



IHI EXHAUST-GAS TURBOCHARGER

RU 110, 130

INSTRUCTIONS FOR OPERATION

Ishikawajima-Harima Heavy Industries Co., Ltd.

FORWARD

To extend the life of the IHI Exhaust-Gas Turbocharger (hereinafter briefly called "turbocharger") and have it perform satisfactory functions, it is important to comply with the procedures for operation and maintenance as well as instructions contained in this instruction manual. Operate the turbocharger after reading through this instruction manual.

CAUTION

1. Order and inquiry

- 1) When ordering the parts, clearly indicate the following symbols in your order sheet :

* Example of stampings on nameplate

Model	: RU 110	RU 130
Machine No.	: RU 1100023	RU 1300056
Specification	: B7SOOUR4C29U	B6SOOUR4C34U

* Required parts

{	Parts name	: Journal bearing	}	Refer to parts list.
	Parts No.	: 60-1		
	Quantity	: Two pieces		

- 2) Address your order and inquiry to the following :

The nearest service station of engine manufacturer

2. Exemptions of liability

In respect of accidents during the guarantee period that are recognized as being clearly attributable to IHI's design or manufacture, IHI will make repairs free of charge, but IHI will assume no responsibility even during the guarantee period for the following accidents.

- 1) Accidents due to the use contrary to the instructions contained in this manual
- 2) Accidents due to a failure to make a periodic replacement of wearing parts
- 3) Accidents due to the use of parts other than IHI parts
- 4) Accidents due to the use in excess of the rated capacity

3. Communication

Regarding the doubts about this instruction manual, obscure points therein, special cases not stated therein or any disorder, etc., please contact the engine manufacturer or the nearest IHI business office.

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1. Specifications

Type of turbocharger	RU 110	RU 130
Type of turbine	Radial flow type	Radial flow type
Lubrication system	External lubrication	External lubrication
Type of bearing	Full floating type	Full floating type
Allowable continuous max. turbine speed (R.P.M.)	85,000	66,500
Allowable continuous max. gas inlet temperature (°C)	750	750
Dry weight (Kg)	22	35

2. Construction and function of turbocharger

2-1) Outline of construction and function

(1) Turbine

Exhaust gas from the engine passes through the nozzle of the turbine casing, is accelerated and blown to the turbine impeller and provides the turbine shaft with turning effort.

This is called "exhaust gas turbine", in which seal rings and heat protector are incorporated so that gas may not adversely affect the bearings.

(2) Blower

The blower impeller fitted to the turbine shaft receives the turning force, inhales air, compresses and delivers it to the cylinders. This is called "blower".

(3) Bearing

Thrust bearing

Since thrust is constantly applied to the turbine shaft, the thrust bearing is provided to prevent move of the shaft due to such thrust.

Journal bearing

A floating type is employed. In comparison with the ordinary fixed type, a dual oil film is formed on the internal and external faces of the bearing and the bearing effects a follow-up turning and therefore the sliding speed of the bearing face becomes lower than the turbine shaft revolving speed, resulting in an increase of dynamic stabilization effect.

(4) Blower side sealing mechanism

To prevent leak of feed air and oil, the back (seal plate) of the blower impeller is of a dual wall construction and the seal ring provided therein.

2-2) Structure and parts list

(1) RU110

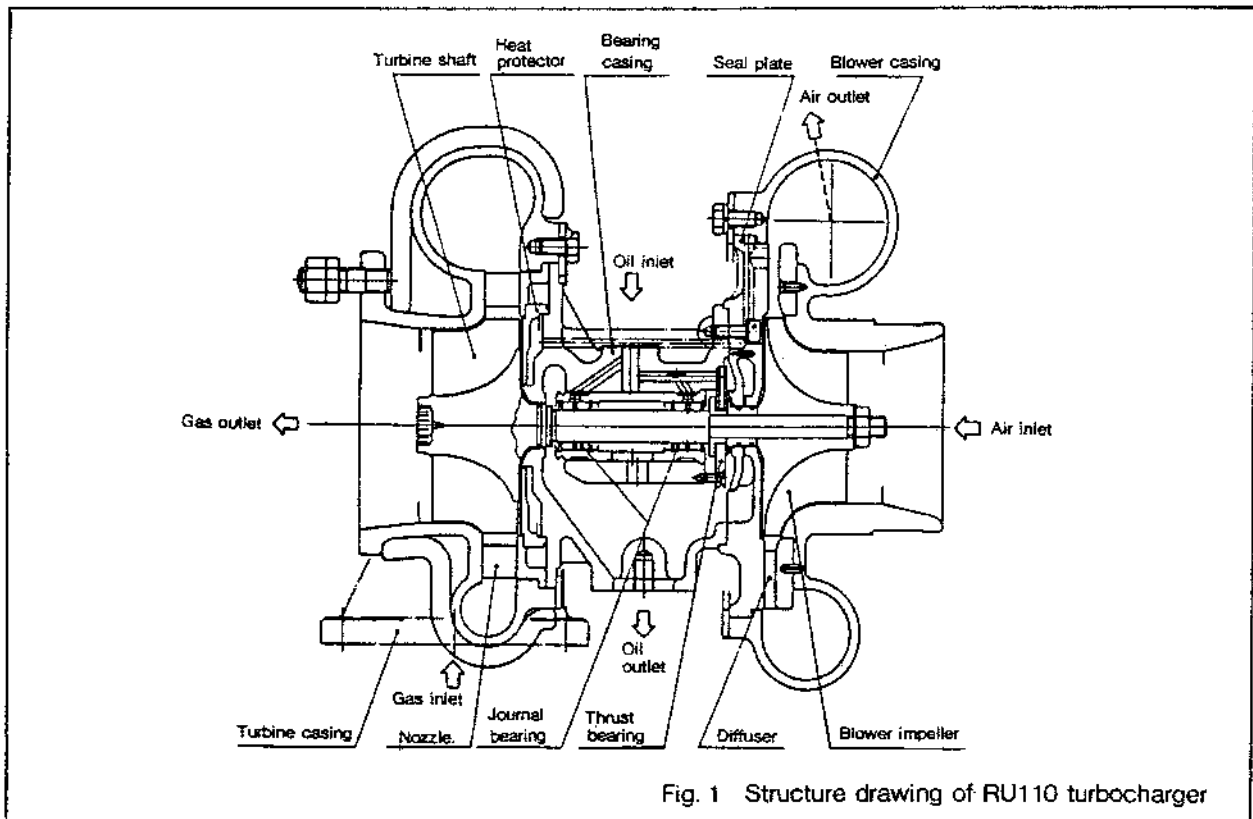


Fig. 1 Structure drawing of RU110 turbocharger

RU 110 Turbocharger Parts List

NO	Parts name	quantity	NO	Parts name	quantity
10-1	Turbine shaft	1	50-7	Flush head screw M4	4
-2	Thrust bush	1	-8	Toothed lock washer, flush type	4
-3	Oil thrower	1	60-1	Journal bearing	2
-4	Shaft end nut M10	1	-2	Thrust bearing	1
-6	Turbine side seal ring	1	70-1	Turbine casing (with insulation cover)	1 4
-7	Blower side seal ring	2	-2	Stud bolt M12	4
20-1	Blower impeller	1	-3	Nut, type 1, M12	4
30-1	Blower casing	1	-4	Nut, type 3, M12	8
-2	Blower side clamp	3	-5	Hexagon bolt M8	4
-3	Hexagon bolt M8	6	-6	Turbine side clamp	2
-5	Spring washer 8	6	-7	Lock plate	4
-7	Flush head screw M4	1 or 3	-8	Insulation cover	1
-8	Name plate	1	71-1	Turbine casing	1
-9	Screw rivet	2	-2	Stud bolt M12	4
35-1	Diffuser	1	-3	Nut, type 1, M12	4
40-1	Seal plate	1	-4	Nut, type 3, M12	8
50-1	Bearing casing	1	-5	Hexagon bolt M8	4
-2	Bearing bush	1	-6	Turbine side clamp	2
-3	Snap ring	4	-7	Lock plate	4
-4	Hexagon socket head bolt M6	4	80-1	Turbine nozzle	1
-5	Flush spring washer	4			
-6	Heat protector P	1			

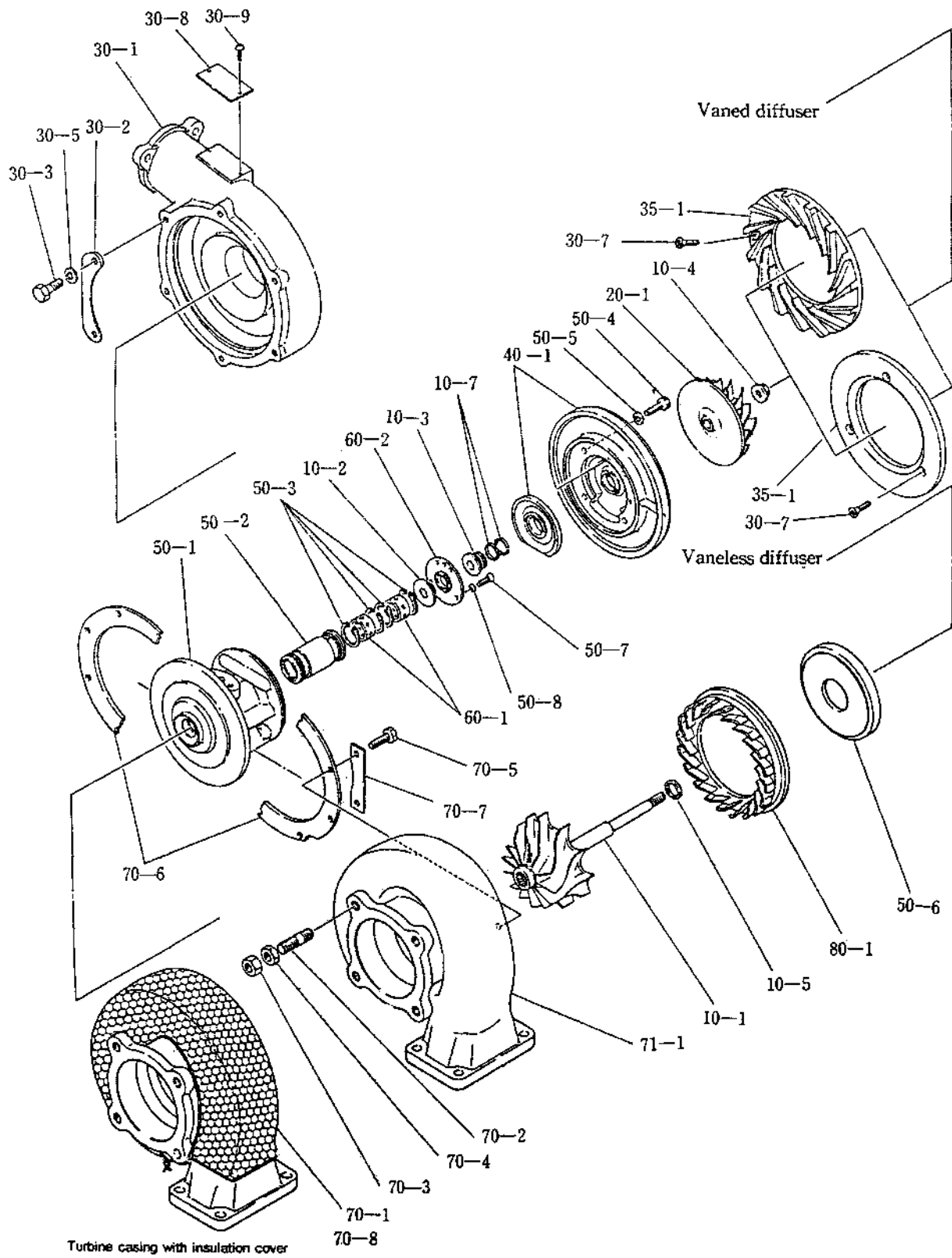


Fig. 2 Exploded view of RU110 turbocharger

(2) RU130

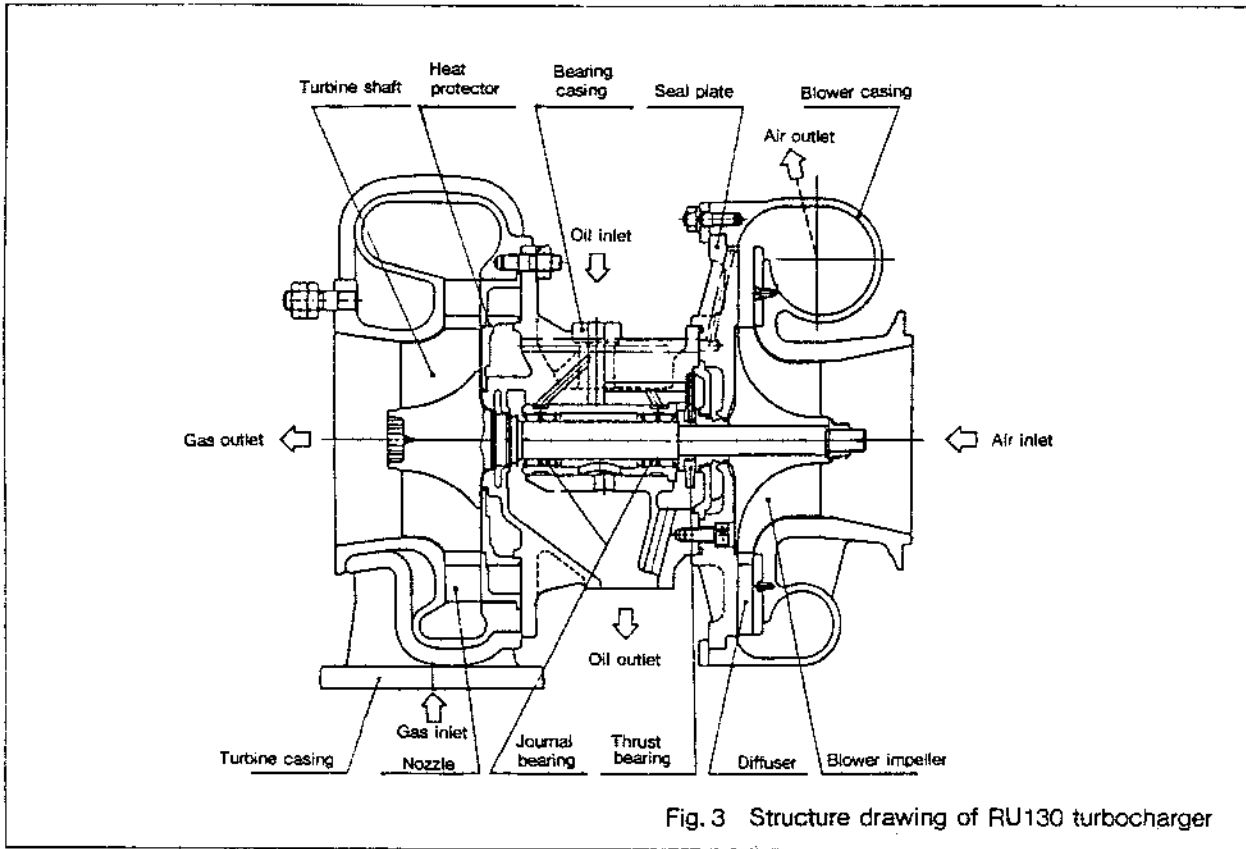


Fig. 3 Structure drawing of RU130 turbocharger

RU 130 Turbocharger Parts List

NO	Parts name	quantity	NO	Parts name	quantity
10-1	Turbine shaft	1	50-5	Flush spring washer 8	7
-2	Thrust bush	1	-6	Heat protector P	1
-3	Oil thrower	1	-7	Flush head screw M6	4
-4	Shaft end nut M14	1	-8	Toothed lock washer, flush type, 6	4
-5	Turbine side seal ring (large)	1	60-1	Journal bearing	2
-6	Turbine side seal ring (small)	1	-2	Thrust bearing	1
-7	Blower side seal ring (large)	1	70-1	Turbine casing (with insulation cover)	1
-8	Blower side seal ring (small)	1	-2	Stud bolt M12	4
20-1	Blower impeller	1	-3	Nut, type 1, M12	4
30-1	Blower casing	1	-4	Nut, type 3, M12	4
-2	Blower side clamp	4	-5	Stud bolt M10	12
-3	Stud bolt M8	12	-6	Nut M10	12
-4	Hexagon nut M8	12	-7	Lock plate	6
-5	Spring washer 8	12	-8	Insulation cover	1
-7	Flush head screw M5	1 or 3	71-1	Turbine casing	1
-8	Name plate	1	-2	Stud bolt M12	4
-9	Screw rivet	2	-3	Nut, type 1, M12	4
35-1	Diffuser	1	-4	Nut, type 3, M12	4
40-1	Seal plate	1	-5	Stud bolt M10	12
-3	"O" ring	1	-6	Nut M10	12
50-1	Bearing casing	1	-7	Lock plate	6
-2	Bearing bush	1	80-1	Turbine nozzle	1
-3	Snap ring	4			
-4	Hexagon socket head bolt M8	7			

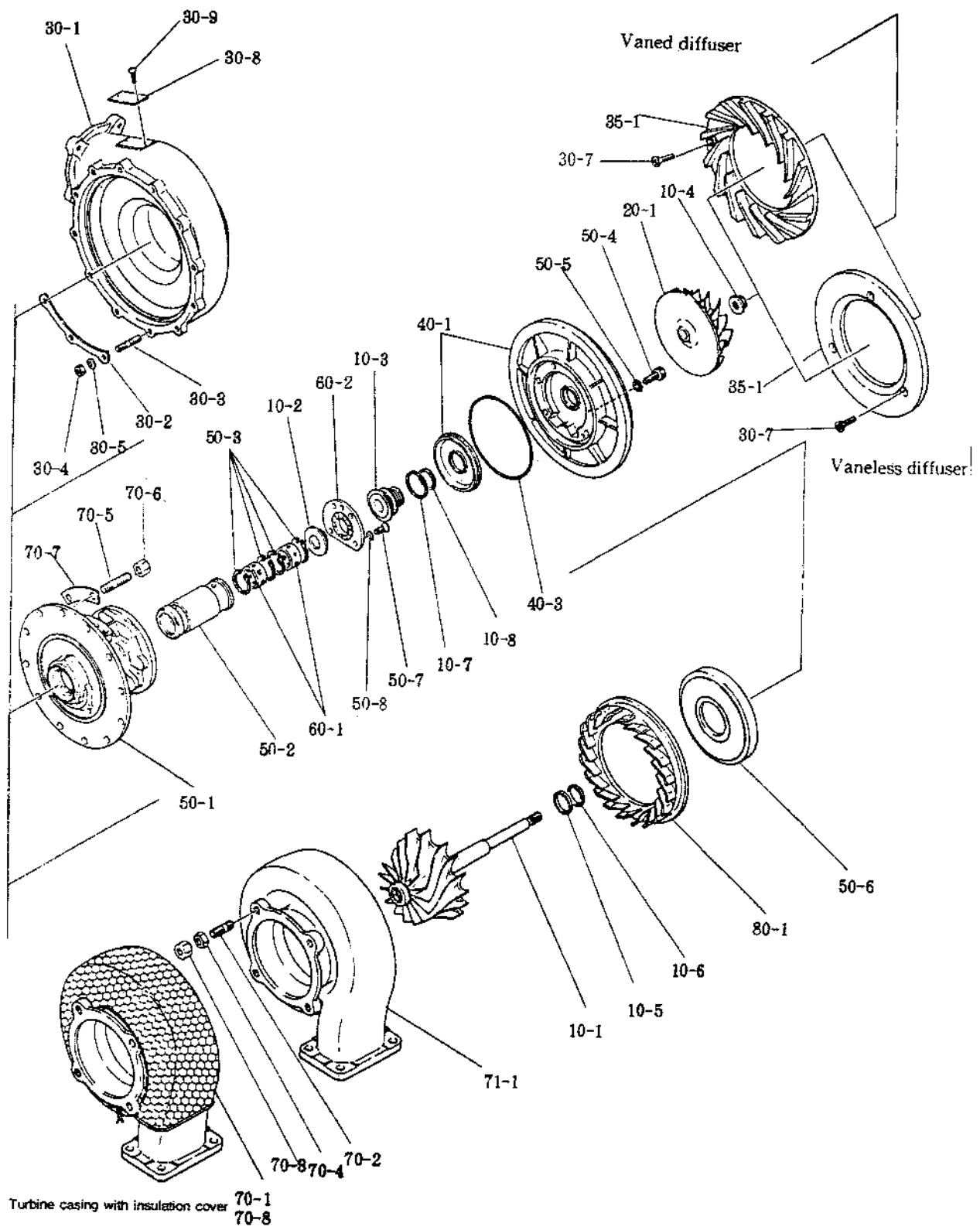


Fig. 4 Exploded view of RU130 turbocharger

3. Handling

3-1) Cautions in engine operation

For starting, running and stopping of the engine, observe the following instructions.

No.	Item	Cautions	Reason
1	Starting	<ol style="list-style-type: none"> 1. Checking of oil level. System oil lubrication : engine oil pan 2. In case of system oil lubrication : Start engine after driving engine with starter until rise of oil pressure 0.5~1.0 kg/cm²g. is confirmed 3. In case oil, oil filter and lubrication system parts have been exchanged or engine has been stopped for a long time (for more than a week) or in cold area, loosen oil pipe joint at inlet of turbocharger and carry out priming (which also serves for air purge) by means of starter or wing pump until oil comes out. Thereafter, be sure to retighten the joint and then proceed to starting. 	<ol style="list-style-type: none"> 1,2 Prevention of delay in oil circulation : If engine is started abruptly, turbocharger starts running before oil reaches it as well various parts of engine, resulting in abnormal wear or seizure of bearings due to insufficient circulation. 3. Improvement of oil fluidity : In a cold area or when engine has been stopped for a long time, fluidity of oil is lowered.
2.	Directly after starting	<ol style="list-style-type: none"> 1. Warm up engine after starting. Perform idling for at least 5 minutes after starting. However, since more than 20 minutes of idling affects engine combustion, apply load from time to time if idling has to be continued for more than 20 minutes under unavoidable circumstances. 	<ol style="list-style-type: none"> 1. Abrupt load If load is applied abruptly directly after starting and before engine and turbocharger are not running smoothly, seizure will arise at points to which oil is not yet fed fully.

No.	Item	Cautions	Reason
		2. Check various parts to ensure that there is no leak of oil, gas and air.	2. Oil, gas and air leak and especially oil leak causes drop of oil pressure and shortage of lubrication, resulting in seizure of bearings.
3.	During operation	Confirm the following : 1. Oil pressure During idling : More than 1.0 kg/cm ² Under full load : 3.0~5.0 kg/cm ² 2. If abnormal sound or vibration is produced, stop running in gradually lowering rpm and look into the cause.	1. Too low oil pressure causes abnormal wear or seizure of bearings. Too high oil pressure causes oil leak. 2. If operation is continued when abnormal sound or vibration is being produced, repair becomes impossible and engine trouble is caused.
4.	Stopping	1. Lower load after high load. 2. Stop engine after idling for at least 5 minutes or so.	1. If engine is stopped abruptly after running under high load, heat is transmitted from turbine impeller in a red hot condition to bearing, oil burns and seizure of bearing metal and turbine shaft is caused.

3-2) Routine inspection and maintenance

The condition of the turbocharger is greatly influenced rather by the condition of maintenance of the engine itself.

It is necessary to perform handling specified for the engine reliably.

Cautions to be taken will be described in the following :

(3) Suction system

With regard to the suction system, pay attention to the air cleaner.

In the case of the oil bath type of air cleaner, the cleaning effect is lowered if oil level is lower than specified, whereas if oil level is too high, oil is sucked up and contaminates the case. In particular, if the rotor is contaminated, precisely adjusted balance is lost to cause vibration and great force is applied to the bearing and causes seizure or abnormal wear of the bearing ; therefore, it is important to use a perfect air cleaner at all times.

In the case of the paper type of filter, clean it according to the indication on the duster indicator so as to minimize suction resistance.

(2) Exhaust system

With regard to the exhaust system, pay attention to the prevention of gas leak and seizure. If exhaust gas leaks from exhaust pipe and turbocharger fittings, etc., turbocharge effect is lowered and therefore pay attention to the tightened condition of parts. Since heat-resisting steel nuts are used for the turbine casing and other parts to be subjected to high heat during operation, be careful not to replace them with ordinary steel nuts and further, apply screw seizure preventive paint to the tightened nuts at specified points.

(3) Fuel system

If the full-load stopper to control max. injection of the fuel injection pump or the maximum speed stopper to control its maximum number of revolutions, etc. is adjusted without using the pump tester, the turbocharger may run at overspeed and be destroyed.

On the other hand, if spraying from the fuel injection nozzle becomes poor or the injection timing gets out of order, exhaust gas temperature rises and affects the turbocharger adversely ; therefore, perform nozzle test as in the case of non-supercharged engines.

(4) Lubrication system

With regard to the lubrication system, pay attention to oil quality and the time of replacement of oil filter.

In the case of engine with turbocharger, deterioration of oil affects the engine proper and the turbocharger as well quite adversely. Accordingly, use oil for the turbocharger under the following conditions.

Description		Specification	
Quality of oil		Diesel engine oil API Service class : CC, CD.	
		SAE NO.	Oil temp. before turbocharger
		SAE 20	35 ~ 60 °C
		SAE 30	42 ~ 80 °C
		SAE 40	50 ~ 90 °C
Oil change interval	Construction machine	Every 100-150 hrs.	
	Marine engine & generator	Every 400-500 hrs.	
Cleaning and inspection of oil filter		Refer to engine manufacturer's instruction manual.	

Note : Engine system oil lubrication

In case the oil change interval is different from the engine oil change interval, determine the change interval by consulting with the engine manufacturer.

3-3) Periodical inspection and maintenance

Check up conditions and contamination of the turbocharger as a whole periodically.

Though the frequency of inspection varies with the operating conditions, conduct inspection per type of use as follows.

Use		Inspection interval			
		Every month	Every 3 months	Every 6 months	Every 12 months
Item	Construction machinery	Every month	Every 3 months	Every 6 months	Every 12 months
	Marine engine & generator	Every 100 hrs	Every 300 hrs	Every 600 hrs	Every 1200 hrs
	Inspection points	Every 400 hrs	Every 1200 hrs	Every 2400 hrs	Every 4800 hrs
Turbocharger	Checking of clamped parts for tightness	○			
	Revolving condition of turbine shaft		○		
	Checking of play of turbine shaft			○	
	Disassembling, cleaning and inspection of entire turbo-charger				○
Lubricating system	Cleaning and inspection of oil filter	In accordance with instruction manual of the engine manufacturer			
	Engine oil change				
	Inspection of oil pipe system	○			
Feed and exhaust system	Inspection of feed and exhaust pipe system	○			

(1) Procedures for inspection of revolving condition of rotor

Check up the revolving condition of the rotor in listening to abnormal sound, if any, during revolution. When conducting the check in using a sound locating bar, apply the bar tip strongly to the turbocharger case and increase engine rpm gradually. In this case, an emission of sharp sound intermittently every two to three seconds indicates abnormality. In case where such phenomenon has arisen, there is the possibility of a failure in the rotor and therefore the turbocharger must be replaced or disassembled and repaired.

(2) Procedures for inspection of rotor play

Dismount the turbocharger from the engine and check the rotor for play in axial and radial directions as follows. After dismounting the turbocharger from the engine, be sure to cover oil outlet and inlet openings with gum tape or the like.

Play in axial direction of rotor

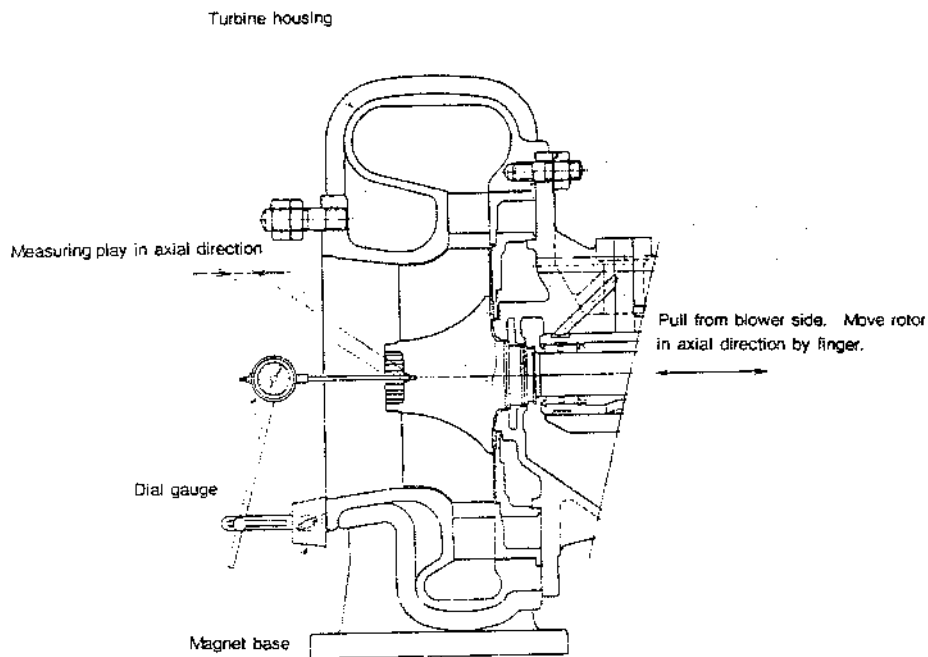


Fig. 5 Play in axial direction

	RU110	RU130
Service standard	0.06~0.10 m/m	0.07~0.11 m/m
Wear limit	0.20 m/m	0.20 m/m

Play in radial direction of rotor

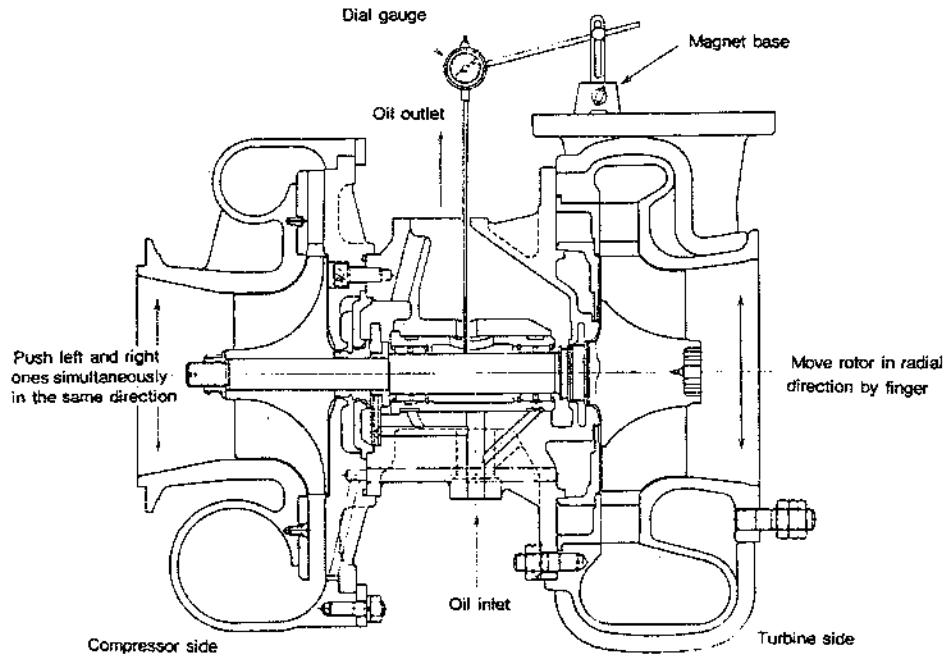


Fig. 6 Play in radial direction

	RU110	RU130
service standard	0.09~0.14m/m	0.11~0.17m/m
wear limit	0.26m/m	0.29m/m

If play in the axial and radial directions has exceeded the wear limits, replace the turbocharger or disassemble and repair it.

(3) Procedures for disassembling, cleaning and inspection of turbocharger

Dismantle the turbocharger from the engine and perform disassembling, cleaning and inspection of turbocharger. After dismantling the turbocharger from the engine, be sure to cover oil outlet and inlet openings with gum tape or the like.

Perform work in this case in accordance with the **Turbocharger Maintenance Manual**.

(4) Cautions to be taken when mounting turbocharger on engine

When mounting the turbocharger on the engine or in the case of handling after mounting, perform work in strictly observing the following instructions. **In particular, take due caution against mixing of foreign matter in the interior of the turbocharger.**

<Lubrication system>

Before mounting the turbocharger on the engine, pour new engine oil through the oil inlet opening and turn the turbine shaft manually to lubricate journal metal and thrust metal.

Carry out cleaning of oil inlet and outlet pipes from engine and confirm that there is no collapse of pipe nor any dust and foreign matter in pipe.

Connect the lubrication system securely so that there may be no oil leak from oil pipe connections.

<Suction system>

Confirm that there is no dust nor foreign matter in the suction system.

Connect the suction system securely so that there may be no air leak from connections with suction dust and air cleaner.

<Exhaust system>

Confirm that there is no dust nor foreign matter in the exhaust pipe system.

Since heat-resisting steel bolts and nuts are employed, when fitting them, be careful not to use common bolts and nuts with them inadvertently. Further, apply seizure preventives to tightened bolts and nuts.

Connect exhaust pipes securely so that there may be no gas leak from pipe connections.

4. Phenomena observable at time of trouble

If there is any failure in the turbocharger, it cannot fully exhibit its function and required engine output cannot be obtained. If there is any trouble, the following phenomena arise and therefore engine parts and turbocharger should be checked.

- (1) Dense exhaust smoke
- (2) White exhaust smoke
- (3) Rapid decrease of engine oil
- (4) Drop of output
- (5) Emission of abnormal sound
- (6) Great vibration

5. Procedures for washing of turbocharger blower

When cleaning the blower with the turbocharger mounted on the engine, comply with the following procedures.

5-1) General

- (1) Use "Blower-Wash" and clear water for washing.
- (2) Determine the interval of washing on the basis of time when feed air pressure has fallen by about 10 % under normal operating conditions. About once a week of washing is appropriate, though the proper interval of washing varies considerably with the operating conditions.
- (3) Since cleaning of whole turbocharge is impossible under this method, also perform a periodical disassembling and cleaning.
- (4) Do not remove the cap on the injection opening except at the time of washing.

5-2) Procedures

- (1) Open all the drains in the air intake system of the engine.
- (2) For washing, under service load (3, 4~4 '4 L), inject a specified quantity of "Blower-Wash" during 4 to 10 seconds in using a syringe.

Specified quantity	Model of turbocharger	RU110, 120	RU130, 150, 160
	Injection volume at a time	0.15 l	0.20 l

- (3) After the lapse of approx. 3 to 5 minutes after injection of "Blower-Wash" to loosen sticking contaminants, inject and wash with the same volume of clear as "Blower-Wash".
- (4) Use a hand pump or a vinyl container for injection. If a large volume of "Blower-Wash" flows into turbocharger and engine, it causes a trouble : therefore, strictly observe the specified quantity.
- (5) If there is no change in feed air pressure or exhaust temperature before and after washing, repeat washing after 10 minutes. If no change occurs even after repeaing washing 3 to 4 times, it is due to excessive contamination of the blower or other cause. Disassembling and cleaning or other steps are required in such a case.
- (6) For at least 15 minutes after injection, run and dry the engine under load.
- (7) In case injection is difficult due to the installed position, connect a vinyl tube or the like.
- (8) Provide a drain cock at the lowest position of the cooler so as to avoid accumulation of liquid.