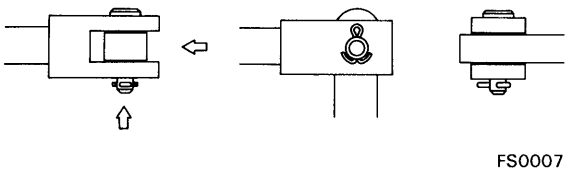



### 2. Cotter pin

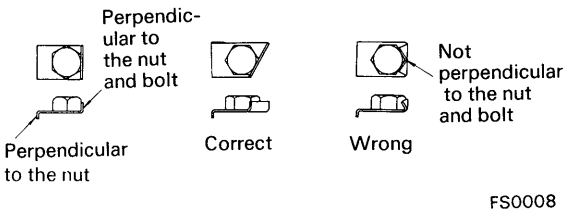



- Bend the head and ends of the cotter pin upwards as far as possible.




### 3. Lock washer




### 4. Thread tightener

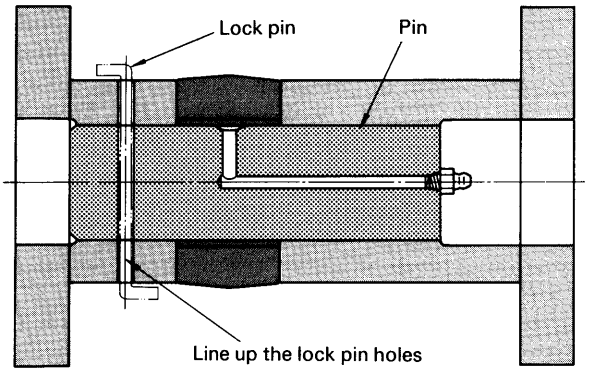
1) Wash and degrease the bolt and bolt hole with trichloroethylene and dry. Coat the bolt threads with two or three drops of thread tightener and tighten the bolts.
2) After an hour had passed, the bolt cannot be loosened or tightened any further.
   If retightening becomes necessary, the bolt must be completely removed, the old thread tightener removed, and a new coat applied.

## 6. PRECAUTIONS FOR PRESS-FITTING

- Coat the surfaces of the parts to be press-fitted with anti-friction grease (molybdenum disulfide) — unless they are tapered.
- For taper spline-to-serration fittings
  1) Check that the splines and serrations are free from dust, burr, dents and indentations.
  2) Insert and align the splines and serrations by hand before press-fitting the shaft into the hole.
  3) If the spline-serration assembly is loose, disassemble and examine for wear. Replace worn parts with new ones.

## 7. PRECAUTIONS FOR ASSEMBLING THE PIN AND SHAFT

Before reassembling the pin and shaft, check the positions of the locking device and fastening device on the other side. This is especially important when the shaft is retracted from the inside of the hole as illustrated in the accompanying diagram. To ensure proper reassembly, make sure that the lock pin holes coincide.

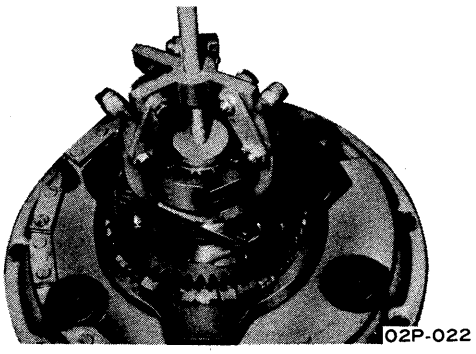



FS0009

## 8. SERVICE TOOLS

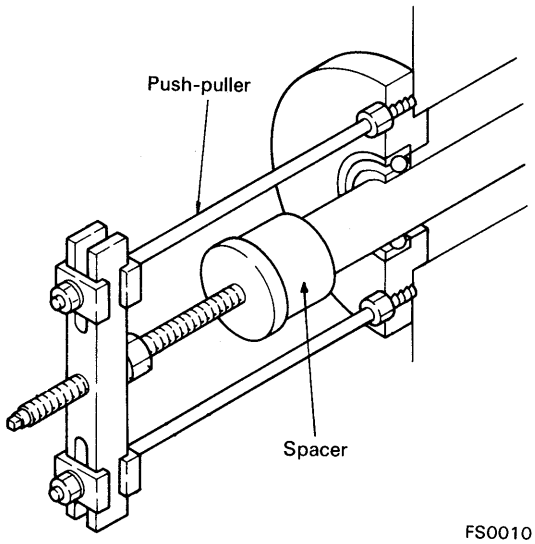
**1. Gear puller**

Fit the gear puller over the gear or bearing and tighten the bolt on the gear puller to remove the part from the shaft.




**2. Push-puller**

When the screw of the push-puller does not reach the surface of the part to be pushed, insert a spacer. It is also a good idea to insert a plate to prevent the head of the screw from damaging the part.



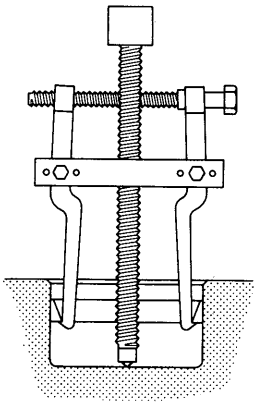

FS0010

**3. Bearing coupler**

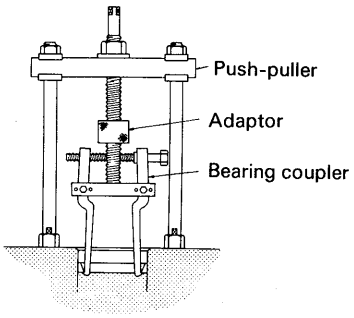
This can be used two ways:

1) When the bottom of the hole is strong enough to withstand the applied force.

2) When the bottom of the hole is not strong enough to withstand the applied force.

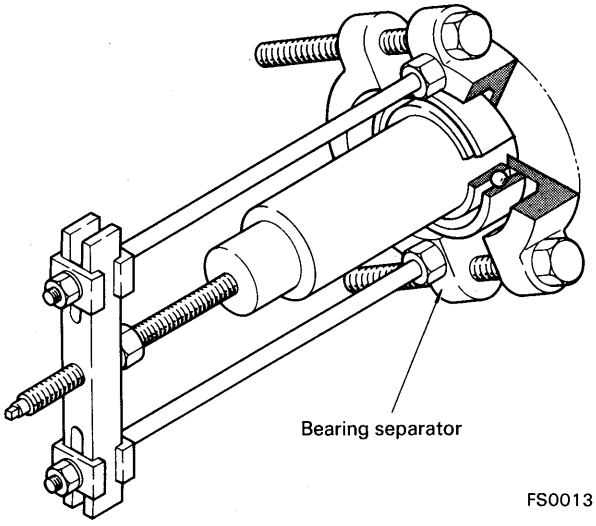


FS0011

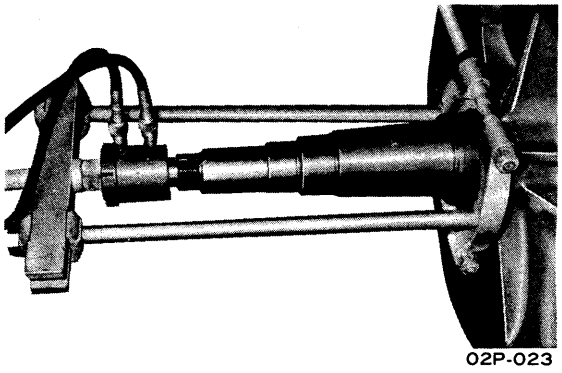



FS0012

**4. Bearing separator**



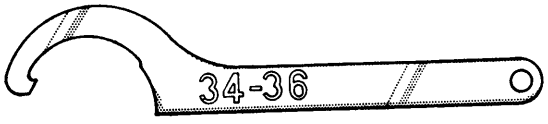

FS0013



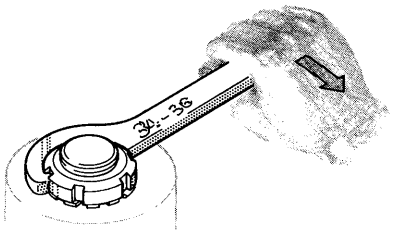
02P-023

**5. Hook wrench**

A hook wrench has a claw which hooks into the turning sockets of round nuts. The wrench size is defined by the outer diameter of the round nut turned. The accompanying figure shows a hook wrench designed for use with round nuts of two different sizes.

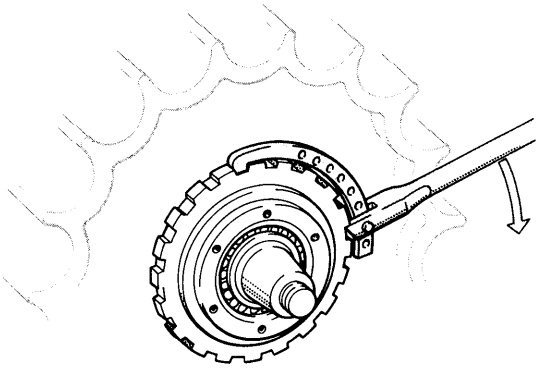



FS0014




FS0015

Removal and Installation of the Sprocket Wheel



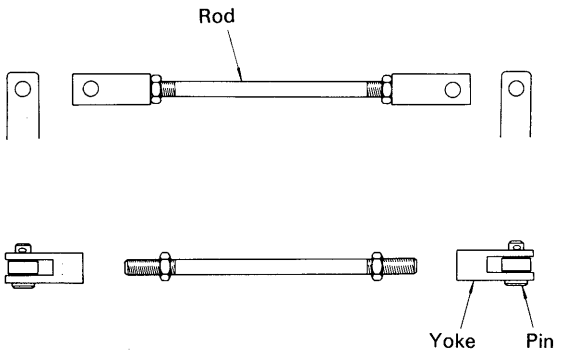
FS0016

## 9. CLEARANCE ADJUSTMENTS

Store each set of shims or washers so that they can be installed in their original condition at the time of reassembly.

## 10. LINK RODS

1) If it is necessary to change the length of the link rod in order to remove it, first record the original length so that the rod can be easily reassembled in its original condition.
2) Remove the link rod at the pins.



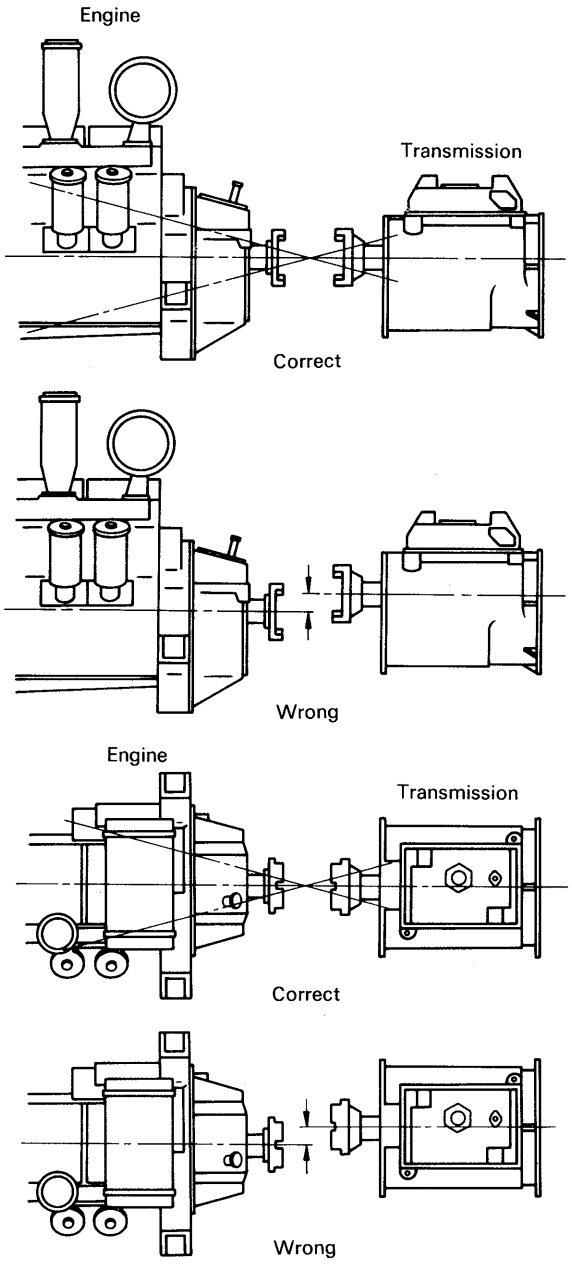

FS0017

## 11. SHIMS AND WASHERS

1) Shims are used to center the engine and adjust the action of the bevel gears. Handle very carefully as they get deformed easily.
2) Record the numbers and positions to speed adjustment after reinstallation.
3) Do not reuse any shims or washers that are deteriorated, damaged, bent or deformed.
4) Insert thin shims between thicker ones.

## 12. CENTERING

Centering is very important for interfaces in the power train — for example, between the engine and the transmission and between the bevel gear shaft and the final drives. Incorrect centering only increases the stresses acting on the turning parts, so always make sure that the deviation is within the specified limits.




FS0018

# MEASURING INSTRUCTIONS

## PREPARATIONS BEFORE CHECKING

1. **Cleaning of parts**
   Wash parts to be checked. Special care should be paid to thoroughly remove dust and dirt from the surfaces on which measurements are to be made so that possible errors can be eliminated.

2. **Minor repair of part surfaces**
   Remove scratches, dents and rust from parts to be checked. If the surface are rough, the measurements will be inaccurate. When smoothing any surface, be careful not to use an oilstone or sand paper coarser than the finished surface.

3. **Preparation of measuring tools**
   Clean the tools and thoroughly remove dust and dirt from the surfaces which contact parts. Check the tools for proper function and zero-point adjustment. Remedy any abnormality.

4. **Maintenance of measuring tools**
   Handle all tools with sufficient care and do not subject them to unreasonable force or shocks which can affect their delicate construction. Periodically check the tools for accuracy and, if necessary, calibrate them. Put the tools back into their cases and return them to their fixed storage locations whenever not in use. It is recommended to assign a person to be responsible for the proper storage of measuring tools.

## MEASURING TOOLS

- Repeat each measurement two or three times to eliminate possible errors. Further repetition will be necessary, if there is a large variation in the readings.
- When measuring the inside or outside diameter of a cylindrical object, take two readings with the measuring device put in two directions at right angles to each other. Repeat this at several points along the overall length of the object.
- Along eye-measurement below the unit of a scale may be used for making a comparison between two approximately equal measurements, the accuracy of such eye-measurements should not be considered as reliable.
- At the start of each measurement, select a measuring device having an accuracy appropriate for judging whether the measurement reaches its allowable limit.

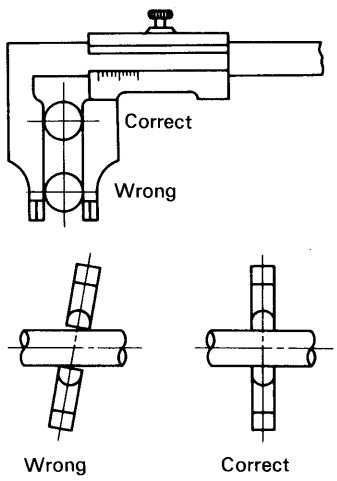
## BLOCK GAUGES

- To bring two blocks into contact, wash each block with benzene to remove rust-preventing oil and wipe with a clean cotton cloth. Put one block on the other, causing a sliding or twisting movement between the two.
- If the contact between two blocks feels rough, apply a fine-grade oilstone to the blocks along their edges. (Do not try to rub the contact surface of the blocks.)
- Do not leave the blocks in contact for a long time. Long-time contact will make the blocks difficult to separate or cause black rust to appear on the contact surfaces.
- When separating two blocks, slide or twist them. Do not try to pull them apart, by force or strike them with a mallet.
- When storing a block gauge, wipe off moisture, dirt and fingerprints, coat with a rust-preventing lubricant such as vaseline, and put the gauge back in its case.

## VERNIER CALIPERS

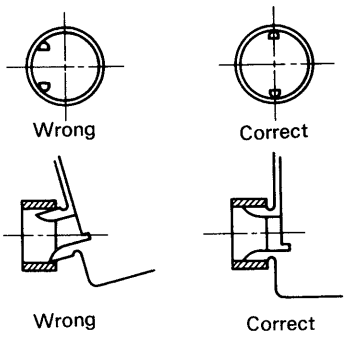
- At the start of measurement, close the jaws and check that there is no clearance (due to wear) between the jaws and that the "zero" point of the graduation is in exact alignment with the "zero" point of the vernier scale.

- **Measuring an outer diameter**



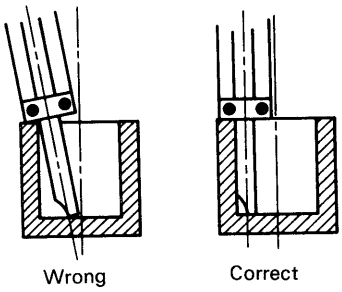

FS0019

- **Measuring an inner diameter**




FS0020

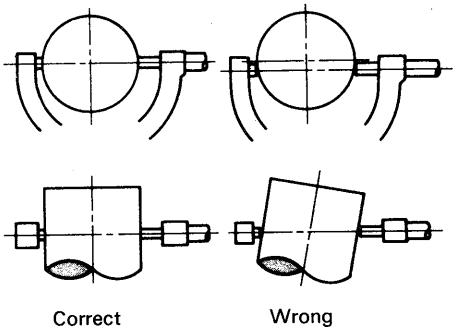
- **Measuring a depth**




FS0021

## MICROMETERS

- Put the anvil onto an object at a right angle and turn in the spindle until it comes into contact with the object. Rotate the ratchet stop until there are two or three idle rotations, then read the measurement.
- When reading a measurement, keep your eyes at a right angle to the graduation on the sleeve.
- To turn back the spindle, rotate the thimble with your fingers.



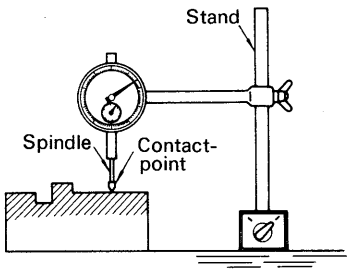

FS0022

- When storing a micrometer, leave a slight clearance between the anvil and the spindle.

## DIAL GAUGES

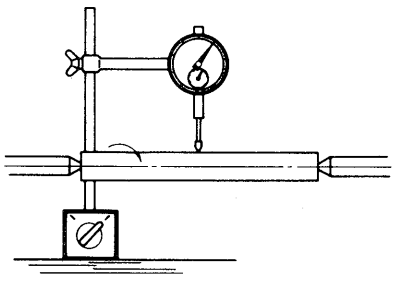
- Carefully put the gauge contact-point on a surface to be measured to protect the delicate gauge against shock.
- Set the zero-point of the gauge with care to keep the movement of the contact-point within its stroke during measurement.
- Careless setting of the zero-point may cause the spindle to retract or extend to its limit, thus making measurement impossible.
- The measurements of the dial gauge are accompanied by relatively large errors because minute variations of the contact-point (and accompanying errors) are indicated by the dial pointer through an expanding mechanism using gears. The reliability of eye measurements can not be assured below the minimum unit on the scale.

- **Measuring protrusions, depressions or steps**
  Set the zero-point so that vertical movement of the probe does not exceed its stroke limits, and slide the base of the gauge on a flat surface.




FS0023

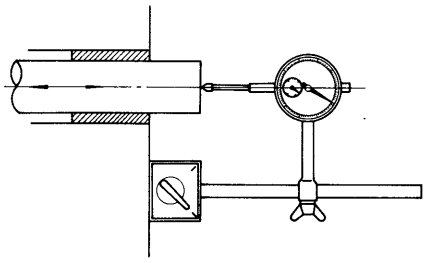
- **Measuring bending**



FS0024

Read the Total Indicator Reading (T.I.R.) while moving the object back and forth or vertically. Turn the object one complete rotation and read the difference between the maximum and minimum indications of the gauge pointer.

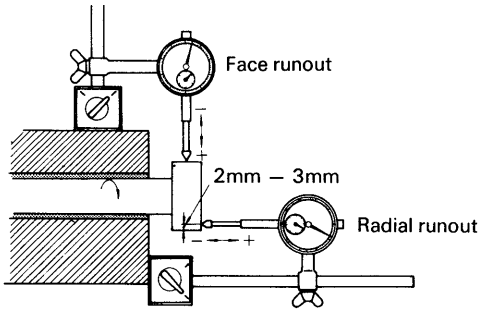
- **Measuring end play, looseness or deviation**



FS0025

Read the T.I.R. while moving the object back and forth or vertically.

- **Measuring face runout or radial runout**



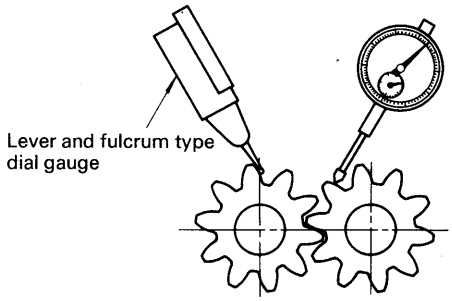

FS0026

1) Read runout at six or more positions during one complete rotation of the object.
2) At the start of each measurement, set the zero-point at the middle of the assumable range of the spindle movement. Be careful not to confuse positive and negative readings of runout.

| | Face runout | Radial runout |
|---|---|---|
| When the pointer is to the right of "0" | + | – |
| When the pointer is to the left of "0" | – | + |

3) When measuring face runout, place the contact-point on the object along a circle 2 or 3 mm smaller in diameter than the outside diameter of the object.

- **Measuring gear backlash**

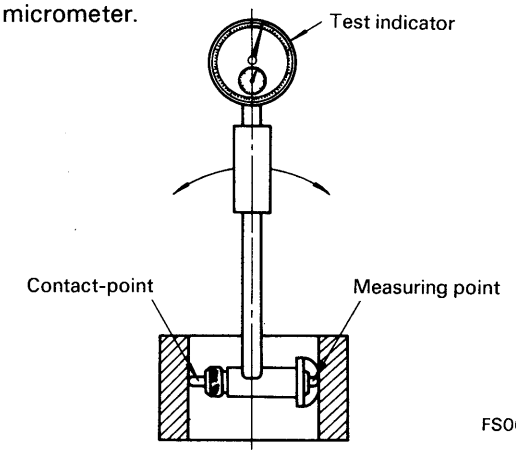



FS0027

1) Fully mesh one of two gears and place the dial gauge contact-point on a tooth of the other gear. Swing the free gear within the limits of its play in the rotational directions, and read the T.I.R.
2) Use of the lever and fulcrum type dial gauge is recommended for this purpose as the contact-point placed on the gear is moved tangentially to the gear pitch circle.
3) The lever and fulcrum type dial gauge is suitable for use in a narrow space or for a special measurement which requires placing the contact-point on an object at an angle to the spindle of the gauge.
   Since the contact-point of this type of gauge has a very narrow measuring range (usually 3 mm or less), the contact-point should be carefully checked for contact with the object during measurement.

## CYLINDER GAUGES

- Install a contact-point having a length approximately equal to the cylinder bore to the measured on the cylinder gauge. Set the zero-point of the test indicator to the bore diameter of the standard cylinder measured with a reference ring gauge or a micrometer.




FS0028

- Insert the gauge into the bore to be measured and read the minimum indication of the test indicator while giving swings to the gauge about the tip of the detachable rod used as the fulcrum.
- When the minimum reading is obtained on the right side of the zero point of the test indicator, and the reading to the standard value to which the zero point is set.
  When the minimum reading is obtained on the left side of the zero point, subtract the reading from the standard value.

# PARTS CHECKING INSTRUCTIONS

- Check disassembled parts to see if they are reusable or need repair. If the part failed due to an external source, determine the cause and correct before assembly.

## 1. GENERAL PRECAUTIONS

- Visually inspect parts for cracks, pitting, corrosion, scoring, ridging etc. To ensure proper inspection, every part should be clean before inspection.
- If the cause of the defect can be found, it will be a great help to analyze the part condition; whether the defect will progress or not, and the possibility of future trouble.
  Knowing the cause of the defect, the service man can give good advice to the customer to prevent him from having the same trouble again.
- Visual inspection can not find minute or hidden damage. Other methods of inspection are as follows;
  a) Water-pressure or air-pressure test
  b) Color check or magnetic damage test

## 2. CRACKS

- If the part is found to be cracked by visual inspection, it should be replaced or repaired.
- If the length or depth of crack exceeds 1/3 of the thickness of the part, it should be replaced instead of repaired.
- A part having an internal crack should be replaced.

## 3. PITTING

**1) Pitting by cavitation**

In most cases, cavitation is accompanied by chemical corrosion. After removing rust or scale, carefully inspect the depth of pitting.

- When the pitting can not be repaired within the allowable limit, replace the part.
- If pitting is not deep, resurface the part after removing the rust and scale.

**2) Pitting due to removal of surface**

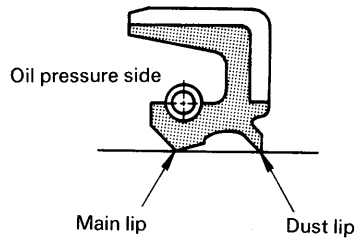
- If ball bearing is pitted, replace it.
- If more than 1/3 of the contact face is pitted, the part should be replaced.
- If pitting is not serious, resurface the part.

# PARTS HANDLING

## 1. OIL SEALS

### 1. Direction

Be careful to install the oil seal with its lips facing in the proper direction, as shown in the figure below.



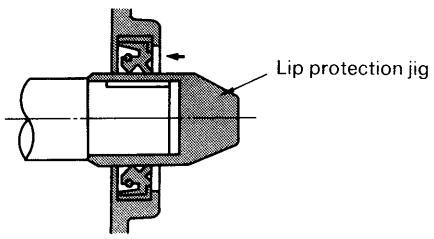

FS0029

### 2. Inspection prior to installation

1) Keep the oil seals free from dust, rust and scratches.
   Take special care to prevent rust or scratches on the lips.
2) To check the oil seal lip for smoothness, gently slide a wire across its surface. If the wire catches, replace the oil seal with a new one.
   ★ Make sure that the wire used for this test does not scratch the lip surface.
3) Do not use the oil seal on a shaft where it would come into contact with rust or scratches on the shaft surface.
4) When removing the oil seal, take care not to damage the housing or shaft surfaces.

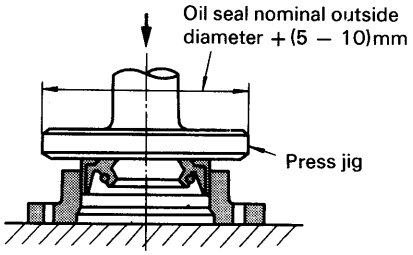
### 3. Installing the oil seal

1) Coat the surface to which the oil seal is to be applied with a lubricant or grease.
   ★ If the lip should double over as the oil seal is being fitted over the shaft, return it to its proper place by rotating the shaft and pulling the oil seal slightly backwards.
2) When installing an oil seal on a shaft machined with a keyway, splines, or threads, use a suitable jig to protect the lip.



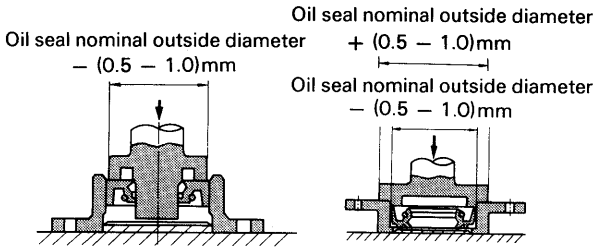

FS0030

3) Use a suitable press to press fit the oil seal into the housing.
   • When installing the oil seal flush with the housing surface . . .



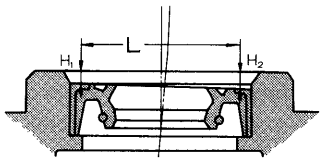

FS0031

   • When installing the oil seal inside the housing . . .




FS0032 FS0033

4) After press-fitting the oil seal, check that it has not been installed at an angle to the housing.




Max. permissible oil seal slant
$(H_2 - H_1)/2 \leqq 1/400$

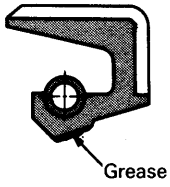
FS0034

**4. Applying grease to the lips**

Before installing an oil seal, coat it with grease according to the following procedure to prevent friction from burning the seal surfaces while the machine is being started.

1) Single-lip oil seal

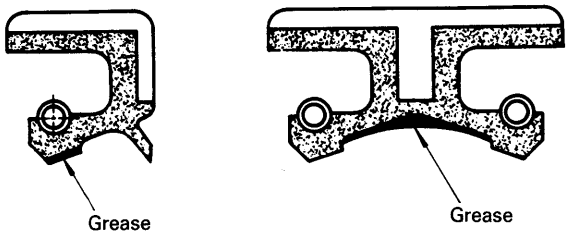
Place a flat, uniform coating of grease on the surface away from the sealing surface.




FS0035

2) Double-lip oil seal

Coat the entire surface between the two lips with grease in the manner shown in the accompanying figures.




FS0036

**5. Applying adhesives**

Take special care when applying adhesives to the outer surface of oil seals. Adhesive on the surface of the lip or shaft leads to oil leakage.

★ Since any adhesives on the surface of the press jig will soon transfer to the oil seal lips, clean the jig before use.

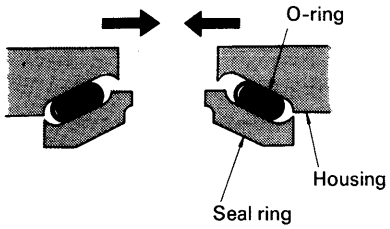
## 2. FLOATING SEALS

**1. Handling floating seals**

1) Keep each pair of floating seals bundled together with tape to avoid mix-ups when they are reinstalled.
2) Discard the old O-rings. Always use new ones when installing the floating seals.
3) Replace a floating seal if its contact surface is rusted.

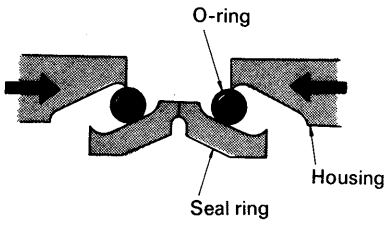
**2. Installing floating seals**

1) Remove all rust and dust from the mounting surfaces of the seal. Use sandpaper to remove any rust that might come into contact with the O-ring.
2) When installing the floating seal, coat the mounting surfaces with oil. Then install the O-ring, taking care not to twist it.
   ★ Do not coat the O-ring with oil.
   ★ The floating seal has been correctly installed if the seal ring rotates.
3) After installing the O-ring and seal rings in both housings, mate the two together.




FS0037

4) An installer is recommended for inserting the O-rings.
   ★ Using a screwdriver or other pointed object risks scarring the O-ring.
5) Attempting to mate the two housings together without the O-rings and seal rings in place can damage the O-rings and lead to oil leakage.




FS0038

## 3. O-RINGS

### 1. Handling

1) Discard any O-ring that has been in storage too long or has hardened.
2) Use only the O-rings prescribed for the part in the PARTS BOOK. This is especially important for those rings used with high-temperature engine parts, where heat-resistant and durable materials such as silicon are required.
3) ALWAYS USE NEW O-RINGS.

### 2. O-ring types

KOMATSU O-rings are marked with colored dots as shown in the accompanying chart.

| Marking | Part Number | Material | Application |
|---|---|---|---|
| One blue spot | 07000-0 ..... | Nitrile rubber | For low-pressure |
| Two blue spots | 07000-1 ..... | Nitrile rubber | For high-pressure |
| One green spot | 07000-3 ..... | Fluorine rubber | For low-pressure |
| Two green spots | 07000-2 ..... | Fluorine rubber | For high-pressure |
| One red spot | 07000-4 ..... | Nitrile rubber | For low-pressure in cold weather |
| Two red spots | 07000-5 ..... | Nitrile rubber | For high-pressure in cold weather |
| Orange spot | 07000-6 ..... | Silicon rubber | For low-pressure in hot weather |

### 3. Inserting O-rings

After coating the O-ring with oil, insert carefully so as not to damage it. Silicon rubber O-rings require special care since they tear easily.

## 4. GASKETS

### 1. Handling gaskets

1) Always replace packings, gaskets and copper packings with new ones.
2) Make sure that there are no scratches or burrs on the contact surfaces of the gasket.

### 2. Installing gaskets

1) Make sure that the holes in the gasket match those in the mating part.
2) Apply gasket sealant to the joints so specified in the SHOP MANUAL.

### 3. Precautions for using liquid gasket

1) Remove all scratches, dirt, paint, grease and old gasket sealant before applying a new coat.
2) Coat the specified area evenly and let dry for several minutes.
3) Assemble the mating parts when the gasket sealant is stickly to the touch.

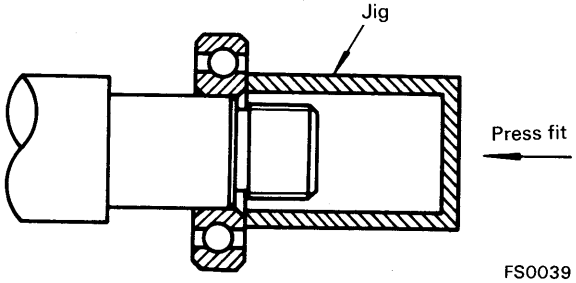
## 5. BEARINGS

### 1. Handling bearings

1) Shield the bearings from dust and dirt; even the tiniest speck rapidly accelerates wear.
   ★ Leave the bearings in their protective packaging until just before they are to be installed.
2) Protect a bearing from excessive force and shocks.
   ★ Never dry a bearing with compressed air after cleaning.

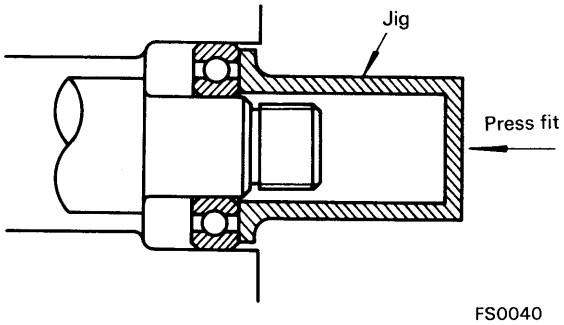
### 2. Installing bearings

1) Never drive a bearing onto a shaft by pounding on the outer race or into an opening by pounding on the inner race. Such pounding produces dents in the tracks in the races.
2) When a bearing must be fitted onto a shaft with some interference, press-fit the inner race with the jig shown in the accompanying figure.



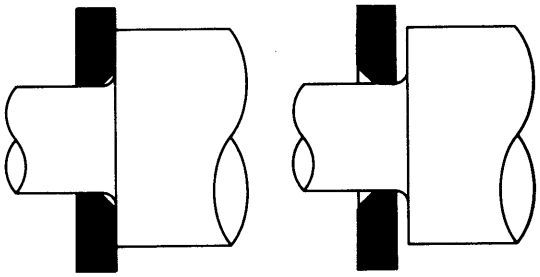

FS0039

3) If the shaft of opening has considerable interference, heat the bearing before installing.
★ Do not heat above 120°C.
4) When a non-separable bearing must be fitted with interference for both races, press-fit with the jig shown in the accompanying figure.



FS0040

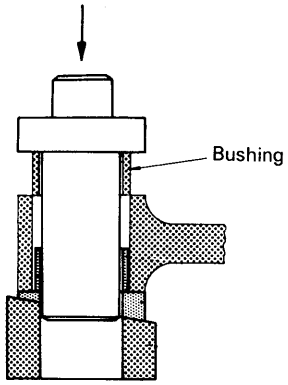
5) Thoroughly coat the bearing with oil before installing.
6) Install the bearing, spacer or washer with its chamfered surface facing the step on the shaft.



FS0041

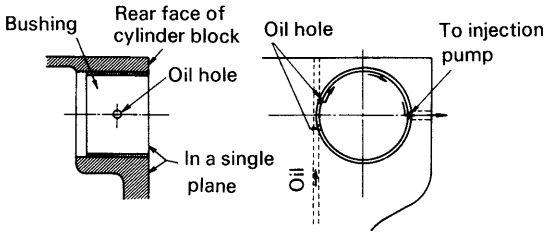
## 6. PRESS FITTING BUSHINGS

Do not drive in a bushing directly with a hammer. Use a press so that pressure is uniform over the entire circumference.
1) If no press is available, hammer in the bushing using a driving tool so that the force is distributed evenly.



FS0042

2) If the bushing has an oil hole, bring the hole into exact alignment with the oil hole in the housing.



FS0043

3) When a bushing has been removed, remove all burrs and foreign matter from the mounting hole, and then clean.

## 7. REMOVING SNAP RINGS

1) Use snap ring pliers to remove or install snap rings. Do not overexpand them—especially the smaller ones.
2) After installing, check to make sure that the snap ring is firmly in place within its groove.

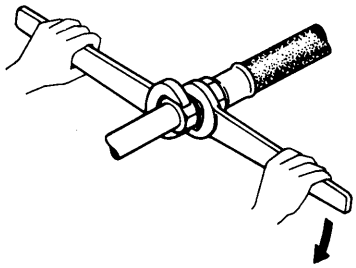
## 8. HYDRAULIC PIPING

**⚠ Precautions for servicing the work equipment hydraulic system**

1) Lower the work equipment to the ground and turn off the engine.
2) Loosen the oil filler cap to relieve pressure in the hydraulic oil tank.
3) Operate the control levers 2 or 3 times to eliminate hydraulic pressure remaining in the piping to be disassembled.
4) Support the work equipment on a stand to prevent it from falling when the piping is removed and the hydraulic pressure is released.

### 1. Removing the hydraulic piping

1) Disconnect hydraulic tubes from hoses or other tubes by holding the nut on the spigot (the male side of the joint) with a wrench while loosening the one on the socket (the female side).

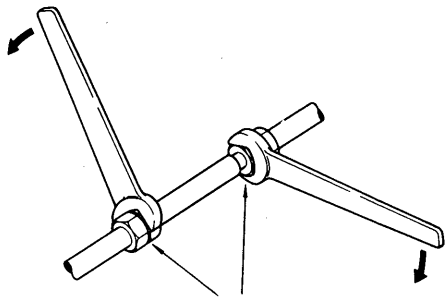


FS0044

2) Seal the ends of the disconnected tubes and hoses and the oil ports to the hydraulic equipment with blind plugs to keep out foreign matter. For the same reason, seal the ports of the hydraulic tank with adhesive tape.
3) Have appropriately-sized containers underneath to catch the hydraulic fluid that will flow out when the piping is disconnected. Clean up all spills immediately.
4) When working under the machine, position yourself out of the way of the oil shower.
5) Tag the ends of all piping removed as well as the ports to which they were attached.

### 2. Installing the hydraulic piping

1) Thoroughly clean each piece of piping with a suitable detergent (for example, light oil, kerosene, trichloroethane) and remove all traces of detergent with compressed air.
2) Repair the sealing faces or, if the scratches and dents are too large, replace.
3) Do not use gasket sealant for hydraulic piping!
4) Install the piping so that all the identification tags match.
5) When a pipe must be joined at both ends, tightening only one end at a time may make it too short. First fit both ends by hand and then tighten the ends by turns. (See figure.)

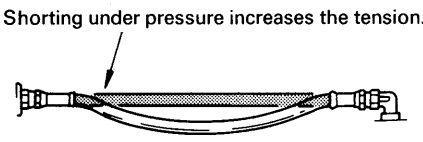



FS0045

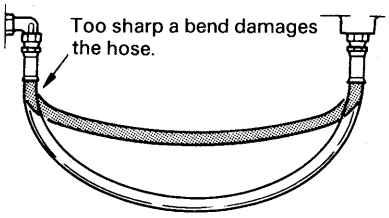
6) To ensure tight-fitting seals, tighten the nuts to 80% of the specified torque, loosen 90°, and then tighten to the full torque.
7) After completing all connections, run the engine at idling speed and operate all the control levers of the hydraulic attachments. Then check the oil level in the hydraulic tank and add oil as necessary.

### 3. Handling high-pressure hoses

1) Do not try to shorten the hose. A hose shorter than the specified length is subject to the defects shown in the accompanying figures.

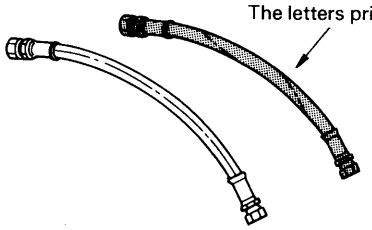



FS0046



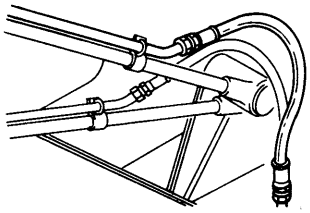

FS0047

2) Make sure the hose is not twisted after it is installed.

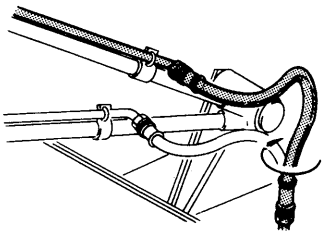



FS0048

3) Similarly, the hose must not twist as it moves.



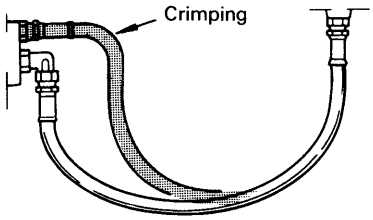
FS0049



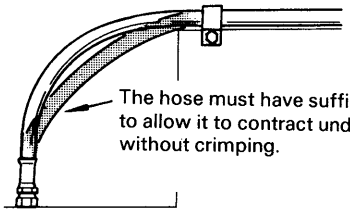
Improper connection causes the hose to twist as the pipe moves.

FS0050

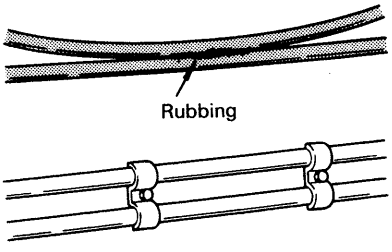
4) The last figures on this page are examples of poor connections.




FS0051



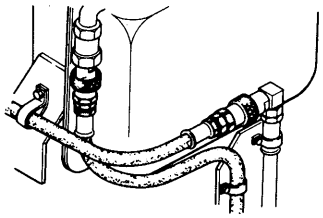

FS0052




FS0053

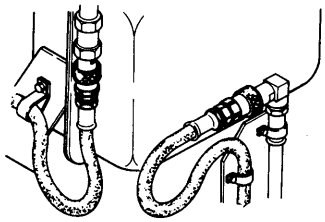
**4. Handling hoses with self-seal couplings**

1) Do not attempt to connect or disconnect or coupling without first relieving the internal hydraulic pressure.
   ★ The gushing hydraulic fluid will not only soil the surroundings, but the high flow rate may also damage the O-ring of the coupling.
2) Never use a hammer to tighten or loosen a coupling.
   ★ Such sharp blows can deform the coupling, leading to oil leakage or cracking of the coupling.
3) Protect the disconnected piping from the intrusion of dust and dirt! If it is to remain disconnected for some time, seal by connecting to another coupling or by fitting a dust cap or a blind plug to each end.



FS0054

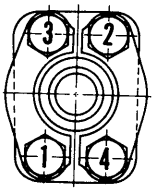
During storage



FS0055

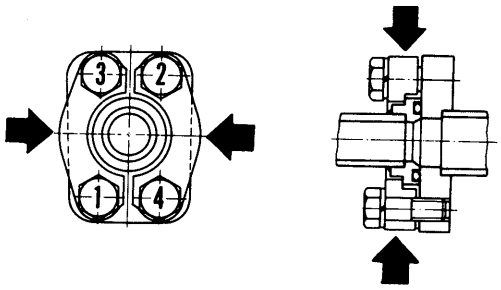
5. Handling split flanges

1) Follow the bolt tightening sequence given in the figure.




FS0056

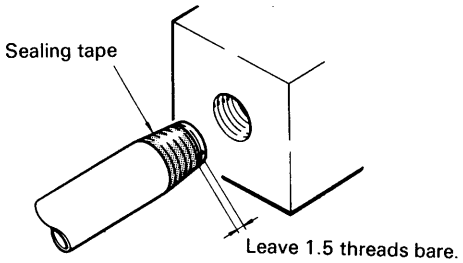
2) Press the two halves completely together and tighten them uniformly. If they are not held tightly together, they will separate by a distance equivalent to the clearance between the fastening bolts and their holes, forming a pathway for oil leakage.




FS0057

**6. Using sealing tape**

1) To prevent oil leakage, wind sealing tape around the tapered thread before inserting the plug into the plug hole.
2) Wrap all but the first 1.5 threads at the tip and then force the tape into the threads with a fingernail. Wind the tape in the same direction as the threads.

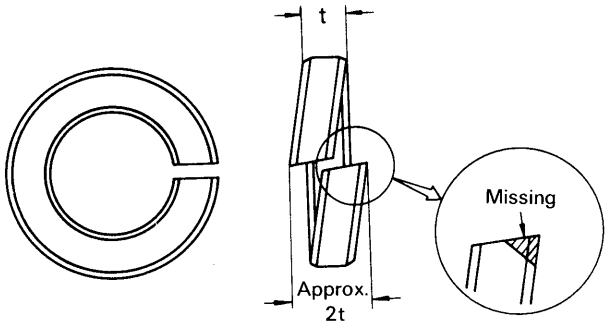



FS0058

## 9. SPRING WASHERS

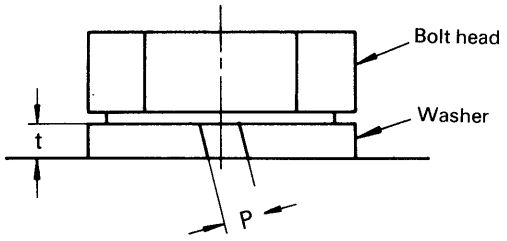
**Judging suitability**

1) Discard the spring washer if the overlapping portion is worn or damaged.




FS0059

2) Discard if the distance P is more than 2t/3.

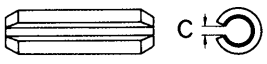



FS0060

## 10. SPRING (ROLL) PINS

**Handling spring pins**

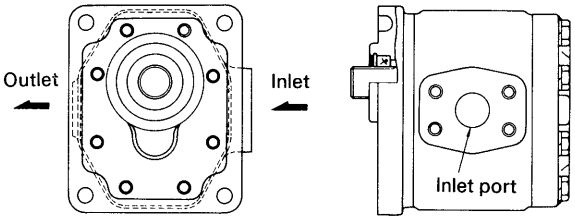
1) A spring pin performs somewhat better when the split is placed facing the load instead of at a right angle to the load.




FS0061

## 11. PUMP

1) After assembly and before installation, fill the pump with oil through the intake port to provide initial lubrication.
2) Before installing the pump, turn the drive shaft by hand to make sure that it turns smoothly without any catching.

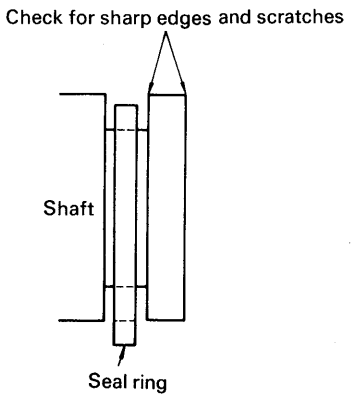



FS0062

3) Test run the installed pump and check for unusual noises and leakage.

## 12. SEAL RINGS

1) Seal rings are very delicate, so handle and store carefully.
2) Do not reuse rubber seal rings.
3) Avoid excessive stretching when fitting a seal ring over a shaft; it decreases the ring's performance.
4) Remove all sharp edges before fitting a seal ring into a slot on an abutment.




FS0063

# HOISTING INSTRUCTIONS

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

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

**2. Wire ropes**

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

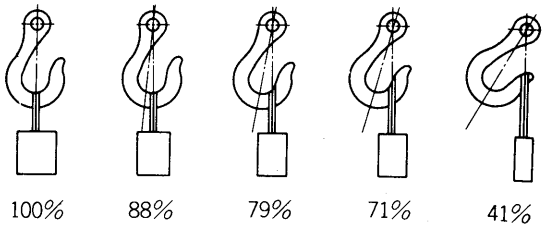
Wire ropes
(Standard "Z" or "S" twist ropes without galvanizing)

| Rope diameter (mm) | Allowable load (tons) |
|---|---|
| 10 | 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 |

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

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

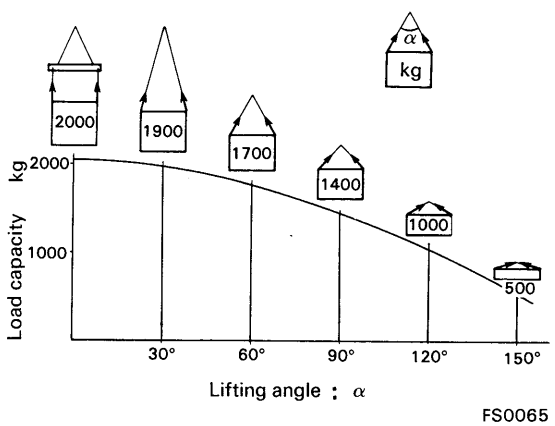



FS0064

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

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

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




FS0065

kg

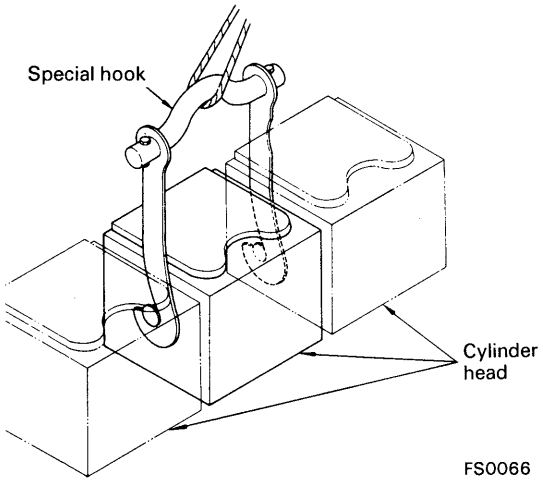
- Approximate reduction of allowable load for wire ropes at various hanging angles.

| Hanging angle | Reduction in % |
|---|---|
| 30° or less | 10% |
| 31° – 60° | 20% |
| 61° – 90° | 30% |
| 91° – 120° | 50% |

⚠ Hanging angles should not exceed 150°.

5) When hoisting several parts as a unit, be careful not to allow any part of the unit to fall. Use a suitable container when hoisting many small parts at a time.

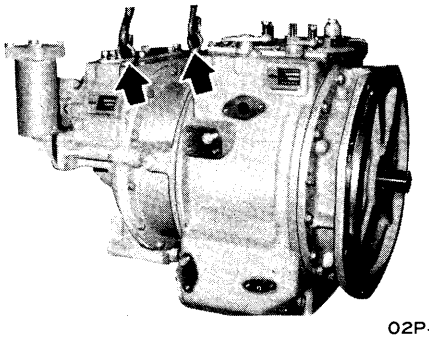
6) Select the most suitable sling device when hoisting a specially-shaped object.



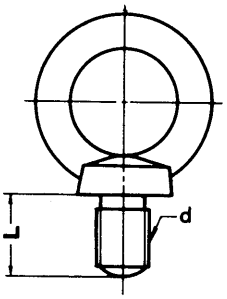

FS0066

7) When using a hoist to turn over a heavy part, observe the following instructions:
   - Clear as much of the area surrounding the part as possible.
   - When turning the part over, take special care to prevent the ropes from slackening and the part from slipping when the center of gravity changes.
   - Gradually slacken the wire ropes after making sure that the part is completely turned over.
     Slackening the ropes before complete turning of the part may cause the part to fall back to its original position.

**3. Hanging bolts**



02P-021




FS0067

| Part Number | d | Pitch | L | Allowable load (kg) |
|---|---|---|---|---|
| 04530-0815 | 8 | 1.25 | 15 | 80 |
| 04530-1018 | 10 | 1.5 | 18 | 150 |
| 04530-1222 | 12 | 1.75 | 22 | 220 |
| 04530-1628 | 16 | 2.0 | 28 | 450 |
| 04530-2030 | 20 | 2.5 | 30 | 630 |
| 04530-2438 | 24 | 3.0 | 38 | 950 |
| 04530-3045 | 30 | 3.0 | 45 | 1500 |
| 04530-3655 | 36 | 3.0 | 55 | 2300 |
| 04530-4625 | 46 | 3.0 | 25 | 3400 |
| 04530-4870 | 48 | 3.0 | 70 | 4500 |

★ The allowable load in the table means the maximum static load which the bolt can withstand. The values of allowable load given in the table should be reduced, taking the necessary safety factors into consideration, as these bolts will be subjected to shocks during actual hoisting operation. The allowable loads in the table are applicable to the bolts slung vertically from a hoist.

# STANDARD TIGHTENING TORQUE

kgm

## 1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of **"Disassembly and Assembly"**.

| Thread diameter of bolt (mm) | Width across flat (mm) | (T) kgm | (H) Nm |
|---|---|---|---|
| 6 | 10 | 1.35±0.15 | 13.2±1.4 |
| 8 | 13 | 3.2±0.3 | 31.4±2.9 |
| 10 | 17 | 6.7±0.7 | 65.7±6.8 |
| 12 | 19 | 11.5±1.0 | 112±9.8 |
| 14 | 22 | 18.0±2.0 | 177±19 |
| 16 | 24 | 28.5±3 | 279±29 |
| 18 | 27 | 39±4 | 383±39 |
| 20 | 30 | 56±6 | 549±58 |
| 22 | 32 | 76±8 | 745±78 |
| 24 | 36 | 94.5±10 | 927±98 |
| 27 | 41 | 135±15 | 1320±140 |
| 30 | 46 | 175±20 | 1720±190 |
| 33 | 50 | 225±25 | 2210±240 |
| 36 | 55 | 280±30 | 2750±290 |
| 39 | 60 | 335±35 | 3280±340 |

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

★ **Nm (newton meter): 1Nm ≒ 0.1 kgm**

## 2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

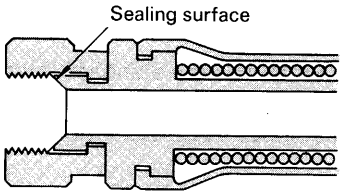
Use these torques for split flange bolts.

| Thread diameter of bolt (mm) | Width across flats (mm) | Tightening torque kgm | Tightening torque Nm |
|---|---|---|---|
| 10 | 14 | 6.7±0.7 | 65.7±6.8 |
| 12 | 17 | 11.5±1 | 112±9.8 |
| 16 | 22 | 28.5±3 | 279±29 |

kgm

### 3. TIGHTENING TORQUE FOR NUTS OF FLARED

Use these torques for nut part of flared.




FS0068

| Thread diameter of nut part (mm) | Width across flats of nut part (mm) | Tightening torque | |
|---|---|---|---|
| | | kgm | Nm |
| 14 | 19 | 2.5±0.5 | 24.5±4.9 |
| 18 | 24 | 5±2 | 49±19.6 |
| 22 | 27 | 8±2 | 78.5±19.6 |
| 24 | 32 | 14±3 | 137.3±29.4 |
| 30 | 36 | 18±3 | 176.5±29.4 |
| 33 | 41 | 20±5 | 196.1±49 |
| 36 | 46 | 25±5 | 245.2±49 |
| 42 | 55 | 30±5 | 294.2±49 |

## COATING MATERIALS

The recommended coating materials prescribed in Komatsu Shop Manuals are listed below.

| Nomenclature | Komatsu code | Applications |
|---|---|---|
| Adhesives | LT-1A | Used to apply rubber pads, rubber gaskets, and cork plugs. |
| | LT-1B | Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed. |
| | LT-2* | Preventing bolts, nuts and plugs from loosening and leaking oil. |
| | LT-3 | Provides an airtight, electrically insulating seal. Used for aluminum surfaces. |
| Liquid gasket | LG-1 | Used with gaskets and packings to increase sealing effect. |
| | LG-3 | Heat-resistant gasket for precombustion chambers and exhaust piping. |
| | LG-4 | Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 – 0.08 mm) |
| | LG-5 | Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter. |
| Antifriction compound (Lubricant including molybdenum disulfide) | LM-P | Applied to bearings and taper shafts to facilitate press-fitting and to prevent sticking, burning or rusting. |
| Grease (Lithium grease) | G2-LI | Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work. |
| Vaseline | — | Used for protecting battery electrode terminals from corrosion. |

*LT-2 is also called LOCTITE in the shop manuals.

# ELECTRIC WIRE CODE

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

## CLASSIFICATION BY THICKNESS

| Nominal number | Copper wire | | | Cable O.D. (mm) | Current rating (A) | Applicable circuit |
|---|---|---|---|---|---|---|
| | Number strands | Dia. of strands (mm) | Cross section ($mm^2$) | | | |
| 01 | 11 | 0.32 | 0.88 | 2.4 | 12 | Starting, lighting, signal etc. |
| 02 | 26 | 0.32 | 2.09 | 3.1 | 20 | Lighting, signal etc. |
| 05 | 65 | 0.32 | 5.23 | 4.6 | 37 | Charging and signal |
| 15 | 84 | 0.45 | 13.36 | 7.0 | 59 | Starting (Glow plug) |
| 40 | 85 | 0.80 | 42.73 | 11.4 | 135 | Starting |
| 60 | 127 | 0.80 | 63.84 | 13.6 | 178 | Starting |
| 100 | 217 | 0.80 | 109.1 | 17.6 | 230 | Starting |

## CLASSIFICATION BY COLOR AND CODE

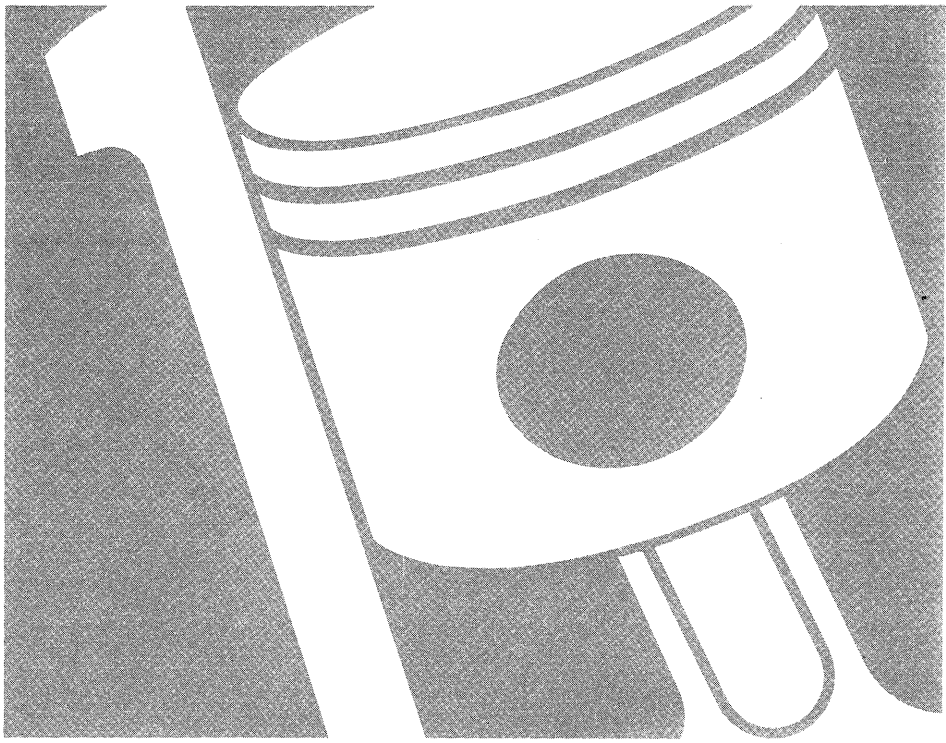
| Priority | Classification \ Circuits | | Starting | Charging | Lighting | Signal | Instrument | Other |
|---|---|---|---|---|---|---|---|---|
| 1 | Primary | Code | B | W | R | G | Y | L |
| | | Color | Black | White | Red | Green | Yellow | Blue |
| 2 | Auxiliary | Code | BW | WR | RW | GW | YR |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

# SHOP MANUAL

# N-855 SERIES

**Engine Serial No. 26100001 and up**

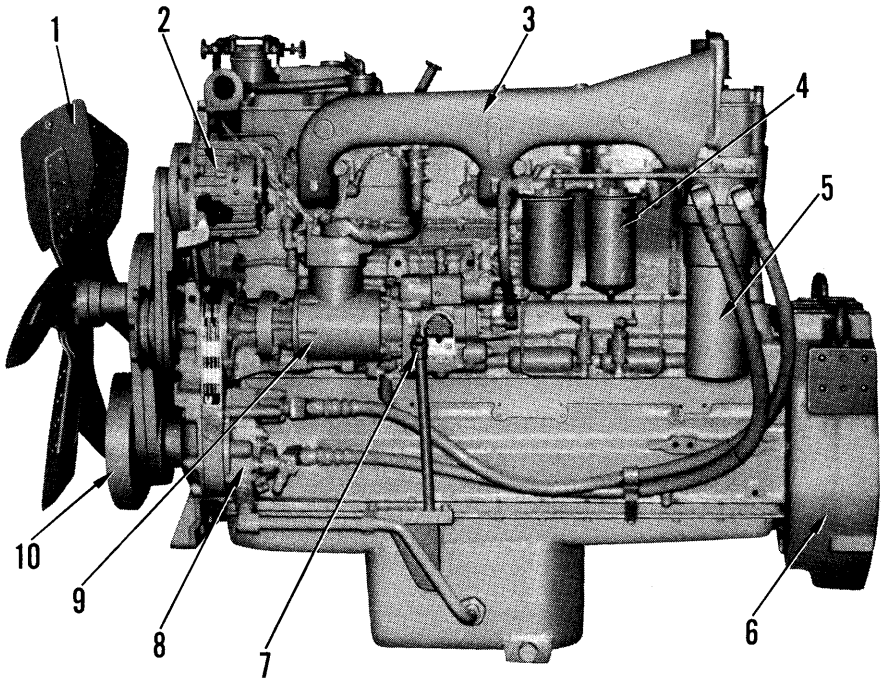
## 01 ENGINE GENERAL



# CONTENTS

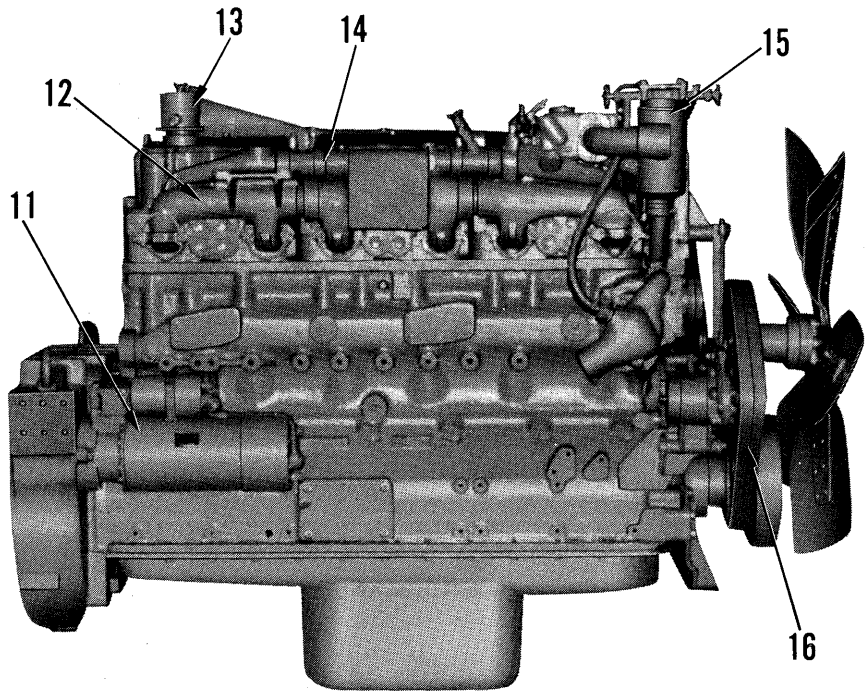
# GENERAL VIEW

## N-855-C (For PC300-1, 2 and PC300LC-1, 2)




6710P004-1

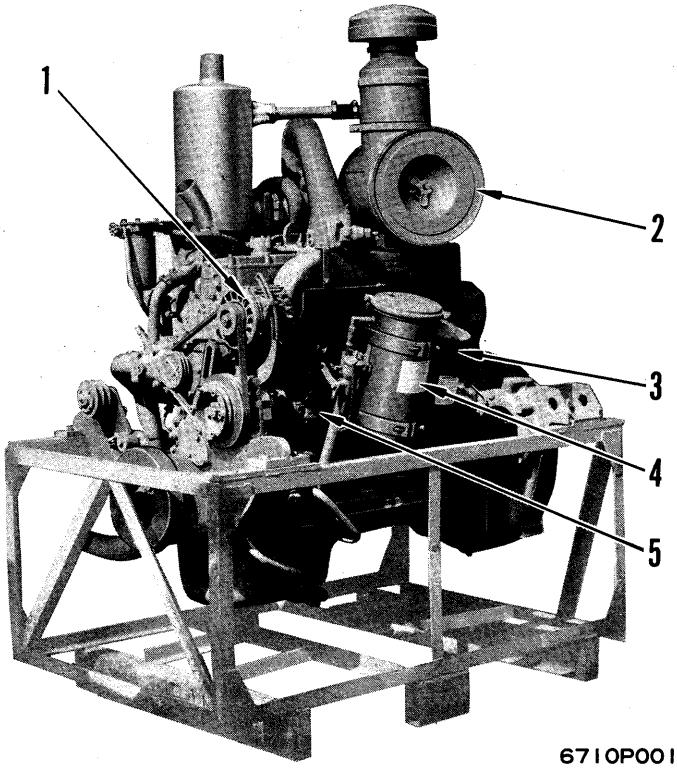
1. Fan
2. Alternator
3. Intake manifold
4. Fuel filter
5. Oil filter
6. Flywheel housing
7. PT fuel pump
8. Oil pump
9. Air compressor
10. Vibration damper




6710P004-2

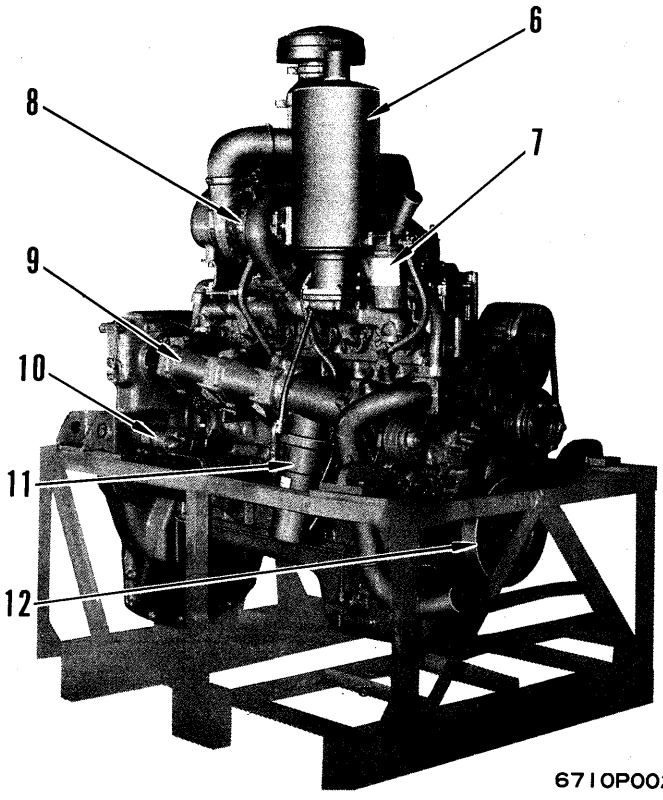
11. Starting motor
12. Exhaust manifold
13. Breather
14. Water manifold
15. Corrosion resistor
16. Fan belt

## NT-855-C (For D80, 85A-18)




6710P001

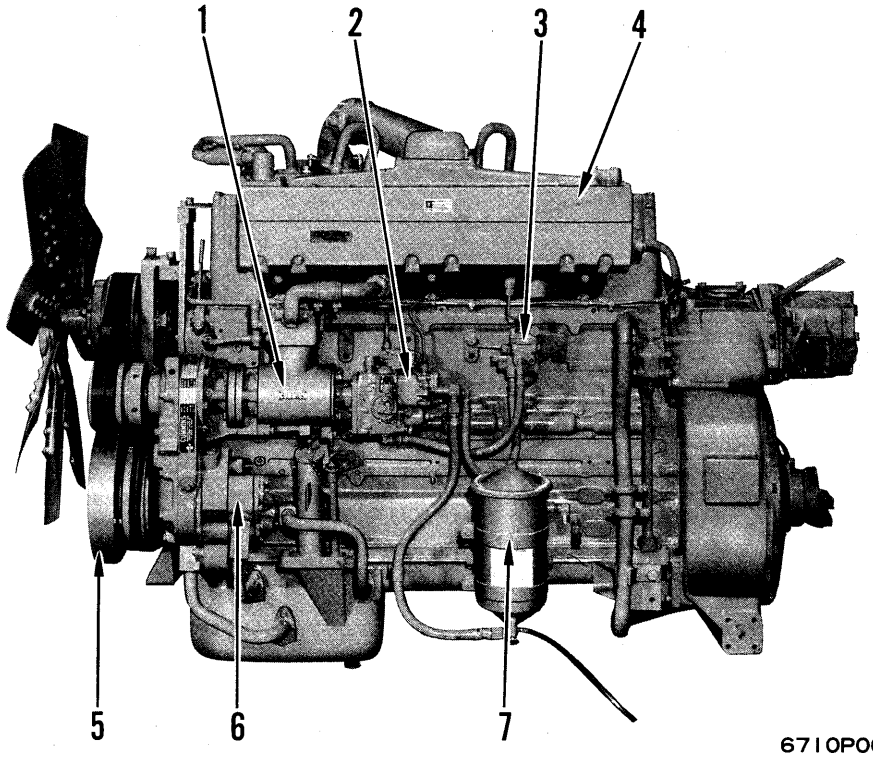
1. Alternator
2. Air cleaner
3. Fuel filter
4. By-pass filter
5. PT fuel pump




6710P002

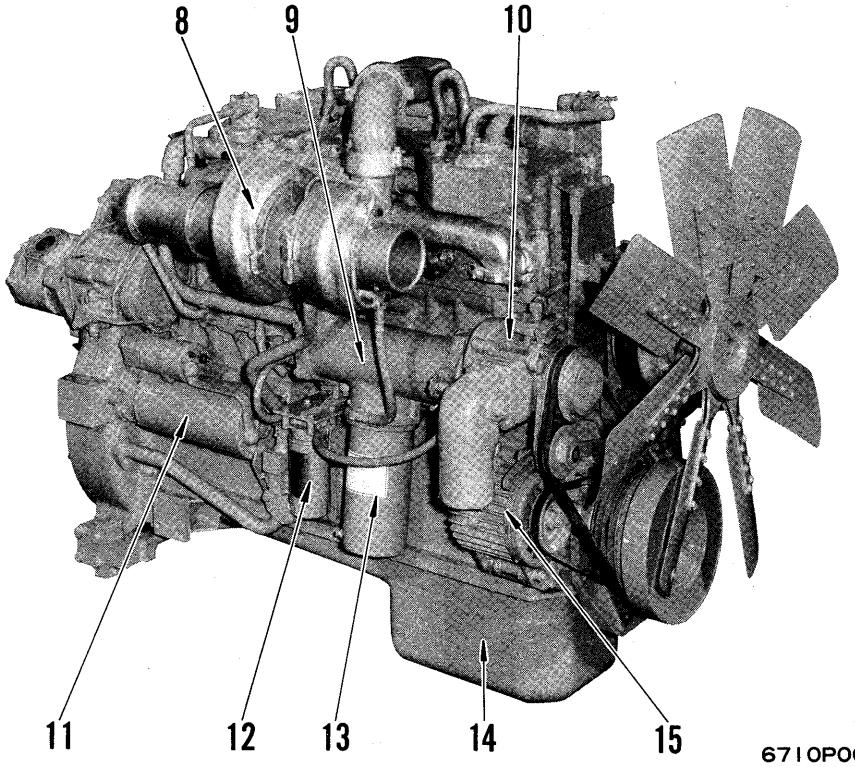
6. Muffler
7. Corrosion resistor
8. Turbocharger
9. Oil cooler
10. Starting motor
11. Oil filter
12. Vibration damper

## NTA-855-C (For HD320-2)




6710P003

1. Air compressor
2. PT fuel pump
3. Aneroid control valve
4. After-cooler
5. Vibration damper
6. Oil pump
7. Fuel filter




6710P004

8. Turbocharger
9. Oil cooler
10. Water pump
11. Starting motor
12. Corrosion resistor
13. Full-flow filter
14. Oil pan
15. Alternator

# SPECIFICATIONS

| Engine model | | | N-855-C | NT-855-C | |
|---|---|---|---|---|---|
| Applicable machine model | | | PC300-1, 2<br>PC300LC-1, 2 | D80A, E-18<br>D85A, E, P-18 | D80F-18 |
| Number of cylinder — Bore x Stroke | | (mm) | 6 — 139.7 x 152.4 | 6 — 139.7 x 152.4 | |
| Total piston displacement | | (cc) | 14,010 | 14,010 | |
| Firing order | | | 1 — 5 — 3 — 6 — 2 — 4 | 1 — 5 — 3 — 6 — 2 — 4 | |
| Dimensions | Overall length | (mm) | 1,676 | 1,691 | 1,691 |
| | Overall width | (mm) | 857 | 1,110 | 1,110 |
| | Overall height | | | | |
| | (Excluding exhaust pipe) | (mm) | 1,279 | 1,953 | 1,953 |
| | (Including exhaust pipe) | (mm) | — | — | — |
| Performance | Flywheel horsepower | (HP/rpm) | 180/1,850 | 220/1,800 | 260/1,950 |
| | Maximum torque | (kgm/rpm) | 83.5/1,300 | 105/1,250 | 118/1,400 |
| | High idling speed | (rpm) | 1,985 — 2,085 | 1,900 — 2,000 | 2,100 — 2,200 |
| | Low idling speed | (rpm) | 550 — 600 | 600 — 650 | 600 — 650 |
| | Minimum fuel consumption ratio | (g/HPh) | 175 | 175 | 175 |
| Dry weight | | (kg) | 1,450 | 1,750 | 1,750 |
| Fuel pump | | | Cummins PT fuel pump | Cummins PT fuel pump | |
| Governor | | | Cummins VS governor (Centrifugal, all-speed type) | Cummins VS governor (Centrifugal, all-speed type) | |
| Lubricating oil capacity (Refill capacity) | | (ℓ) | 43<br>(38) | 43<br>(38) | 43<br>(38) |
| Cooling water capacity | | (ℓ) | 43 | 79 | 79 |
| Alternator | | | 24V, 25A | 24V, 25A | 24V, 25A |
| Starting motor | | | 24V, 11kW | 24V, 11kW | 24V, 11kW |
| Battery | | | 12V, 170Ah x 2 | 12V 170Ah x 2 | 12V 170Ah x 2 |
| Turbocharger | | | — | Cummins ST-50 | Cummins ST-50 |
| After-cooler | | | — | — | — |
| Others | | | — | — | — |

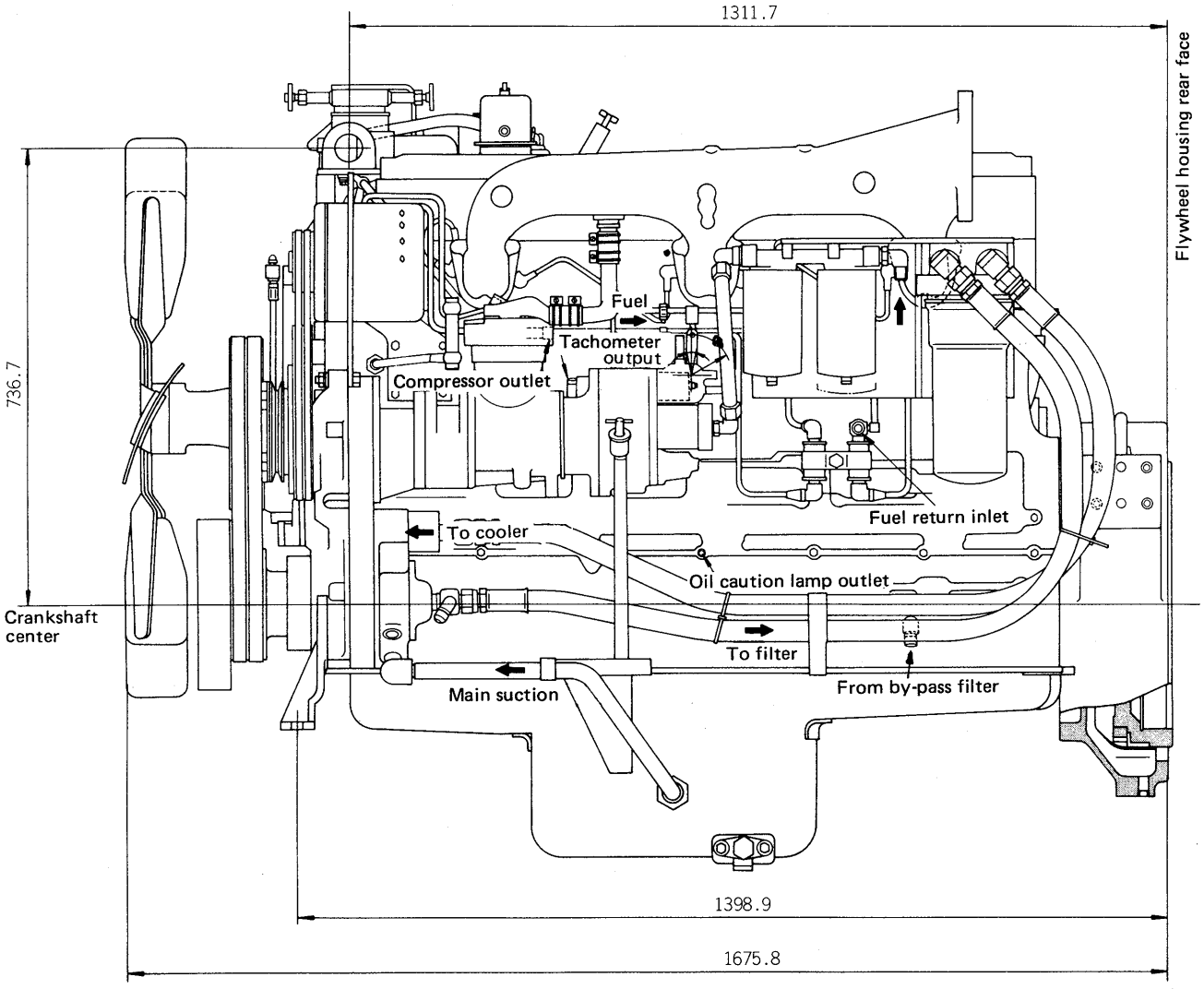
| Engine model | | | NT-855-C | | |
|---|---|---|---|---|---|
| Applicable machine model | | | D95S-2 | PC400-1<br>PC400LC-1 | W170-2 |
| Number of cylinder – Bore x Stroke | | (mm) | 6 – 139.7 x 152.4 | | |
| Total piston displacement | | (cc) | 14,010 | | |
| Firing order | | | 1 – 5 – 3 – 6 – 2 – 4 | | |
| Dimensions | Overall length | (mm) | 1,680 | 1,676 | 1,715 |
| | Overall width | (mm) | 1,110 | 968 | 955 |
| | Overall height | | | | |
| | (Excluding exhaust pipe) | (mm) | 1,773 | 1,263 | 1,843 |
| | (Including exhaust pipe) | (mm) | – | – | 2,545 |
| Performance | Flywheel horsepower | (HP/rpm) | 245/1,850 | 233/1,800 | 235/2,200 |
| | Maximum torque | (kgm/rpm) | 112/1,200 | 116/1,200 | 100/1,400 |
| | High idling speed | (rpm) | 2,000 – 2,100 | 1,950 – 2,050 | 2,350 – 2,450 |
| | Low idling speed | (rpm) | 600 – 650 | 600 – 650 | 670 – 730 |
| | Minimum fuel consumption ratio | (g/HPh) | 170 | 175 | 168 |
| Dry weight | | (kg) | 1,750 | 1,500 | 1,485 |
| Fuel pump | | | Cummins PT fuel pump | | |
| Governor | | | Cummins VS governor (Centrifugal, all-speed type) | | |
| Lubricating oil capacity (Refill capacity) | | (ℓ) | 43<br>(38) | 43<br>(38) | 43<br>(38) |
| Cooling water capacity | | (ℓ) | 90 | 67 | 85 |
| Alternator | | | 24V, 25A | 24V, 25A | 24V, 35A |
| Starting motor | | | 24V, 11kW | 24V, 11kW | 24V, 11kW |
| Battery | | | 12V 200Ah x 2 | 12V 170Ah x 2 | 12V 200Ah x 2 |
| Turbocharger | | | Cummins ST-50 | Cummins ST-50 | Cummins ST-50 |
| After-cooler | | | – | – | – |
| Others | | | – | – | – |

| NT-855-C | NTA-855-C | | | |
|---|---|---|---|---|
| W180-1 | HD320-2 Eng. No. 26102754 – 26155098 | HD320-2 Eng. No. 26155099 and up | HD320-3 | WS16S-2 |
| 6 – 139.7 x 152.4 | 6 – 139.7 x 152.4 | | | |
| 14,010 | 14.010 | | | |
| 1 – 5 – 3 – 6 – 2 – 4 | 1 – 5 – 3 – 6 – 2 – 4 | | | |
| 1,680 | 1,688 | 1,735 | 1,680 | 1,687 |
| 955 | 976 | 998 | 998 | 970 |
| 1,845 | 1,362 | 1,352 | 1,352 | 1,252 |
| 2,445 | – | – | – | – |
| 280/2,300 | 405/2,300 | | 405/2,300 | 364/2,100 |
| 116/1,600 | 142/1,700 | | 142/1,700 | 140/1,500 |
| 2,430 – 2,530 | 2,430 – 2,530 | | 2,430 – 2,530 | 2,250 – 2,350 |
| 600 – 700 | 600 – 650 | | 675 – 725 | 610 – 650 |
| 170 | 175 | | 175 | 175 |
| 1,485 | 1,700 | 1,570 | 1,570 | 1,570 |
| Cummins PT fuel pump Cummins VS governor (Centrifugal, all-speed type) | Cummins PT fuel pump Cummins VS governor (Centrifugal, all-speed type) | Cummins PT fuel pump Cummins MVS governor (Max. and min. speed type) | | Cummins PT fuel pump Cummins VS governor (Centrifugal, all-speed type) |
| 43 (38) | 43 (38) | 43 (38) | 43 (38) | 43 (38) |
| 85 | 125 | 125 | 125 | 125 |
| 24V, 35A | 24V, 35A | 24V, 35A | 24V, 24A | 24V, 35A |
| 24V, 11kW | 24V, 11kW | 24V, 11kW | 24V, 11kW | 24V, 11kW |
| 12V 200Ah x 2 | 12V 200Ah x 2 | 12V 200Ah x 2 | 12V 200Ah x 2 | 12V 200Ah x 2 |
| Cummins ST-50 | Komatsu KTR-130 | Komatsu KTR-130 | Komatsu KTR-130 | Cummins ST-50 |
| – | With | With | With | With |
| – | – | – | – | – |

| | | | | |
|---|---|---|---|---|
| Engine model | | | NTA-855-C | |
| Applicable machine model | | | WS23-1 | |
| Number of cylinder — Bore x Stroke | | (mm) | 6 — 139.7 x 152.4 | |
| Total piston displacement | | (cc) | 14,010 | |
| Firing order | | | 1 — 5 — 3 — 6 — 2 — 4 | |
| Dimensions | Overall length | (mm) | | |
| | Overall width | (mm) | | |
| | Overall height | | | |
| | (Excluding exhaust pipe) | (mm) | | |
| | (Including exhaust pipe) | (mm) | | |
| Performance | Flywheel horsepower | (HP/rpm) | 364/2,100 | |
| | Maximum torque | (kgm/rpm) | 140/1,500 | |
| | High idling speed | (rpm) | 2,250 — 2,350 | |
| | Low idling speed | (rpm) | 610 — 650 | |
| | Minimum fuel consumption ratio | (g/HPh) | 175 | |
| Dry weight | | (kg) | 1,570 (Front)<br>1,520 (Rear) | |
| Fuel pump | | | Cummins PT fuel pump | |
| Governor | | | Cummins VS governor (Centrifugal, all-speed type) | |
| Lubricating oil capacity (Refill capacity) | | (ℓ) | 43<br>(38) | |
| Cooling water capacity | | (ℓ) | 125 | |
| Alternator | | | 24V, 35A | |
| Starting motor | | | 24V, 11kW | |
| Battery | | | 12V 200Ah x 2 | |
| Turbocharger | | | Cummins ST-50 | |
| After-cooler | | | With | |
| Others | | | — | |

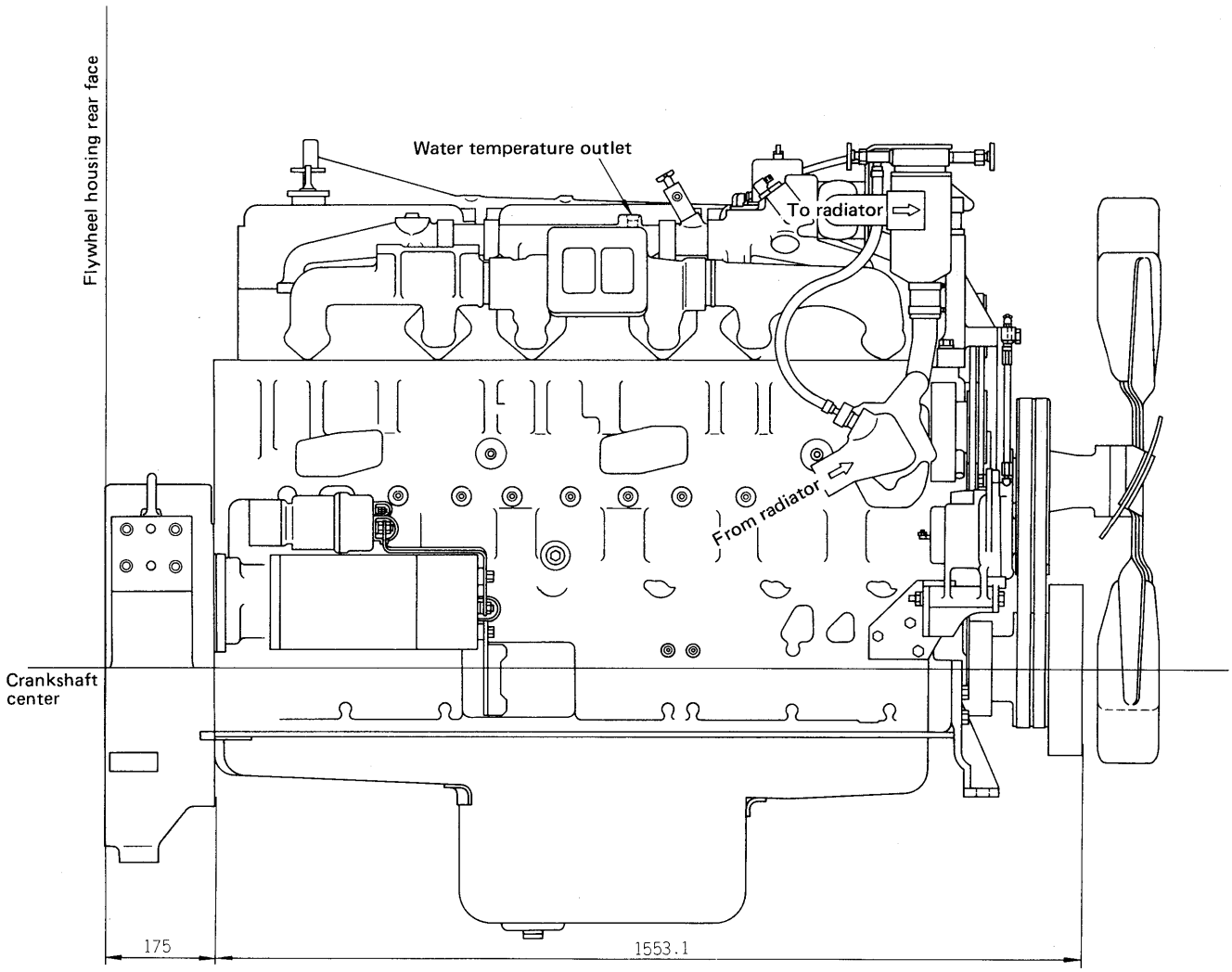
# ASSEMBLY DRAWING

## N-855-C LEFT SIDE VIEW (For PC300-1)



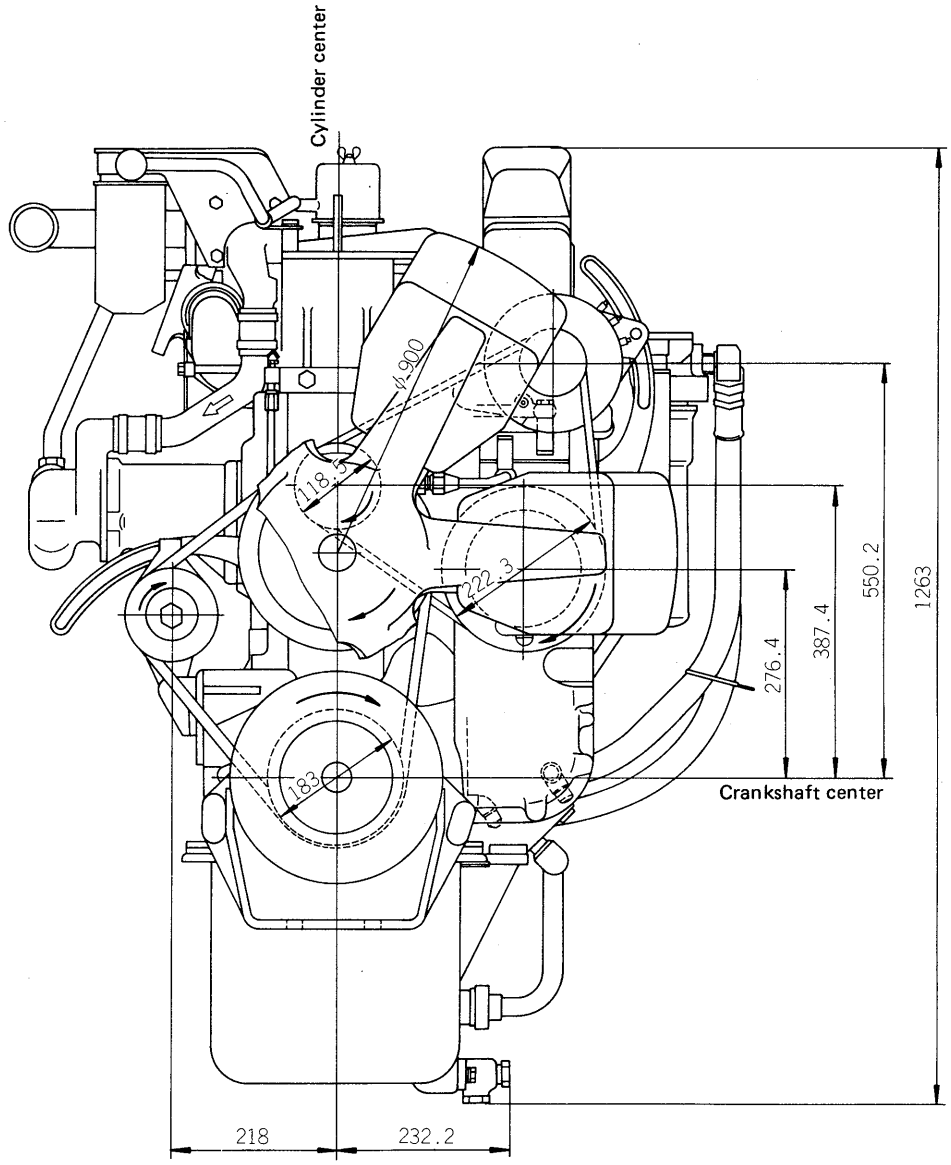

6710F106B

## N-855-C RIGHT SIDE VIEW (For PC300-1)



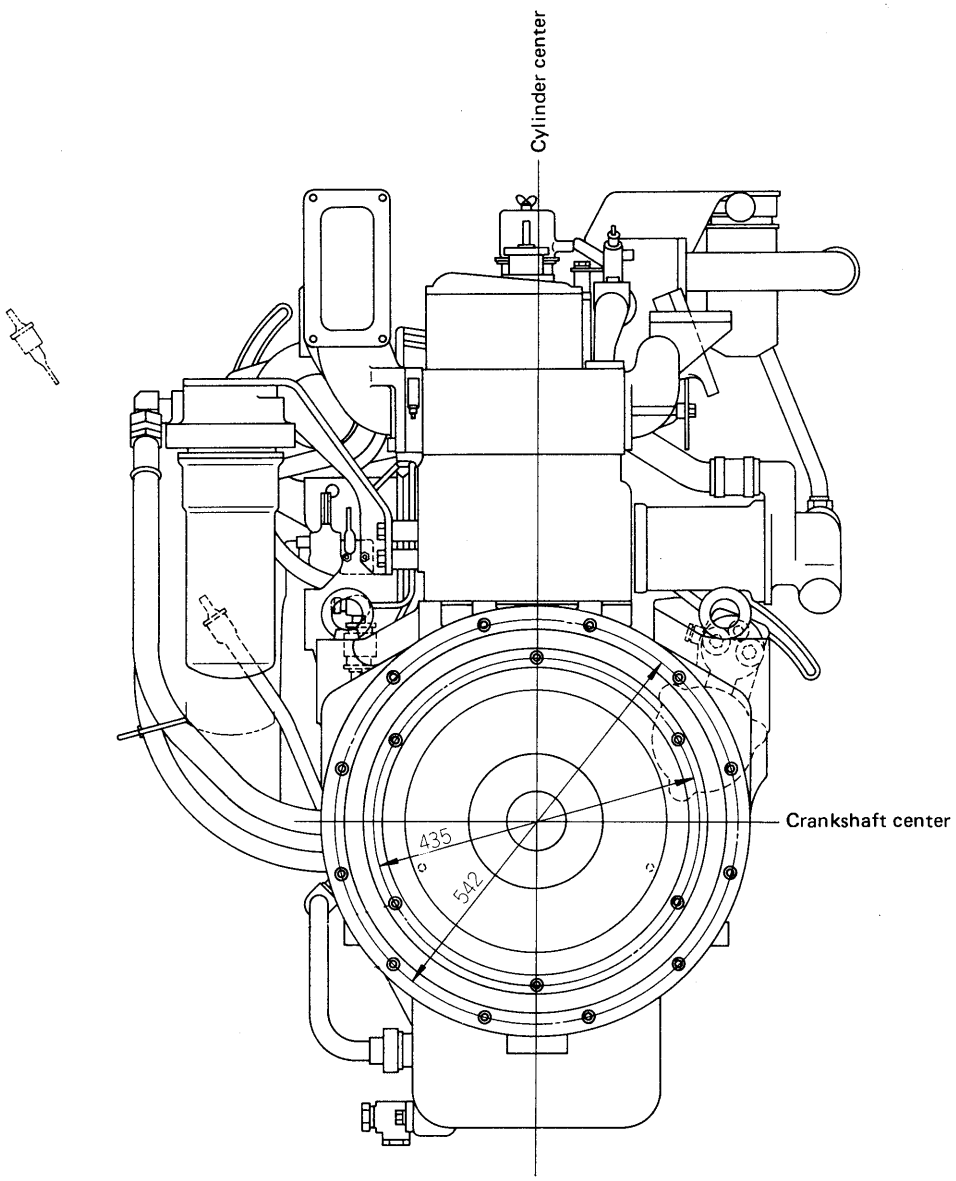

6710F107A

## N-855-C FRONT VIEW (For PC300-1)



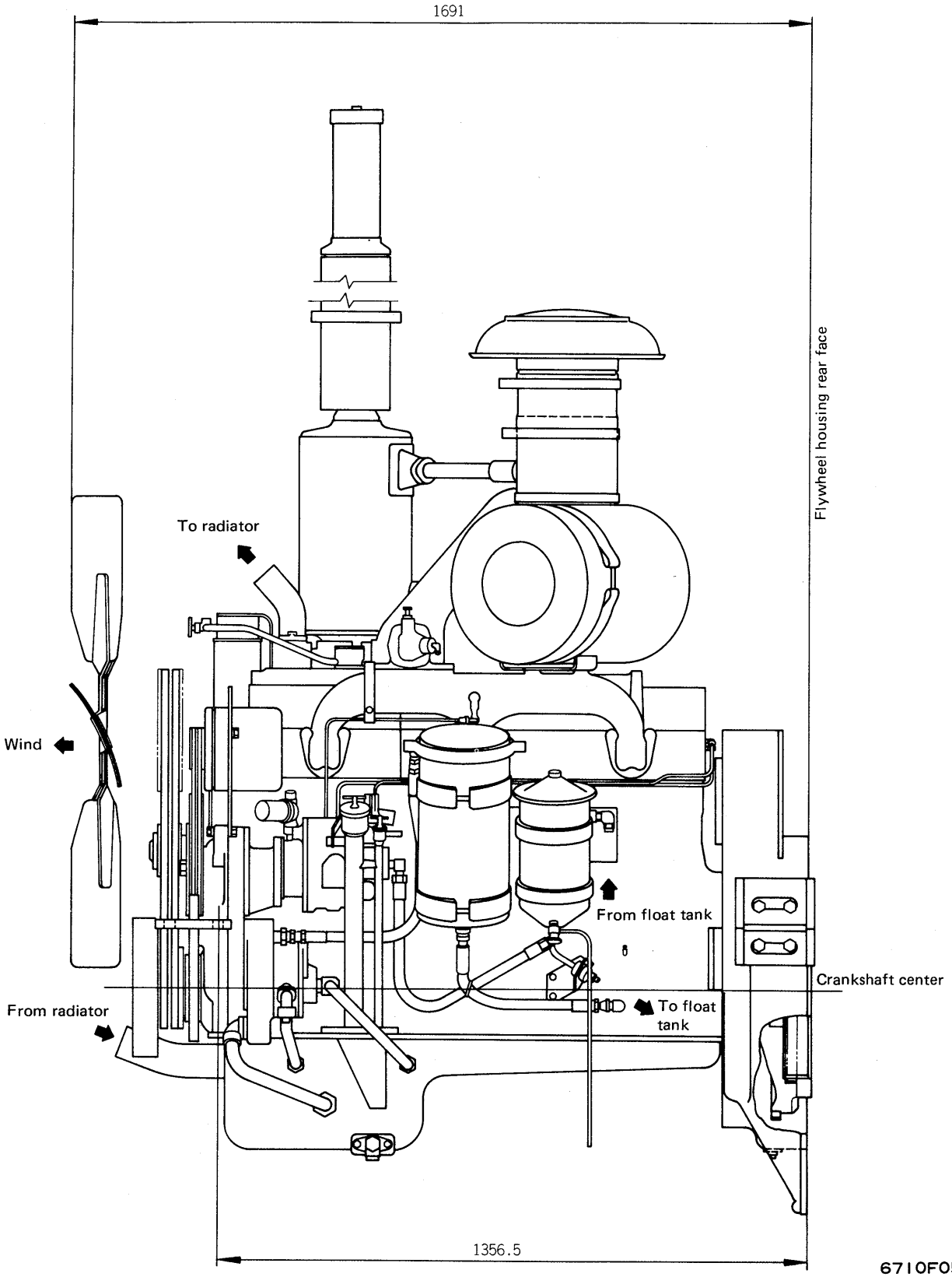

6710F108A

## N-855-C REAR VIEW (For PC300-1)

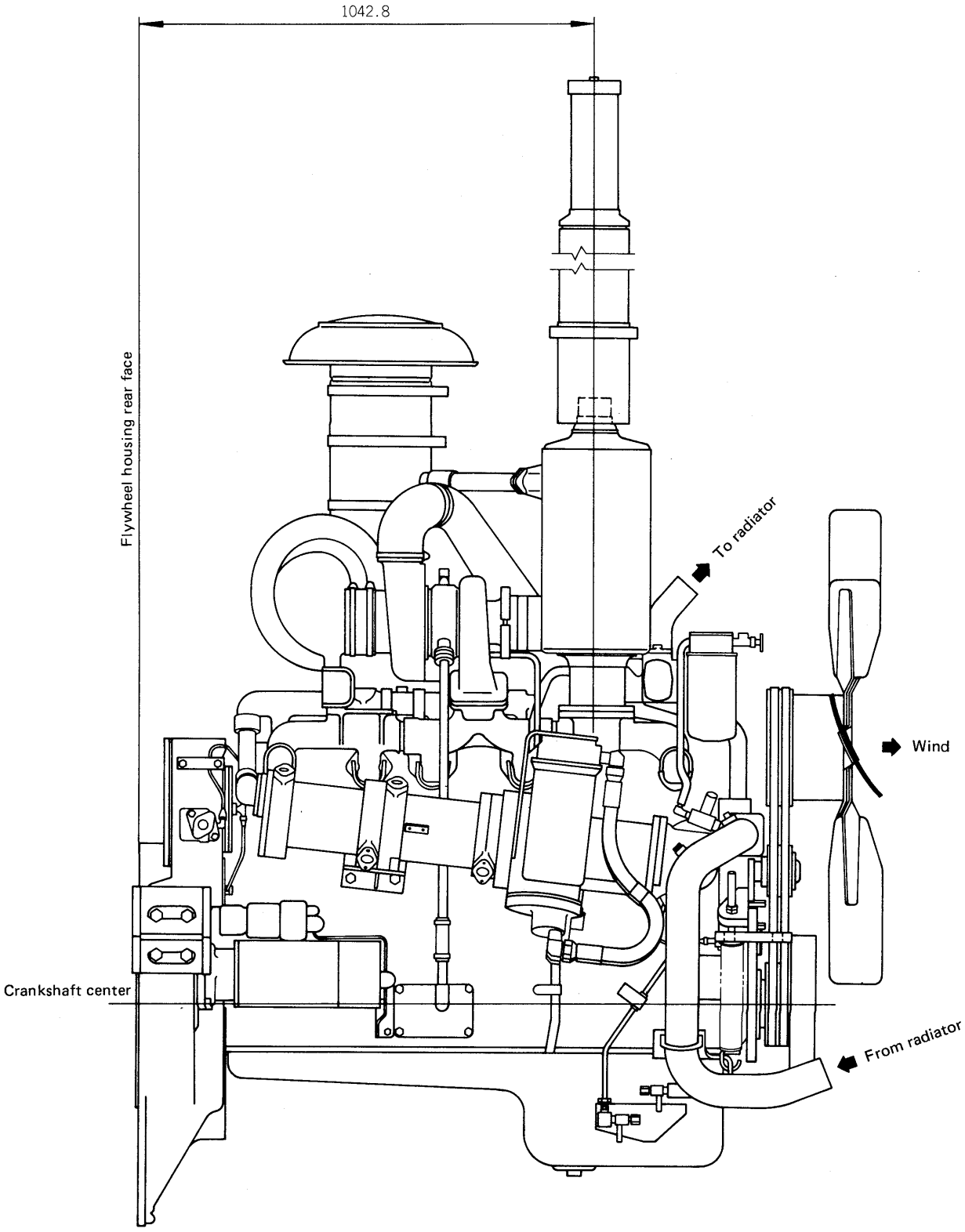



6710F109A

## NT-855-C LEFT SIDE VIEW (For D80, 85A-18)

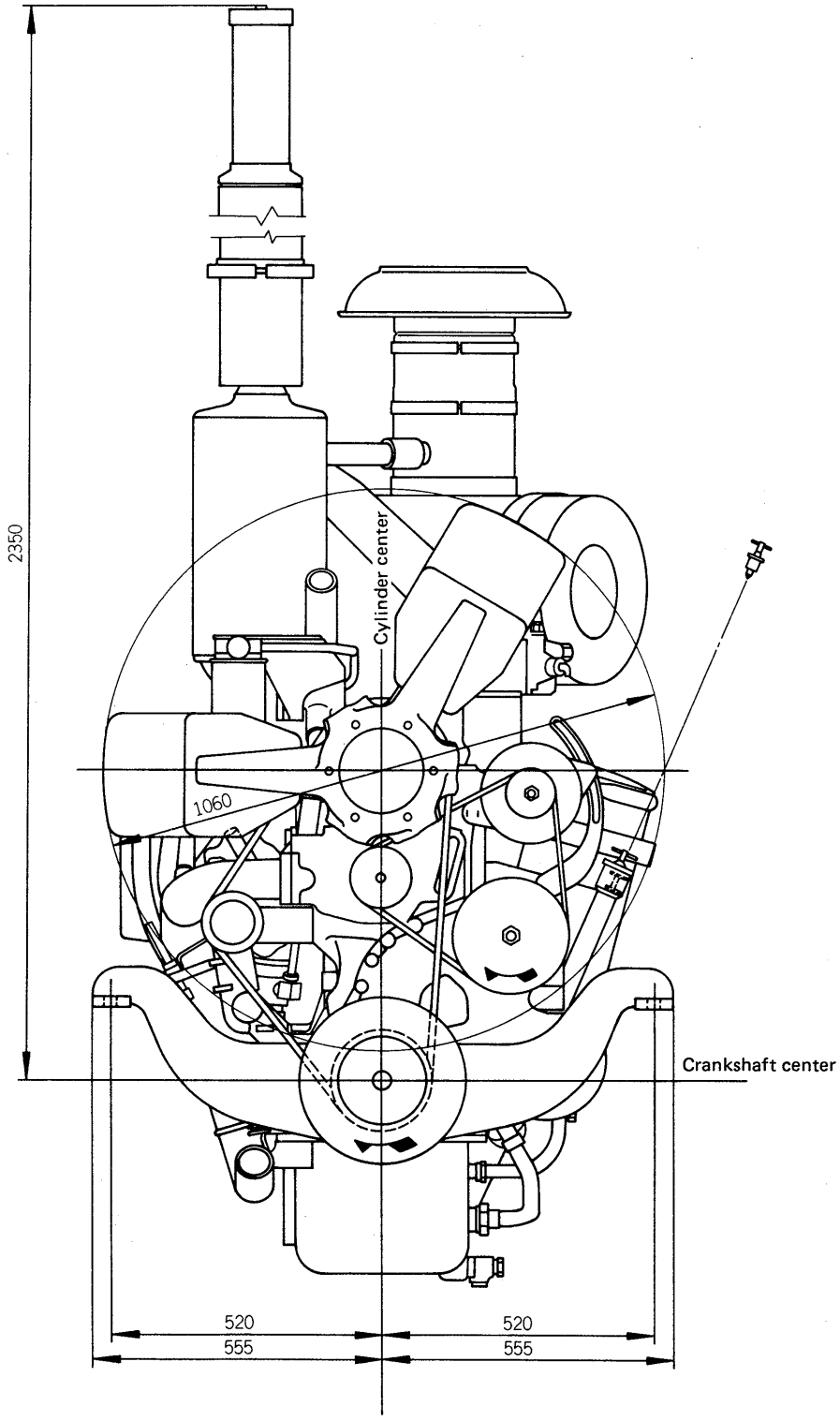


## NT-855-C RIGHT SIDE VIEW (For D80, 85A-18)



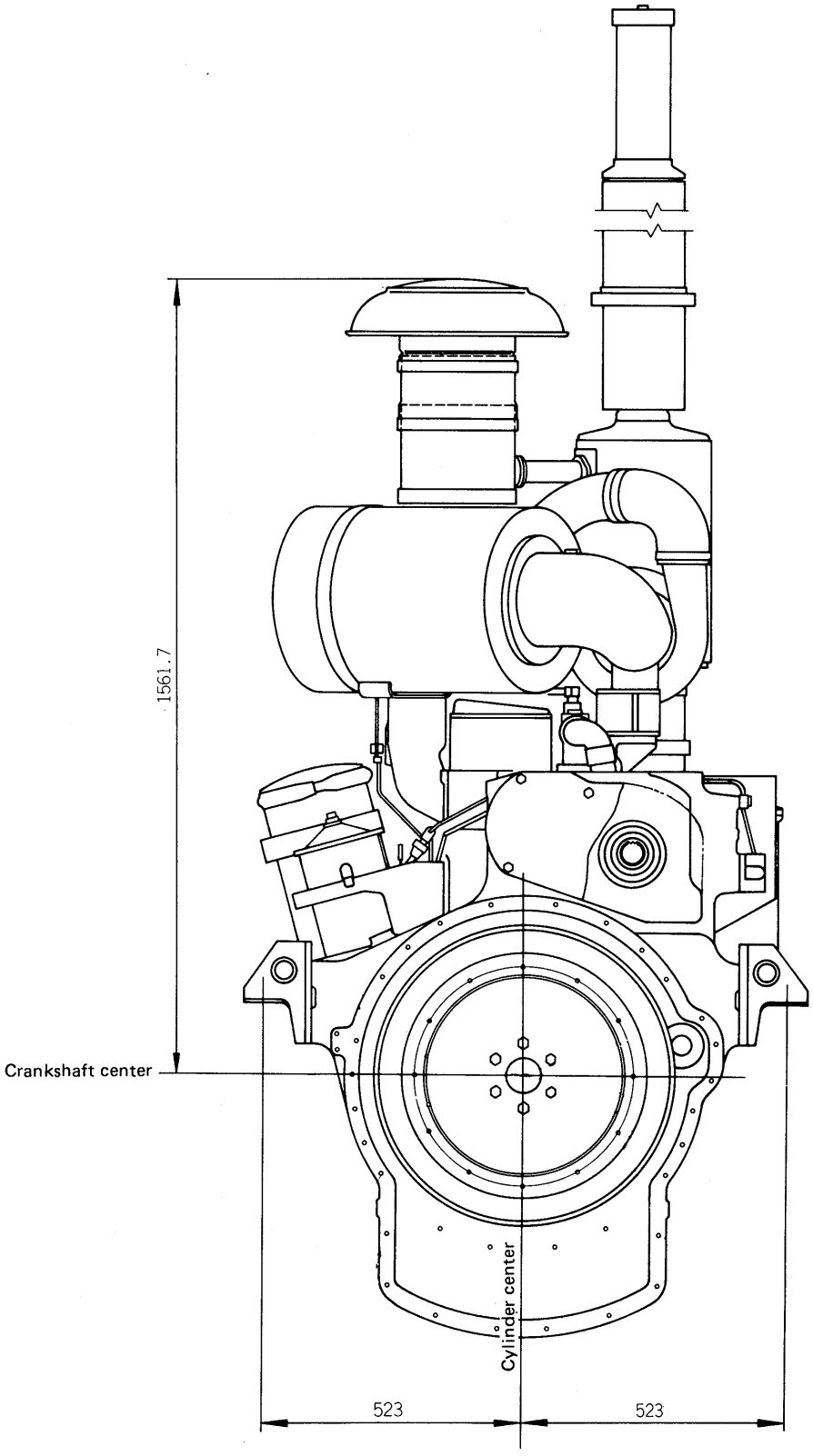

6710F051

## NT-855-C FRONT VIEW (For D80, 85A-18)



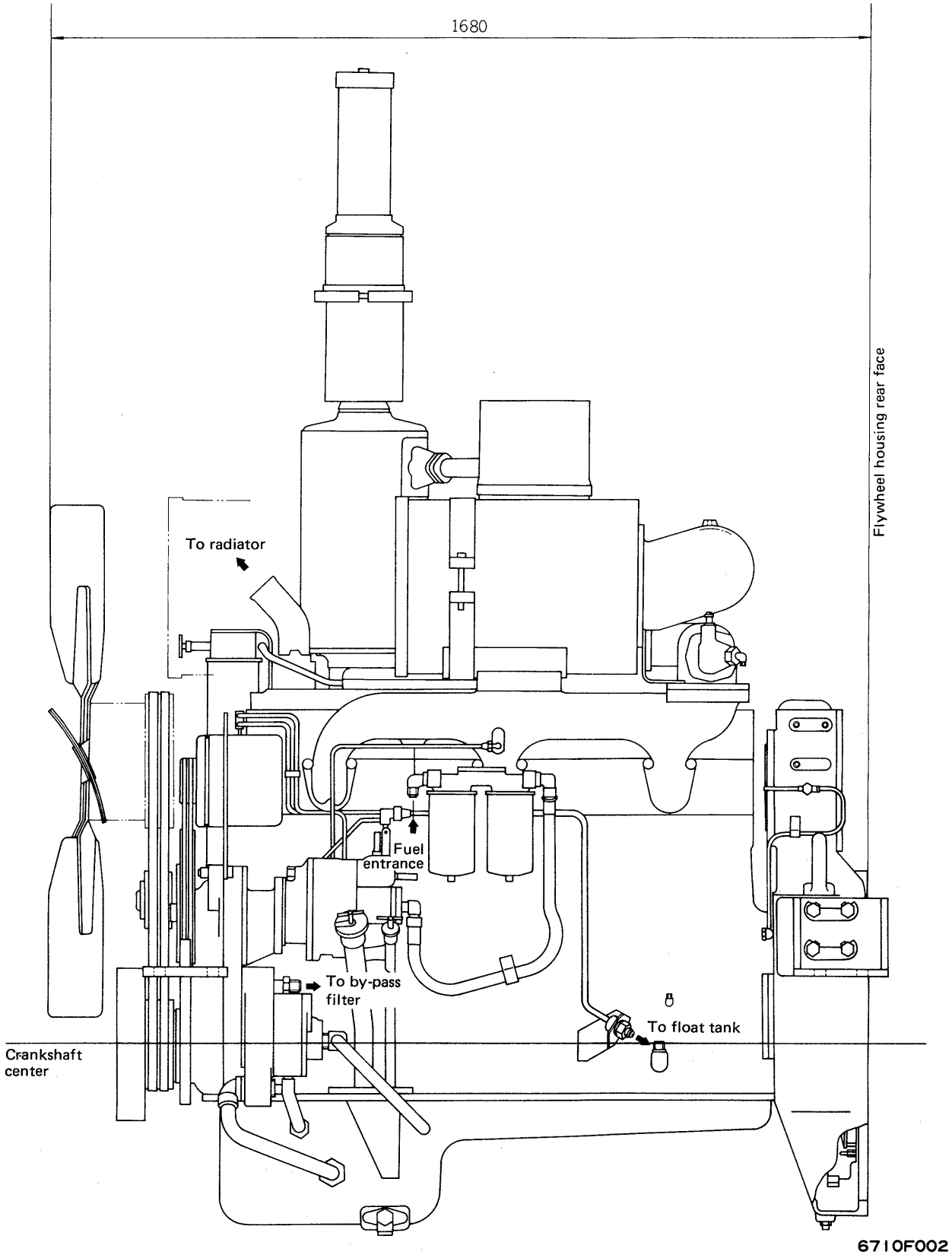

6710F052

## NT-855-C REAR VIEW (For D80, 85A-18)

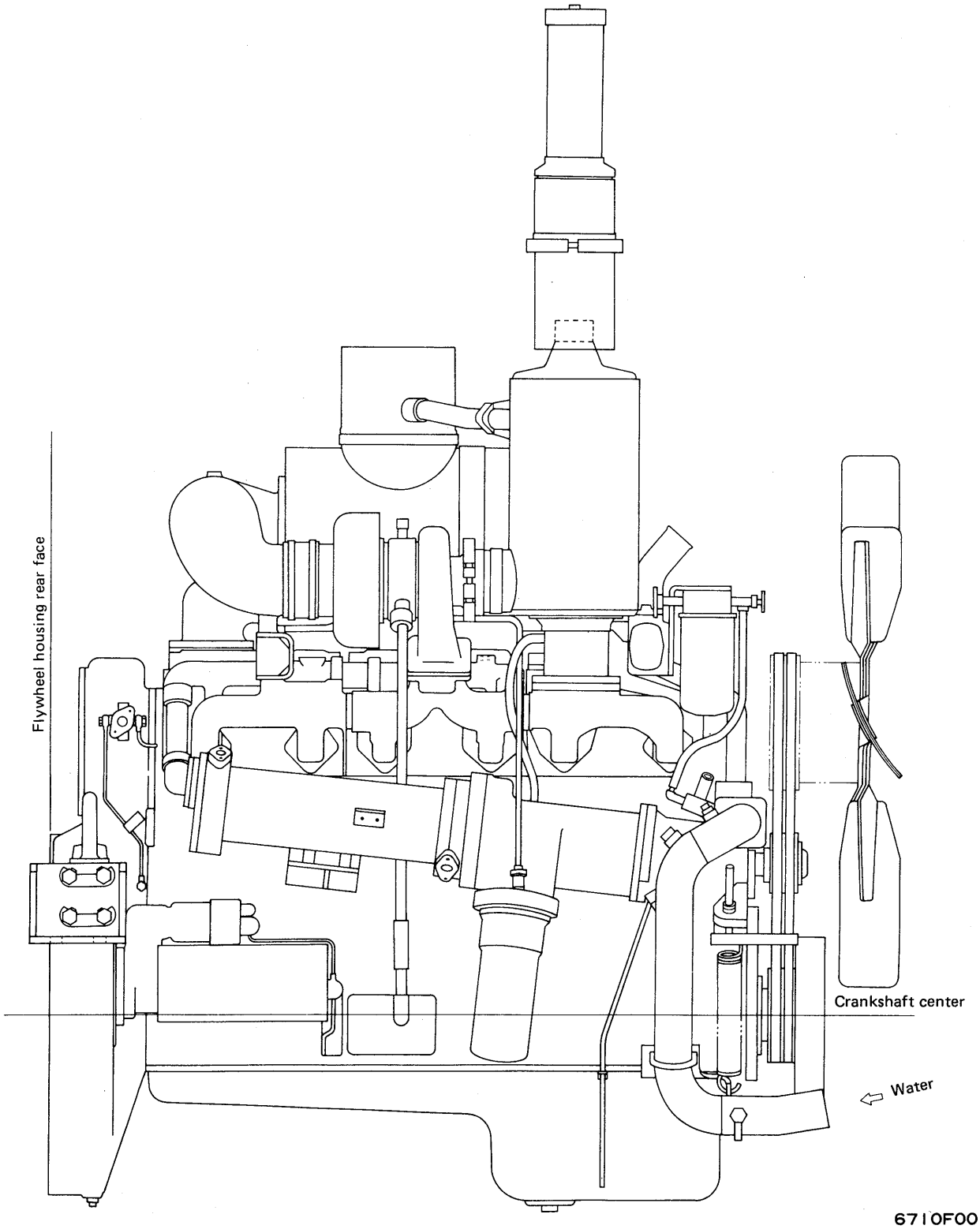



6710F053

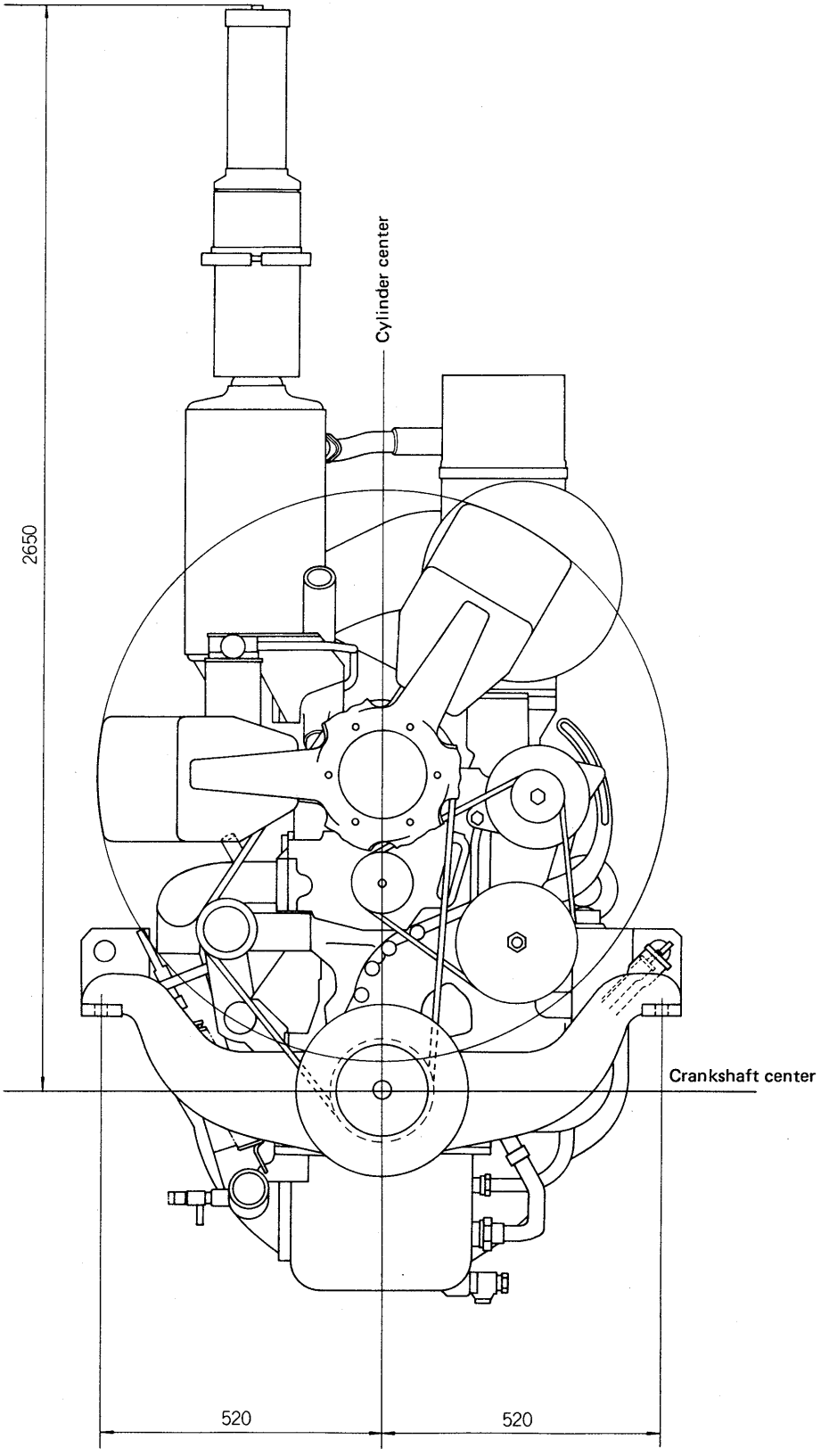
## NT-855-C LEFT SIDE VIEW (For D95S-2)



## NT-855-C RIGHT SIDE VIEW (For D95S-2)

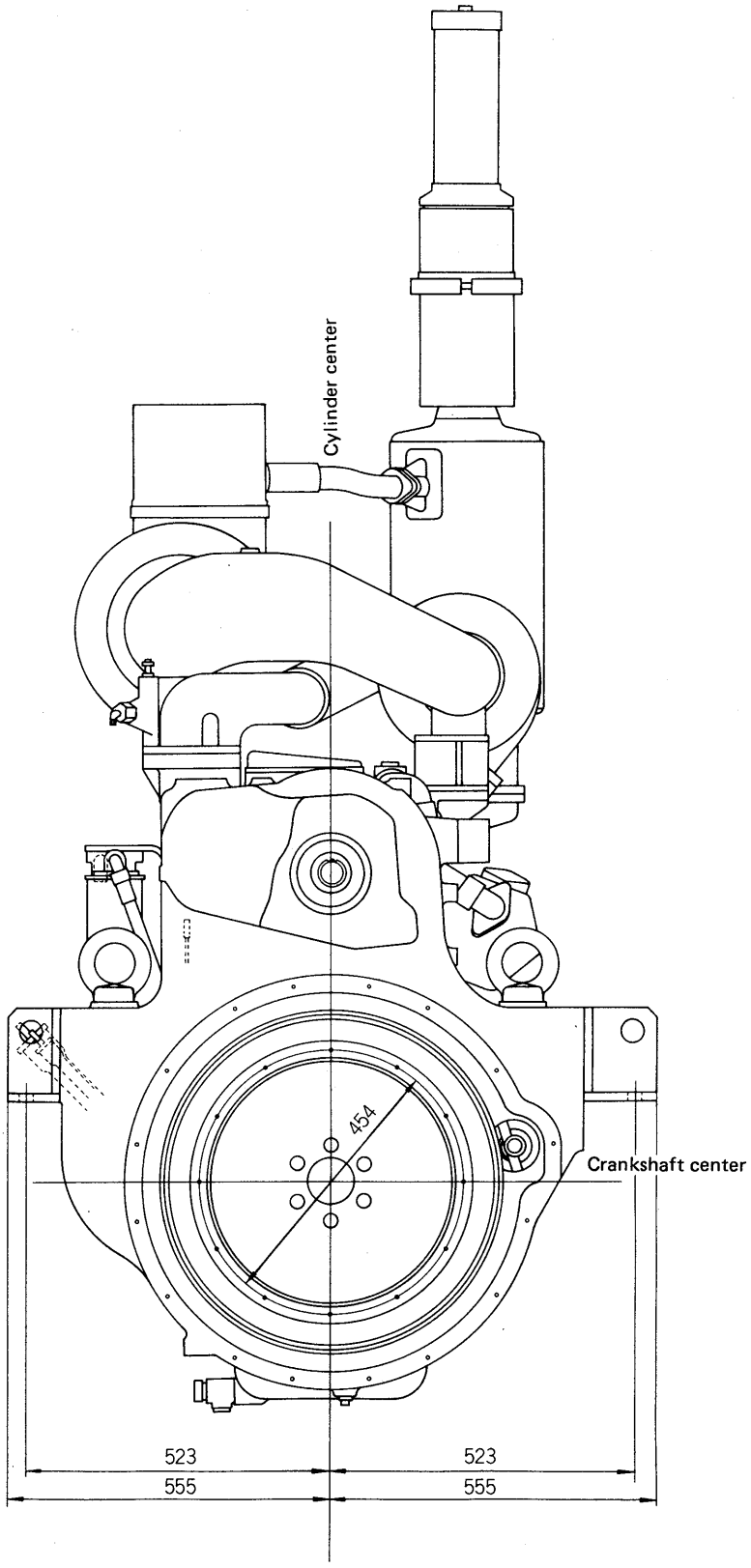


## NT-855-C FRONT VIEW (For D95S-2)



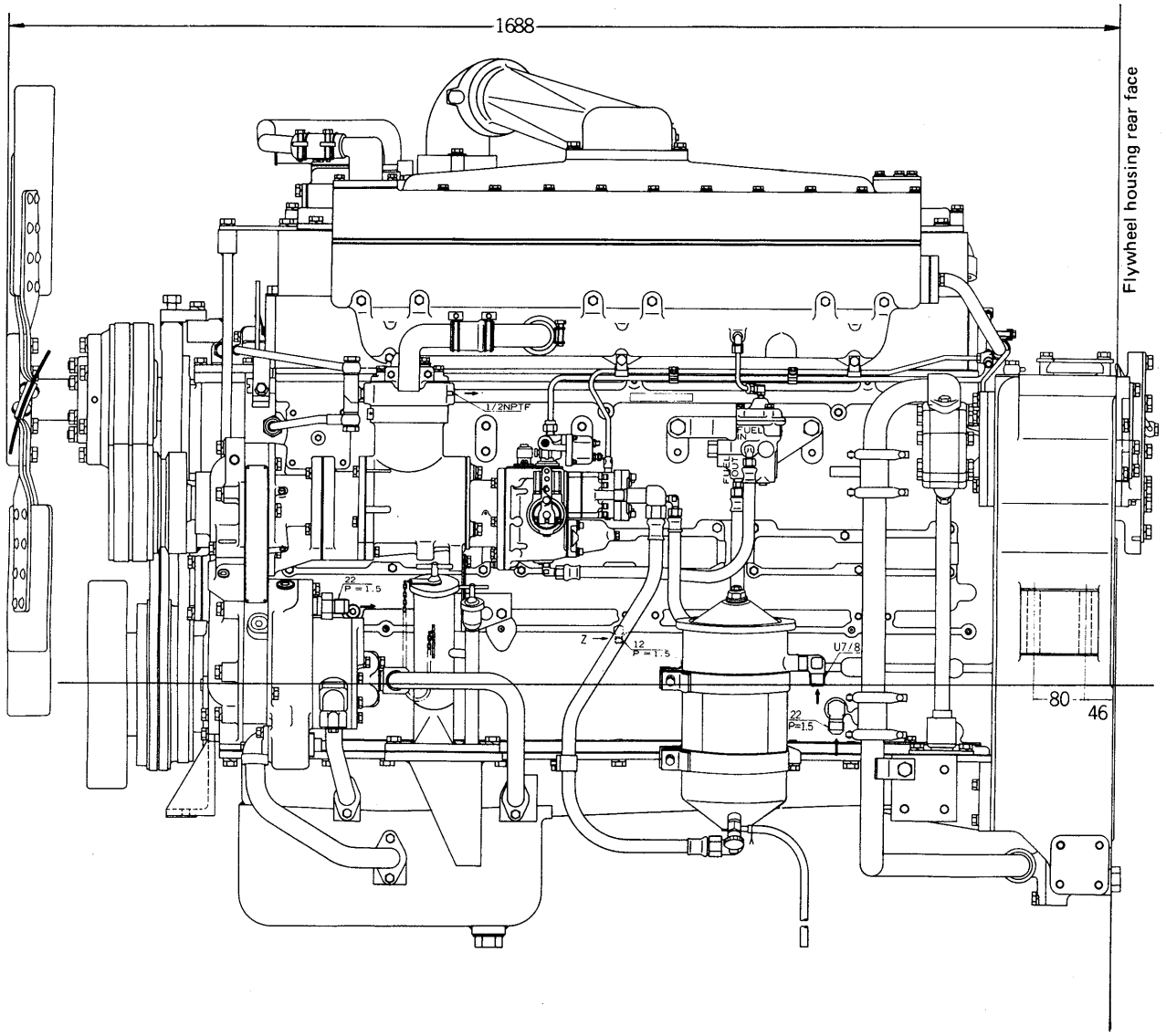

6710F003

## NT-855-C REAR VIEW (For D95S-2)



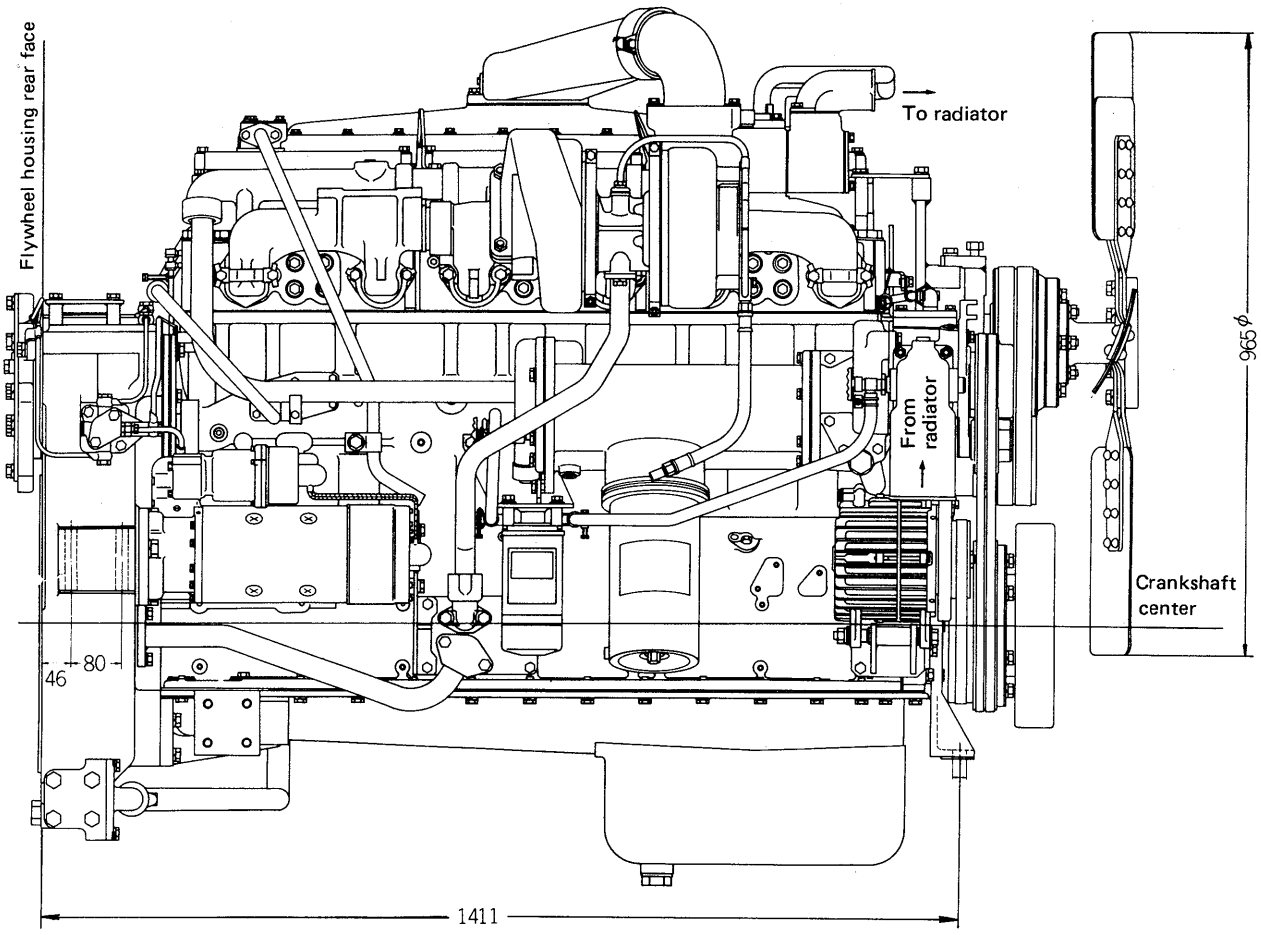

6710F004

## NTA-855-C LEFT SIDE VIEW (For HD320-2 Engine No. 26102754 – 26155098)



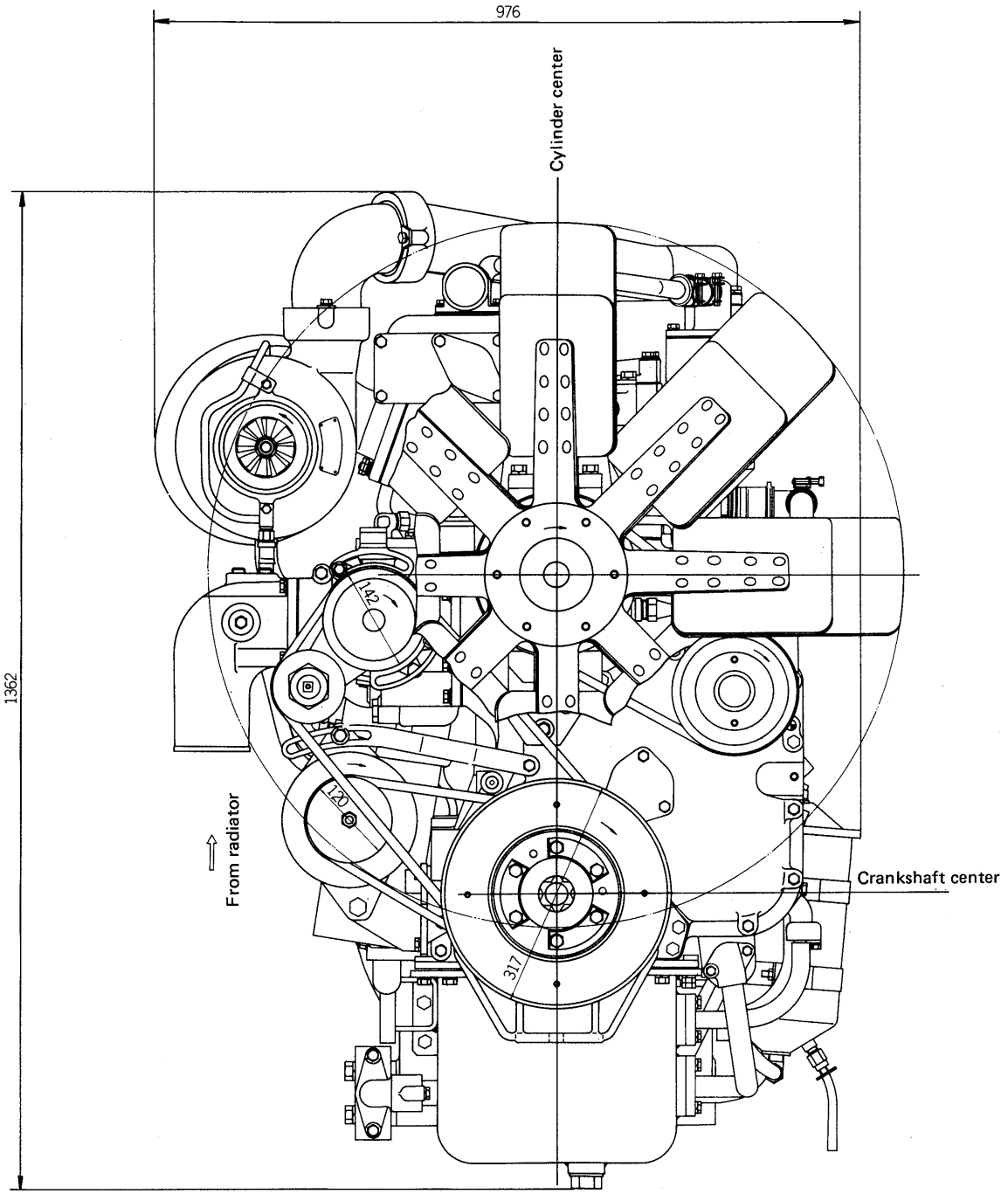

6710F005

## NTA-855-C RIGHT SIDE VIEW (For HD320-2 Engine No. 26102754 – 26155098)



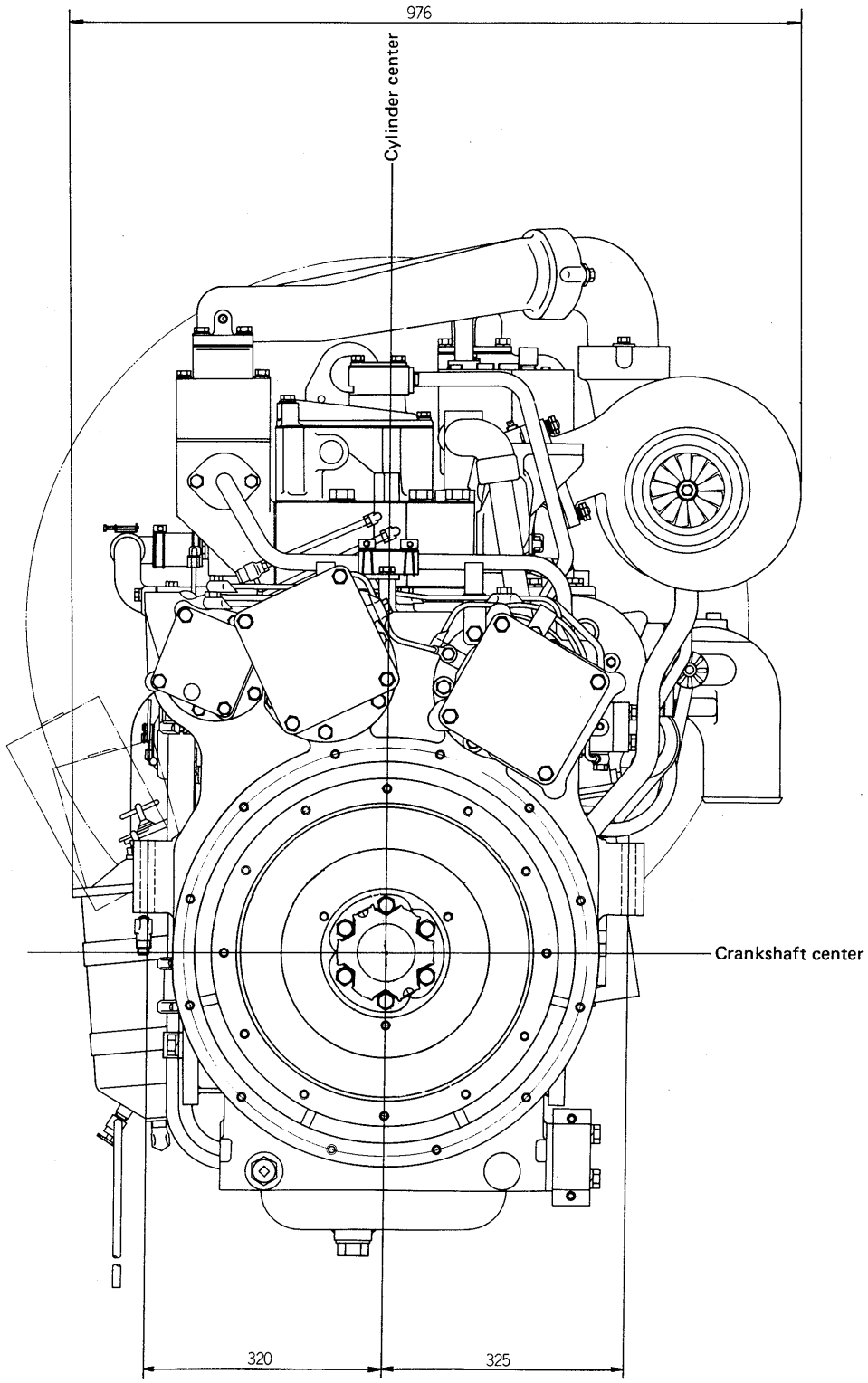

6710F006

## NTA-855-C FRONT VIEW (For HD320-2 Engine No. 26102754 – 26155098)



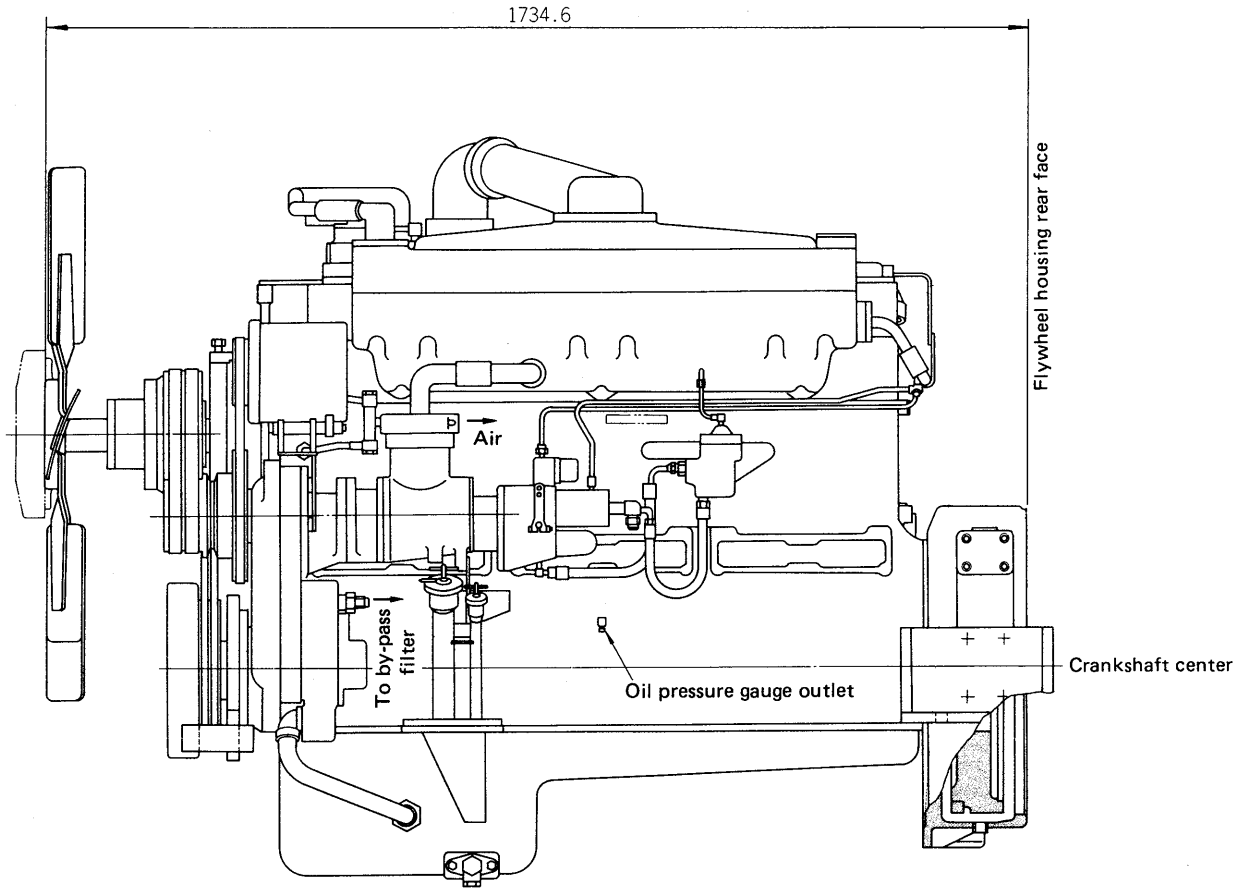

6710F007

## NTA-855-C REAR VIEW (For HD320-2 Engine No. 26102754 – 26155098)



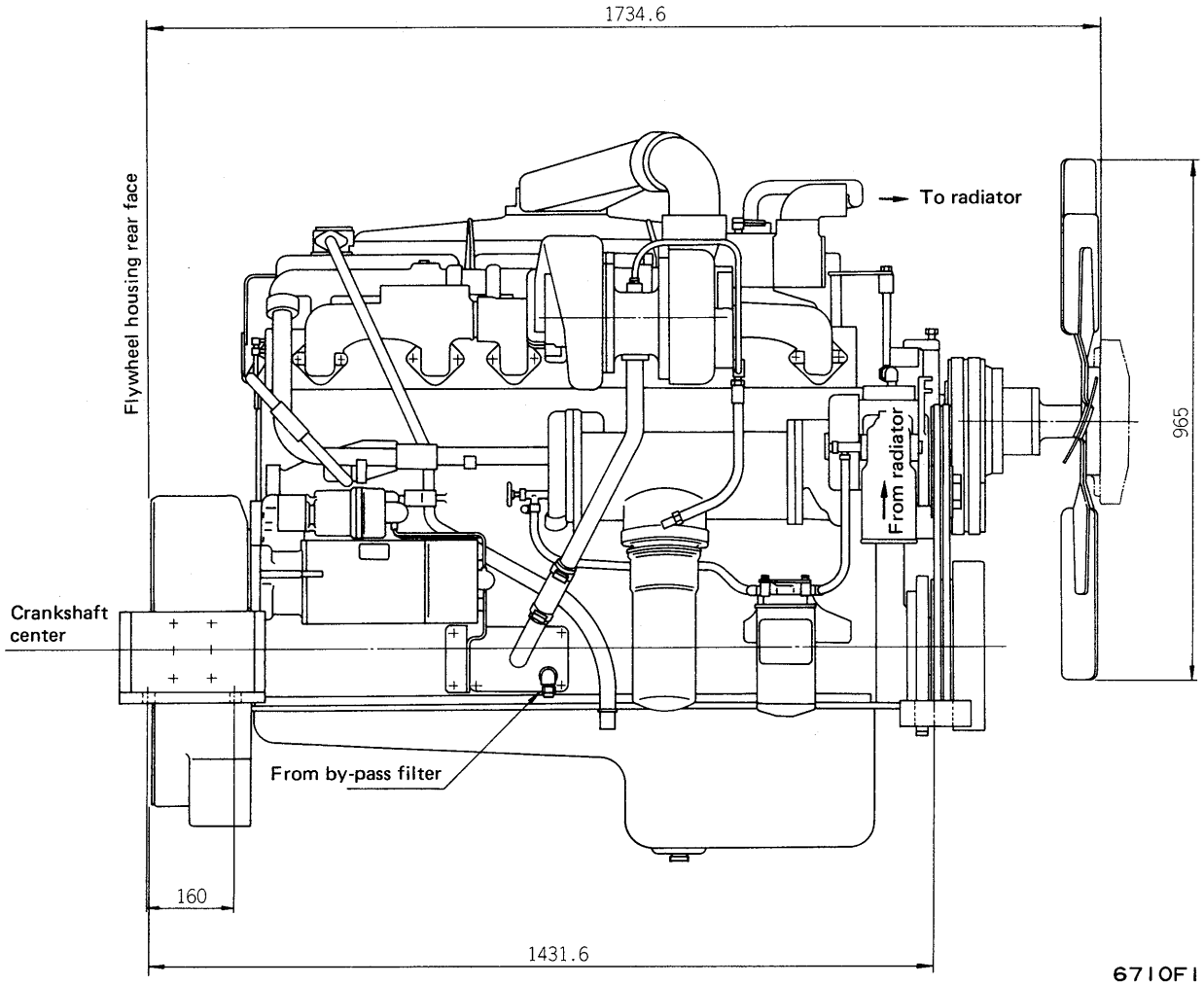

6710F008

## NTA-855-C LEFT SIDE VIEW (For HD320-2 Engine No. 26155099 and up)

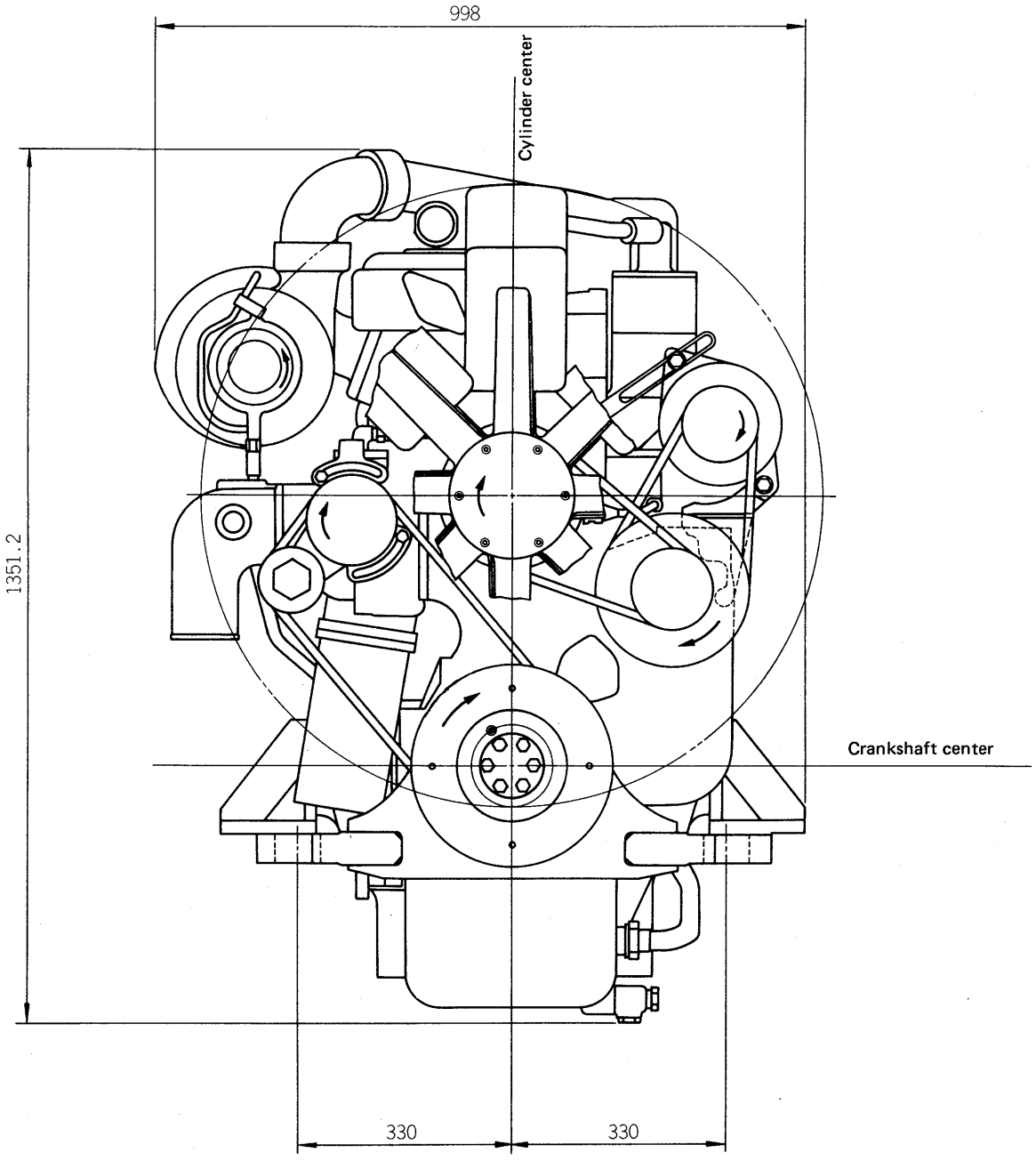



6710F113

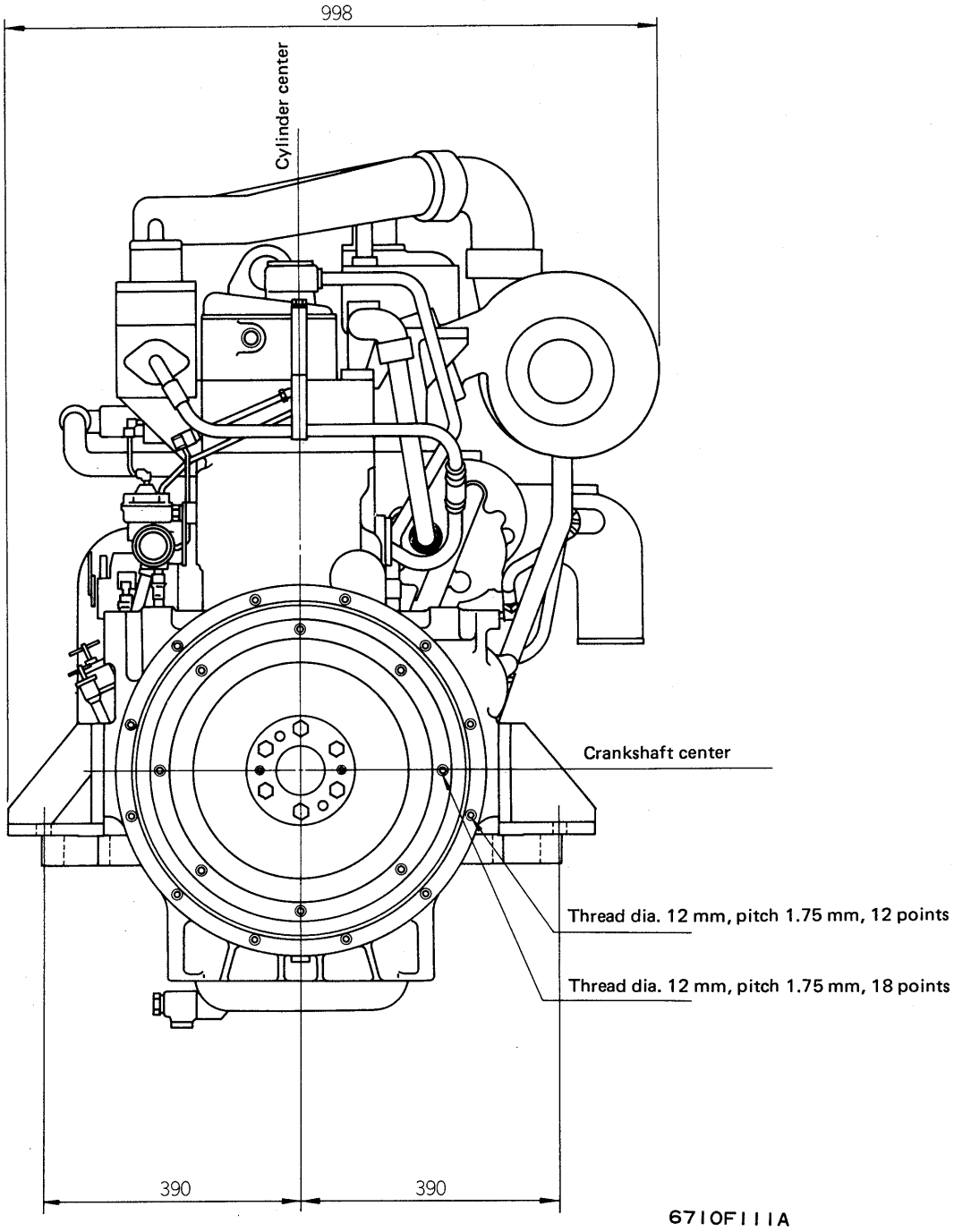
## NTA-855-C RIGHT SIDE VIEW (For HD320-2 Engine No. 26155099 and up)



## NTA-855-C FRONT VIEW (For HD320-2 Engine No. 26155099 and up)



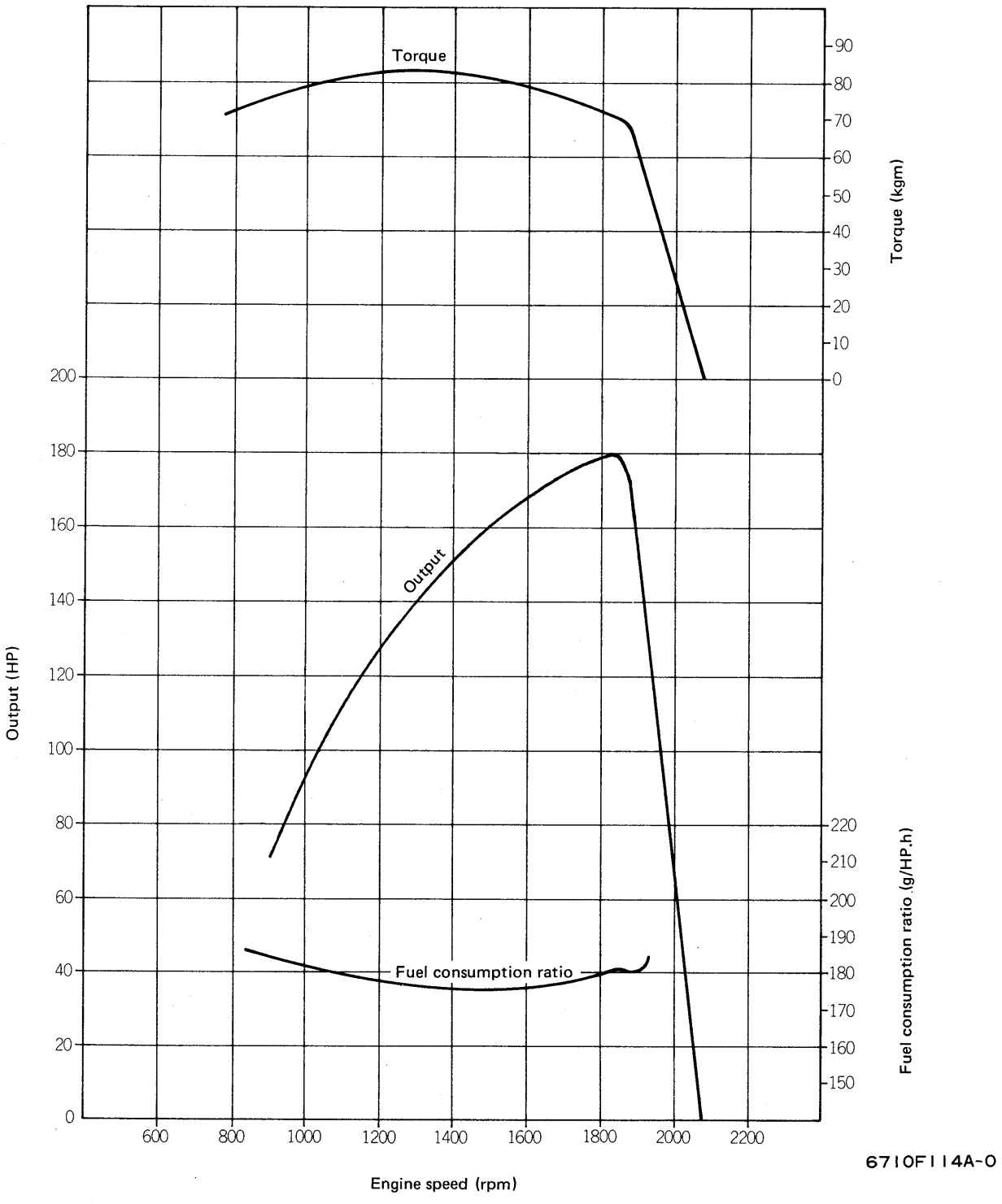
## NTA-855-C REAR VIEW (For HD320-2 Engine No. 26155099 and up)



# PERFORMANCE CURVE

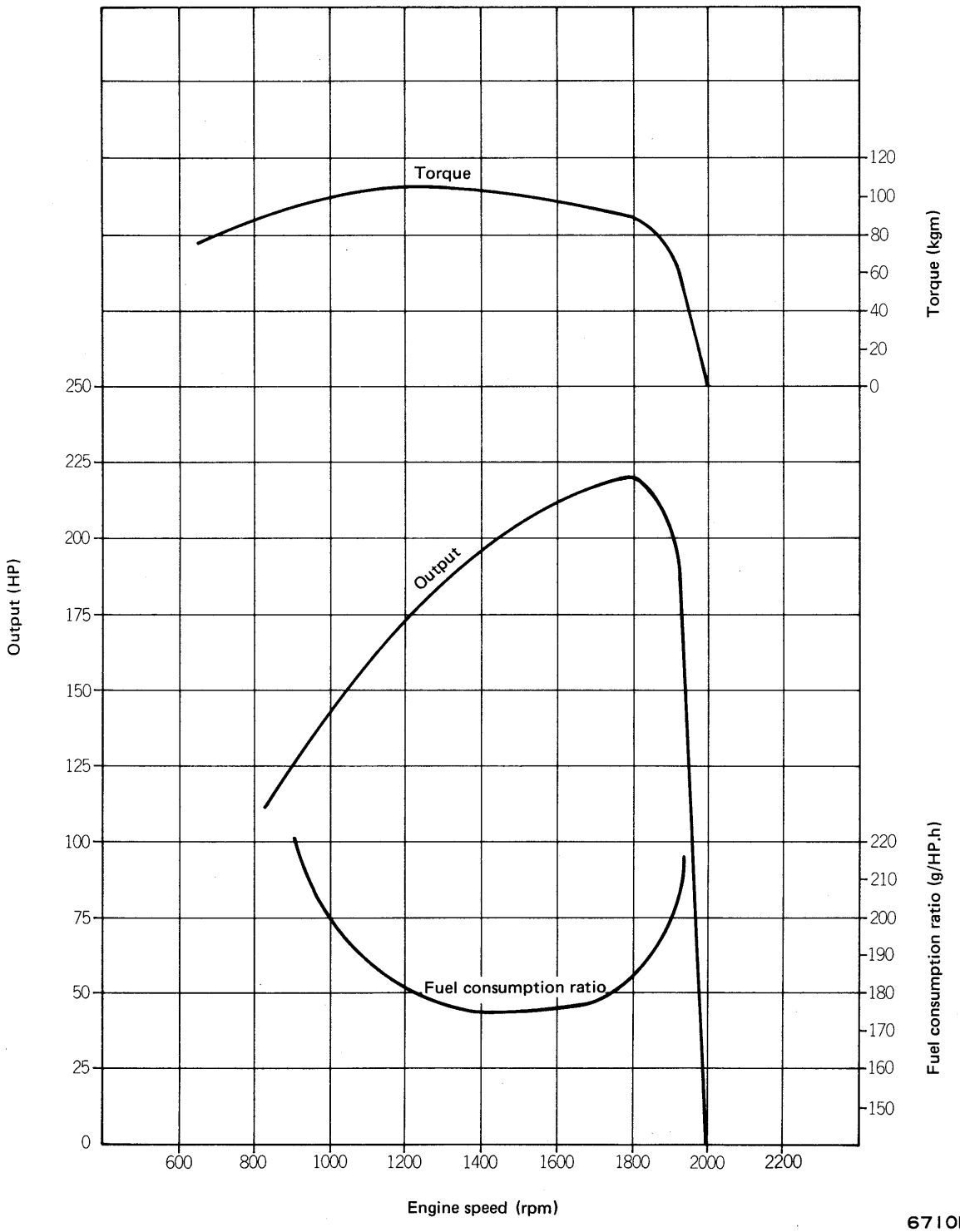
## N-855-C (For PC300-1, 2 and PC300LC-1, 2)

| | | |
|---|---|---|
| Flywheel horsepower | : | 180HP/1,850 rpm |
| Maximum torque | : | 83.5 kgm/1,300 rpm |
| Minimum fuel consumption ratio | : | 175 g/HP.h |



## NT-855-C (For D80A, E-18 and D85A, E, P-18)

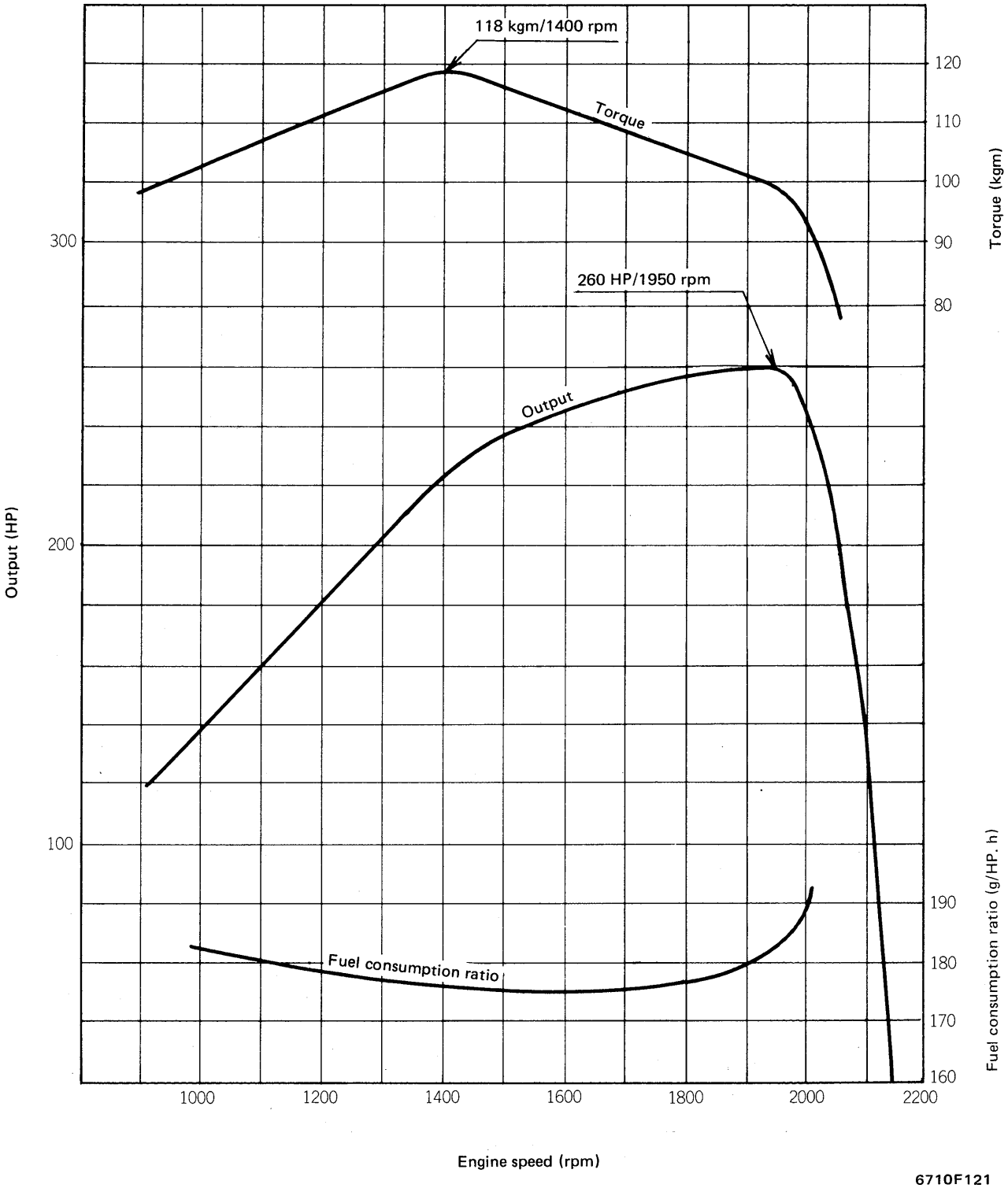
Flywheel horsepower : 220HP/1,800 rpm
Maximum torque : 105kgm/1,250 rpm
Minimum fuel consumption ratio : 175 g/HP.h




6710F009A-0

## NT-855-C (For D80F-18)

Flywheel horsepower : 260 HP/1,950 rpm
Maximum torque : 118 kgm/1,400 rpm
Minimum fuel consumption ratio : 175 g/HP.h



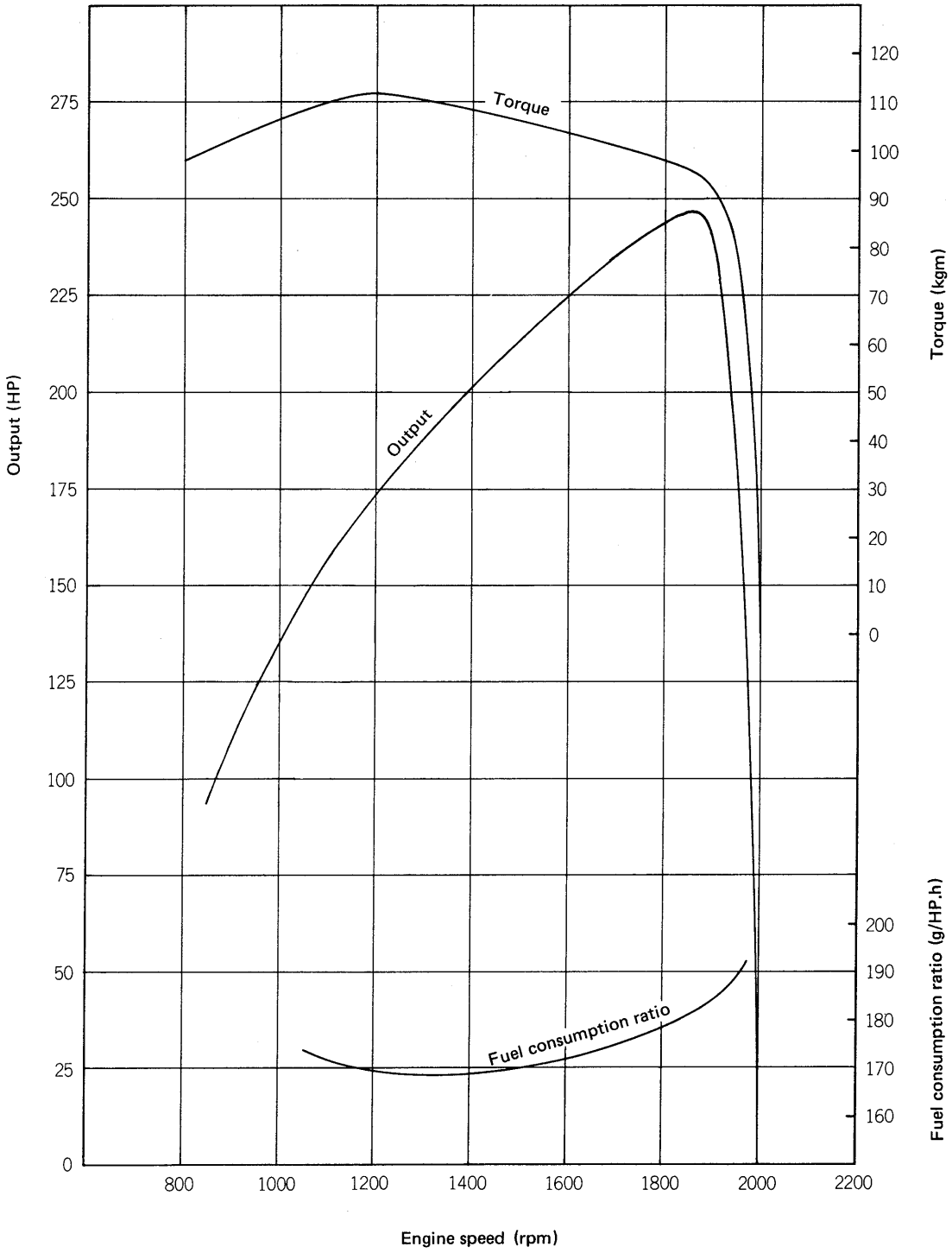

6710F121

## NT-855-C (For D95S-2)

Flywheel horsepower : 245HP/1,850rpm

Maximum torque : 112kgm/1,200rpm

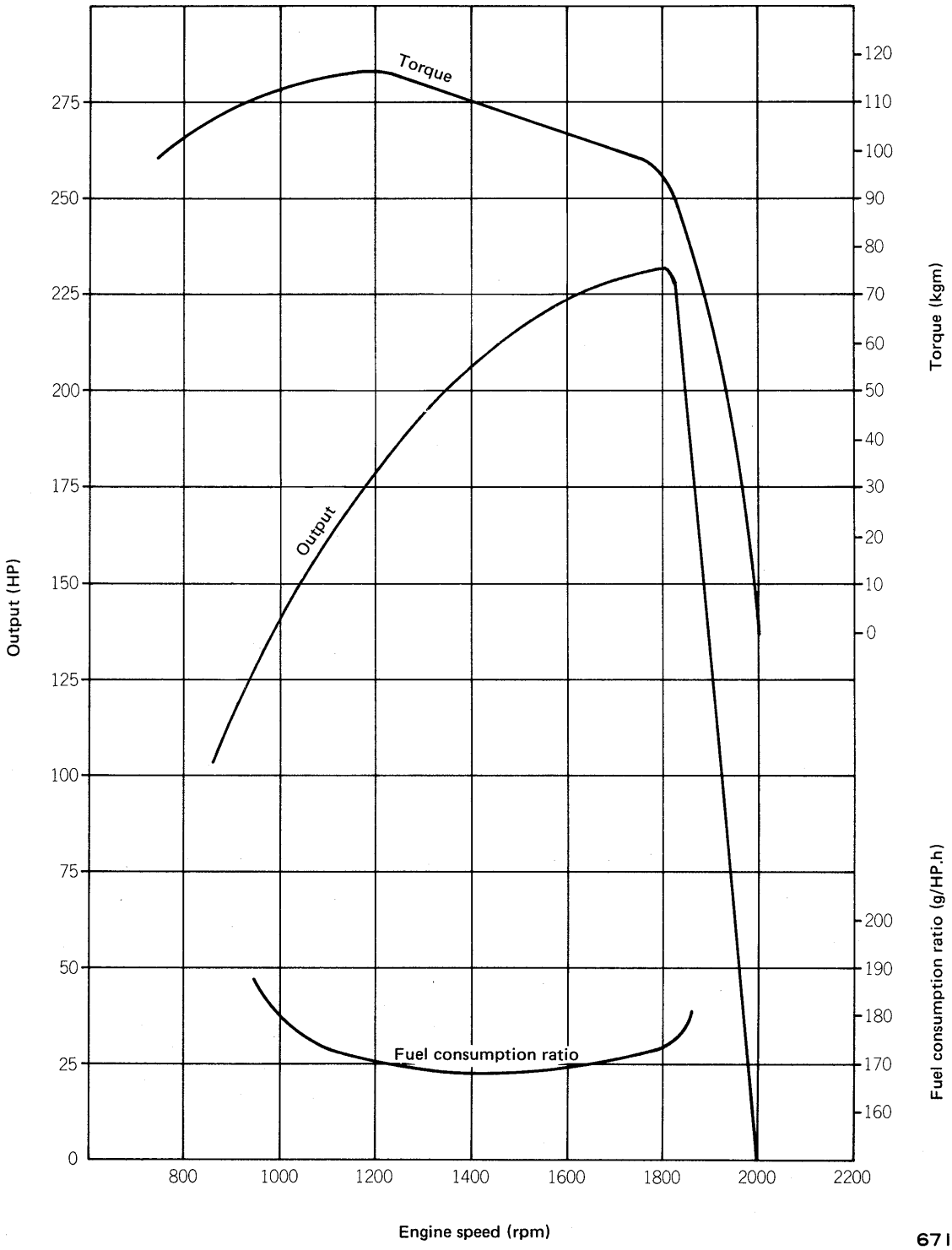
Minimum fuel consumption ratio : 169g/HP.h




6710F010

## NT-855-C (For PC400-1, PC400LC-1)

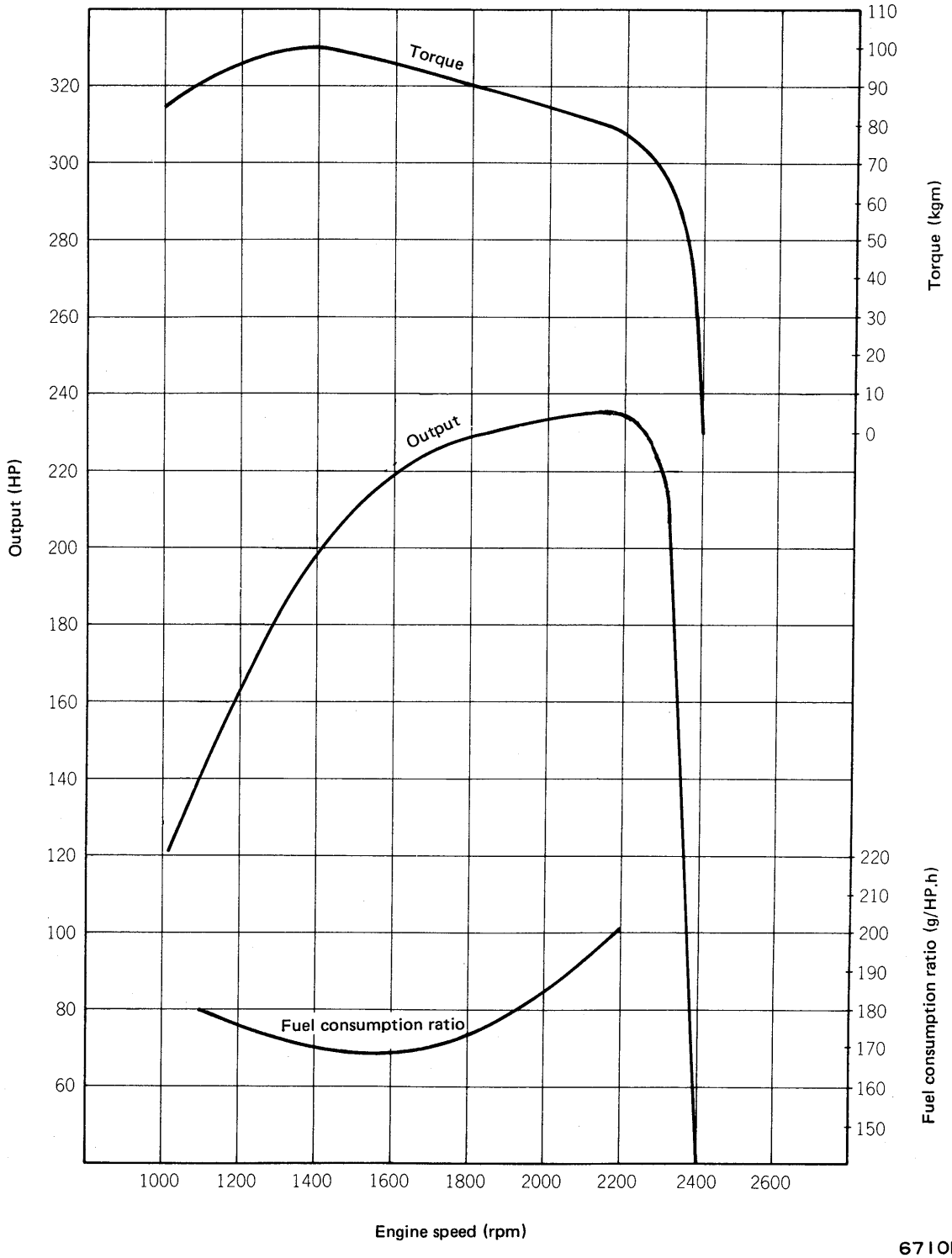
Flywheel horsepower : 233HP/1,800 rpm
Maximum torque : 116kgm/1,200 rpm
Minimum fuel consumption ratio : 175g/HP.h




6710F010-1

## NT-855 (For W170-2)

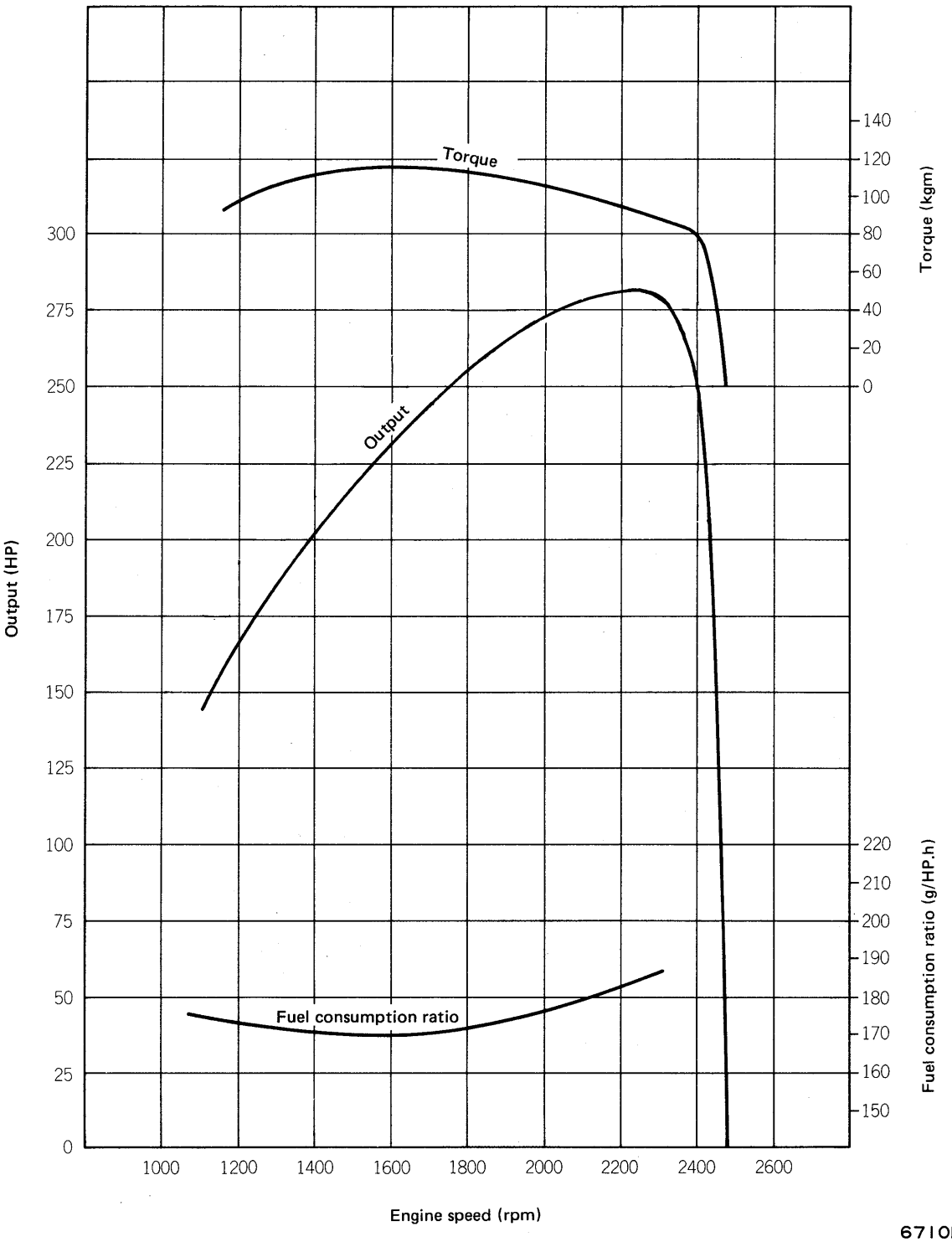
Flywheel horsepower : 235HP/2,200rpm
Maximum torque : 100kgm/1,400rpm
Minimum fuel consumption ratio : 168g/HP.h




6710F010-2

## NT-855 (For W180-1)

Flywheel horsepower : 280HP/2,300rpm
Maximum torque : 116kgm/1,600rpm
Minimum fuel consumption ratio : 170g/HP.h



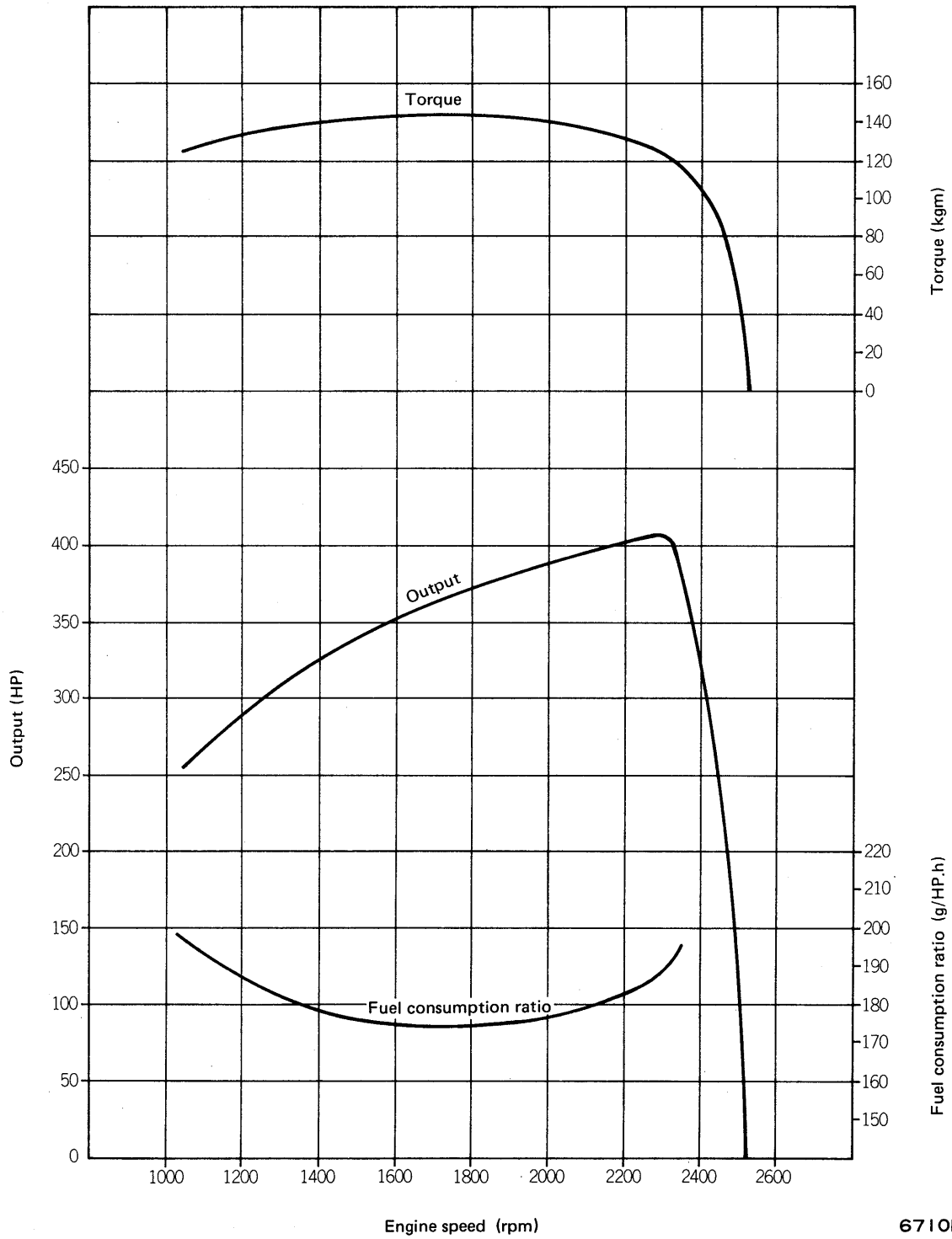

6710F116-0

## NTA-855-C (For HD320-2 and HD320-3)

Flywheel horsepower : 405HP/2,300rpm

Maximum torque : 142kgm/1,700rpm

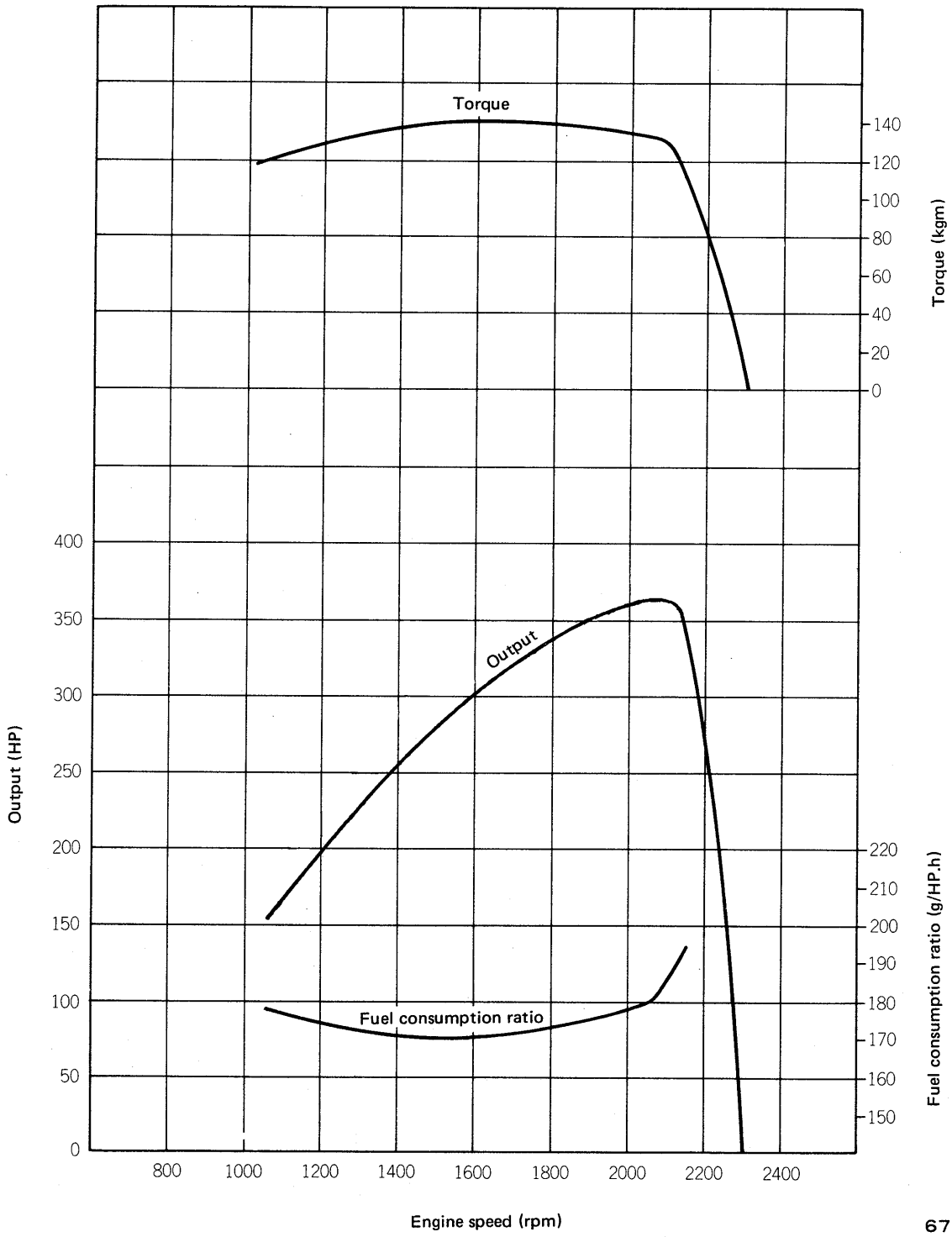
Minimum fuel consumption ratio : 175g/HP.h




6710F011A

## NTA-855 (For WS16S-2 and WS23-1)

Flywheel horsepower : 364HP/2,100rpm
Maximum torque : 140kgm/1,500rpm
Minimum fuel consumption ratio : 175 g/HP.h




6710F117-0

# WEIGHT TABLE

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

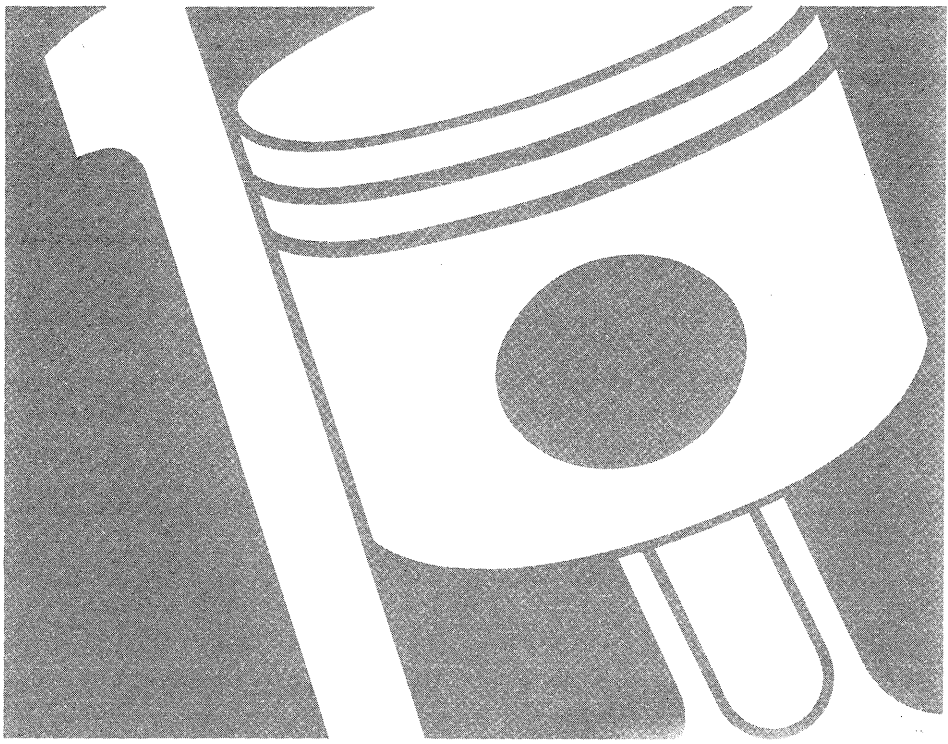
| No. | Item | Components | N-855-C | NT-855-C | NTA-855-C | Remarks |
|---|---|---|---|---|---|---|
| 1 | Turbocharger | | – | 27.5 | 27.5 | Cummins ST-50 |
| | | | – | – | 32 | Komatsu KTR-130 |
| 2 | After-cooler | | – | – | 27 | |
| 3 | Cylinder head assembly | Cylinder head, valve, valve spring | 40.5 | 40.5 | 40.5 | |
| 4 | Cylinder block assembly | Cylinder block, cylinder liner, main bearing cap | 350 | 350 | 350 | |
| 5 | Flywheel assembly | Flywheel, ring gear | 49 | 49 | – | PC300-1, 2 PC300LC-1, 2 PC400-1, PC400LC-1 |
| | | | – | 87 | – | D80A, E, F-18 |
| | | | – | 65.5 | – | D85A, E, P-18 D95S-2 |
| | | | – | 51 | – | W170-2, W180-1 |
| | | | – | – | 55.5 | HD320-2, 3 WS16S-2, WS23-1 |
| 6 | Flywheel housing | | 84 | 84 | – | PC300-1, 2, PC300LC-1, 2 PC400-1, PC400LC-1, W170-2, W180-1 |
| | | | – | 152 | – | D80A, E, F-18 |
| | | | – | 139 | – | D85A, E, P-18 |
| | | | – | 150 | – | D95S-2 |
| | | | – | – | 92 | |
| 7 | Timing gear case | | 22 | 22 | 22 | |
| 8 | Oil pan | | 32 | 32 | 32 | |
| 9 | Crankshaft assembly | Crankshaft, crankshaft gear | 157 | 157 | 157 | |
| 10 | Camshaft assembly | Camshaft, camshaft gear, thrust plate | 18 | 18 | 18 | |
| 11 | Piston and connecting rod assembly | Piston, piston ring, piston pin, connecting rod, connecting rod cap | 61 | 61 | 61 | Whole weights |
| 12 | PT fuel pump | | 10 | 10 | 10 | |
| 13 | Water pump | | 11.5 | 13 | 13 | |
| 14 | Starting motor | | 45 | 45 | 45 | |
| 15 | Alternator | | 14 | 14 | 14 | |
| | | | – | – | 18 | HD320-2, 3 WS16S-2, WS23-1 |

# SHOP MANUAL

# N-855 SERIES

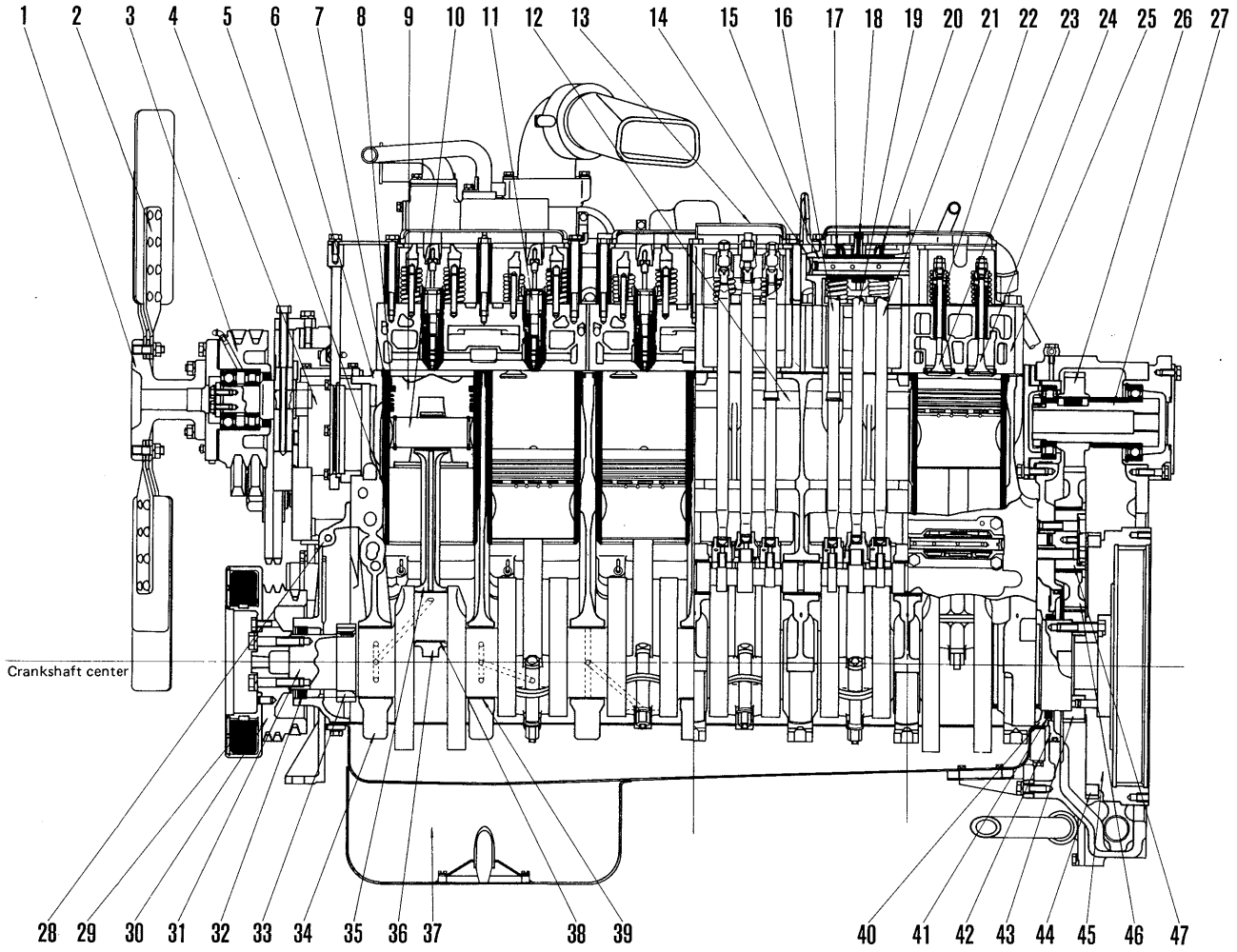
**Engine Serial No. 26100001 and up**

# 11 ENGINE STRUCTURE AND FUNCTION



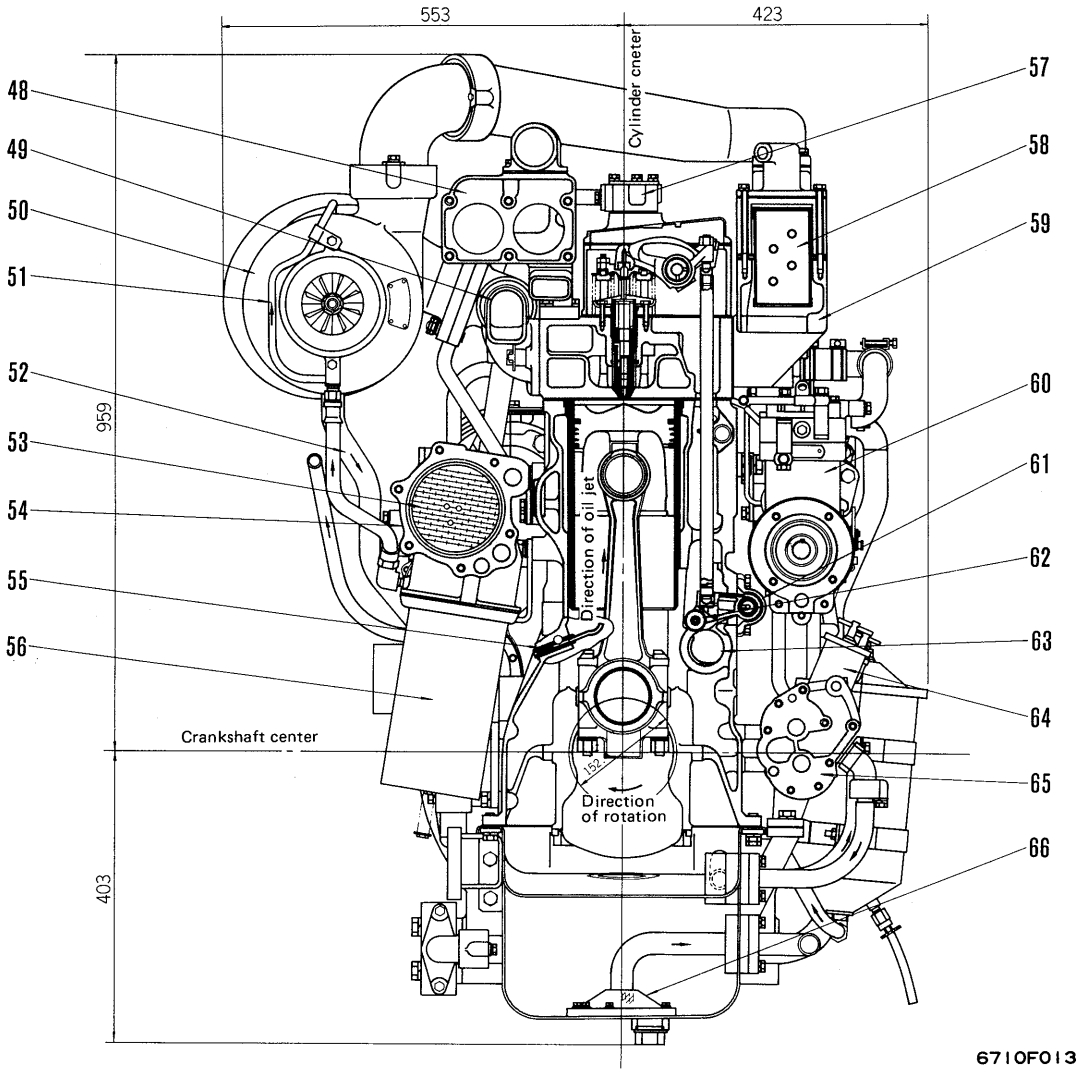
# CONTENTS

# GENERAL STRUCTURE




6710F012

1. Fan spacer
2. Fan
3. Fan pulley
4. Water pump
5. Liner seal ring
6. Cylinder block
7. Cylinder liner
8. Piston ring
9. Piston
10. Piston pin
11. Injector
12. Compression release shaft
13. Rocker arm housing
14. Rocker arm housing
15. Rocker arm shaft
16. Push rod (Exhaust)
17. Rocker arm (Exhaust)
18. Rocker arm (Injector)
19. Push rod (Injector)
20. Rocker arm (Intake)
21. Push rod (Intake)
22. Valve guide
23. Valve (Intake)
24. Valve (Exhaust)
25. Cylinder head
26. PTO gear
27. PTO gear shaft
28. Gear case
29. Vibration damper
30. Crankshaft pulley
31. Crankshaft
32. Front oil seal
33. Crankshaft gear
34. Main bearing cap
35. Connecting rod
36. Connecting rod cap
37. Oil pan
38. Connecting rod bearing
39. Main bearing
40. Rear cover plate
41. Rear oil seal
42. Seal retainer
43. PTO drive gear
44. Ring gear
45. Flywheel
46. PTO idler gear
47. PTO idler shaft
48. Thermostat housing
49. Exhaust manifold
50. Turbocharger
51. Oil pipe (to turbocharger)
52. Oil pipe (from turbocharger)




53. Oil cooler element
54. Oil cooler housing
55. Piston cooling nozzle
56. Full-flow filter
57. Crankcase breather
58. After-cooler core
59. After-cooler housing
60. Air compressor
61. Cam follower shaft
62. Cam roller
63. Camshaft
64. Oil filler
65. Oil pump
66. Oil strainer

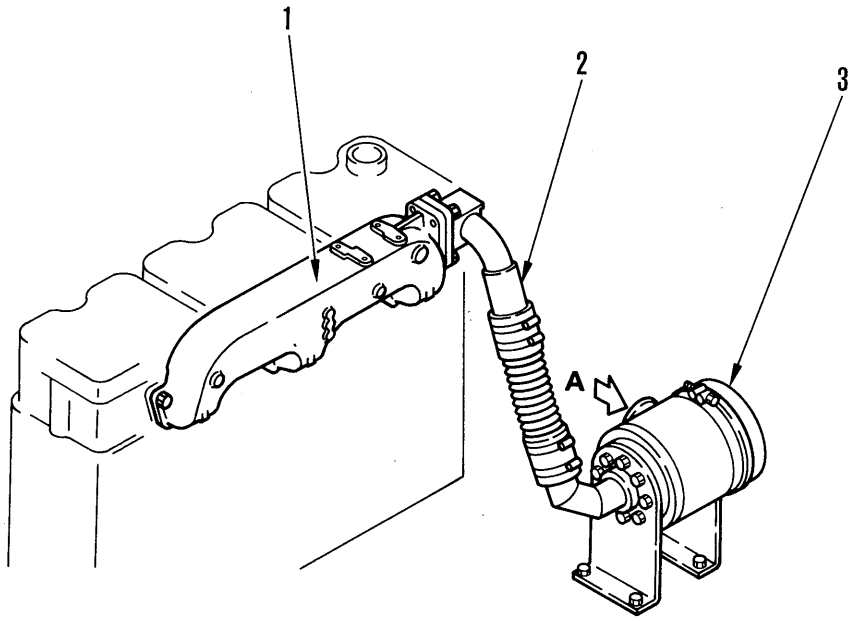
Engine:
N-855-C
NT-855-C (With turbocharger)
NTA-855-C
(With turbocharger and after-cooler)

Type: In-line, 6-cylinders, water-cooled, direct fuel injection, 4-cycle diesel engine.

# INTAKE AND EXHAUST SYSTEM

## N-855-C (For PC300-1, 2, PC300LC-1, 2)

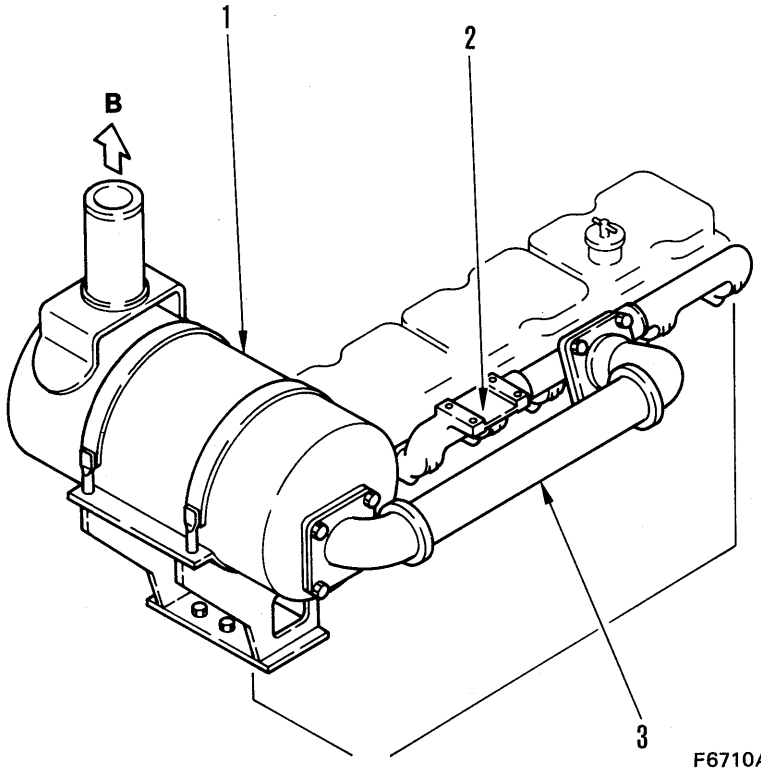
### INTAKE SYSTEM




F6710A001

1. Intake manifold
2. Intake connector pipe
3. Air cleaner
A. Intake

### EXHAUST SYSTEM

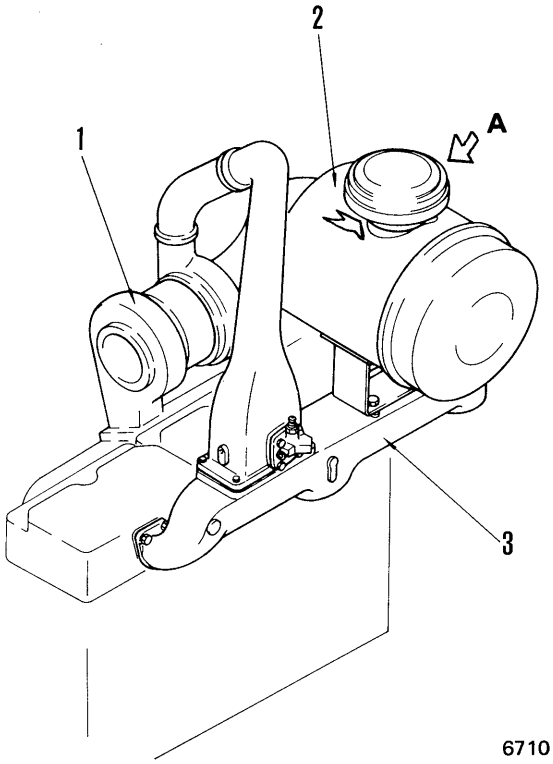



F6710A002

1. Muffler
2. Exhaust manifold
3. Exhaust connector pipe
B. Exhaust

## NT-855-C (For D80, 85-18, D95S-2)

### INTAKE SYSTEM

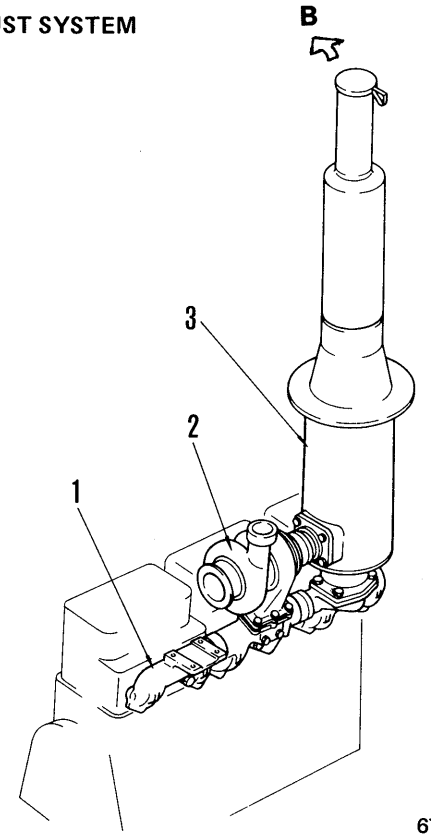



6710F054

1. Turbocharger
2. Air cleaner
3. Intake manifold

A. Intake

### EXHAUST SYSTEM



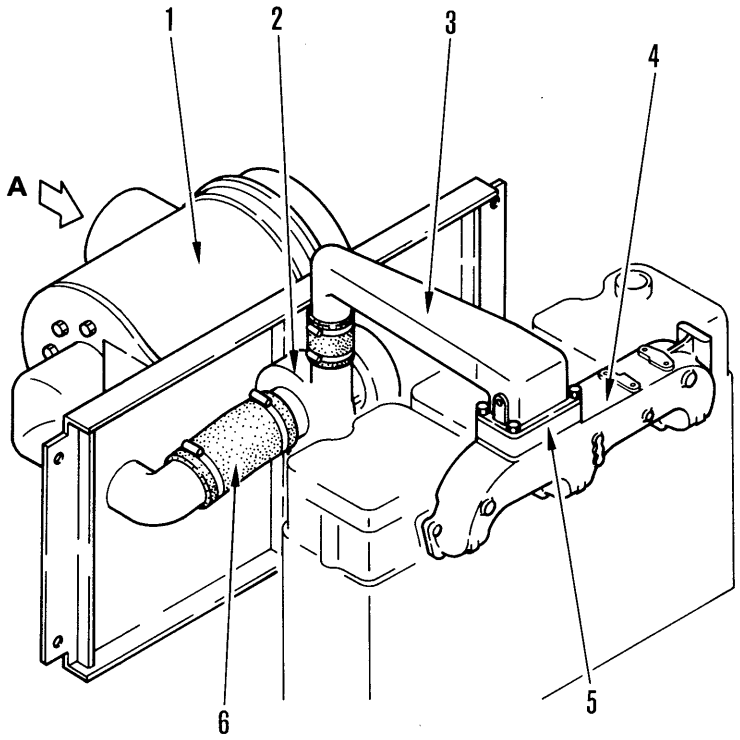

6710F056

1. Exhaust manifold
2. Turbocharger
3. Muffler

B. Exhaust

## NT-855-C (For PC400-1, PC400LC-1)

### INTAKE SYSTEM

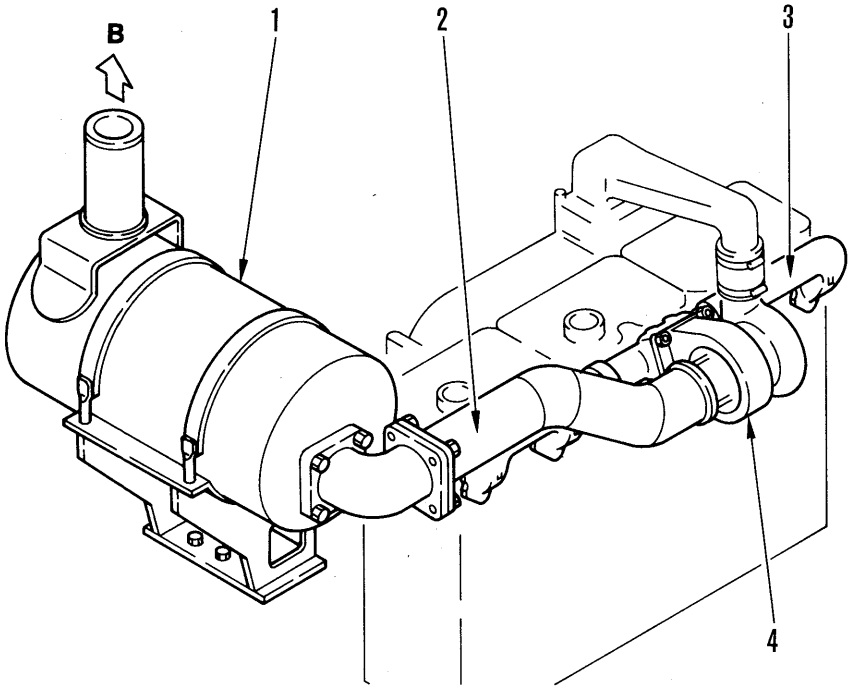



F6710A003

1. Air cleaner
2. Turbocharger
3. Intake connector pipe
4. Intake manifold
5. Electrical intake air heater
6. Intake connector pipe

A. Intake

### EXHAUST SYSTEM



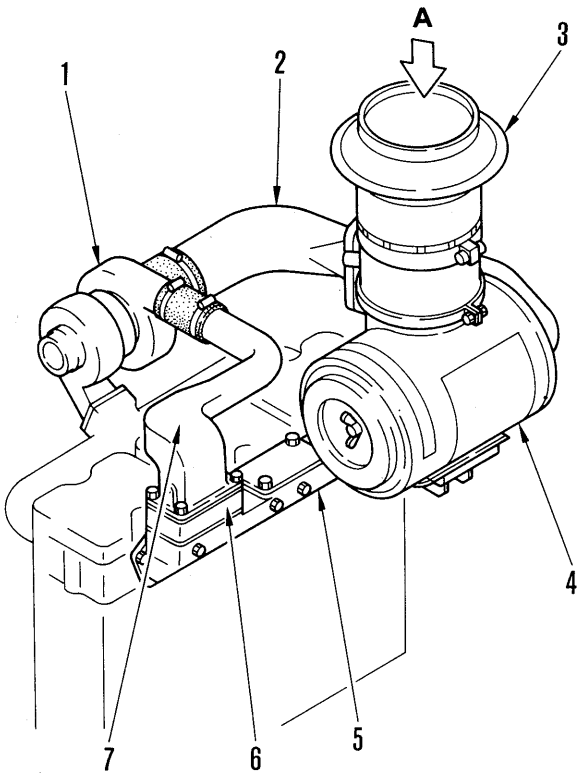

F6710A004

1. Muffler
2. Exhaust connector pipe
3. Exhaust manifold
4. Turbocharger

B. Exhaust

## NT-855-C (For W170-2, W180-1)

### INTAKE SYSTEM

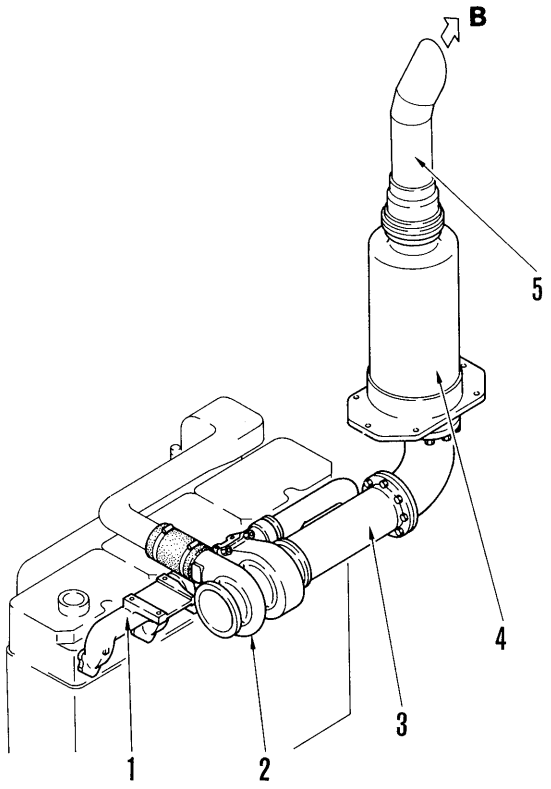



F6710A005

1. Turbocharger
2. Intake connector pipe
3. Precleaner
4. Air cleaner
5. Intake manifold
6. Electrical intake air heater
7. Intake connector pipe

A. Intake

### EXHAUST SYSTEM



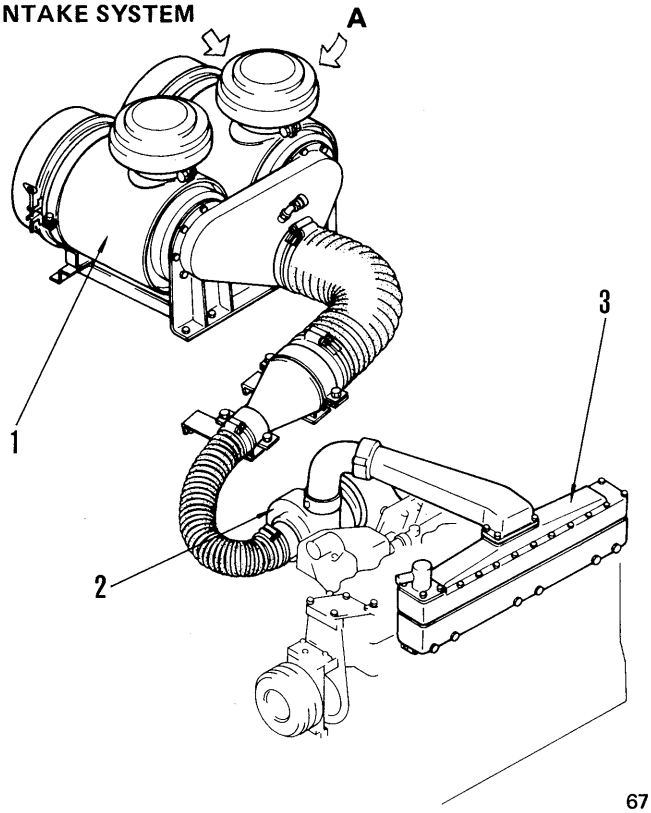

F6710A006

1. Exhaust manifold
2. Turbocharger
3. Exhaust connector pipe
4. Muffler
5. Exhaust pipe

B. Exhaust

## NTA-855-C (For HD320-2)

### INTAKE SYSTEM

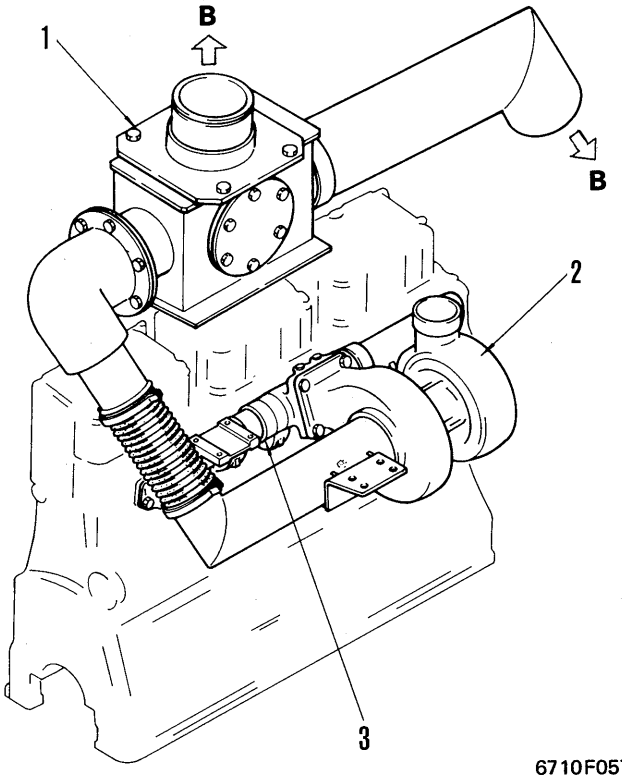



6710F055

1. Air cleaner
2. Turbocharger
3. After-cooler

A. Intake

### EXHAUST SYSTEM



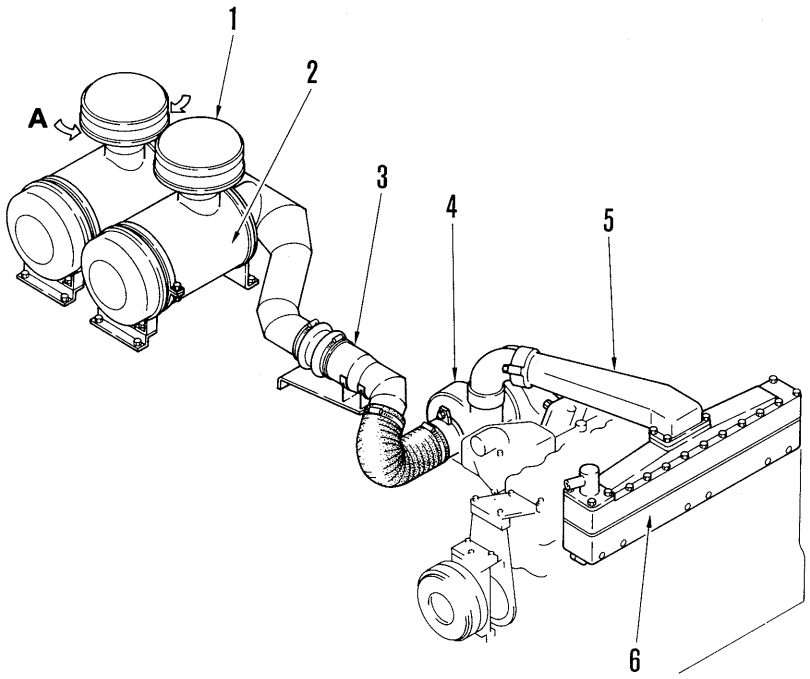

6710F057

1. Muffler
2. Turbocharger
3. Exhaust manifold

B. Exhaust

## NTA-855-C (For HD320-3)

### INTAKE SYSTEM

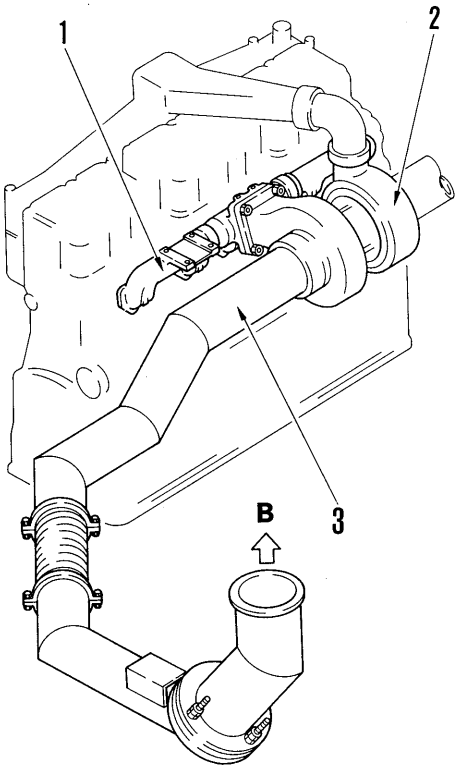



F6710A007

1. Precleaner
2. Air cleaner
3. Intake connector pipe
4. Turbocharger
5. Intake connector pipe
6. After-cooler

A. Intake

### EXHAUST SYSTEM



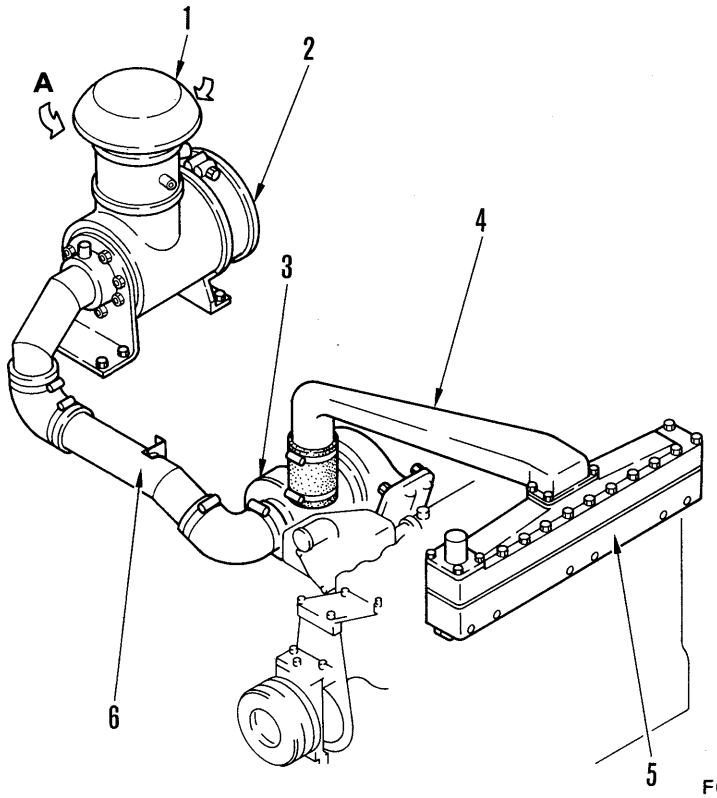

F6710A008

1. Exhaust manifold
2. Turbocharger
3. Exhaust pipe

B. Exhaust

## NTA-855-C (For WS16S-2, WS23-1-FRONT ENGINE)

### INTAKE SYSTEM

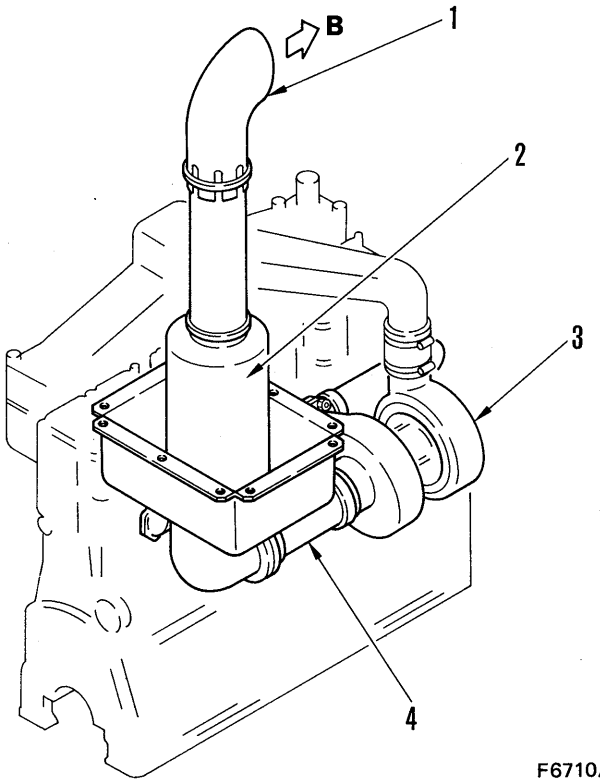



F6710A009

1. Precleaner
2. Air cleaner
3. Turbocharger
4. Intake connector pipe
5. After-cooler
6. Intake connector pipe

A. Intake

### EXHAUST SYSTEM



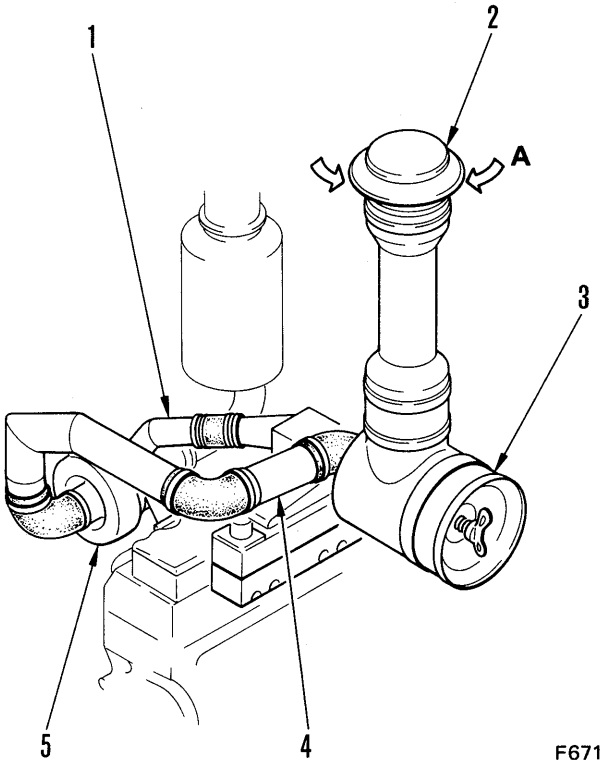

F6710A010

1. Exhaust pipe
2. Muffler
3. Turbocharger
4. Exhaust connector pipe

B. Exhaust

## NTA-855-C (For WS23-1-REAR ENGINE)

### INTAKE SYSTEM

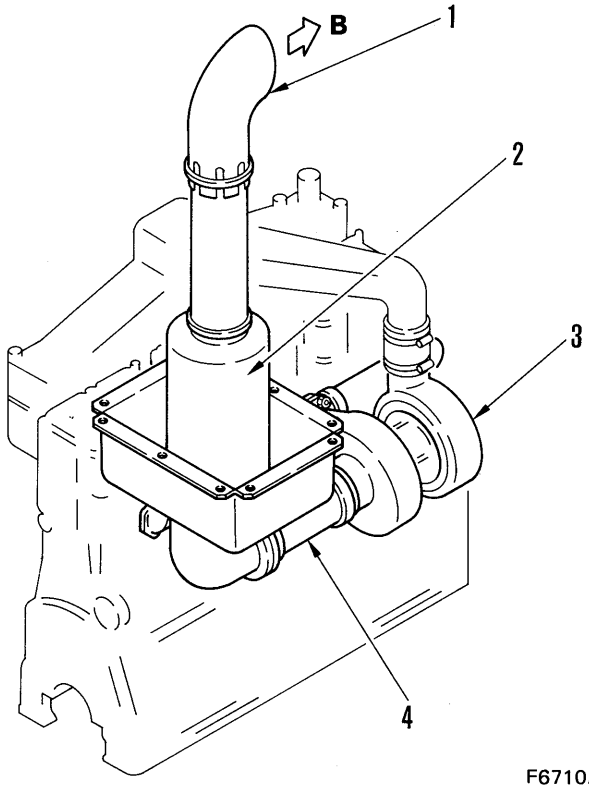



F6710A011

1. Intake connector pipe
2. Precleaner
3. Air cleaner
4. Intake connector pipe
5. Turbocharger

A. Intake

### EXHAUST SYSTEM




F6710A010

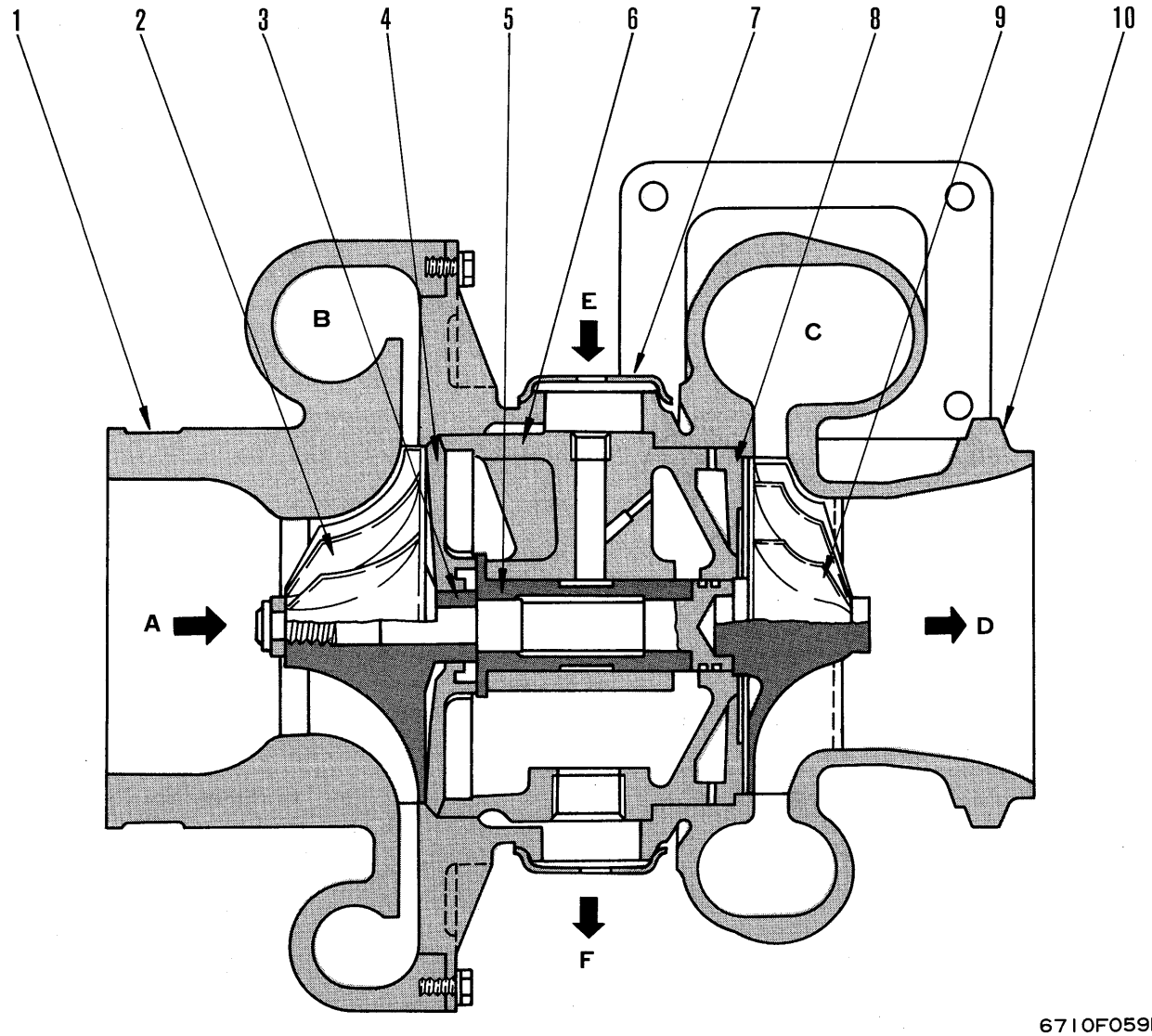
1. Exhaust pipe
2. Muffler
3. Turbocharger
4. Exhaust connector pipe

B. Exhaust

# TURBOCHARGER

W9163-2

## CUMMINS ST-50 (NT-855-C and NTA-855-C)




67I0F059B

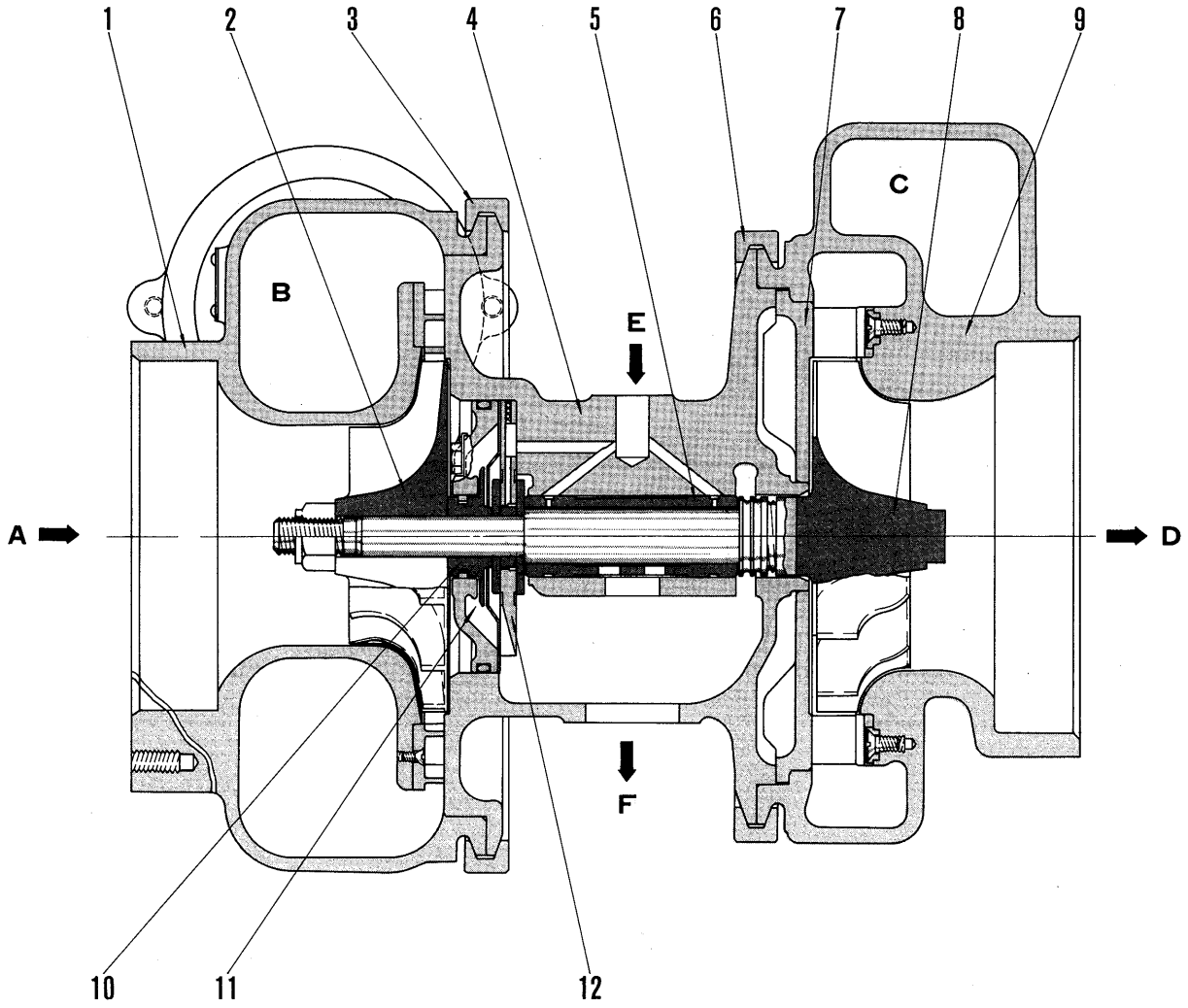
1. Blower housing
2. Blower impeller
3. Sleeve
4. Shield
5. Journal bearing
6. Center housing
7. Clamp
8. Shield
9. Turbine impeller
10. Turbine housing

A. Air inlet
B. Air outlet
C. Exhaust inlet
D. Exhaust outlet
E. Lubricating oil inlet
F. Lubricating oil outlet

**Turbocharger specifications**

| | |
|---|---|
| Model: | Cummins ST-50 |
| Length x Width x Height | 334mm x 278mm x 308mm |
| Weight: | 27.5kg |
| Continuous rotation: | 70,000 rpm |
| Maximum charging | 31.2kg/min. |
| Maximum temperature (At inlet) | 705°C and below |
| Direction of rotation (viewed from blower): | Clockwise |
| Lubrication method: | Forced lubrication with engine oil |

## KOMATSU KTR-130 (NTA-855-C)




67I0F058

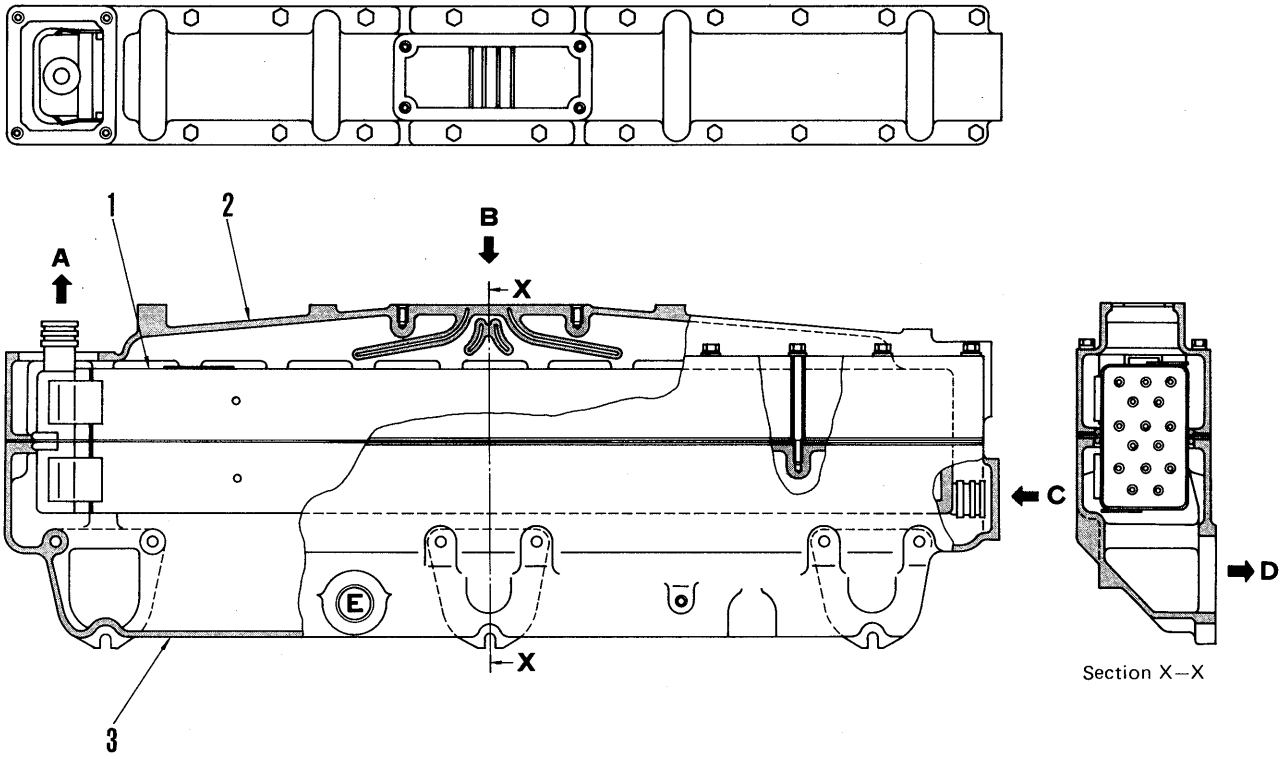
1. Blower housing
2. Blower impeller
3. Clamp
4. Bearing housing
5. Journal bearing
6. Clamp
7. Shield
8. Turbine impeller
9. Turbine housing
10. Slinger
11. Insert
12. Thrust bearing
A. Air inlet
B. Air outlet
C. Exhaust inlet
D. Exhaust outlet
E. From oil filter
F. To oil pan drain

**Turbocharger specifications**

| | |
|---|---|
| Model: | Komatsu KTR-130 |
| Length x Width x Height | 325mm x 295mm x 344mm |
| Weight: | 30kg |
| Continuous rotation: | 70,000rpm |
| Maximum charging | 31.8kg/min. |
| Maximum temperature (At inlet) | 750°C and below |
| Direction of rotation (viewed from blower): | Clockwise |
| Lubrication method: | Forced lubrication with engine oil |

# AFTER-COOLER

## NTA-855-C



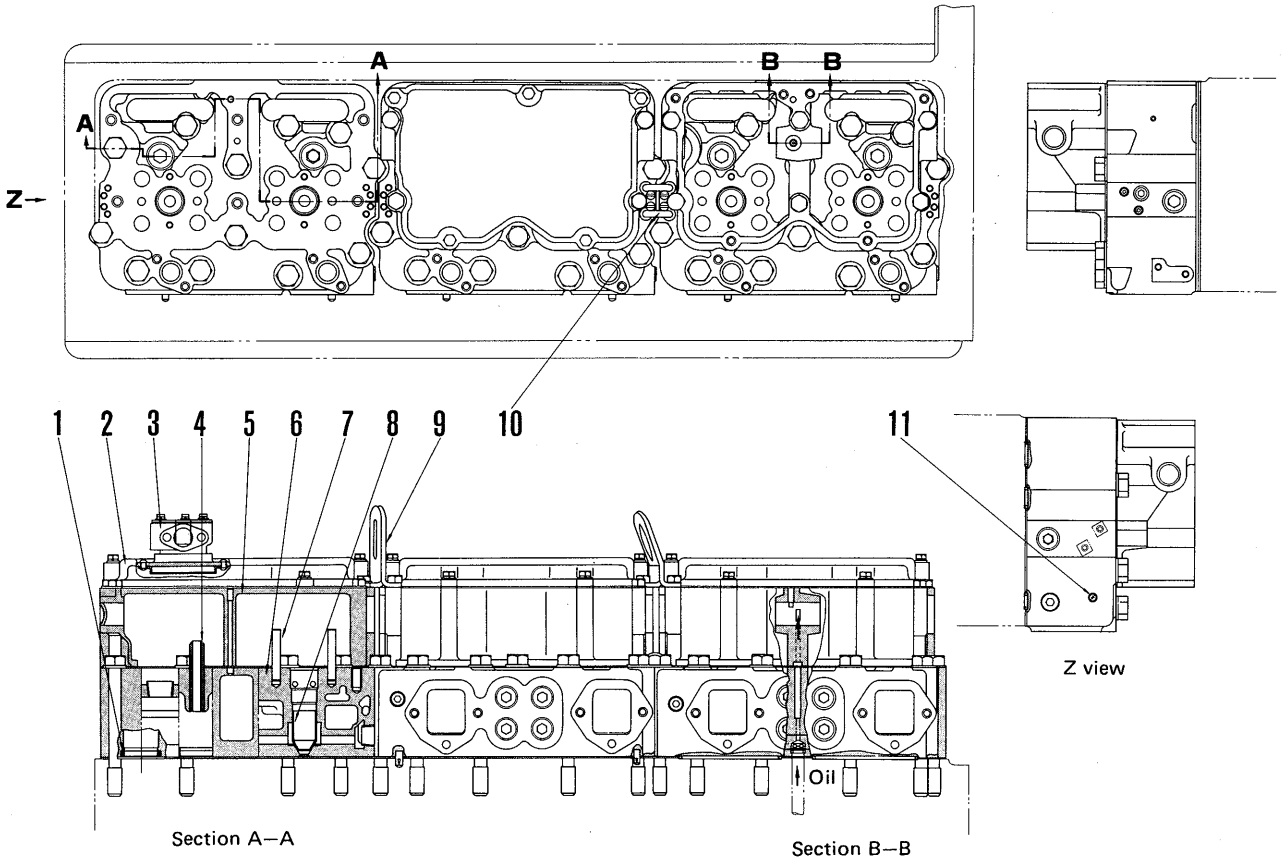

6710F060

1. Core
2. Cover
3. Housing

A. Water outlet (To thermostat)
B. Air intake (From turbocharger)
C. Water intake (From cylinder block)
D. Air outlet (To intake manifold)
E. Compressor outlet

# ENGINE BODY

## CYLINDER HEAD




6710F061

1. Valve seat insert
2. Rocker arm housing cover
3. Crank case breather
4. Valve guide
5. Rocker arm housing
6. Cylinder head
7. Crosshead guide
8. Injector sleeve
9. Lifting bracket
10. Fuel cross tube
11. Fuse plug

### CYLINDER HEAD

- Direct injection, 4-valve, injector type
- 1 cylinder head for 2 cylinder

### VALVE SEAT INSERT

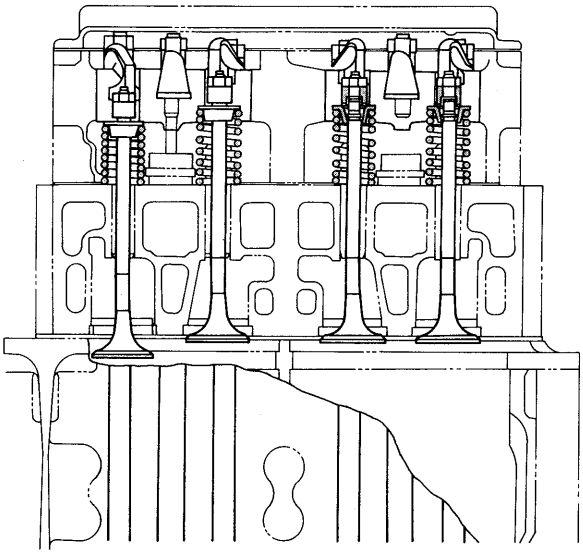
N-855-C:

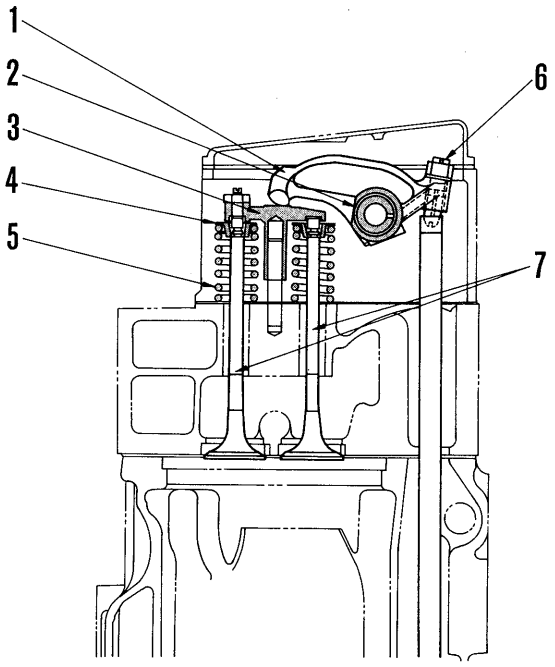
Press-fitted insert for exhaust.

NT-855-C, NTA-855-C:

Press fitted insert for intake and exhaust.

# VALVE SYSTEM






Intake valve

6710F062

1. Intake rocker arm
2. Rocker arm shaft
3. Crosshead
4. Valve guide
5. Valve spring
6. Rocker arm adjustment screw
7. Intake valve
8. Exhaust rocker arm
9. Crosshead adjustment screw
10. Exhaust valve

## VALVE CLEARANCE

- Engine No. 26102754 – 26155791

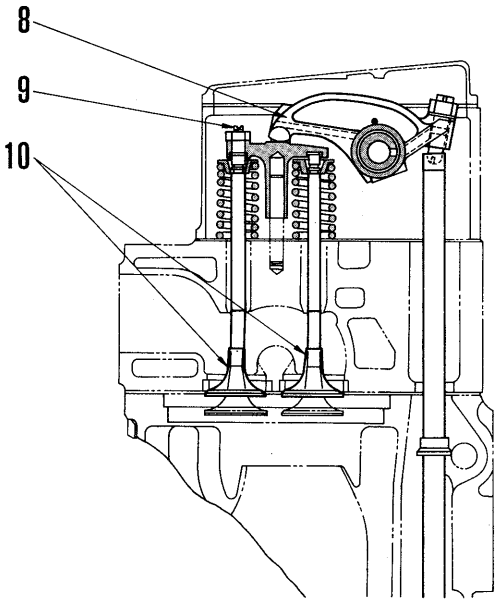
Unit: mm

| | Intake valve | Exhaust valve |
|---|---|---|
| Cold (20°C) | 0.41 | 0.74 |
| Warm (60°C) | 0.36 | 0.69 |

- Engine No. 26155792 and up

Unit: mm

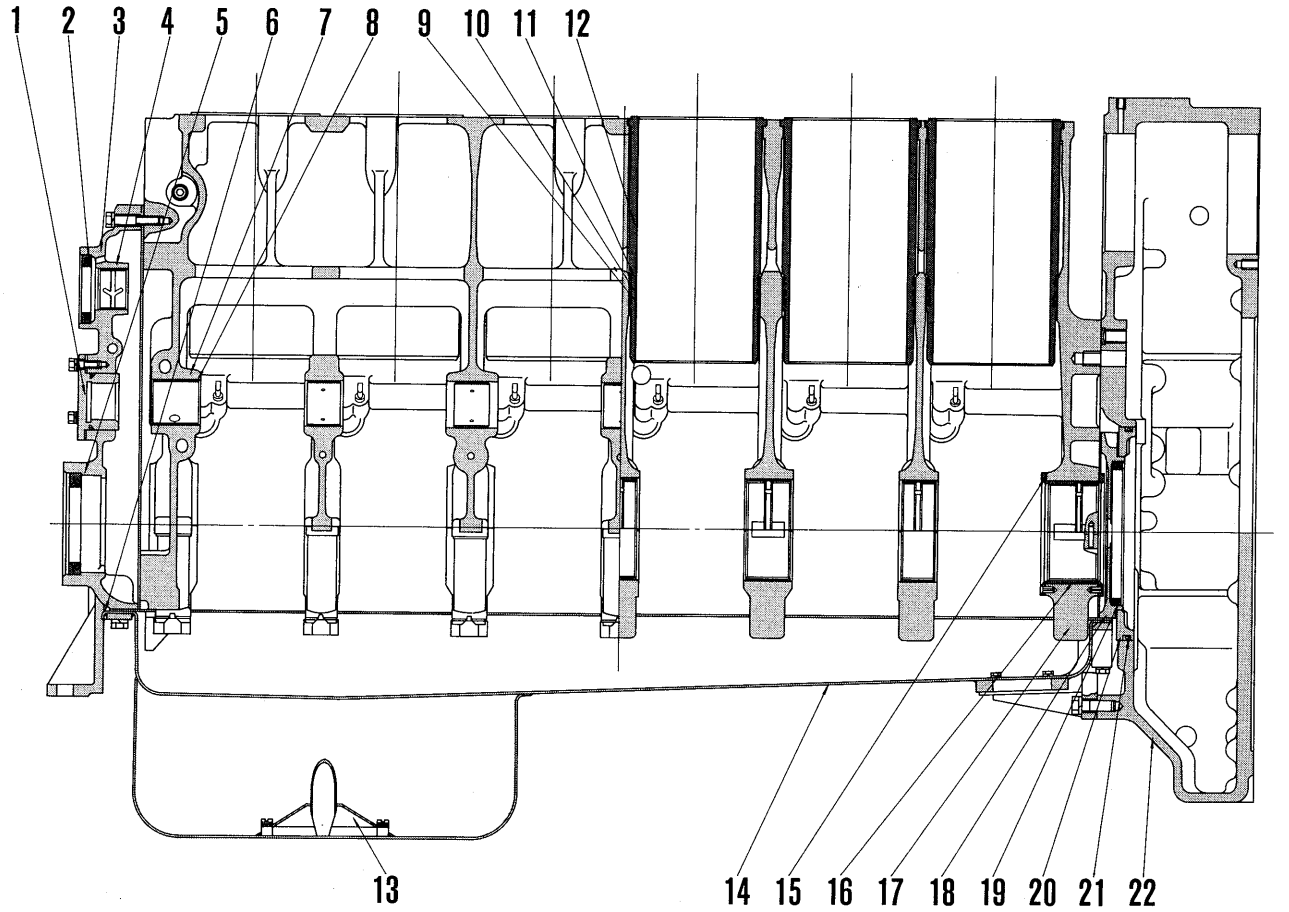
| | Intake valve | Exhaust valve |
|---|---|---|
| Cold (20°C) | 0.36 | 0.69 |
| Warm (60°C) | 0.36 | 0.69 |




Exhaust valve

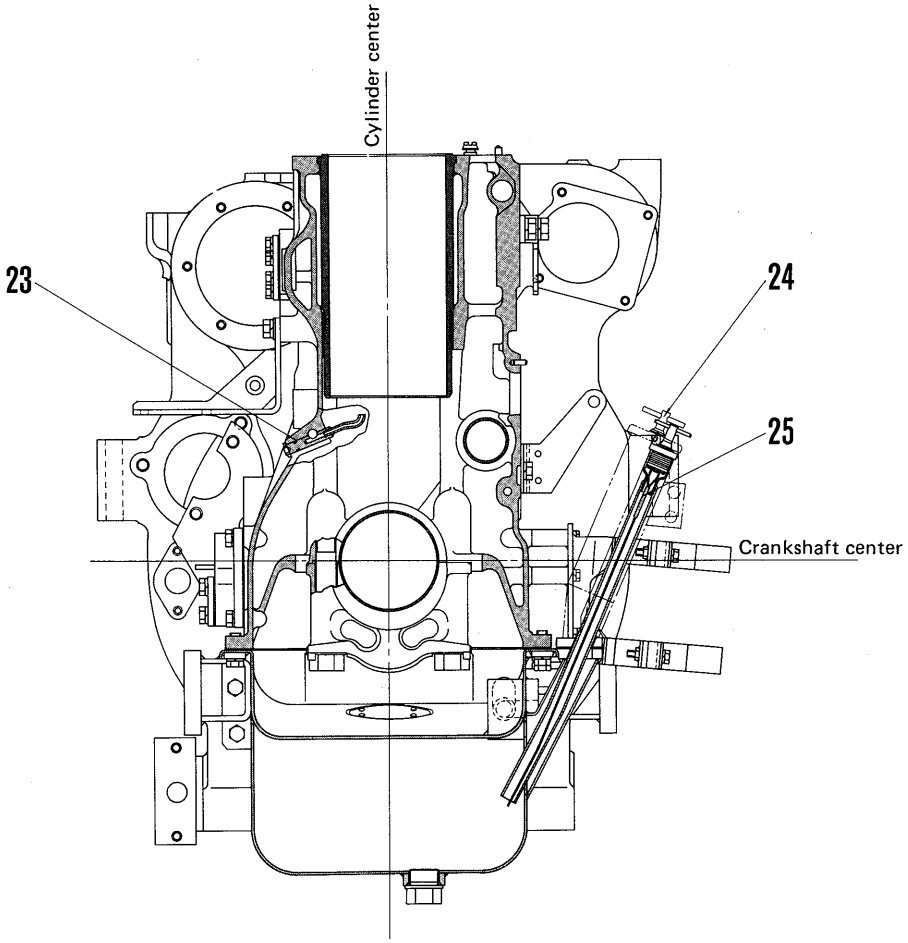
6710F063

# CYLINDER BLOCK




6710F064A

1. Camshaft support
2. Accessory drive seal
3. Gear case
4. Accessory drive gear
5. Front oil seal
6. Front support
7. Cylinder block
8. Camshaft bushing
9. Liner O-ring (Silicon rubber)
10. Liner O-ring (Nitrile rubber)
11. Liner clevis seal
12. Cylinder liner
13. Oil strainer
14. Oil pan
15. Thrust bearing
16. Main bearing
17. Main bearing cap
18. Rear cover
19. Rear oil seal
20. Oil seal retainer




6710F065

21. Retainer O-ring
22. Flywheel housing
23. Piston cooling nozzle
24. Oil filler
25. Oil level gauge

**Cylinder liner**

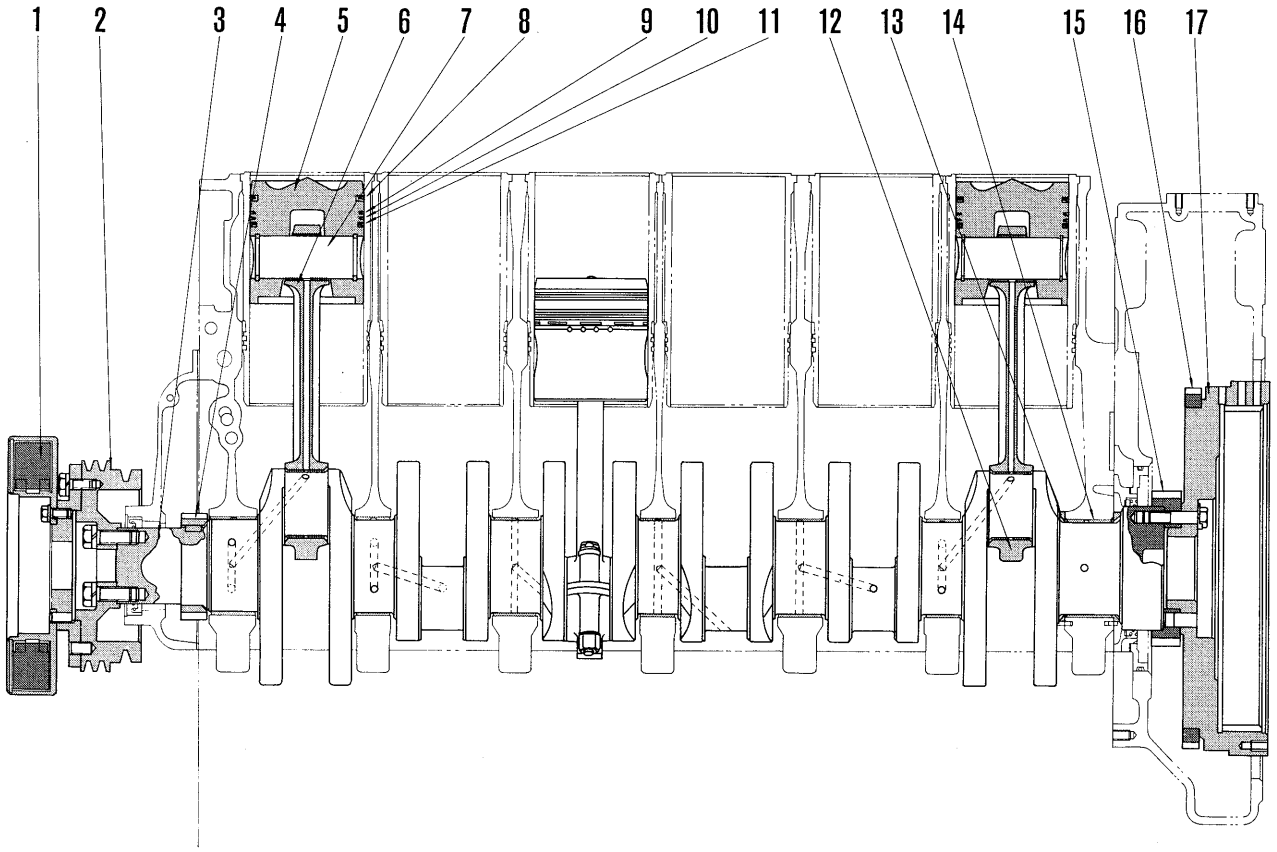
Wet liner

Clevis seal, O-ring x 2

**Cylinder block**

Crankshaft: 7 bearings
Camshaft: 7 bearings

# MAIN CIRCULATION SYSTEM




6710F066A

1. Vibration damper
2. Crankshaft pulley
3. Crankshaft
4. Crankshaft gear (No. of teeth: 36)
5. Piston
6. Connecting rod
7. Piston pin
8. Top ring
9. Second ring
10. Third ring
11. Oil ring
12. Connecting rod cap
13. Thrust bearing
14. Main bearing cap
15. PTO drive gear (No. of teeth: D80, 85-18: 44 D95S-2: 49)
16. Ring gear (No. of teeth: 138)
17. Flywheel

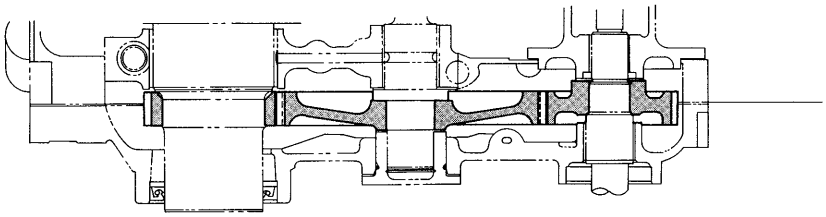
**CRANKSHAFT**

- Journal and filet portion: Induction hardening

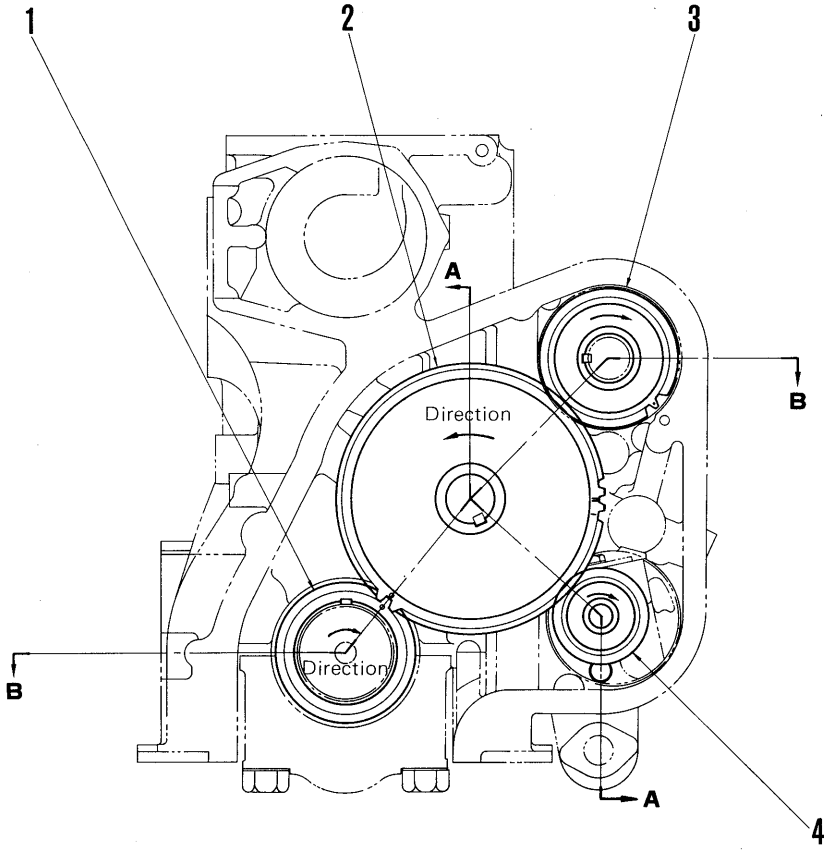
**PISTON RING**

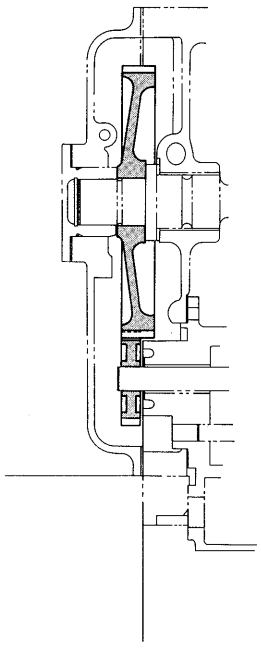
- N-855-C, NT-855-C: 4 rings
- NTA-855-C
  Engine No. 26102754 – 26134153: 5 rings
  Engine No. 26134154 and up: 4 rings

# TIMING GEAR



Section B—B



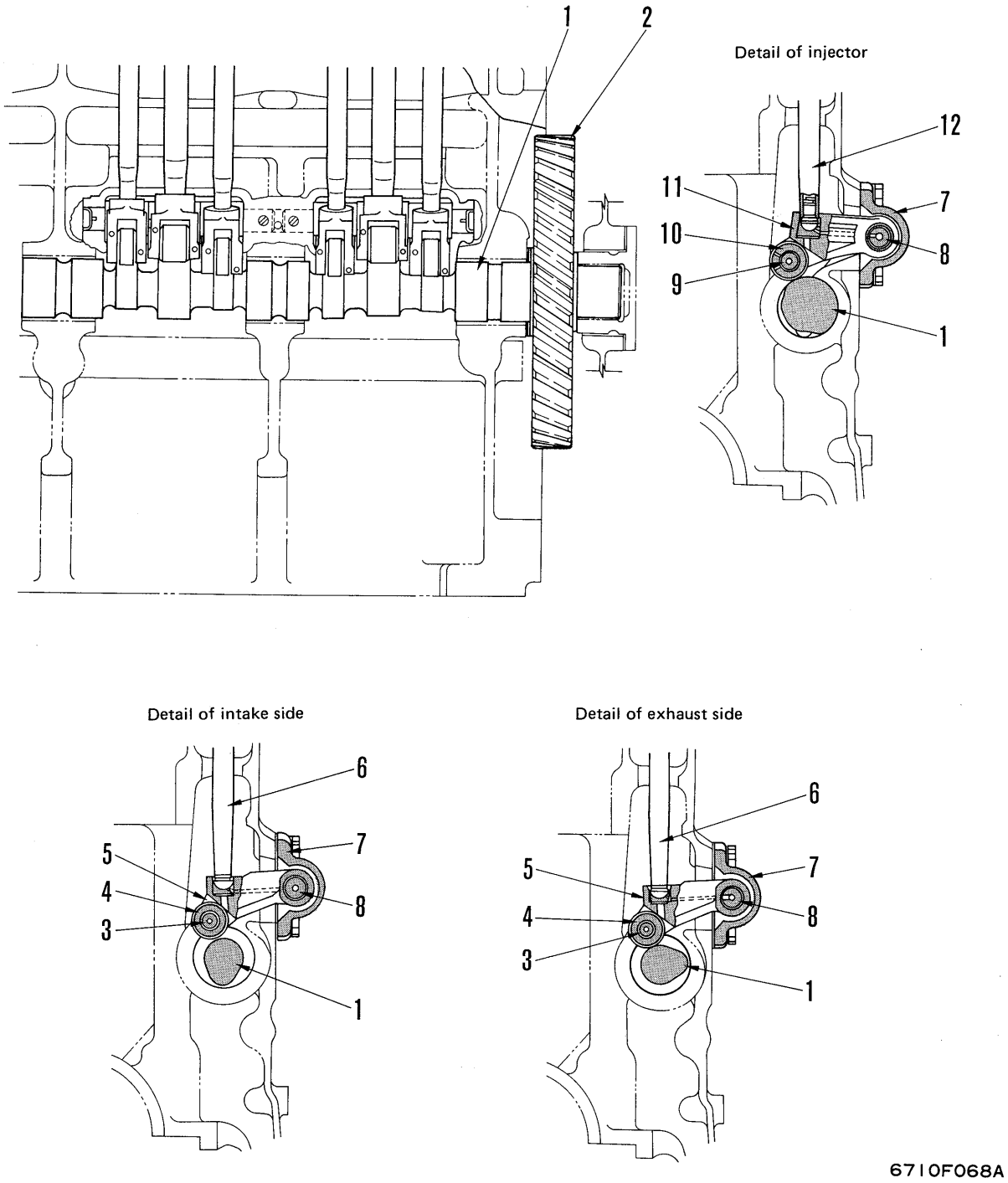



Section A—A

6710F067

1. Crankshaft (Number of teeth 36)
2. Camshaft gear (Number of teeth 72)
3. Accessory drive gear (Number of teeth 36)
4. Oil pump drive gear (Number of teeth 24)

# CAMSHAFT, CAM FOLLOWER AND PUSH ROD

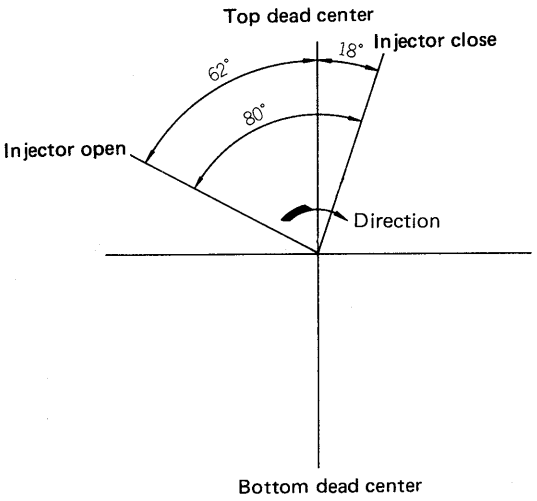



1. Camshaft
2. Camshaft gear (No. of teeth: 72)
3. Roller pin (For valve)
4. Cam roller (For valve)
5. Lever (For valve)
6. Push rod (For valve)
7. Cam follower housing
8. Lever shaft
9. Roller pin (For injector)
10. Cam roller (For injector)
11. Lever (For injector)
12. Push rod (For injector)

**CAMSHAFT**

- Cam and journal portion: Induction hardening

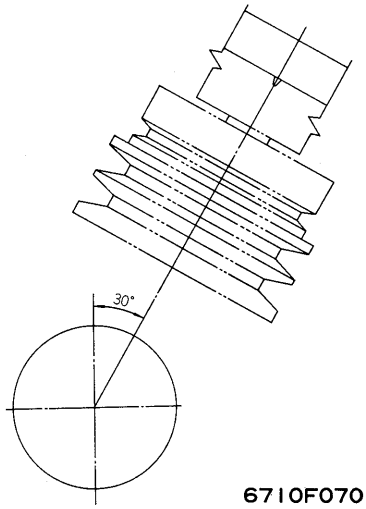
# INJECTION TIMING




6710F069A

**Injector, valve clearance point position**

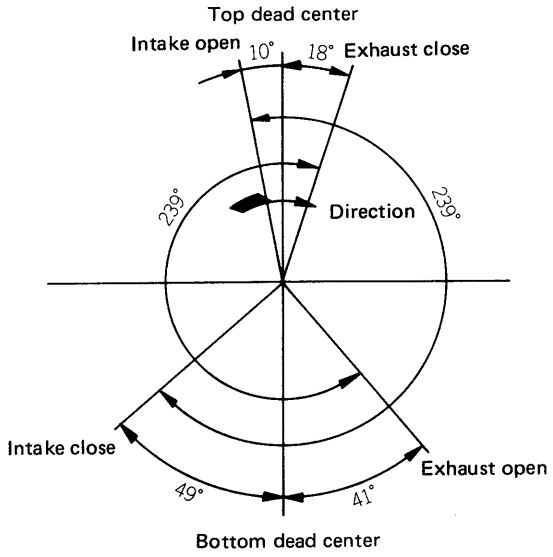
(Shows 1.6 cylinder)




6710F070

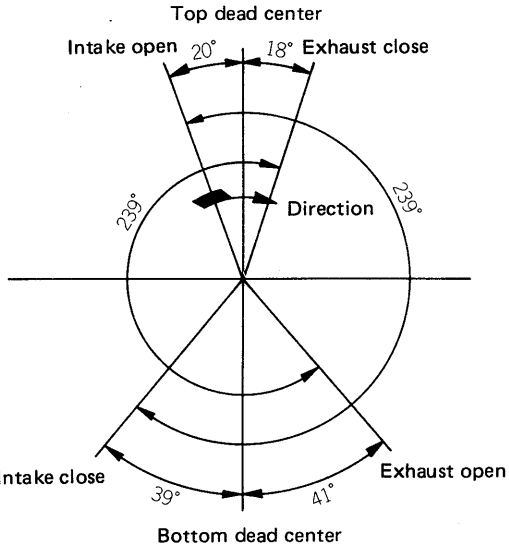
# VALVE TIMING

**N-855-C**




6710F072A

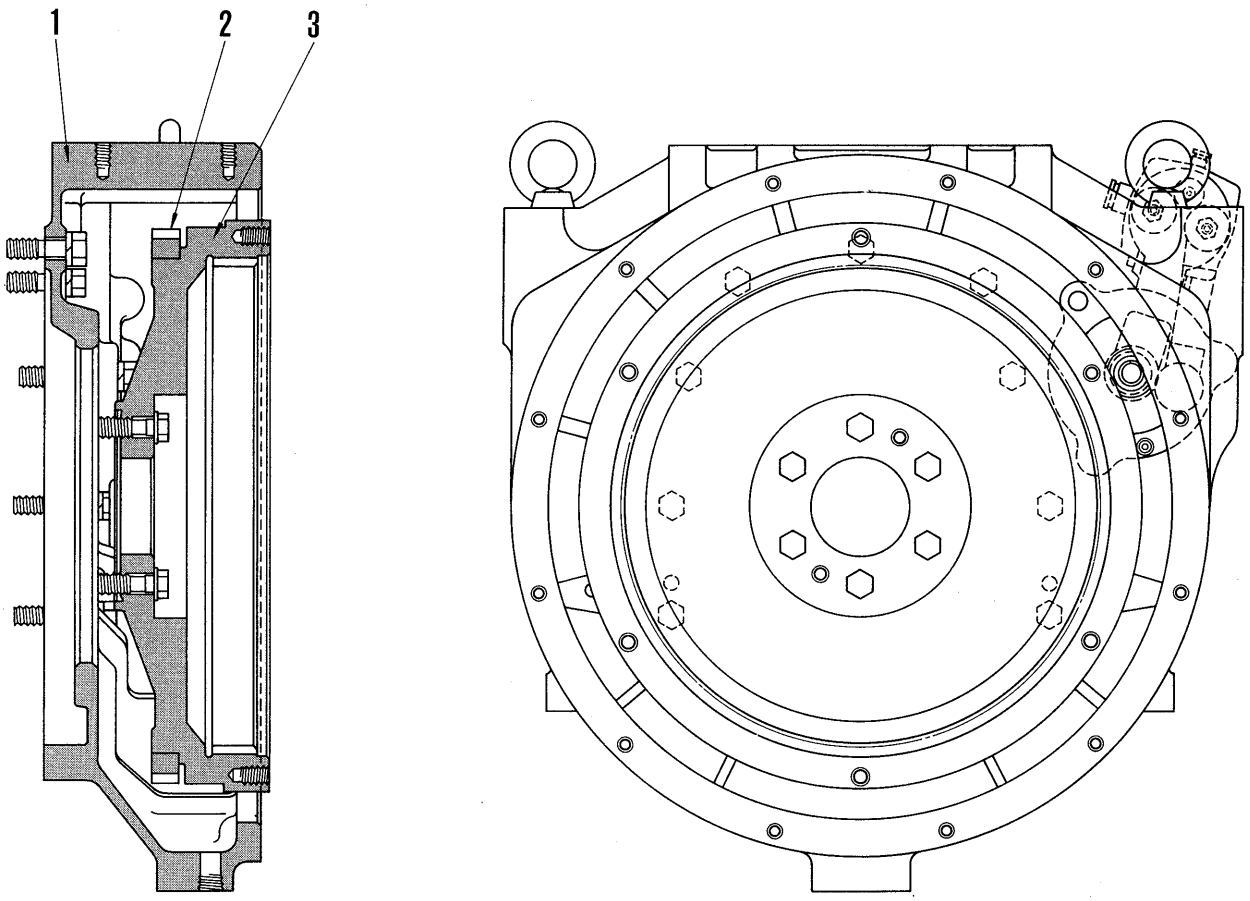
**NT-855-C, NTA-855-C**




6710F071A

# FLYWHEEL AND FLYWHEEL HOUSING

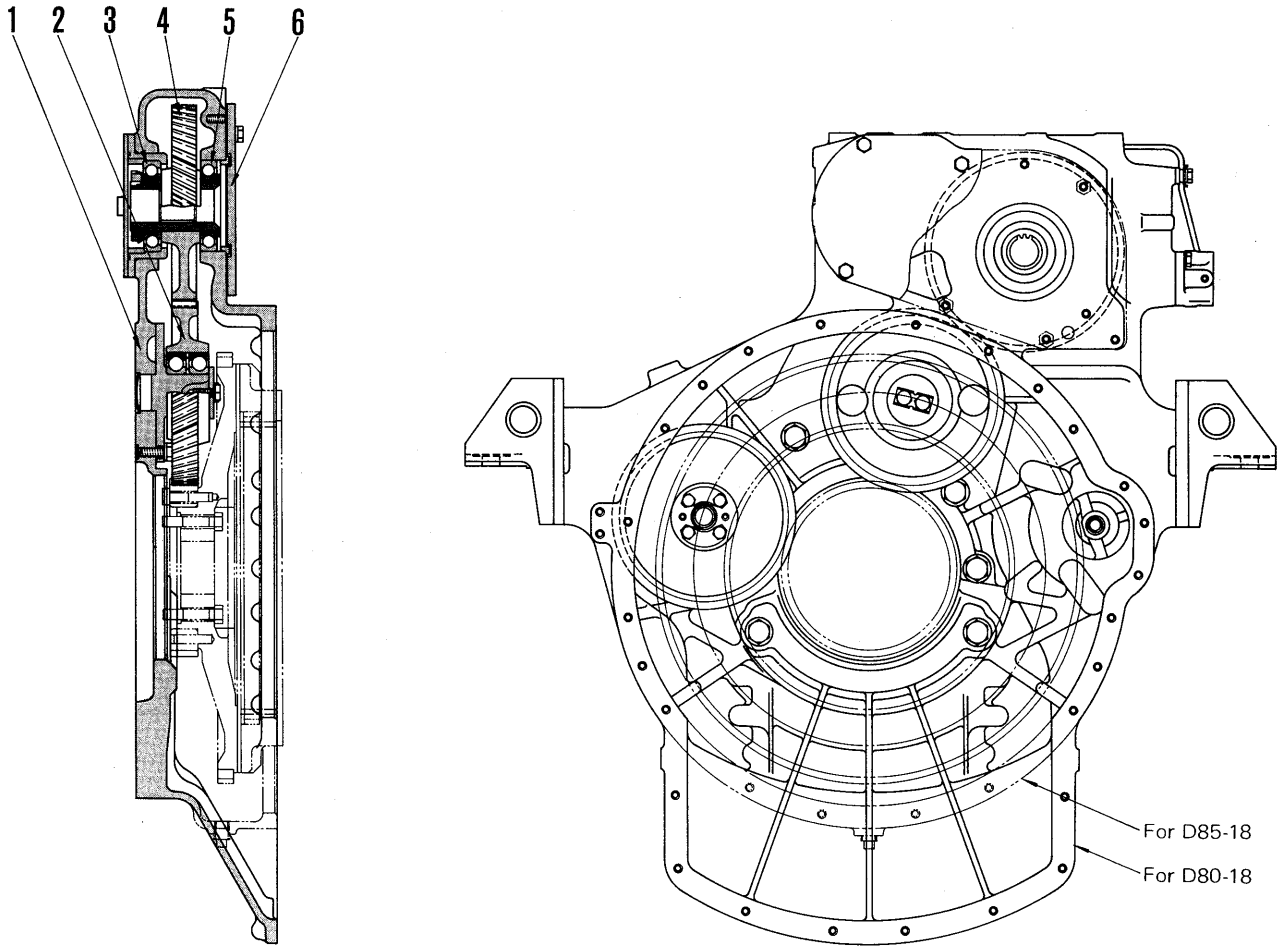
## N-855-C (For PC300-1, 2 and PC300LC-1, 2)




6710F072-1

1. Flywheel housing
2. Ring gear (No. of teeth: 138)
3. Flywheel

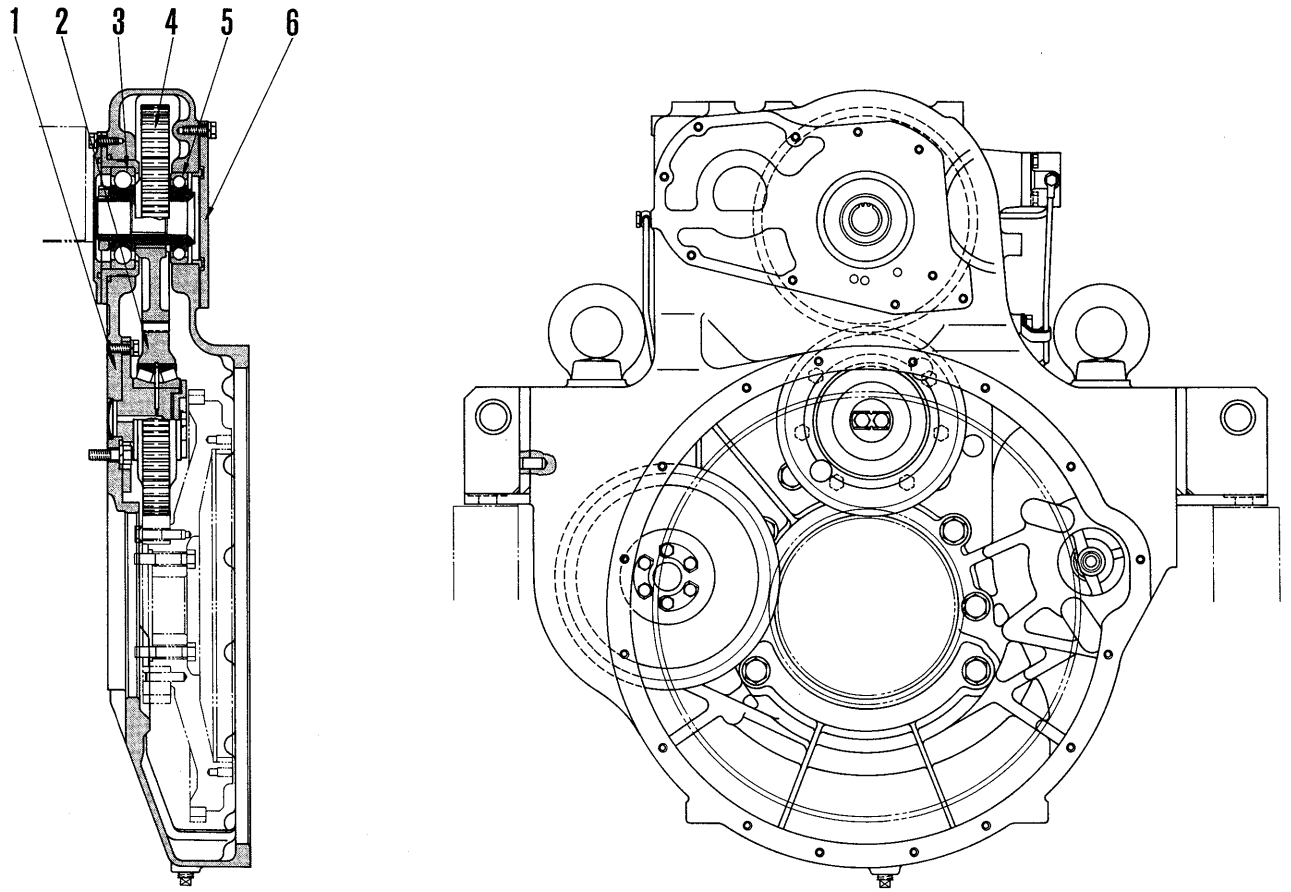
## NT-855-C (For D80·85-18)




6710F073

1. Flywheel housing
2. Idler gear (Number of teeth 51)
3. Ball bearing
4. P.T.O. gear (Number of teeth: 56)
5. Ball bearing
6. P.T.O. cover

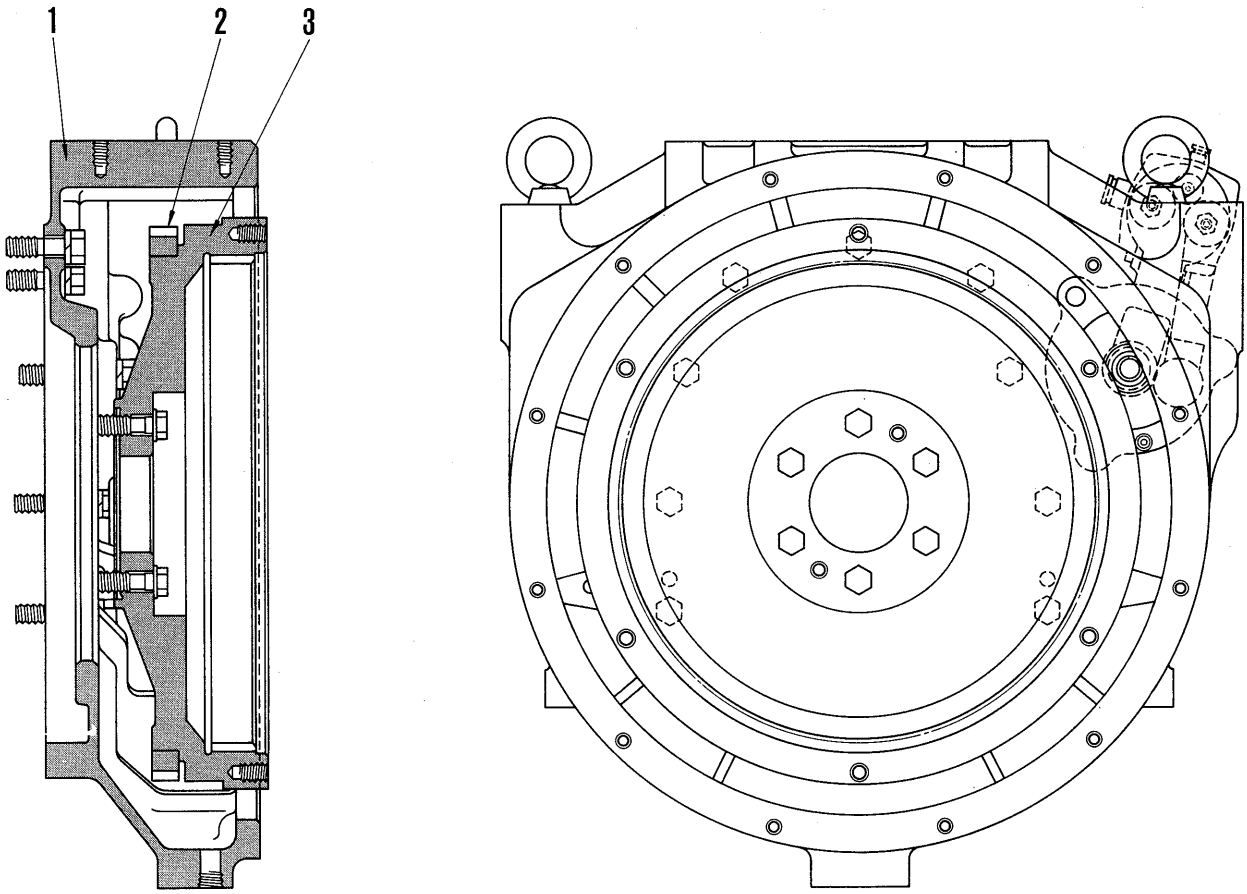
## NT-855-C (For D95S-2)




6710F074

1. Flywheel housing
2. Idle gear (Number of teeth 43)
3. Ball bearing
4. P.T.O. gear (Number of teeth: 51)
5. Ball bearing
6. P.T.O. cover

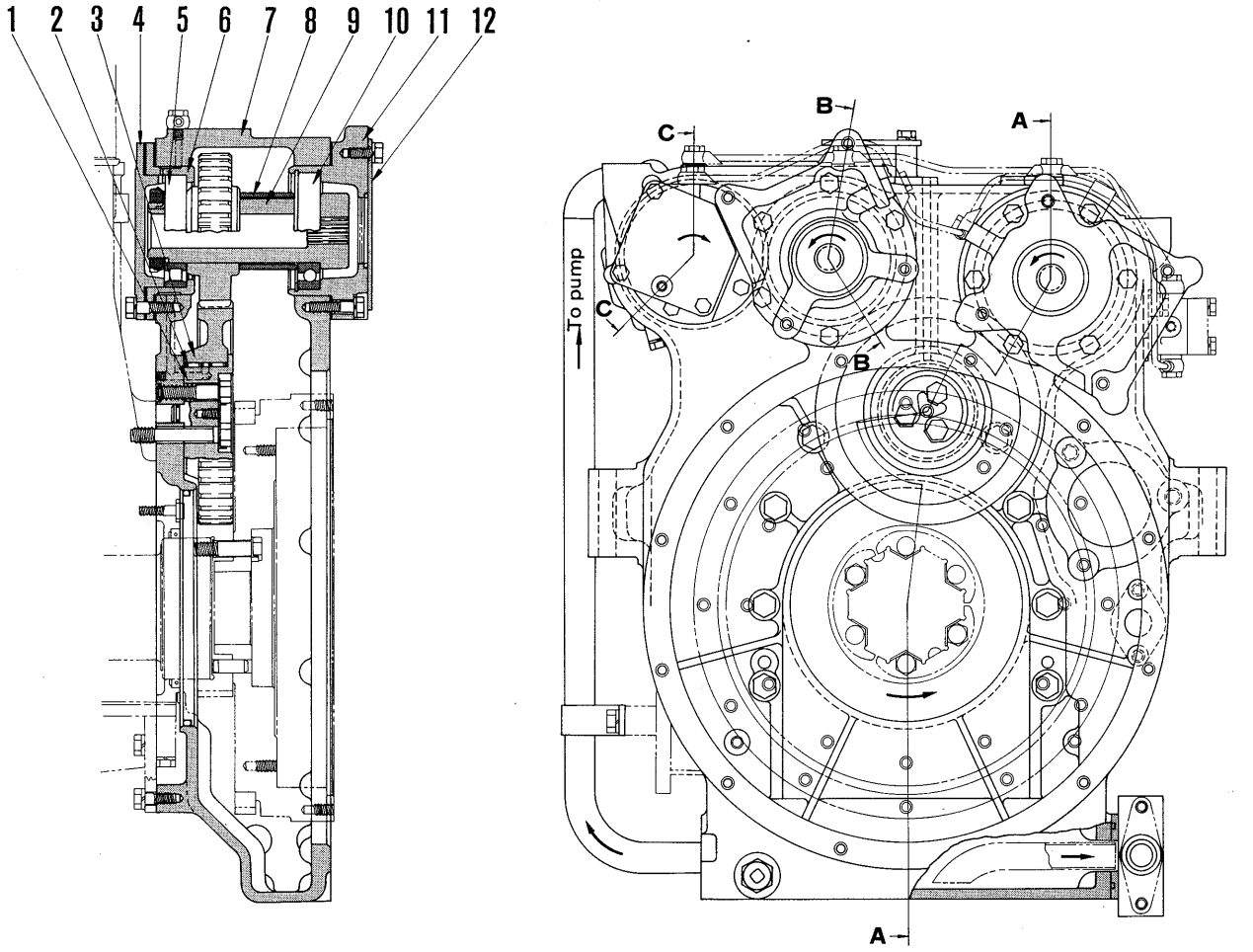
## NT-855-C (For PC400-1, PC400LC-1, W170-2, W180-1)




6710F072-1

1. Flywheel housing
2. Ring gear (No. of teeth: 138)
3. Flywheel

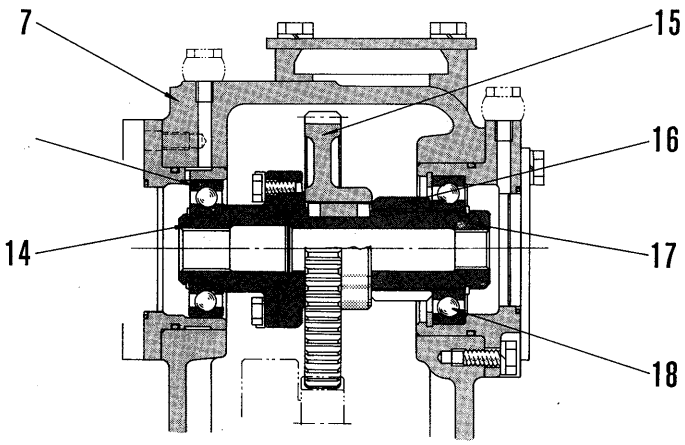
## NTA-855-C (For HD320-2 Engine No. 26102754 – 26155098)




Section A–A

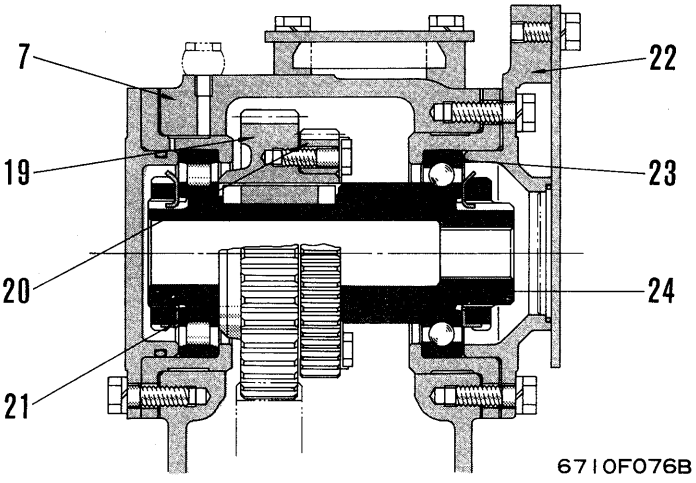
6710F075A

1. P.T.O. idler gear shaft
2. Needle bearing
3. P.T.O. idler gear (Number of teeth 52)
4. Bearing case cover
5. Roller bearing
6. Bearing case
7. Flywheel housing
8. Spacer
9. Steering pump drive shaft
10. Ball bearing
11. Bearing case
12. Bearing case cover




Section C-C (Scavenging pump drive system)

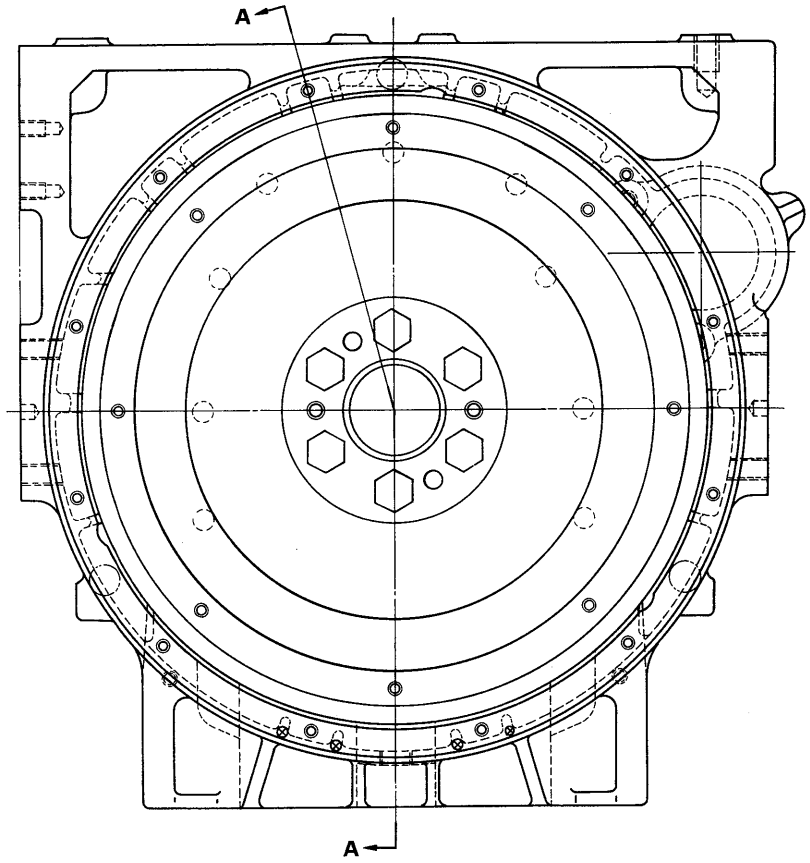
13. Ball bearing
14. Scavenging pump drive shaft
15. Scavenging pump drive gear (Number of teeth 51)
16. Spacer
17. Scavenging pump drive shaft
18. Ball bearing

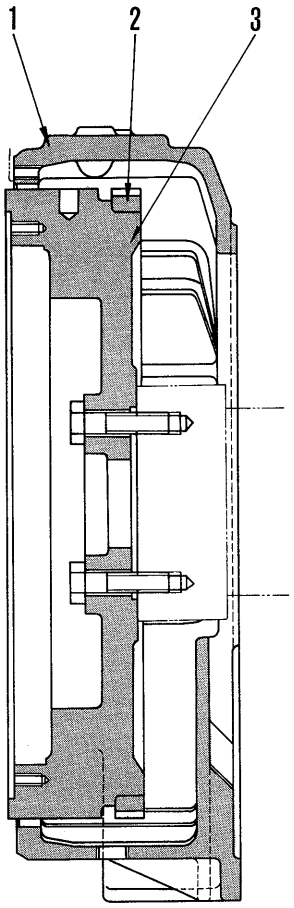



Section B-B (Hydraulic pump drive system)

19. Hydraulic pump drive gear (Number of teeth 35)
20. Scavenging pump driven gear (Number of teeth 46)
21. Roller bearing
22. Bearing case cover
23. Ball bearing
24. Hydraulic pump drive shaft

## NTA-855-C (For HD320-2 Engine No. 26155099 and up) (For WS16S-2 and WS23-1)



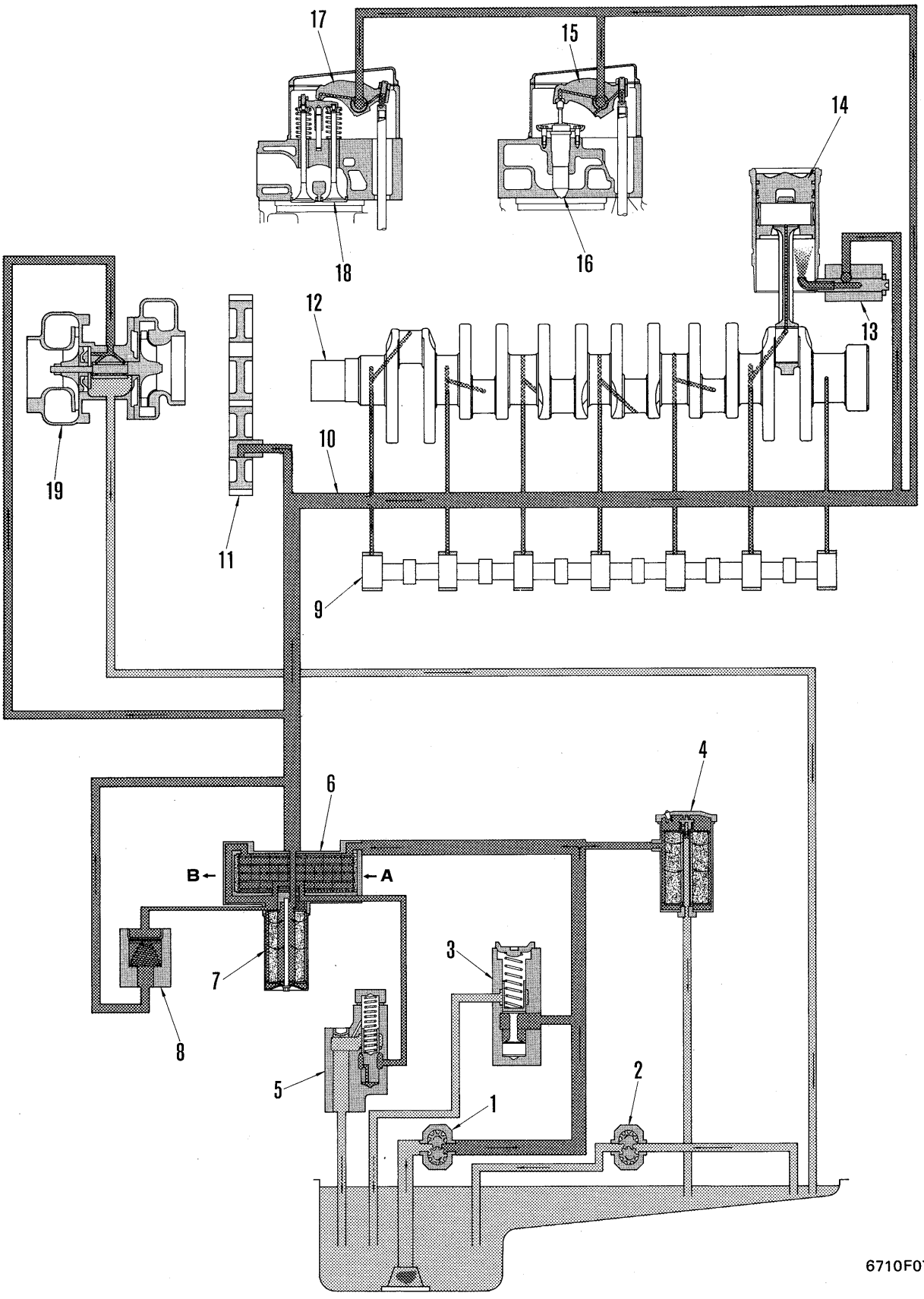

Section A–A

6710F115A

1. Flywheel housing
2. Ring gear (No. of teeth: 118)
3. Flywheel

# LUBRICATION SYSTEM

## LUBRICATION SYSTEM CHART




6710F077A

1. Oil pump
2. P.T.O. scavenging pump
3. By-pass valve (9.15±0.25kg/cm$^2$ )
4. By-pass filter
5. Regulator valve (4.4±0.4kg/cm$^2$ )
6. Oil cooler
7. Oil filter
8. Oil filter safety valve (3.15±0.35kg/cm$^2$ )
9. Camshaft
10. Main oil gallery
11. Timing gear
12. Crankshaft
13. Piston cooling nozzle
14. Piston
15. Rocker arm (For injector)
16. Injector
17. Rocker arm (For intake and exhaust valve)
18. Intake and exhaust valve
19. Turbocharger

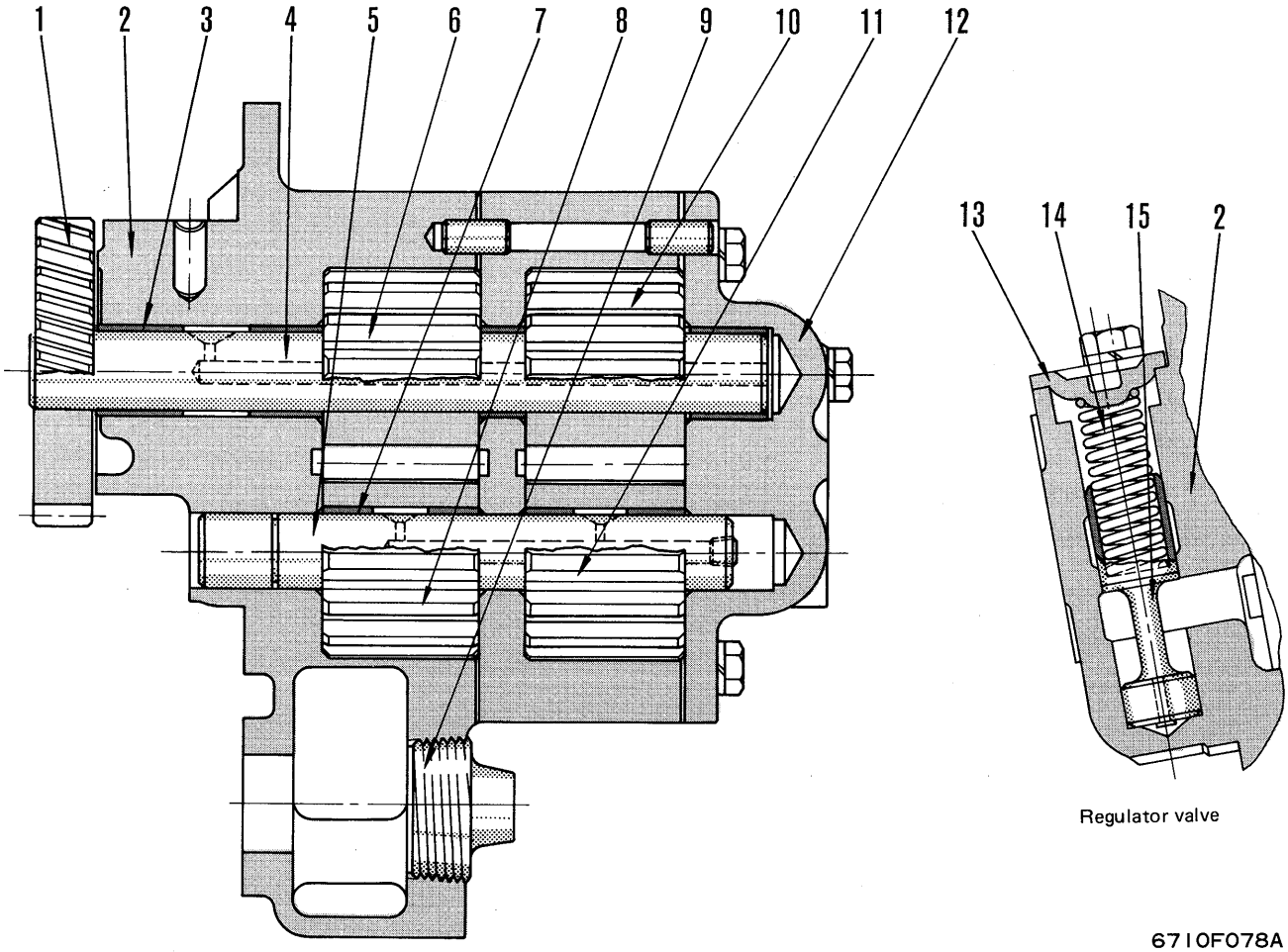
A. From water pump

B. To water manifold

# OIL PUMP

## WITH SCAVENGING PUMP

**NT-855-C (For D80, 85-18, D95S-2)**
**NTA-855-C (For HD320 Engine No. 26102754 – 26136175 and 26136178 – 26138576)**




6710F078A

1. Pump drive gear (No. of teeth: 27)
2. Pump body
3. Bushing
4. Drive shaft
5. Driven shaft
6. Oil pump drive gear (No. of teeth: 9)
7. Bushing
8. Oil pump driven gear (No. of teeth: 9)
9. Plug
10. Scavenging pump drive gear (No. of teeth: 9)
11. Scavenging pump driven gear (No. of teeth: 9)
12. Pump cover
13. Valve retainer
14. Valve spring
15. Regulator valve spool

**OIL PUMP**

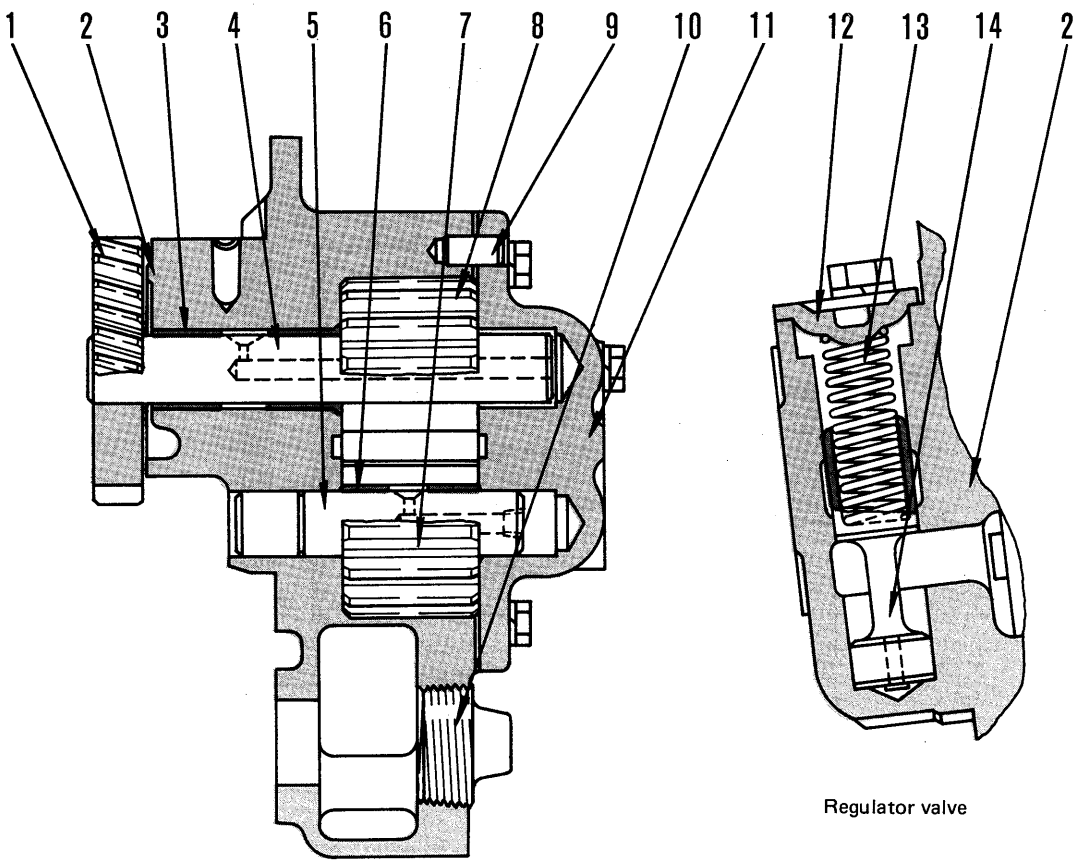
- Type: Gear pump
- Pump speed: Engine speed x 1.333

**REGULATOR VALVE**

- Set pressure: 4.4 ± 0.4 kg/cm$^2$

## WITHOUT SCAVENGING PUMP

**N-855-C**
**NT-855-C (For PC400-1, PC400LC-1, W170-2, W180-1)**
**NTA-855-C (For HD320 Engine No. 26136176, 26136177 and 26138577 and up)**
**(For WS16S-2, WS23-1)**




671OF079

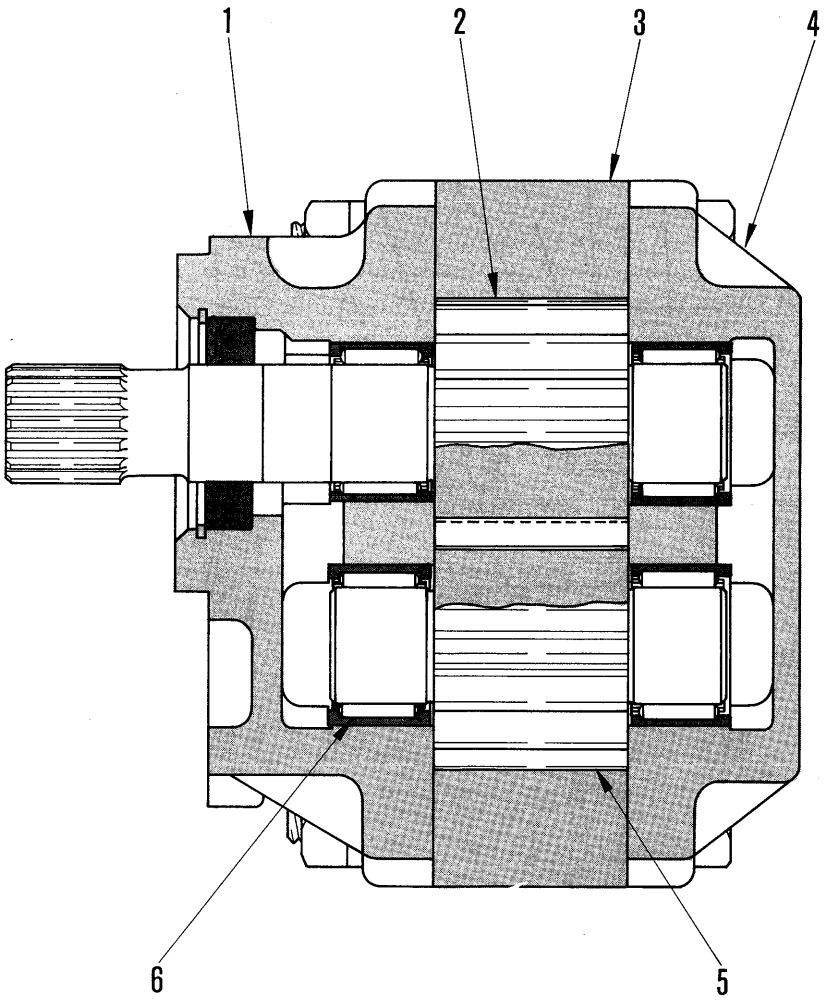
1. Pump drive gear (No. of teeth: 27)
2. Pump body
3. Bushing
4. Drive shaft
5. Driven shaft
6. Bushing
7. Oil pump driven gear (No. of teeth: 9)
8. Oil pump drive gear (No. of teeth: 9)
9. Dowel pin
10. Plug
11. Cover
12. Valve retainer
13. Valve spring
14. Regulator valve spring

**OIL PUMP**
- Type: Gear pump
- Pump speed: Engine speed x 1.333

**REGULATOR VALVE**
- Set pressure: 4.4 ± 0.4 kg/cm$^2$

# PTO SCAVENGING PUMP

## NTA-855-C (For HD320 Engine No. 26102754 – 26155098)




6710F080

1. Front housing
2. Drive gear (No. of teeth: 15)
3. Gear housing
4. Rear housing
5. Driven gear (No. of teeth: 15)
6. Needle bearing

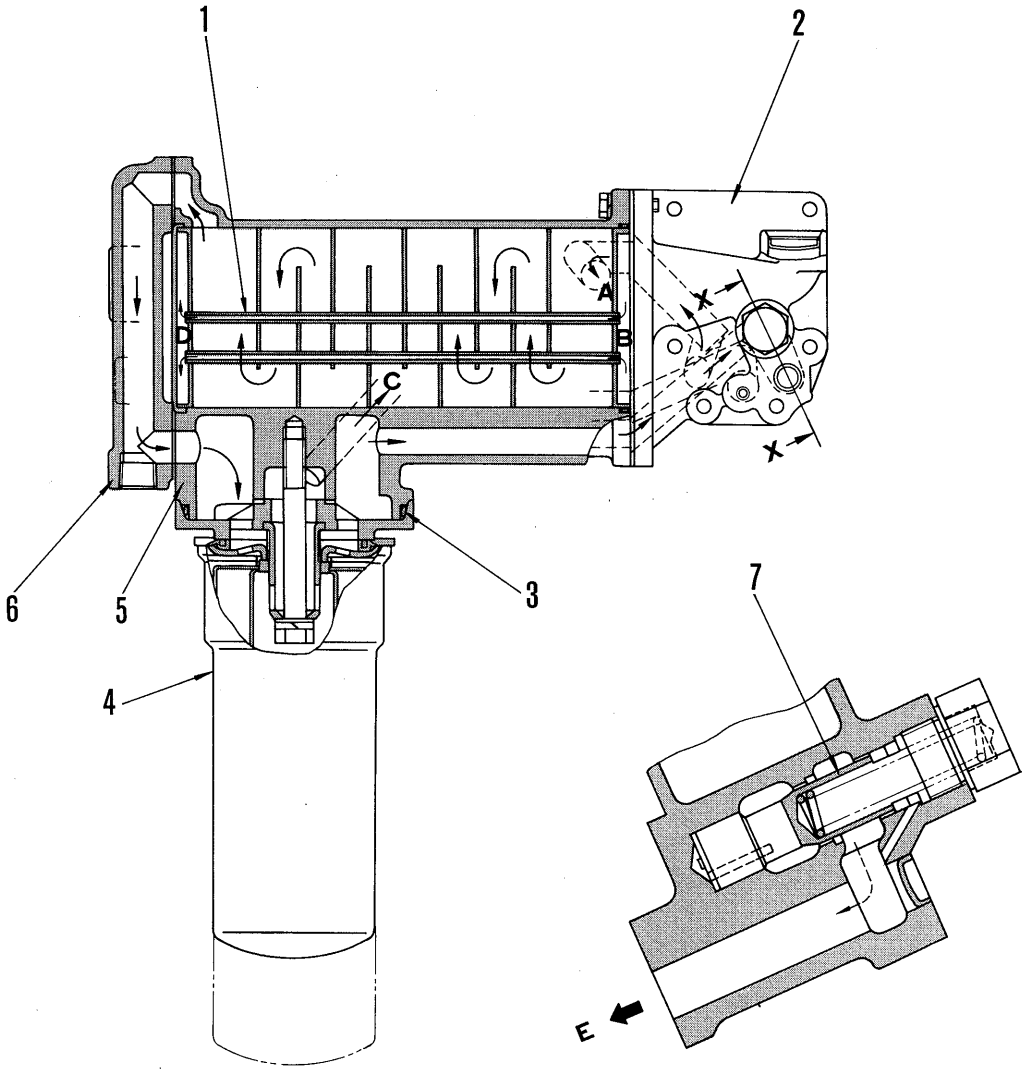
**Specifications**

- Model: FAR032
- Max. revolution: 2,300 rpm
- Max. pressure: 30 kg/cm$^2$

# OIL FILTER AND OIL COOLER

## OIL FILTER BUILD IN OIL COOLER

**NT-855-C (D80, 85-18, D95S-2)**
**NTA-855-C (WS16S-2, WS23-1)**




Section X–X

6710F081A

1. Cooler element
2. Oil cooler cover
3. Seal ring
4. Oil filter
5. Oil cooler housing
6. Oil cooler cover
7. Regulator valve

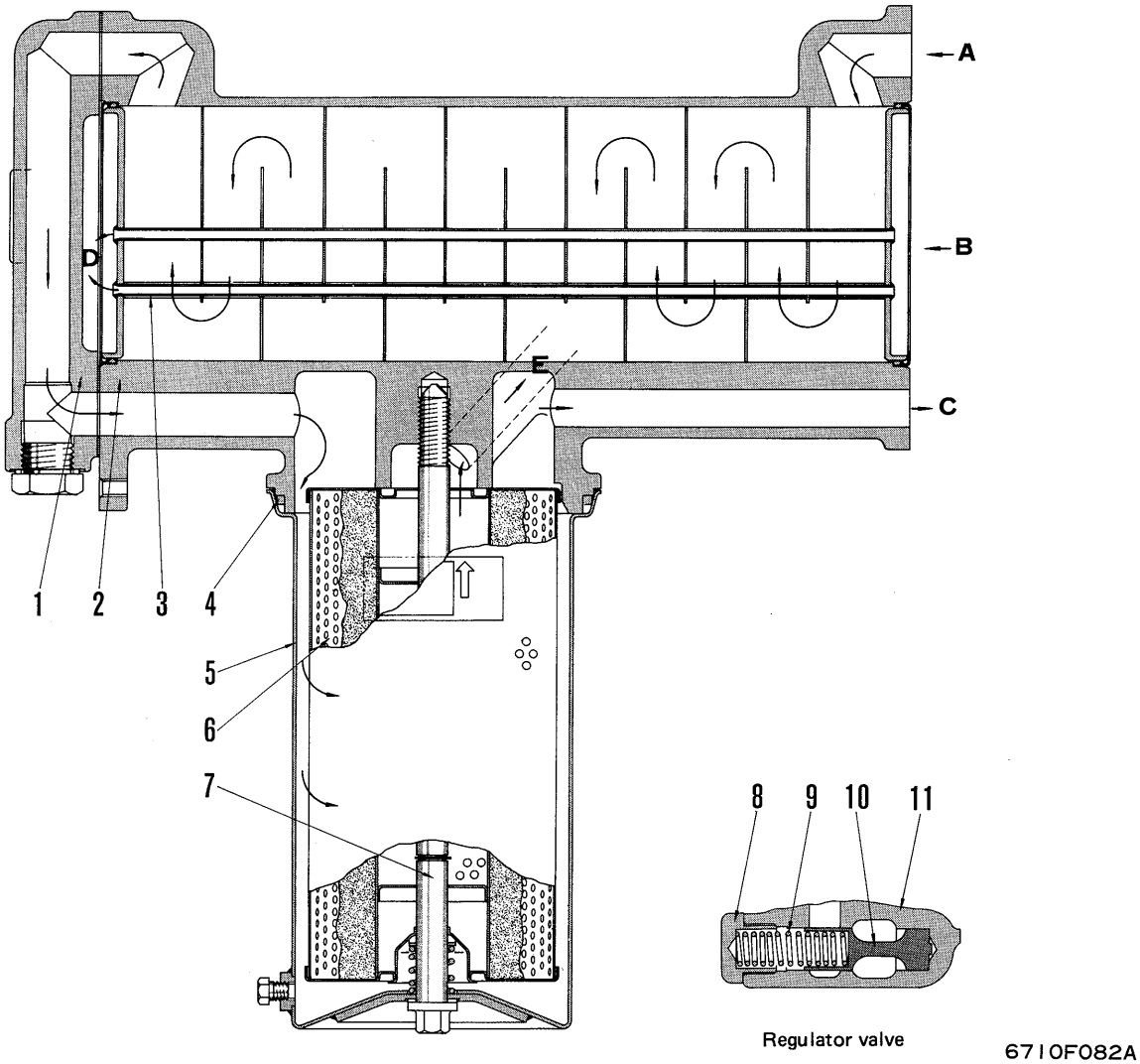
A. From oil pump (oil)
B. From water pump (water)
C. To main gallery (oil)
D. To water manifold (water)
E. To oil pan

**OIL FILTER**
- Filtration area: 0.84 $m^2$

**OIL COOLER**
- Effective area: 1.058 $m^2$

**REGULATOR VALVE**
- Set pressure: 4.4 ± 0.4 $kg/cm^2$

## NTA-855-C (HD320 Engine No. 26102754 – 26155098)




1. Cooler cover
2. Cooler housing
3. Cooler element
4. Seal ring
5. Filter case
6. Filter element
7. Center bolt
8. Cap
9. Valve spring
10. Regulator valve
11. Water pump inlet housing

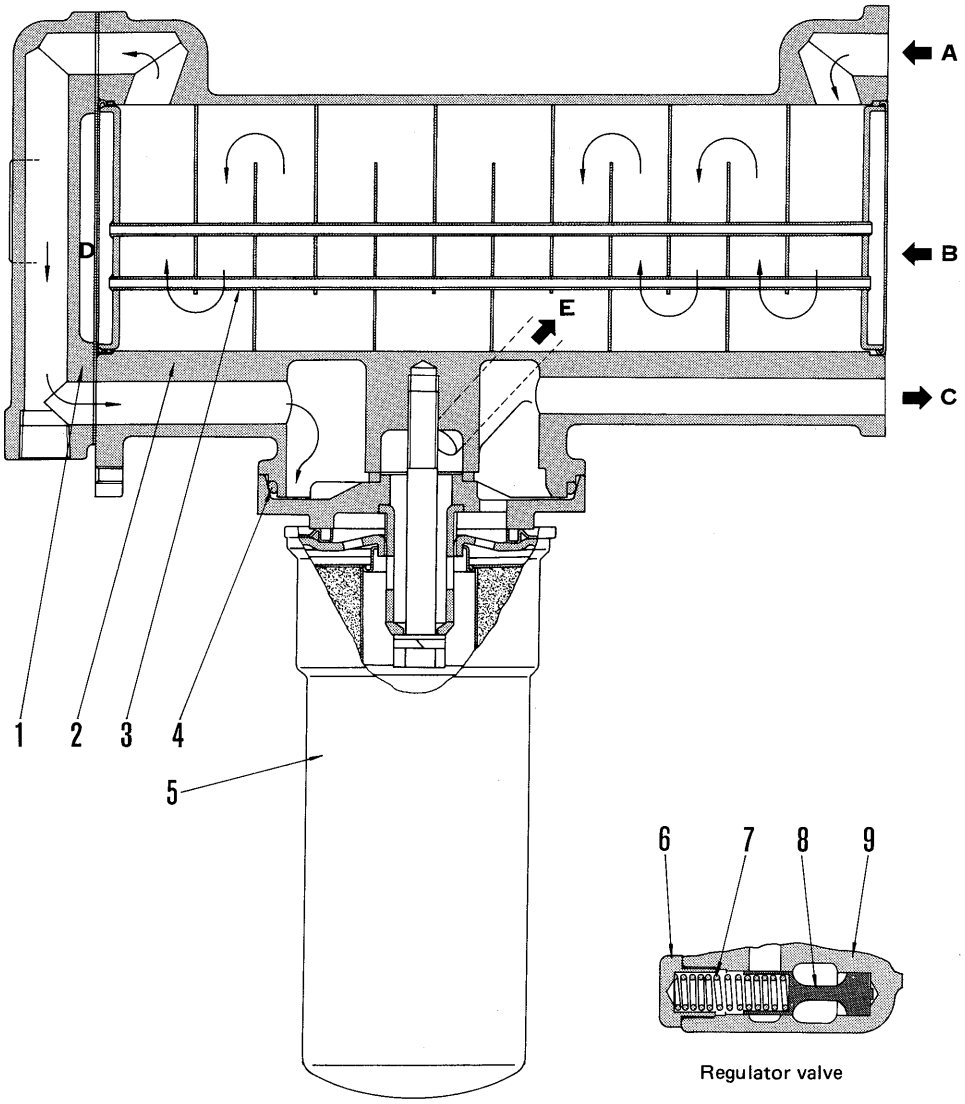
A. From oil pump (oil)
B. From water pump (water)
C. To regulator valve (oil)
D. To water manifold (water)
E. To main gallery (oil)

**OIL FILTER**
- Filtration area: 0.84 $m^2$

**OIL COOLER**
- Effective area: 1.37 $m^2$

**REGULATOR VALVE**
- Set pressure: 4.4 ± 0.4 $kg/cm^2$

## NTA-855-C (HD320 Engine No. 26155099 and up)




Regulator valve

6710F083A

1. Cooler cover
2. Cooler housing
3. Cooler element
4. Seal ring
5. Oil filter
6. Cap
7. Valve spring
8. Regulator valve
9. Water pump inlet housing

A. From oil pump (oil)
B. From water pump (water)
C. To regulator valve (oil)
D. To water manifold (water)
E. To main gallery (oil)

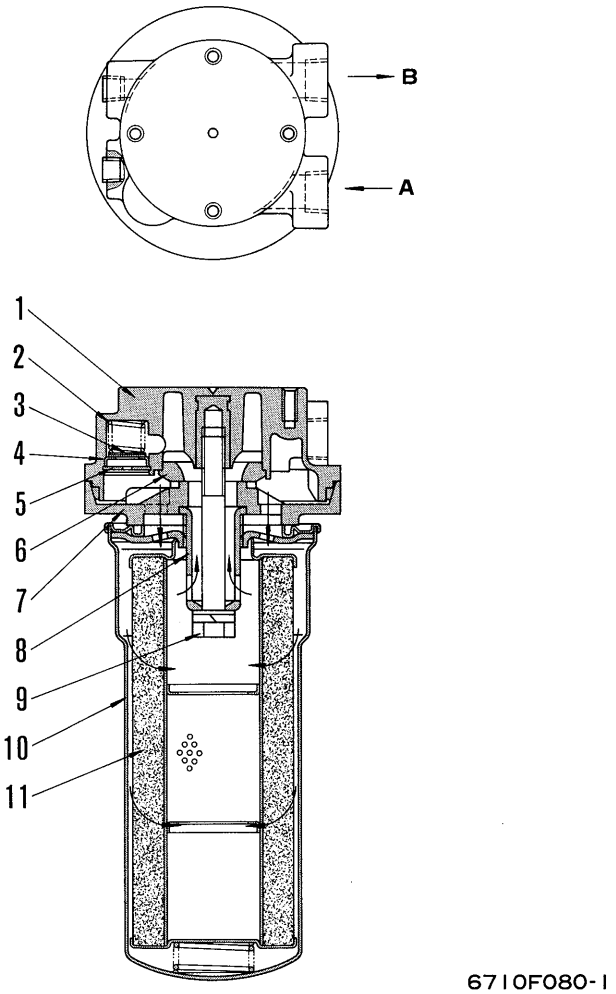
**OIL FILTER**
- Filtration area: 0.84 $m^2$

**OIL COOLER**
- Effective area: 1.37 $m^2$

**REGULATOR VALVE**
- Set pressure: 4.4 ± 0.4 kg/$cm^2$

# FULL-FLOW FILTER

**N-855-C**
**NT-855-C (For PC400-1, PC400LC-1, W170-2, W180-1)**




6710F080-1

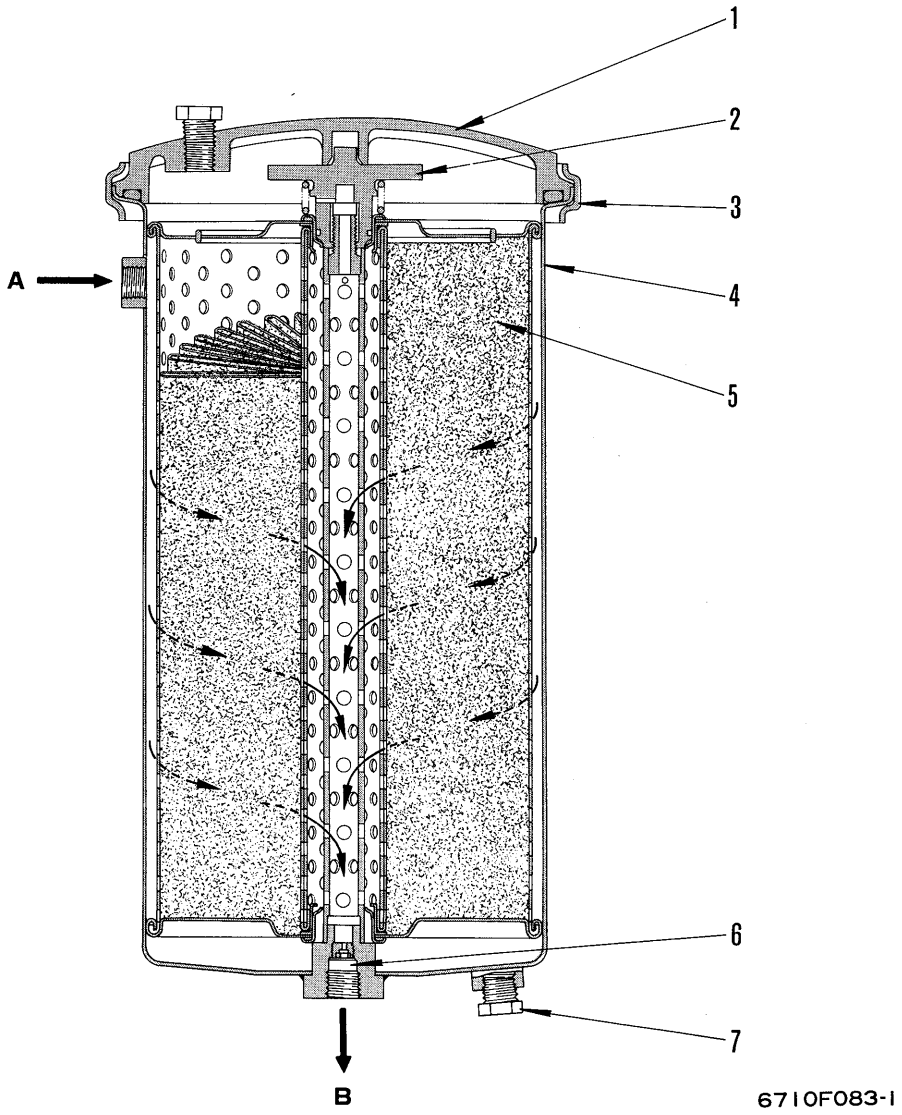
1. Head bracket
2. Valve spring
3. Safety valve
4. Valve seat
5. Ring
6. Adapter
7. Adapter
8. Insert
9. Center bolt
10. Cartridge
11. Element

A. Fuel inlet
B. Fuel outlet

**FULL-FLOW FILTER**
- Filtration area: 0.84 $m^2$

**SAFETY VALVE**
- Set pressure: 3.14 ± 0.34 $kg/cm^2$

# BY-PASS FILTER

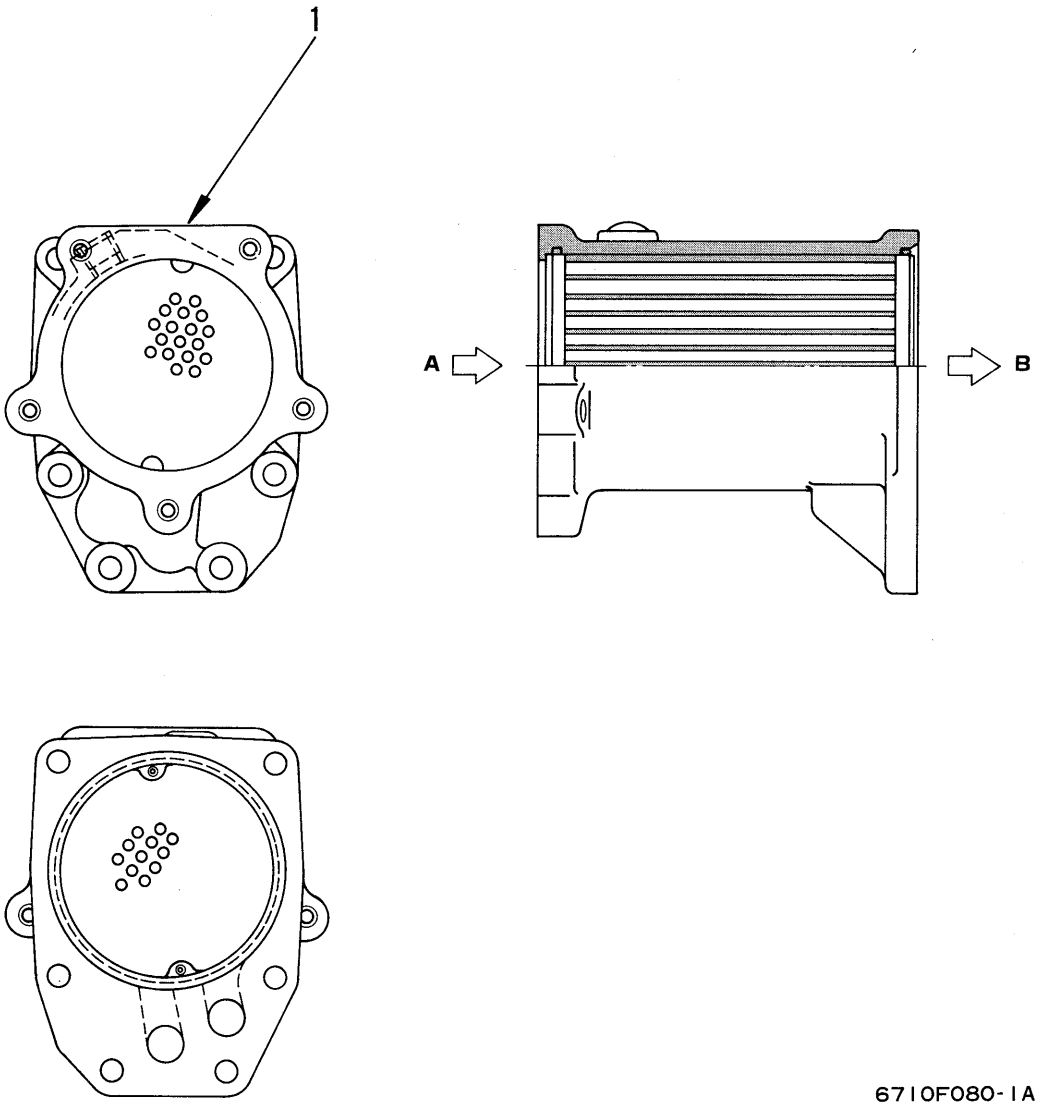



1. Filter cover
2. Support
3. Coupling
4. Filter case
5. Filter element
6. Orifice plug
7. Drain plug

A. From oil pump
B. To oil pan

# OIL COOLER

## N-855-C




6710F080-1A

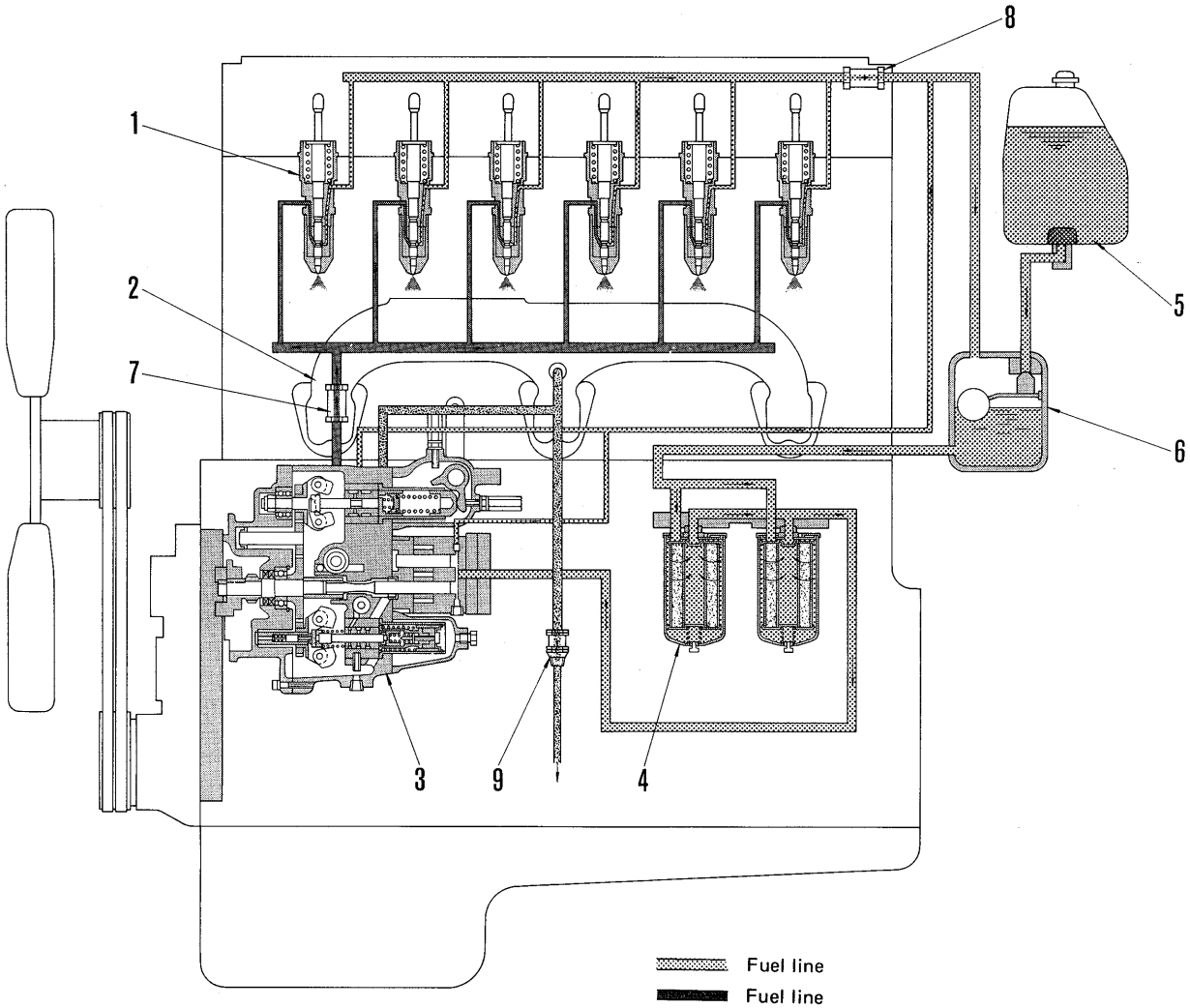
1. Oil cooler

A. Water inlet
B. Water outlet

# FUEL SYSTEM

## FUEL SYSTEM CHART

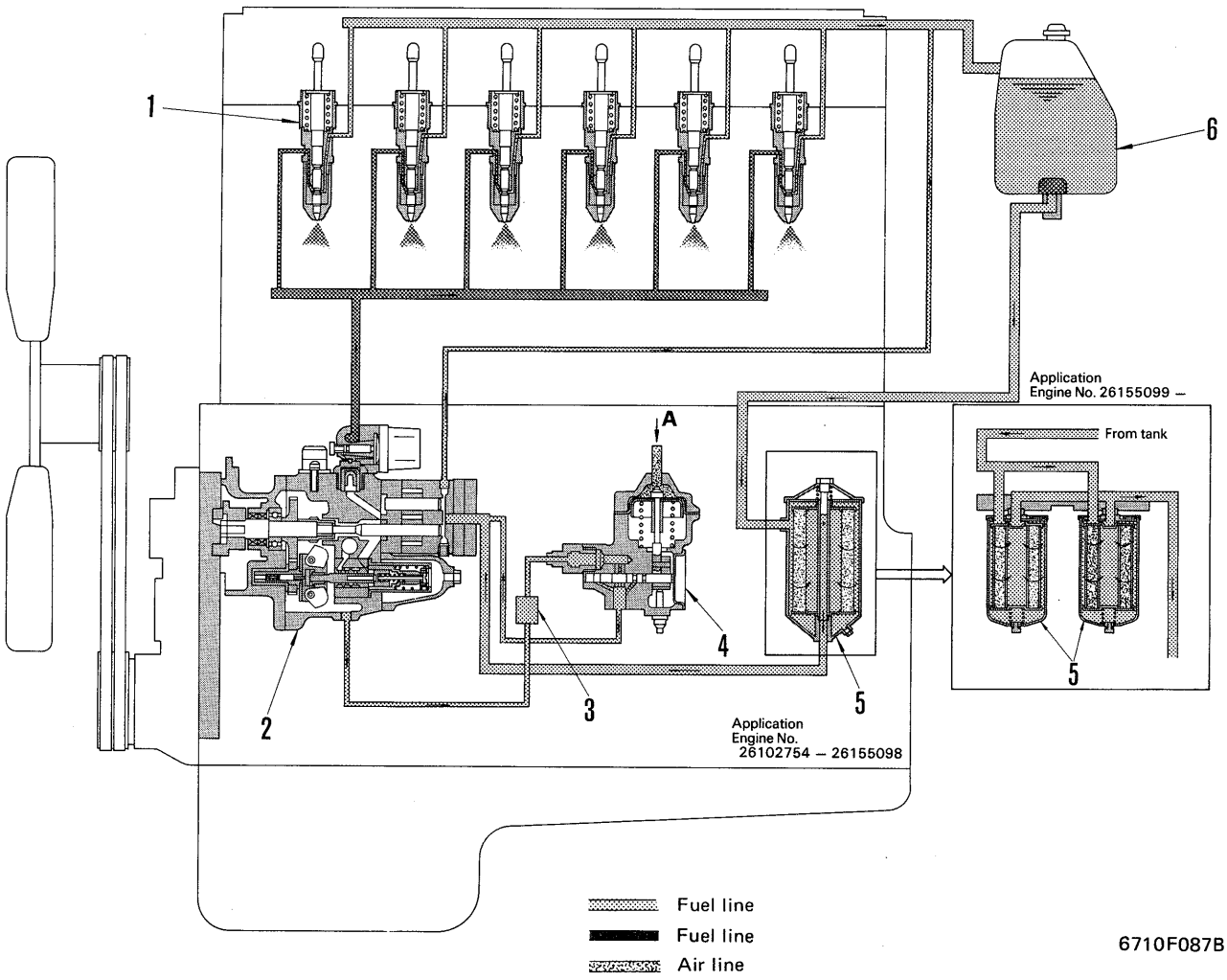
**N-855-C**
**NT-855-C**
**NTA-855-C (Except HD320-2, HD320-3)**




6710F086A

1. Injector
2. Intake manifold
3. PT fuel pump
4. Fuel filter
5. Fuel tank
6. Float tank
7. Check valve
   (Cracking pressure: 0.28 ± 0.07 kg/cm²)
8. Check valve
   (Cracking pressure: 0.027 ± 0.008 kg/cm²)
9. Check valve
   (Cracking pressure: 0.035 kg/cm²)

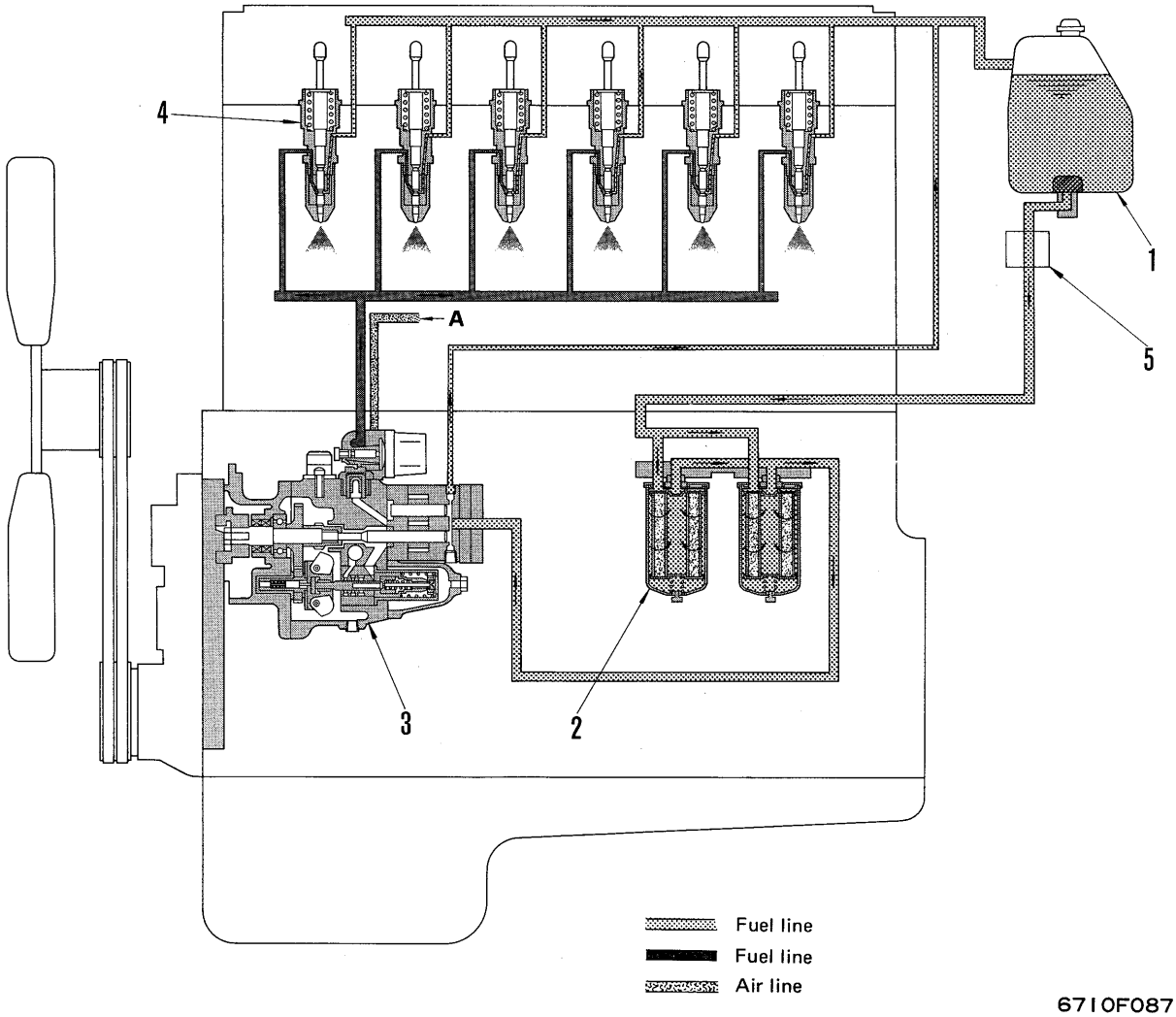
## NTA-855-C (HD320-2)




1. Injector
2. PT fuel pump
3. Check valve
4. Aneroid control valve
5. Fuel filter
6. Fuel tank

A. From after-cooler (air)

## NTA-855-C (HD320-3)

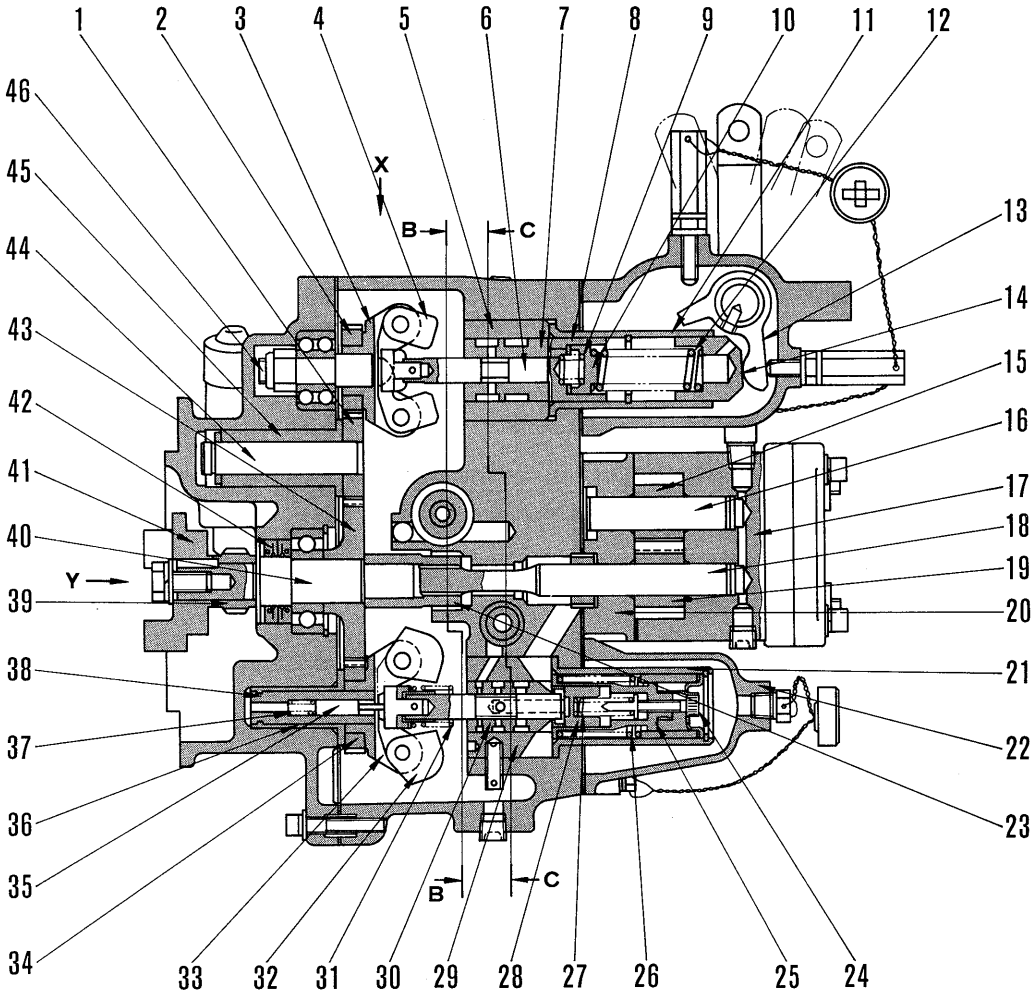



1. Fuel tank
2. Fuel filter
3. PT fuel pump
4. Injector

A. From after-cooler (air)

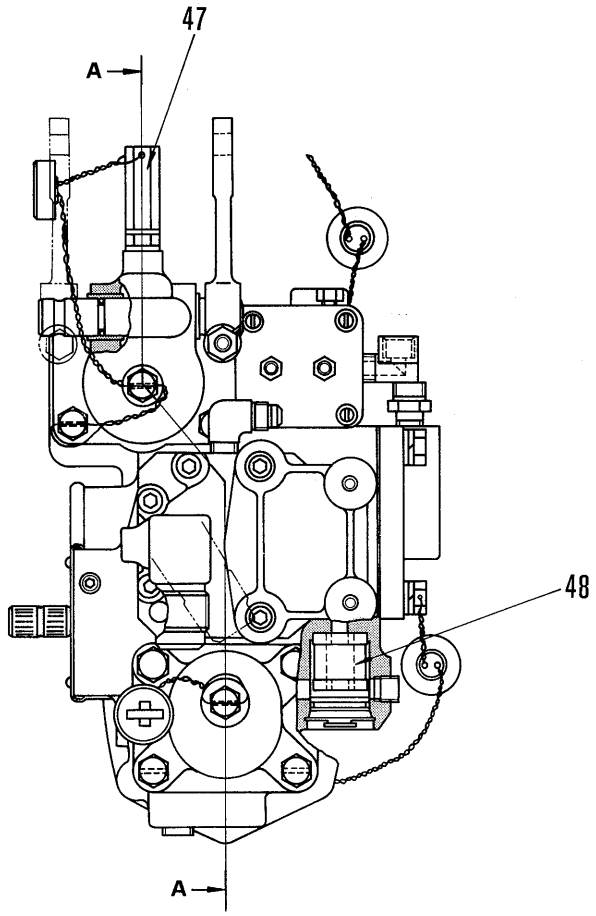
# PT FUEL PUMP

**N-855-C**
**NT-855-C**
**NTA-855-C (Except HD320-2 and HD320-3)**



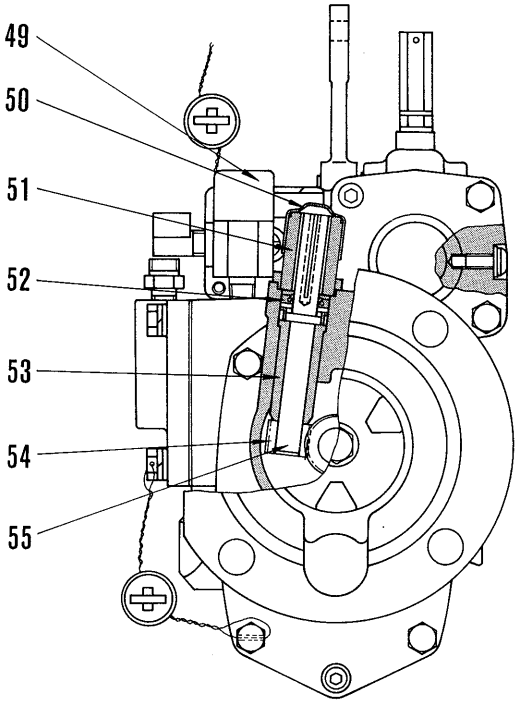

Section A — A

1. Idler gear (No. of teeth: 26)
2. VS governor drive gear (No. of teeth: 26)
3. Weight carrier
4. Weight
5. VS governor barrel
6. VS governor plunger
7. VS governor sleeve
8. VS governor idler plunger
9. VS governor idle spring
10. VS governor spring retainer
11. VS governor spring pack housing
12. VS governor spring
13. Stopper lever
14. Throttle plunger
15. Pump driven gear (No. of teeth: 10)
16. Driven shaft
17. Gear pump body
18. Gear pump drive shaft
19. Pump drive gear (No. of teeth: 10)
20. Gear pump cover

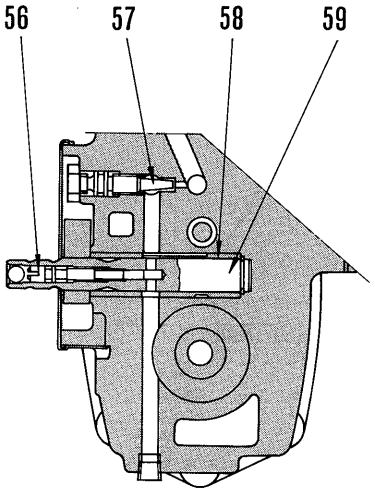



6710F090A

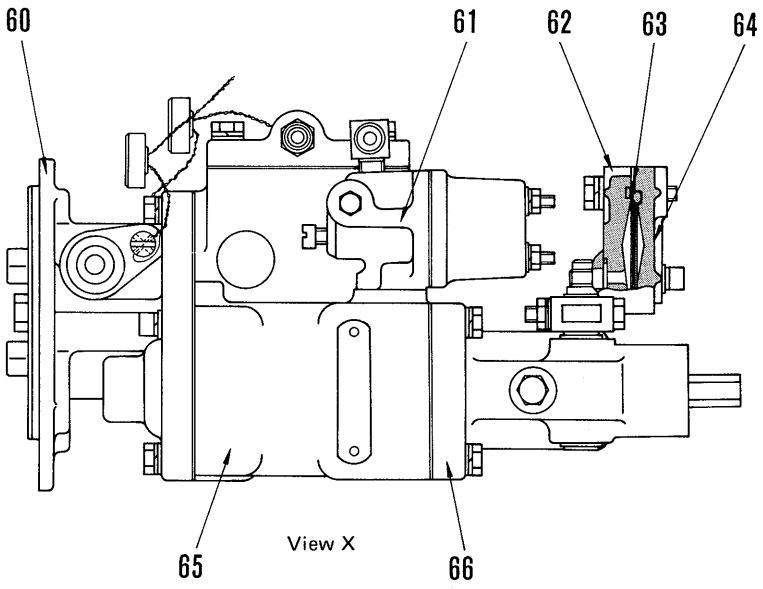
21. Spring pack housing
22. Spring pack cover
23. Coupling
24. Idle adjustment screw
25. Governor plunger guide
26. Main governor spring
27. Main governor idle spring
28. Idler plunger (button)
29. Governor barrel
30. Governor sleeve
31. Torque spring
32. Main governor weight
33. Weight carrier
34. Main governor drive gear (No. of teeth: 26)
35. Weight assist plunger
36. Bushing
37. Weight assist spring
38. Governor weight shaft
39. Service meter drive gear (No. of teeth: 9)
40. PT pump drive shaft
41. Drive coupling
42. Oil seal
43. Drive gear (No. of teeth: 49)
44. Idle shaft
45. Bushing
46. VS governor shaft
47. Adjustment screw
48. Filter screen




View Y

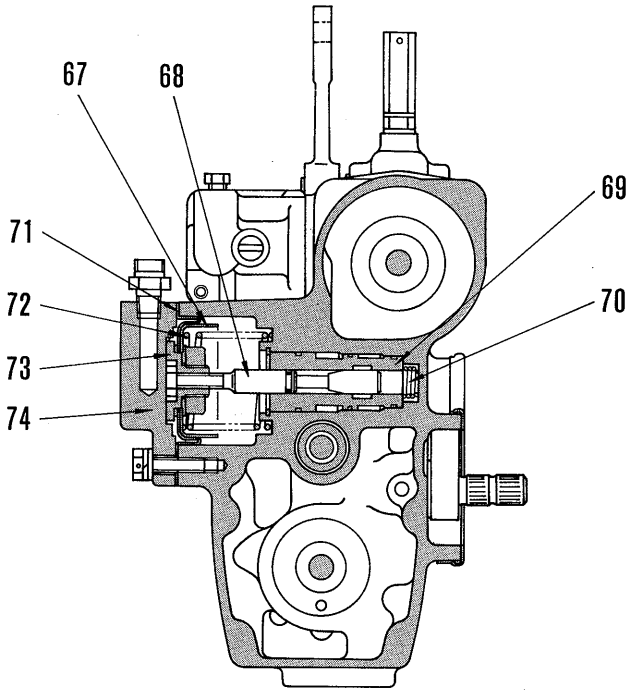



Section C–C



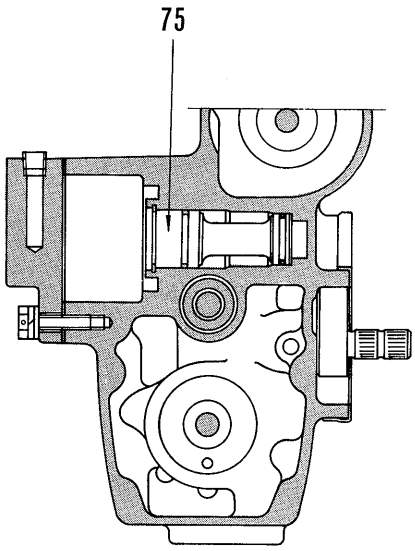

View X

49. Breather
50. Dust cap
51. Drive housing
52. Oil seal
53. Bushing
54. Service meter drive gear (No. of teeth: 9)
55. Service meter drive shaft
56. Idle screw
57. Needle barrel
58. Sleeve
59. Throttle shaft
60. PT pump cover
61. Shut-off valve
62. Damper body
63. Diaphragm




Section B–B

With AFC



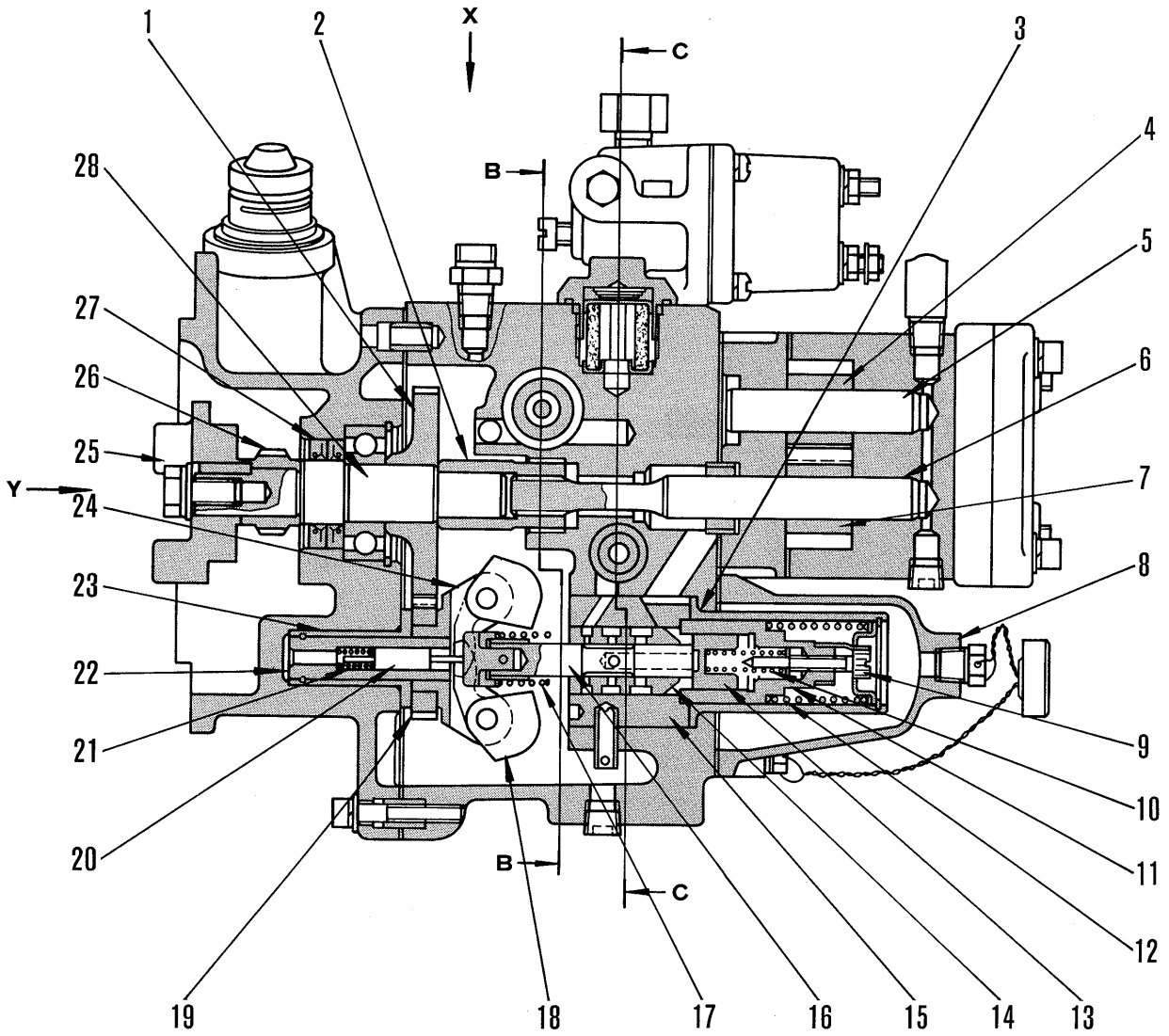

Section B–B

Without AFC

6710F091A

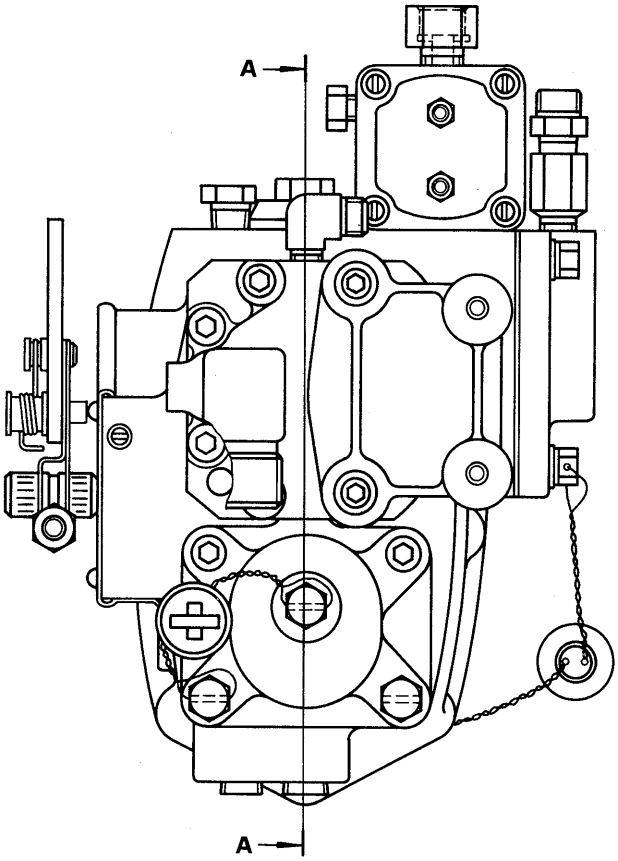
64. Pulsation damper cover
65. PT pump housing
66. Spring pack cover
67. AFC piston
68. AFC plunger
69. AFC barrel
70. Spring
71. AFC bellows
72. AFC spring
73. AFC center bolt
74. AFC cover
75. Barrel

## NTA-855-C (For HD320-2 and HD320-3)



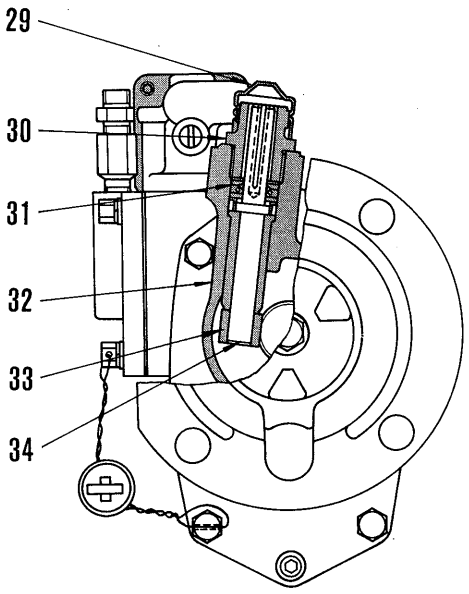

Section A–A

1. PT pump drive gear (No. of teeth: 49)
2. Coupling
3. Spring pack cover
4. Pump driven gear (No. of teeth: 10)
5. Driven shaft
6. Gear pump drive shaft
7. Pump drive gear (No. of teeth: 10)
8. Spring pack cover
9. Idler adjustment screw
10. Idler spring
11. Plunger guide
12. Governor spring
13. Idler plunger (button)
14. Governor sleeve
15. Governor barrel
16. Governor plunger
17. Torque spring
18. Governor weight
19. Governor drive gear (No. of teeth: 26)
20. Weight assist plunger

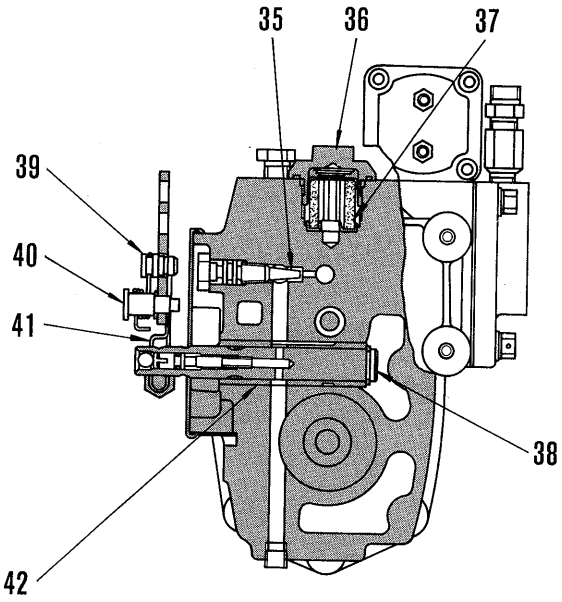



67I0F088A

21. Weight assist spring
22. Governor weight shaft
23. Bushing
24. Weight carrier
25. Drive coupling
26. Service meter drive gear (No. of teeth: 9)
27. Oil seal
28. PT pump drive shaft

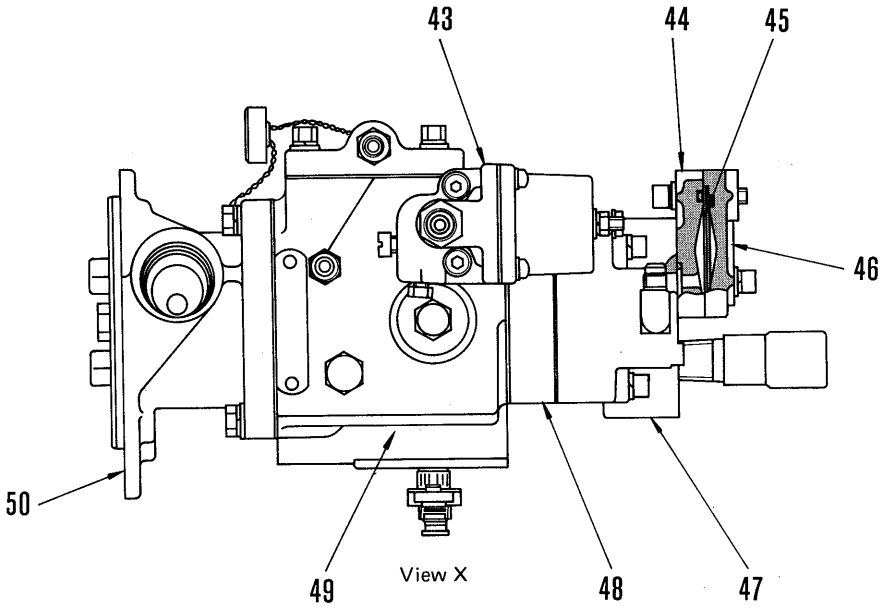



View Y

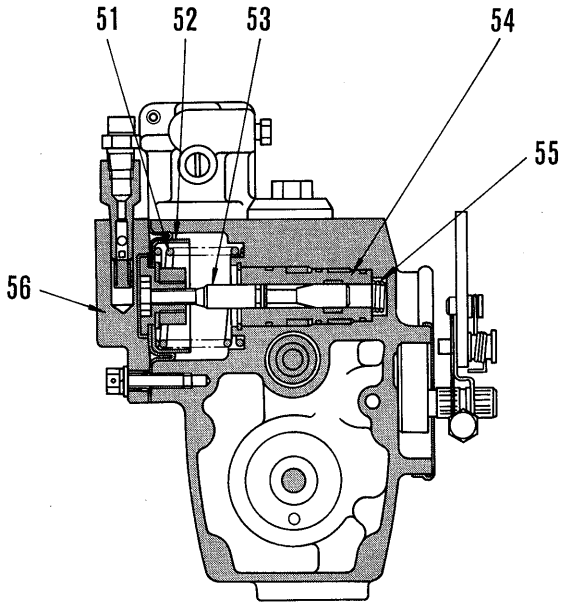



Section C – C

29. Dust cap
30. Service meter drive housing
31. Oil seal
32. Bushing
33. Service meter drive gear (No. of teeth: 9)
34. Service meter drive shaft
35. Needle valve
36. Filter cap
37. Filter screen
38. Throttle shaft
39. Stopper
40. Swivel joint
41. Throttle lever
42. Sleeve

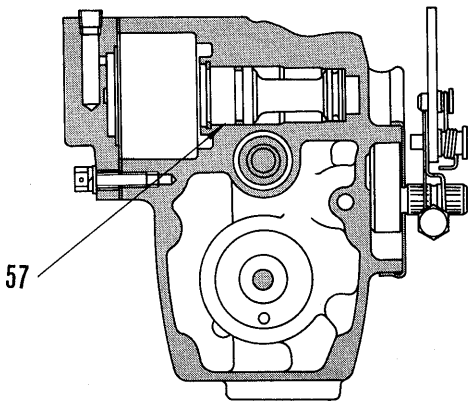



View X




Section B–B

With AFC




Section B–B

Without AFC

6710F089A

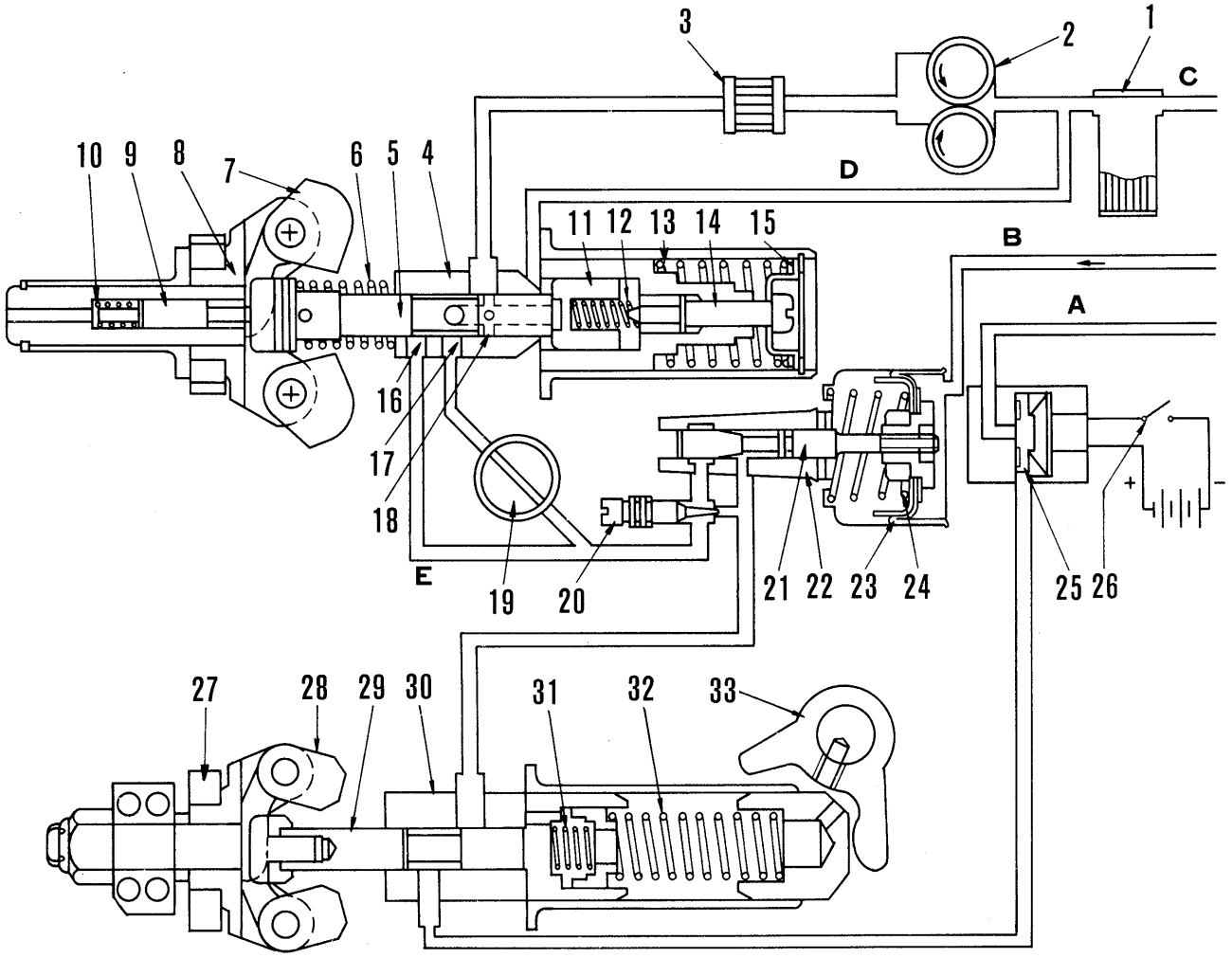
43. Shut-off valve
44. Pulsation damper body
45. Diaphragm
46. Damper cover
47. Gear pump housing
48. Gear pump cover
49. PT pump housing
50. PT pump front cover
51. AFC spring
52. AFC piston
53. AFC plunger
54. AFC barrel
55. Spring
56. AFC cover
57. Barrel

## PTG-VS FUEL PUMP FUEL FLOW AND GOVERNOR (For NT-855-C)

The schematics show a PTG-VS fuel pump with an air fuel control (AFC). The PTG-VS fuel pump has two governors in series: The PTG governor and the VS governor. The PTG governor has the same hardware and function as in the PTG fuel pump. The VS governor is a restricting governor that senses engine speed. The fuel flows from the fuel filter through the PTG governor, AFC section, VS governor, shut down valve, and to the injectors. The PTG-VS (variable speed) fuel pump provides stable constant speed operation at any throttle or speed setting.

### ENGINE NOT RUNNING

Ignition switch is open, solenoid valve is closed. The VS throttle is in the closed position when the engine is not running, eliminating any flow or pressure in engine fuel passages. Turbo boost pressure is not available to act upon diaphragm, to deflect AFC spring. The AFC plunger is in the closed position.




6710F121

1. Fuel filter
2. Gear pump
3. Filter screen
4. Governor plunger
5. Weight assist plunger
6. Torque control spring
7. Fly weights (Governor weights)
8. Fly weight drive gear
9. Weight assist plunger
10. Weight assist spring
11. Idle spring plunger
12. Idle speed spring
13. Governor spring
14. Idle speed adjusting screw
15. Maximum speed governor shims
16. Idler speed governor port
17. Main governor port
18. Governor dump port
19. Throttle shaft
20. AFC needle valve
21. AFC control plunger
22. AFC barrel
23. Diaphragm (Bellows)
24. AFC spring
25. Solenoid valve
26. Ignition switch
27. VS governor weight drive gear
28. Fly weights (VS governor weights)
29. Weight assist plunger (VS governor plunger)
30. VS governor sleeve
31. Governor spring (VS idle speed spring)
32. VS maximum speed governor spring
33. VS throttle

A: Fuel to injectors
B: Air from intake manifold
C: Fuel from tank
D: By-passed fuel
E: Idle fuel passage

### STARTING AND IDLE

Ignition switch is closed, causing solenoid valve to be energized and in open position. The gear pump supplies fuel to the governor; the governor weights push the governor plunger to a position to supply fuel to the VS governor. The VS governor weights move the VS plunger to open and regulate idle. Fuel pressure then forces the idle spring plunger back to allow excess fuel to by-pass and regulate pressure. Idle fuel which has flowed through the restricted "no air" needle valve, passes through the VS governor and on to the solenoid valve. The AFC plunger blocks fuel from passing through the AFC barrel due to insufficient turbo "boost" pressure available to act upon the diaphragm to deflect the AFC spring.

### NORMAL DRIVING

The throttle is connected to a pedal or lever by which the operator controls fuel flow and rail pressure to the injectors. The position of the VS governor plunger, which is positioned by the counteracting forces of the VS governor spring and the VS governor weight force, controls the amount of fuel flow and rail to the injectors. The governor weight force increases as speed increases. The amount of fuel delivered to the VS governor depends upon the regulating counteracting forces of the governor spring and torque spring which influences the amount of fuel by-passed at the end of the governor plunger and idle spring plunger. The maximum fuel pressure and fuel flow are regulated in the speed range of the engine by the governor itself. Fuel is passing through the needle valve and AFC barrel since sufficient turbo "boost" is available to act upon the diaphragm and overcome the AFC spring. The final fuel flow is regulated at the VS governor and passes through the solenoid valve on to the injector.

### BEGINNING OF HIGH SPEED GOVERNING

Fuel is still flowing from the governor through both the needle valve and AFC barrel, VS governor, to the solenoid, and on to the injectors. However, it can be noticed that the VS governor port is being closed which causes more fuel to be by-passed by the plunger and idle spring plunger. The VS plunger and port thereby control governor regulation on the droop curve by restricting fuel flow.

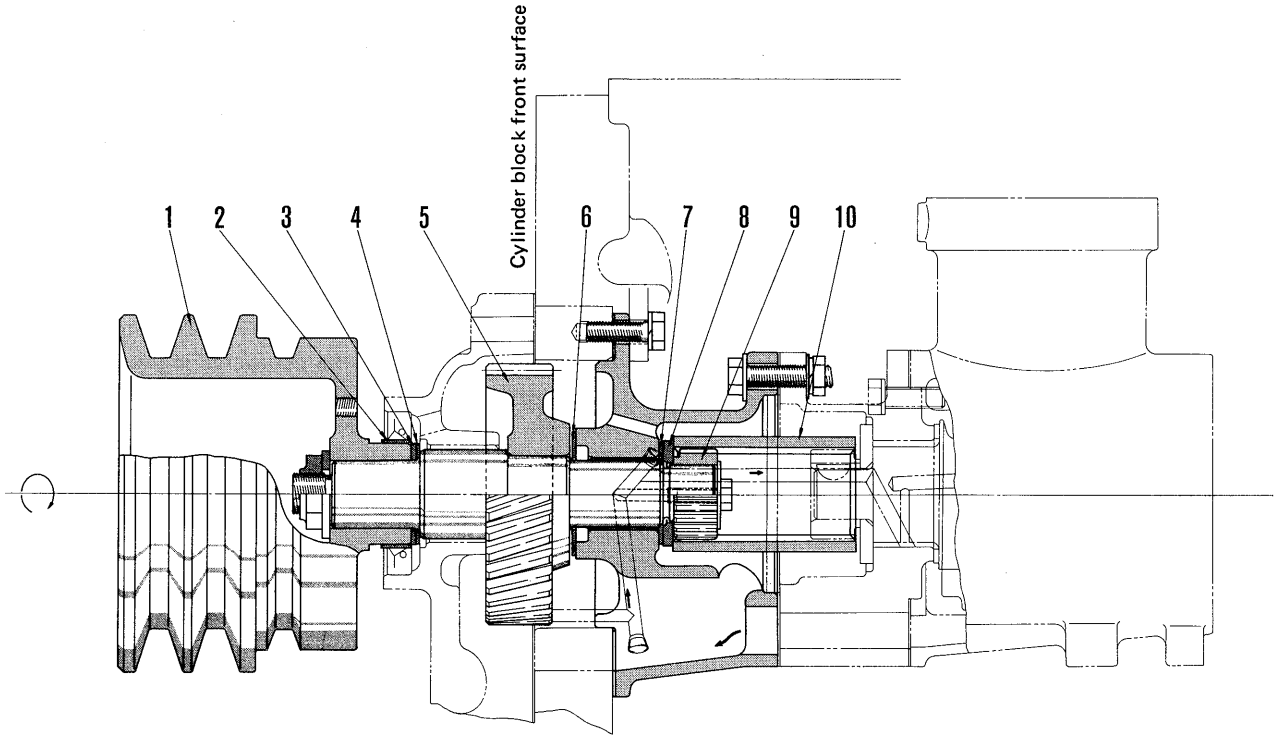
### COMPLETE HIGH SPEED GOVERNING

Gear pump supplied fuel is flowing to the VS governor, which is restricting the flow of fuel to the engine. The supplied fuel is being by-passed by the plunger and idle spring plunger and dump holes; thus only sufficient fuel will pass to maintain high idle speed. The throttle is open and fuel will flow through restricted "no air" needle valve, and on to solenoid valve. AFC plunger blocks fuel from passing through AFC barrel. Turbo "boost" pressure is not available to act upon diaphragm to deflect AFC spring.

# PT FUEL PUMP DRIVE

## WITH AIR COMPRESSOR

**NT-855-C (PC400-1, PC400LC-1, W170-2, W180-1)**
**NTA-855-C (HD320-2, 3, WS16S-2, WS26-1)**

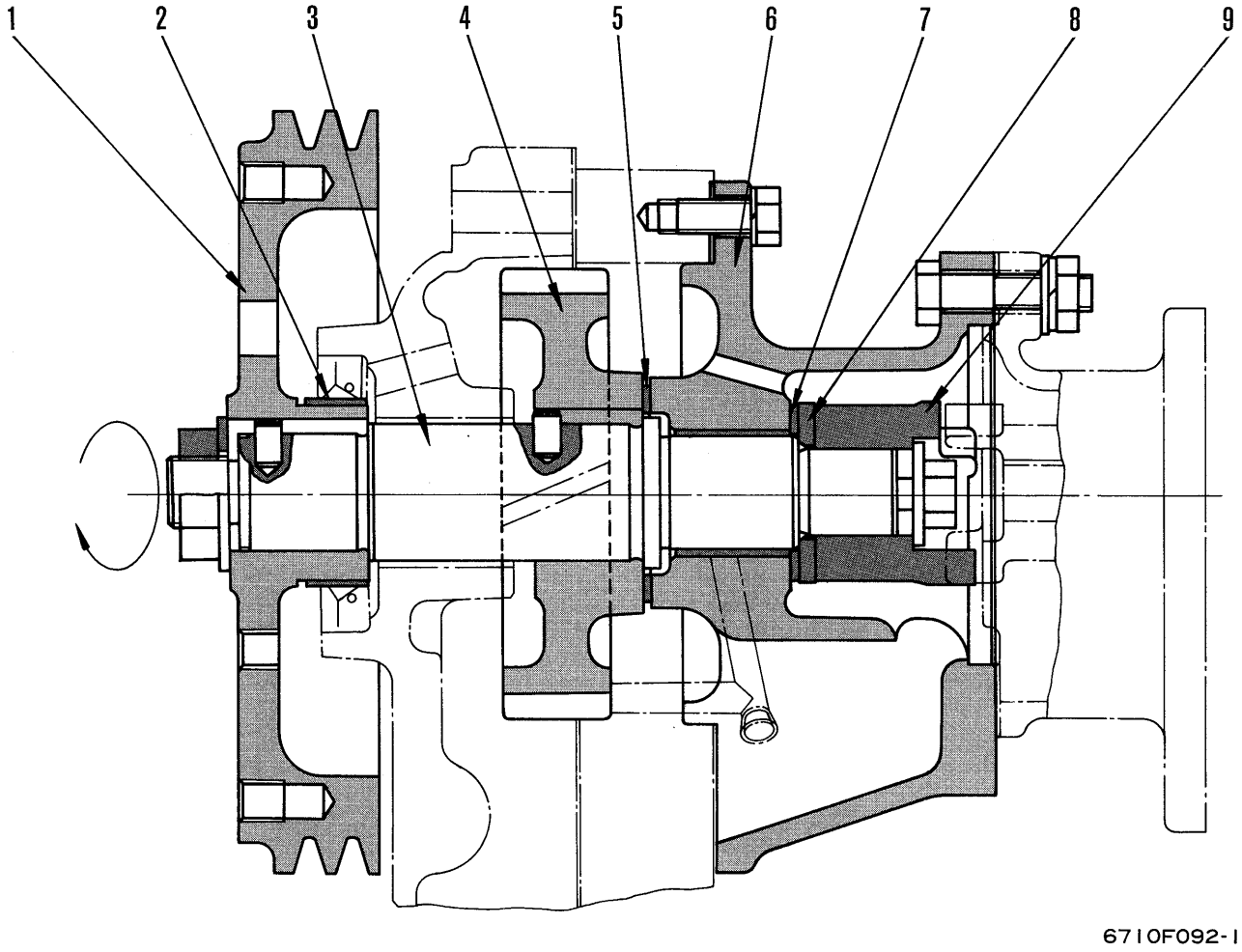



6710F092A

1. Accessory drive pulley
2. Sleeve
3. Slinger (NTA-855-C)
4. Spacer
5. Accessory drive gear (No. of teeth: 36)
6. Thrust washer
7. Thrust washer
8. Washer
9. Drive coupling
10. Coupling

## WITHOUT AIR COMPRESSOR

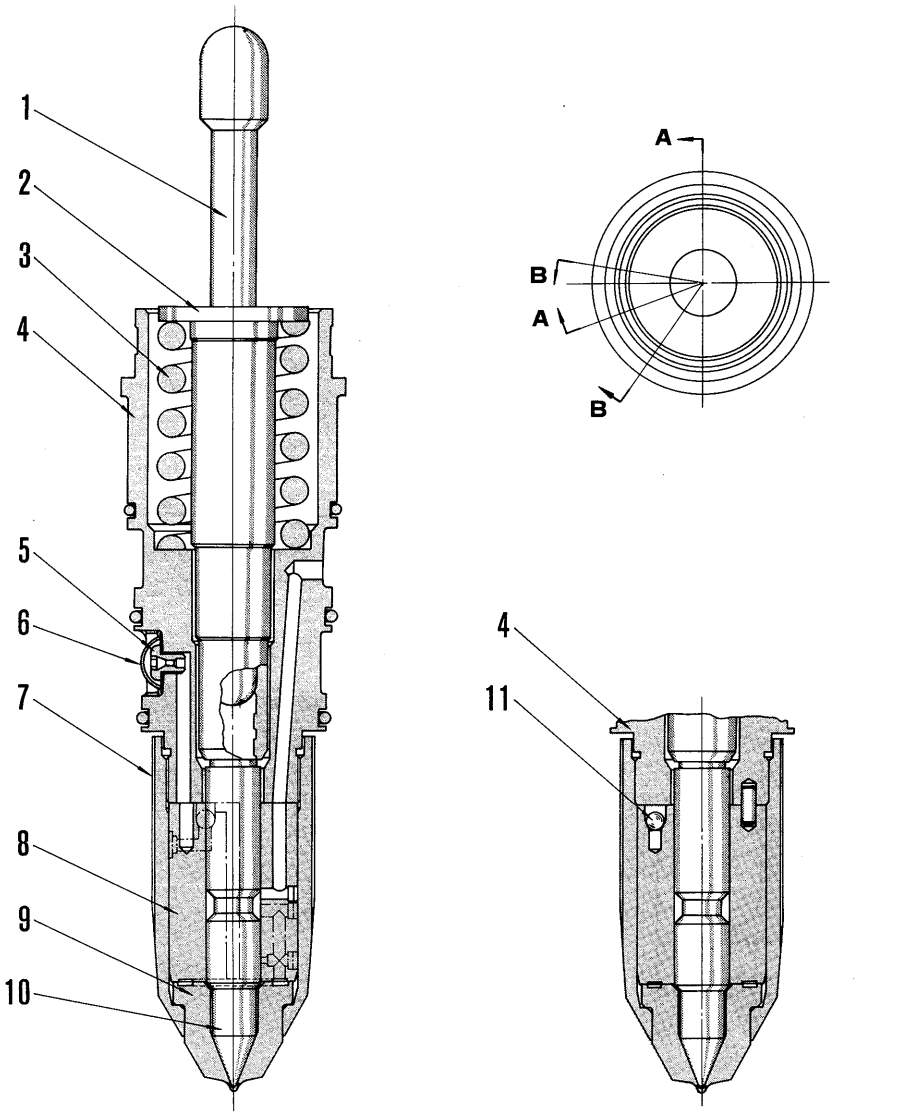
### NT-855-C (D80, 85-18, D95S-2)




6710F092-1

1. Accessory drive pulley
2. Wear sleeve
3. Accessory drive shaft
4. Accessory drive gear (No. of teeth: 36)
5. Thrust washer
6. Drive case
7. Thrust washer
8. Washer
9. Coupling

# INJECTOR




Section A—A

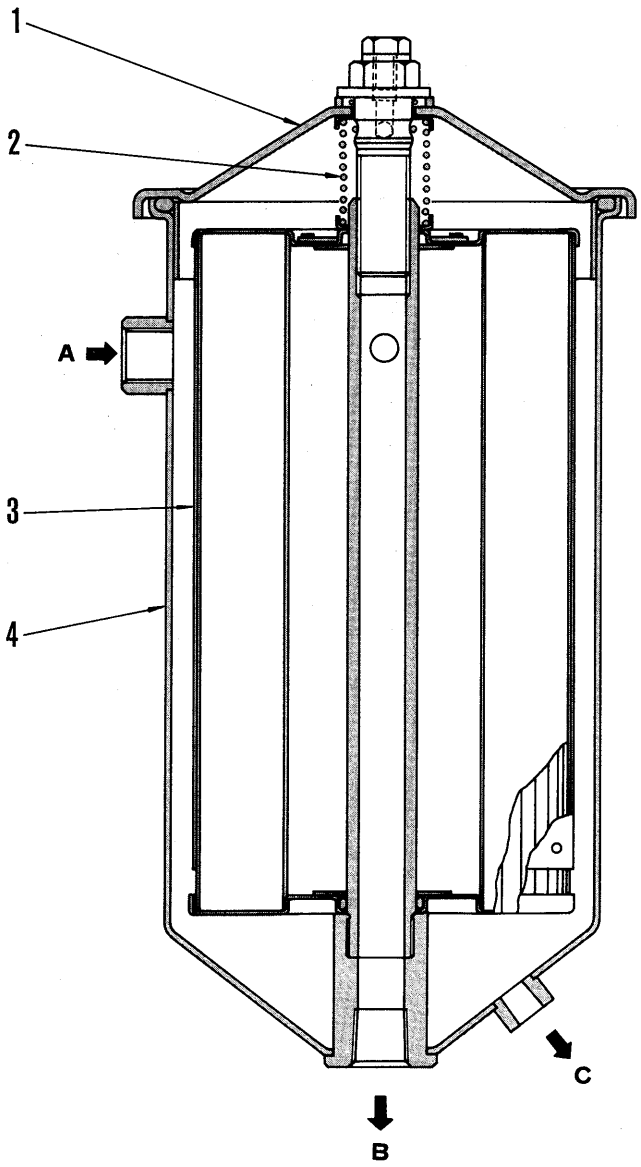
Section B—B

6710F093

1. Plunger link
2. Plunger coupling
3. Injector spring
4. Injector adapter
5. Orifice plug
6. Filter screen
7. Injector retainer
8. Injector barrel
9. Injector cup
10. Injector plunger
11. Check ball valve

# FUEL FILTER

## Center bolt type




6710F094

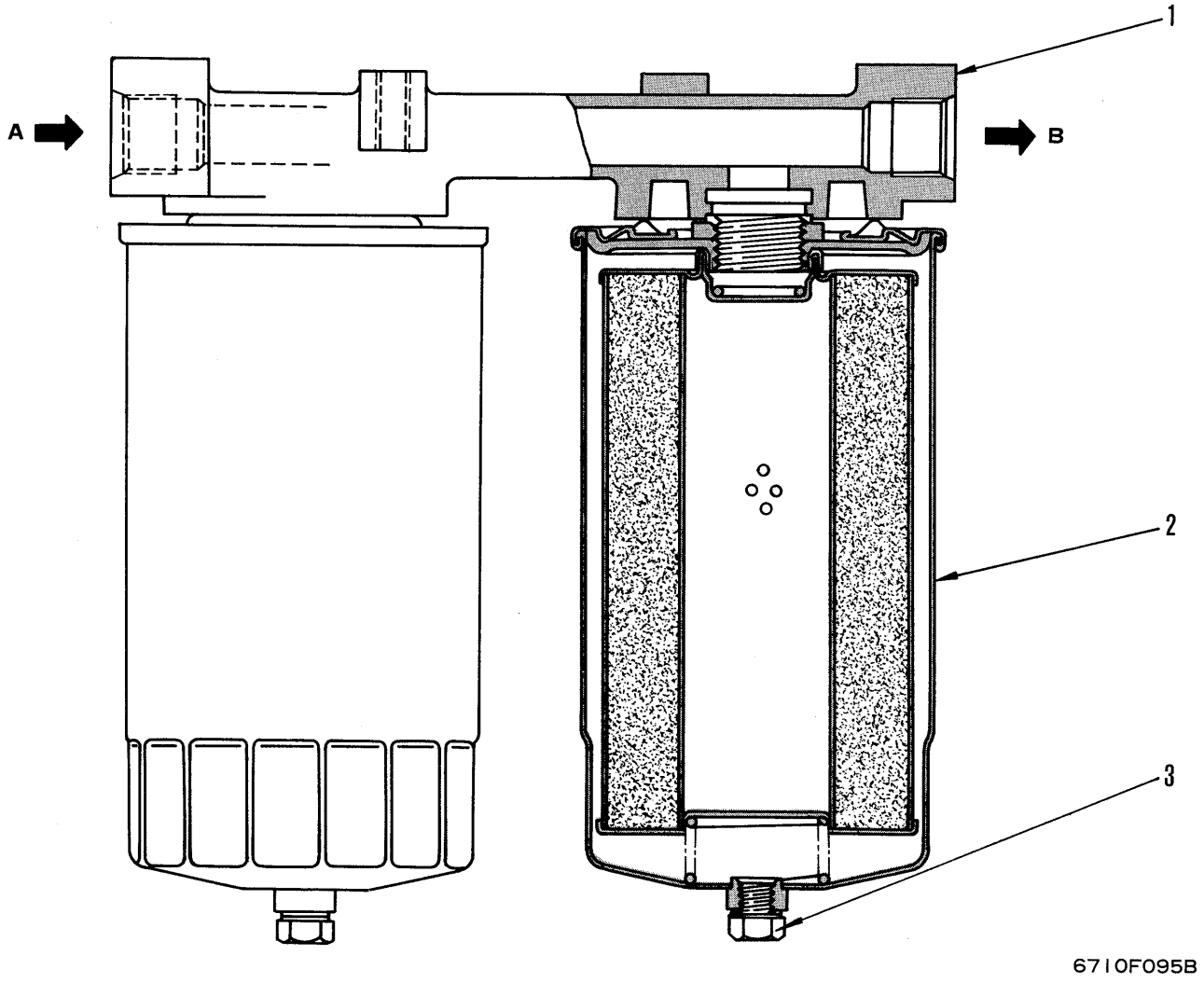
1. Cover
2. Spring
3. Element
4. Body

A. From fuel tank
B. To PT fuel pump
C. To drain

**Filter**

Filtration area : 1.21m$^2$

## Cartridge type




1. Filter bracket
2. Cartridge assembly
3. Drain plug

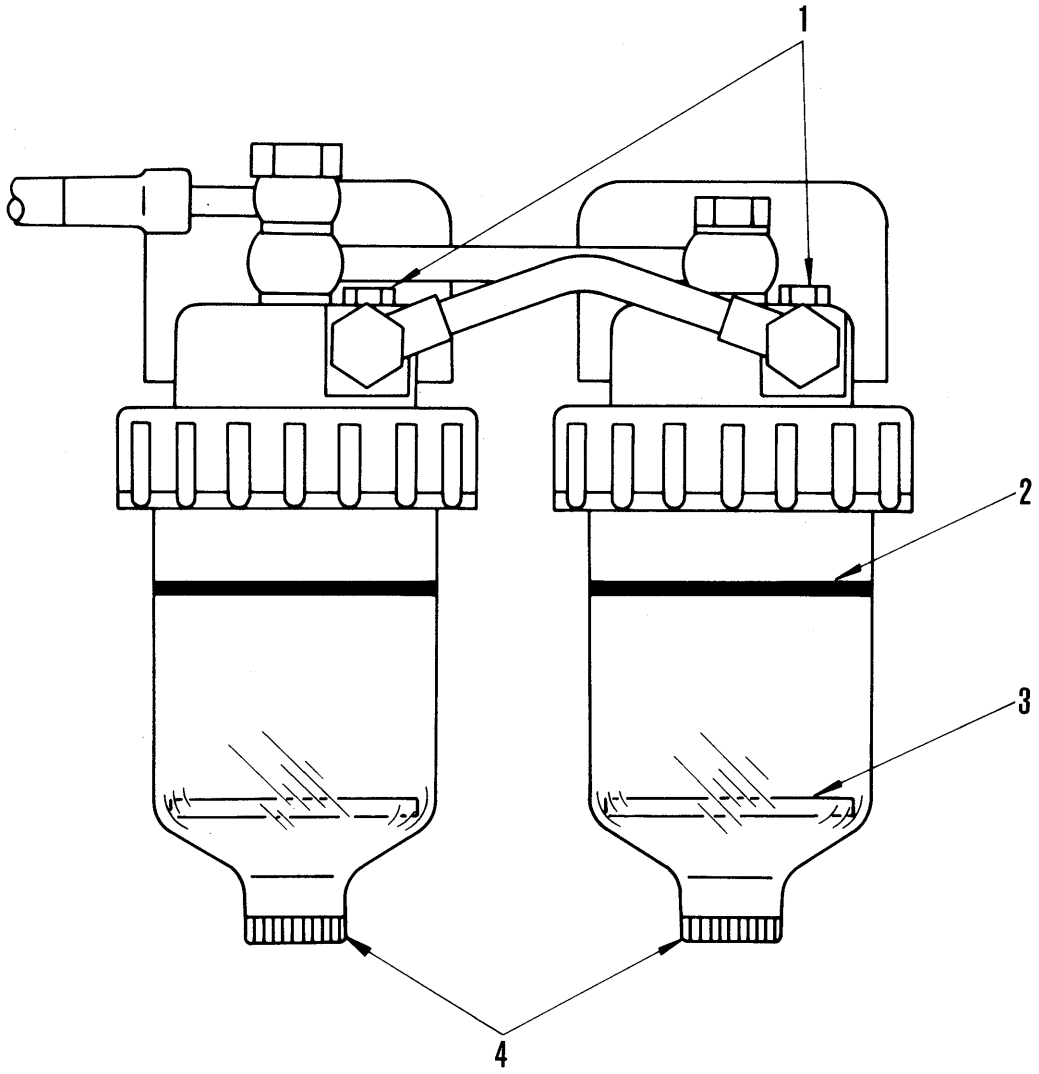
A. From fuel tank

B. To PT fuel pump

**Filter**

Filtration area : $1.0m^2$ ($0.5m^2$ x 2)

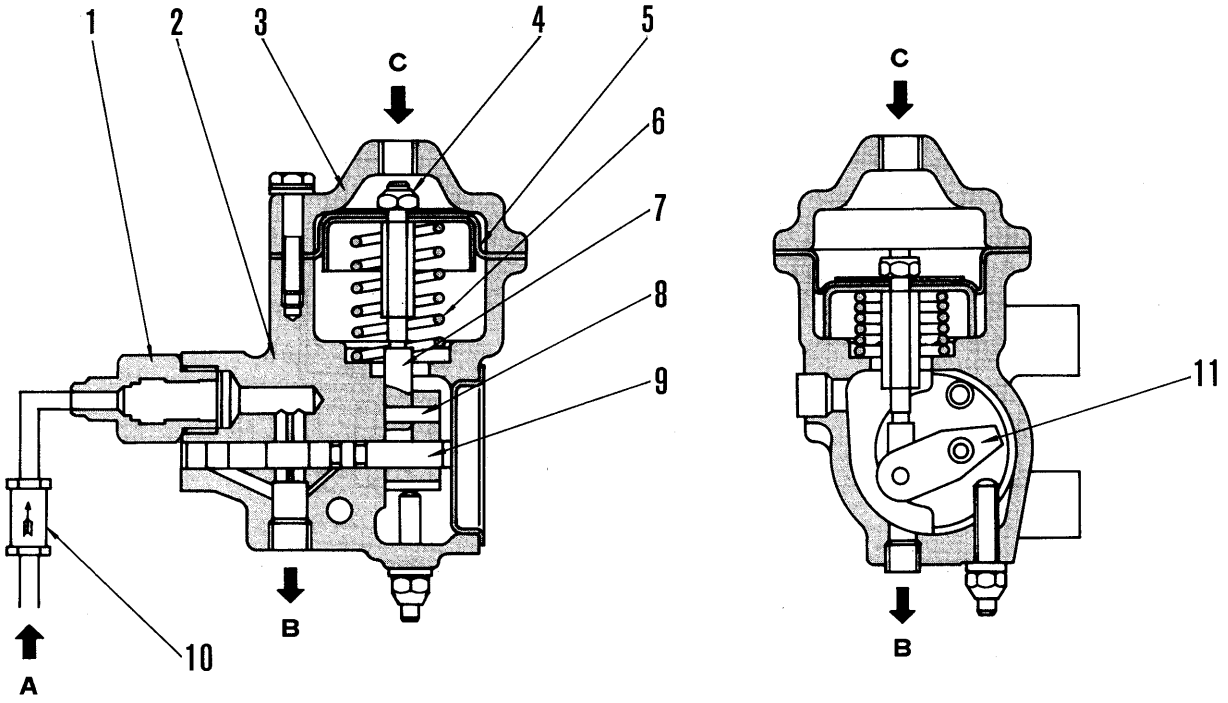
# WATER SEPARATOR (OPTION)




1. Air bleeding plug
2. Allowable water level (red line)
3. Float
   (floats on water to indicate the water level)
4. Drain plug

# ANEROID CONTROL VALVE

## NTA-855-C (For HD320-2)




6710F096

1. Inlet fitting
2. Housing
3. Cover
4. Upper shaft
5. Piston
6. Aneroid control spring
7. Lower shaft
8. Aneroid control pin
9. Aneroid control valve
10. Check valve
11. Aneroid control lever

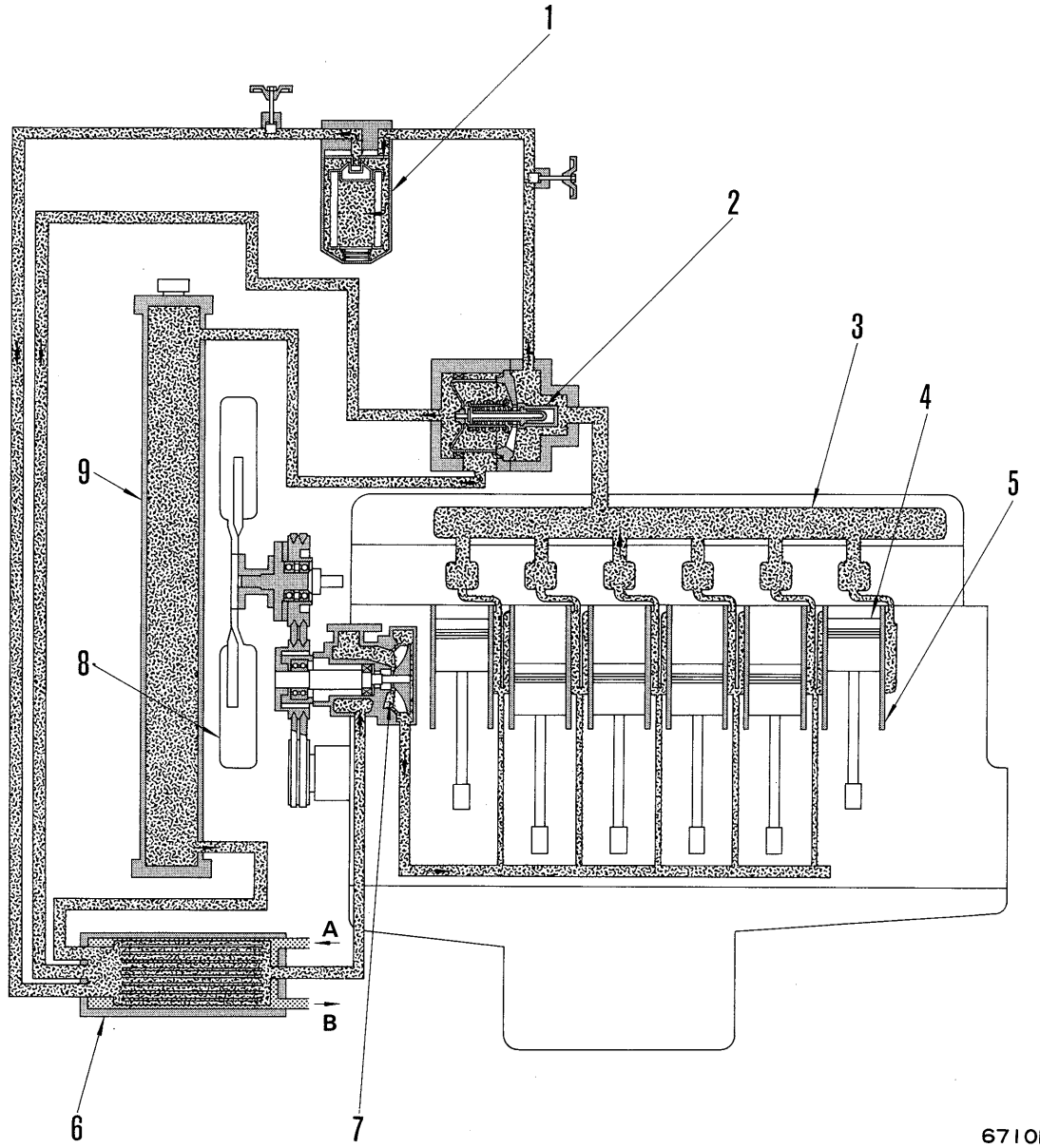
A. From PT fuel pump
B. To PT fuel pump
C. From after-cooler

**Check valve pressure** : 1.05±0.25kg/cm$^2$

# COOLING SYSTEM

## COOLING SYSTEM CHART

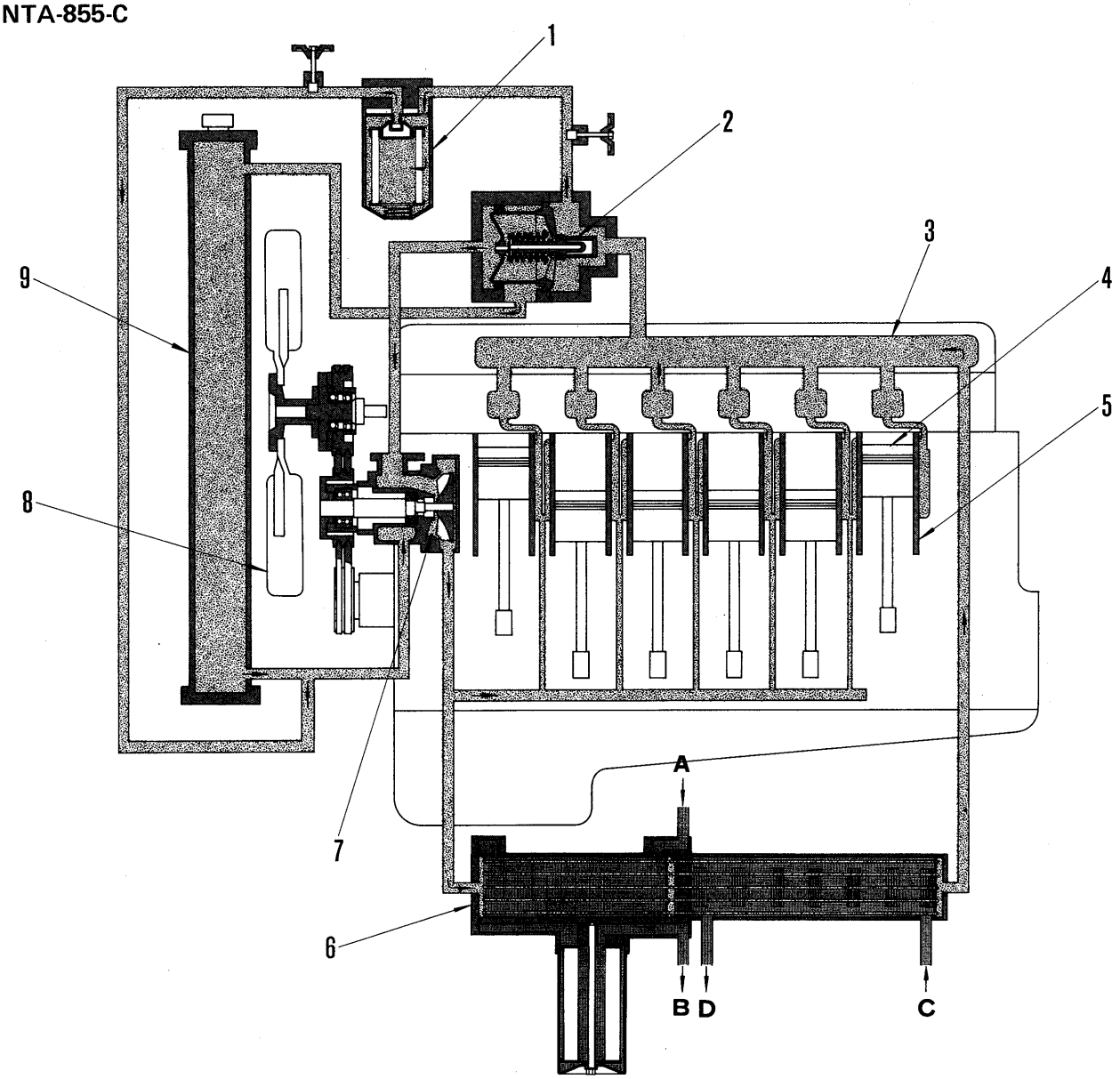
**N-855-C**




6710F096-1

1. Corrosion resistor
2. Thermostat
3. Water manifold
4. Piston
5. Cylinder liner
6. Oil cooler
7. Water pump
8. Fan
9. Radiator
A. From oil pump (oil)
B. To main gallery (oil)

**NT-855-C**
**NTA-855-C**



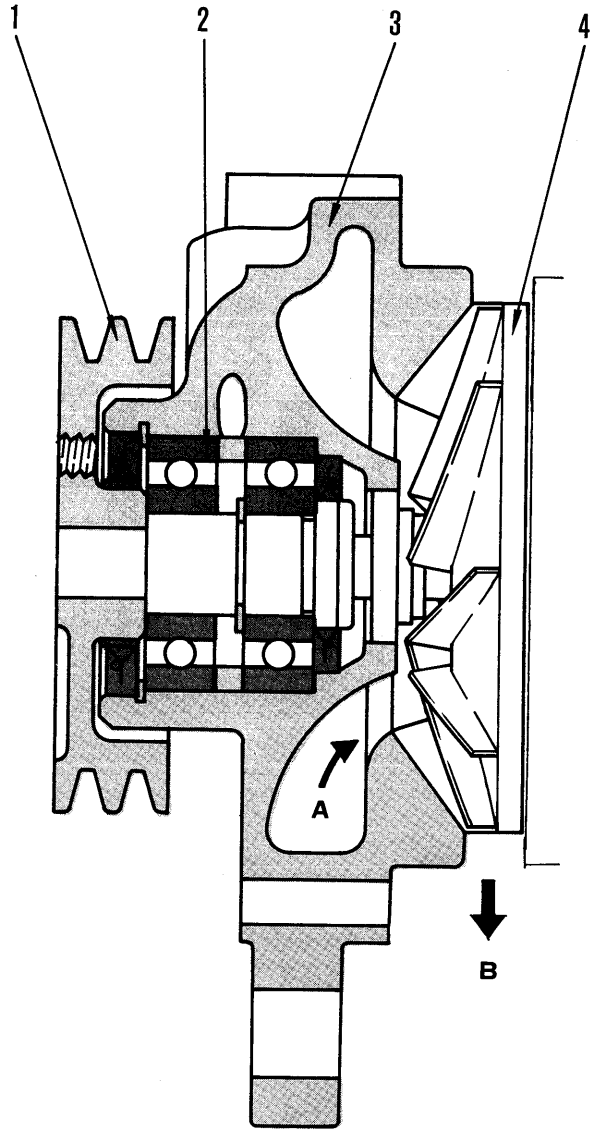

6710F097A

1. Corrosion resistor
2. Thermostat
3. Water manifold
4. Piston
5. Cylinder liner
6. Oil cooler
7. Water pump
8. Fan
9. Radiator

A. From oil pump (oil)
B. To main gallery (oil)
C. From machine chassis (oil)
D. To machine chassis (oil)

# WATER PUMP

**N-855-C**
**NT-855-C**
**NTA-855-C (WS16S-2, WS23-1)**

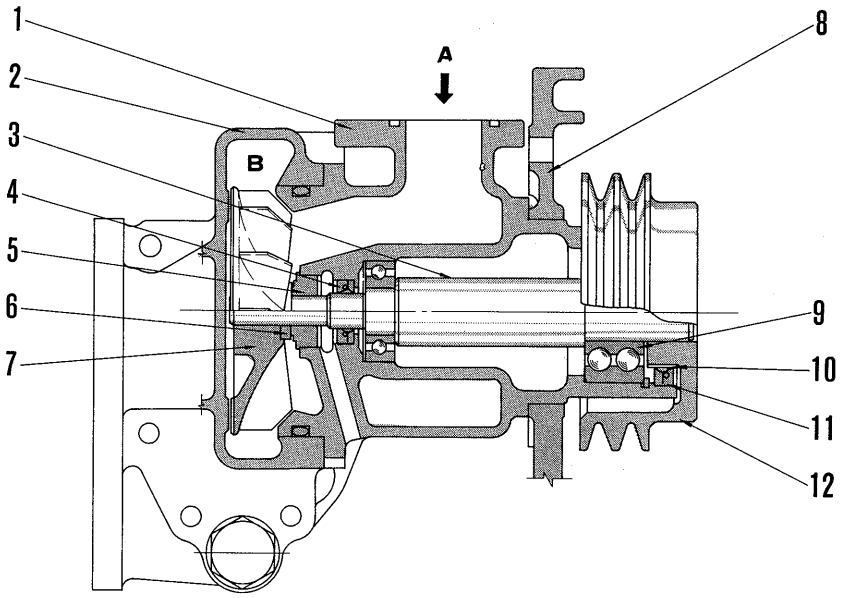


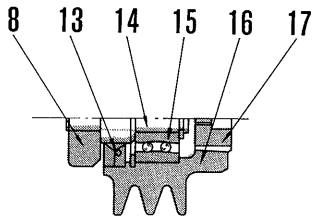

6710F098A

1. Pulley (O.D.: 118.5 mm)
2. Ball bearing
3. Pump housing
4. Impeller

A. From radiator
B. To oil cooler

## NTA-855-C (For HD320-2)



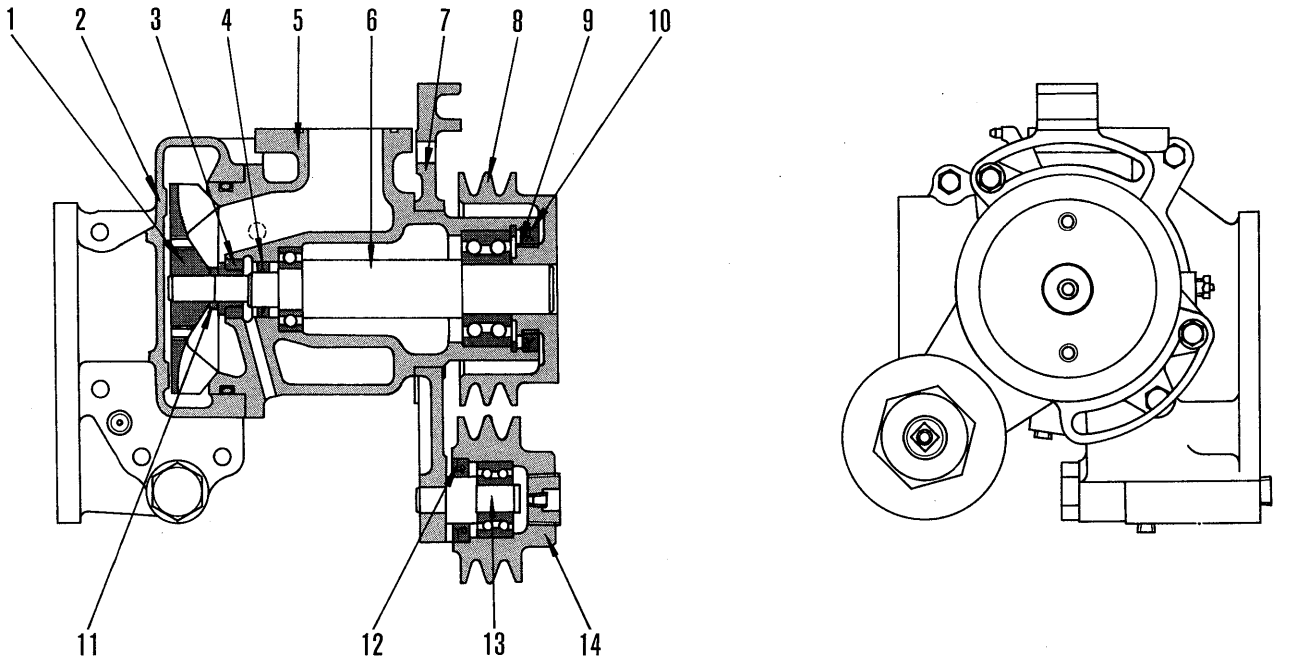

Idler pulley

6710F099A

1. Inlet housing
2. Pump housing
3. Pump shaft
4. Oil seal
5. Water seal
6. Pump seat
7. Impeller
8. Idler pulley bracket
9. Ball bearing
10. Wear sleeve
11. Oil seal
12. Pump pulley (O.D.: 142 mm)
13. Oil seal
14. Idler pulley shaft
15. Ball bearing
16. Idler pulley
17. Plug

A. From radiator, thermostat
B. To oil cooler, cylinder block

## NTA-855 (For HD320-3)

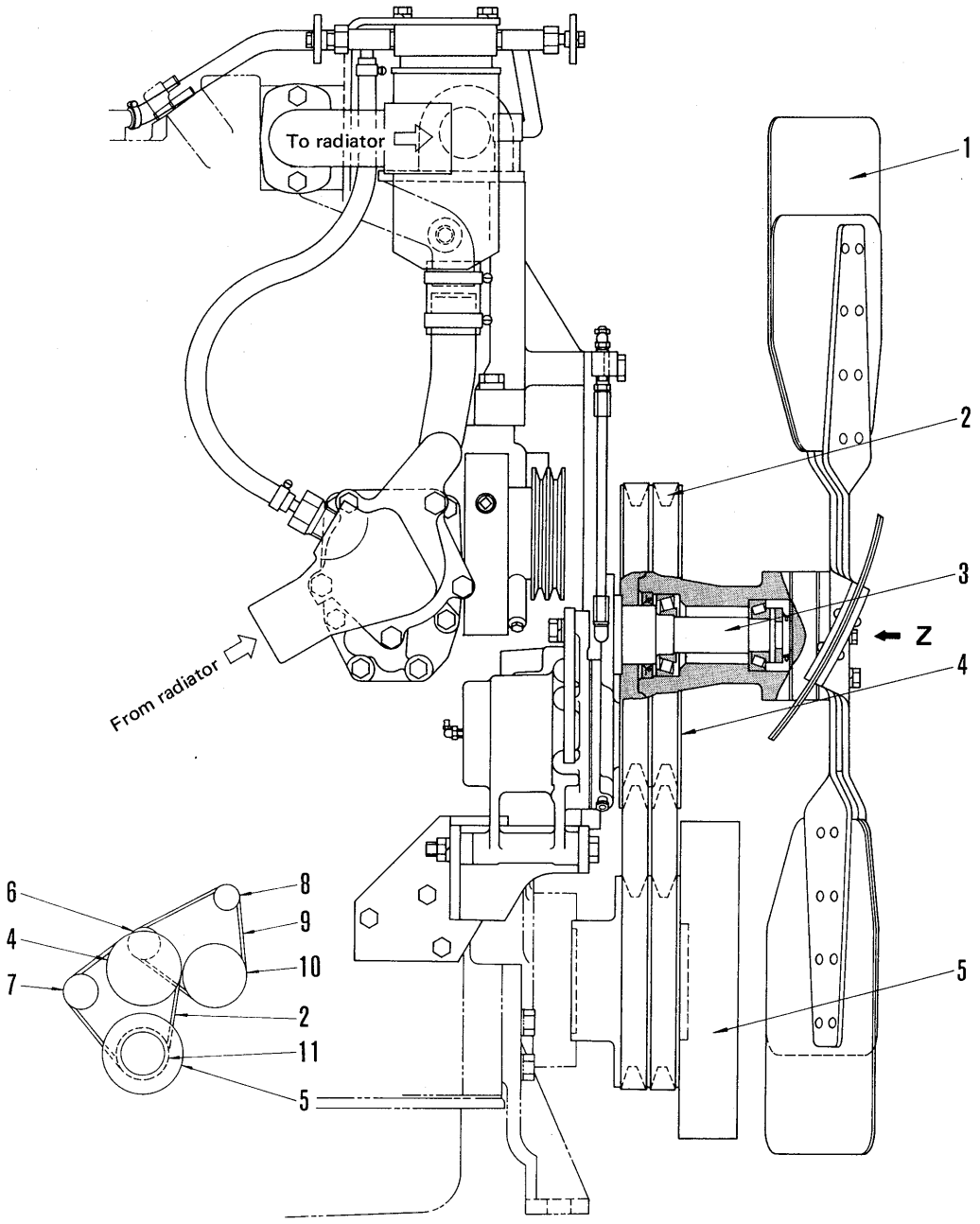



6710F099-3

1. Impeller
2. Inlet housing
3. Water seal
4. Oil seal
5. Pump housing
6. Pump shaft
7. Idler pulley bracket
8. Pump pulley
9. Wear sleeve
10. Oil seal
11. Pump seat
12. Oil seal
13. Idler pulley shaft
14. Idler pulley

# FAN DRIVE

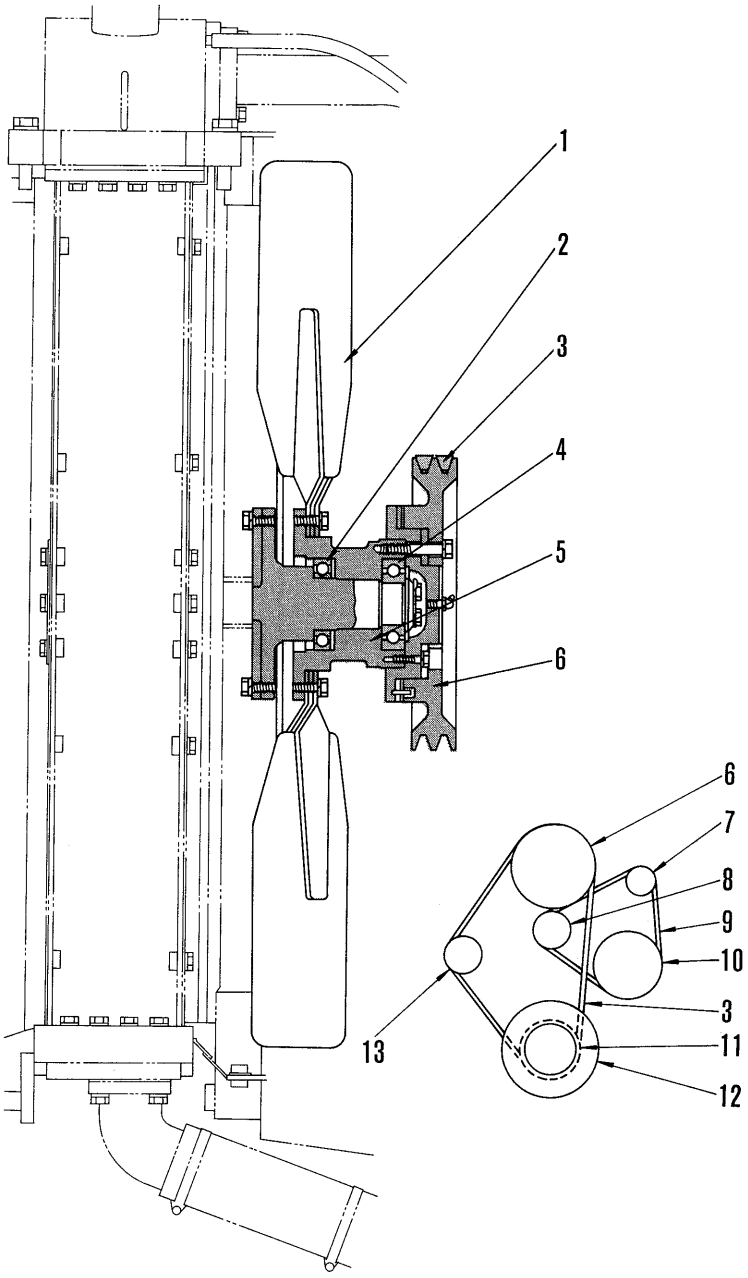
## N-855-C




6710F099-1A

1. Fan
2. V-belt
3. Fan drive shaft
4. Fan pulley (O.D.: 262 mm)
5. Vibration damper
6. Water pump pulley (O.D.: 118.5 mm)
7. Tension pulley (O.D.: 125 mm)
8. Alternator pulley (O.D.: 95 mm)
9. V-belt
10. Accessary drive pulley (O.D.: 222.3 mm)
11. Crank pulley (O.D.: 183 mm)

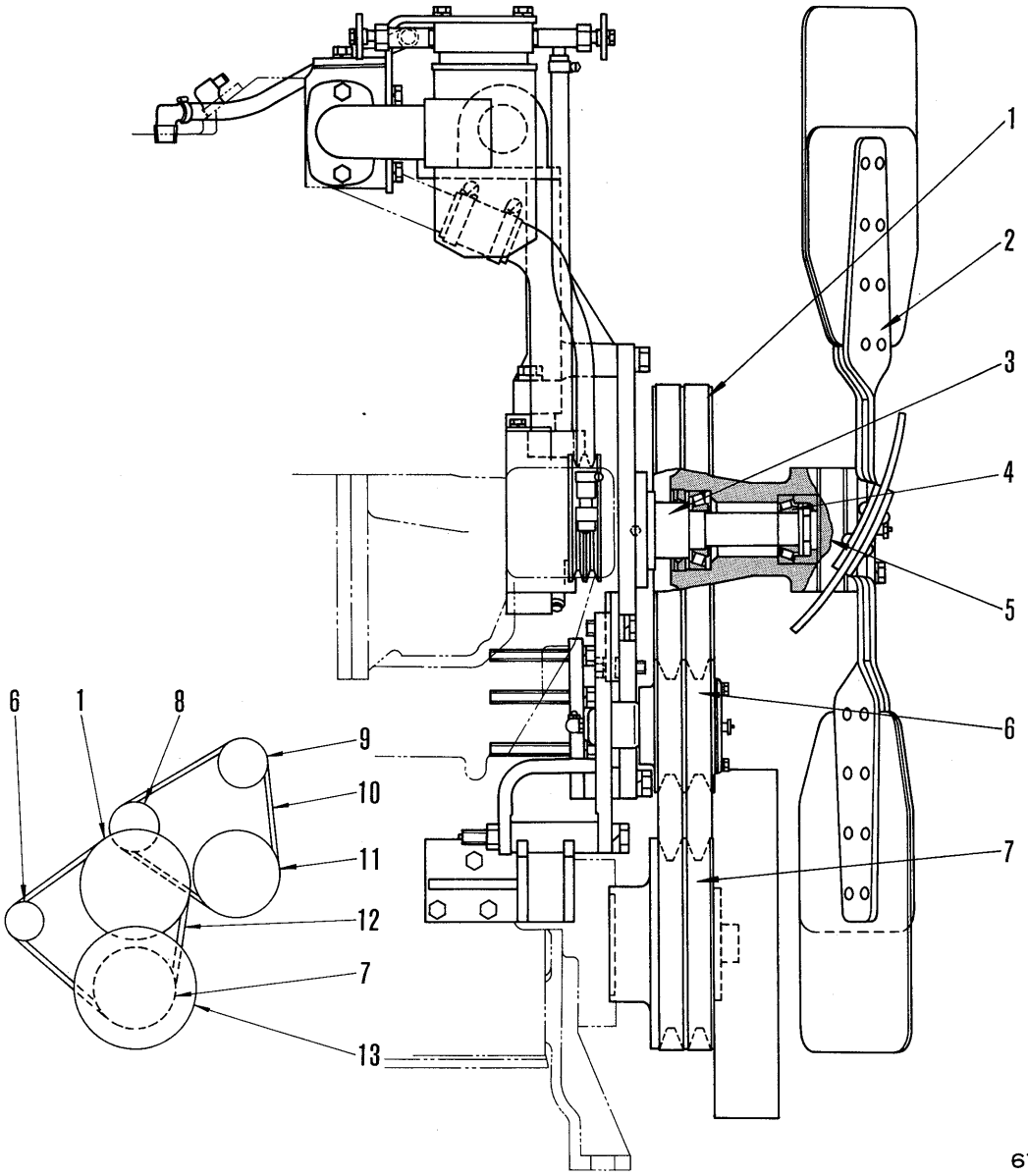
## NT-855-C (For D80, 85-18, D95S-2)




6710F100A

1. Fan
2. Ball bearing
3. V-belt
4. Ball bearing
5. Fan spacer
6. Fan pulley (O.D.: 262 mm)
7. Alternator pulley (O.D.: 95 mm)
8. Water pump pulley (O.D.: 118.5 mm)
9. V-belt
10. Accessary drive pulley (O.D.: 222 mm)
11. Crank pulley (O.D.: 183 mm)
12. Vibration damper
13. Tension pulley (O.D.: 120 mm)

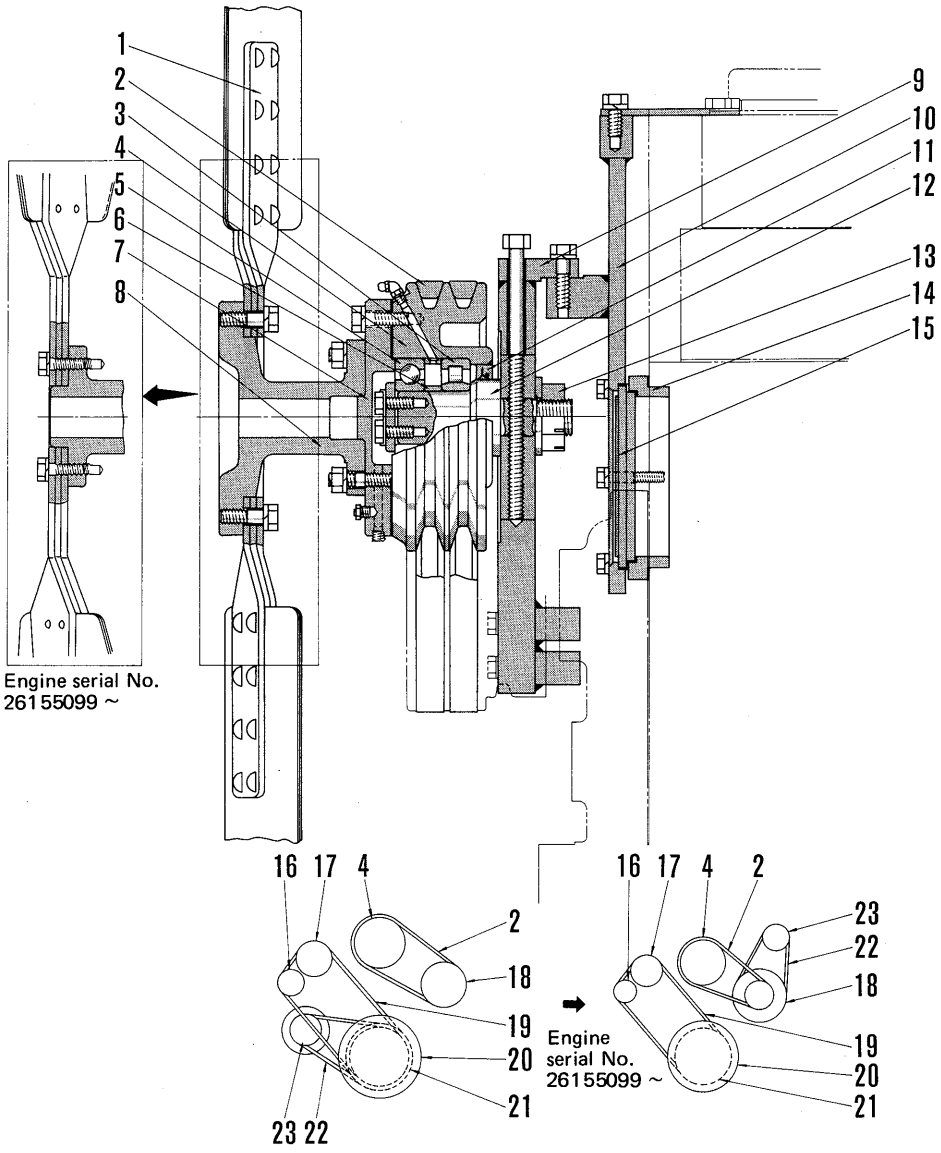
## NT-855-C (For PC400-1, PC400LC-1, W170-2, W180-1)
## NTA-855-C (For WS16S-2, WS23-1)




671 0F099-4

1. Fan pulley (O.D.)
   (O.D. for PC400-1: 262 mm
   W170-2, W180-1: 315 mm,
   WS16S-2: 336 mm)
2. Fan
3. Fan drive shaft
4. Ball bearing
5. Fan spacer
6. Tension pulley
   (O.D. for PC400-1, W170-2, W180-1:
   120 mm, WS16S-2: 118 mm)
7. Crank pulley
   (O.D. for PC400-1: 194 mm,
   W170-2, W180-1: 180 mm,
   WS16S-2: 192 mm)
8. Water pump pulley (O.D.: 118 mm)
9. Alternator pulley (O.D.: 118 mm)
10. V-belt
11. Accessary drive pulley (O.D.: 222 mm)
12. V-belt
13. Vibration damper

## NTA-855-C (For HD320-2, HD320-3)

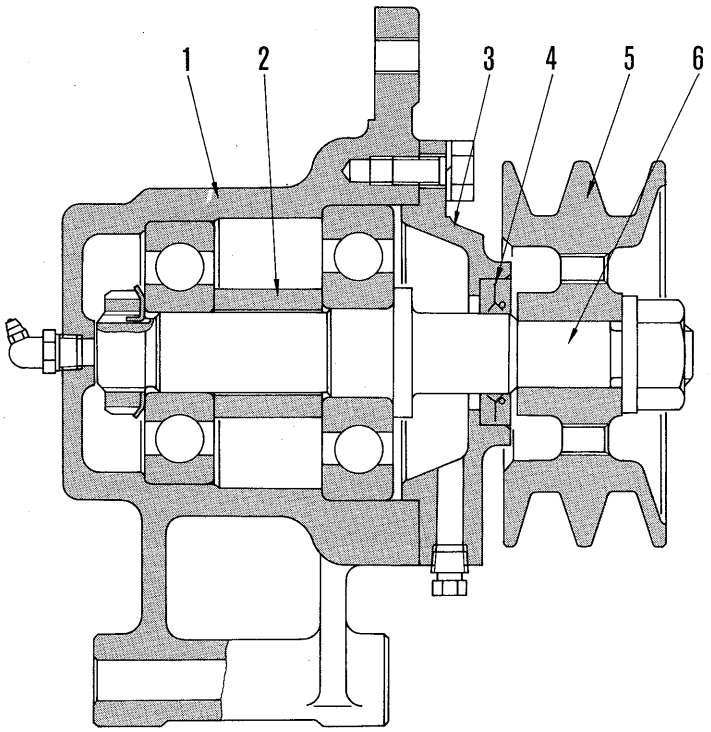



67I0FI01B

1. Fan
2. V-belt
3. Roller bearing
4. Fan pulley (O.D.: 228 to 247 mm)
5. Ball bearing
6. Spacer
7. Cover
8. Fan spacer
9. Bracket
10. Fan bracket
11. Oil seal
12. Fan drive shaft
13. Lock nut
14. Water pump support
15. Water pump cover
16. Idler pulley (O.D.: 101.5 mm)
17. Water pump pulley (O.D.: 118 mm)
18. Accessary drive pulley
    (Alternator drive O.D.: Change 155 mm to 238 mm)
    (Fan drive O.D.: 155 mm)
19. V-belt
20. Vibration damper
21. Crank pulley
    (Water pump drive O.D.:
    change 238 mm to 260.5 mm)
    (Alternator drive O.D.: 260.5 mm)
22. V-belt
23. Alternator pulley (O.D.: 120 mm)

# TENSION PULLEY

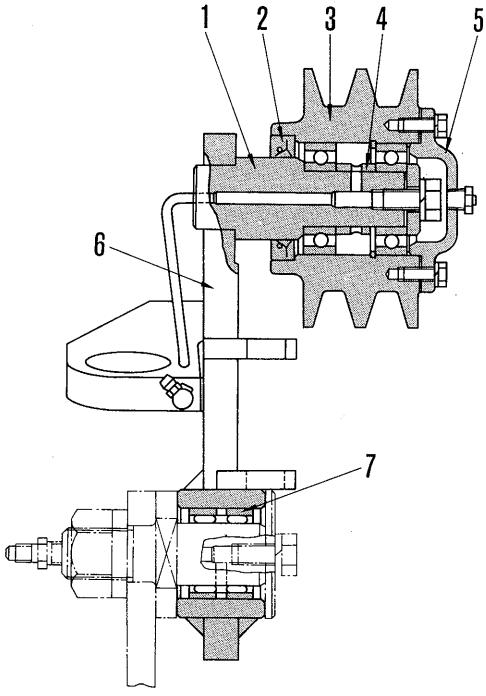
## N-855-C




6710F099-2A

1. Tension pulley bracket
2. Spacer
e. Cover
4. Oil seal
5. Tension pulley
6. Tension pulley shaft

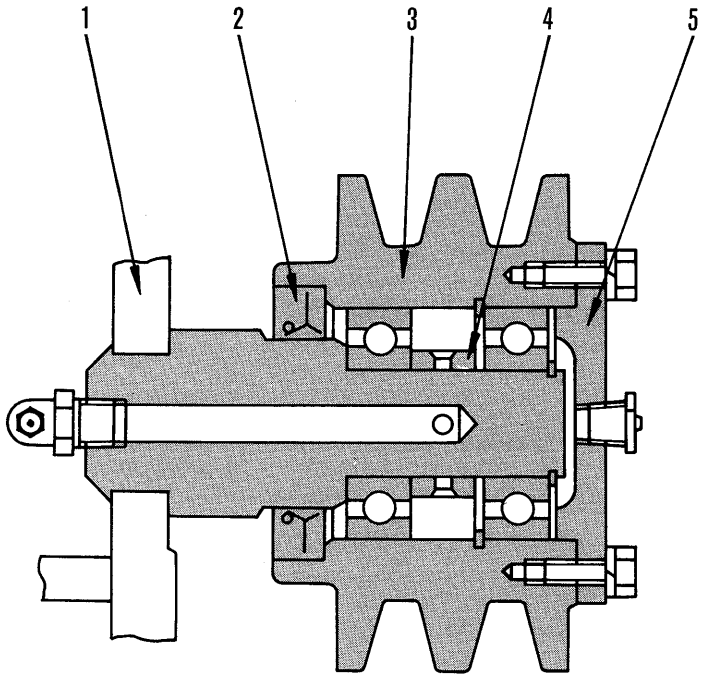
## NT-855-C (For D80, 85-18, D95S-2)




6710F099-5

1. Tension pulley shaft
2. Oil seal
3. Tension pulley
4. Spacer
5. Pulley cover
6. Tension pulley bracket
7. Needle bearing

## NT-855-C (For PC400-1, W170-2, W180-1)
## NTA-855-C (For WS16S-2, WS23-1)

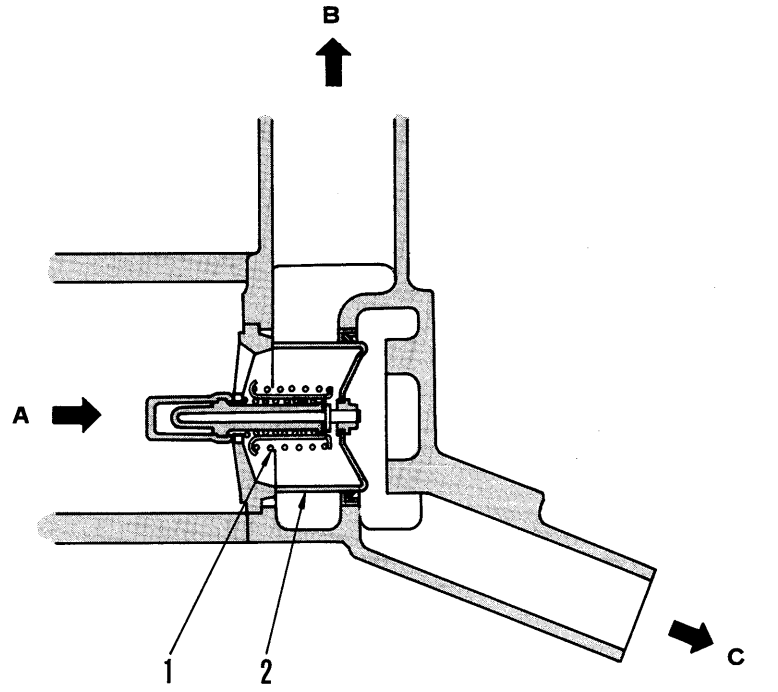



6710F099-6

1. Bracket
2. Oil seal
3. Tension pulley
4. Spacer
5. Cover

# THERMOSTAT

## NT-855-C



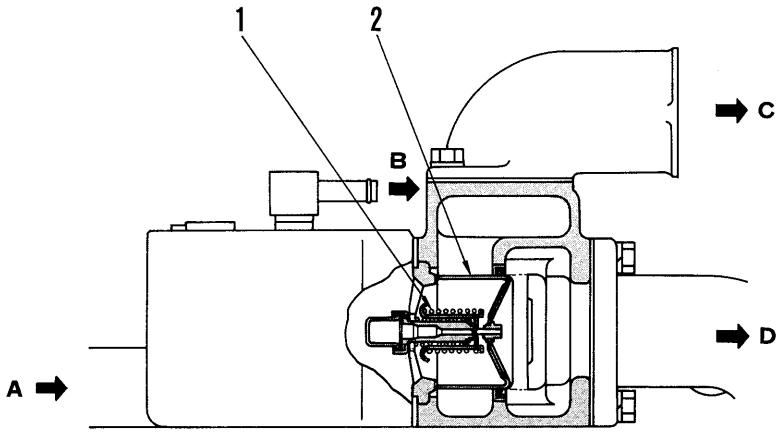

6710F102

1. Spring
2. Thermostat case

A. From water manifold
B. To radiator upper tank
C. To water pump

| | |
|---|---|
| Opening temperature | : 75.5~78.5°C |
| Full opening temperature | : 90°C |
| Full opening lift | : 10mm minimum |

## NTA-855-C




6710F103

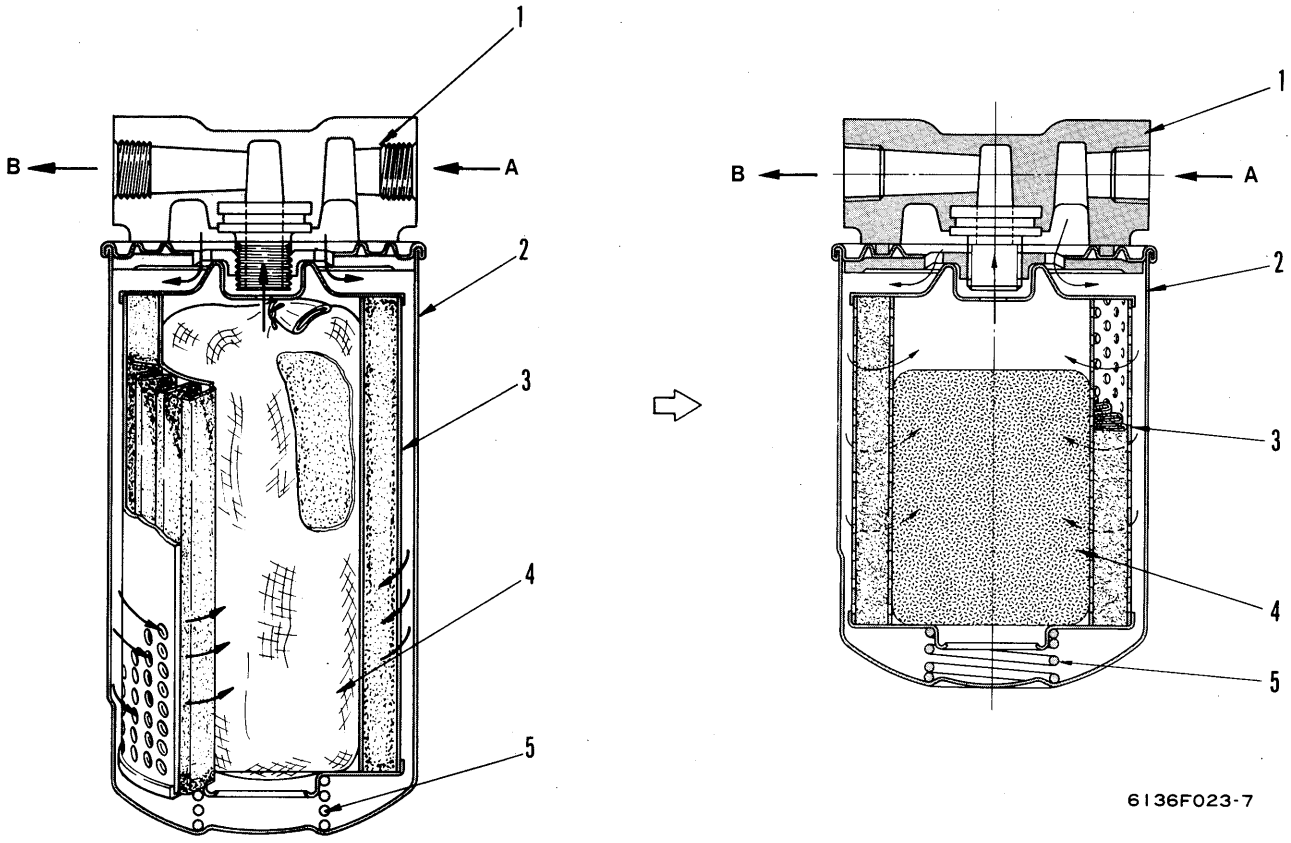
1. Spring
2. Thermostat

A. From water manifold
B. To radiator upper tank
C. To radiator upper tank
D. To water pump

| | |
|---|---|
| Opening temperature | : 74.5~78.5°C |
| Full opening temperature | : 90°C |
| Full opening lift | : 10mm minimum |

# CORROSION RESISTOR

## CARTRIDGE TYPE



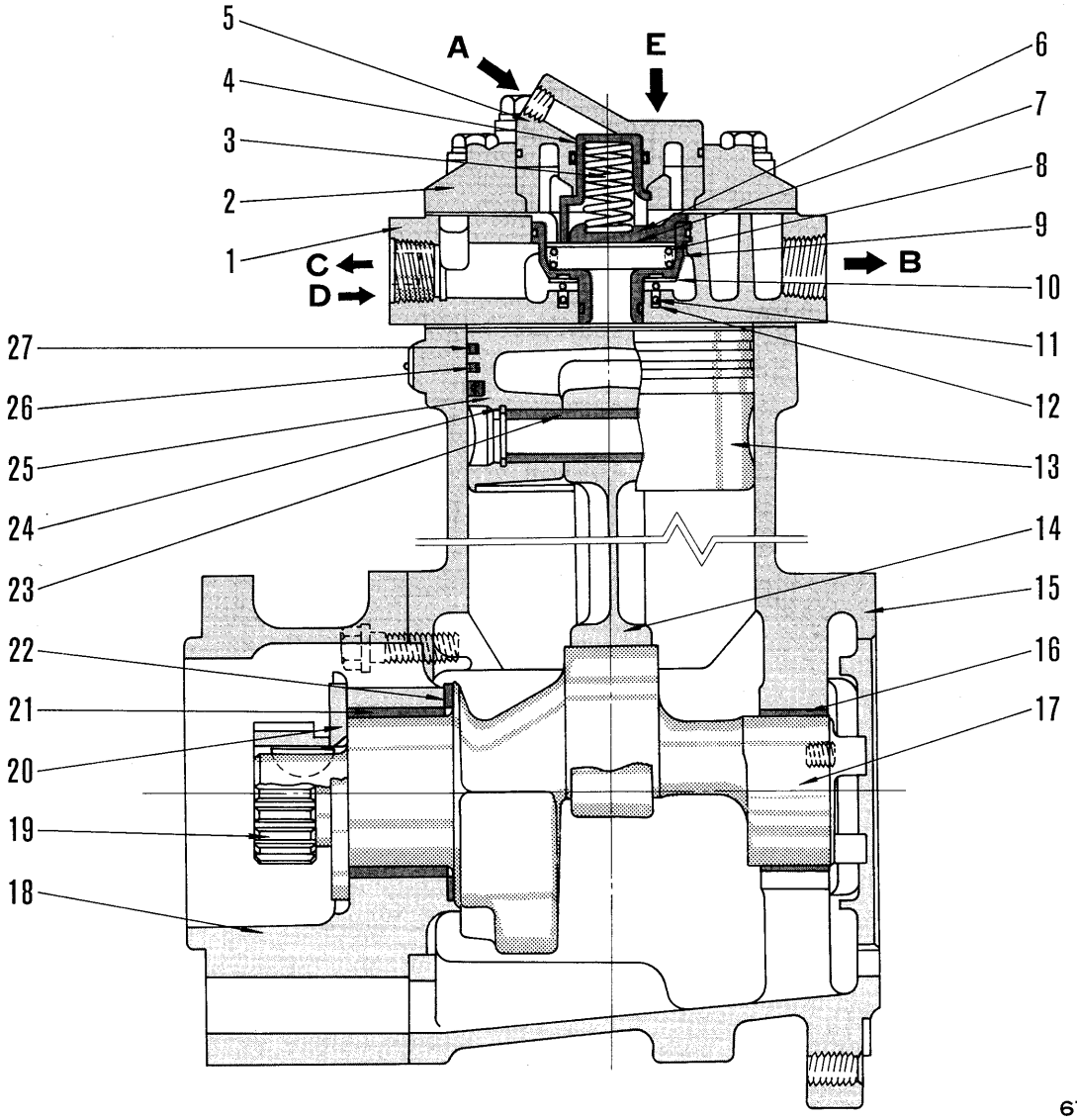

1. Bracket
2. Cartridge
3. Element (Paper)
4. Element (Chemicals)
5. Spring

A. Water inlet
B. Water outlet

# ACCESSORY

## AIR COMPRESSOR

(For N-855-C, NTA-855-C)



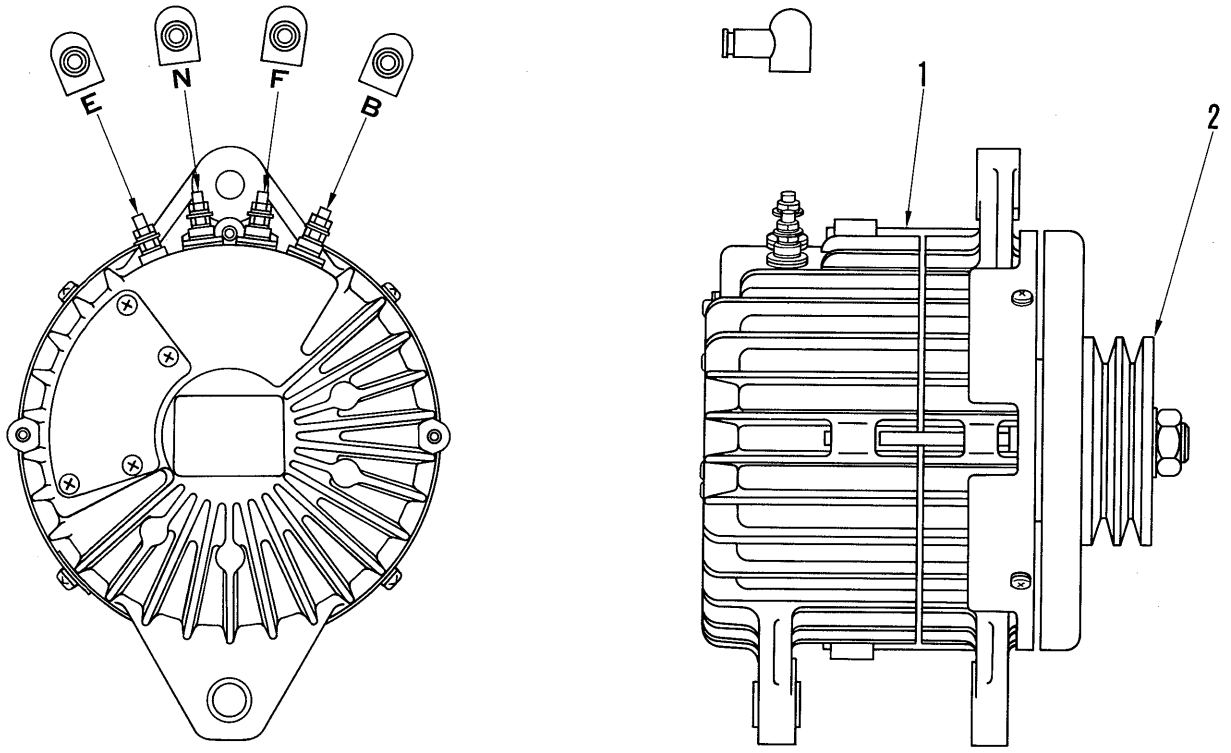

671OF105

1. Cylinder head
2. Cylinder head cover
3. Unloader valve spring
4. Unloader valve cap
5. Unloader valve body
6. Inlet valve seat
7. Inlet valve
8. Inlet valve spring
9. Outlet valve seat
10. Outlet valve
11. Outlet valve spring
12. Wear plate
13. Piston
14. Connecting rod
15. Crankcase
16. Crankcase bushing
17. Crankshaft
18. Support
19. Half coupling
20. Thrust washer
21. Support bushing
22. Thrust washer
23. Piston pin
24. Snap ring
25. Oil ring
26. Piston ring (No. 2)
27. Piston ring (TOP)

A. From air tank
B. To air tank
C. Cooling water outlet
D. Cooling water inlet
E. From intake manifold

# ELECTRICAL SYSTEM

## ALTERNATOR

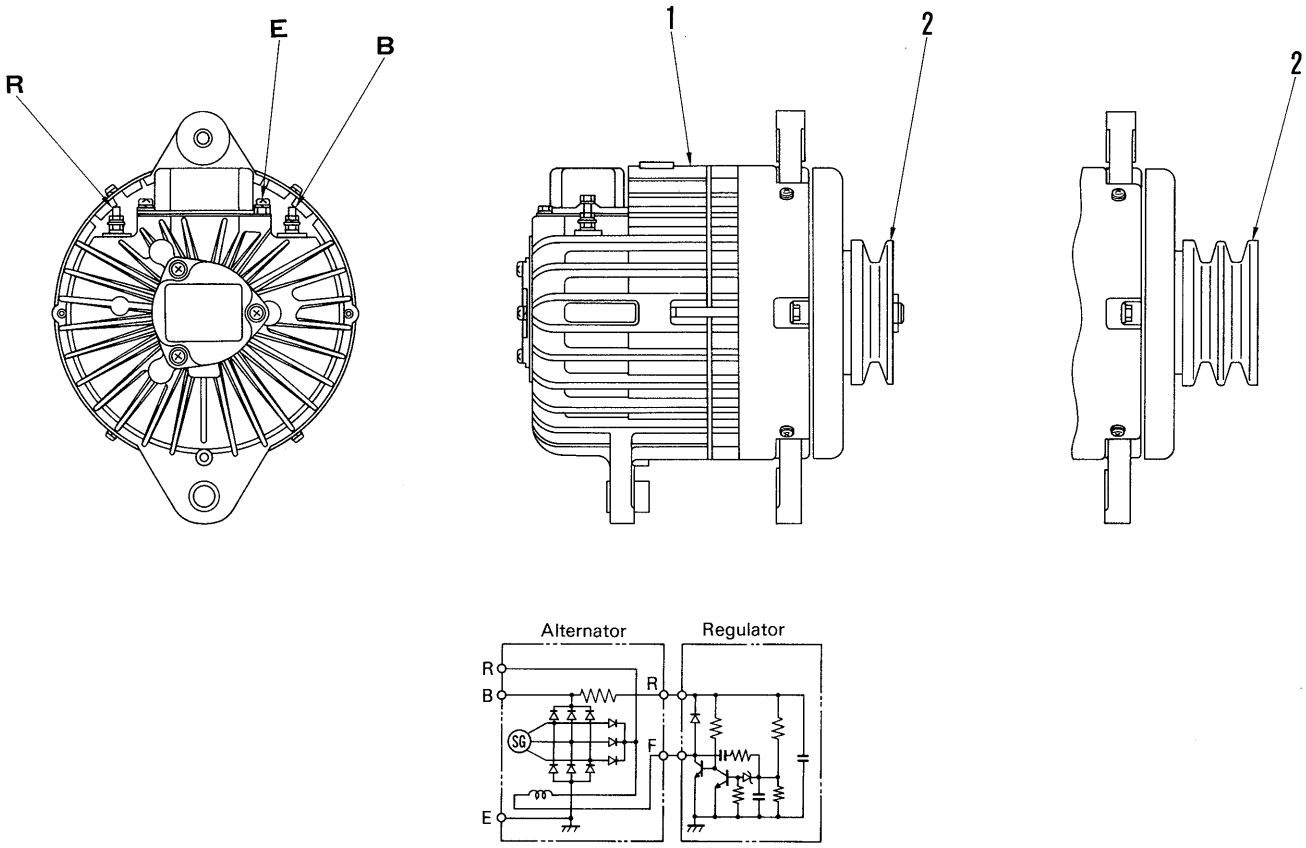



F6710A012

1. Alternator
2. Pulley

E, N, F, B: Terminal

| Engine model | Applicable machine | Type | Specification | Pulley O.D. (mm) | Weight (kg) |
|---|---|---|---|---|---|
| N-855-C | PC300-1, 2<br>PC300LC-1, 2 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 25A | 95 | 14 |
| NT-855-C | D85A, E, P, F-18<br>D85A, E-18<br>D95S-2<br>PC400-1, PC400LC-1 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 25A | 95 | 14 |
| | W170-2 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 35A | 120 | 15 |

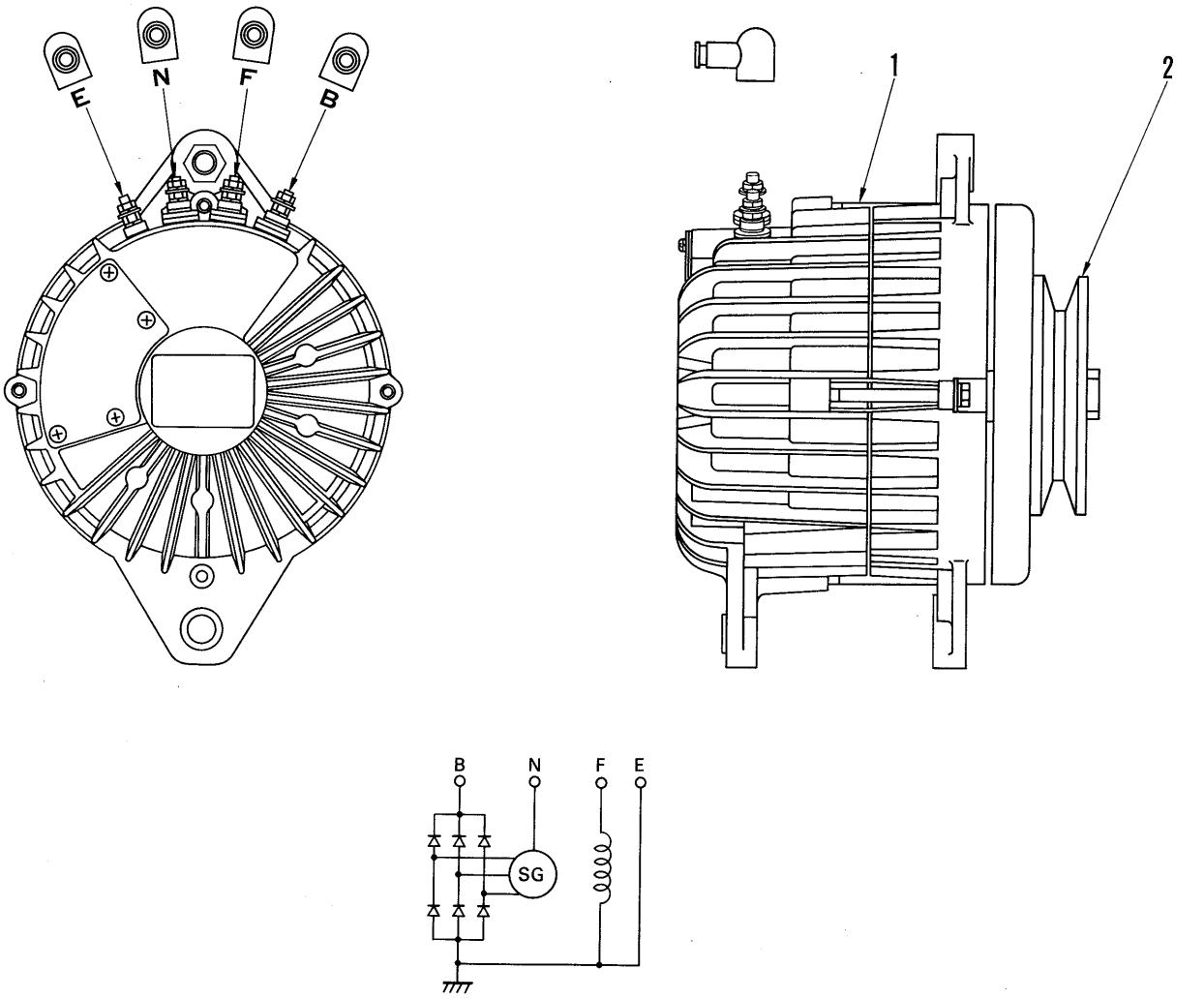



F6710A013

1. Alternator
2. Pulley

B, E, F, R: Terminal

| Engine model | Applicable machine | Type | Specification | Pulley O.D. (mm) | Weight (kg) |
|---|---|---|---|---|---|
| NT-855-C | W180-1 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 35A | 95<br>(Double pulley) | 17.5 |
| NTA-855-C | HD320 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 35A | 120<br>(Single pulley) | 18 |
| | WS16S-2<br>WS23-1 | | | 95<br>(Double pulley) | 17.5 |




F6710A014

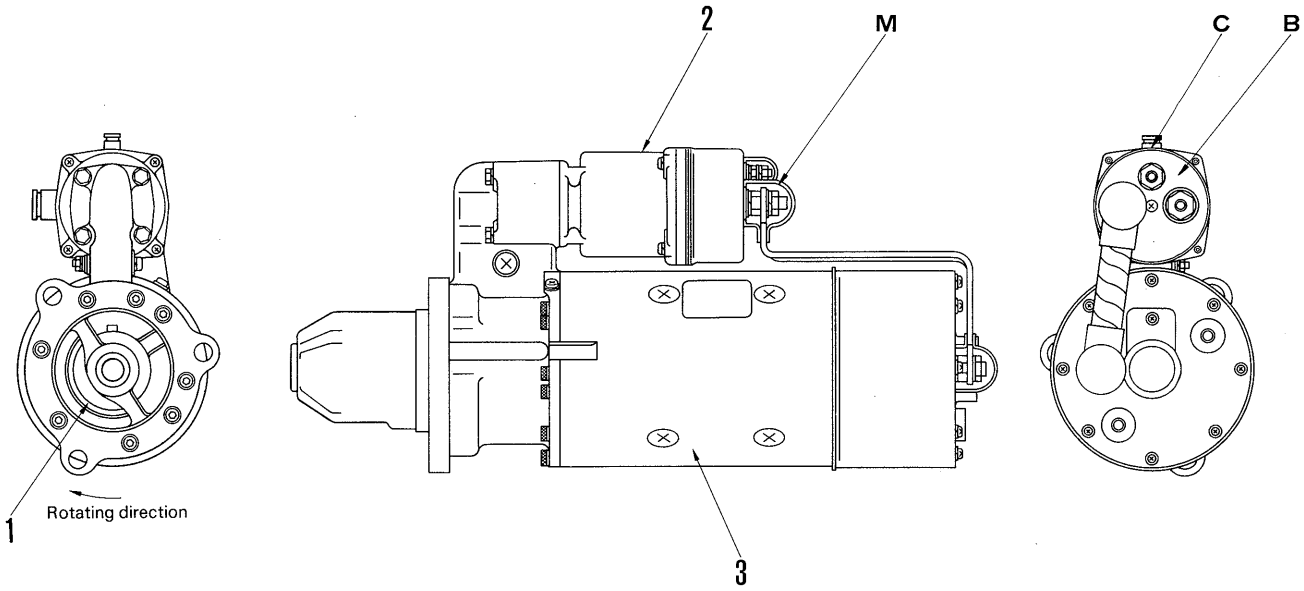
1. Alternator
2. Pulley

B, E, F, N: Terminal

| Engine model | Applicable machine | Type | Specification | Pulley O.D. (mm) | Weight (kg) |
|---|---|---|---|---|---|
| NTA-855-C | HD320 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 35A | 190 | 13 |

# STARTING MOTOR

## WITHOUT SAFETY RELAY



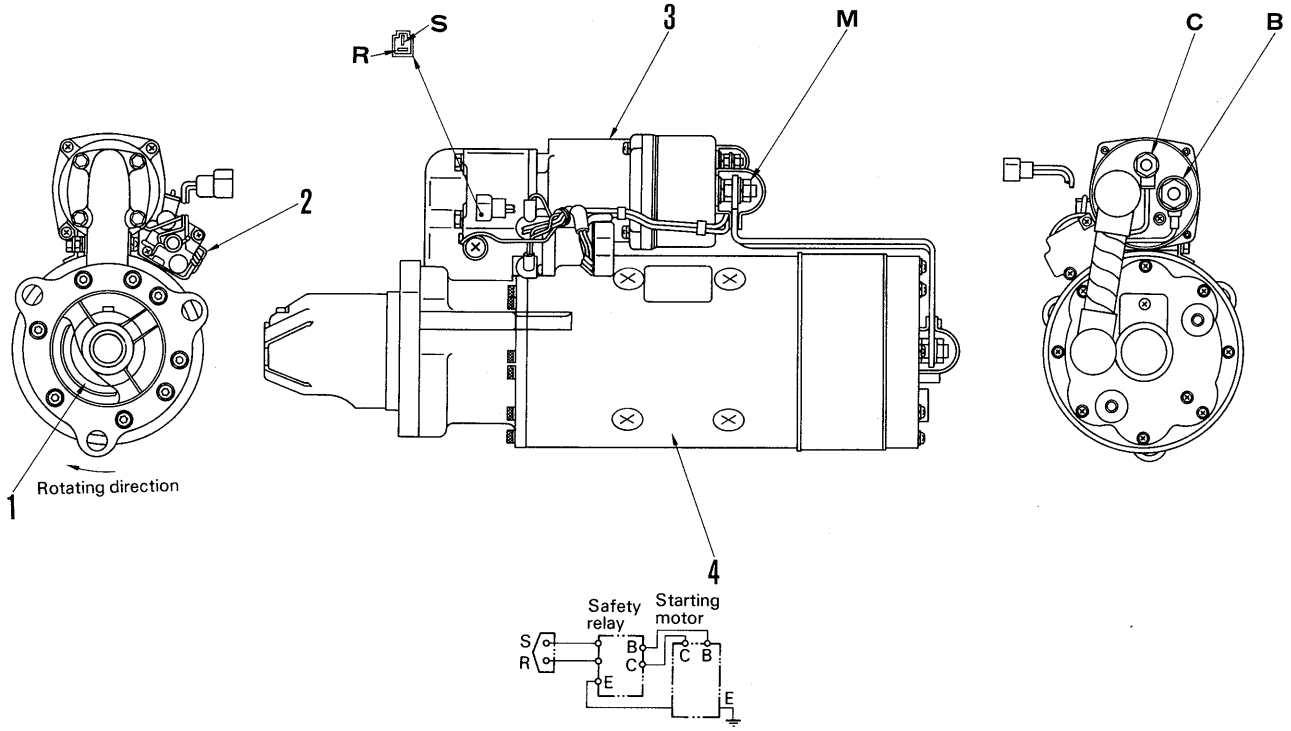

F6710A015

1. Pinion
2. Magnetic switch
3. Starting motor

B, C, M: Terminal

| Engine model | Applicable machine | Type | Specification | Number of pinion teeth | Weight (kg) |
|---|---|---|---|---|---|
| N-855-C | All machine | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 11kW | 11 | 44.5 |
| NT-855-C | All machine | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 11kW | 11 | 44.5 |
| NTA-855-C | HD320-2, 3<br>WS16S-2<br>WS23-1 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 11kW | 11 | 44.5 |

## WITH SAFETY RELAY




F6710A016

1. Pinion
2. Safety relay
3. Magnetic switch
4. Starting motor

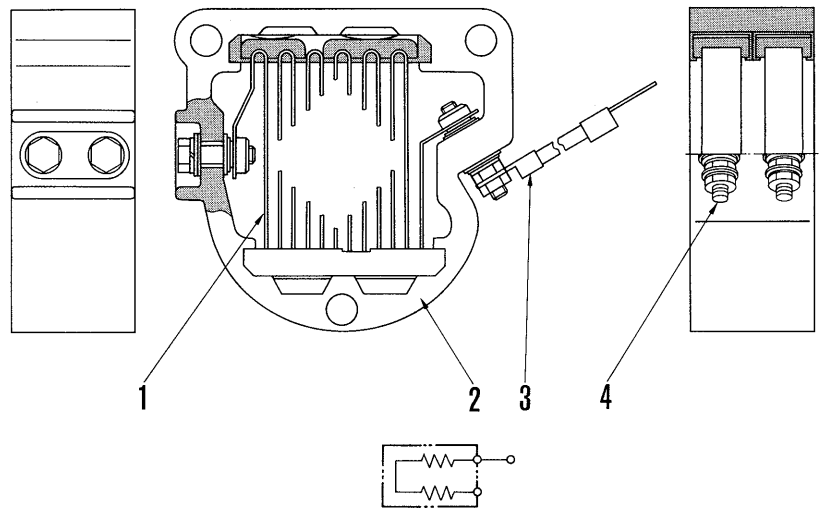
B, C, E, M, R, S: Terminal

| Engine model | Applicable machine | Type | Specification | Number of pinion teeth | Weight (kg) |
|---|---|---|---|---|---|
| NT-855-C | W170-2<br>W180-1 | Maker: NIKKO DENKI<br>Type: Sealed | 24V, 11kW | 11 | 45 |

# ELECTRICAL INTAKE AIR HEATER

## RIBBON TYPE

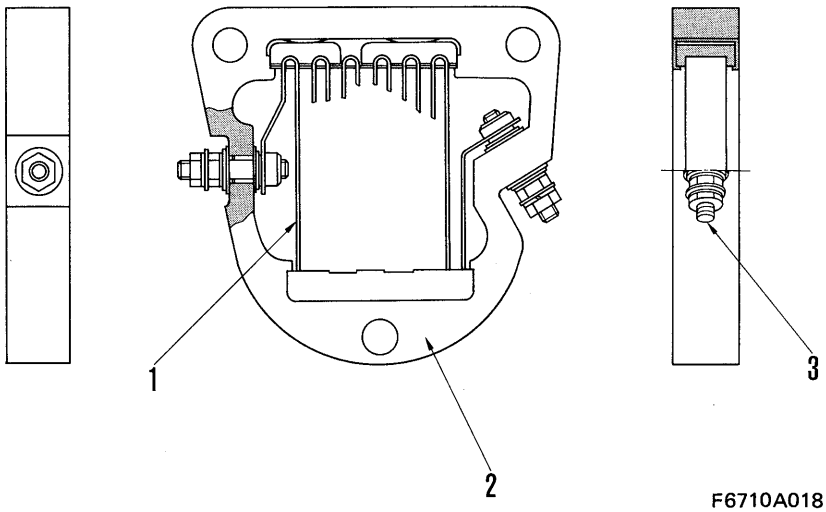
- SMALL SIZE (For PC300-1, 2, PC300LC-1, 2)




1. Heater coil
2. Heater body
3. Earth wire
4. Terminal

F6710A017

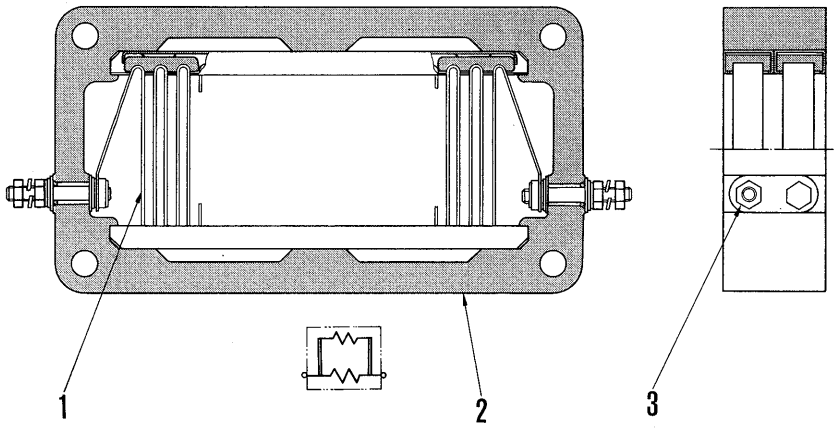
- SMALL SIZE (For PC400-1, PC400LC-1, W170-2, W180-1)




1. Heater coil
2. Heater body
3. Terminal

F6710A018

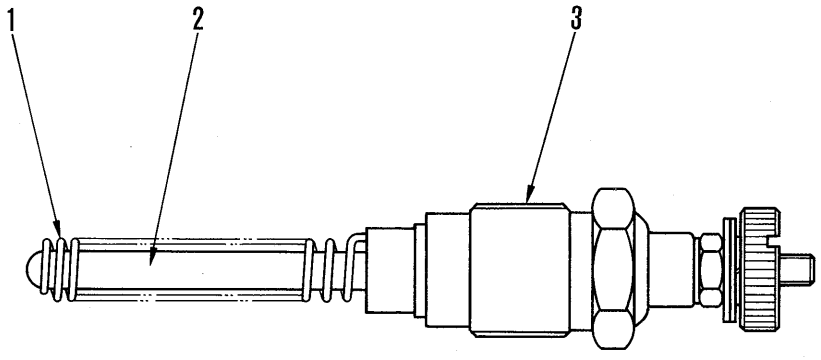
- **LARGE SIZE (For PC400-1, PC400LC-1, W170-2, W180-1)**




1. Heater coil
2. Heater body
3. Terminal

F6710A019

**COIL TYPE (For D80, 85-18, D95S-2)**




1. Heater coil
2. Tube
3. Heater body

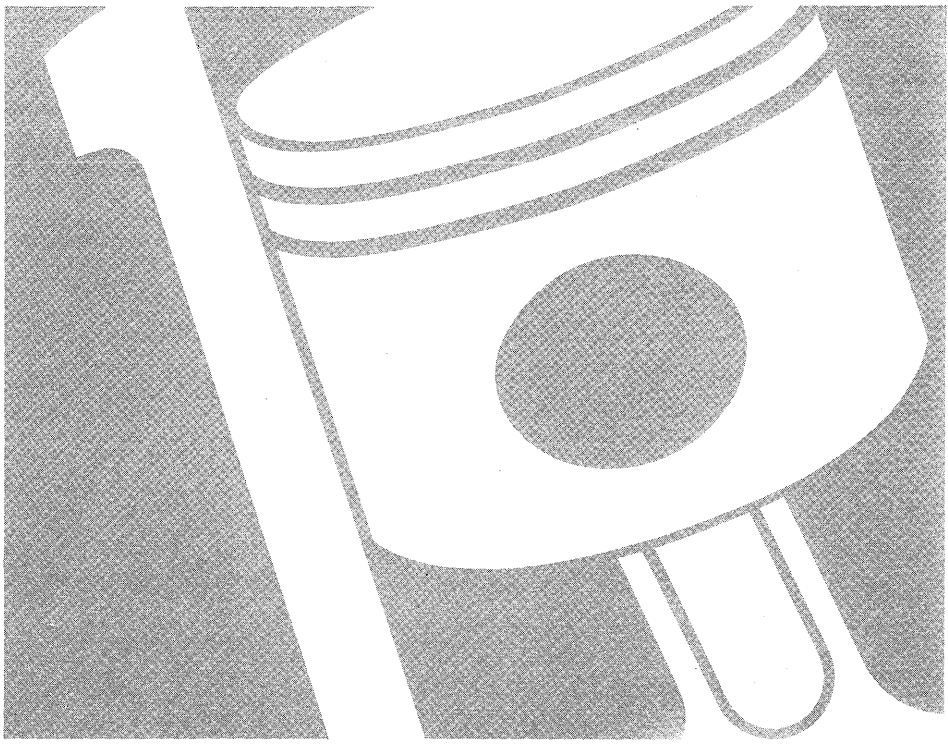
F6710A020

# SHOP MANUAL

# N-855 SERIES

Engine Serial No. 26100001 and up

## 12 ENGINE TESTING AND ADJUSTING



# CONTENTS

# TESTING AND ADJUTING INJECTOR AND VALVE CLEARANCE

★ When testing and adjusting the injector and the valve clearance, work in the same cranking position and adjust the injector first.
★ Test and adjust the injectors and valve clearances in the following engine firing order:
Firing order: 1 — 5 — 3 — 6 — 2 — 4

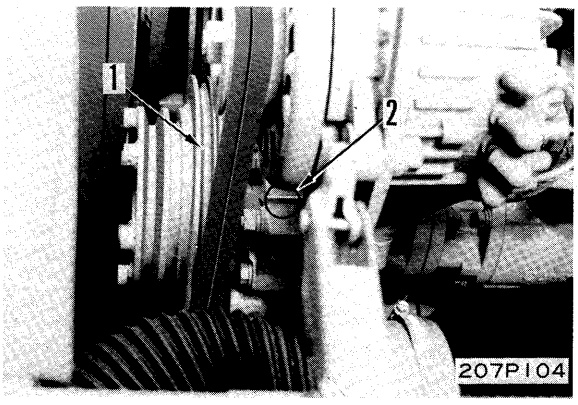
## ADJUSTING INJECTORS

**Special tools**

| | Part Number | Part name | Q'ty |
|---|---|---|---|
| A | 795-630-1803 | Torque wrench set | 1 |
| B | 795-130-2103 | Torque wrench set | 1 |

★ Remove the rocker arm housing cover.
★ When adjusting No. 3 and No. 4 injectors, remove crossover pipe.

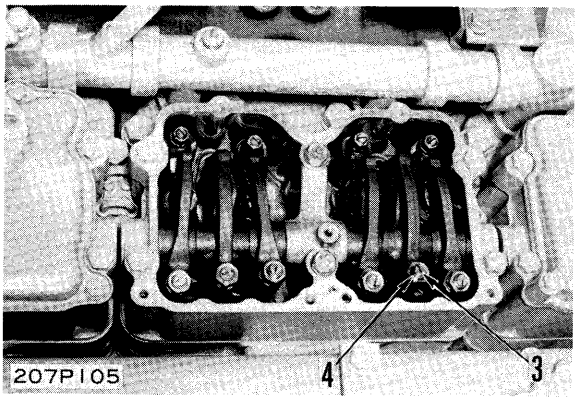
1. Rotate the crankshaft in the normal direction and, while watching the valve movement, align stamp "1.6VS" on accessory pulley (1) with pointer (2) on the gear case.
★ When stamp "1.6VS" is aligned with the pointer, either No. 1 or No. 6 cylinder should be in compression TDC position.
If the valves for No. 1 cylinder is still in motion at this stage, the cylinder is not in the compression TDC position. In this case, rotate the crankshaft one complete turn in the normal direction.




2. Loosen locknut (4) for adjustment screw (3).

3. Screw in the adjustment screw until the injector plunger comes into contact with the cup. Then, screw in the adjustment screw about 15° to drive the fuel out of the cup.

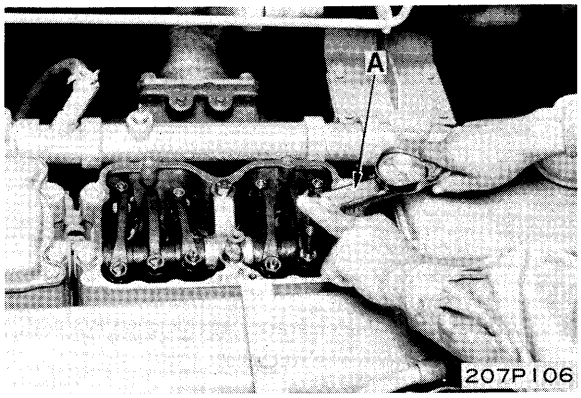
4. Back off the adjustment scerw one complete turn.



5. Tighten the adjustment screw to the specified torque with the torque wrench in tool **A**.

kgm Adjustment screw: Unit: kgm

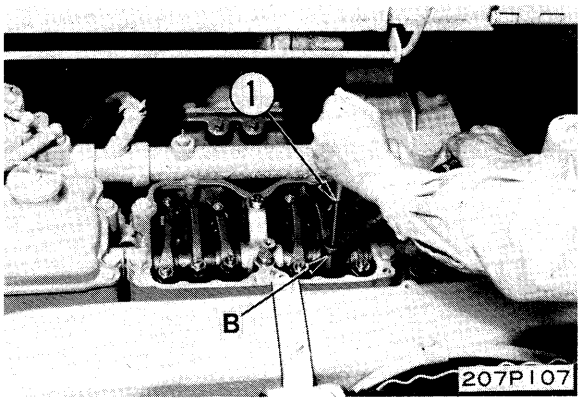
| Engine No. | 26102754 – 26155791 | 26155792 and up |
|---|---|---|
| Cold (20°C) | 0.55 | 0.83 |
| Warm (60°C) | 0.69 | 0.83 |




6. Hold the adjustment screw with screwdriver ① and tighten the locknut with tool **B**.

kgm Locknut: 4.8 ± 0.7 kgm

★ After the valve clearance is tested and adjusted in the same cranking position, adjust the next injector in the firing order, use the same manner described above.



## TESTING AND ADJUSTING THE VALVE CLEARANCE

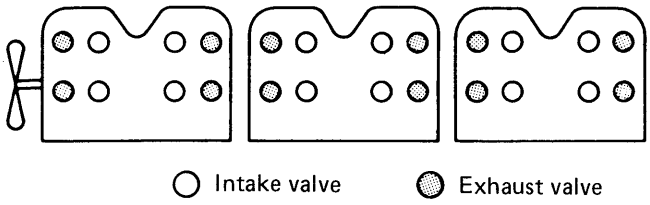
**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-130-2103 | Torque wrench set | 1 |
| B | 795-562-1300 | Feeler gauge | 1 |

- Adjust the valve clearance in the same cranking position, after the injector is adjusted.

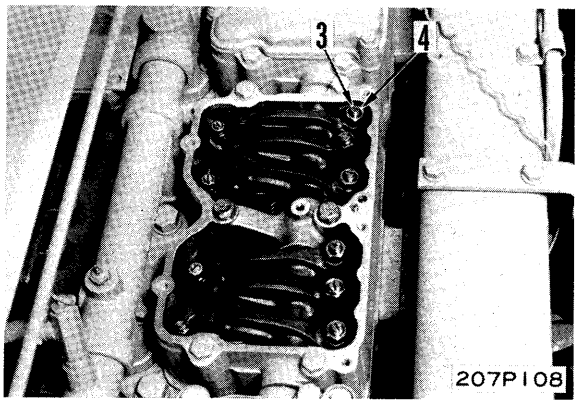
- "Testing" the valve clearance means checking to see if a feeler gauge of the specified clearance can slide lightly when inserted between the rocker arm lever and the crosshead.
  ★ If the clearance deviates from the standard value, adjust the clearance in the following manner.

★ Valve arrangement




207F201

1 Loosen locknut (4) for adjustment screw (3).
2 Insert feeler gauge **C** between the rocker arm lever and the crosshead, and adjust the clearance with the adjustment screw just until the gauge can be slided lightly.

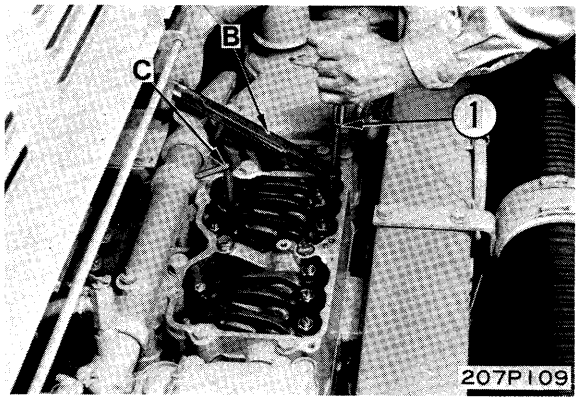



3 Hold the adjustment screw with screwdriver ① and tighten the locknut with wrench **B**.

kgm Locknut: 4.8 ± 0.7 kgm

★ After the locknut is tightened, check the clearance again.

★ Adjust the other valve clearances according to the firing order in the same way as described above.



# MEASURING COMPRESSION PRESSURE

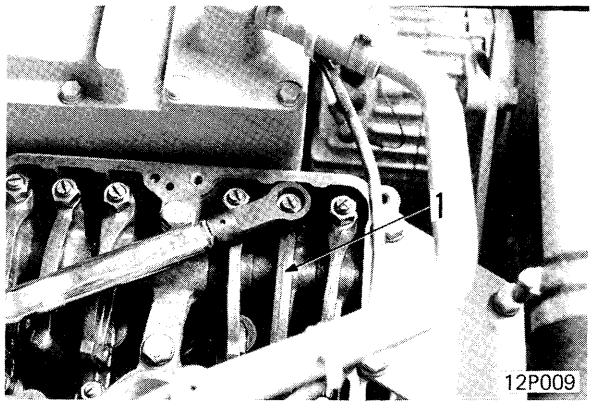
**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| H | 795-132-6401 | Injector puller | 1 |
| I | | Adapter | 1 |
| T | 795-502-1203 | Compression gauge | 1 |

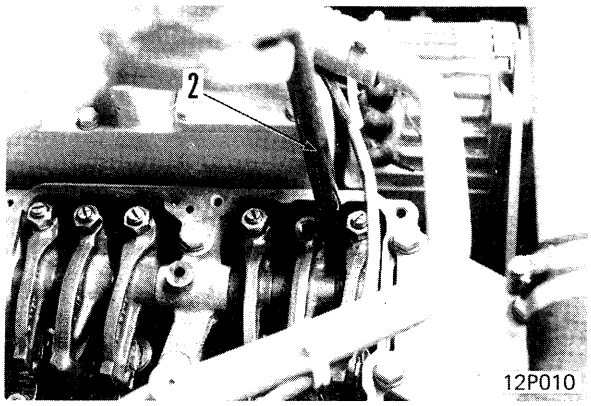
⚠ When measuring the compression pressure, be careful not to burn yourself on the exhaust pipe or to get caught in a revolving part of the engine.

★ Adjust the valve clearance before measuring.
★ For details, see TESTING AND ADJUSTING THE VALVE CLEARANCE.

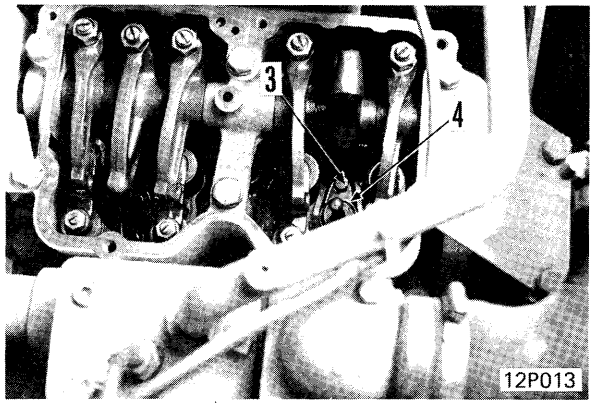
1. Loosen the locknut for injector lever (1) and remove the adjustment screw.



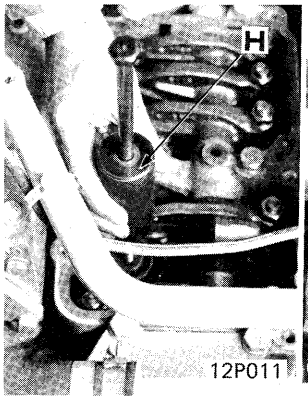

2. Remove push rod (2).

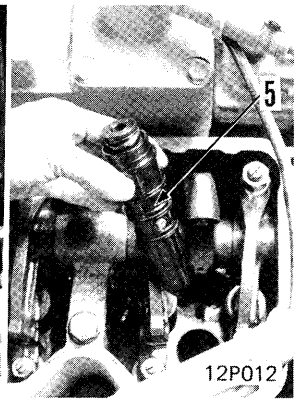



3. Remove mounting bolt (3) and clamp (4).

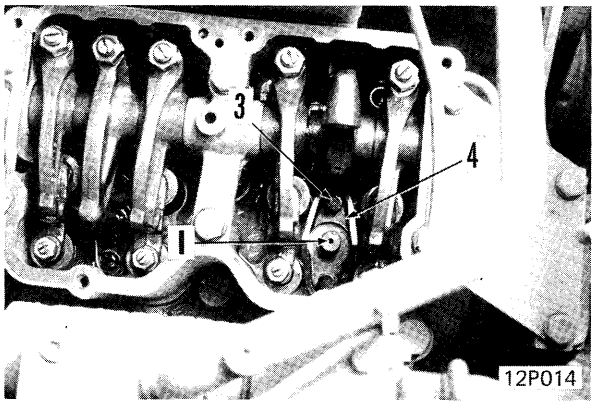



4. Pull out injector assembly (5) with injector puller **H**.

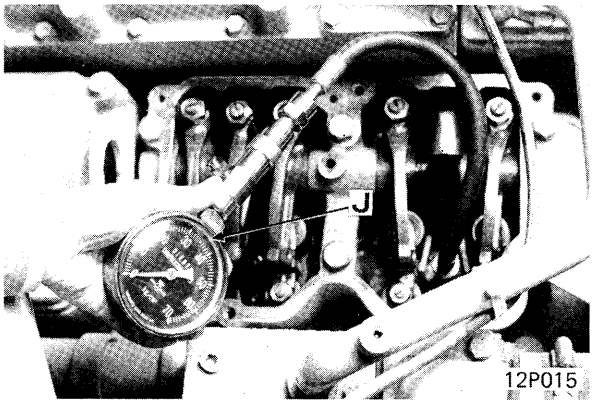


5. Install adapter **I** and tighten clamp (4) with bolt (3).
   kgm Bolt: 1.55 ± 0.55 kgm

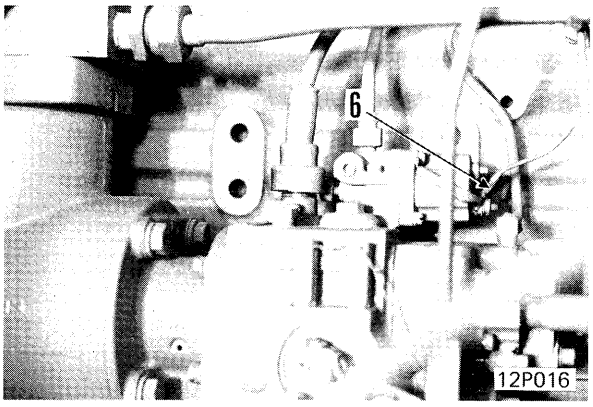



6. Connect the hose and gauge **J**.




7. Disconnect wiring (6) for the shut-off valve.

   ⚠ Take care not to let the disconnected wiring come into contact with the machine body.



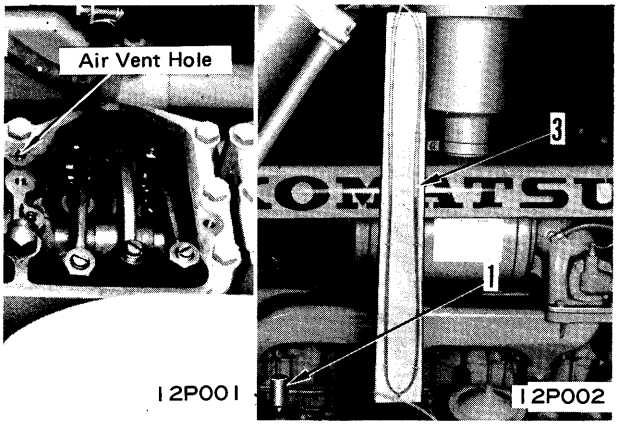

8. Crank the engine with the starting motor and measure the compression pressure.
   - ★ Read out the pressure from the compression gauge when the gauge hand has come to a stand still.
   - ★ When measuring the compression pressure, measure the engine speed as well and confirm that the engine speed is within the specified range in the measurement conditions.

# MEASURING BLOW-BY PRESSURE

★ Measure blow-by after the engine has warmed up (oil temperature at least 60°C or water temperature at least 70°C).

1. Remove the rocker arm housing cover.
   ★ Unnecessary in the case on an engine fitted with a turbocharger.
2. Block up the air vent holes of each rocker arm housing.
   ★ When taking blow-by measurements, block up the air vent holes in order to prevent the passage of air from the cylinder head to the air intake side.
   ★ In the case of an engine fitted with a turbocharger, the air vent holes are plugged up.
3. Install the rocker arm housing cover.
4. Install blow-by check tool (1) over the oil filler or breather port using the adapter provided with the check tool.
5. Connect the check tool to U-tube manometer (3) or a pressure gauge by means of tubing.
6. Block up all openings (breather, oil filler, oil level gauge guide, etc.) except the one over which the blow-by check tool is mounted, in order to prevent leakage.
7. Run the engine and read off the blow-by pressure.

★ **After completion of the above measurements, open up the air vent holes.**



## DETERMINATION OF RESULTS OF BLOW-BY MEASUREMENT AND REMEDY

★ The blow-by standard is specified as the value obtained at the rated output of the engine. At high idling, it is possible to obtain about 80% of the blow-by obtained at rated engine output. For this reason, the blow-by standard is sometimes specified at high idling.

★ When it is difficult to operate the engine at rated output during field measurements, for example, take measurements under full stall operation or the previously mentioned high idling condition in order to obtain a value similar to that obtained at rated engine output.

★ The blow-by standard is specified for an engine installed in a new machine. The actual measured value will thus vary depending upon the operating time and maintenance condition of the machine.

★ The measured blow-by value may sometimes abruptly increase depending upon the degree of overlap of the piston ring gaps or may vary depending upon the operating condition of the machine. It is thus dangerous to assume that an abnormality in the blow-by reference value is related to a fault in the engine.

★ If a measured blow-by value is considered to be abnormal, it is necessary to thoroughly investigate the following items which are related to blow-by.

1 Oil consumption
2 Exhaust color
3 Starting performance
4 Oil deterioration

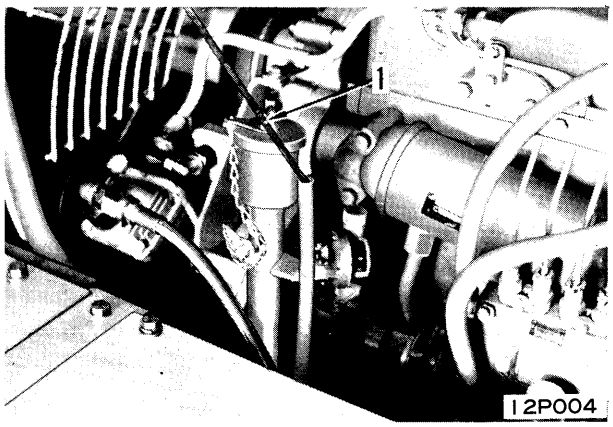
★ The main causes of abnormal blow-by area:

1 Worn piston rings and liners
2 Worn valve stems and guides
3 Blocked breather
4 Abnormal combustion

Of these, it is possible to check 1 and 2 by measureing the compression pressure.

# MEASURING OIL CONSUMPTION

### Measuring oil consumption




- ★ Measure the oil consumption using oil level gauge (1) in terms of the amount of oil required to maintain a constant oil level.
- ★ In order to do this, it is necessary to perform the oil level inspections accurately.
- ★ In order to eliminate errors due to changes in oil temperature and oil circulation, inspect the oil at the stop level at the commencement of operation.
- ★ In the case of an engine in which the oil is poured in from the cylinder head, inspect the oil level after a lapse of at least 30 minutes from the time the oil is poured in.

### Oil consumption

- ★ The oil consumption will vary greatly depending upon the size of the engine, whether or not a turbocharger is fitted, and the operating conditions, etc.
- ★ It will also vary depending upon the operating hours, temperature and external pressure (high altitude work), etc.
- ★ In addition, the oil consumption will also increase momentarily when the piston ring gaps overlap.

### Oil consumption rate

- ★ Because the oil consumption will vary considerably depending upon the type of machine and operating conditions, etc., it is very difficult to determine whether or not the oil consumption is normal simply by saying that it is X$\ell$ per day. Because of this the OIL CONSUMPTION RATE is used. This expresses the amount of oil consumed for a given amount of fuel, after compensating for change due to machine type (engine size) and operating condition.

$$\text{Oil consumption rate} = \frac{\text{Oil consumption}}{\text{Fuel consumption}} \times 100\%$$

**Determination of oil consumption rate**

★ In order to determine the oil consumption rate, it is necessary to accurately measure the fuel consumption in addition, of course, to accurately reading the oil level so as to accurately derive the oil consumption.

★ Because the oil consumption will vary depending upon various conditions, it is necessary to determine the oil consumption rate on the basis of measurements taken over as long a period as possible (one month is necessary).
- If the oil consumption is quite large, take appropriate action as soon as possible.

★ Oil consumption on a new machine (one which has been run for no more than 500 hours) tends to be high owing to the fact that the sliding surfaces are not properly worn in (oil consumption tends to be 0.3 to 1.0% greater than the oil consumption on a machine that is already run in).

★ The oil consumption of an engine fitted with a turbocharger will tend to be high because of oil circulation to the turbocharger, etc. (oil consumption tends to be 0.3 to 1.0% greater than the oil consumption on a machine not fitted with a turbocharger).

★ The oil consumption on a vehicle which has been run for a large number of hours will be high due to wear of piston rings and liners, etc.

★ If an engine is run at high speed on a light load, oil consumption will be high despite the low fuel consumption because of the fact that the oil circulation quantity will remain constant and also on account of the increase of raising oil from the piston rings due to the combustion pressure remaining the same.

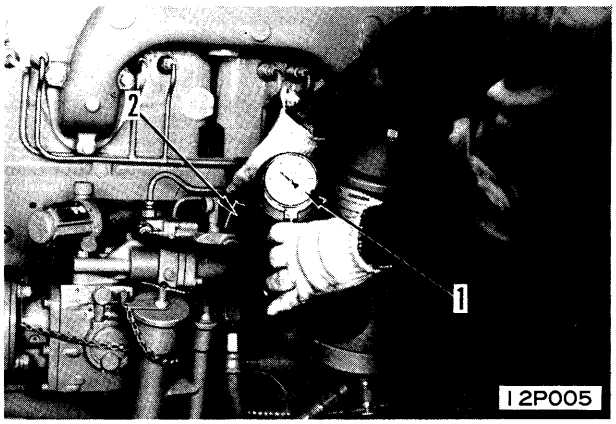
★ When determining the oil consumption rate, it is necessary to take into consideration the aforementioned various conditions. It must be borne in mind that a simple numerical determination will result in incorrect remedial measures.
As a general guide, if oil consumption is 0.5 to 1.0% greater than other similar type machine → exercise care; if it is 1.0 to 2% greater → consumption high; if it 2% or greater → consumption very large or excessive.

# MEASURING FUEL PRESSURE

★ Check and measure the fuel pressure using a test bench.

★ This section describes a simple method of inspecting and measuring the fuel pressure, which can be performed even in the field.

1. Remove the fuel pressure outlet plug from the PT pump shut-off valve.
2. Screw in the nipple, and connect up the hose and fuel pressure gauge (1).
3. Warm up the engine for a period of 5 to 10 minutes.
   ★ Continue engine warm-up until the water and oil temperatures enter the specified operating range (green region).




4. Read off the maximum indication on the fuel pressure gauge when the fuel control lever (2) is abruptly pulled from the low idling position to the high idling position.
   ★ Because the maximum value is only maintained for 0.3 to 0.5 seconds, confirm the reading by repeating this test 2 or 3 times.

★ By carrying out the above simplified inspection and measurement procedure, it is possible to obtain a value of about 90 to 100% of the fuel pressure corresponding to rated output.

★ The results of this simplified inspection and measurement procedure can be determined as satisfactory if they are within about 85 to 105% of the fuel pressure at rated output (test bench standard), taking into account measuring errors and measuring accuracy, etc.

# PT PUMP CALIBRATION DATA

NOTES:
1. Some calibration data show two or more set standards. Setting to either standard is acceptable, but setting to the latest standard will facilitate adjustment of engine output after installing a pump to the engine.
   In other words, a pump preset to the standard in parentheses in the application column should be set to the standard without parentheses at the time of overhaul.
2. If the pump sets to a different pump code, the code number punched on the pump nameplate should also be changed.

## 1. MACHINE MODELS AND PT PUMP CODE NUMBERS

| Machine Model | Specifications | Engine Model | Applicable Engine No. | PT Pump Code | Page |
|---|---|---|---|---|---|
| D80A-18 | Standard | NT-855-C | 26139838 to 26155378 | GR-J141 | 12-017 |
| | | | 26155379 and up | GR-J173 | 12-021 |
| D85A-18 | Standard | NT-855-C | 26139849 to 26155897 | GR-J141 | 12-017 |
| | | | 26155898 and up | GR-J173 | 12-021 |
| D80F-18 | Standard | NT-855-C | | GR-J207 | 12-024 |
| D95S-2 | Standard | NT-855-C | 26153623 and up | GR-J161 | 12-019 |
| PC300-1, 2<br>PC300LC-1, 2 | Standard | N-855-C | 26162054 and up | GR-J144 | 12-018 |
| PC400-1 | Standard | NT-855-C | 26163093 and up | GR-J203 | 12-022 |
| HD320-2<br>HS300S | Standard | NTA-855 | 26138589 to 169351 | GR-J138 | 12-016 |
| HD320-3 | Standard | NTA-855 | 26169352 and up | GR-J172 | 12-020 |
| WS16S-2 | Standard | NTA-855-C | 26164237 and up | GR-J217 | 12-025 |
| W170-2 | Standard | NT-855-C | 26178483 and up | GR-J241 | 12-026 |
| W180-1 | Standard | NT-855-C | 26169968 and up | GR-J205 | 12-023 |

# 2. CALIBRATION DATA (Arranged in the order of PT pump code numbers)

| Pump Code | GR-J 138 |
|---|---|

| Machine Model | HD320-2, HS300S | Rated | HP/rpm | 405/2300 |
|---|---|---|---|---|
| Engine Model | NTA855-C | Max. Torque | kgm(ft.lb.)/rpm | 142 (1027) /1700 |
| | | High Idling | rpm | 2430 to 2530 |
| Pump P/N | 6610-71-1011 | | | |

| | | Application | | | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/2300 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 322(710)/2300 | | |
| | 3 | Governor Cut-off | | rpm | 2360 to 2420 | | |
| | 4 | Governor Set at 2.8 kg/cm²(40 psi) | | | 2450 to 2570 | | |
| | 5 | Governor Set at 1.4 kg/cm²(20 psi) | | | 2460 to 2600 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 15.3 (218)/2300 | | |
| | 7 | Check Point | | | 9.8 to 10.3/1700 (140 to 146) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 2.7 to 3.2 (39 to 45) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 2.8 (40) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min./rpm | 35 to 70/2300 (2.1 to 3.1) | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | – | | |
| | | | | kg/cm²(psi) | – | | |
| | | | Fuel | rpm | – | | |
| | | | | kg/cm²(psi) | – | | |
| | | | | kg(lb.)/hour | – | | |
| | 12 | No Air Set | | rpm | – | | |
| | | | | kg/cm² (psi) | – | | |
| | | | | kg(lb.)/hour | – | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6710-71-1300 | | |
| | | | | Cummins P/N | – | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Right, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6710-71-2570 | | |
| | | | | Cummins P/N | 203849 | | |
| | 3 | Coupling | | Komatsu P/N | 6684-71-2381 | | |
| | | | | Cummins P/N | 101918 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6610-71-4010 | | |
| | | | | Cummins P/N | BM-69986 | | |
| | 5 | Direction of Cooling Elbow | | | Left, viewed from coupling | | |

| | | Application | | | | |
|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | Komatsu P/N | 6610-71-6550 | | |
| | | | Cummins P/N | 140418 | | |
| | | | Code No. | #37 | | |
| | 2 | MVS Idle Spring | Komatsu P/N | 6710-71-3260 | | |
| | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | Komatsu P/N | 6610-71-1411 | | |
| | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | Komatsu P/N | 6610-71-5510 | | |
| | | | Cummins P/N | 143247 | | |
| | | | Color Code | Yellow | | |
| | 5 | Governor Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 2 | | |
| | 6 | Torque Spring | Komatsu P/N | Non | | |
| | | | Cummins P/N | Non | | |
| | | | Color Code | Non | | |
| | 7 | Torque Spring Shims | mm(in.) x Q'ty | Non | | |
| | 8 | Weight Assist Spring | Komatsu P/N | 6610-71-2140 | | |
| | | | Cummins P/N | 143847 | | |
| | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | mm (in.) x Q'ty | 0.51(0.02) x 5 | | |
| | 10 | Weight Assist Protrusion | mm(irl.) | Non | | |
| | 11 | MVS Governor Spring | Komatsu P/N | Non | | |
| | | | Cummins P/N | Non | | |
| | | | Color Code | Non | | |
| | 12 | MVS Governor Spring Shims | mm(in.) x Q'ty | Non | | |
| | 13 | AFC Spring | Komatsu P/N | – | | |
| | | | Cummins P/N | – | | |
| | | | Color Code | – | | |

| Pump Code | GR-J 141 | | | |
|---|---|---|---|---|
| Machine Model | D80A-18, D85A-18 | Rated | HP/rpm | 220/1800 |
| Engine Model | NT-855-C | Max. Torque | kgm(ft.lb.)/rpm | 105 (759)/1250 |
| | | High Idling | rpm | 1900 to 2000 |
| Pump P/N | 6711-71-1022 | | | |

| | | Application | | | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/1800 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 163.3(360)/1800 | | |
| | 3 | Governor Cut-off | | rpm | 1900 to 1930<br>1830 to 1860 | | |
| | 4 | Governor Set at 2.8 kg/cm²(40 psi) | | | 1920 to 1960 | | |
| | 5 | Governor Set at 1.4 kg/cm²(20 psi) | | | 1930 to 1990 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 7.7 (110)/1800 | | |
| | 7 | Check Point | | | 5.6 to 5.9/1250<br>(80 to 84) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 3.0 to 3.4<br>(42 to 48) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 3.0 (42) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min./rpm | Non | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | 178(7) | | |
| | | | | kg/cm²(psi) | 0.24 (3.4) | | |
| | | | Fuel | rpm | 1600 | | |
| | | | | kg/cm²(psi) | 5.3 (75) | | |
| | | | | kg(lb.)/hour | 162 (357)/H | | |
| | 12 | No Air Set | | rpm | 1600 | | |
| | | | | kg/cm² (psi) | 4.8 (68) | | |
| | | | | kg(lb.)/hour | 136 (300)/H | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6680-71-3281 | | |
| | | | | Cummins P/N | 423641 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | – | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6711-71-4100 | | |
| | | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | | Left, viewed from coupling | | |

| | | Application | | | | |
|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | Komatsu P/N | 6610-71-6550 | | |
| | | | Cummins P/N | 140418 | | |
| | | | Code No. | #37 | | |
| | 2 | MVS Idle Spring | Komatsu P/N | 6710-71-3260 | | |
| | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | Komatsu P/N | 6610-71-1411 | | |
| | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | Komatsu P/N | 6610-71-5580 | | |
| | | | Cummins P/N | 143254 | | |
| | | | Color Code | Red-Brown | | |
| | 5 | Governor Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 5<br>0.25(0.01) x 3 | | |
| | 6 | Torque Spring | Komatsu P/N | 6610-71-5140 | | |
| | | | Cummins P/N | 138782 | | |
| | | | Color Code | Red-Blue | | |
| | 7 | Torque Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 1 | | |
| | 8 | Weight Assist Spring | Komatsu P/N | 6610-71-2140 | | |
| | | | Cummins P/N | 143847 | | |
| | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | mm (in.) x Q'ty | 0.51(0.02) x 2 | | |
| | 10 | Weight Assist Protrusion | mm(in.) | 23.3 to 23.7<br>(0.9 to 0.93) | | |
| | 11 | MVS Governor Spring | Komatsu P/N | 6610-71-6120 | | |
| | | | Cummins P/N | 109686 | | |
| | | | Color Code | Blue | | |
| | 12 | MVS Governor Spring Shims | mm(in.) x Q'ty | Non | | |
| | 13 | AFC Spring | Komatsu P/N | 6710-72-2910 | | |
| | | | Cummins P/N | 179818 | | |
| | | | Color Code | Blue-Orange | | |

| Pump Code | GR-J 144 | | | |
|---|---|---|---|---|
| Machine Model | PC300-1 and PC300LC-1 | Rated | HP/rpm | 180/1850 |
| Engine Model | N855-C | Max. Torque | kgm(ft.lb.)/rpm | 85.8 (621)/1300 |
| | | High Idling | rpm | 1985 to 2085 |
| Pump P/N | 6712-71-1020 | | | |

| | | Application | | | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/1850 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 122.4(270)/1850 | | |
| | 3 | Governor Cut-off | | rpm | 1970 to 2000<br>1920 to 1970 | | |
| | 4 | Governor Set at 2.8 kg/cm²(40 psi) | | | 1990 to 2050 | | |
| | 5 | Governor Set at 1.4 kg/cm²(20 psi) | | | 2010 to 2080 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 9.1 (130)/1850 | | |
| | 7 | Check Point | | | 6.3 to 6.7/1300<br>(89 to 95) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 3.0 to 3.5<br>(43 to 50) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 1.8 (25) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min./rpm | Non | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | – | | |
| | | | | kg/cm²(psi) | – | | |
| | | | Fuel | rpm | – | | |
| | | | | kg/cm²(psi) | – | | |
| | | | | kg(lb.)/hour | – | | |
| | 12 | No Air Set | | rpm | – | | |
| | | | | kg/cm² (psi) | – | | |
| | | | | kg(lb.)/hour | – | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6680-71-3281 | | |
| | | | | Cummins P/N | 423641 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6711-71-4100 | | |
| | | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | | Away from coupling | | |

| | | Application | | | | |
|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | Komatsu P/N | 6610-71-6550 | | |
| | | | Cummins P/N | 140418 | | |
| | | | Code No. | #37 | | |
| | 2 | MVS Idle Spring | Komatsu P/N | 6710-71-3260 | | |
| | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | Komatsu P/N | 6610-71-1411 | | |
| | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | Komatsu P/N | 6610-71-5560 | | |
| | | | Cummins P/N | 143252 | | |
| | | | Color Code | Red | | |
| | 5 | Governor Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 1<br>0.25(0.01) x 1 | | |
| | 6 | Torque Spring | Komatsu P/N | Non | | |
| | | | Cummins P/N | Non | | |
| | | | Color Code | Non | | |
| | 7 | Torque Spring Shims | mm(in.) x Q'ty | Non | | |
| | 8 | Weight Assist Spring | Komatsu P/N | 6610-71-2140 | | |
| | | | Cummins P/N | 143847 | | |
| | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | mm (in.) x Q'ty | Non | | |
| | 10 | Weight Assist Protrusion | mm(in.) | 22.3 to 22.8<br>(0.8 to 0.9) | | |
| | 11 | MVS Governor Spring | Komatsu P/N | 6610-71-6230 | | |
| | | | Cummins P/N | 107787 | | |
| | | | Color Code | Blue-Yellow | | |
| | 12 | MVS Governor Spring Shims | mm(in.) x Q'ty | Non | | |
| | 13 | AFC Spring | Komatsu P/N | – | | |
| | | | Cummins P/N | – | | |
| | | | Color Code | – | | |

| Pump Code | GR-J 161 | | | |
|---|---|---|---|---|
| Machine Model | D95S-2 | Rated | HP/rpm | 245/1850 |
| Engine Model | NT855-C | Max. Torque | kgm(ft.lb.)/rpm | 112 (810)/1200 |
| | | High Idling | rpm | 2000 to 2100 |
| Pump P/N | 6711-71-1070 | | | |

| | | Application | | | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/1850 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 176.9(390)/1850 | | |
| | 3 | Governor Cut-off | | rpm | 2000 to 2050<br>1930 to 1950 | | |
| | 4 | Governor Set at 2.8 kg/cm²(40 psi) | | | 2000 to 2060 | | |
| | 5 | Governor Set at 1.4 kg/cm²(20 psi) | | | 2010 to 2080 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 2010 to 2080 | | |
| | 7 | Check Point | | | 8.2 (117)/1850 | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 5.8 to 6.0/1200<br>(82 to 86) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 3.4 to 3.7<br>(48 to 53) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min./rpm | 3.1 (50) | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | 178 (7) | | |
| | | | | kg/cm²(psi) | 0.2 (3.4) | | |
| | | | Fuel | rpm | 1600 | | |
| | | | | kg/cm²(psi) | 5 (78) | | |
| | | | | kg(lb.)/hour | 170 (375)/H | | |
| | 12 | No Air Set | | rpm | 1600 | | |
| | | | | kg/cm² (psi) | 6 (87) | | |
| | | | | kg(lb.)/hour | 136 (300)/H | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6680-71-3281 | | |
| | | | | Cummins P/N | 423641 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | – | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6711-71-4100 | | |
| | | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | | Left, viewed from coupling | | |

| | | Application | | | | |
|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | Komatsu P/N | 6610-71-6530 | | |
| | | | Cummins P/N | 141634 | | |
| | | | Code No. | #32 | | |
| | 2 | MVS Idle Spring | Komatsu P/N | 6710-71-3260 | | |
| | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | Komatsu P/N | 6610-71-1411 | | |
| | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | Komatsu P/N | 6610-71-5580 | | |
| | | | Cummins P/N | 143254 | | |
| | | | Color Code | Red-Brown | | |
| | 5 | Governor Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 7<br>0.25(0.01) x 2 | | |
| | 6 | Torque Spring | Komatsu P/N | 6610-71-5140 | | |
| | | | Cummins P/N | 138782 | | |
| | | | Color Code | Red-Blue | | |
| | 7 | Torque Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 2 | | |
| | 8 | Weight Assist Spring | Komatsu P/N | 6610-71-2140 | | |
| | | | Cummins P/N | 143847 | | |
| | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | mm (in.) x Q'ty | 0.51(0.02) x 3 | | |
| | 10 | Weight Assist Protrusion | mm(in.) | 22.8 to 23.3<br>(0.9 to 0.92) | | |
| | 11 | MVS Governor Spring | Komatsu P/N | 6610-71-6120 | | |
| | | | Cummins P/N | 109686 | | |
| | | | Color Code | Blue | | |
| | 12 | MVS.Governor Spring Shims | mm(in.) x Q'ty | Non | | |
| | 13 | AFC Spring | Komatsu P/N | 6710-72-2910 | | |
| | | | Cummins P/N | 179818 | | |
| | | | Color Code | Blue-Orange | | |

| Pump Code | GR-J172 | Pump Type | PTG-AFC-AUTO | | |
|---|---|---|---|---|---|
| Machine Model | HD320-3 | | Rated | HP/rpm | 405/2300 |
| Engine Model | NTA-855-C | | Max. Torque | kgm(ft.lb.)/rpm | 146(1056)/1700 |
| | | | High Idling | rpm | 2430 to 2530 |
| Pump P/N | 6710-71-1060 | | | | |

| | | | | Application | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/2300 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 131.5(290)/2300 | | |
| | 3 | Governor Cut-off | | rpm | 2320 to 2370 | | |
| | 4 | Governor Set at 2.8 kg/cm$^2$ (40 psi) | | | 2410 to 2470 | | |
| | 5 | Governor Set at 1.4 kg/cm$^2$ (20 psi) | | | 2430 to 2500 | | |
| | 6 | Intake Manifold Pressure | | kg/cm$^2$ (psi)/rpm | 15.5 (220)/2300 | | |
| | 7 | Check Point | | | 10.8 to 11.0/1700 (153 to 157) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm$^2$ (psi) | 3.2 to 3.9 (45 to 55) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 4.4 (63) | | |
| | 10 | Throttle Leakage | | cc(in.$^3$)/min/rpm | 35 to 80/2300 (2.1 to 4.9) | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | 279 (11) | | |
| | | | | kg/cm$^2$ (psi) | 0.38 (5.4) | | |
| | | | Fuel | rpm | 1600 | | |
| | | | | kg/cm$^2$ (psi) | 7.7 (110) | | |
| | | | | kg(lb.)/hour | 2.49 (5.48) | | |
| | 12 | No Air Set | | rpm | 1600 | | |
| | | | | kg/cm$^2$ (psi) | 4.9 (70) | | |
| | | | | kg(lb.)/hour | 181 (400) | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6710-71-1300 | | |
| | | | | Cummins P/N | – | | |
| | | | | Direction | Vertical | | |
| | | | | Place | | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6610-71-2571 | | |
| | | | | Cummins P/N | 403971 | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6684-71-4100 | | |
| | | | | Cummins P/N | AR-90265 | | |
| | 5 | Direction of Cooling Elbow | | | Away from coupling | | |

| | | | | Application | | | |
|---|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | | Komatsu P/N | 6610-71-6550 | | |
| | | | | Cummins P/N | 140418 | | |
| | | | | Code No. | 37 | | |
| | 2 | MVS Idle Spring | | Komatsu P/N | 6710-71-3260 | | |
| | | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | | Komatsu P/N | 6610-71-1411 | | |
| | | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | | Komatsu P/N | 6610-71-5530 | | |
| | | | | Cummins P/N | 143249 | | |
| | | | | Color Code | Yellow – White | | |
| | 5 | Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 6<br>0.25(0.01) x 1 | | |
| | 6 | Torque Spring | | Komatsu P/N | – | | |
| | | | | Cummins P/N | – | | |
| | | | | Color Code | – | | |
| | 7 | Torque Spring Shims | | mm(in.) x Q'ty | – | | |
| | 8 | Weight Assist Spring | | Komatsu P/N | 6610-71-2140 | | |
| | | | | Cummins P/N | 143847 | | |
| | | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 1 | | |
| | 10 | Weight Assist Protrusion | | mm(in.) | 22.0 to 22.5 (0.87 to 0.87) | | |
| | 11 | MVS Governor Spring | | Komatsu P/N | – | | |
| | | | | Cummins P/N | – | | |
| | | | | Color Code | – | | |
| | 12 | MVS Governor Spring Shims | | mm(in.) x Q'ty | – | | |
| | 13 | AFC Spring | | Komatsu P/N | 6710-72-2930 | | |
| | | | | Cummins P/N | 179820 | | |
| | | | | Color Code | Blue – Purple | | |

| Pump Code | GR-J 173 | | | |
|---|---|---|---|---|
| Machine Model | D80A-18, D85A-18 | Rated | HP/rpm | 220/1800 |
| Engine Model | NT855-C | Max. Torque | kgm(ft.lb.)/rpm | 105 (759)/1250 |
| | | High Idling | rpm | 1900 to 2000 |
| Pump P/N | 6711-71-1023 | | | |

| Application | | | | | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/1800 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 165.5(365)/1800 | | |
| | 3 | Governor Cut-off | | rpm | 1920 to 1950<br>1850 to 1880 | | |
| | 4 | Governor Set at 2.8 kg/cm²(40 psi) | | | 1920 to 1960 | | |
| | 5 | Governor Set at 1.4 kg/cm²(20 psi) | | | 1930 to 1990 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 7.5 (107)/1800 | | |
| | 7 | Check Point | | | 5.4 to 5.8/1250<br>(77 to 82) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 3.1 to 3.4<br>(44 to 48) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 3.0 (42) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min./rpm | Non | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | 101 (4) | | |
| | | | | kg/cm²(psi) | 0.1 (2) | | |
| | | | Fuel | rpm | 1600 | | |
| | | | | kg/cm²(psi) | 5.5 (78) | | |
| | | | | kg(lb.)/hour | 162 (357)/H | | |
| | 12 | No Air Set | | rpm | 1600 | | |
| | | | | kg/cm² (psi) | 5.5 (78) | | |
| | | | | kg(lb.)/hour | 136 (300)/H | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6680-71-3281 | | |
| | | | | Cummins P/N | 423641 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | – | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6711-71-4100 | | |
| | | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | | Away from coupling | | |

| Application | | | | | | | |
|---|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | | Komatsu P/N | 6610-71-6550 | | |
| | | | | Cummins P/N | 140418 | | |
| | | | | Code No. | #37 | | |
| | 2 | MVS Idle Spring | | Komatsu P/N | 6710-71-3260 | | |
| | | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | | Komatsu P/N | 6610-71-1411 | | |
| | | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | | Komatsu P/N | 6610-71-5580 | | |
| | | | | Cummins P/N | 143254 | | |
| | | | | Color Code | Red-Brown | | |
| | 5 | Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 6<br>0.25(0.01) x 2 | | |
| | 6 | Torque Spring | | Komatsu P/N | 6610-71-5140 | | |
| | | | | Cummins P/N | 138782 | | |
| | | | | Color Code | Red-Blue | | |
| | 7 | Torque Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 1 | | |
| | 8 | Weight Assist Spring | | Komatsu P/N | 6610-71-2140 | | |
| | | | | Cummins P/N | 143847 | | |
| | | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | | mm (in.) x Q'ty | Non | | |
| | 10 | Weight Assist Protrusion | | mm(in.) | 22.3 to 22.8<br>(0.8 to 0.9) | | |
| | 11 | MVS Governor Spring | | Komatsu P/N | 6610-71-6120 | | |
| | | | | Cummins P/N | 109686 | | |
| | | | | Color Code | Blue | | |
| | 12 | MVS Governor Spring Shims | | mm(in.) x Q'ty | Non | | |
| | 13 | AFC Spring | | Komatsu P/N | 6710-72-2910 | | |
| | | | | Cummins P/N | 179818 | | |
| | | | | Color Code | Blue-Orange | | |

| Pump Code | GR-J 203 | | | |
|---|---|---|---|---|
| Machine Model | PC400-1 | Rated | HP/rpm | 233/1800 |
| Engine Model | NT855-C | Max. Torque | kgm(ft.lb.)/rpm | 116 (839)/1200 |
| | | High Idling | rpm | 1950 to 2050 |
| Pump P/N | 6711-71-1100 | | | |

| Application | | | | | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/1800 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 176.9(390)/1800 | | |
| | 3 | Governor Cut-off | | rpm | 1900 to 1930<br>1850 to 1890 | | |
| | 4 | Governor Set at 2.8 kg/cm²(40 psi) | | | 1950 to 2000 | | |
| | 5 | Governor Set at 1.4 kg/cm²(20 psi) | | | 1960 to 2040 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 8.4 (120)/1800 | | |
| | 7 | Check Point | | | 6.5 to 6.8/1200<br>(92 to 96) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 4.2 to 4.8<br>(60 to 68) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | | 5.3 (75) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min./rpm | Non | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | – | | |
| | | | | kg/cm²(psi) | – | | |
| | | | Fuel | rpm | – | | |
| | | | | kg/cm²(psi) | – | | |
| | | | | kg(lb.)/hour | – | | |
| | 12 | No Air Set | | rpm | – | | |
| | | | | kg/cm² (psi) | – | | |
| | | | | kg(lb.)/hour | – | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6680-71-3281 | | |
| | | | | Cummins P/N | 423641 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | – | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6711-71-4100 | | |
| | | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | | Away from coupling | | |

| Application | | | | | | | |
|---|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | | Komatsu P/N | 6610-71-6510 | | |
| | | | | Cummins P/N | 141632 | | |
| | | | | Code No. | #27 | | |
| | 2 | MVS Idle Spring | | Komatsu P/N | 6710-71-3260 | | |
| | | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | | Komatsu P/N | 6610-71-1411 | | |
| | | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | | Komatsu P/N | 6610-71-5570 | | |
| | | | | Cummins P/N | 143253 | | |
| | | | | Color Code | Red-Yellow | | |
| | 5 | Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 2<br>0.25(0.01) x 1 | | |
| | 6 | Torque Spring | | Komatsu P/N | 6610-71-5150 | | |
| | | | | Cummins P/N | 138783 | | |
| | | | | Color Code | Red-Brown | | |
| | 7 | Torque Spring Shims | | mm(in.) x Q'ty | Non | | |
| | 8 | Weight Assist Spring | | Komatsu P/N | 6610-71-2290 | | |
| | | | | Cummins P/N | – | | |
| | | | | Color Code | Red-White | | |
| | 9 | Weight Assist Spring Shims | | mm (in.) x Q'ty | 0.51(0.02) x 4 | | |
| | 10 | Weight Assist Protrusion | | mm(in.) | 25.5 to 26.0<br>(1.0 to 1.02) | | |
| | 11 | MVS Governor Spring | | Komatsu P/N | 6610-71-6130 | | |
| | | | | Cummins P/N | 70821 | | |
| | | | | Color Code | Red | | |
| | 12 | MVS Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 4 | | |
| | 13 | AFC Spring | | Komatsu P/N | – | | |
| | | | | Cummins P/N | – | | |
| | | | | Color Code | – | | |

| Pump Code | GR-J205 | Pump Type | PTG-VS-AFC | | |
|---|---|---|---|---|---|
| Machine Model | W180-1 | | Rated | HP/rpm | 295/2300 |
| Engine Model | NT-855 | | Max. Torque | kgm(ft.lb.)/rpm | 116(840)/1600 |
| | | | High Idling | rpm | 2430 to 2530 |
| Pump P/N | 6711-71-1140 | | | | |

| | | | | Application | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/2300 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 102.9(227)/2300 | | |
| | 3 | Governor Cut-off | | rpm | Auto. 2420 to 2450<br>VS 2350 to 2400 | | |
| | 4 | Governor Set at 2.8 kg/cm$^2$ (40 psi) | | rpm | 2440 to 2510 | | |
| | 5 | Governor Set at 1.4 kg/cm$^2$ (20 psi) | | rpm | 2450 to 2530 | | |
| | 6 | Intake Manifold Pressure | | kg/cm$^2$ (psi)/rpm | 12.5(178)/2300 | | |
| | 7 | Check Point | | kg/cm$^2$ (psi)/rpm | 8.1 to 8.4/1600<br>(115 to 120) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm$^2$ (psi) | 2.8 to 3.5<br>(40 to 50) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | kg/cm$^2$ (psi) | 3.9 (55) | | |
| | 10 | Throttle Leakage | | cc(in.$^3$)/min/rpm | – | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | 145 (5.7) | | |
| | | | | kg/cm$^2$ (psi) | 0.20 (2.8) | | |
| | | | Fuel | rpm | 1600 | | |
| | | | | kg/cm$^2$ (psi) | 8.4 (120) | | |
| | | | | kg(lb.)/hour | 168 (370) | | |
| | 12 | No Air Set | | rpm | 1600 | | |
| | | | | kg/cm$^2$ (psi) | 7.9 (112) | | |
| | | | | kg(lb.)/hour | 125 (275) | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6675-71-3281 | | |
| | | | | Cummins P/N | 413691 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | – | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6610-71-4010 | | |
| | | | | Cummins P/N | BM-69986 | | |
| | 5 | Direction of Cooling Elbow | | | Left, viewed from coupling | | |

| | | | | Application | | | |
|---|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | | Komatsu P/N | 6610-71-6570 | | |
| | | | | Cummins P/N | 140923 | | |
| | | | | Code No. | 42 | | |
| | 2 | MVS Idle Spring | | Komatsu P/N | 6710-71-3260 | | |
| | | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | | Komatsu P/N | 6610-71-1411 | | |
| | | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | | Komatsu P/N | 6610-71-5510 | | |
| | | | | Cummins P/N | 143247 | | |
| | | | | Color Code | Yellow | | |
| | 5 | Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 1<br>0.25(0.01) x 1 | | |
| | 6 | Torque Spring | | Komatsu P/N | 6610-71-5160 | | |
| | | | | Cummins P/N | 138784 | | |
| | | | | Color Code | Red – Yellow | | |
| | 7 | Torque Spring Shims | | mm(in.) x Q'ty | – | | |
| | 8 | Weight Assist Spring | | Komatsu P/N | 6610-71-2140 | | |
| | | | | Cummins P/N | 143847 | | |
| | | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 4 | | |
| | 10 | Weight Assist Protrusion | | mm(in.) | – | | |
| | 11 | MVS Governor Spring | | Komatsu P/N | 6610-71-6120 | | |
| | | | | Cummins P/N | 109686 | | |
| | | | | Color Code | Blue | | |
| | 12 | MVS Governor Spring Shims | | mm(in.) x Q'ty | – | | |
| | 13 | AFC Spring | | Komatsu P/N | 6710-72-2910 | | |
| | | | | Cummins P/N | 179818 | | |
| | | | | Color Code | Blue – Orange | | |

| Pump Code | GR-J207 | Pump Type | PTG-VS-AFC | | |
|---|---|---|---|---|---|
| Machine Model | D80F-18 | | Rated | HP/rpm | 260/1950 |
| Engine Model | NT-855 | | Max. Torque | kgm(ft-lb)/rpm | 118/1200 |
| | | | High Idling | rpm | 1900 to 2000 |
| Pump P/N | 6711-71-1110 | | | | |

| | | Application | | | | |
|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | mmHg(in.Hg)/rpm | 127(5.0)/1800 | | |
| | 2 | Flow Meter Set | kg(lb)/hour/rpm | 166(365)/1800 | | |
| | 3 | Governor Cut-off | rpm | AUTO 1900 to 1930<br>VS 1840 to 1870 | | |
| | 4 | Governor Set at 2.8 kg/cm² (40 psi) | | 1940 to 1980 | | |
| | 5 | Governor Set at 1.4 kg/cm² (20 psi) | | 1950 to 1990 | | |
| | 6 | Intake Manifold Pressure | kg/cm² (psi)/rpm | 8.4(120)/1800 | | |
| | 7 | Check Point | | 6.2 to 6.5/1200 (88 to 92) | | |
| | 8 | Weight Assist Set at 800 rpm | kg/cm² (psi) | 4.2 to 4.7 (60 to 67) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | 3.5 (50) | | |
| | 10 | Throttle Leakage | cc(in³)/min/rpm | – | | |
| | 11 | AFC Set – Air | mmHg(in.Hg) | 178 (7.0) | | |
| | | | kg/cm² (psi) | 0.24 (3.4) | | |
| | | AFC Set – Fuel | rpm | 1600 | | |
| | | | kg/cm² (psi) | 6.1 (87) | | |
| | | | kg(lb)/hour | 172 (380) | | |
| | 12 | No Air Set | rpm | 1600 | | |
| | | | kg/cm² (psi) | 5.6 (80) | | |
| | | | kg(lb)/hour | 145 (320) | | |
| Attached Parts | 1 | Governor Lever | Komatsu P/N | 6680-71-3281 | | |
| | | | Cummins P/N | 423641 | | |
| | | | Direction | Vertical | | |
| | | | Place | Left, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | Komatsu P/N | 6691-71-2570 | | |
| | | | Cummins P/N | – | | |
| | 3 | Coupling | Komatsu P/N | 6710-71-2470 | | |
| | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | Komatsu P/N | 6711-71-4100 | | |
| | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | Away from coupling | | |

| | | Application | | | | |
|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | Komatsu P/N | 6610-71-6550 | | |
| | | | Cummins P/N | 140418 | | |
| | | | Code No. | 37 | | |
| | 2 | VS Idle Spring | Komatsu P/N | 6710-71-3260 | | |
| | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | Komatsu P/N | 6610-71-1411 | | |
| | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | Komatsu P/N | 6610-71-5570 | | |
| | | | Cummins P/N | 143253 | | |
| | | | Color Code | Red-Yellow | | |
| | 5 | Governor Spring Shims | mm(in) x Q'ty | 0.51(0.02) x 3 | | |
| | 6 | Torque spring | Komatsu P/N | 6610-71-5150 | | |
| | | | Cummins P/N | 138783 | | |
| | | | Color Code | Red-Brown | | |
| | 7 | Torque Spring Shims | mm(in) x Q'ty | – | | |
| | 8 | Weight Assist Spring | Komatsu P/N | 6610-71-2290 | | |
| | | | Cummins P/N | – | | |
| | | | Color Code | White-Red | | |
| | 9 | Weight Assist Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 2 | | |
| | 10 | Weight Assist Protrusion | mm(in.) | 23.5 to 24.0 (9.25 to 9.45) | | |
| | 11 | VS Governor Spring | Komatsu P/N | 6610-71-6140 | | |
| | | | Cummins P/N | 109687 | | |
| | | | Color Code | Yellow | | |
| | 12 | VS Governor Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 4 | | |
| | 13 | AFC Spring | Komatsu P/N | 6710-72-2910 | | |
| | | | Cummins P/N | 179818 | | |
| | | | Color Code | Blue-Orange | | |

| Pump Code | GR-J217 | Pump Type | PTG-VS-AFC | | |
|---|---|---|---|---|---|
| Machine Model | WS16S-2 | | Rated | HP/rpm | 364/2100 |
| Engine Model | NTA-855-C | | Max. Torque | kgm(ft.lb.)/rpm | 140(1013)/1500 |
| | | | High Idling | rpm | 2300 to 2400 |
| Pump P/N | 6710-71-1042 | | | | |

| | | | Application | | | |
|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | mmHg(in.Hg)/rpm | 127(5.0)/2100 | | |
| | 2 | Flow Meter Set | kg(lb.)/hour/rpm | 129.7(286)/2100 | | |
| | 3 | Governor Cut-off | rpm | AUTO2250 to 2290<br>VS 2170 to 2200 | | |
| | 4 | Governor Set at 2.8 kg/cm$^2$ (40 psi) | | 2270 to 2330 | | |
| | 5 | Governor Set at 1.4 kg/cm$^2$ (20 psi) | | 2300 to 2380 | | |
| | 6 | Intake Manifold Pressure | kg/cm$^2$(psi)/rpm | 12.7(180)/2100 | | |
| | 7 | Check Point | | 8.7 to 9.3/1600<br>(124 to 132) | | |
| | 8 | Weight Assist Set at 800 rpm | kg/cm$^2$(psi) | 2.6 to 3.1<br>(37 to 44) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | 3.4 (48) | | |
| | 10 | Throttle Leakage | cc(in.$^3$)/min/rpm | – | | |
| | 11 | AFC Set – Air | mmHg(in.Hg) | 178 (7) | | |
| | | | kg/cm$^2$ (psi) | 0.24(3.4) | | |
| | | AFC Set – Fuel | rpm | 1600 | | |
| | | | kg/cm$^2$ (psi) | 9.8 (140) | | |
| | | | kg(lb.)/hour | 211 (465) | | |
| | 12 | No Air Set | rpm | 1600 | | |
| | | | kg/cm$^2$ (psi) | 6.3 (89) | | |
| | | | kg(lb.)/hour | 159 (350) | | |
| Attached Parts | 1 | Governor Lever | Komatsu P/N | 6680-71-3281 | | |
| | | | Cummins P/N | 413691 | | |
| | | | Direction | Vertical | | |
| | | | Place | Right, viewed from coupling | | |
| | 2 | Fuel Inlet Elbow | Komatsu P/N | 6691-71-2570 | | |
| | | | Cummins P/N | – | | |
| | 3 | Coupling | Komatsu P/N | 6710-71-2470 | | |
| | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | Komatsu P/N | 6711-71-4100 | | |
| | | | Cummins P/N | 3326200 | | |
| | 5 | Direction of Cooling Elbow | | Away from coupling | | |

| | | | Application | | | |
|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | Komatsu P/N | 6610-71-6460 | | |
| | | | Cummins P/N | 140417 | | |
| | | | Code No. | 17 | | |
| | 2 | VS Idle Spring | Komatsu P/N | 6710-71-3260 | | |
| | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | Komatsu P/N | 6610-71-1411 | | |
| | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | Komatsu P/N | 6610-71-5510 | | |
| | | | Cummins P/N | 143247 | | |
| | | | Color Code | Yellow | | |
| | 5 | Governor Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 1 | | |
| | 6 | Torque Spring | Komatsu P/N | 6610-71-5100 | | |
| | | | Cummins P/N | 138768 | | |
| | | | Color Code | Red | | |
| | 7 | Torque Spring Shims | mm(in.) x Q'ty | – | | |
| | 8 | Weight Assist Spring | Komatsu P/N | 6610-71-2140 | | |
| | | | Cummins P/N | 143847 | | |
| | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | mm(in.) x Q'ty | 0.51(0.02) x 1 | | |
| | 10 | Weight Assist Protrusion | mm(in.) | – | | |
| | 11 | VS Governor Spring | Komatsu P/N | 6610-71-6180 | | |
| | | | Cummins P/N | 109690 | | |
| | | | Color Code | Pink | | |
| | 12 | VS Governor Spring Shims | mm(in.) x Q'ty | – | | |
| | 13 | AFC Spring | Komatsu P/N | 6710-72-2910 | | |
| | | | Cummins P/N | 179818 | | |
| | | | Color Code | Blue – Orange | | |

| Pump Code | GR-J241 | Pump Type | PTG-VS-AFC | | |
|---|---|---|---|---|---|
| Machine Model | W170-2 | | Rated | HP/rpm | 235/2200 |
| Engine Model | NT-855-C | | Max. Torque | kgm(ft.lb.)/rpm | 100(723)/1400 |
| | | | High Idling | rpm | 2350 to 2450 |
| Pump P/N | 6711-71-1170 | | | | |

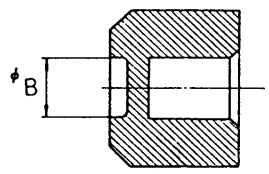
| | | | | Application | | | |
|---|---|---|---|---|---|---|---|
| Specification | 1 | Vacuum Set | | mmHg(in.Hg)/rpm | 127(5.0)/2300 | | |
| | 2 | Flow Meter Set | | kg(lb.)/hour/rpm | 89.3(197)/2200 | | |
| | 3 | Governor Cut-off | | rpm | AUTO 2330 to 2370<br>VS 2280 to 2310 | | |
| | 4 | Governor Set at 2.8 kg/cm² (40 psi) | | rpm | 2370 to 2420 | | |
| | 5 | Governor Set at 1.4 kg/cm² (20 psi) | | rpm | 2380 to 2430 | | |
| | 6 | Intake Manifold Pressure | | kg/cm²(psi)/rpm | 9.2(131)/2200 | | |
| | 7 | Check Point | | kg/cm²(psi)/rpm | 5.4 to 5.7/1400<br>(77 to 81) | | |
| | 8 | Weight Assist Set at 800 rpm | | kg/cm²(psi) | 2.1 to 2.8<br>(30 to 40) | | |
| | 9 | Idle Speed Pressure at 500 rpm | | kg/cm²(psi) | 4.9 (70) | | |
| | 10 | Throttle Leakage | | cc(in.³)/min/rpm | – | | |
| | 11 | AFC Set | Air | mmHg(in.Hg) | 178 (7) | | |
| | | | | kg/cm² (psi) | 0.24 (3.4) | | |
| | | | Fuel | rpm | 1600 | | |
| | | | | kg/cm² (psi) | 5.3 (75) | | |
| | | | | kg(lb.)/hour | 162 (357) | | |
| | 12 | No Air Set | | rpm | 1600 | | |
| | | | | kg/cm² (psi) | 4.8 (68) | | |
| | | | | kg(lb.)/hour | 136 (300) | | |
| Attached Parts | 1 | Governor Lever | | Komatsu P/N | 6675-71-3281 | | |
| | | | | Cummins P/N | 413691 | | |
| | | | | Direction | Vertical | | |
| | | | | Place | Left, viwed from coupling | | |
| | 2 | Fuel Inlet Elbow | | Komatsu P/N | 6691-71-2570 | | |
| | | | | Cummins P/N | – | | |
| | 3 | Coupling | | Komatsu P/N | 6710-71-2470 | | |
| | | | | Cummins P/N | 212613 | | |
| | 4 | Shut-off Valve | | Komatsu P/N | 6610-71-4010 | | |
| | | | | Cummins P/N | BM-69986 | | |
| | 5 | Direction of Cooling Elbow | | | Left, viwed from coupling | | |

| | | | | Application | | | |
|---|---|---|---|---|---|---|---|
| Internal Parts | 1 | Idle Plunger | | Komatsu P/N | 6610-71-6550 | | |
| | | | | Cummins P/N | 140418 | | |
| | | | | Code No. | 37 | | |
| | 2 | MVS Idle Spring | | Komatsu P/N | 6710-71-3260 | | |
| | | | | Cummins P/N | 70778 | | |
| | 3 | Governor Plunger | | Komatsu P/N | 6610-71-1411 | | |
| | | | | Cummins P/N | 169660 | | |
| | 4 | Governor Spring | | Komatsu P/N | 6610-71-5530 | | |
| | | | | Cummins P/N | 143249 | | |
| | | | | Color Code | Yellow – White | | |
| | 5 | Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 1<br>0.25(0.01) x 2 | | |
| | 6 | Torque Spring | | Komatsu P/N | 6610-71-5100 | | |
| | | | | Cummins P/N | 138768 | | |
| | | | | Color Code | Red | | |
| | 7 | Torque Spring Shims | | mm(in.) x Q'ty | – | | |
| | 8 | Weight Assist Spring | | Komatsu P/N | 6610-71-2140 | | |
| | | | | Cummins P/N | 143847 | | |
| | | | | Color Code | Blue | | |
| | 9 | Weight Assist Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 3 | | |
| | 10 | Weight Assist Protrusion | | mm(in.) | 22.5 to 23.0<br>(0.88 to 0.91) | | |
| | 11 | MVS Governor Spring | | Komatsu P/N | 6610-71-6150 | | |
| | | | | Cummins P/N | 70822 | | |
| | | | | Color Code | Green | | |
| | 12 | MVS Governor Spring Shims | | mm(in.) x Q'ty | 0.51(0.02) x 6 | | |
| | 13 | AFC Spring | | Komatsu P/N | 6710-72-2910 | | |
| | | | | Cummins P/N | 179818 | | |
| | | | | Color Code | Blue – Orange | | |

# PT FUEL PUMP PARTS SPECIFICATION

## IDLE PLUNGER

| Code No. | Dimension B (mm) | Komatsu Parts No. | Cummins Parts No. |
|---|---|---|---|
| 5 | 5.30 – 5.37 | 6610-71-6410 | 141623 |
| 7 | 5.42 – 5.50 | 6610-71-6420 | 141624 |
| 10 | 5.55 – 5.63 | 6610-71-6430 | 141625 |
| 12 | 5.68 – 5.75 | 6610-71-6440 | 141626 |
| 15 | 5.80 – 5.88 | 6610-71-6450 | 139894 |
| 17 | 5.93 – 6.01 | 6610-71-6460 | 140417 |
| 20 | 6.06 – 6.13 | 6610-71-6470 | 141629 |
| 22 | 6.19 – 6.26 | 6610-71-6480 | 141630 |
| 25 | 6.31 – 6.39 | 6610-71-6490 | 141631 |
| 27 | 6.44 – 6.52 | 6610-71-6510 | 141632 |
| 30 | 6.57 – 6.64 | 6610-71-6520 | 141633 |
| 32 | 6.69 – 7.77 | 6610-71-6530 | 141634 |
| 35 | 6.82 – 6.90 | 6610-71-6540 | 140922 |
| 37 | 6.94 – 7.02 | 6610-71-6550 | 140418 |
| 40 | 7.07 – 7.15 | 6610-71-6560 | 137370 |
| 42 | 7.20 – 7.28 | 6610-71-6570 | 140923 |
| 45 | 7.33 – 7.40 | 6610-71-6580 | 138862 |
| 47 | 7.46 – 7.53 | 6610-71-6590 | 140924 |
| 50 | 7.58 – 7.66 | 6610-71-6610 | 140925 |
| 52 | 7.71 – 7.79 | 6610-71-6620 | 139618 |
| 55 | 7.84 – 7.91 | 6610-71-6630 | 139619 |
| 57 | 7.96 – 8.04 | 6610-71-6640 | 140926 |
| 60 | 8.09 – 8.17 | 6610-71-6650 | 140927 |
| 62 | 8.22 – 8.29 | 6610-71-6660 | 141636 |
| 65 | 8.34 – 8.42 | 6610-71-6670 | 141637 |
| 67 | 8.47 – 8.55 | 6610-71-6680 | 141638 |
| 170 | 8.60 – 8.67 | – | 145947 |
| 172 | 8.72 – 8.80 | – | 145948 |
| 175 | 8.85 – 8.93 | – | 145949 |
| 177 | 8.98 – 9.06 | – | 145950 |
| 180 | 9.11 – 9.18 | – | 145951 |
| 182 | 9.23 – 9.31 | – | 145952 |
| 185 | 9.35 – 9.44 | – | 145953 |
| 187 | 9.49 – 9.56 | – | 145954 |
| 190 | 9.61 – 9.69 | – | 145955 |
| 192 | 9.74 – 9.82 | – | 145956 |
| 195 | 9.87 – 9.94 | – | 145957 |
| 197 | 9.99 – 10.07 | – | 145958 |
| 200 | 10.12 – 10.20 | – | 145959 |
| 202 | 10.25 – 10.33 | – | 145960 |
| 205 | 10.38 – 10.45 | – | 145961 |
| 207 | 10.50 – 10.58 | – | 145962 |
| 210 | 10.63 – 10.71 | – | 145963 |
| 212 | 10.76 – 10.83 | – | 145964 |
| 215 | 10.88 – 10.96 | – | 145965 |
| 217 | 11.01 – 11.09 | – | 145966 |
| 220 | 11.14 – 11.21 | – | 145967 |
| 222 | 11.26 – 11.34 | – | 145968 |
| 225 | 11.39 – 11.47 | – | 145969 |
| 227 | 11.52 – 11.60 | – | 145970 |
| 230 | 11.65 – 11.72 | – | 145971 |
| 232 | 11.77 – 11.85 | – | 145972 |
| 235 | 11.90 – 11.98 | – | 145973 |
| 237 | 12.03 – 12.10 | – | 145974 |



## GOVERNOR SPRING

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate (kg/cm²) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| | 70711-G | Orange/White | | | 1.37 | 5.5 | |
| | 70711-H | Lt. Blue/Orange | | | 1.37 | 6.5 | |
| | 70711-J | Lt. Green/White | | | 1.30 | 6.2 | |
| | 70711-K | Orange/Lt. Green | | | 1.19 | 7.2 | |
| 6610-71-5510 | 143247 | Yellow | 37.77 | 0.63 | 2.34 | 7.4 | |
| 6610-71-5520 | 143248 | Yellow/Green | 37.77 | 0.57 | 2.34 | 7.9 | 70711 |
| 6610-71-5530 | 143249 | Yellow/White | 37.77 | 0.52 | 2.18 | 7.1 | |
| 6610-71-5540 | 143250 | Red/White | 37.77 | 0.46 | 2.18 | 7.7 | 70711A |
| 6610-71-5550 | 143251 | Blue/Purple | 37.77 | 0.41 | 2.18 | 8.4 | 70711B |
| 6610-71-5560 | 143252 | Red | 37.77 | 0.36 | 2.03 | 7.6 | |
| 6610-71-5570 | 143253 | Red/Yellow | 37.77 | 0.30 | 2.03 | 8.6 | 70711C |
| 6610-71-5580 | 143254 | Red/Purple | 37.77 | 0.25 | 1.83 | 7.5 | 135158 |
| 6610-71-5590 | 143255 | Red/Green | 37.77 | 0.20 | 1.70 | 7.8 | 70711D |
| 6610-71-5610 | 143256 | White/Blue | 37.77 | 0.14 | 1.57 | 7.5 | 70711E-F |
| 6610-71-5620 | 144478 | White | 44.12 | 0.46 | 2.18 | 7.7 | |
| 6610-71-5630 | 144479 | Green | 44.12 | 0.41 | 2.18 | 8.4 | |
| 6610-71-5640 | 144490 | Orange | 31.42 | 0.36 | 2.03 | 7.6 | |
| 6610-71-5650 | 144491 | Light Blue | 31.42 | 0.30 | 2.03 | 8.6 | |
| 6610-71-5660 | 147292 | Purple | 35.69 | 0.68 | 2.34 | 7.0 | |
| 6610-71-5670 | 147293 | Orange/Yellow | 33.58 | 0.73 | 2.34 | 6.6 | |
| 6610-71-5690 | 147294 | White/Purple | 31.62 | 0.79 | 2.34 | 6.3 | |
| 6610-71-5680 | 147295 | Orange/Red | 31.42 | 0.84 | 2.34 | 6.0 | |
| 6610-71-5710 | 147296 | Purple/Green | 31.42 | 0.89 | 2.34 | 5.8 | |
| | 153232 | Blue | 31.42 | | 2.18 | 7.1 | |
| 6610-71-5720 | 153235 | Green/Orange | 34.59 | 0.30 | 2.03 | 8.6 | |
| 6610-71-5730 | 153236 | Green/Blue | 34.59 | 0.46 | 2.18 | 7.7 | |
| 6610-71-5740 | 153237 | Blue/Yellow | 34.59 | 0.41 | 2.18 | 8.4 | |
| 6610-71-5750 | 153238 | Blue/Red | 34.59 | 0.36 | 2.03 | 7.6 | |
| | 157059 | Blue/Orange | 37.77 | 0.78 | 2.34 | 6.3 | |
| | 177629 | Purple/Orange | 32.26 | 1.11 | 2.59 | 6.1 | |
| | 3000932 | Purple/Lt. Blue | 44.12 | 0.36 | 2.03 | 7.6 | |
| | 3000933 | Purple/Orange | 44.12 | 0.30 | 2.03 | 8.6 | |

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate ($kg/cm^2$) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| | 3000934 | Blue/Lt. Blue | 44.12 | 0.25 | 1.83 | 7.5 | |
| | 3000935 | Green/Lt. Blue | 44.12 | 0.20 | 1.83 | 9.0 | |
| | 3000936 | Yellow/Lt. Blue | 31.42 | 0.73 | 2.34 | 6.7 | |
| | 3000937 | White/Lt. Blue | 31.42 | 0.68 | 2.34 | 7.0 | |
| | 3000938 | Red/Lt. Blue | 31.42 | 0.62 | 2.34 | 7.4 | |
| | 3000939 | White/Orange | 31.42 | 0.57 | 2.34 | 7.9 | |
| | 3000940 | Orange/Lt. Blue | 31.42 | 0.47 | 2.18 | 7.7 | |
| | 3000941 | Green/White | 31.42 | 0.41 | 2.18 | 8.4 | |
| | 3001146 | Yellow/Purple | 40.64 | 0.20 | 1.83 | 9.0 | |
| | 3001147 | Brown | 40.64 | 0.25 | 1.93 | 8.7 | |
| | 3001148 | Brown/Green | 40.64 | 0.30 | 2.03 | 8.7 | |
| | 3001149 | Brown/White | 40.64 | 0.36 | 2.03 | 7.7 | |
| | 3001150 | Brown/Yellow | 40.64 | 0.41 | 2.18 | 8.5 | |
| | 3001151 | Brown/Red | 40.64 | 0.46 | 2.18 | 7.7 | |
| | 3001152 | Brown/Blue | 40.64 | 0.52 | 2.18 | 7.1 | |
| | 3001153 | Grey | 40.64 | 0.57 | 2.34 | 8.0 | |
| | 3001154 | Brown/Orange | 40.64 | 0.63 | 2.34 | 7.4 | |
| | 3001155 | Brown/Lt. Blue | 34.59 | 0.52 | 2.18 | 7.1 | |
| | 3001156 | Brown/Purple | 34.59 | 0.57 | 2.34 | 7.9 | |
| | 3001157 | Grey/Yellow | 34.59 | 0.63 | 2.34 | 7.4 | |
| | 3001158 | Grey/Green | 34.59 | 0.68 | 2.34 | 7.0 | |
| | 3001159 | Grey/White | 34.59 | 0.73 | 2.34 | 6.7 | |
| | 3001160 | Grey/Red | 31.42 | 0.95 | 2.34 | 5.5 | |
| | 3001161 | Grey/Blue | 31.42 | 1.00 | 2.34 | 5.4 | |
| | 3001162 | Grey/Brown | 31.42 | 1.05 | 2.34 | 5.3 | |
| | 3001163 | Grey/Orange | 31.42 | 1.11 | 2.34 | 5.1 | |
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## TORQUE SPRING

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate ($kg/cm^2$) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| 6610-71-5100 | 138768 | Red | 16.26 – 16.76 | 0.18 | 1.12 | 6.5 | |
| 6610-71-5110 | 138769 | Blue | 16.26 – 16.76 | 0.21 | 1.12 | 5.7 | |
| 6610-71-5120 | 138780 | Green | 16.26 – 16.76 | 0.25 | 1.12 | 5.2 | |
| 6610-71-5130 | 138781 | Yellow | 16.26 – 16.76 | 0.29 | 1.19 | 5.6 | |
| 6610-71-5140 | 138782 | Red/Blue | 16.26 – 16.76 | 0.32 | 1.19 | 5.2 | |
| 6610-71-5150 | 138783 | Red/Green | 16.26 – 16.76 | 0.36 | 1.30 | 5.9 | |
| 6610-71-5160 | 138784 | Red/Yellow | 16.26 – 16.76 | 0.39 | 1.30 | 5.5 | |
| 6610-71-5200 | 138785 | Red | 14.99 – 15.49 | 0.18 | 1.12 | 6.5 | |
| 6610-71-5210 | 138786 | Blue | 14.99 – 15.49 | 0.21 | 1.12 | 5.7 | |
| 6610-71-5220 | 138787 | Green | 14.99 – 15.49 | 0.25 | 1.12 | 5.2 | |
| 6610-71-5230 | 138788 | Yellow | 14.99 – 15.49 | 0.29 | 1.19 | 5.6 | |
| 6610-71-5240 | 138789 | Red/Blue | 14.99 – 15.49 | 0.32 | 1.19 | 5.2 | |
| 6610-71-5250 | 138790 | Red/Green | 14.99 – 15.49 | 0.36 | 1.30 | 5.9 | |
| 6610-71-5260 | 138791 | Red/Yellow | 14.99 – 15.49 | 0.39 | 1.30 | 5.5 | |
| 6610-71-5270 | 138792 | Blue/Green | 14.99 – 15.49 | 0.43 | 1.30 | 5.2 | |
| 6610-71-5300 | 138793 | Red | 13.72 – 14.22 | 0.18 | 1.12 | 6.5 | |
| 6610-71-5310 | 138794 | Blue | 13.72 – 14.22 | 0.21 | 1.12 | 5.7 | |
| 6610-71-5320 | 138795 | Green | 13.72 – 14.22 | 0.25 | 1.12 | 5.2 | |
| 6610-71-5330 | 138796 | Yellow | 13.72 – 14.22 | 0.29 | 1.19 | 5.6 | |
| 6610-71-5340 | 138797 | Red/Purple | 13.72 – 14.22 | 0.32 | 1.19 | 5.2 | |
| 6610-71-5350 | 138798 | Red/Green | 13.72 – 14.22 | 0.36 | 1.30 | 5.9 | |
| 6610-71-5360 | 138799 | Red/Yellow | 13.72 – 14.22 | 0.39 | 1.30 | 5.5 | |
| 6610-71-5370 | 138800 | Blue/Green | 13.72 – 14.22 | 0.43 | 1.30 | 5.2 | |
| 6610-71-5380 | 138801 | Blue/Yellow | 13.72 – 14.22 | 0.46 | 1.30 | 4.7 | |
| 6610-71-5390 | 138802 | Green/Yellow | 12.45 – 12.95 | 0.50 | 1.37 | 5.4 | |
| 6610-71-5400 | 138803 | Red | 12.45 – 12.95 | 0.18 | 1.12 | 6.5 | |
| 6610-71-5410 | 138804 | Blue | 12.45 – 12.95 | 0.21 | 1.12 | 5.7 | |
| 6610-71-5420 | 138805 | Green | 12.45 – 12.95 | 0.25 | 1.12 | 5.2 | |
| 6610-71-5430 | 138993 | Yellow | 12.45 – 12.95 | 0.29 | 1.19 | 5.6 | |
| 6610-71-5440 | 138994 | Red/Blue | 12.45 – 12.95 | 0.32 | 1.19 | 5.2 | |
| 6610-71-5450 | 138995 | Red/Green | 12.45 – 12.95 | 0.36 | 1.30 | 5.9 | |
| 6610-71-5460 | 138996 | Red/Yellow | 12.45 – 12.95 | 0.39 | 1.30 | 5.5 | |

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate (kg/cm²) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| 6610-71-5470 | 138997 | Blue/Green | 12.45 – 12.95 | 0.43 | 1.30 | 5.2 | |
| 6610-71-5480 | 138998 | Blue/Yellow | 12.45 – 12.95 | 0.46 | 1.30 | 4.7 | |
| 6610-71-5490 | 138999 | Green/Yellow | 12.45 – 12.95 | 0.50 | 1.37 | 5.4 | |
| 6610-71-5170 | 139584 | Blue/Green | 16.26 – 16.76 | 0.43 | 1.30 | 5.2 | |
| 6610-71-5180 | 139585 | Blue/Yellow | 16.26 – 16.76 | 0.46 | 1.30 | 4.7 | |
| 6610-71-5190 | 139586 | Green/Yellow | 16.26 – 16.76 | 0.50 | 1.37 | 5.4 | |
| 6610-71-5280 | 139587 | Blue/Yellow | 14.99 – 15.49 | 0.46 | 1.30 | 4.7 | |
| 6610-71-5290 | 139588 | Geen/Yellow | 14.99 – 15.49 | 0.50 | 1.37 | 5.4 | |
| | 142696 | White/Blue | 16.26 – 16.76 | 0.14 | 1.04 | 6.3 | |
| | 142697 | White/Yellow | 16.26 – 16.76 | 0.11 | 1.04 | 7.7 | |
| | 142698 | White/Green | 16.26 – 16.76 | 0.07 | 0.89 | 6.7 | |
| | 142699 | White/Blue | 14.99 – 15.49 | 0.14 | 1.04 | 6.3 | |
| | 142700 | White/Yellow | 14.99 – 15.49 | 0.11 | 1.04 | 7.7 | |
| | 142701 | White/Green | 14.99 – 15.49 | 0.07 | 0.89 | 6.7 | |
| | 142702 | White/Blue | 13.72 – 14.22 | 0.14 | 1.04 | 6.3 | |
| | 142703 | White/Yellow | 13.72 – 14.22 | 0.11 | 1.04 | 7.7 | |
| | 142704 | White/Green | 13.72 – 14.22 | 0.07 | 0.89 | 6.7 | |
| | 142705 | White/Blue | 12.45 – 12.95 | 0.14 | 1.04 | 6.3 | |
| | 142706 | White/Yellow | 12.45 – 12.95 | 0.11 | 1.04 | 7.7 | |
| | 142707 | White/Green | 12.45 – 12.95 | 0.07 | 0.89 | 6.7 | |
| | 142843 | White/Blue | 21.34 – 21.84 | 0.14 | 1.04 | 6.3 | |
| | 142844 | Red | 21.34 – 21.84 | 0.18 | 1.12 | 6.5 | |
| | 142845 | Blue | 21.34 – 21.84 | 0.21 | 1.19 | 6.8 | |
| | 142846 | Green | 21.34 – 21.84 | 0.25 | 1.19 | 6.1 | |
| | 142850 | White/Blue | 20.07 – 20.57 | 0.14 | 1.04 | 6.3 | |
| | 142851 | Red | 20.07 – 20.57 | 0.18 | 1.12 | 6.5 | |
| | 142852 | Blue | 20.07 – 20.57 | 0.21 | 1.19 | 6.8 | |
| | 142853 | Green | 20.07 – 20.57 | 0.25 | 1.19 | 6.1 | |
| | 142854 | Yellow | 20.07 – 20.57 | 0.28 | 1.19 | 5.6 | |
| | 142855 | Red/Blue | 20.07 – 20.57 | 0.32 | 1.30 | 6.3 | |
| | 142857 | White/Blue | 18.80 – 19.30 | 0.14 | 1.04 | 6.3 | |
| | 142858 | Red | 18.80 – 19.30 | 0.27 | 1.12 | 6.5 | |

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate ($kg/cm^2$) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| | 142859 | Blue | 18.80 – 19.30 | 0.21 | 1.19 | 6.8 | |
| | 142860 | Green | 18.80 – 19.30 | 0.25 | 1.19 | 6.1 | |
| | 142861 | Yellow | 18.80 – 19.30 | 0.28 | 1.19 | 5.6 | |
| | 142862 | Red/Blue | 18.80 – 19.30 | 0.32 | 1.30 | 6.3 | |
| | 142863 | Red/Green | 18.80 – 19.30 | 0.36 | 1.30 | 5.9 | |
| | 142864 | White/Blue | 17.53 – 18.03 | 0.14 | 1.04 | 6.3 | |
| | 142865 | Red | 17.53 – 18.03 | 0.17 | 1.12 | 5.5 | |
| | 142866 | Blue | 17.53 – 18.03 | 0.21 | 1.19 | 6.8 | |
| | 142867 | Green | 17.53 – 18.03 | 0.25 | 1.19 | 6.1 | |
| | 142868 | Yellow | 17.53 – 18.03 | 0.28 | 1.19 | 5.6 | |
| | 142869 | Red/Blue | 17.53 – 18.03 | 0.32 | 1.30 | 6.3 | |
| | 142870 | Red/Green | 17.53 – 18.03 | 0.36 | 1.30 | 5.9 | |
| | 3002047 | White | 16.26 – 16.76 | 0.54 | 1.37 | 5.2 | |
| | 3002048 | White/Red | 16.26 – 16.76 | 0.57 | 1.37 | 5.0 | |
| | 3002049 | Brown | 16.26 – 16.76 | 0.61 | 1.37 | 4.8 | |
| | 3002050 | Brown/Red | 16.26 – 16.76 | 0.64 | 1.50 | 5.6 | |
| | 3002051 | Brown/Blue | 16.26 – 16.76 | 0.68 | 1.50 | 5.5 | |
| | 3002052 | Brown/Green | 16.26 – 16.76 | 0.71 | 1.50 | 5.3 | |
| | 3002053 | White | 14.99 – 15.49 | 0.54 | 1.37 | 5.2 | |
| | 3002054 | White/Red | 14.99 – 15.49 | 0.57 | 1.37 | 5.0 | |
| | 3002055 | Brown | 14.99 – 15.49 | 0.61 | 1.37 | 4.8 | |
| | 3002056 | Brown/Red | 14.99 – 15.49 | 0.64 | 1.37 | 4.6 | |
| | 3002057 | Brown/Blue | 14.99 – 15.49 | 0.68 | 1.50 | 5.5 | |
| | 3002058 | Brown/Green | 14.99 – 15.49 | 0.71 | 1.50 | 5.3 | |
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## MVS GOVERNOR SPRING

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate (kg/cm²) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| 6610-71-6130 | 70821 | Red | 34.42 – 36.45 | 0.53 | 1.83 | 10 | |
| 6610-71-6150 | 70822 | Green | 33.48 – 35.51 | 0.86 | 2.03 | 9.5 | |
| 6610-71-6110 | 101002 | White | 37.44 – 39.47 | 0.27 | 1.60 | 11 | |
| 6610-71-6190 | 105422 | Black | 37.29 – 39.32 | 0.14 | 1.37 | 11 | |
| 6610-71-6230 | 107787 | Yellow/Blue | 36.63 – 38.66 | 0.40 | 1.83 | 12 | |
| 6610-71-6120 | 109686 | Blue | 32.46 – 34.49 | 0.66 | 1.83 | 8.5 | |
| 6610-71-6140 | 109687 | Yellow | 33.20 – 35.13 | 0.80 | 2.03 | 10 | |
| 6610-71-6160 | 109688 | Green/White | 33.78 – 35.81 | 0.91 | 2.03 | 9 | |
| 6610-71-6170 | 109689 | Grey | 34.14 – 36.17 | 1.00 | 2.03 | 8.5 | |
| 6610-71-6180 | 109690 | Pink | 34.44 – 36.47 | 1.09 | 2.03 | 8 | |
| 6610-71-6210 | 110460 | Orange | 38.05 – 40.08 | 0.20 | 1.60 | 14 | |
| 6610-71-6220 | 110461 | Purple | 37.80 – 39.83 | 0.33 | 1.60 | 12 | |
| | 116508 | | 10.3 | | 0.74 | 10.5 | Idle |
| 6610-71-6240 | 118128 | Black/White | 38.56 – 40.59 | 0.11 | 1.37 | 14 | |
| 6610-71-6250 | 118934 | Blue/White | 35.53 – 37.57 | 0.46 | 1.83 | 11 | |
| 6610-71-6260 | 118935 | Orange/White | 37.03 – 39.07 | 0.33 | 1.60 | 9 | |
| | 143849 | Yellow | 15.50 – 17.52 | 0.13 | 0.64 | 9 | Idle, SVS |
| | 153232 | Blue | 30.41 – 32.43 | 0.52 | 2.18 | 7.1 | |
| | 153240 | | 9.91 – 11.93 | 0.52 | 1.12 | 5.5 | Idle, MVS and VS |
| | 201116 | Green | 14.87 – 16.89 | 0.08 | 0.81 | 7.4 | Idle |
| | | | | | | | |
| | | | | | | | |

## MVS GOVERNOR PLUNGER

| Komatsu Part No. | Cummins Part No. | Class size | Color code | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 6689-71-3350 | 154460 | 0 | Red | 7.910 – 7.914 | |
| | 154461 | 0 | Red | 7.910 – 7.914 | |
| | 154462 | 1 | Blue | 7.915 – 7.919 | |
| | 154463 | 1 | Blue | 7.915 – 7.919 | |
| | 168906 | 2 | Green | 7.930 – 7.935 | |
| | 168908 | 2 | Green | 7.930 – 7.935 | |
| | 168907 | 3 | Yellow | 7.938 – 7.942 | |
| | 168909 | 3 | Yellow | 7.938 – 7.942 | |
| | | | | | |

## AFC SPRING

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate ($kg/cm^2$) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| 6710-72-2820 | 179804 | White | 31.24 | 0.36 | 2.67 | 5.2 | |
| 6710-72-2840 | 179806 | Blue | 31.24 | 0.54 | 2.67 | 4.1 | |
| 6710-72-2860 | 179808 | Purple | 31.24 | 0.71 | 3.05 | 4.6 | |
| 6710-72-2880 | 179816 | Blue/White | 31.24 | 0.89 | 3.05 | 4.1 | |
| 6710-72-2910 | 179818 | Blue/Orange | 31.24 | 1.07 | 3.43 | 4.7 | |
| 6710-72-2920 | 179819 | Blue/Orange | | | | | |
| 6710-72-2930 | 179820 | Blue/Purple | 31.24 | 1.25 | 3.43 | 4.3 | |
| 6710-72-2940 | 179821 | | | | | | |
| 6710-72-2950 | 179822 | White/Green | 31.24 | 1.43 | 3.43 | 4.1 | |
| 6710-72-2960 | 179823 | | | | | | |
| 6710-72-2970 | 179824 | White/Red | 31.24 | 1.61 | 3.43 | 3.9 | |
| 6710-72-2990 | 179826 | White/Yellow | 31.24 | 1.79 | 3.76 | 4.4 | |
| 6710-72-3120 | 179828 | Green/Red | 31.24 | 1.96 | 3.76 | 4.2 | |
| 6710-72-3140 | 179830 | Green/Yellow | 31.24 | 2.14 | 3.76 | 4.0 | |
| 6710-72-3160 | 179832 | Orange/Purple | 31.24 | 2.32 | 3.76 | 3.8 | |
| 6710-72-3180 | 179834 | Red/Purple | 31.24 | 2.50 | 3.76 | 3.7 | |
| 6710-72-3210 | 179836 | Purple/Yellow | 31.24 | 2.68 | 3.96 | 4.0 | |
| 6710-72-3230 | 3000592 | Light Green | 31.24 | 2.86 | 3.96 | 3.9 | |
| | | | | | | | |

## WEIGHT ASSIST SPRING

| Komatsu Part No. | Cummins Part No. | Color code | Free length (mm) | Spring rate ($kg/cm^2$) | Wire dia. (mm) | Number coils | Remarks |
|---|---|---|---|---|---|---|---|
| | 143846 | Red | 15.90 – 16.66 | 0.17 | | | |
| 6610-71-2140 | 143847 | Blue | 14.45 – 15.21 | 0.24 | 0.71 | 9.7 | |
| | 143848 | White | 13.06 – 13.82 | 0.39 | 0.76 | 9.0 | |
| | 143849 | Yellow | 16.13 – 16.89 | 0.14 | 0.76 | 11.0 | |
| | 143850 | Red/Yellow | 17.65 – 18.42 | 0.09 | | | |
| | 143851 | Red/Brown | 11.68 – 12.45 | 0.42 | | | |
| 6691-71-2140 | 143852 | Red/Yellow | 11.68 – 12.45 | 0.36 | 0.71 | 9.5 | |
| | 143853 | Red/Brown | 11.68 – 12.45 | 0.30 | | | |
| | 143854 | Blue/Yellow | 11.68 – 12.45 | 0.24 | | | |
| | 143855 | White/Yellow | 11.68 – 12.45 | 0.12 | 0.56 | 10.0 | |
| 6610-71-2290 | 416920 | White/Red | 16.64 – 17.40 | 0.47 | 0.81 | 10.0 | |
| | 650662 | Green | 17.65 – 18.42 | 0.09 | 0.56 | 7.5 | |
| 6610-71-2190 | | White | 16.70 – 17.30 | 0.42 | 0.81 | 11.0 | |
| | | | | | | | |
| | | | | | | | |

## ADJUSTMENT SHIM

| Parts Name | Komatsu Parts No. | Cummins Parts No. | Thickness (mm) | Remarks |
|---|---|---|---|---|
| Throttle adjustment shim | 6610-71-1240 | 142179 | 0.76 | |
| | 6610-71-1250 | 70750 | 0.25 | |
| | 6610-71-1260 | 70750-A | 0.13 | |
| | 6610-71-1290 | 70750-B | 0.05 | |
| Governor spring shim | 6610-71-6350 | 70717 | 0.51 | |
| | 6610-71-6360 | 70717-A | 0.25 | |
| | 6610-71-6370 | 70717-B | 0.13 | |
| Torque spring shim | 6610-71-1460 | 101841 | 0.31 | |
| | 6610-71-1470 | 101842 | 0.25 | |
| | 6610-71-1480 | 101843 | 0.51 | |
| Weight assist shim | 6610-71-2160 | 144179 | 0.51 | 0.38 – 0.64 mm |
| MVS governor leak adjustment shim | 6610-71-3410 | 153379 | 0.51 | |
| | 6610-71-3420 | 153380 | 0.25 | |
| | 6610-71-3470 | 153381 | 0.19 | |
| | 6610-71-3430 | – | 0.13 | |
| MVS governor adjustment shim | 6610-71-6310 | 70811 | 0.51 | |
| | 6610-71-6320 | 70811-A | 0.25 | |
| | 6610-71-6330 | 70811-B | 0.13 | |

# INJECTOR SPECIFICATION

## DELIVERY VOLUME

| Injector Ass'y Parts No. | | Delivery volume | | Pressure (Psi) | No. of hole — Size x Angle | Seat orifice | Inside diameter of adjustment orifice |
|---|---|---|---|---|---|---|---|
| Komatsu Parts No. | Cummins Parts No. | cc/1000st | Code | | | | |
| 6710-11-3010 | AR-40098 | 177 – 178 | 178 | 120 | 8 – 0.008" x 18° | 0.020" | 0.028" – 0.029" |
| 6710-11-3011 | 3003940 | 177 – 178 800 st | – | 120 | 8 – 0.008" x 18° | 0.020" | 0.028" – 0.029" |
| 6712-11-3011 | 3003943 | 121 – 122 | – | 120 | 8 – 0.0065" x 17° | 0.020" | 0.018" – 0.019" |

## ADJUSTMENT ORIFICE

| Komatsu Parts No. | Cummins Parts No. | Inside diameter | |
|---|---|---|---|
| | | mm | Inch |
| CU177282 | 177282 | 0.36 | 0.014 |
| 6710-11-3410 | 177283 | 0.38 | 0.015 |
| 6710-11-3420 | 177284 | 0.41 | 0.016 |
| 6710-11-3430 | 177285 | 0.43 | 0.017 |
| 6710-11-3440 | 177286 | 0.46 | 0.018 |
| 6710-11-3450 | 177287 | 0.48 | 0.019 |
| 6710-11-3460 | 177288 | 0.51 | 0.020 |
| 6710-11-3470 | 177289 | 0.53 | 0.021 |
| 6710-11-3480 | 177290 | 0.56 | 0.022 |
| 6710-11-3490 | 177291 | 0.58 | 0.023 |
| 6710-11-3510 | 177292 | 0.61 | 0.024 |
| 6710-11-3520 | 177293 | 0.64 | 0.025 |
| 6710-11-3530 | 177294 | 0.66 | 0.026 |
| 6710-11-3540 | 177295 | 0.68 | 0.027 |
| 6710-11-3550 | 177296 | 0.71 | 0.028 |
| 6710-11-3560 | 177297 | 0.74 | 0.029 |
| 6710-11-3570 | 177298 | 0.76 | 0.030 |
| 6710-11-3580 | 177299 | 0.79 | 0.031 |
| 6710-11-3590 | 177332 | 0.81 | 0.032 |

| Komatsu Parts No. | Cummins Parts No. | Inside diameter | |
|---|---|---|---|
| | | mm | Inch |
| 6710-11-3610 | 179333 | 0.84 | 0.033 |
| 6710-11-3620 | 179334 | 0.86 | 0.034 |
| 6710-11-3630 | 179335 | 0.89 | 0.035 |
| 6710-11-3640 | 179336 | 0.91 | 0.036 |
| 6710-11-3650 | 179337 | 0.94 | 0.037 |
| 6710-11-3660 | 179338 | 0.97 | 0.038 |
| 6710-11-3670 | 179339 | 0.99 | 0.039 |
| 6710-11-3680 | 179340 | 1.02 | 0.040 |
| 6710-11-3690 | 179341 | 1.04 | 0.041 |
| 6710-11-3710 | 179342 | 1.07 | 0.042 |
| 6710-11-3720 | 179343 | 1.09 | 0.043 |
| 6710-11-3730 | 179344 | 1.12 | 0.044 |
| 6710-11-3740 | 179345 | 1.14 | 0.045 |
| 6710-11-3750 | 179346 | 1.17 | 0.046 |
| 6710-11-3760 | 179347 | 1.19 | 0.047 |
| 6710-11-3770 | 179348 | 1.22 | 0.048 |
| 6710-11-3780 | 179349 | 1.24 | 0.049 |
| 6710-11-3790 | 179350 | 1.27 | 0.050 |

# RUN-IN STANDARD

- Load are given for the case of the dynamometer arm length is 716 mm.
  This list shows the standard on condition that the fan is removed.

| Engine model | Machine model | Item | | Order | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 |
| N-855-C | PC300-1, 2<br>PC300LC-1, 2 | Running time | min. | 10 | 20 | 20 | 10 | | |
| | | Engine speed | rpm | 550 – 600 | 1,000 | 1,400 | 1,850 | | |
| | | Load | kg | 0 | 37 | 81 | 108 | | |
| | | Output | HP | 0 | 36 | 110 | 194 | | |
| NT-855-C | D80A,E-18<br>D80A,E,P-18 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 600 – 650 | 1,100 | 1,400 | 1,600 | 1,800 | |
| | | Load | kg | 0 | 33 | 66 | 98 | 131 | |
| | | Output | HP | 0 | 36 | 92.5 | 157 | 236 | |
| | D80F-18 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 600 – 650 | 1,200 | 1,550 | 1,750 | 1,950 | |
| | | Load | kg | 0 | 35 | 70 | 105 | 140 | |
| | | Output | HP | 0 | 41 | 105 | 178.5 | 265 | |
| | D95S-2 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 600 – 650 | 1,150 | 1,450 | 1,700 | 1,850 | |
| | | Load | kg | 0 | 35 | 70 | 104 | 142 | |
| | | Output | HP | 0 | 39 | 98.5 | 172 | 255 | |
| | PC400-1<br>PC400LC-1 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 600 – 650 | 1,100 | 1,400 | 1,600 | 1,800 | |
| | | Load | kg | 0 | 35 | 70 | 106 | 141 | |
| | | Output | HP | 0 | 38 | 95 | 165 | 246 | |
| | W170-2 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 670 – 730 | 1,300 | 1,750 | 2,000 | 2,200 | |
| | | Load | kg | 0 | 28 | 57 | 85 | 113 | |
| | | Output | HP | 0 | 35 | 97 | 165 | 242 | |
| | W180-1 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 670 – 730 | 1,400 | 1,800 | 2,100 | 2,300 | |
| | | Load | kg | 0 | 32 | 64 | 96 | 128 | |
| | | Output | HP | 0 | 44 | 112 | 196 | 285 | |

| Engine model | Machine model | Item | | Order | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 |
| NTA-855-C | HD320-2 HD320-3 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 610 – 650 | 1,400 | 1,800 | 2,100 | 2,300 | |
| | | Load | kg | 0 | 45 | 91 | 136 | 181 | |
| | | Output | HP | 0 | 63 | 164 | 285.5 | 416 | |
| | WS16S-2 WS23-1 | Running time | min. | 5 | 10 | 20 | 30 | 10 | |
| | | Engine speed | rpm | 610 – 650 | 1,400 | 1,600 | 1,900 | 2,100 | |
| | | Load | kg | 0 | 41 | 96 | 137 | 182 | |
| | | Output | HP | 0 | 55 | 148 | 252 | 371 | |

# PERFORMANCE TEST CRITERIA

| Engine model | Machine model | Test item | Specified value (fully equipped) | Engine speed (rpm) | Dynamometer load (kg) | Output (HP) |
|---|---|---|---|---|---|---|
| N-855-C | PC300-1,2 PC300LC-1,2 | Flywheel horsepower | 180HP/1,850rpm | 1,845 – 1,855 | 103.0 – 113.2 | 180.5 – 198.5 |
| | | Maximum torque | 85.5HP/1,300rpm | 1,200 – 1,400 | 118.9 – 126.1 | – |
| | | High idling speed | 1,985 – 2,085rpm | 1,985 – 2,085 | 0 | 0 |
| | | Low idling speed | 550 – 600rpm | 550 – 600 | 0 | 0 |
| NT-855-C | D80A,E-18 D85A,E,P-18 | Flywheel horsepower | 220HP/1,800rpm | 1,795 – 1,805 | 127.8 – 135.1 | 230.0 – 243.2 |
| | | Maximum torque | 105kgm/1,250rpm | 1,150 – 1,350 | 149.3 – 158.1 | – |
| | | High idling speed | 1,900 – 2,000rpm | 1,900 – 2,000 | 0 | 0 |
| | | Low idling speed | 600 – 650rpm | 600 – 650 | 0 | 0 |
| | D80F-18 | Flywheel horsepower | 260HP/1,950rpm | 1,945 – 1,955 | 139.9 – 148.1 | 264.5 – 280.1 |
| | | Maximum torque | 118kgm/1,400rpm | 1,300 – 1,500 | 168.2 – 173.0 | – |
| | | High idling speed | 2,100 – 2,200rpm | 2,100 – 2,200 | 0 | 0 |
| | | Low idling speed | 600 – 650rpm | 600 – 650 | 0 | 0 |
| | D95S-2 | Flywheel horsepower | 245HP/1,850rpm | 1,845 – 1,855 | 137.9 – 145.7 | 255.0 – 269.7 |
| | | Maximum torque | 112kgm/1,200rpm | 1,100 – 1,300 | 158.7 – 168.0 | – |
| | | High idling speed | 2,000 – 2,100rpm | 2,000 – 2,100 | 0 | 0 |
| | | Low idling speed | 600 – 650rpm | 600 – 650 | 0 | 0 |
| | PC400-1 PC400LC-1 | Flywheel horsepower | 233HP/1,800rpm | 1,795 – 1,805 | 137.1 – 145.1 | 239.6 – 253.6 |
| | | Maximum torque | 116kgm/1,200rpm | 1,100 – 1,300 | 160.6 – 170.4 | – |
| | | High idling speed | 1,950 – 2,050rpm | 1,950 – 2,050 | 0 | 0 |
| | | Low idling speed | 600 – 650rpm | 600 – 650 | 0 | 0 |
| | W170-2 | Flywheel horsepower | 235HP/2,200rpm | 2,195 – 2,205 | 113.5 – 120.1 | 242.3 – 256.3 |
| | | Maximum torque | 100kgm/1,400rpm | 1,300 – 1,500 | 142.8 – 151.1 | – |
| | | High idling speed | 2,350 – 2,450rpm | 2,350 – 2,450 | 0 | 0 |
| | | Low idling speed | 670 – 730rpm | 670 – 730 | 0 | 0 |
| | W180-1 | Flywheel horsepower | 280HP/2,300rpm | 2,295 – 2,305 | 128.0 – 135.4 | 285.6 – 302.3 |
| | | Maximum torque | 116kgm/1,600rpm | 1,500 – 1,700 | 160.9 – 170.6 | – |
| | | High idling speed | 2,430 – 2,530rpm | 2,430 – 2,530 | 0 | 0 |
| | | Low idling speed | 600 – 700rpm | 600 – 700 | 0 | 0 |

| Torque (kgm) | Fuel pressure (kg/cm²) | Coolant temperature (°C) | Lubricating oil temperature (°C) | Lubricating oil pressure (kg/cm²) | Exhaust temperature (°C) (t = Intake air temp. −20°C) |
|---|---|---|---|---|---|
| – | 8.5 – 9.5 | 70 – 90 | 80 – 100 | 3.5 – 5.5 | Max. 650 + 3t |
| 85.1 – 90.3 | – | 70 – 90 | 80 – 100 | – | Max. 680 + 3t |
| 0 | – | 70 – 90 | 80 – 100 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |
| – | 7.0 – 8.0 | 70 – 90 | 80 – 100 | 3.5 – 5.5 | Max. 650 + 3t |
| 106.9 – 113.2 | – | 70 – 90 | 80 – 100 | – | Max. 680 + 3t |
| 0 | – | 70 – 90 | 80 – 100 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |
| – | 9.7 – 10.7 | 70 – 90 | 80 – 100 | 3.5 – 5.5 | Max. 650 + 3t |
| 120.4 – 123.9 | – | 70 – 90 | 80 – 100 | – | Max. 680 + 3t |
| 0 | – | 70 – 90 | 80 – 100 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |
| – | 7.5 – 8.7 | 70 – 90 | 80 – 110 | 3.5 – 5.5 | Max. 650 + 3t |
| 113.6 – 120.3 | – | 70 – 90 | 80 – 110 | – | Max. 680 + 3t |
| 0 | – | 70 – 90 | 80 – 110 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |
| – | 7.5 – 9.0 | 70 – 90 | 80 – 110 | 3.5 – 5.5 | Max. 650 + 3t |
| 115 – 122 | – | 70 – 90 | 80 – 110 | – | Max. 680 + 3t |
| 0 | – | 70 – 90 | 80 – 110 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |
| – | 9.6 – 10.6 | 70 – 90 | 80 – 110 | 3.5 – 5.5 | Max. 650 + 3t |
| 102.2 – 108.2 | – | 70 – 90 | 80 – 110 | – | Max. 680 + 3t |
| 0 | – | 70 – 90 | 80 – 110 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |
| – | 11.4 – 12.4 | 70 – 90 | 80 – 110 | 3.5 – 5.5 | Max. 650 + 3t |
| 115.2 – 122.2 | – | 70 – 90 | 80 – 110 | – | Max. 650 + 3t |
| 0 | – | 70 – 90 | 80 – 110 | – | – |
| 0 | – | 70 – 90 | Min. 80 | Min. 1.0 | – |

| Engine model | Machine model | Test item | Specified value (fully equipped) | Engine speed (rpm) | Dynamometer load (kg) | Output (HP) |
|---|---|---|---|---|---|---|
| NTA-855-C | HD320-2 | Flywheel horsepower | 405HP/2,300rpm | 2,295 – 2,305 | 176.0 – 185.2 | 404.7 – 426.0 |
| | | Maximum torque | 142kgm/1,700rpm | 1,600 – 1,800 | 193.7 – 203.9 | – |
| | | High idling speed | 2,430 – 2,530 rpm | 2,430 – 2,530 | 0 | 0 |
| | | Low idling speed | 600 – 650rpm | 600 – 650 | 0 | 0 |
| | HD320-3 | Flywheel horsepower | 405HP/2,300rpm | 2,295 – 2,305 | 176.0 – 185.2 | 404.7 – 426.0 |
| | | Maximum torque | 142kgm/1,700rpm | 1,600 – 1,800 | 193.7 – 203.9 | – |
| | | High idling speed | 2,430 – 2,530rpm | 2,430 – 2,530 | 0 | 0 |
| | | Low idling speed | 675 – 725rpm | 675 – 725 | 0 | 0 |
| | WS16S-2 WS23-1 | Flywheel horsepower | 364HP/2,100rpm | 2,095 – 2,105 | 176.4 – 187.4 | 359.4 – 381.7 |
| | | Maximum torque | 140kgm/1,500rpm | 1,400 – 1,600 | 191.3 – 203.2 | – |
| | | High idling speed | 2,430 – 2,530rpm | 2,430 – 2,530 | 0 | 0 |
| | | Low idling speed | 610 – 650rpm | 610 – 650 | 0 | 0 |

| Torque (kgm) | Fuel pressure (kg/cm²) | Coolant temperature (°C) | Lubricating oil temperature (°C) | Lubricating oil pressure (kg/cm²) | Exhaust temperature (°C) (t = Intake air temp. −20°C) |
|---|---|---|---|---|---|
| – | 14.6 – 15.6 | 70 – 95 | 80 – 110 | 3.5 – 5.5 | Max. 700 + 3t |
| 138.7 – 14.6.0 | 0 | 70 – 95 | 80 – 110 | – | Max. 700 + 3t |
| 0 | 0 | 70 – 95 | 80 – 110 | – | – |
| 0 | 0 | 70 – 95 | Min. 80 | Min. 1.0 | – |
| – | 14.6 – 15.6 | 70 – 95 | 80 – 110 | 3.5 – 5.5 | Max. 700 + 3t |
| 138.7 – 146.0 | 0 | 70 – 95 | 80 – 110 | – | Max. 700 + 3t |
| 0 | 0 | 70 – 95 | 80 – 110 | – | – |
| 0 | 0 | 70 – 95 | Min. 80 | Min. 1.0 | – |
| – | 12.4 – 13.2 | 70 – 95 | 80 – 110 | 3.5 – 5.5 | Max. 650 + 3t |
| 137.1 – 145.5 | – | 70 – 95 | 80 – 110 | – | Max. 680 + 3t |
| 0 | – | 70 – 95 | 80 – 110 | – | – |
| 0 | – | 70 – 95 | Min. 80 | Min. 1.0 | – |

# TESTING AND ADJUSTING TOOL LIST

| No. | Testing and adjusting item | Fault finding tool list | Part No. | Remarks |
|---|---|---|---|---|
| 1 | Engine speed | Multi-tachometer | 799-203-8000 | Degital reading: 60 – 20,000 rpm |
| 2 | Battery S.G. | Battery coolant tester | 795-500-1000 | 1.100 – 1.300 |
| 3 | Freezing temperature of cooling water | | | –5 – –50°C |
| 4 | Water temperature, oil temperature, intake air temperature | Thermistor temperature gauge | 790-500-1300 | 0 – 200°C |
| 5 | Exhaust temperature | | | 0 – 1,000°C |
| 6 | Lubricating oil pressure | Engine pressure measuring kit | 799-203-2002 | 0 – 10 kg/cm² |
| 7 | Fuel pressure | | | 0 – 20 kg/cm² |
| 8 | Intake pressure, exhaust pressure | | | 0 – 1,500 mmHg |
| 9 | Blow-by pressure | | | 0 – 1,000 mm$H_2O$ |
| 10 | Intake resistance | | | –1,000 – 0 mm$H_2O$ |
| 11 | Compression pressure | Compression gauge | 795-502-1203 | 0 – 70 kg/cm² |
| 12 | Blow-by pressure | Blow-by checker | 799-201-1503 | 0 – 500 mm$H_2O$ |
| 13 | Valve clearance | Feeler gauge | 795-562-1200<br>795-562-1300 | 0.41, 0.74 mm<br>0.36, 0.69 mm |
| 14 | Exhaust gas color | Handy smoke checker | 799-201-9000 | Dirtiness 0 – 70% with standard color (Dirtiness % x 1/10 ≒ Bosch scale) |
| 15 | Water and fuel content in oil | Engine oil checker | 799-201-6000 | Provided with 0.1 and 0.2 water content standard samples. |
| 16 | PT pump fuel pressure | Fuel pressure gauge | 799-201-1300 | 0 – 25 kg/cm² |
| 17 | PT pump vacuum pressure | Vacuum gauge | 799-201-1200 | 0 – 70 kg/cm² |
| 18 | Injector timing | Timing fixture | 795-140-1604 | |
| 19 | Coolant quality | Water quality tester | 799-202-7001 | PH, nitrite ion concentration |
| 20 | Pressure valve performance Leakage in cooling system | Radiator cap tester | 799-202-9001 | 0 – 2 kg/cm² |
| 21 | Radiator blockage (wind speed) | Anemometer (Air speed gauge) | 799-202-2001 | 0 – 40 m/s |
| 22 | Engine cranking | Cranking kit | 795-610-1000 | |
| 23 | Electrical circuit | Tester | Commercially available | Current, Voltage, Resistance |

# TESTING AND ADJUSTING DATA

| Engine model | | | | | N-855-C | | NT-855-C | |
|---|---|---|---|---|---|---|---|---|
| Applicable machine model | | | | | PC300-1,2<br>PC300LC-1,2 | | D80A,E-18<br>D85A,E,P-18 | |
| Classification | Item | Condition, etc. | | Unit | Standard value | Permissible value | Standard value | Permissible value |
| Performance | Engine speed | High idling speed | | rpm | 1,985 – 2,085 | 1,985 – 2,085 | 1,900 – 2,000 | 1,900 – 2,000 |
| | | Low idling speed | | rpm | 550 – 600 | 550 – 600 | 600 – 650 | 600 – 650 |
| | Necessary starting speed | 0°C | | rpm | Min. 150 | – | Min. 150 | – |
| | | –20°C (with starting aid) | | rpm | Min. 100 | – | Min. 100 | – |
| Intake and exhaust system | Intake resistance | At rated output | | mmH₂O | Max. 330 | 550 | Max. 330 | 550 |
| | Intake pressure | At rated output | | mmHg | – | – | – | – |
| | Exhaust pressure | At rated output | | mmHg | – | – | – | – |
| | Exhaust temperature | All speed<br>(Intake air temp.: 20°C) | | °C | Max. 680 | Max. 680 | Max. 680 | Max. 680 |
| | Exhaust gas color | Quick acceleration | | Bosch index | Max. 6.0 | 7.0 | Max. 6.5 | 7.5 |
| | | At high idling | | | Max. 2.5 | 3.5 | Max. 2.5 | 3.5 |
| | Valve clearance | Cold | Intake valve | mm | 0.36 | – | 0.36 | – |
| | | | Exhaust valve | mm | 0.69 | – | 0.69 | – |
| | | Warm | Intake valve | mm | 0.36 | – | 0.36 | – |
| | | | Exhaust valve | mm | 0.69 | – | 0.69 | – |
| Engine body | Compression pressure | Oil temperature: 40 – 60°C | | kg/cm² | Min. 32 | 23 | Min. 29 | 20 |
| | | (Engine speed) | | (rpm) | (230 – 260) | (230 – 260) | (170 – 180) | (170 – 180) |
| | Blow-by pressure | At high idling<br>Oil temperature: Min. 60°C | | mmH₂O | Max. 100 | 200 | Max. 100 | 200 |
| Lubrication system | Oil pressure (SAE30, oil temperature: Min. 80°C) | At high idling | | kg/cm² | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 |
| | | At low idling | | kg/cm² | Min. 1.0 | 0.7 | Min. 1.0 | Min. 1.0 |
| | Oil temperature | All speed (oil in oil pan) | | °C | 80 – 100 | 120 | 80 – 100 | 120 |
| | Oil consumption ratio | At continuous rated output<br>(Ratio to fuel consumption) | | % | Max. 1.0 | 1.5 | Max. 1.0 | 1.5 |
| Fuel system | PT pump fuel pressure | At rated output | | kg/cm² | 8.5 – 9.5 | – | 7.0 – 8.0 | – |
| | | Quick acceleration | | kg/cm² | | – | | – |
| Cooling system | Coolant temperature | All speed<br>(At engine outlet) | | °C | 70 – 90 | 100 | 70 – 90 | 100 |
| | Thermostat function | Valve opening temperature | | °C | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 |
| | | Full opening temperature | | °C | 90 | – | 90 | – |
| | | Full opening lift | | mm | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 |
| | Radiator pressure valve | Opening pressure<br>(Differential pressure) | | kg/cm² | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 |
| | Fan speed | At engine rated speed | | rpm | 1,310 – 1,370 | 1,270 | 950 – 990 | 920 |
| | Fan belt tension | Deflects when pushed with a force of 6 kg | | mm | See page 12-040 | | | |

NT-855-C

| D80F-18 | | D95S-2 | | PC400-1<br>PC400LC-1 | | W170-2 | |
|---|---|---|---|---|---|---|---|
| Standard value | Permissible value | Standard value | Permissible value | Standard value | Permissible value | Standard value | Permissible value |
| 2,100 – 2,200 | 2,100 – 2,200 | 2,000 – 2,100 | 2,000 – 2,100 | 1,950 – 2,050 | 1,950 – 2,050 | 2,350 – 2,450 | 2,350 – 2,450 |
| 600 – 650 | 600 – 650 | 600 – 650 | 600 – 650 | 600 – 650 | 600 – 650 | 670 – 730 | 670 – 730 |
| Min. 150 | – | Min. 150 | – | Min. 150 | – | Min. 150 | – |
| Min. 100 | – | Min. 100 | – | Min. 100 | – | Min. 100 | – |
| Max. 330 | 550 | Max. 330 | 550 | Max. 330 | 550 | Max. 330 | 550 |
| – | – | – | – | – | – | – | – |
| – | – | – | – | – | – | – | – |
| Max. 680 | Max. 680 | Max. 680 | Max. 680 | Max. 680 | Max. 680 | Max. 680 | Max. 680 |
| Max. 4.5 | | Max. 6.5 | 7.5 | Max. 6.5 | 7.5 | Max. 6.5 | 7.5 |
| Max. 2.5 | | Max. 2.5 | 3.5 | Max. 2.5 | 3.5 | Max. 2.5 | 3.5 |
| 0.36 | – | 0.36 | – | 0.36 | – | 0.36 | – |
| 0.69 | – | 0.69 | – | 0.69 | – | 0.69 | – |
| 0.36 | – | 0.36 | – | 0.36 | – | 0.36 | – |
| 0.69 | – | 0.69 | – | 0.69 | – | 0.69 | – |
| Min. 29 | 24 | Min. 29 | 20 | Min. 29 | 20 | Min. 29 | 20 |
| (170 – 180) | (170 – 180) | (170 – 180) | (170 – 180) | (170 – 180) | (170 – 180) | (170 – 180) | (170 – 180) |
| Max. 100 | 200 | Max. 100 | 200 | Max. 100 | 200 | Max. 100 | 200 |
| 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 |
| Min. 1.0 | Min. 1.0 | Min. 1.0 | 0.7 | Min. 1.0 | 0.7 | Min. 1.0 | 0.7 |
| 80 – 100 | 120 | 80 – 110 | 120 | 80 – 110 | 120 | 80 – 110 | 120 |
| Max. 1.0 | 1.5 | Max. 1.0 | 1.5 | Max. 1.0 | 1.5 | Max. 1.0 | 1.5 |
| 7.0 – 8.0 | – | 7.5 – 8.7 | – | 7.5 – 9.0 | – | 9.6 – 10.6 | – |
| | – | | – | | – | | – |
| 70 – 90 | 100 | 70 – 90 | 100 | 70 – 90 | 100 | 70 – 90 | 100 |
| 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 |
| 90 | – | 90 | – | 90 | – | 90 | – |
| 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 |
| 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 |
| | | 1.075 – 1.125 | 1.045 | 1,300 – 1,360 | 1,260 | 1,535 – 1,615 | 1,495 |

See page 12-040

| Engine model | | | | | NT-855-C | | NTA-855-C | |
|---|---|---|---|---|---|---|---|---|
| Applicable machine model | | | | | W180-1 | | HD320-2 (Engine No. 26102754 – 26155791) | |
| Classification | Item | Condition, etc. | | Unit | Standard value | Permissible value | Standard value | Permissible value |
| Performance | Engine speed | High idling speed | | rpm | 2,430 – 2,530 | 2,430 – 2,530 | 2,430 – 2,530 | 2,430 – 2,530 |
| | | Low idling speed | | rpm | 600 – 700 | 600 – 700 | 600 – 650 | 600 – 650 |
| | Necessary starting speed | 0°C | | rpm | Min. 150 | – | Min. 160 | – |
| | | –20°C (with starting aid) | | rpm | Min. 100 | – | Min. 100 | – |
| Intake and exhaust system | Intake resistance | At rated output | | mmH2O | Max. 330 | 550 | Max. 330 | 550 |
| | Intake pressure | At rated output | | mmHg | – | – | 1,000 – 1,100 | – |
| | Exhaust pressure | At rated output | | mmHg | – | – | Max. 75 | – |
| | Exhaust temperature | All speed (Intake air temp.: 20°C) | | °C | Max. 680 | Max. 680 | Max. 700 | Max. 700 |
| | Exhaust gas color | Quick acceleration | | Bosch index | Max. 6.5 | 7.5 | Max. 7.0 | 8.0 |
| | | At high idling | | | Max. 2.5 | 3.5 | Max. 2.5 | 3.5 |
| | Valve clearance | Cold | Intake valve | mm | 0.36 | – | 0.41 | – |
| | | | Exhaust valve | mm | 0.69 | – | 0.74 | – |
| | | Warm | Intake valve | mm | 0.36 | – | 0.36 | – |
| | | | Exhaust valve | mm | 0.69 | – | 0.69 | – |
| Engine body | Compression pressure | Oil temperature: 40 – 60°C | | kg/cm² | Min. 29 | 20 | Min. 26 | 18 |
| | | (Engine speed) | | (rpm) | (170 – 180) | (170 – 180) | (230 – 260) | (230 – 260) |
| | Blow-by pressure | At high idling Oil temperature: Min. 60°C | | mmH2O | Max. 100 | 200 | Max. 150 | 300 |
| Lubrication system | Oil pressure (SAE30, oil temperature: Min. 80°C) | At high idling | | kg/cm² | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 |
| | | At low idling | | kg/cm² | Min. 1.0 | 0.7 | Min. 1.0 | 0.7 |
| | Oil temperature | All speed (oil in oil pan) | | °C | 80 – 110 | 120 | 80 – 110 | 120 |
| | Oil consumption ratio | At continuous rated output (Ratio to fuel consumption) | | % | Max. 1.0 | 1.5 | Max. 1.0 | 1.5 |
| Fuel system | PT pump fuel pressure | At rated output | | kg/cm² | 11.4 – 12.4 | – | 14.6 – 15.6 | – |
| | | Quick acceleration | | kg/cm² | | – | 70 – 95 | – |
| Cooling system | Coolant temperature | All speed (At engine outlet) | | °C | 70 – 90 | 100 | 70 – 95 | 100 |
| | Thermostat function | Valve opening temperature | | °C | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 |
| | | Full opening temperature | | °C | 90 | – | 90 | – |
| | | Full opening lift | | mm | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 |
| | Radiator pressure valve | Opening pressure (Differential pressure) | | kg/cm² | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 |
| | Fan speed | At engine rated speed | | rpm | 1,285 – 1,345 | 1,250 | 1,170 – 1,230 | 1,140 |
| | Fan belt tension | Deflects when pushed with a force of 6 kg | | mm | See page 12-040 | | | |

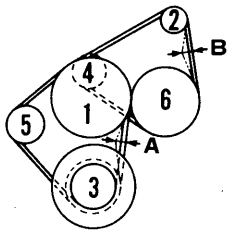
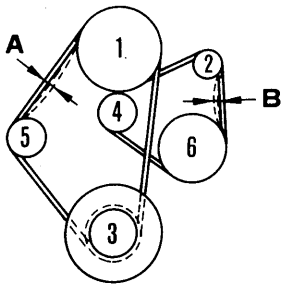
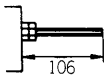
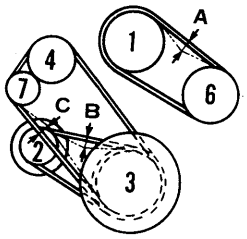
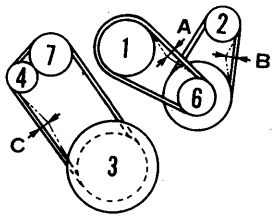
| NTA-855-C | | | | | | | |
|---|---|---|---|---|---|---|---|
| HD320-2 (Engine No. 26155791 and up) | | HD320-3 | | WS16S-2 WS23-1 | | | |
| Standard value | Permissible value | Standard value | Permissible value | Standard value | Permissible value | Standard value | Permissible value |
| 2,430 – 2,530 | 2,430 – 2,530 | 2,430 – 2,530 | 2,430 – 2,530 | 2,430 – 2,530 | 2,430 – 2,530 | | |
| 600 – 650 | 600 – 650 | 675 – 725 | 675 – 725 | 610 – 650 | 610 – 650 | | |
| Min. 160 | – | Min. 160 | – | Min. 160 | – | | |
| Min. 100 | – | Min. 100 | – | Min. 100 | – | | |
| Max. 330 | 550 | Max. 330 | 550 | Max. 330 | 550 | | |
| 1,000 – 1,100 | – | 1,000 – 1,100 | – | – | – | | |
| Max. 75 | – | Max. 75 | – | Max. 75 | – | | |
| Max. 700 | Max. 700 | Max. 700 | Max. 700 | Max. 680 | Max. 680 | | |
| Max. 7.0 | 8.0 | Max. 7.0 | 8.0 | Max. 7.0 | 8.0 | | |
| Max. 2.5 | 3.5 | Max. 2.5 | 3.5 | Max. 2.5 | 3.5 | | |
| 0.36 | – | 0.36 | – | 0.36 | – | | |
| 0.69 | – | 0.69 | – | 0.69 | – | | |
| 0.36 | – | 0.36 | – | 0.36 | – | | |
| 0.69 | – | 0.69 | – | 0.69 | – | | |
| Min. 26 | 18 | Min. 26 | 18 | Min. 26 | 18 | | |
| (230 – 260) | (230 – 260) | (230 – 260) | (230 – 260) | (230 – 260) | (230 – 260) | | |
| Max. 150 | 300 | Max. 150 | 300 | Max. 150 | 300 | | |
| 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | 3.5 – 5.5 | | |
| Min. 1.0 | 0.7 | Min. 1.0 | 0.7 | Min. 1.0 | 0.7 | | |
| 80 – 110 | 120 | 80 – 110 | 120 | 80 – 110 | 120 | | |
| Max. 1.0 | 1.5 | Max. 1.0 | 1.5 | Max. 1.0 | 1.5 | | |
| 14.6 – 15.6 | – | 14.6 – 15.6 | – | 14.6 – 15.6 | – | | |
| | – | | – | | – | | |
| 70 – 95 | 100 | 70 – 95 | 100 | 70 – 95 | 100 | | |
| 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | 74.5 – 78.5 | | |
| 90 | – | 90 | – | 90 | – | | |
| 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | 10 ± 0.5 | | |
| 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | 0.75 ± 0.1 | | |
| 1,170 – 1,230 | 1,140 | 1,450 – 1,520 | 1,410 | 1,170 – 2,030 | 1,140 | | |

See page 12-040

## V-BELT TENSION

- Deflects when pushed at center of v-belt with a force of 6 kg.

( ): Range

| V-belt setting condition | Engine model | Applicable machine model | Belt tension (mm) | | |
|---|---|---|---|---|---|
| | | | A | B | C |
|  6710F119 | N-855-C | PC300-1, 2<br>PC300LC-1, 2 | 7<br>(5 – 9) | 10<br>(8 – 12) | |
| | NT-855-C | PC400-1, PC400LC-1<br>W170-2, W180-1 | | | |
| | NTA-855-C | WS16S-2<br>WS23-1 | | | |
|  6710F120A | NT-855-C | D80A, E, F-18<br>D80A, E, P-18<br>D95S-2 | Auto-tension adjustment value: 106<br>  | 10<br>(8 – 12) | |
|  6710F121 | NTA-855-C | HD320-2 | 10<br>(8 – 12) | 10<br>(8 – 12) | 12<br>(10 – 14) |
|  6710F122 | NTA-855-C | HD320-3 | 10<br>(8 – 12) | 10<br>(8 – 12) | 12<br>(10 – 14) |

1. Fan pulley
2. Alternator pulley
3. Crankshaft pulley
4. Water pump pulley
5. Tension pulley
6. Accessory drive pulley
7. Idle pulley

# TROUBLESHOOTING

## METHOD OF READING TROUBLESHOOTING TABLE

### DESCRIPTION OF SYMBOLS USED IN TROUBLESHOOTING TABLE

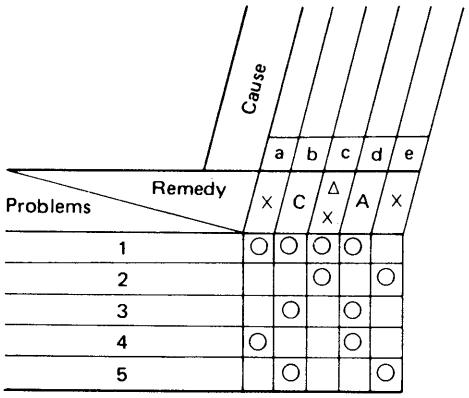
The following symbols are used in the "Remedy" column to indicate the method of eliminating the cause of a fault.

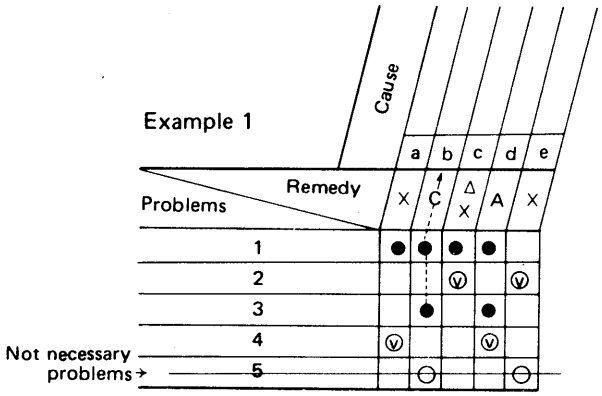
X: Replace; Δ: Repair;
A: Adjusting; C: Clean

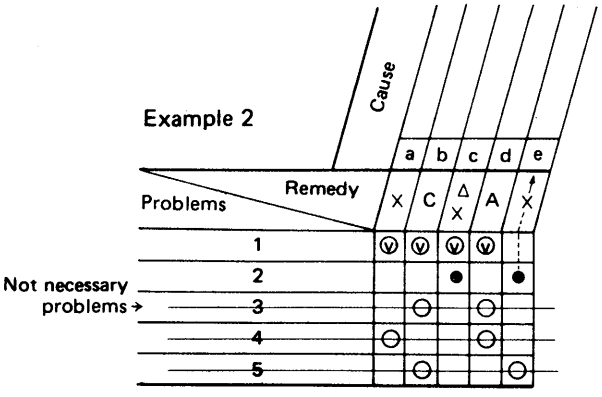
### METHOD OF READING TROUBLESHOOTING TABLE

- The symbol ○ in the table is inserted only for causes which can be diagnosed. If a cause cannot be diagnosed, the corresponding box is left blank.

- If the result of problems 1 using the troubleshooting table shown at right is abnormal, the cause of the trouble can be assumed to lie between a and d. Because it is not possible to make a problems regarding e, it is necessary to perform the next problems (owing to the possibility of a multiple fault).
  If the result of problems 1 is normal, the cause of the fault does not lie between a and d. In such a case, before diagnosing the cause as e, however, carry out a check by means of problems 2 or 5.
- If now the result of problems 1 is abnormal and the result of problems 2 normal, the cause is one of a, b or d. In addition, if the result of problems 3 is abnormal, the cause will be narrowed down to one of b or d. To determine which of b or d is the actual cause, perform problems 4.
- If the result of problems is abnormal, blacken out the corresponding ○ in the table and then perform the next problems on these causes in order to narrow the likely causes.




Example 1:

Problems 1 → Abnormal
Problems 2 → Normal
Problems 3 → Abnormal
Problems 4 → Normal

} From the table of example 1, the cause of the fault is b.

Example 2:

Problems 1 → Normal
Problems 2 → Abnormal

} From the table of example 2, the cause of the fault is e.

★ In example 2, it is evident that the cause is e without carrying out problems 2, however problems 2 is performed by way of an additional check.

Example 3:

Problems 1 → Abnormal
Problems 2 → Normal
Problems 3 → Normal
} From the table of example 3, the cause is one of a, c and e.

Continue problems

Problems 4 → Normal
Problems 5 → Normal
} From the table of example 3-1, the cause is c.

Example 3

| Problems \ Remedy | X | C | Δ X | A | X |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| 1 | ● | ● | ● | ● | |
| 2 | | | ● | | ● |
| 3 | | Ⓥ | | Ⓥ | |
| 4 | ○ | | | ○ | |
| 5 | | ○ | | | ○ |

Example 3-1

| Problems \ Remedy | X | C | Δ X | A | X |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| 1 | ● | ● | ● | ● | |
| 2 | | | ● | | ● |
| 3 | | Ⓥ | | Ⓥ | |
| 4 | Ⓥ | | | Ⓥ | |
| 5 | | Ⓥ | | | Ⓥ |

Example 4:

Problems 1 → Abnormal
Problems 2 → Normal
} From the table of example 4, the cause is one of a, b or d.

Continue problems

Problems 3 → Abnormal
Problems 4 → Abnormal
Problems 5 → Normal
} From the table of example 4-1, the cause is a or d.

Example 4

| Problems \ Remedy | X | C | Δ X | A | X |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| 1 | ● | ● | ● | ● | |
| 2 | | | Ⓥ | | Ⓥ |
| 3 | | ○ | | ○ | |
| 4 | ○ | | | ○ | |
| 5 | | ○ | | | ○ |

Example 4-1

| Problems \ Remedy | X | C | Δ X | A | X |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| 1 | ● | ● | ● | ● | |
| 2 | | | Ⓥ | | Ⓥ |
| 3 | | ● | | ● | |
| 4 | ● | | | ● | |
| 5 | | Ⓥ | | | Ⓥ |

As can be seen from the above examples, it is not necessary to perform all of the problems.
Also, looking at a particular cause, no matter how many • marks there are in the column corresponding to that cause, it will cease to be an actual cause if there is even one Ⓥ mark in the same column.

# TROUBLESHOOTING TABLE

## 1. Starting defective or badness.

### 1) Engine does not turn.

**Questions to ask operator before starting troubleshooting**

1. Did machine stop suddenly during operation? → Damage or seizure of internal parts.
2. Did machine make abnormal noise during operation? → Damaged parts.

★ **Cause h:** battery charging rate

| Temperature \ Charging rate | 100% | 90% | 80% | 75% | 70% |
|---|---|---|---|---|---|
| 20°C | 1.28 | 1.26 | 1.24 | 1.23 | 1.22 |
| 0°C | 1.29 | 1.27 | 1.25 | 1.24 | 1.23 |
| −10°C | 1.30 | 1.28 | 1.26 | 1.25 | 1.24 |

- Specific gravity should be at least figure for 70% charging rate.
- In cold weather, specific gravity must be at least figure for 75% charging rate.

| No. | Problems \ Remedy / Cause | a Stopping piston from moving by foreign matter in cylinder. | b Damage to connecting rod or crankshaft | c Bushing and bearing biting into each other | d Intake and exhaust vales are blocked in cylinder | e Damage to pump or supply system | f Failure in power train | g Seizure of moving parts | h Battery insufficiently charged → See No. 20 | i Damage to pinion or ring gear | j Pinion movement force insufficient, wrong meshing position | k Battery terminal connection defective, wiring defective | l Electrical system defective → see No. 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | X | X | X | X | X | X | X | X | X<br>△ | △<br>X | — | |
| 1 | When setting the starting switch to START; 1) No sound of pinion moving out. | | | | | | | | | | | ○ | |
| | 2) Pinion grates. | | | | | | | | | ○ | | | |
| | 3) Pinion engages but does not turn. | ○ | ○ | ○ | ○ | ○ | ○ | | | | | | |
| 2 | When checking battery, electrolyte level or specific gravity is low. | | | | | | | ○ | | | | | |
| 3 | When cranking engine with barring tool; 1) Does not move. | | | | | | ○ | | | | | | |
| | 2) Moves backlash only. | | | | ○ | | | | | | | | |
| | 3) Can be turned in reverse direction. | ○ | ○ | ○ | | | | | | | | | |
| 4 | Remove head cover. When checking valve cotter, it is out of place. | | | ○ | | | | | | | | | |
| 5 | Remove oil pan. When checking internal parts, they are abnormal. | | ○ | | | | | | | | | | |
| 6 | Remove cylinder head. When checking internal parts, foreign matter appears. | ○ | | | | | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

**2) Engine turns but no exhaust gas is emitted.**

**Check before troubleshooting**

1. Is there any fuel in fuel tank?
2. Is fuel feed valve open?
3. Is fuel piping leaking or damaged between fuel tank and inside of float tank?
4. Is fuel piping leaking or damaged between float tank and PT pump?
5. Is fuel piping leaking or damaged between PT pump and injector?
6. Is there any water, rust or sludge mixed with fuel drained from fuel tank or fuel filter?
   (PT pump or injector are frequent cause of failure.)
7. Did fuel be added in tank after replacing fuel filter.
8. Is compression release lever placed in "RELEASE" position.

| No. | Problems / Remedy | Cause a: Float valve in float tank function defective | b: PT pump or PT pump drive shaft damaged | c: PT pump filter screen assembling defective | d: Air leaking into system between fuel filter and PT pump | e: Air leaking into system from fuel filter gasket | f: Fuel piping air leaking into system between float tank and fuel filter | g: Shut-off valve function or wiring defective | h: Compression release device defective |
|---|---|---|---|---|---|---|---|---|---|
| | | ΔX | X | Δ | ΔX | XΔ | ΔX | XΔ | ΔX |
| 1 | No reaction even if compression release lever is operated. | | | | | | | | ○ |
| 2 | Engine starts when screwing in the knob of shut-off valve. | | | | | | | ○ | |
| 3 | No fuel comes out even if fuel is drained from fuel filter. | ○ | ○ | | ○ | | | | |
| 4 | No fuel comes out even if PT pump fuel pressure take-off plug is loosened. | ○ | ○ | ○ | | | | | |
| 5 | Remove the PT pump. No reaction even if drive shaft is turned. | | ○ | | | | | | |
| 6 | No fuel comes out even if float tank outlet hose is loosened. | ○ | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

### 3) Exhaust gas is emitted but engine does not start.

**Check before troubleshooting**

1. Is dust indicator red? → cleaner element clogged.
2. Is SAE30 oil being used at temperatures below 0°C? (Oil viscosity is too high) → at temperatures below 0°C, use SAE10W oil.
3. Is ASTM D975 No. 2 diesel fuel being used at temperatures below – 10°C? (Clogging caused by precipitated parafin) → use ASTM D975 No. 1 at temperatures below – 10°C.
4. Is fuel control lever bent? Is there any play? Is the pin out of place?
5. Is fuel tube damaged or leaking between PT pump and injector.

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

| No. | Problems / Remedy | Cause a: Foreign matter causing block between cleaner | b: Injector timing defective (rarely sole cause of failure) | c: Valve clearance defective (rarely sole cause of failure) | d: Piston, ring or liner worn | e: Injector clogged | f: Injector seized and cup cracked | g: Air cleaner elements clogged | h: Compression release lever device defective | i: Battery charge too low | j: Heater nozzle clogged | k: Fuel piping of priming pump tangled or clogged | l: Heater plug wiring broken or wiring defective | m: Electrical intake air heater wiring broken or wiring defective |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | A | A | X | CX | X | CX | ΔX | A | CX | CX | XΔ | XΔ |
| 1 | Heater mount does not become warm. (Cold weather operation.) (Engine with electrical intake air heater.) | | | | | | | | | | | | | ○ |
| 2 | Glow plug lamp does not light even if turn starting switch to HEATER. (Cold weather operation) | | | | | | | | | | | | ○ | |
| 3 | Fuel pressure does not raise when operating the priming pump. Or the reaction does not be felt when operating it (Cold weather operation). | | | | | | | | | | | ○ | | |
| 4 | When starting switch turns to "HEAT", heater mount is warm but engine does not start. | | | | | | | | | ○ | | | | |
| 5 | Rotating speed of starting motor is too slow to start engine. | | | | | | | | ○ | | | | | |
| 6 | When checking battery, electrolyte level or specific gravity is too low. | | | | | | | | ○ | | | | | |
| 7 | No reaction even if compression release lever is operated. | | | | | | | ○ | | | | | | |
| 8 | Engine starts if air cleaner element is removed. | | | | | | ○ | | | | | | | |
| 9 | Remove the injector. When checking, injection spray condition, no injection. | | | | | ○ | | | | | | | | |
| 10 | Compression pressure is too low; blow-by is high. | | | ○ | | | | | | | | | | |
| 11 | Valve clearance is not proper valve. | | | ○ | | | | | | | | | | |
| 12 | Remove the cylinder head cover. Injector timing is not proper position. | | ○ | | | | | | | | | | | |
| 13 | Air cleaner does not aspirate air. (After maintenance) | ○ | | | | | | | | | | | | |

## 2. Engine stopped during operation.

**Questions to ask operator before starting problems.**

1. Did engine stop slowly? → fuel supply cut.
2. Did engine stop suddenly? → internal parts damaged or seized.
3. Did engine make abnormal noise? → parts damaged.

**Check before troubleshooting**

1. Is there any fuel in fuel tank?
2. Is fuel control lever bent? Is there any play? Is the pin out of place?
3. Is fuel piping leaking or damaged between fuel tank and injector?
4. Is beed hole of fuel tank cap clogged?

| No. | Problems / Cause / Remedy | a Float valve function defective | b PT pump or PT pump drive shaft damaged | c Wiring of shut-off valve wiring broken or function defective | d Air leaking into system between fuel filter and PT pump | e Air leaking into system from fuel filter gasket | f Fuel piping air leaking into system between float tank and fuel | g Part of intake or exhaust valve blocking cylinder | h Pump or other auxiliary mechanism seized | i Piston or bearing seized | j Failure of machine power train |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Remedy | ΔX | X | ΔX | ΔX | XΔ | ΔX | XΔ | X | X | XΔ |
| 1 | Starting motor cranks engine, but engine stops if gear shift lever is moved to any speed position. | | | | | | | | | | ○ |
| 2 | Starting motor does not crank engine. 1) Engine does not turn when cranking engine with barring tool. | | | | | | | | | ○ | |
| | 2) Engine turns backlash distance only. | | | | | | | ○ | | | |
| | 3) Engine can be turned in reverse direction. | | | | | | ○ | | | | |
| 3 | No fuel comes out even if fuel is drained from fuel filter. | | | | | ○ | | | | | |
| 4 | Engine starts when screwing in the knob of shut-off valve. | | | ○ | | | | | | | |
| 5 | Remove the PT pump. No reaction even if drive shaft is turned. | | ○ | | | | | | | | |
| 6 | No fuel comes out even if float tank outlet hose is loosened. | ○ | | | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 3. Engine runs abnormally.

### 1) Engine speed is too high.

| | Cause | Remedy |
|---|---|---|
| a | PTG governor or MVS governor plunger seized or rusted or adjustment defective. | ΔXA |

### 2) Engine speed does not increase.

| | Cause | Remedy |
|---|---|---|
| a | Fuel return piping damaged or clogged between injector and float tank. | ΔCX |
| b | PTG governor or MVS governor plunger seized or rusted or adjustment defective. | ΔXΔ |

### 3) Engine deceleration time (over 15sec.) and stop time (over 10 sec.) are long.

| | Cause | Remedy |
|---|---|---|
| a | Fuel return piping damaged or clogged between injector and float tank. | ΔCX |
| b | Movement of PTG governor and MVS governor plunger defective. | ΔXA |

### 4) Engine does not stop.

| | Cause | Remedy |
|---|---|---|
| a | Shut-off valve remained opening (Shut-off valve being caught the other thing and rusted) | ΔX |

### 5) Hunting.

★ Hunting may be happened for several time when air in circuit bleeds, after maintaing fuel system and replacing fuel filter element.

| | Cause | Remedy |
|---|---|---|
| a | Fuel piping air leaking into system between float tank and fuel filter. | ΔX |
| b | Air leaking into system from fuel filter gasket. | XΔ |
| c | Fuel piping air leaking into system between fuel filter and PT pump. | ΔX |
| d | Movement of PTG governor and MVS governor plunger defective. | ΔXA |

★ In case of improper engine-running causes the trouble of PT pump (PTG governor or MVS governor plunger seized or rusted or adjustment defective), the mixed water and dirt and used non-specified fuel are considered.
Check for the fuel drain tank or fuel filter.

★ Inspection, adjustment and repair of PT pump inside perform only the shop prepared test stand.

★ Engine damages if PT pump pressure sets the higher than standard pressure and the pump for other modal is equipped in order to cover the lack of engine power.

## 4. Fuel consumption is more.

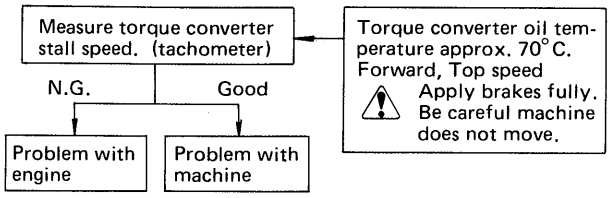
Ask the operator that you fell why fuel consumption is more.

| Symbol | Cause | Remedy |
|---|---|---|
| a | Fuel leakage from fuel tank, fuel filter, PT pump and piping. | ΔX |
| b | Fuel leakage from inlet and outlet of injector, fuel passage in head cover and seal of pump. | Follow problems "9. Oil level raises". |
| c | Over-injection, worse fuel consumption. | Follow Problems "6. Exhaust gas is black". |

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

## 5. Lack of power.

★ If lack of power is accompanied by black exhaust gas, follow problems "6. Exhaust gas is black".
★ First troubleshoot whether the cause is in the engine or in the chassis as follows.




- Judge mainly checking for track tension, brake function, acceleration and engine high idling speed when mounting DIRECT transmission.

**Check before troubleshooting**

1. Is fuel piping damaged between fuel tank and float tank?
2. Is fuel piping damaged or leaking (air leaking into system) between float tank and PT pump?
3. Is fuel tube damaged or leaking between PT pump and injector?
4. Is fuel control lever linkage bent? Is there any play?
5. Is beed hole of fuel tank cap clogged?
6. Is there any water, rust or sludge mixed with fuel drained from fuel tank?
   (PT pump or injector are frequent causes of failure.)
   (Check strainer clogged when no fuel comes out.)
7. Is incorrect fuel being used?

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

| No. | Problems / Remedy | a Injector plunger seized or clogged | b PT pump out of adjustment or parts worn | c Air leaking into system between fuel filter and PT pump | d Air leaking into system from fuel filter gasket | e Air leaking into system between float tank and fuel filter | f Fuel piping clogged between fuel tank and PT pump | g Float valve function defective. | h Fuel leaking from injector inlet | i Fuel leaking from fuel piping inside cylinder head cover |
|---|---|---|---|---|---|---|---|---|---|---|
| | | XC | AX | ΔX | XΔ | ΔX | C | ΔX | ΔX | ΔX |
| 1 | Oil level rises. (Fuel mixed with engine oil) | | | | | | | | ○ | |
| 2 | Fuel pressure is lack. | | ○ | | ○ | | ○ | | | |
| 3 | Excessive of vacuum pressure. | | | | | | ○ | | | |
| 4 | Lack of vacuum pressure (pressure is not stationary). | | | | ○ | | | | | |
| 5 | Lack of vacuum pressure (pressure is stationary). | | ○ | | | | | | | |
| 6 | Check the injector. | ○ | | | | | | | | |

## 6. Exhaust gas is black.

**Check before troubleshooting**

1. Is dust indicator red? → Air cleaner element clogged.
2. Is PT pump seal out of position? → Pump out of adjustment (excessive injection).
3. Is fuel return piping damaged of injector?
4. Is air leaking between turbocharger and cylinder head?
5. Is standard spec. machine operating at high altitude?

| No. | Problems / Remedy | A | ΔX | Δ CX | A | ΔX | X | XC | X | CX |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cause | a | b | c | d | e | f | g | h | i |
| | | Injection timing defective | Turbocharger seized | Muffler, exhaust pipe damaged or clogged | Valve clearance defective | Defective contact between valve and valve seat | Piston, ring or liner worn | Injector cup cracked. Injector clogged. | PT pump out of adjustment | Air cleaner element clogged |
| 1 | Exhaust gas color improves when air cleaner element is removed. | | | | | | | | | ○ |
| 2 | Fuel pressure is too large. | | | | | | | | ○ | |
| 3 | Remove the injector and injection spray conditions are defective when checking it. | | | | | | | ○ | | |
| 4 | Blow-by is excessive. | | | | | | ○ | | | |
| 5 | Compression pressure is lack. | | | | | ○ | ○ | | | |
| 6 | Valve clearance is too large or too small. | | | | ○ | | | | | |
| 7 | Exhaust gas color improves when muffler is removed. | | | ○ | | | | | | |
| 8 | Turbocharger is sluggish when turned by hands. | | ○ | | | | | | | |
| 9 | Injection timing is not matched. | ○ | | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 7. Exhaust gas is blue. (Combustion of engine oil)

**Check before troubleshooting**

1. Has engine continued to run for over 20 mins at low idling? → Oil coming up into cylinder, oil leak from seal at turbocharger turbine side.
2. Has engine continued to run for over 20 mins at high idling? → Oil coming up or down into cylinder, oil leak from seal at turbocharger blower side.
3. Is turbocharger oil return pipe damaged? → oil leak from turbocharger seal.

| No. | Problems / Remedy | X | C | X | X | X |
|---|---|---|---|---|---|---|
| | Cause | a | b | c | d | e |
| | | Intake valve, valve guide worn | Breather element clogged | Piston, ring or liner worn | Seal worn at turbocharger turbine side | Seal worn at turbocharger blower side |
| | | (oil coming down into cylinder) | | (oil coming up into cylinder) | | |
| 1 | Inside of turbocharger intake pipe is coated with oil. | | | | | ○ |
| 2 | Turbocharger shaft play is excessive. | | | | ○ | ○ |
| 3 | Compression pressure is lack. | | | ○ | | |
| 4 | Blow-by is excessive. | | | ○ | | |
| 5 | When checking breather element, it is clogged with oil. | | ○ | | | |
| 6 | Remove cylinder head. When checking intake valve and valve guide, the clearance of them is big. | ○ | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 8. Oil consumption too high.

Before starting the diagnosis, ask the operator why the noticed the fuel consumption was too high.

★ If answer is: "Oil consumption was high and exhaust gas was blue", follow problems "7. Exhaust gas is blue".

**Check before troubleshooting**

Is engine or engine lower part coated with oil.
(Remove earth and sand and check.)

| No. | Problems \ Remedy / Cause | a Rear seal or seal contact face worn or damaged | b Oil cooler damaged | c Oil leaking from oil drain plug | d Oil leaking from cylinder head, oil pan, gear case, flywheel housing and mounts | e Oil leaking from oil piping | f Oil leaking from oil filter or oil cooler | g Oil leaking from turbocharger |
|---|---|---|---|---|---|---|---|---|
| | | XΔ | X | Δ | XΔ | ΔX | ΔX | ΔX |
| 1 | Oil leaking out of engine (check around engine). | | | | ○ | | | |
| 2 | Cooling water is mixed with engine oil. | | ○ | | | | | |
| 3 | Oil in main clutch or TORQFLOW transmission or damper increases. | ○ | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 9. Oil level rises. (Mixed water or fuel)

**Check before troubleshooting**

- Is the cooler of engine oil dirt – white? → Mixed water.

| No. | Problems / Remedy | Cause a: Failure in hydraulic pump for machine | b: Rear seal or seal contact face worn or damaged | c: Oil leaking inside PT pump (forced lubrication pump) | d: Fuel leaking from tube inside cylinder head cover | e: After-cooler damaged | f: Injector defective | g: Liner O-ring damaged | h: Cylinder block or cylinder liner damaged | i: Cylinder head gasket damaged | j: Oil cooler pipe or O-ring damaged |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | xΔ | xΔ | xΔ | xΔ | x | x | x | x | x | x |
| 1 | Water mixed with engine oil. | | | | | ○ | | | | | |
| 2 | Fuel mixed with engine oil. | | | ○ | | | | | | | |
| 3 | Oil in main clutch or TORQFLOW transmission or damper decreases. | | ○ | | | | | | | | |
| 4 | Seal or seal contact face of hydraulic pump drive shaft is worn or damaged. | ○ | | | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 10. Oil quickly becomes dirty.

**Before starting the troubleshooting, ask the operator the following questions.**

1. Were oil and oil filter changed in accordance with the "Operation and Maintenance Manual"?
2. Was improper oil used?

| No. | Problems / Remedy | Leak of exhaust gas through seal on turbocharger turbine side (a) XΔ | Piston, ring or liner worn (b) X | Valve or valve guide worn (c) XΔ |
|---|---|---|---|---|
| 1 | Exhaust gas is blue when engine is run at high speed with light load. | | ○ | ○ |
| 2 | Compression pressure is lack. | | ○ | ○ |
| 3 | Blow-by is excessive. | | ○ | |
| 4 | After running at high idling for approx. 10 mins., oil can be seen leaking from turbocharger turbine outlet. | ○ | | |
| 5 | Turbocharger shaft play is excessive. | ○ | | |

★ If the above problems does not reveal the cause, a common secondary cause of dirty oil is carbon from incomplete combustion mixing with the oil. In this case follow problems in "6. Exhaust gas is black".

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

## 11. Engine oil pressure gauge indicator fluctuates abnormally.

| No. | Problems / Remedy | Cause: Regulator valve defective (a) | Instrument panel loose (b) | Engine oil pressure gauge defective (c) | Lack of oil in oil pan (fluctuation occurs particularly when operating on slopes) (d) |
|---|---|---|---|---|---|
| | | A ΔX | Δ | X | A |
| 1 | Oil level in oil pan is too low. (Check whether oil consumption is excessive.) | | | | ○ |
| 2 | Fluctuation stops when gauge is replaced. | | | ○ | |
| 3 | Mounts in instrument panel are loose. (Check directly) | | ○ | | |
| 4 | Regulator valve is catched, spring is fatigued, valve or valve guide is damaged. (Check directly) | ○ | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 12. Lack of oil pressure.

(At engine speed of over 700 rpm, indicator of engine oil pressure gauge is to left of "green range".)

**Question to be asked before starting trouble-shooting.**
Is 10W oil being used at temperatures above 0°C?

| No. | Problems / Remedy | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cause | Oil pump defective | Regulator valve function defective | Oil strainer in oil pan clogged | Oil pipe in oil pan damaged or clogged | Scavenging oil pump defective | Bearing or journal worn | Oil filter element clogged and bypass valve function defective | Oil hose, tube clogged or damaged | Engine oil pressure gauge defective | Gauge tube clogged or damaged | Lack of oil in oil pan (particularly with lack of oil when operating on slopes) | Water or fuel mixed with oil → see No. 9 | Oil leaking from connection of oil hose and tube | Oil leaking from tube or connections of engine oil pressure gauge |
| | | △ X | △ XA | C | X C | X △ | X | X ΔA | C XΔ | C XΔ | X | A | – | X △ | X △ |
| 1 | Oil is leak from hose or tube. (Check for signs of external oil leakage). | | | | | | | | | | | | | ○ | |
| 2 | Water or fuel mixed with fuel. | | | | | | | | | | | | ○ | | |
| 3 | Oil in oil pan is lack (no sign of external oil leakage). | | | | | | | | | | | ○ | | | |
| 4 | Engine oil pressure is normal if gauge is replaced. | | | | | | | | | ○ | | | | | |
| 5 | Oil hose, tube are clogged or damaged. (Check directly) | | | | | | | ○ | | | | | | | |
| 6 | Oil filter is clogged and bypass valve function is defective. (Check directly) | | | | | | ○ | | | | | | | | |
| 7 | Metal particles are caught in oil filter element. K.O.W.A (oil analysis) shows abnormality. | | | | | ○ | | | | | | | | | |
| 8 | Engine oil pressure drops only when going uphill. (with oil level normal) | | | | ○ | | | | | | | | | | |
| 9 | Remove oil pan. When checking oil, strainer is clogged or oil pipe is damaged. | | | ○ | | | | | | | | | | | |
| 10 | Regulator valve is catching, spring is fatigued, valve or valve guide is damaged. (Check directly) | | ○ | | | | | | | | | | | | |
| 11 | Oil pump does not rotate smoothly and oil pump shaft play is excessive. | ○ | | | | | | | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace △: Repair
A: Adjust C: Clean

## 13. Oil in cooling system.

| | Cause | Remedy |
|---|---|---|
| a | Pipe broken in oil cooler. O-ring damaged. | X |
| b | Head gasket damaged | X |
| c | Cylinder head cracked | X |
| d | Cylinder block cracked | X |

## 14. Water temperature does not rise.

Water temperature gauge indicator is to left of "green range".

★ In cold weather operation, if reversible fan and radiator are not fitted, the engine may not warm up.

| No. | Problems / Remedy | Thermostat defective (stays open) a | Water temperature gauge defective b |
|---|---|---|---|
| | | X | X |
| 1 | Water temperature rises if gauge is replaced. | | ○ |
| 2 | When thermostat is removed, it is found to stay open; or performance test shows cracking temperature is too low. | ○ | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 15. Water temperature rises excessively.

(Water temperature gauge indicator goes to right of "green range", engine overheats.)

⚠ Never remove the radiator cap when the temperature is still high. Boiling water may spurt out and cause serious burns.

★ When the engine overheats, stopping the engine immediately means water is no longer sent out by the water pump. As a result the temperature of the parts being cooled rises sharply and this may cause cracking or other damage to the engine.

**Before starting the troubleshooting, ask the operator the following questions.**

1. Is anti-freeze being used in summer?
2. Is water being supplied according to the "Operation and Maintenance Manual".

**Check before troubleshooting**

1. Is machine being operated under excessive load?
2. Is fan damaged or deformed?
3. Is belt groove of fan pulley or crank pulley worn?
4. Are radiator shutter and reversible fan being used properly?

| No. | Problems / Remedy | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cause | Excessive use of machine with torque converter stalled | Torque converter damaged | Water temperature gauge defective | Thermostat seal defective (dose not open) | Thermostat defective (does not open) | Water pump defective | Radiator core fins clogged or damaged | Fan belt tension incorrect | Cylinder block or head cracked, sleeve damaged | Head gasket, precombustion chamber gasket damaged | Cylinder liner or piston ring damaged, oil cooler pipe damaged | Water leaking from water tube or hose | Water leaking from radiator | Water leaking from water pump or oil cooler |
| | | A | △X | X | X | X | X △ | C X | A | X | X | X | X △ | X △ | X △ |
| 1 | Coolant level is too low. | | | | | | | | | ○ | | | ○ | | |
| 2 | Cooling water mixed with oil. | | | | | | | | | ○ | | | | | |
| 3 | Fan belt loosens. | | | | | | | ○ | | | | | | | |
| 4 | Radiator core is damaged or clogged with mud or dust. | | | | | | ○ | | | | | | | | |
| 5 | Difference in temperature between upper and lower tanks is extreme. | | | | | ○ | | | | | | | | | |
| 6 | Radiator is only slightly warm. | | | ○ | ○ | | | | | | | | | | |
| 7 | Valve opens when testing thermostat only. | | | ○ | | | | | | | | | | | |
| 8 | If water temperature gauge is replaced, it returns to normal. | | ○ | | | | | | | | | | | | |
| 9 | Torque converter oil temperature is too high. (with TORQFLOW transmission) | ○ | | | | | | | | | | | | | |

★ If exhaust smoke is black, follow problems "6. Exhaust gas is black".

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

## 16. Too much vibration.

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

| No. | Problems / Remedy | Cause: Wear of front support pilot (a) | Intake or exhaust valve stuck or damaged (b) | Intake or exhaust valve broken or worn (c) | Bushings or bearings (main bearing, connecting rod bearing, cam bushing, etc.) worn (d) | PT pump out of adjustment (excessive injection) (e) | Air in fuel piping between float tank and PT pump (f) | Injector clogged and cup worn (g) | Injector plunger seized (h) | PT pump out of adjustment (low speeds out of adjustment) (i) | Thermostat defective (stays open) (j) | Vibration damper defective (k) | Engine mounting bolts loose (l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Remedy | X | X | X | X | A | ΔX | X C | X | A | X | X | Δ |
| 1 | Engine mounting bolts are loose. (Check directly) | | | | | | | | | | | | ○ |
| 2 | Vibration damper is not warm to touch after operation; during operation, gear noise is also excessive. | | | | | | | | | | | ○ | |
| 3 | Exhaust gas is black. | | | | | ○ | | ○ | | | ○ | | |
| 4 | Water temperature does not rise or rises slowly. | | | | | | | | | | ○ | | |
| 5 | Low idling speed are low. | | | | | | ○ | ○ | ○ | ○ | | | |
| 6 | Plunger does not move when checking the injector after removing cylinder head cover. | | | | | | | | ○ | | | | |
| 7 | Injection spray condition is defective when removing injector and check | | | | | | | ○ | | | | | |
| 8 | Vacuum pressure is low or hot stationary. | | | | | | ○ | | | | | | |
| 9 | Fuel pressure is excessive. | | | | | ○ | | | | | | | |
| 10 | Oil pressure is low at low idling. | | | | ○ | | | | | | | | |
| 11 | Remove the cam follower housing and it is abnormal. | | | ○ | | | | | | | | | |
| 12 | Remove cylinder head. When checking it, the tappet or intake and exhaust valves are abnormal. | | ○ | | | | | | | | | | |
| 13 | The wear and clearance of front support pilot are large. | ○ | | | | | | | | | | | |

## 17. Abnormal noise emitted.

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

★ When noises indicating internal damaged are being emitted continuing to operate the machine may make the damage worse.
★ As far as possible, classify the abnormal noise to make location of the cause easier.
Type of noise;
- Interference
- Abnormal combustion
- Gears
- Internal, external
- Engine, power train

| No. | Problems / Remedy | a Valve or piston broken | b Valve stem stuck | c Cam follower worn | d Timing gear or P.T.O. gear or oil pump gear broken or worn | e Bolt missing from connecting rod cap or main cap | f Cam bushing out of place | g Injector clogged | h Injector seized | i Valve clearance defective | j Piston, ring or liner worn | k PT pump out of adjustment | l Vibration damper defective | m Thermostat defective | n Interference of fan or fan belt; fan deformed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | X | X | X | X | ΔX | XΔ | CX | X | A | X | A | X | X | ΔX |
| 1 | External or interference engine noise occurs. | | | | | | | | | | | | | | ○ |
| 2 | Exhaust gas is black. | | | | | | ○ | | ○ | ○ | ○ | | | ○ | |
| 3 | Combustion noise is abnormal. | | | | | | ○ | ○ | | | ○ | | | ○ | |
| 4 | Water temperature does not rise. | | | | | | | | | | | | | ○ | |
| 5 | Vibration damper is not warm to touch after operation; during operation, gear noise is also excessive. | | | | | | | | | | | | ○ | | |
| 6 | Fuel pressure (discharge pressure) is high. Seal of PT pump is abolished. | | | | | | | | | | | ○ | | | |
| 7 | Compression pressure is lack, blow-by is excessive. | | | | | | | | | | ○ | | | | |
| 8 | Valve clearance is too large or too small. | | | | | | | | ○ | | | | | | |
| 9 | Injector function is defective. (Plunger does not move up and down.) | | | | | | | ○ | | | | | | | |
| 10 | Injector injection spray is defective. (Remove it and check.) | | | | | | ○ | | | | | | | | |
| 11 | Remove oil pan. When checking it, internal engine noise is excessive. | | | | | ○ | | | | | | | | | |
| 12 | Remove gear cover. Gear noise is occurred. | | | | ○ | | | | | | | | | | |
| 13 | Remove cam follower housing. It is abnormal. | | | ○ | | | | | | | | | | | |
| 14 | When removing cylinder head, Internal engine noise is excessive. | ○ | | | | | | | | | | | | | |

## 18. Excessive wear of engine parts.

**Before starting the troubleshooting, ask the operator the following questions.**

1. Is the specified oil being used?
2. Is the specified fuel being used?
3. Is the air cleaner element cleaned and replaced according to the "Operation and Maintenance Manual"?
4. Is the fuel filter element cleaned and replaced according to the "Operation and Maintenance Manual"?
5. Are the engine oil and oil filter element replaced according to the "Operation and Maintenance Manual"?
6. Has there been repeated rapid acceleration, or rapid gear shifting?
7. Is the machine warmed up before operation, and left idling before stopping engine according to the "Operation and Maintenance Manual"?

| No. | Problems / Remedy | Fuel filter element damaged or clogged (a) X | Dirt or water mixed with fuel (b) C | Dirty oil (c) – | Water mixed with oil (d) – | Fuel mixed with oil (e) – | Abnormal combustion (f) – | Air leaking into system between precleaner and cylinder head (g) ΔX | Air cleaner element damaged (h) X | Precleaner damaged or improperly cleaned (i) XC |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Dirt gets into engine. (Check directly) | | | | | | | ○ | | |
| 2 | Exhaust gas is black. (See problems "6. Exhaust gas is black") | | | | | | ○ | | | |
| 3 | Fuel is mixed with oil. (See problems "9. Oil level rise") | | | | | ○ | | | | |
| 4 | Water is mixed with oil. (See problems "9. Oil level rise") | | | | ○ | | | | | |
| 5 | Oil is dirty. (See problems "10. Oil quickly becomes dirty") | | | ○ | | | | | | |
| 6 | Dirt or water drains out when fuel tank drain plug is removed. | | ○ | | | | | | | |
| 7 | Fuel filter is dirty or damaged. | ○ | | | | | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 19. Engine does not start because of fault in electrical system. (Check starting circuit)

⚠ When checking, take care not to be caught in fan or other rotating parts if engine starts.

**Check before troubleshooting**

1. Is battery electrolyte level or specific gravity too low?
2. Check starting circuit for broken or disconnected wires, loose terminals or short circuits (Visual check).
   Battery ⟷ Safety relay ⟷ Starting switch ⟷ Battery relay switch ⟷ Battery
3. Immediately after repair, mistaken wiring connection is possible cause.
4. When problems 1-1) "Engine does not turn" gives cause i "Electrical system defective", use this problems.

| No. | Problems | Remedy | Cause: Starting motor defective (a) | Internal wiring or performance of safety relay defective (b) | Internal wiring or performance of safety switch defective (c) | Internal wiring or performance of battery relay switch defective (d) | Internal wiring or performance of starting switch defective (e) |
|---|---|---|---|---|---|---|---|
| | | | XΔ | ΔX | ΔX | ΔX | ΔX |
| 1 | If terminals (B) and (C) of starting motor are connected, pinion moves out.<br>★ Sparks are produced by this test.<br>⚠ When pinion movement is confirmed, disconnect-terminals immediately. | | | ○ | ○ | ○ | ○ |
| 2 | If terminals (B) and (C) of starting switch are connected, engine will start. | | | | | | ○ |
| 3 | If terminals (b) and (E) of battery relay switch are connected, engine will start. | | | | | ○ | |
| 4 | If plug terminal of safety switch is connected to terminal (B) or (+) of starting motor, engine will start. | | | | ○ | | |
| 5 | If terminals (B) and (C) of safety relay are connected, engine will start. | | | ○ | | | |
| 6 | Starting motor does not turn even if No. 1 starting motor terminals (B) and (C) are connected. | | ○ | | | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace Δ: Repair
A: Adjust C: Clean

## 20. Battery does not charge. (Check charging circuit)

⚠ When checking, take care not to be caught in fan or other rotating parts if engine starts. Take care also not to cause short circuits.

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace Δ: Repair
A: Adjust C: Clean

Before starting the troubleshooting, ask the operator if the battery is old (in use for 2 or more years).

**Check before troubleshooting**

1. Is alternator drive belt loose?
2. Check starting circuit for broken or disconnected wires, loose terminals or short circuits. (Visual check, continuity check).
   Battery ⟷ Starting switch ⟷ Ammeter ⟷ Regulator ⟷ Alternator⟷ Battery relay switch ⟷ Battery
3. Do lamps or heater exceed specified limit? Are they left on?
   ★ When engine is stopped and charged lamp stays on, or ammeter indicator deflects to one side, lamps are still on, or there is a short circuit.
4. Following repairs, mistaken wiring connection is possible cause.

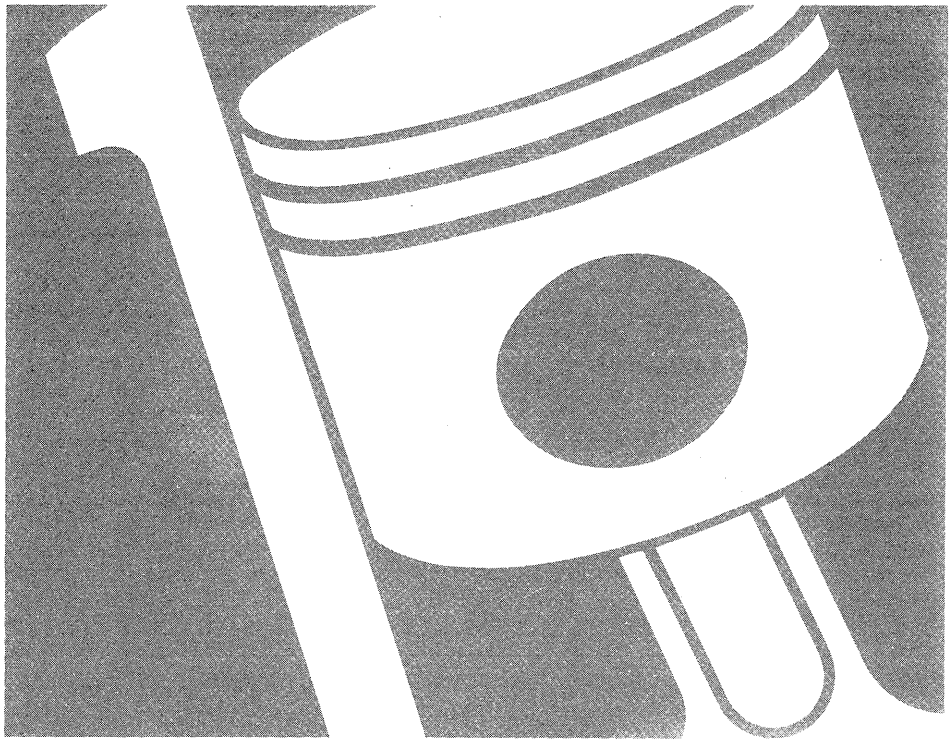
| No. | Problems \ Cause / Remedy | a: Alternator defective (XΔ) | b: Internal wiring or performance of regulator defective (ΔX) | c: Internal wiring or performance of ammeter or charging lamp defective (ΔX) | d: Internal wiring or performance of starting switch defective (ΔX) | e: Battery defective (X) |
|---|---|---|---|---|---|---|
| 1 | During operation, deflection of ammeter and charging lamp are normal. | | | | | ○ |
| 2 | Continuity test using tester shows;<br>1) Little or no continuity when terminals (AC) and (B) of starting switch are connected. (with switch ON) | | | | ○ | |
| | 2) When the starting switch is ON, continuity between them above 1) is proper, but when being OFF, no continuity. | | | | ○ | |
| | 3) Little or no continuity between (+) terminal and (−) terminal of ammeter or charging lamp. | | | ○ | | |
| 3 | Run engine at medium speed (1,000 – 1,500 rpm) and measure charging voltage with tester.<br>1) Tester does not show charging voltage (26 – 30V) between terminal (E) of alternator and terminal (N) of regulator. | ○ | ○ | | | |
| | 2) Tester shows charging voltage between terminals (A) and (E) of dynamo, or between terminals (B) and (E) of alternator, but does not show with above. | | ○ | | | |
| | 3) Tester shows charging voltage with 2) only. | ○ | | | | |

# SHOP MANUAL

# N-855 SERIES

**Engine Serial No. 26100001 and up**

# 13 ENGINE DISASSEMBLY AND ASSEMBLY

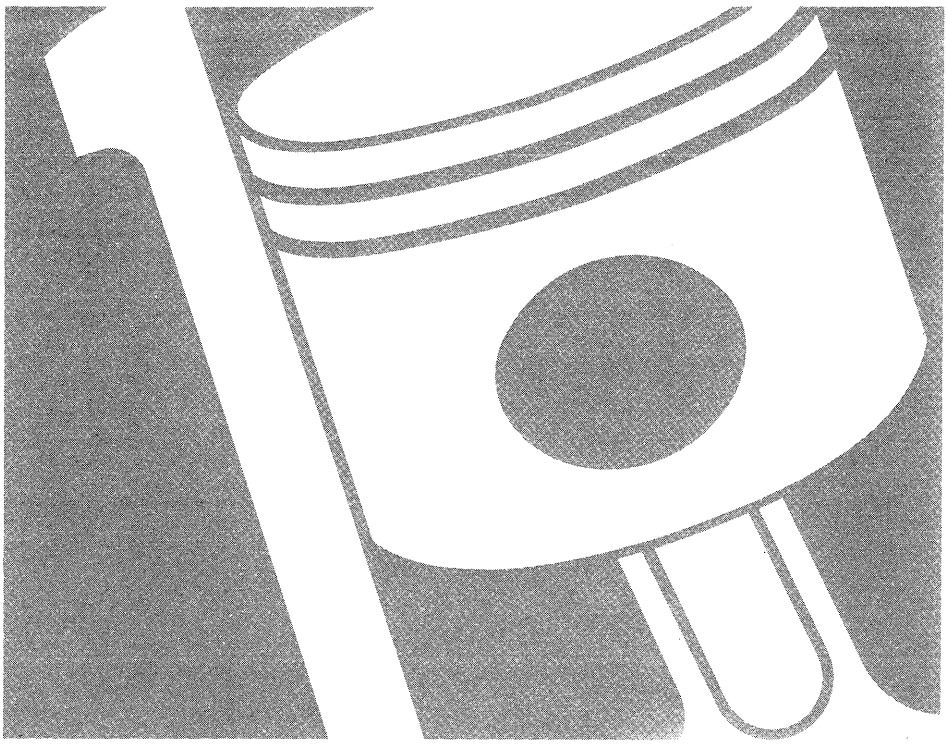


# SHOP MANUAL

# N-855 SERIES

**Engine Serial No. 26100001 and up**

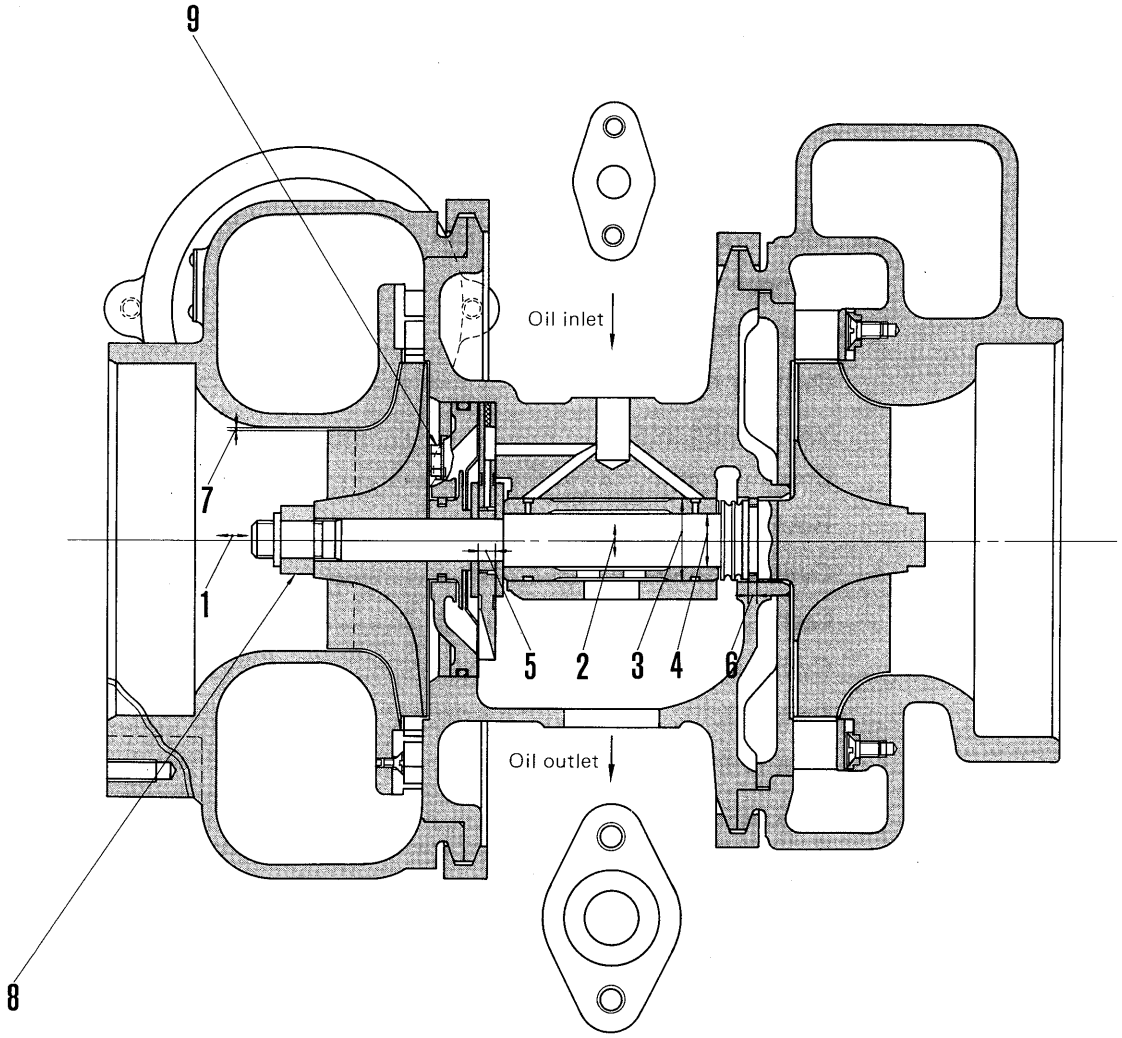
# 14 ENGINE MAINTENANCE STANDARD

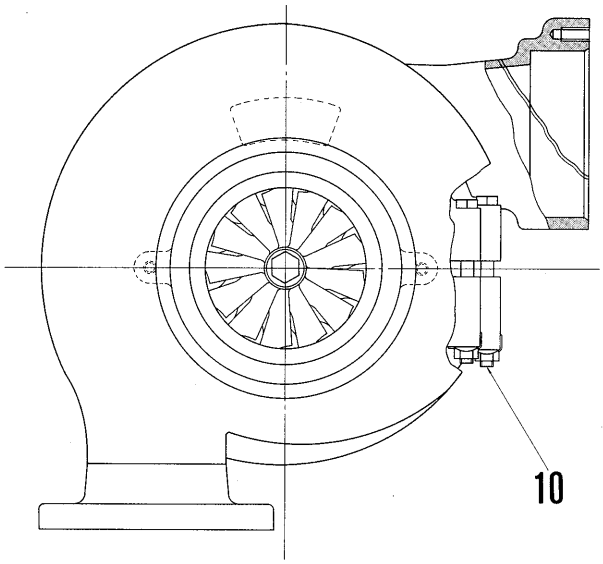


# CONTENTS

# INTAKE AND EXHAUST SYSTEM

## TURBOCHARGER (KTR130 for NTA-855-C)



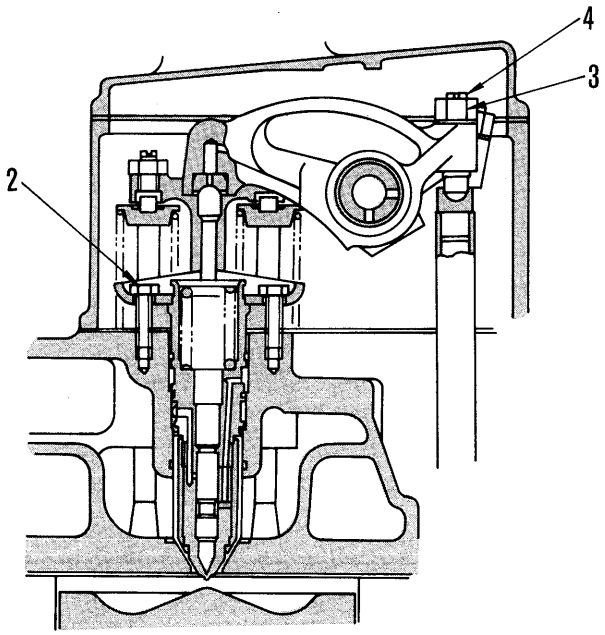




6710F023

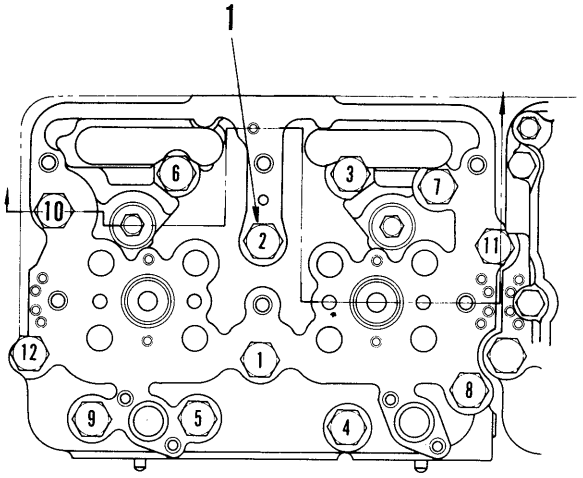
Unit: mm

| No. | Check item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| 1 | End play of wheel shaft | Standard size | | | Repair limit | | Replace thrust parts |
| | | 0.08 – 0.13 | | | 0.18 | | |
| 2 | Radial play of wheel shaft | 0.25 – 0.43 | | | 0.60 | | Replace bearing parts |
| 3 | Journal bearing center housing | Standard size | Tolerance | | Repair limit | | Replace |
| | | | Shaft | Hole | Shaft | Hole | |
| | | 30 | -0.060<br>-0.080 | +0.020<br>0 | 29.89 | 30.04 | |
| 4 | Journal bearing turbine shaft | 20 | -0.030<br>-0.045 | +0.015<br>0 | 19.95 | 20.05 | |
| 5 | Thickness of thrust bearing | Standard size | Tolerance | | Repair limit | | |
| | | | Width | Groove | Width | Groove | |
| | | 6 | -0.08<br>-0.11 | +0.02<br>0 | 5.86 | 6.04 | |
| 6 | Thickness of seal ring | 3 | -0.08<br>-0.10 | -0.03<br>-0.04 | 2.85 | 3.05 | |
| 7 | Clearance between blower housing and impeller | Clearance limit: 0.20 | | | | | Replace bearing parts |
| 8 | Tightening torque of blower impeller lock nut | Target (kgm) | | | Range (kgm) | | Retighten |
| | | 8.5 | | | 8.0 – 9.0 | | |
| 9 | Tightening torque of insert bolt | 1.25 | | | 1.0 – 1.5 | | |
| 10 | Tightening torque of V-band lock nut | 0.95 | | | 0.9 – 1.0 | | |

# ENGINE BODY
## CYLINDER HEAD




6710F024

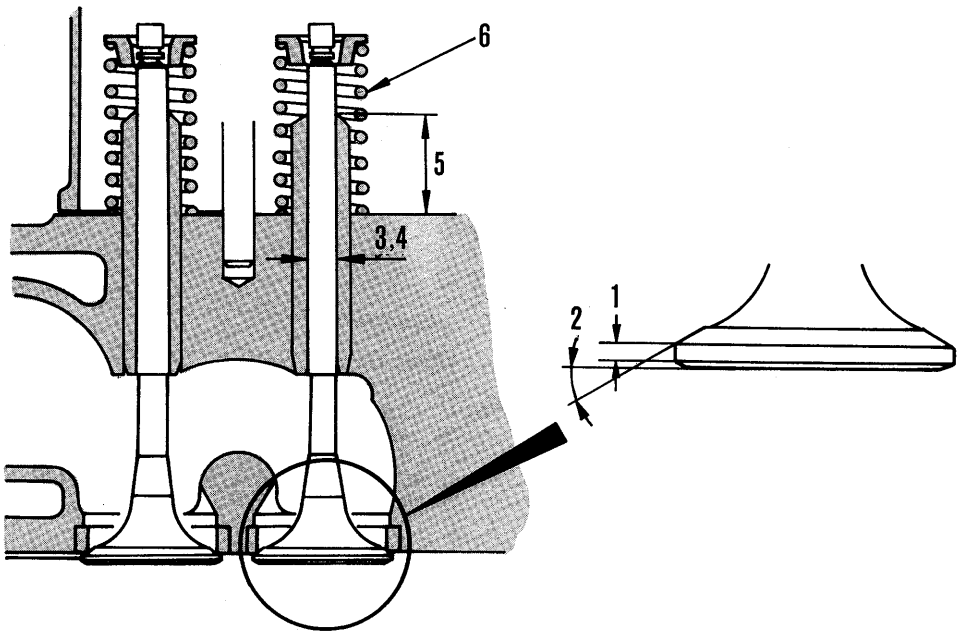



6710F025

Unit: mm

| No. | Check item | Criteria | | | | Remedy |
|---|---|---|---|---|---|---|
| 1 | Tightening torque of cylinder head mounting bolts (coat bolt threads and washers with oil and tighten in sequence given in diagram above) | Order | Target (kgm) | Range (kgm) | | |
| | | 1st step | 3.5 | – | | |
| | | 2nd step | 12.5 | 11.1 – 13.8 | | |
| | | 3rd step | 40.1 | 38.7 – 41.5 | | |
| 2 | Tightening torque of injector clamp | 1.55 ± 0.05 kgm (Tighten 0.5 kgm each in turn) | | | | |
| 3 | Tightening torque of injector adjustment locknut | 4.8 ± 0.7 kgm (Using adapter: 4.1 ± 0.6 kgm) | | | | |
| 4 | Adjustment torque of injector | Engine No. | Engine condition | Target (kgm) | Range (kgm) | |
| | | 26102754 – 26155791 | Cold (20°C) | 0.55 | | |
| | | | Warm (60°) | 0.69 | | |
| | | 26155792 and up | Cold (20°C) | 0.83 | | |
| | | | Warm (60°C) | 0.83 | | |
| – | Injector timing | Engine | Cranking angle | Top gauge | Cam profile gauge | | Adjust |
| | | | | | Rated side | Advance side | |
| | | N-855-C | BTDC 19° | –5.16 | –0.762 | –0.711 | |
| | | NT-855-C | BTDC 19° | –5.16 | –0.965 | –0.864 | |
| | | NTA-855-C | BTDC 19° | –5.16 | –1.105 | –1.003 | |

# VALVE, VALVE GUIDE

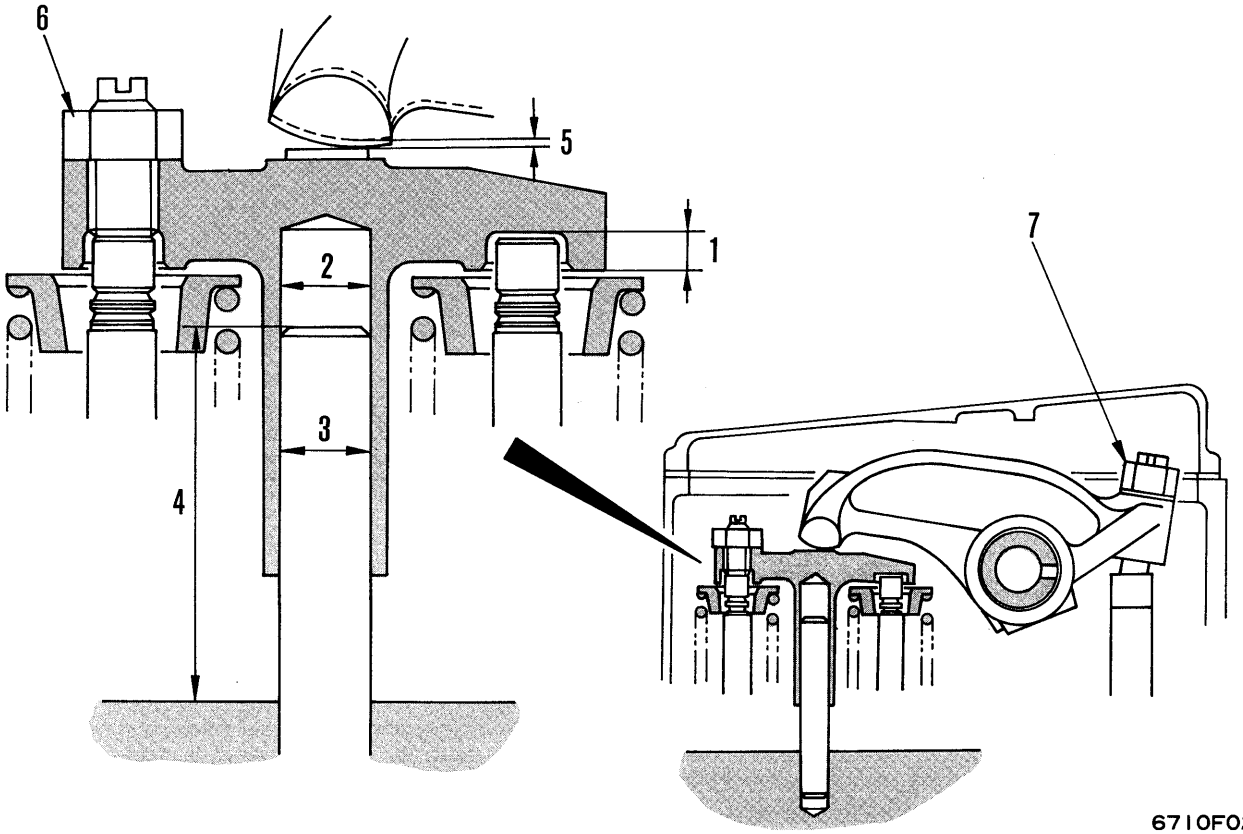



6710F026

Unit: mm

| No. | Check item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Thickness of valve head | Standard size | | Repair limit | Replace |
| | | | | 2.67 | |
| 2 | Valve seat angle | Standard | Tolerance | Repair limit | |
| | | 30° | | | |
| 3 | Valve stem outside diameter | Standard size | Tolerance | Repair limit | |
| | | 11.5 | -0.045<br>-0.070 | 11.41 | |
| 4 | Valve guide inside diameter | 11.5 | +0.011<br>-0.004 | 11.56 | |
| 5 | Protrusion of valve guide | 33.53 | ±0.13 | – | |
| 6 | Valve spring | Standard size | | | Repair limit | |
| | | Free length | Installed length | Installed load | Free length | Installed load |
| | | 68.20 | 57.15 | 70.3kg | – | 64.9kg |
| | Squareness of valve spring | Repair limit: within 2° | | | | |

# CROSSHEAD AND CROSSHEAD GUIDE

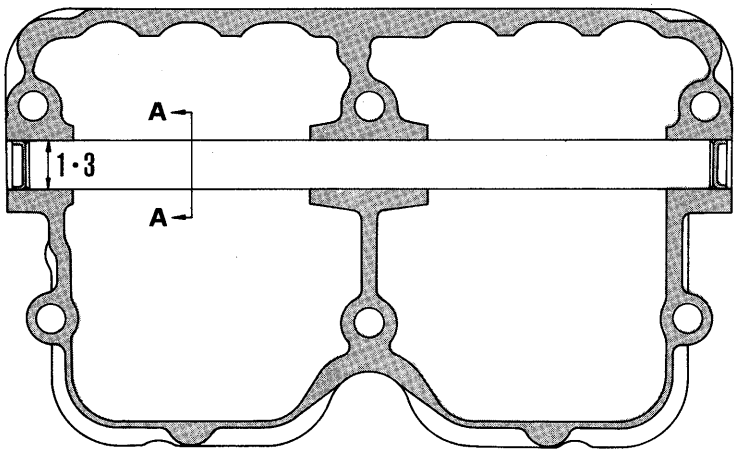



6710F027

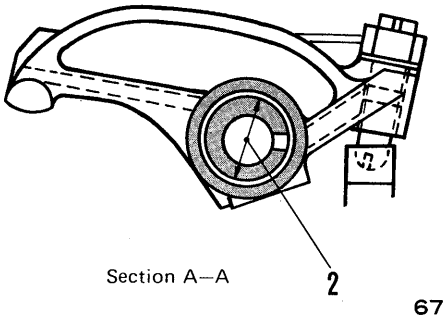
Unit: mm

| No. | Check Item | Criteria | | | | Remedy |
|---|---|---|---|---|---|---|
| 1 | Depth of crosshead stem | Standard size | | Tolerance | Repair limit | Replace |
| | | 3 | | +0.56<br>+0.05 | 3.61 | |
| 2 | Inside diameter of crosshead | 11 | | +0.074<br>+0.024 | 11.18 | |
| 3 | Outside diameter of grosshead guard | 11 | | +0.010<br>0 | 10.97 | |
| 4 | Protrusion of crosshead guide | 47.5 | | ± 0.25 | – | |
| 5 | Valve clearance | Engine No. | Engine condition | Intake valve | Exhaust valve | Adjust |
| | | 26102754 – 26155791 | Cold (20°C) | 0.41 | 0.74 | |
| | | | Warm (80°C) | 0.36 | 0.69 | |
| | | 26155792 and up | Cold (20°C) | 0.36 | 0.69 | |
| | | | Warm (60°C) | 0.36 | 0.69 | |
| 6 | Tightening torque of crosshead locknut | 4.8 ± 0.7 kgm (Using adapter: 4.15 ± 0.65 kgm) | | | | |
| 7 | Tightening torque of locknut for rocker arm adjustment screw | 3.15 ± 0.35 kgm | | | | |

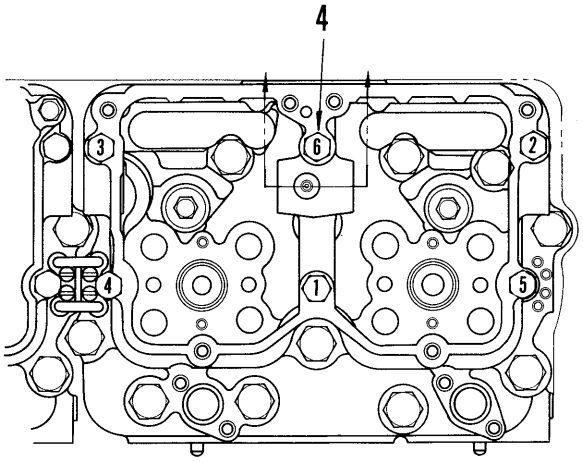
# ROCKER LEVER, SHAFT




6710F028A




6710F116

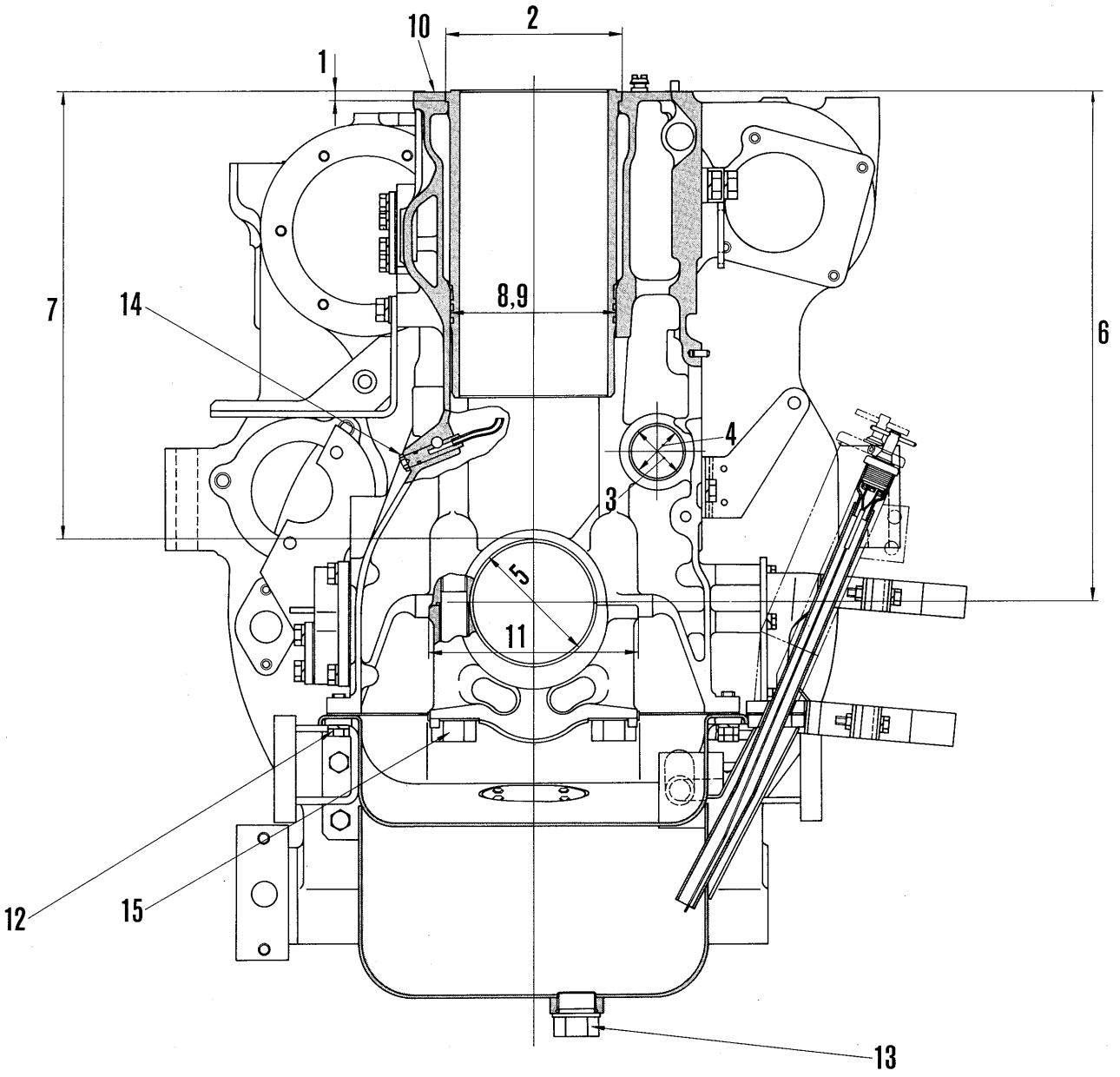



6710F029

Unit: mm

| No. | Check item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Lever shaft hole diameter in rocker housing | Standard size | Tolerance | Repair limit | Replace |
| | | 28.5 | +0.065<br>+0.045 | | |
| 2 | Rocker lever bushing bore | 28.5 | +0.139<br>+0.062 | 28.66 | |
| 3 | Rocker lever shaft diameter | 28.5 | +0.037<br>+0.024 | 28.50 | |
| 4 | Tightening torque of rocker arm housing mounting bolts (coat bolt threads and washers with oil and tighten in sequence given in diagram above) | 8.2 ± 0.7 kgm | | | Retighten |

# CYLINDER BLOCK

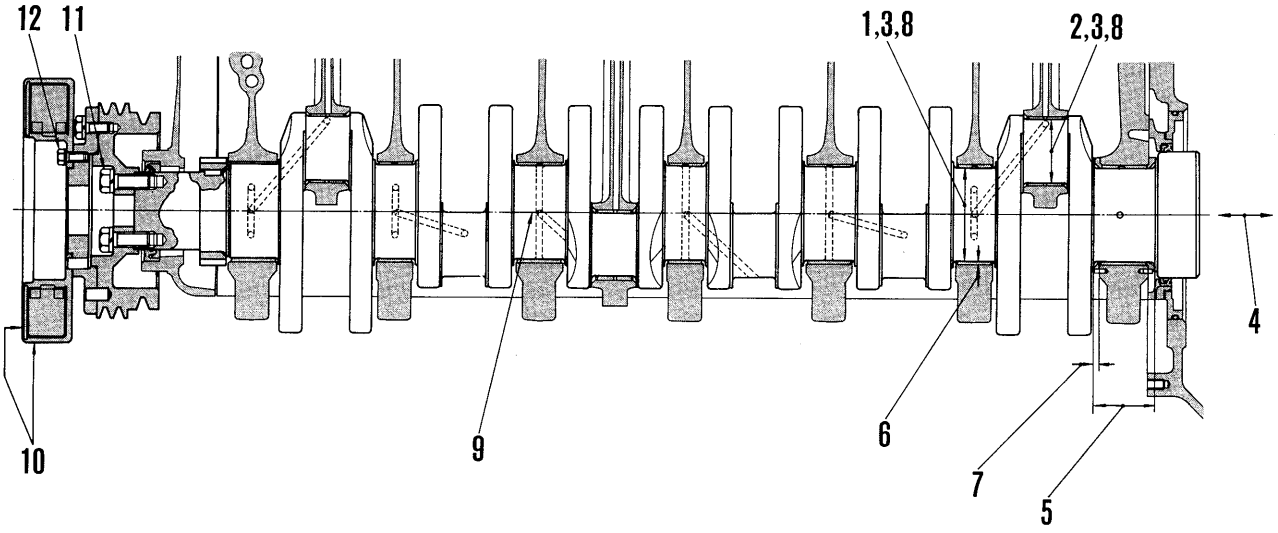



6710F030

Unit: mm

| No. | Check Item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Counterbore depth | Standard size | Tolerance | Repair limit | Repair by grinding or replace |
| | | 9 | +0.059<br>−0.110 | 10.46 | |
| 2 | Inside diameter of counterbore (Measure at 6.5 mm from top face) | 166.7 | +0.013<br>−0.038 | 166.77 | |
| 3 | Inside diameter of camshaft bushing mounting hole | 54 | +0.089<br>+0.064 | 54.11 | Replace |
| 4 | Inside diameter of camshaft bushing (When installed.) | 50.8 | +0.013<br>−0.025 | 50.84 | Replace bushing |
| 5 | Inside diameter of main bearing mounting hole | 120.6 | +0.050<br>+0.012 | 120.66 | |
| 6 | Height of cylinder block (From main bearing center) | 482.7 | +0.050<br>+0.002 | 482.45 | Replace |
| 7 | Height of cylinder block (From checking ring) | 422.4 | +0.027<br>−0.023 | 422.12 | |
| 8 | Inside diameter of cylinder block (Cylinder liner inserted portion) | 155.6 | 0<br>−0.050 | — | |
| 9 | Clearance between cylinder block and cylinder liner | Clearance limit: 0.05 — 0.20 | | | |
| 10 | Distortion of cylinder head mounting surface | Repair limit: 0.052 (for 100 mm) | | | Repair by grinding |
| 11 | Interference between cylinder block and main bearing cap | Interference limit: 0.10 — 0.18 | | | Replace |
| 12 | Tightening torque of oil pan mounting bolt | Block portion: 5.2 ± 0.3 kgm<br>Rear plate portion: 2.0 ± 0.3 kgm | | | |
| 13 | Tightening torque of oil pan drain plug | 9 ± 1 kgm | | | |
| 14 | Tightening torque of piston cooling nozzle | 2.55 ± 0.35 kgm | | | |
| 15 | Tightening torque of main bearing cap bolt | Order | Target (kgm) | Range (kgm) | |
| | | 1st step | 20.0 | 19.3 — 20.7 | |
| | | 2nd step | 42.2 | 41.5 — 42.9 | |
| | | 3rd step | Loosen completely | | |
| | | 4th step | 20.2 | 19.3 — 20.7 | |
| | | 5th step | 42.2 | 41.5 — 42.9 | |

# CRANKSHAFT AND VIBRATION DAMPER




6710F031

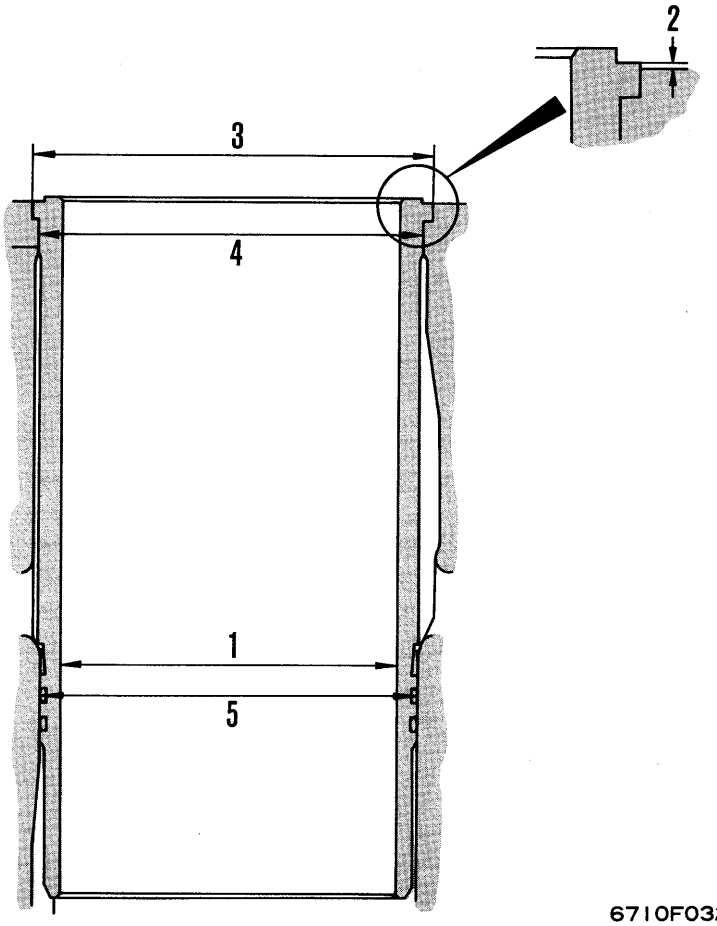
Unit: mm

| No. | Check Item | Criteria | | | | Remedy |
|---|---|---|---|---|---|---|
| | | Size | Standard size | Tolerance | Repair limit | |
| 1 | Outside diameter of main journal | STD | 114.00 | +0.300<br>+0.262 | 114.22 | Repair by using under size bearing or replace. |
| | | 0.25 U.S. | 113.75 | +0.296<br>+0.271 | 113.97 | |
| | | 0.50 U.S. | 113.50 | +0.292<br>+0.267 | 113.72 | |
| | | 0.75 U.S. | 113.25 | +0.288<br>+0.263 | 113.46 | |
| | | 1.00 U.S. | 113.00 | +0.284<br>+0.259 | 113.21 | |

Unit: mm

| No. | Check Item | Criteria | | | | Remedy |
|---|---|---|---|---|---|---|
| 2 | Outside diameter of crank pin journal | Size | Standard size | Tolerance | Repair limit | Repair by using under size bearing or replace |
| | | STD | 79.00 | +0.375<br>+0.337 | 79.30 | |
| | | 0.25 U.S | 78.75 | +0.371<br>+0.346 | 79.05 | |
| | | 0.50 U.S. | 78.50 | +0.367<br>+0.342 | 78.79 | |
| | | 0.75 U.S. | 78.25 | +0.363<br>+0.338 | 78.54 | |
| | | 1.00 U.S. | 78.00 | +0.359<br>+0.334 | 78.28 | |
| 3 | Roundness of journal | Repair limit: Within 0.013 (Total indicator reading) | | | | |
| 4 | End play of crankshaft | Standard clearance | | Clearance limit | | Repair by using over size bearing or replace |
| | | 0.18 – 0.43 | | 0.56 | | |
| 5 | Width of journal at thrust journal | Size | Standard size | Tolerance | Repair limit | Repair by using over size bearing or replace. |
| | | STD | 76.20 | +0.07<br>+0.02 | 76.35 | |
| 6 | Thickness of main bearing | STD | 3.10 | +0.042<br>+0.024 | 3.09 | Replace |
| 7 | Thickness of thrust bearing | STD | 6.20 | +0.07<br>+0.02 | Determine by crankshaft end play | |
| | | 0.25 O.S. | 6.45 | +0.08<br>+0.03 | | |
| | | 0.50 O.S. | 6.70 | +0.08<br>+0.03 | | |
| 8 | Clearance of main journal | Standard clearance | | Clearance limit | | Repair by using under size bearing or replace. |
| | | 0.035 – 0.125 | | 0.18 | | |
| | Clearance of crank pin journal | 0.040 – 0.110 | | 0.18 | | |
| 9 | Bend of crankshaft | Repair limit: 0.09 (Total indicator reading) | | | | |
| 10 | Face runout of vibration damper | Repair limit: 0.25 (Total indicator reading) | | | | Repair mounting flange or replace. |
| | Radial runout of vibration damper | Repair limit: 0.25 (Total indicator reading) | | | | |
| 11 | Tightening torque of crankshaft pulley mounting bolt | 26.5 ± 1.0 kgm | | | | |
| 12 | Tightening torque of vibration damper mounting bolt | 8.0 ± 0.2 kgm | | | | |

# CYLINDER LINER

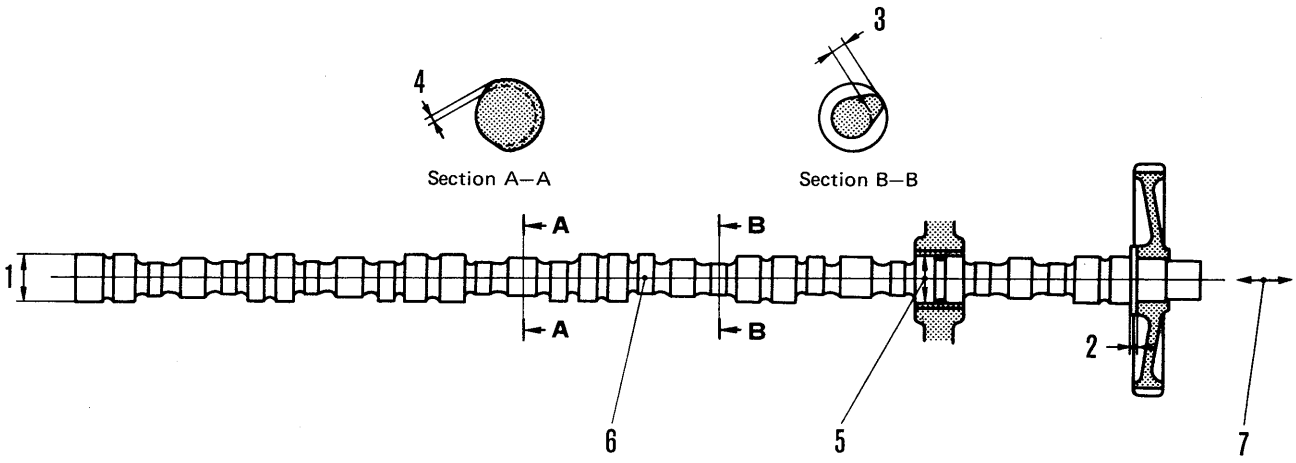



6710F032

Unit: mm

| No. | Check item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Inside diameter of cylinder liner | Standard size | Tolerance | Repair limit | Replace |
| | | 139.7 | +0.025<br>-0.013 | 139.83 | |
| | Roundness of cylinder liner | Top of liner Repair limit: 0.08<br>At O-ring Repair limit: 0.05 | | | |
| 2 | Protrusion of cylinder liner | Tolerance 0.08 — 0.15 | | | Adjust with shims |
| 3 | Outside diameter of cylinder liner at top of counterbore | Standard size | Tolerance | | Replace |
| | | 166.3 | +0.30<br>+0.02 | | |
| 4 | Outside diameter of cylinder liner at bottom of counterbore | 159.8 | +0.19<br>+0.03 | | |
| 5 | Outside diameter of cylinder liner at O-ring | 155.0 | +0.45<br>+0.37 | | |

# CAMSHAFT

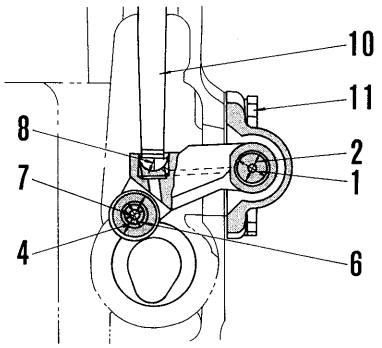


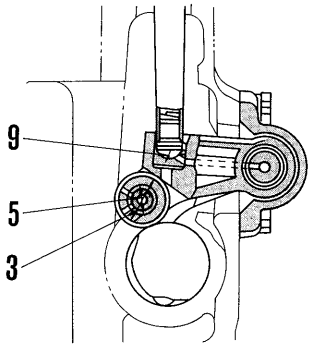

6710F033A

Unit: mm

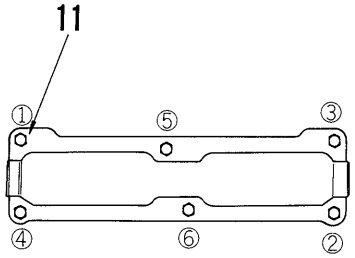
| No. | Check Item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Outside diameter of camshaft journal | Standard size | Tolerance | Repair limit | Replace |
| | | 50.7 | +0.049<br>+0.024 | 50.70 | |
| 2 | Thickness of thrust plate | 2.4 | +0.090<br>+0.038 | 2.11 | |
| 3 | Valve cam lift | | | | |
| 4 | Injector cam lift | | | | |
| 5 | Clearance of camshaft journal | Standard clearance | | Clearance limit | Replace bushing |
| | | 0.026 – 0.089 | | 0.14 | |
| 6 | Bend of camshaft | Repair limit: 0.10 | | | Replace |
| 7 | End play | Standard: 0.20 – 0.33 | | | Replace thrust plate |

# CAM FOLLOWER AND PUSH ROD




6710F034

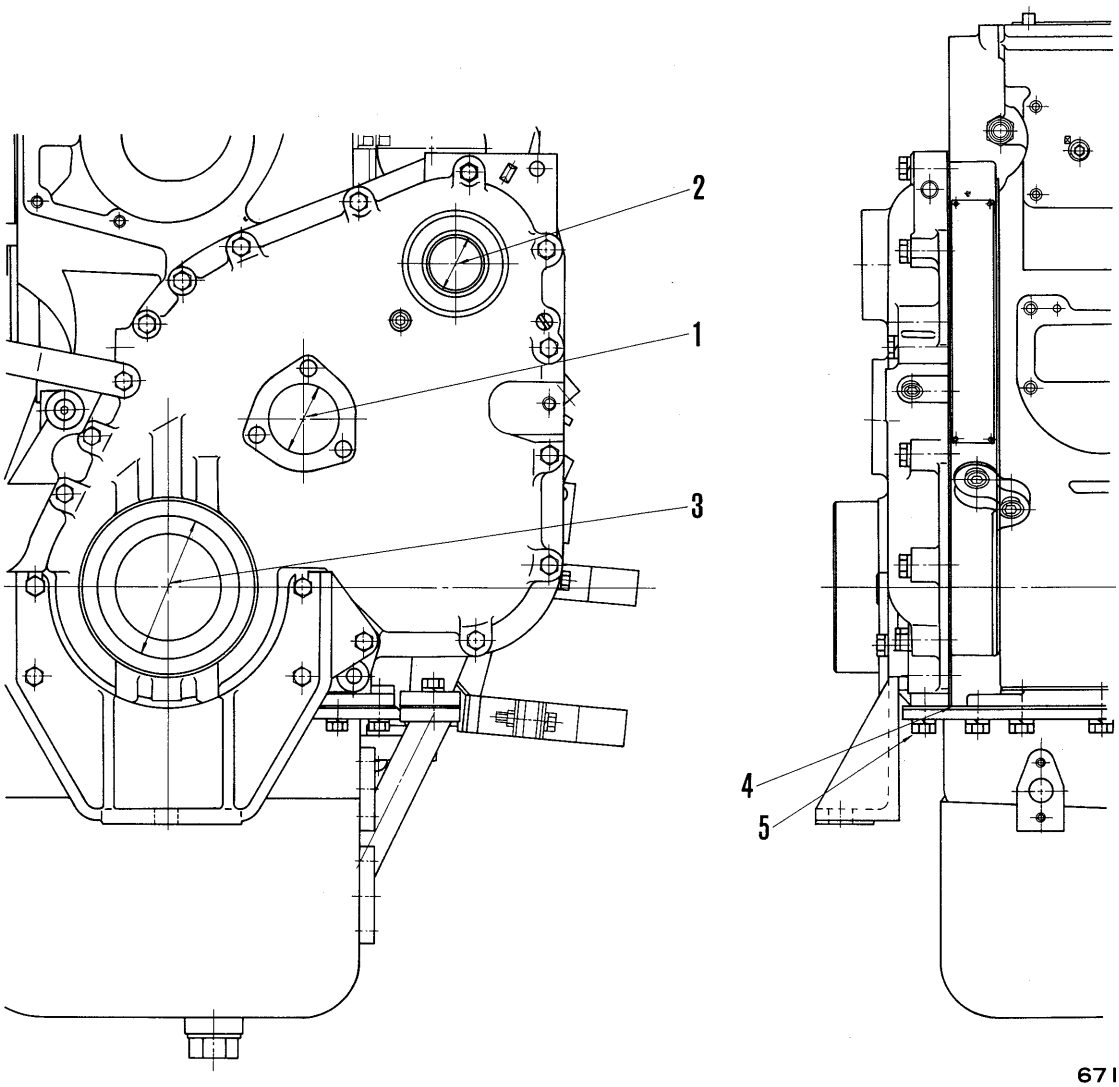



6710F035

Unit: mm

| No. | Check item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Outside diameter of cam follower shaft | Standard size | Tolerance | Repair limit | Replace |
| | | 19 | +0.025<br>+0.012 | 19.00 | |
| 2 | Inside diameter of cam follower bushing | 19 | +0.063<br>+0.037 | 19.09 | |
| 3 | Outside diameter of cam roller (injector) | 31.7 | +0.075<br>+0.025 | 31.67 | |
| 4 | Outside diameter of cam roller (valve) | 31.7 | +0.050<br>+0.025 | 31.67 | |
| 5 | Inside diameter of cam roller (Injector) | 12.8 | +0.002<br>-0.024 | 12.83 | |
| 6 | Inside diameter of cam roller (Valve) | 12.7 | +0.038<br>+0.013 | 12.78 | |
| 7 | Outside diameter of cam follower pin | 12.7 | 0<br>-0.013 | 12.62 | |
| 8 | Radius of push rod ball end | Standard size | | Tolerance | |
| | | 15.8 | | +0.075<br>+0.024 | |
| 9 | Radius of push rod socket end | 13 | | +0.21<br>-0.17 | |
| 10 | Bend of push rod | Repair limit: 0.64 (total deflection of indicator) | | | |
| 11 | Tightening torque of cam follower housing mounting bolt (Tighten in sequence given in diagram) | Order | Target (kgm) | Range (kgm) | Retighten |
| | | Step 1 | 2.5 | 2.1 — 2.8 | |
| | | Step 2 | 4.5 | 4.1 — 4.8 | |

# GEAR AND GEAR COVER

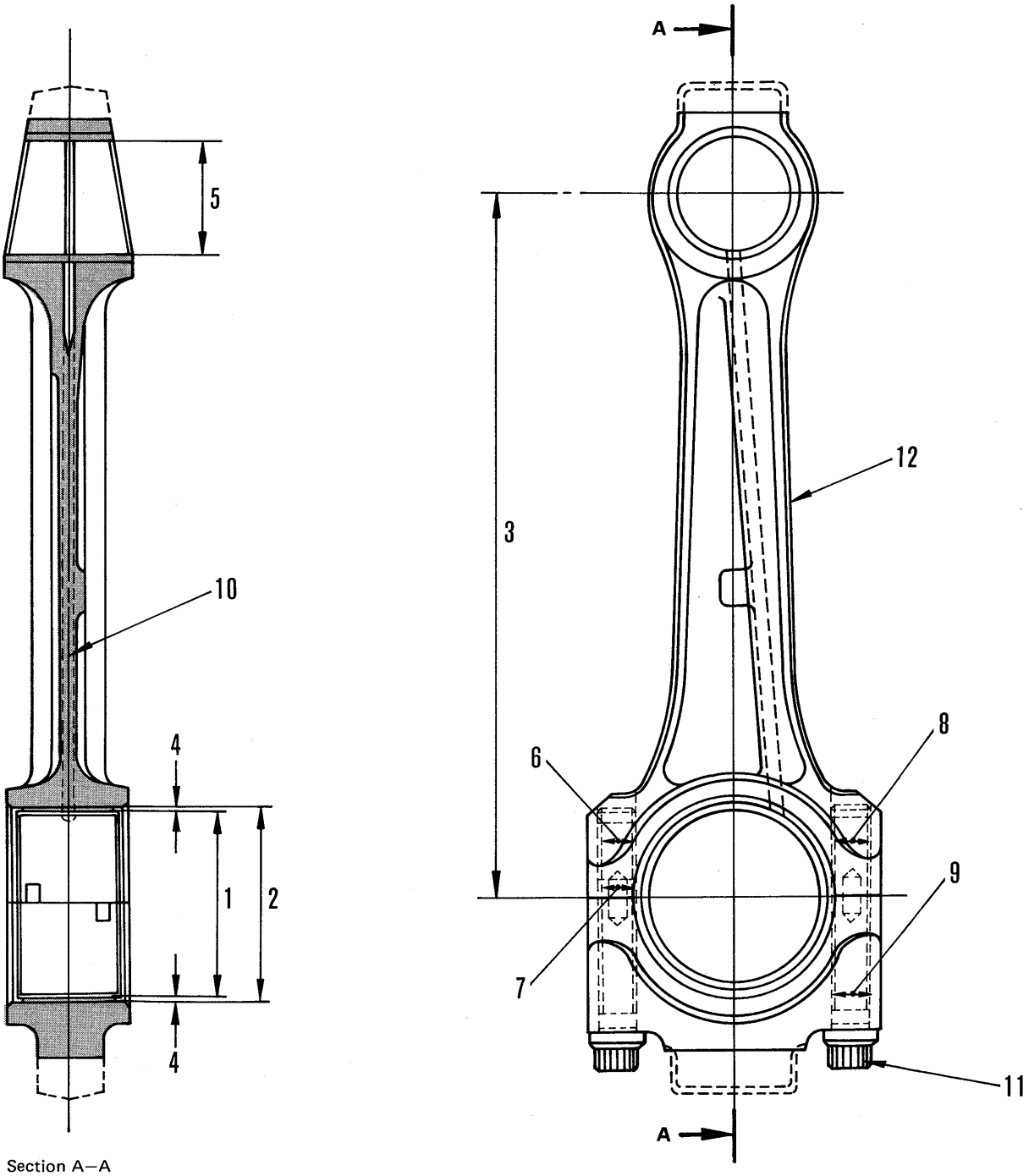



6710F036

Unit: mm

| No. | Check time | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Inside diameter of camshaft support hole | Standard size | Tolerance | Repair limit | Replace |
| | | 44.5 | +0.052<br>-0.025 | 44.63 | |
| 2 | Inside diameter of accessory gear bushing | 44.6 | +0.015<br>-0.086 | 44.67 | Replace bushing |
| 3 | Radial runout of front seal hole | Repair limit: Within 0.25 | | | Replace |
| 4 | Difference in level between gear cover case and cylinder block face | Repair limit: Within 0.05 | | | |
| 5 | Tightening torque of gear case cover mounting bolts | 6.55 ± 0.35 kgm | | | Retighten |

# CONNECTING ROD



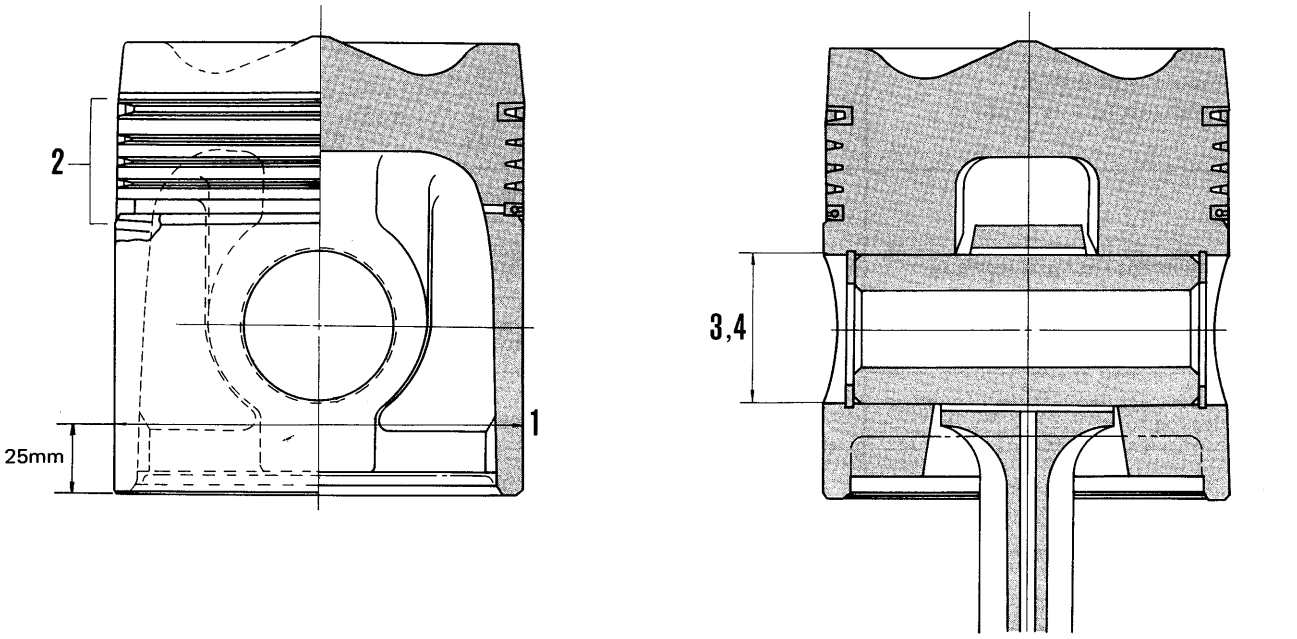

Section A–A

6710F038A

Unit: mm

| No. | Check item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| 1 | Clearance between connecting rod bearing and crankshaft (when bearing is installed.) | Standard size | Tolerance | | Standard | Clearance limit | Replace metal |
| | | | Shaft | Hole | | | |
| | | 79.3 | +0.075<br>+0.035 | +0.179<br>+0.114 | 0.039 – 0.142 | 0.18 | |
| 2 | Connecting rod inside diameter | Standard size | Tolerance | | Repair limit | | Replace as unit with cap |
| | | Engine No. – 26140896 83.1 | +0.039<br>+0.014 | | – | | |
| | | Engine No. 26140897 – 84.2 | +0.044<br>+0.019 | | – | | |
| 3 | Distance between center of connecting rod holes | 304.8 | 0<br>-0.050 | | 304.57 | | |
| 4 | Thickness of connecting rod bearing | 1.80 | +0.052<br>+0.039 | | 1.80 | | Replace bearing |
| 5 | Connecting rod bushing inside diameter | 50.8 | +0.038<br>+0.025 | | 50.86 | | Replace bushing |
| 6 | Connecting rod bolt diameter | 13.8 | +0.040<br>-0.060 | | 13.72 | | Replace as unit with bolt or cap) |
| 7 | Connecting rod bolt diameter | 15.8 | +0.062<br>+0.052 | | 15.86 | | |
| 8 | Connecting rod bolt hole inside diameter | 15.8 | +0.070<br>+0.057 | | 15.87 | | Replace as unit with cap |
| 9 | Connecting rod cap bolt hole inside diameter | 15.8 | +0.078<br>+0.065 | | 15.88 | | |
| 10 | Bend of connecting rod | | | | Repair limit | | Replace as unit with cap |
| | | | | With bushing | 0.10 | | |
| | | | | Without bushing | 0.25 | | |
| | Twist of connecting rod | | | With bushing | 0.25 | | |
| | | | | Without bushing | 0.51 | | |
| | Eccentricity of connecting rod | | | – | 0.30 | | |
| 11 | Tightening torque of connecting rod cap | Procedrue | | Target (kgm) | | Range (kgm) | – |
| | | Step 1 | | 10.1 | | 9.7 – 10.4 | |
| | | Step 2 | | 20.1 | | 19.4 – 20.7 | |
| | | Step 3 | | Loosen completely | | | |
| | | Step 4 | | 3.8 | | 3.5 – 4.1 | |
| | | Step 5 | | 10.1 | | 9.7 – 10.4 | |
| | | Step 6 | | 20.1 | | 19.4 – 20.7 | |
| 12 | Weight | | | | | | Replace |

# PISTON, PISTON RING, PISTON PIN

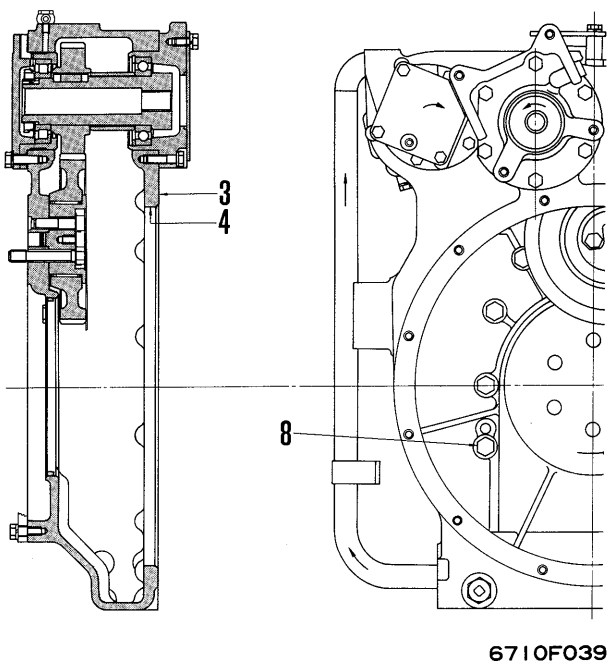



6710F037

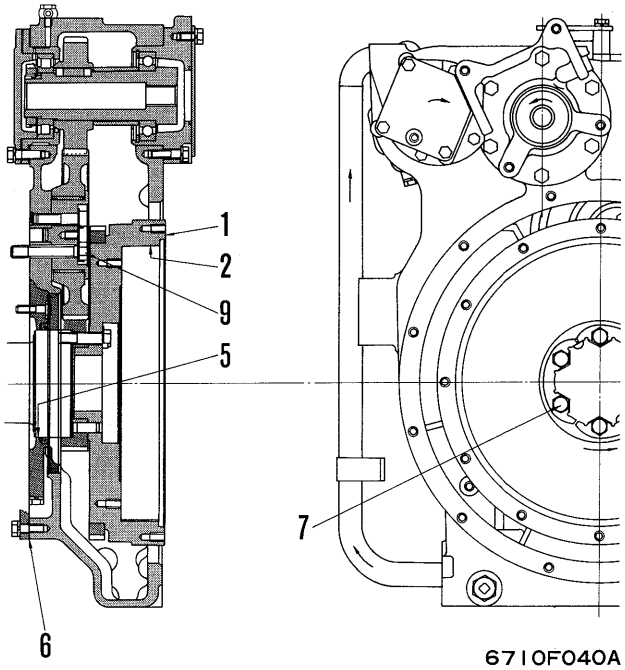
Unit: mm

| No. | Check item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| 1 | Outside diameter of piston | Standard size | Tolerance | Repair limit | Replace |
| | | 139.4 | -0.005<br>-0.030 | 139.27 | |
| 2 | Piston ring gap clearance | Applicable engine | Number of ring | Standard clearance | |
| | | 5-piston ring type | Top ring | 0.43 – 0.69 | |
| | | | No. 2, 3, 4 rings | 0.33 – 0.58 | |
| | | | Oil ring | 0.25 – 0.51 | |
| | | 4-piston ring type | Top ring | 0.43 – 0.69 | |
| | | | No. 2, 3 rings | 0.48 – 0.74 | |
| | | | Oil ring | 0.25 – 0.64 | |
| 3 | Inside diameter of piston pin hole | Standard size | Tolerance | Repair limit | |
| | | 50.7 | +0.072<br>+0.062 | 50.77 | |
| 4 | Outside diameter of piston pin | 50.7 | +0.075<br>+0.070 | 50.75 | |

# FLYWHEEL, FLYWHEEL HOUSING, REAR COVER




6710F039




6710F040A

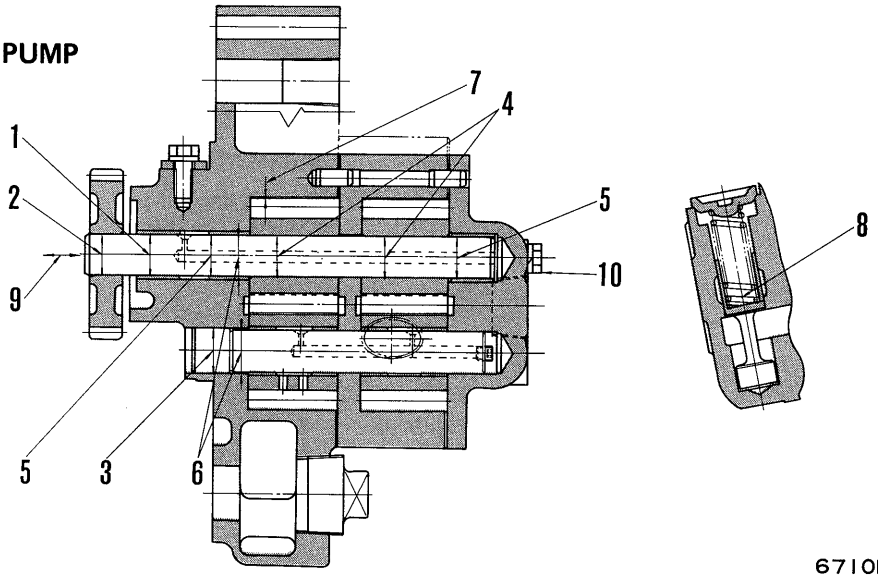
Unit: mm

| No. | Check item | Criteria | Remedy |
|---|---|---|---|
| 1 | Face runout of flywheel | Limit: Within 0.13 (total deflection of indicator) | |
| 2 | Radial runout of flywheel | Limit: Within 0.13 (total deflection of indicator) | |
| 3 | Face runout of flywheel housing | Limit: Within 0.20 (total deflection of indicator) | Replace |
| 4 | Radial runout of flywheel housing | Limit: Within 0.20 (total deflection of indicator) | |
| 5 | Radial runout of rear cover | Limit: Within 0.13 (total deflection of indicator) | |
| 6 | Difference in level between rear cover and oil pan mounting surface | Limit: Within ±0.05 | |
| 7 | Tightening torque of flywheel mounting bolts (Coat bolt thread with engine oil) | 27.0 ± 0.7 kgm | Retighten |
| 8 | Tightening torque of flywheel housing mounting bolts | 20.7 ± 1.3 kgm | |
| 9 | Tightening torque of rear cover mounting bolts | 3.75 ± 0.25 kgm | |

# LUBRICATION SYSTEM

## OIL PUMP

### WITH SCAVENGING PUMP

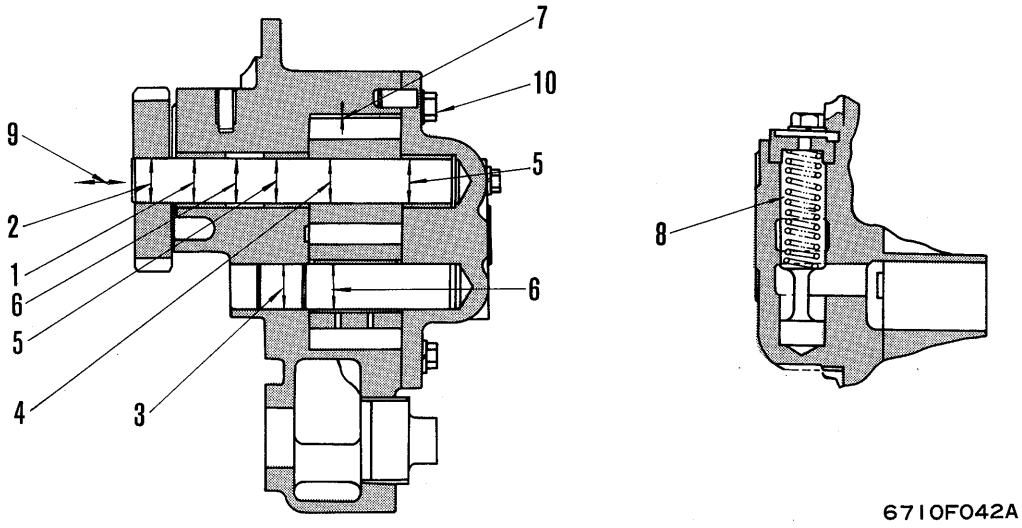



6710F041A

Unit: mm

| No. | Check item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| 1 | Clearance between shaft and bushing | Standard size | Tolerance | | Standard interference | Repair limit | Replace |
| | | | Shaft | Hole | | | |
| | | 22 | +0.225<br>+0.212 | +0.294<br>+0.268 | 0.043 –<br>0.082 | | |
| 2 | Interference between gear and shaft | 22 | +0.225<br>+0.212 | +0.187<br>+0.162 | 0.025 –<br>0.063 | | |
| 3 | Interference between body and shaft | 22 | +0.314<br>+0.301 | +0.289<br>+0.263 | 0.012 –<br>0.051 | | |
| 4 | Interference between shaft and gear | 22 | +0.225<br>+0.212 | +0.220<br>+0.187 | 0.012 –<br>0.038 | | |
| 5 | Inside diameter of cover bushing | Standard size | | Tolerance | | Repair limit | |
| | | 22 | | +0.294<br>+0.268 | | 22.33 | |
| 6 | Outside diameter of shaft | 22 | | +0.225<br>+0.212 | | 22.17 | |
| 7 | Clearance between gear and body | – | | – | | 0.5 | Replace gear or body |
| 8 | Regulator valve spring (when testing) | Standard size | | | | Repair limit | Replace |
| | | Free length | Installed length | Installed load | | Free length | Installed load |
| | | 63.50 | 45.2 | 38.6 ± 1.1kg | | | |
| 9 | End play of shaft | Limit: 0.04 – 0.09 | | | | | Replace |
| 10 | Tightening torque of cover mounting bolts | 2.5 ± 0.5 kgm | | | | | Retighten |

## WITHOUT SCAVENGING PUMP



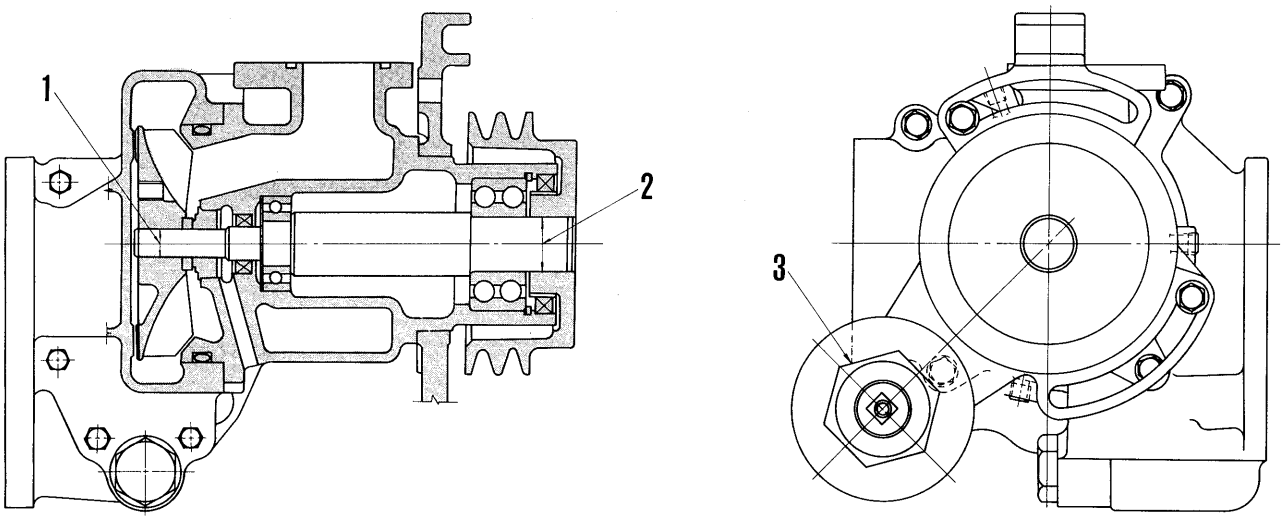

6710F042A

Unit: mm

| No. | Check item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| 1 | Clearance between shaft and bushing | Standard size | Tolerance | | Standard | Repair limit | Replace |
| | | | Shaft | Hole | | | |
| | | 22 | +0.225<br>+0.212 | +0.294<br>+0.268 | Clearance<br>0.043 –<br>0.082 | | |
| 2 | Interference between gear and shaft | 22 | +0.225<br>+0.212 | +0.187<br>+0.162 | Interference<br>0.025 ~<br>0.063 | | |
| 3 | Interference between body and shaft | 22 | +0.314<br>+0.301 | +0.289<br>+0.263 | Interference<br>0.012 –<br>0.051 | | |
| 4 | Interference between gear and shaft | 22 | +0.225<br>+0.212 | +0.220<br>+0.187 | 0.008 (clearance)<br>– 0.038 (interference) | | |
| 5 | Inside diameter of cover bushing | Standard size | | Tolerance | | Repair limit | |
| | | 22 | | +0.294<br>+0.268 | | 22.33 | |
| 6 | Outside diameter of drive shaft | 22 | | +0.225<br>+0.212 | | 22.17 | |
| 7 | Clearance between gear and body | – | | – | | 0.5 | Replace gear or body |
| 8 | Regulator valve spring (when testing) | Standard size | | | | Repair limit | Replace |
| | | Free length | Installed length | Installed load | | Free length / Installed load | |
| | | 63.50 | 45.2 | 38.6 ± 1.1kg | | | |
| 9 | End play of drive shaft | Limit: 0.04 – 0.09 | | | | | |
| 10 | Tightening torque of cover mounting bolts | | | | | | – |

# COOLING SYSTEM

## WATER PUMP AND IDLER PULLEY (NTA-855-C)




6710F043

Unit: mm

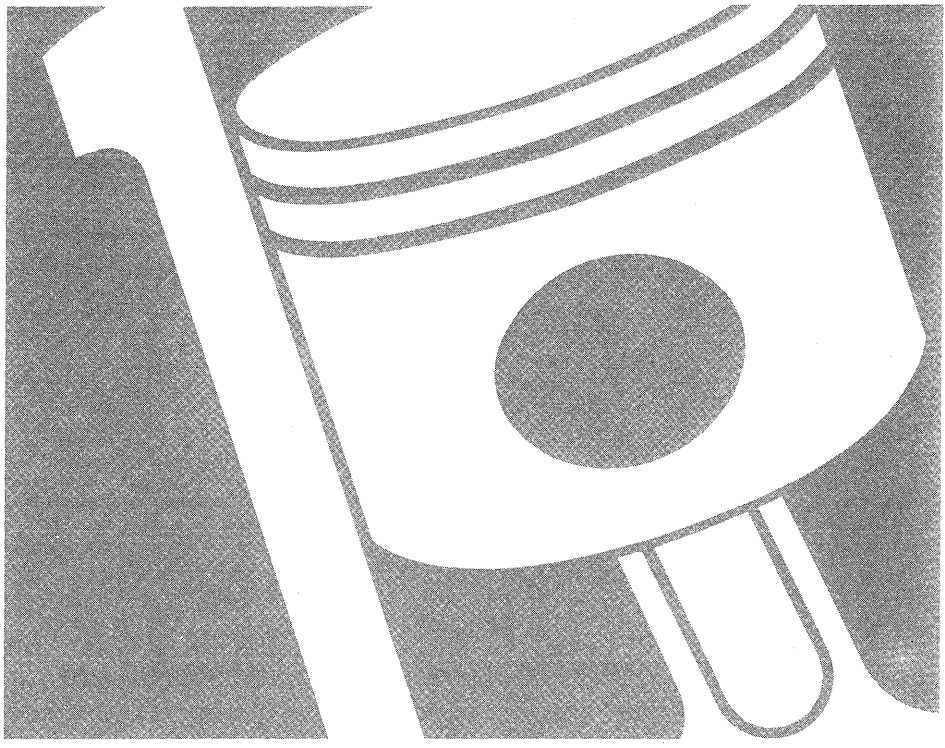
| No. | Check item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| | | Standard size | Tolerance | | Standard interference | Interference limit | |
| | | | Shaft | Hole | | | |
| 1 | Interference between pump shaft and impeller | 15.9 | +0.018<br>+0.008 | -0.025<br>-0.048 | 0.033 – 0.066 | 0.025 | Replace |
| 2 | Interference between pump shaft and pulley | 30.0 | +0.008<br>-0.003 | -0.033<br>-0.061 | 0.030 – 0.069 | 0.025 | |
| 3 | Tightening torque of idler pulley | 4.15 ± 0.15 kgm | | | | | Retighten |

# SHOP MANUAL

# N-855 SERIES

**Engine Serial No. 26100001 and up**

## 15 ENGINE REPAIR AND REPLACEMENT

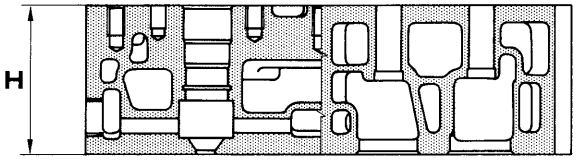


# CONTENTS

# CYLINDER HEAD

## GRINDING AND CORRECTING CYLINDER HEAD MOUNTING FACE

1. **Grinding**
   1) Remove the valve seat inserts.
      For details, see REPLACING VALVE SEAT INSERTS.
   2) Remove the injector sleeves.
      For details, see REPLACING INJECTOR SLEEVES.
   3) Grind the cylinder head to remove deformation or rust. Do not exceed the repair limit of the cylinder head height **H**.
      - ★ **Repair limit of cylinder head height (H): 110.24 mm**
      - ★ **Grinding to limit for one time: 0.10 – 0.15 mm**
      - ★ **Roughness of grinding surface: Within 6S**
      - ★ **Flatness (deformation): Within 0.05 mm**
      - ★ **Grinding limit: 0.3 mm**
      - ★ **Difference in head height per unit: Within 0.15**
   4) Press-fit the next oversize inserts.
      For details, see REPLACING VALVE SEAT INSERTS.
   5) Press-fit injector sleeves.
      For details, see REPLACING INJECTOR SLEEVES.

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2. **Checking after grinding**
- Check that the protrusion of injectors is within the standard value.
  - ★ **Protrusion of injector**
    **Allowed range: 1.52 – 1.78 mm**

# REPLACING VALVE SEAT INSERTS

**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-100-4800 | Valve seat puller | 1 |
| B | 795-100-3003 | Valve seat cutter | 1 |
| C | | Push tool | 1 |
| D | 795-134-1401 | Caulking tool | 1 |
| $D_1$ | 790-101-5821 | Grip | 1 |

★ When repairing and correcting the valve seat without replacing the valve seat insert, correct the valve seat as described in GRINDING AND CORRECTING VALVE SEATS.

**1. Removing valve seat inserts**

1) Using the grinder for valve seat puller A, make a groove in the insert as described below to facilitate the removal.
   ★ Working air pressure: 5 – 6 kg/cm$^2$
   ★ When replacing the grindstone, be sure to cut off the air supply.

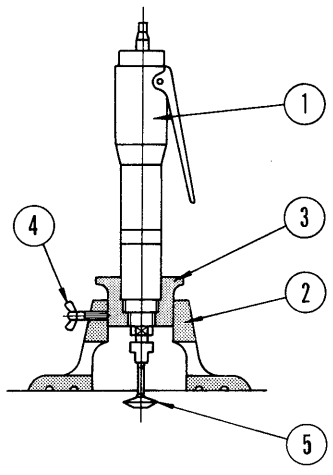
⚠ Before starting the grinding work, make a trial run of the grinder for a minute to confirm that it is in normal operating condition.
   - After the grindstone is replaced, make a trial run of the grinder for three minutes.

⚠ Confirm that the grindstone is not damaged, then install it to the grinder shaft securely.

⚠ Use safety glasses when operating the grinder.

i) Install grindstone ⑤ to grinder ①.

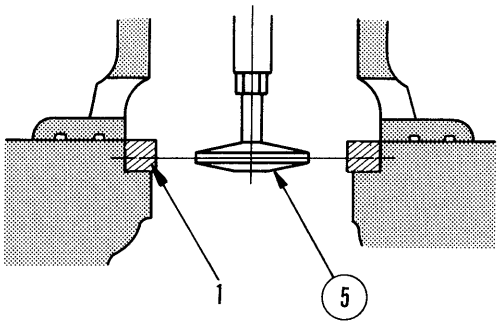
ii) Align the groove on sleeve ③ with holder ② and install the sleeve and the grinder. Use set screw ④ to adjust the grinder position.




6162F504

iii) Adjust the grinder position so that the horizontal center line of grindstone ⑤ is located at the center of valve seat insert (1), then secure the grinder by tightening the set screw.

iv) Fully open the grinder throttle valve and slowly move the rotating grindstone towards insert (1) until it comes into contact.

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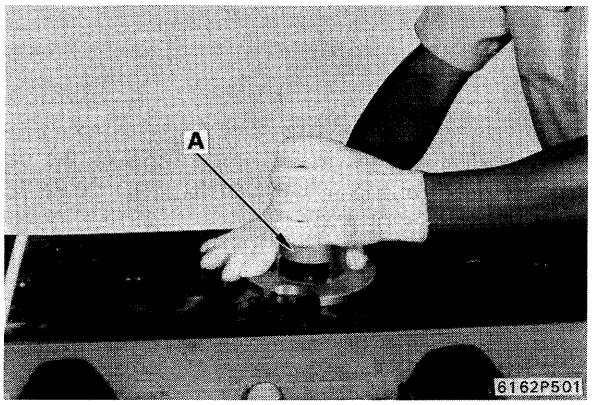
v) While pressing the grindstone lightly towards the inner surface of the insert, move the grindstone in a circle and make a groove in the circumference of the inner surface to a depth of about 1 mm.



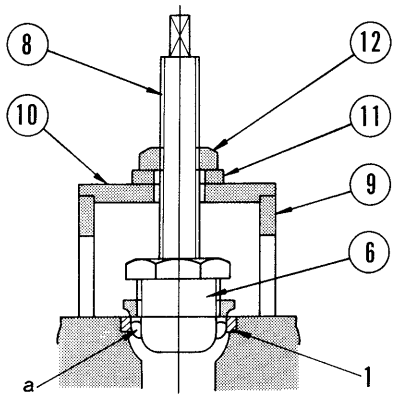

2) Using the puller head on valve seat puller **A**, remove the insert as follows:

i) Press three claws (a) on puller head ⑥ inside by hand and fit the puller head into insert (1).

ii) Tighten screw ⑧ so that the three claws will be pressed into the groove on the inside of the insert.

★ Stop tightening the screw as soon as the claws fit completely into the groove. If the screw is overtightened, the insert may get damaged and it will be difficult to remove.

iii) Place bridge ⑨ around the outside of the puller head, put plates ⑩ and ⑪ on the bridge, and tighten nut ⑫ until the insert is removed.

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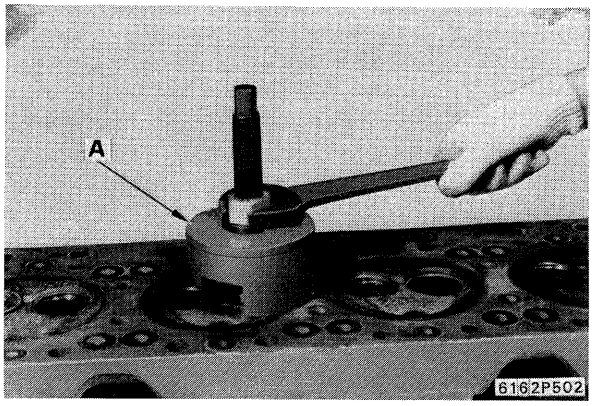
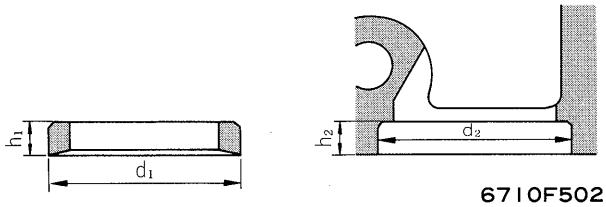


2. **Oversizing the mounting hole of the valve seat insert**
   1) Machine the hole to the next oversize by using valve seat cutter **B**.

- Machining sizes of the insert and the mounting hole.

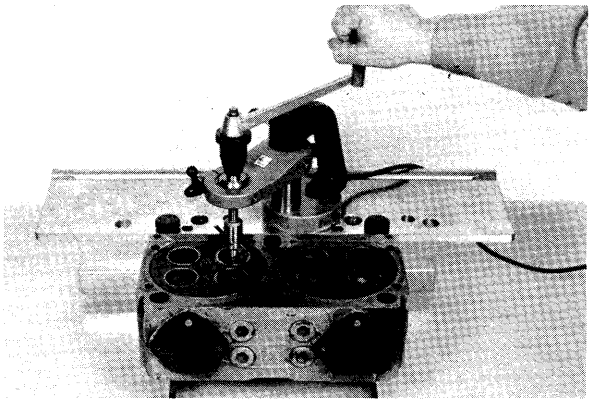



6710F502

Unit: mm

| Stamp on insert | Insert | | Insert mounting hole | |
|---|---|---|---|---|
| | O.D. ($d_1$) | Height ($h_1$) | I.D. ($d_2$) | Depth ($h_2$) |
| S.T.D | 50.877 ± 0.125 | 7.1 ± 0.06 | 50.8 ± 0.013 | 7.3 ± 0.06 |
| 0.125 O.S | 51.004 ± 0.125 | 7.1 ± 0.06 | 50.927 ± 0.013 | 7.3 ± 0.06 |
| 0.25 O.S | 51.131 ± 0.125 | 7.1 ± 0.06 | 51.054 ± 0.013 | 7.3 ± 0.06 |
| 0.50 O.S | 51.385 ± 0.125 | 7.225 ± 0.065 | 51.308 ± 0.013 | 7.43 ± 0.06 |
| 0.75 O.S | 51.639 ± 0.125 | 7.355 ± 0.065 | 51.562 ± 0.013 | 7.56 ± 0.06 |
| 1.00 O.S | 51.892 ± 0.125 | 7.48 ± 0.06 | 51.816 ± 0.013 | 7.68 ± 0.06 |

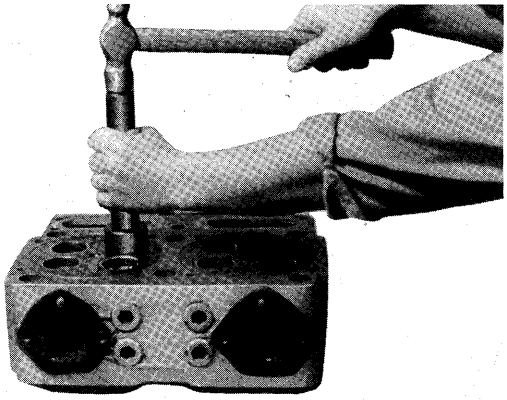
★ **Roughness of the finished inner surface of the insert mounting hole: Within 6.3S**
★ **Roughness of bottom of mounting hole: Within 12.5S**



2) If the caulked section of the mounting hole is damaged, remove the damaged portion within an oversize allowance of 1.00 mm.
   If the damaged portion cannot be removed within an oversize allowance of 1.00 mm, replace the cylinder head.

3. **Press-fitting the insert**
   Press-fit the insert by using insert push tool **C**.

4. **Caulking around the insert**
   Insert caulking tool **D** into the valve guide hole and caulk around the insert by hitting with a hammer.



5. **Finishing the seat surface**
   Finish the seat surface. For details, see GRINDING AND CORRECTING VALVE SEAT.

# GRINDING AND CORRECTING VALVE SEAT SURFACE

**Special tool**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-100-3003 | Valve seat cutter | 1 |

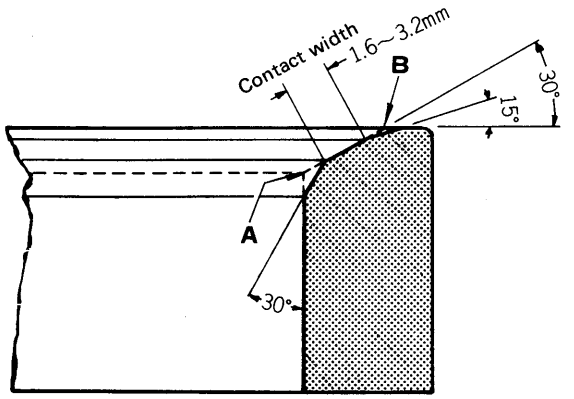
- When the valve seat is rough or when the insert is replaced, grind and correct the seat surface in the following manner.

1. Using valve seat cutter **A**, finish the seat surface to the dimensions given in the drawing at right.
   - ★ **Seat angle: 30°**
   - ★ **Contact width: 1.6 – 3.20 mm**
   - ★ **Concentricity of valve seat to the valve guide: Within 0.05 mm**
   - ★ When the contact width of the seat exceeds 3.2 mm, cut portions **A** and **B** as shown in the drawing.
     If the cutting must be made as far as the chamfered portion of the insert, replace the insert.

2. Apply a coat of abrasive compound to the seat surface and grind the valve and the valve seat surface.

3. Apply a coat of red lead to the seat surface and check the contact surface of the valve seat.

4. Install the valve and conduct a vacuum test.

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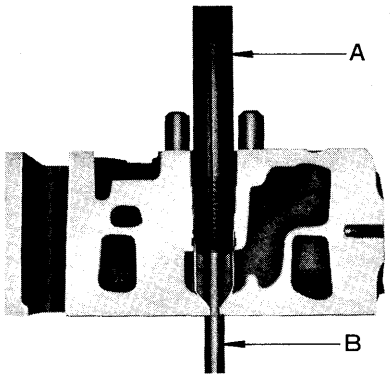
# REPLACING INJECTOR SLEEVES

**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-134-1510 | Sleeve extractor | 1 |
| B | 795-134-1520 | Push bar | 1 |
| C | 795-140-5260 | Bead cutting tool | 1 |
| D | 795-140-5520 | Socket | 1 |
| E | 795-140-5531 | Pilot | 1 |
| F | 795-134-1301 | Grooving tool | 1 |
| G | 795-130-5142 | Sleeve driver | 1 |
| H | 795-130-2501 | Sleeve holding tool | 1 |
| I | 795-132-2101 | Sleeve expander | |
| J | 795-140-5510 | Sleeve cutter set | 1 |
| K | 795-502-1121 | Holder | 1 |

**1. Extracting sleeves**

1) Insert and screw sleeve extractor **A** into injector sleeve.
2) While pressing down the sleeve extractor, insert push bar **B** into the other side and hit the push bar lightly with a hammer to remove the sleeve.
3) Clean the sleeve seat surface to remove all foreign matter and grease.

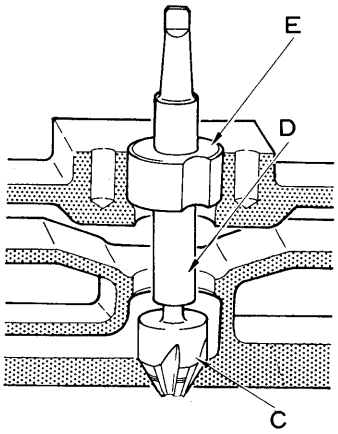



**2. Machining a bead (groove) in the sleeve seat face**

★ If the groove in the seat face is damaged, machine the groove with the bead cutting tool.

1) Install bead cutting tool **C** to a drilling machine using socket **D** and pilot **E**.
2) Machine the groove using an even force while applying cutting oil.
3) To achieve a better finish, keep the cutter rotating lightly for about 10 seconds after the machining.

★ **Rotating speed of cutter: Max. 75 rpm**
★ **Cutting amount: Max. 0.25 mm**

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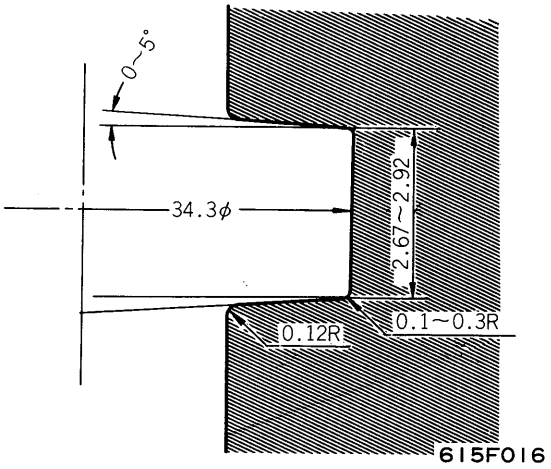
★ When setting the cylinder head on the drilling machine, retain a sufficient clearance beneath the cylinder head so that the cutter tip can protrude through the workpiece.

**3. Machining O-ring grooves**

1) Using grooving tool **F**, finish the groove to the sizes shown in the drawing at right.
2) After grooving, clean and remove all chips and foreign matter from the injector mounting hole.

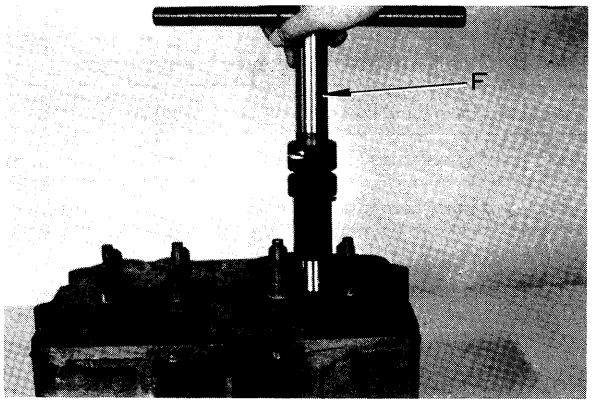



**4. Press-fitting injector sleeves**

1) Apply a coat of oil to an O-ring and fit the O-ring into the groove.
2) Insert sleeve into the cylinder head with sleeve driver **G**.
3) Set holding tool **H** in position and tighten the bolt.

kgm Mounting bolt: 5.2 ± 0.3 kgm

4) Insert a bar of the proper size (20 – 24 mm dia.) into the injector sleeve, attach it to the holding tool, and hit the bar lightly with a hammer until the sleeve seat face comes into snug contact.



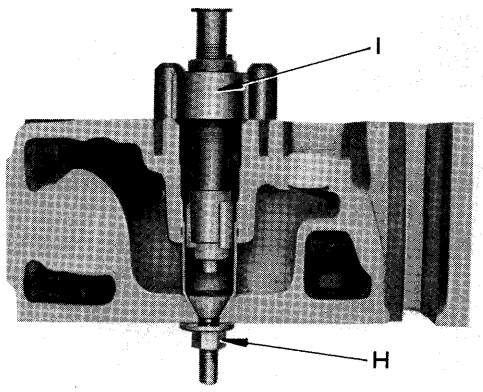

**5. Caulking the upper part of injector sleeves**

1) Set holding tool **H** to the lower part of the sleeve and tighten the bolt.

kgm Mounting bolt: 5.2 ± 0.3 kgm

2) Adjust the press-fit height and the inside diameter of expander **I**.
3) Set the workpiece on a radial drilling machine or upright drilling machina and caulk the upper part of the sleeve.

★ **Rotating speed: 300 – 350 rpm**
★ **Caulking force: 50 kg**
★ **Caulking time: 3 – 5 seconds**

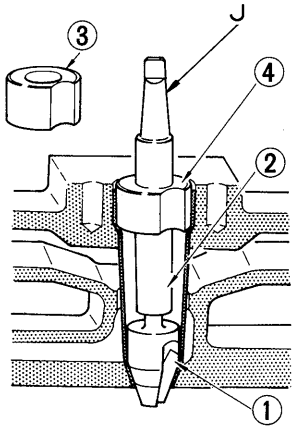


**6. Cutting injector seat face**

1) Install sleeve cutter set **J** on a drilling machine with sleeve cutter ① attached to socket ② and with pilot ③ or ④ as a guide.
2) Cut the injector seat face using an even force while applying cutting oil to the cutter.

★ While cutting the injector seat face, insert an injector and measure the cup protrusion with holder **K** and a dial gauge.

★ **Standard protrusion of injector cup:**
**1.52 – 1.78 mm**



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**7. Checking contact and leakage of the seat surface**

After the injector sleeve is replaced, confirm the contact width of the seat surface and check for water leakage.

★ **Standard contact width of injector seat surface:**
**Min. 1.2 mm**

# REPLACING VALVE GUIDES

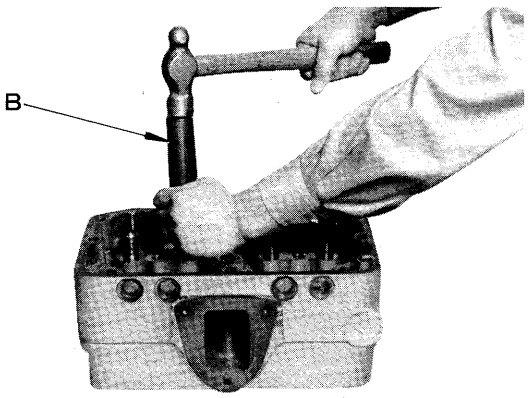
**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-100-1820 | Valve guide remover | 1 |
| B | 795-136-5162 | Valve guide driver | |

1. **Removing valve guides**
   Remove the valve guide using valve guide remover **A**.

2. **Press-fitting valve guides**
   1) Press-fit the valve guide until the tip of valve guide driver **B** comes into contact with the cylinder head.
   2) Measure the protrusion of the valve guide and confirm that the protrusion is within the range of tolerance.

   ★ **Protrusion of valve guide**
   **Tolerance: 33.53 ± 0.13 mm**



# REPLACING CROSSHEAD GUIDES

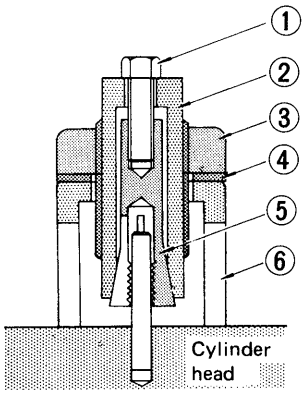
**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-130-3300 | Crosshead guide puller | 1 |
| B | 795-140-1800 | Crosshead guide driver | 1 |

**1. Removing crosshead guides**

Using crosshead guide puller **A**, remove the crosshead guide.

1) Hold the crosshead guide with collet ⑤ on the puller as shown in the drawing.
2) Tighten the collet with bolt ① and lock sleeve ②.
3) Turn nut ③ and pull out the crosshead guide.
4) Remove burrs from the crosshead guide mount and clean the part.

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**2. Press-fitting crosshead guides**

1) Fit the crosshead guide to the cylinder head and set crosshead guide driver **B** in position.
2) Press-fit the crosshead guide until the tip of the driver comes into contact with the cylinder head.

★ **Protrusion of crosshead guide**
**Tolerance: 47.5 ± 0.25 mm**

# GRINDING AND CORRECTING VALVES

**Special tool**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | (Commercially available) | Valve refacer | 1 |

**1. Grinding the seat face**

Grind the seat face with valve refacer **A**.

★ **Valve seat angle: 30°**

**2. Checking after grinding**

Measure the thickness of the valve head and the contact width of the valve seat face and confirm that the measurements are within the ranges of the standard values.

★ **Thickness of valve head**
**Repair limit: 2.67 mm**

★ **Contact width of valve**
**Standard width: 1.6 – 3.2 mm**

# REPLACING ROCKER LEVER BUSHING

**Special tool**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-130-3100 | Mandrel set | 1 |

1. Extract the bushing with the rocker lever mandrel set.

2. Remove burrs and foreign matter from the bushing hole.

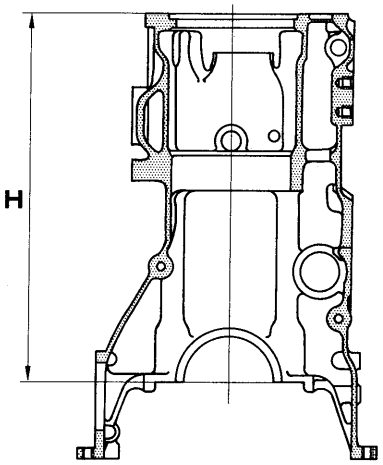
3. Press-fit the bushing with the mandrel set.

★ Align two oil holes.
Note, however, that the oil hole on the crosshead side is blinded for the intake valve.

**Inside diameter of bushing: $28.5^{+0.139}_{+0.062}$ mm**

# CYLINDER BLOCK

## GRINDING AND CORRECTING TOP FACE OF CYLINDER BLOCK



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**1. Grinding**

Grind the top face of cylinder block to remove deformations and corrosion within the repair limit of cylinder block height (H).

- ★ **Repair limit of cylinder block height (H): 482.45 mm**
- ★ **Grinding limit for one time: 0.03 – 0.08 mm**
- ★ **Roughness of grind surface: Max. 6.3 S**
- ★ **Standard flatness (Deformation) Max. 0.05 mm**

**When grinding with a grindstone (Reference):**

- ★ Grindstone speed: 1,650 – 1,950 m/min.
- ★ Table speed: 15 – 30 m/min.
- ★ Grinding limit for one time: 0.025 mm
- ★ Crossfeed for each grinding: 1 – 2 mm
- ★ Grindstone used: A46 1V
- ★ Grinding liquid used: Water soluble

**2. Checking after grinding**

Measure the protrusion of the cylinder liner. If the measurement deviates from the tolerance, correct part of the counterbore. For details, see CORRECTING CYLINDER BLOCK COUNTERBORE.

- ★ **Protrusion of cylinder liner**
  **Allowance: 0.08 – 0.15 mm**
  **Difference in protrusion between cylinders: Max. 0.05 mm**

# CORRECTING CYLINDER LINER COUNTERBORE

**Special tools**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-230-4400 | Counterbore tool | 1 |
| B | ST-681 | Tool adapter | 1 |

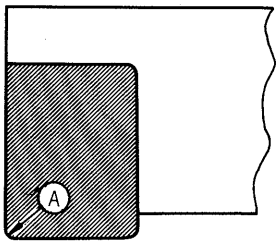
**1. Grinding counterbore section**

1) Check counterbore tool **A** to see if the following requirements are met.
   Portion Ⓐ : 0.2 – 0.3 mm Radius
   Side face: To be flat
2) Install tool adapter **B** to the liner bore.
3) Turn socket head screw ① on the tool and tighten both the upper and lower positioning pins.
4) Adjust tool adjustment sleeve ② so that the cutter comes into contact with the counterbore bottom.
5) While pouring oil on the cutter, rotate the cutter clockwise and apply a constant pressure to machine the counterbore.

★ **Depth of counterbore**
**When the top face is machined:**
**8.89 – 8.94 mm**
**Adjustment with shims, Correcting roughness and drooping: Max. 10.46 mm**

★ To prevent damage to the cutter, do not rotate it counterclockwise while machining.

6) Chamfer the inside edge of the counterbore to a depth of 0.3 to 0.6 mm.




Portion Ⓐ:
0.2 – 0.3 mm Radius
Side face:
To be flat

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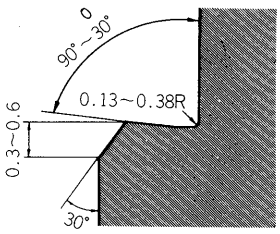


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# REPLACING MAIN BEARING CAPS

**Special tools**

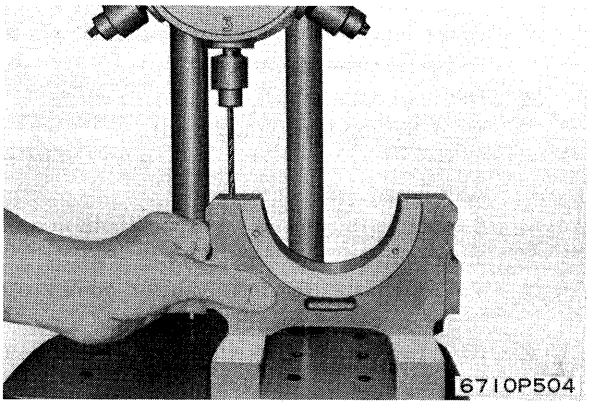
| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 6600-03-3700 | Reaming bar | 1 |
| B | 6600-03-5290 | Hand driver | 1 |
| C | 6600-03-3600 | Checking bar | 1 |
| D | CUST-136 | Boring tool kit | 1 |

- The main bearing cap for replacement is a semi-machined part whose inside diameter is 0.08 mm smaller and which is 0.13 mm longer.
- No. 7 main bearing cap for replacement has no dowel hole machined to mate with the cylinder block.

★ Do not ream the main bore more than necessary.

**1. Modification of main bearing caps**

1) To finish the main bearing cap to the required length, remove the same amount from both sides in each cutting and machine to within the interference allowance for the cylinder block.
   ★ **Interference allowance: 0.10 – 0.18 mm**
2) Machine a dowel hole on No. 7 main bearing cap in the following manner.
   i) Machine the width of the bearing cap to make it level with the thrust face of the cylinder block.
   ii) To determine the position of the dowel hole, apply a coat of red lead to the cap mounting surface on the cylinder block. Then install the cap, so that the mark of the dowel hole is made on the cap.
   iii) Drill a 5 mm dia. hole on the cap.
   iv) Install the cap on the cylinder block and machine the dowel hole on both the cap and the cylinder block.
   Diameter of drilled hole: 7.5 mm
   Depth of hole on the block: 12.3 – 13.1 mm
   Diameter of reamed hole: 7.92 – 7.95 mm
   Depth of hole on the block: 9.15 – 9.90 mm
   v) Countersink the dowel hole.
   Countersinking: 9.5 mm x 60°
   vi) Install a dowel of 0.5 mm dia.



**2. Reaming the main bore**

- Install the bearing cap and tighten to the specified torque.
- Install a dowel pin on No. 7 bearing cap.

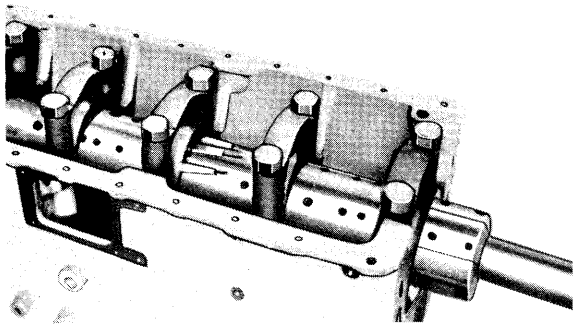
kgm Main bearing cap mounting bolt

kgm

| Order | Target | Range |
|---|---|---|
| 1 | 20 | 19.3 – 20.7 |
| 2 | 42 | 41.5 – 42.9 |
| 3 | 0 | Loosen completely |
| 4 | 20.2 | 19.3 – 20.7 |
| 5 | 42.2 | 41.5 – 42.9 |

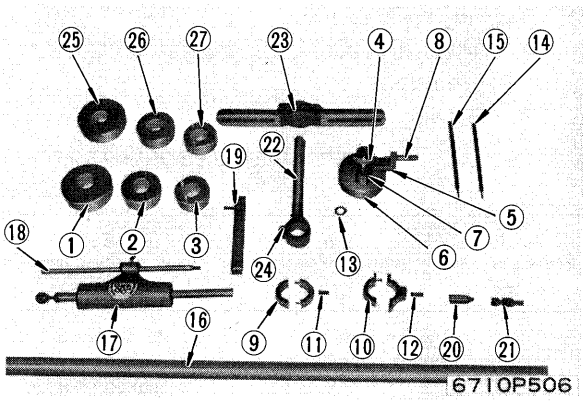
**Reaming the main bore with a reaming bar**

1) Insert reaming bar **A** into the cylinder block. Use two good cap holes behind the bar as guides.
2) Apply a coat of oil to the reaming cutter and the main bearing cap hole to prevent the hole from getting larger and to achieve a better finish.
3) Turn the reamer with hand driver **B** to finish the hole.
   ★ Ream all the main bearing cap holes.
4) After reaming is completed, use checking bar **C** to check for radial runout (misalignment).
5) Measure the inside diameter with a cylinder gauge and confirm that the measurement is within the tolerance.
   ★ **Inside diameter of main bearing cap hole**
   **Tolerance: $120.6\ ^{+0.050}_{+0.012}$ mm**
   ★ **Surface roughness: Max. 3.3S**



**Machining the main bore with the boring tool kit**

- With boring tool kit **D**, the radial runout (misalignment) and the inside diameter of the main bore are measured and machined.

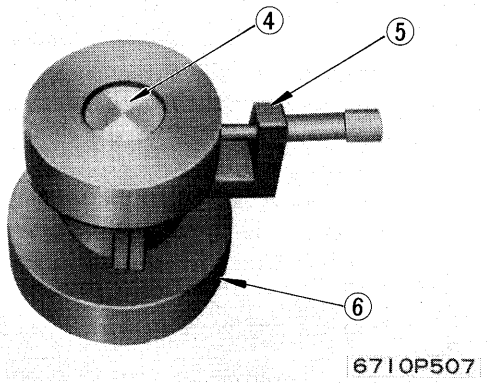


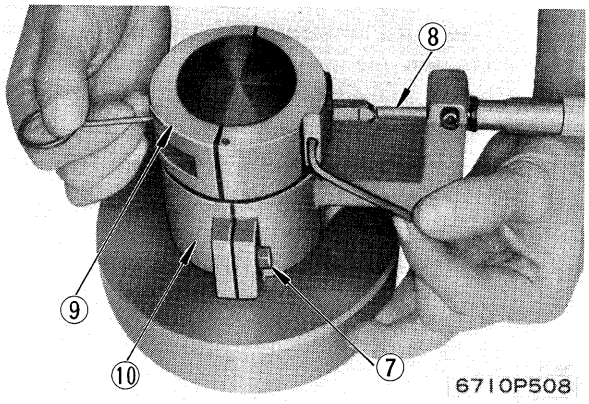

**1. Inserting center rings**

1) Remove two of the undamaged main caps located as far apart from each other as possible.
2) Select center rings ①, ②, and ③ of suitable size from the tool kit, install the center rings to the places from which the two caps were removed, and install the main bearing caps and tighten to the specified torque.

**2. Setting up the cutter**

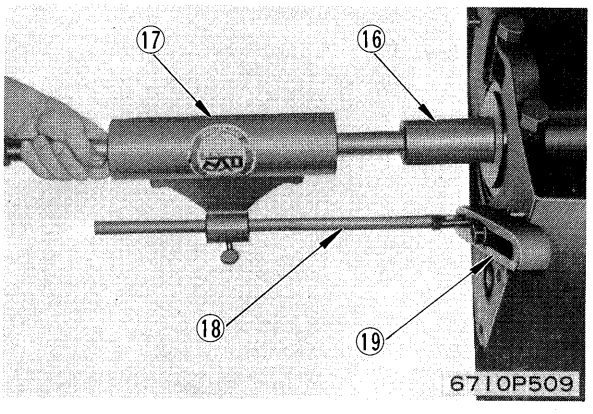
1) Install bracket ⑤ and base ⑥ to micrometer base shaft ④.
2) Tighten socket head screw ⑦ until the bracket on base shaft ④ is secured.
3) Put the center ring on the base shaft.
4) Install micrometer ⑧ to the bracket and set the micrometer to the size of the center ring.
5) Remove the center ring and install cutter holders ⑨ and ⑩ to the base shaft.
6) Install cutters ⑨ and ⑩, adjust them to the size set on the micrometer by using cutter key ⑬, and tighten them with wrenches ⑭ and ⑮.



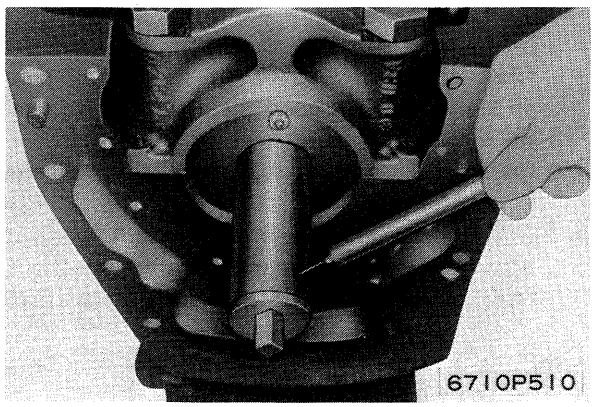



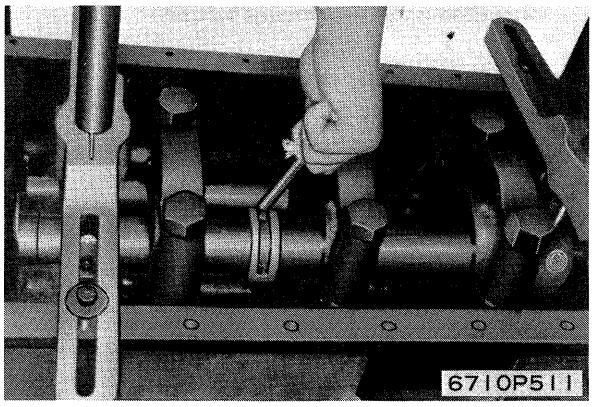

**3. Installing the tool**

1) Apply a coat of oil to the outer surface of boring bar ⑯ and slowly insert the boring bar into the main cap hole while rotating the bar.
2) Install feed assembly ⑰ to the end of the boring bar.
3) Install torsion bar ⑱ to the feed assembly and the feed assembly to the cylinder block.
4) Pull the knob on the feed assembly all the way and rotate it 1/4 turn.



5) Pull the feed assembly all the way and tighten the set screw on the torsion bar.
6) Tighten the torsion bracket end with a bolt and secure the torsion assembly to the block.
7) Back off the knob on the feed assembly 1/4 turn and put it in the pin.
8) Install adapter ⑳ to the end of boring bar.
9) To make the cutting direction clockwise, install swivel joint ㉑ to the 1/2'' drill chuck.
10) Install the tool holder (the cutter position is already set) before the main bearing cap hole to be machined with the boring bar.



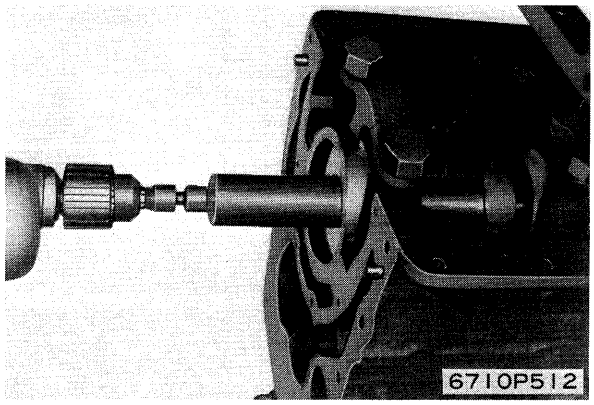



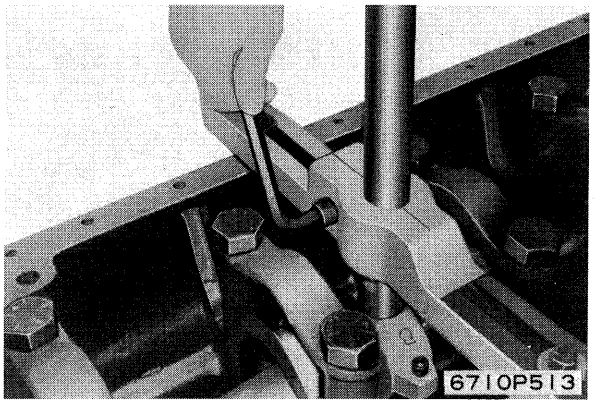

**4. Boring**

★ The boring work is done by rotating the boring bar clockwise at a constant speed.

● Before machining the next main bearing cap hole,
  a. Remove the tool holder.
  b. Pull the knob on the feed assembly and rotate it 1/4 turn.
  c. Push the shaft on the feed assembly all the way in, back off the knob 1/4 turn, and put it in the pin.
  d. Install the tool holder and machine the work-piece in the same way as described above.

★ To prevent the occurrence of misalignment and the deformation of the block mount face of the oil pan during the machining operation, the use of the bridge included in the tools is recommended.
When machining main bearing cap holes at the ends of cylinder block, be sure to use the bridge.
The bridge consists of bearing bar ㉒, bore bridge ㉓, bearing bridge ㉔, anchoring bolts, and washers, assemble then as shown in the photo.



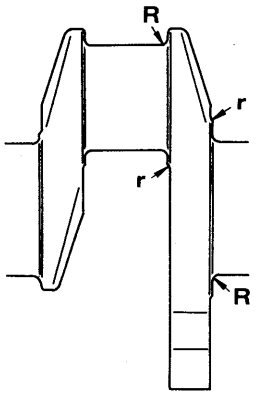
# GRINDING AND CORRECTING CRANKSHAFT

- When correcting wear, slight seizure, or damage on the crankshaft, grind the crankshaft to one of the following undersize dimensions:
  **Undersize dimensions: 0.25, 0.50, 0.75, 1.00 mm**

- If the crankshaft is bent or irregularly worn, it is better to replace the crankshaft then to correct it. (A lot of skill is required to correct the crankshaft.)

- Only the following damaged surfaces may be corrected by means of plating:
  1. Rear seal journal section
  2. Crankshaft gear mount section

- When correcting the crankshaft, pay particular attention to the finish of oil hole inlet R, fillet R, shoulder r, and zone R around the hole.
  - Finishing dimensions of fillet (corner weld)




R: 4.5 $^{+0.4}_{-0.2}$ mm
r: 6.4 mm

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★ **Equipment and jigs required for grinding and correcting work**
1) Magnetic flaw detector
2) Shore hardness tester
3) Etching kit
4) Crankshaft milling machine
5) Crankshaft grinding machine
6) Roughness gauge
7) Ball gauges for measuring fillet R
   **For minimum value: 8.74 ± 0.012 mm (0.35")**
   **For maximum value: 9.90 ± 0.012 mm (0.39")**
   - R gauges, as shown below, may be used in place of the ball gauges.

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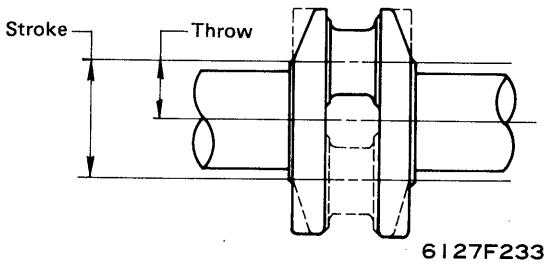
**1. Testing before grinding**
1) Visual check
   Check the crankshaft for cracks, damage, and discoloration caused by seizure and wear, and determine whether or not it is can be repaired by grinding.
2) Hardness test on the journal surface
   Hardness of journal surface (Shore hardness)
   **Allowable range: 60 – 67Hs**
   **Repair limit: 60Hs**
   If the hardness is worse than the repair limit, replace the crankshaft.
3) Torsion test




6127F233

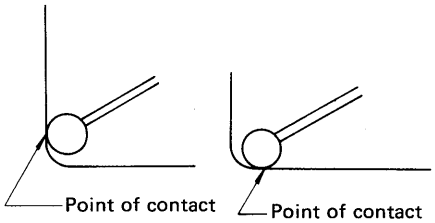
**Throw allowance: 76.2 ± 0.125 mm**
**Horizontal dislocation** (Difference in throw between No. 1 cylinder and the rearmost cylinder): 0.50 mm
**Variation of throw between cylinders:**
**Max. 0.20 mm**
If measurements exceed the above limits, replace the crankshaft.

**2. Testing during and after the correction**

1) Checking R portion of fillet

i) Check that the R portion of the fillet connects smoothly with the shoulder of journal.

ii) Using the ball gauge for measuring fillet R, check that dimension R is between the dimension of the minimum value gauge and the dimension of the maximum value gauge.




6127F234

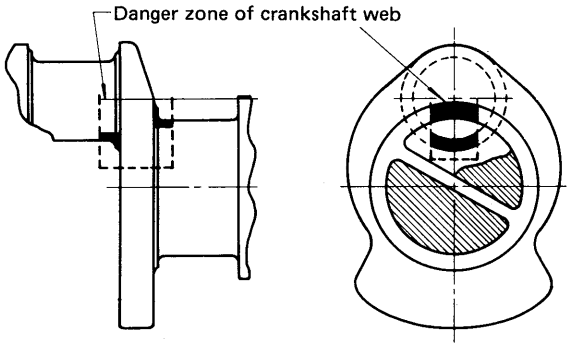
**Fillet R Min. radius: 4.37 mm**
**Max. radius: 4.95 mm**
**Undercut of journal section:**
**Max. 0.013 mm**

2) Checking for traces of seizure by using etching

- After correcting the crankshaft, carry out an etching inspection to check that there are no traces of grinding seizure.
- If any trace of seizure is found, grind off about 0.02 mm and recorrect it to the next undersize dimension.
- After the test, neutralize and clean the surface and apply a coat of anti-corrosion oil to the surface.

3) Magnetic flaw detection

- Before using a corrected crankshaft, perform a magnetic flaw detection test to confirm that there are no cracks.
- Use special care when checking the journal fillets which enter the danger zones of the web of the crankshaft.




6127F235

4) Measuring curvature (measuring alignment)

- Measure the curvature of the crankshaft after milling and check taht it is within the standard range.
- Check the bend (alignment) at the following places:

**i) Alignment of overall length**
**Allowance: Max. 0.09 mm**

**ii) Alignment of adjacent journals**
**Allowance: Max. 0.065 mm**

**iii) Alignment of front end**
**Allowance: Max. 0.025 mm**

**iv) Alignment of rear end**
**Allowance: Max. 0.025 mm**

**3. Machining main journals**

★ Machine every main journal to the same undersize dimensions.

★ Allow 0.007 to 0.008 mm for finishing when milling.

- **Undersize dimensions for the main journal**

Unit: mm

| Size | Standard size | Allowance |
|---|---|---|
| S.T.D | 114.00 | +0.300<br>+0.262 |
| 0.25US | 113.75 | +0.296<br>+0.271 |
| 0.50US | 113.50 | +0.292<br>+0.267 |
| 0.75US | 113.25 | +0.288<br>+0.263 |
| 1.00US | 113.00 | +0.284<br>+-.259 |

- **Out of roundness of main journal (T.I.R.)**
**Tolerance: Max. 0.013 mm**
- Milling conditions (reference)
Grindstone used: 19A46M
Rotating speed of grindstone:
2,000 – 2,700 m/min
Rotating speed of workpiece:
25 – 40 rpm
Feeding speed:
Outer diameter of journal (roughing):
0.3 mm/min
Outer diameter of journal (finishing):
0.04 mm/min

**4. Cutting the thrust faces**

★ It is not always necessary to cut the front and rear thrust faces to the same undersize.

★ When correcting the thrust faces, check that the end play of the crankshaft is within the permitted range.
(For details, see GENERAL ASSEMBLY)

- **Undersize dimensions of thrust faces**

Unit: mm

| | | | Rear thrust face | |
|---|---|---|---|---|
| | | | S.T.D | 0.25OS |
| Front thrust face | S.T.D | Standard size | 76.2 $^{+0.076}_{+0.025}$ | 76.45 $^{+0.076}_{+0.025}$ |
| | | Repair limit | 76.35 | 76.60 |
| | 0.25O.S | Standard size | 76.45 $^{+0.076}_{+0.025}$ | 76.70 $^{+0.076}_{+0.025}$ |
| | | Repair limit | 76.60 | 76.85 |

- **Squareness of thrust face (T.I.R.)**
  **Tolerance: Max. 0.04 mm**
  **Repair limit: 0.05 mm**
- **Thickness of friction surface**
  **Repair limit: 0.13 mm**

**5. Grinding crankshaft pin journal**

★ Grind every crankshaft pin journal to the same undersize dimensions.

★ Allow 0.007 to 0.008 mm for finishing when grinding.

- **Undersize dimensions of pin journal**

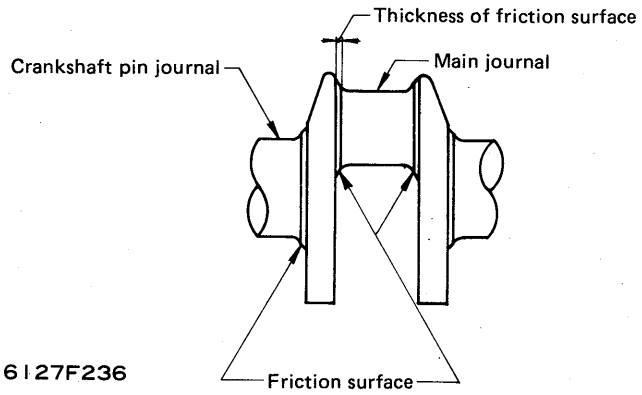
Unit: mm

| Size | Standard size | Allowance |
|---|---|---|
| S.T.D | 79.00 | $^{+0.375}_{+0.337}$ |
| 0.25US | 78.75 | $^{+0.371}_{+0.346}$ |
| 0.50US | 78.50 | $^{+0.367}_{+0.342}$ |
| 0.75US | 78.25 | $^{+0.363}_{+0.338}$ |
| 1.00US | 78.00 | $^{+0.359}_{+0.334}$ |

- **Out of roundness of pin journal (T.I.R.)**
  **Tolerance: Max. 0.013 mm**
- Grinding conditions (reference)
  The same conditions as in the main journal.

**6. Cutting the width of the main journal and pin journal**

- When correcting the friction surface of the main journal and pin journal, correct them with a minimum of milling.
- **Width of crankshaft pin journal**
  **When cutting one side only:**
  **Standard: 54 $^{+0.054}_{-0.025}$ mm**
  **Repair limit: 54.23 mm**
  **When cutting both sides:**
  **Repair limit: 54.48 mm**
- **Thickness of friction surface**
  **Repair limit: 0.13 mm**

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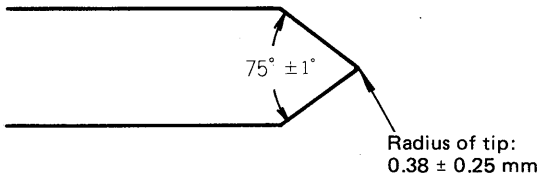
**7. Correcting the grindstone**

- Apply dressing to the grindstone after grinding each journal.
  Dressing feed speed: 180 mm/min
  Cutting: 0.02 mm
- Grindstone dresser
  Angle of tip: 75° ± 1°
  Radius of tip: 0.38 ± 0.25 mm
  Use a tubular type with a built-in industrial diamond on the tip.




6127F237

- Correct the edge of grindstone to match the fillet arc by adjusting the grindstone correcting device.
- When checking and correcting the edge of the grindstone, first grind a piece of wood as a test while checking with a ball gauge.

**8. Prevention of seizure when grinding**

1) Use the plunge method for grinding.
2) Use the whole width of the grindstone when grinding.
   Avoid grinding the surface of the boss, if possible.
3) Apply a sufficient amount of oil to the tool when grinding.
4) When the crankshaft is rotating at 50 rpm, the standard speed at the circumference of the grindstone should be 2,000 m/min.

**9. Finishing the surface**

- **Standard roughness of the surfaces**
  **Journal face, thrust face, and fillet: Max. 1.6S**
  **Taper at tip, boss of pin, and main journal: Max. 3.2S**
- **Finishing allowance: 0.007 – 0.008 mm**

**10. Actions after grinding**

- Check again that all dimensions are as specified.
- Clean all parts and apply a coat of rust preventive oil to the crankshaft.
- When storing for a long period, support at three points, or use a sling and it stand up vertically.

**11. Balancing (reference)**

(Do not make any repair which would affect balance of the crankshaft)

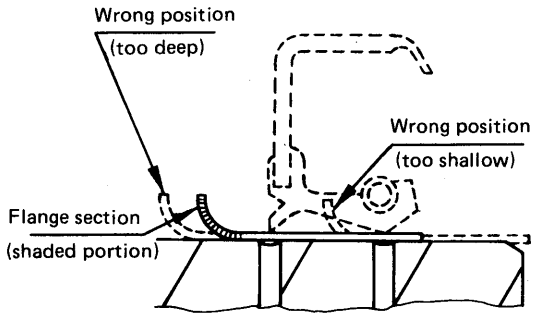
- Permissible limit of unbalance: 72 gcm
- Requirements for obtaining accurate balance of crankshaft
  Curvature of crankshaft: 0.05 mm (T.I.R.)
  Rotating speed of crankshaft: Max. 325 rpm
- Perform the balancing with the crankshaft gear mounted or with a weight (equivalent to the weight of the key on the gear) attached to the keyway.
- The balance is adjusted either by drilling holes on the counterweight or by grinding it.
  Grinding limit of counterweight: 56 g
  Holes to be drilled:
  Number of holes: Max. 5
  Diameter of hole: Max. 19 mm
  Depth of hole: Max. 50 mm
  Distance between hole and side face: Min. 5 mm
  Distance between holes:
  Min. 15° with respect to the center.

# CORRECTING SLEEVES ON CRANKSHAFT REAR SEAL

- When oil leakage occurs because of the wear of the rear seal surface of the crankshaft, the worn rear seal can be corrected by plating, by correcting the rear seal position, or by the following sleeve-fitting method.
- **Sleeve to be used for correcting the rear seal contact face (including press-fit tool)**
  **Part No.: 6610-29-1370**

**1. Press-fitting the sleeve**

1) Clean the contact face of the crankshaft seal and remove burrs, sharp cuts, and dents from the surface.
2) If the seal face is worn with deep scratches, fill the scratches with a powdered metal epoxy filling agent.
   ★ Press-fit a sleeve before the filling agent hardens.
3) If the seal face is worn with shallow scratches, apply a thin coat of a non-hardening sealing agent to the circular face of the correction sleeve.



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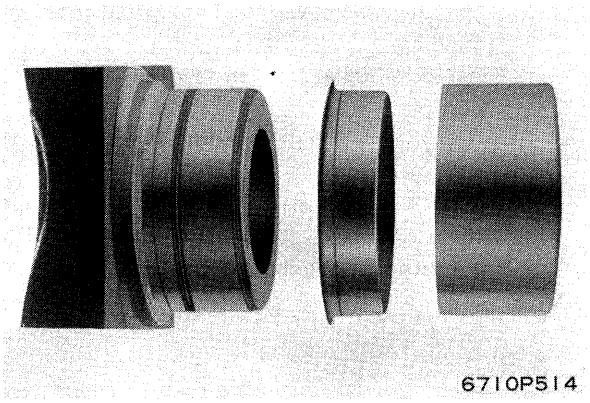
4) Fit a sleeve to the press-fitting tool and press-fit the sleeve by hitting the tool with a large plastic or wooden hammer until the trace of wear on the crankshaft is covered.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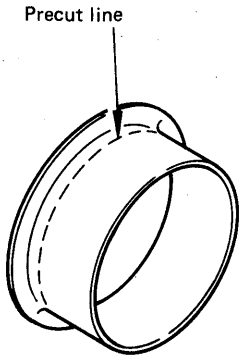
5) Make a cut on the precut line of the sleeve flange with a cutter or knife and cut off the flange section by twisting with nippers.
6) Remove the excess amount of filling and sealing agents forced out.



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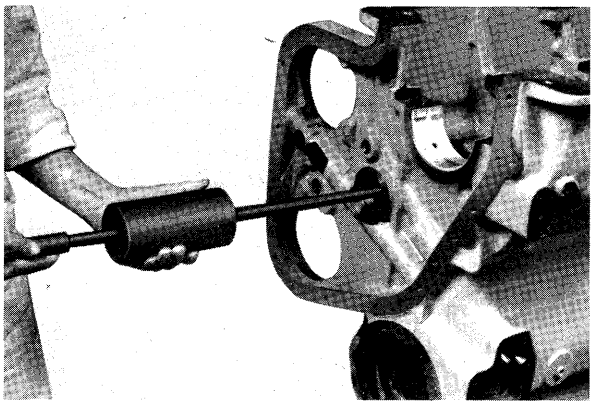
**2. Removing the sleeve**

- When the correction sleeve is press-fit, remove the sleeve in the following way.
  - To remove the sleeve, attach a chisel having a tip radius of about 1.5 mm to the periphery of the sleeve and hit the chisel with a hammer. Repeat it at three to six different points on the periphery until the sleeve is removed.

# REPLACING CAMSHAFT BUSHING

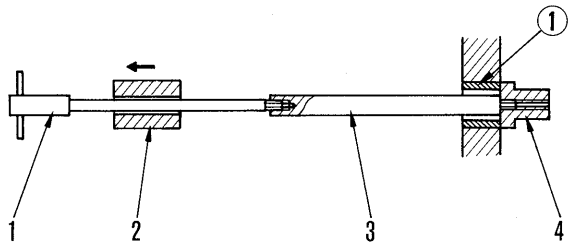


**Special tool**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-230-3402 | Bushing driver | 1 |

**1. Extracting bushing**

1) Insert handle (1) into hammer (2) and install rod (3) to the handle.
2) Insert rod (3) into camshaft bushing ①, insert mandrel (4) into the other side of the bushing, and screw in the mandrel to rod (3).
3) Slide hammer (2) on the handle and give shocks to the bushing until it is removed.
   ★ Remove burrs from the bushing mount hole and clean the hole.

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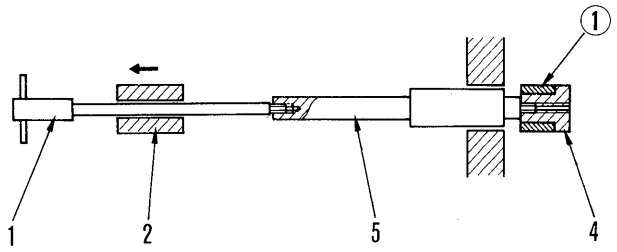
**2. Press-fitting the bushing**

1) Insert handle (1) into hammer (2) and install guide rod (5) to the handle.
2) Insert guide rod (5) to a hole into which a bushing is inserted, set bushing ① on mandrel (4), and screw the mandrel into guide rod (5).
3) Slide hammer (2) on the handle and press-fit the bushing by giving shocks.
   ★ Align the oil hole on bushing.
   ★ Inside diameter of bushing: $50.8\ ^{+0.013}_{-0.025}$ mm




6710F513

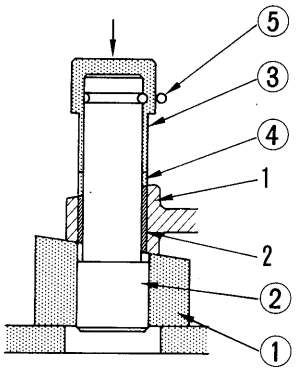
# REPLACING CONNECTING ROD BUSHING

**Special tool**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-240-6200 | Push tool | 1 |

**1. Extracting bushing**

1) As shown in the drawing, install block ①, mandrel ②, drivers ③ and ④, and pin ⑤ of push tool **A** on connecting rod (1).
2) Push down the top face of dirver ③ with a press and remove bushing (2).



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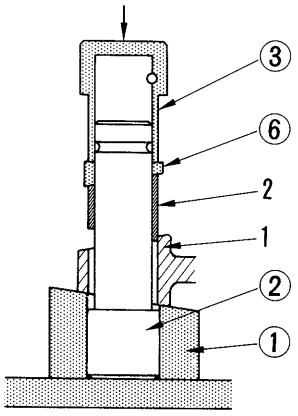
**2. Press-fitting the bushing**

1) Clean and remove burrs from the bushing mount hole.
2) Install new bushing (2), sleeve ⑥, block ①, mandrel ②, and driver ③ to connecting rod (1) as shown in the drawing.
   ★ Place the connecting rod horizontally.
   ★ Align the oil hole on the connecting rod with that on the bushing.
3) Press-fit the bushing by pushing down the top face of driver ③ with apress until sleeve ⑥ comes into contact with the side face of connecting rod.
4) Confirm that the oil holes are aligned with each other and remove burrs and foreign matter from the oil holes.
   ★ **Inside diameter of bushing: $50.8^{+0.038}_{+0.025}$ mm**



6710F515

# REPLACING CAM FOLLOWER LEVER BUSHING

**Special tool**

| | Part Number | Part Name | Q'ty |
|---|---|---|---|
| A | 795-240-2900 | Block mandrel set | 1 |

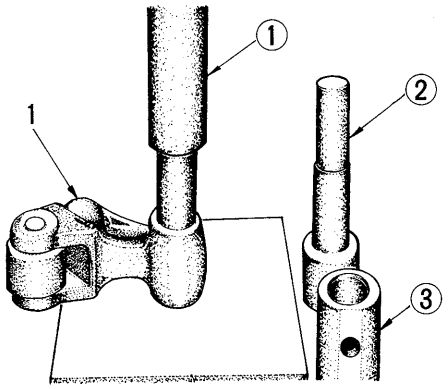
**1. Extracting bushing**

1) Assemble cam follower lever (1) and mandrel ① in block mandrel set **A** and remove the bushing by pressing the mandrel with a press.

**2. Press fitting bushing**

1) Clean and remove burrs from the bushing mount hole.
2) Fit a new bushing and sleeve ③ to mandrel ② for pressfitting, align the oil hole on the cam follower lever with that on the bushing, and press-fit the bushing until the sleeve comes into contact with the lever end.
3) Confirm that the oil holes are aligned with each other and remove burrs and foreign matter from the oil holes.

★ **Inside diameter of bushing: $19^{+0.063}_{+0.037}$ mm**

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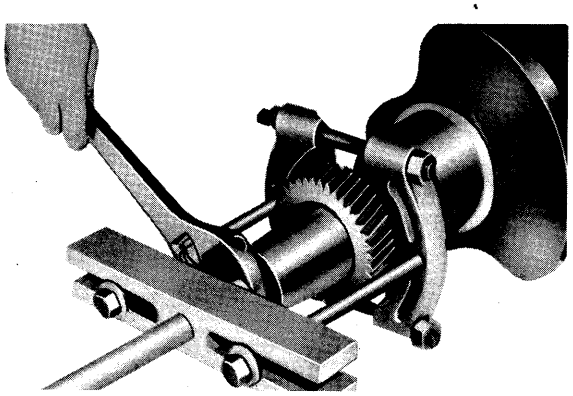
# REPLACING CRANKSHAFT GEAR

1. **Removing gear**

- Remove the gear either by using a gear puller or by making a cut on the gear tooth bottom with a grinder and cracking it with a chisel.



★ Be careful not to damage the shaft.

⚠ Use care in handling the grinder and chisel.

2. **Press-fitting gear**
   1) Check the mounting surface of the gear, keyway, and flange surface for damage. Repair with an oilstone, if damaged.
   2) Drive a new key into the keyway on the shaft.
   3) Heat the gear at the specified shrinking temperature for the given time.

★ **Crankshaft gear shrink-fitting temperature:**
**180 – 200°C**
**Heating time: 30 min.**

   4) Face the timing mark outside and press-fit the gear with a driving tool until the gear side face comes into snug contact with the shaft flange.

★ Drive the gear quickly while it is hot.

# REPLACING CAMSHAFT GEAR

★ To remove the camshaft gear, follow the procedure for replacing the crankshaft gear.

★ **Camshaft gear shrink-fitting temperature:**
**180 – 200°C**
**Heating time: 30 min.**

# REPLACING FLYWHEEL RING GEAR

⚠ Be careful not to drop the flywheel and or cause injury.

1. **Removing the ring gear**

- Make a cut on the gear tooth bottom with a grinder and crack it with a chisel to remove the gear.

⚠ Be careful when using the grinder and chisel.

2. **Press-fitting the ring gear**
   1) Check the ring gear mounting face for damage. If damaged, correct it with an oilstone.
   2) Heat the ring gear at the specified shrinking temperature for the given time.

★ **Ring gear shrink-fitting temperautre:**
**280 – 300°C**
**Heating time: 30 min.**

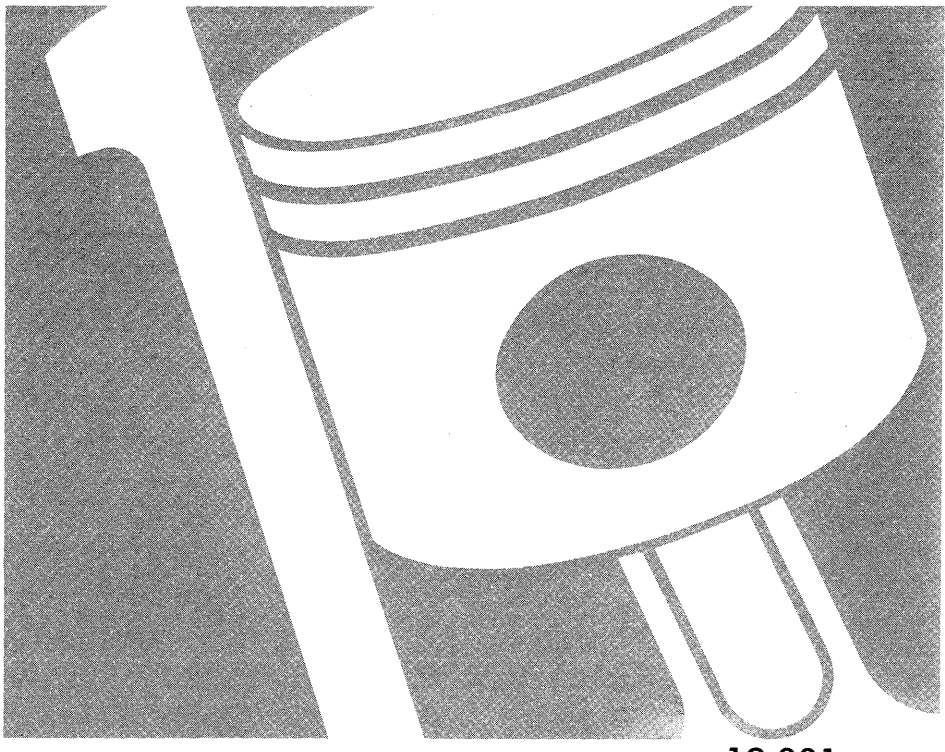
   3) Face the tapered side of the ring gear to the flywheel side and press-fit the ring gear until the side face comes into snug contact with the flywheel.

# SHOP MANUAL

# N-855 SERIES

**Engine Serial No. 26100001 and up**

# 19 OTHERS



# CONTENTS

# STANDARD TIGHTENING TORQUE

## 1. STANDARD TIGHTENING TORQUE OF BOLT AND NUT

(The bolts and nuts without specified torque values must be tightened to the specification of the standard torque value listed in the table below.)

| Nominal diameter (mm) | Width across flats of bolt (mm) | Standard tightening torque (± 10%) (kg.m) |
|---|---|---|
| 6 | 10 | 1.35 |
| 8 | 13 | 3.2 |
| 10 | 17 | 6.7 |
| 12 | 19 | 11.5 |
| 14 | 22 | 18 |
| 16 | 24 | 28.5 |
| 18 | 27 | 39 |
| 20 | 30 | 56 |
| 22 | 32 | 76 |
| 24 | 36 | 94.5 |
| 27 | 41 | 135 |
| 30 | 46 | 175 |
| 33 | 50 | 225 |
| 36 | 55 | 280 |
| 39 | 60 | 335 |

★ Do not use nylon gaskets, seal washers or any other non-ferrous washers.
★ The above table shows figures when using a torque wrench.

## 2. TIGHTENING TORQUE OF SPLIT FLANGE CONNECTION

**PRECAUTIONS WHEN TIGHTENING**

- Examine split flanges, seal surfaces of flange heads and O-ring grooves to check that there is no damage or foreign material.
- Fit O-ring firmly in grooves.
- Install so that flange head is completely connected to contact face.
- Push split flange fully inside before installing.
- Tighten bolts evenly to avoid installing on a slant.
- Do not tighten beyond specified torque.

Unit: kg.m

| Nominal size of piping | Size of bolt thread | Width across flats of bolt (mm) | Tightening torque (kg.m) |
|---|---|---|---|
| 04, 05, 06 | M 8 P 1.25 | 12 | 2.5 ± 1 |
| 10, 12 | M10 P 1.5 | 14 | 5.5 ± 2 |
| 14, 20 | M12 P 1.75 | 17 | 9.0 ± 3.5 |