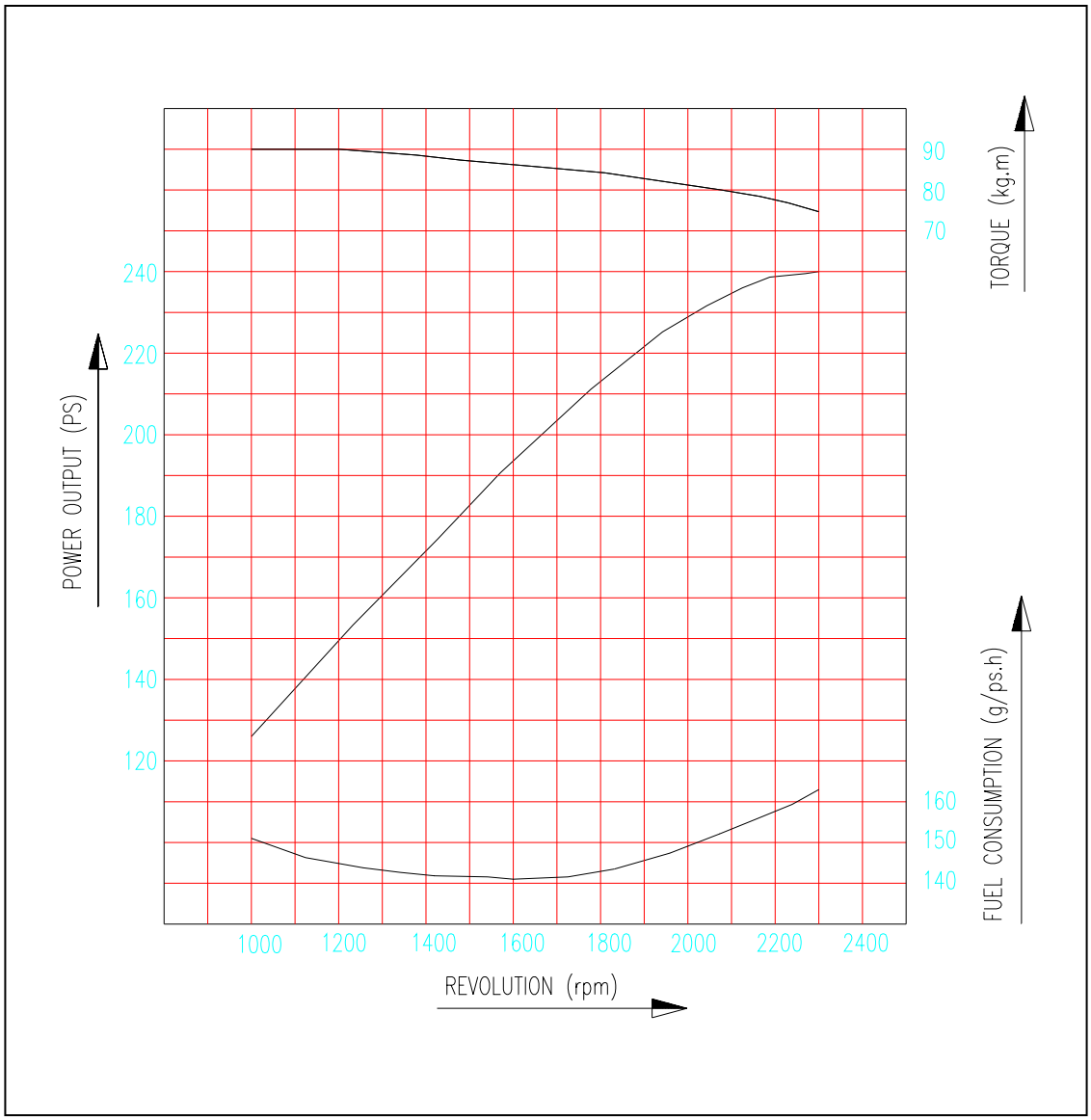
1. GENERAL INFORMATION

1.1. General Repair Instructions

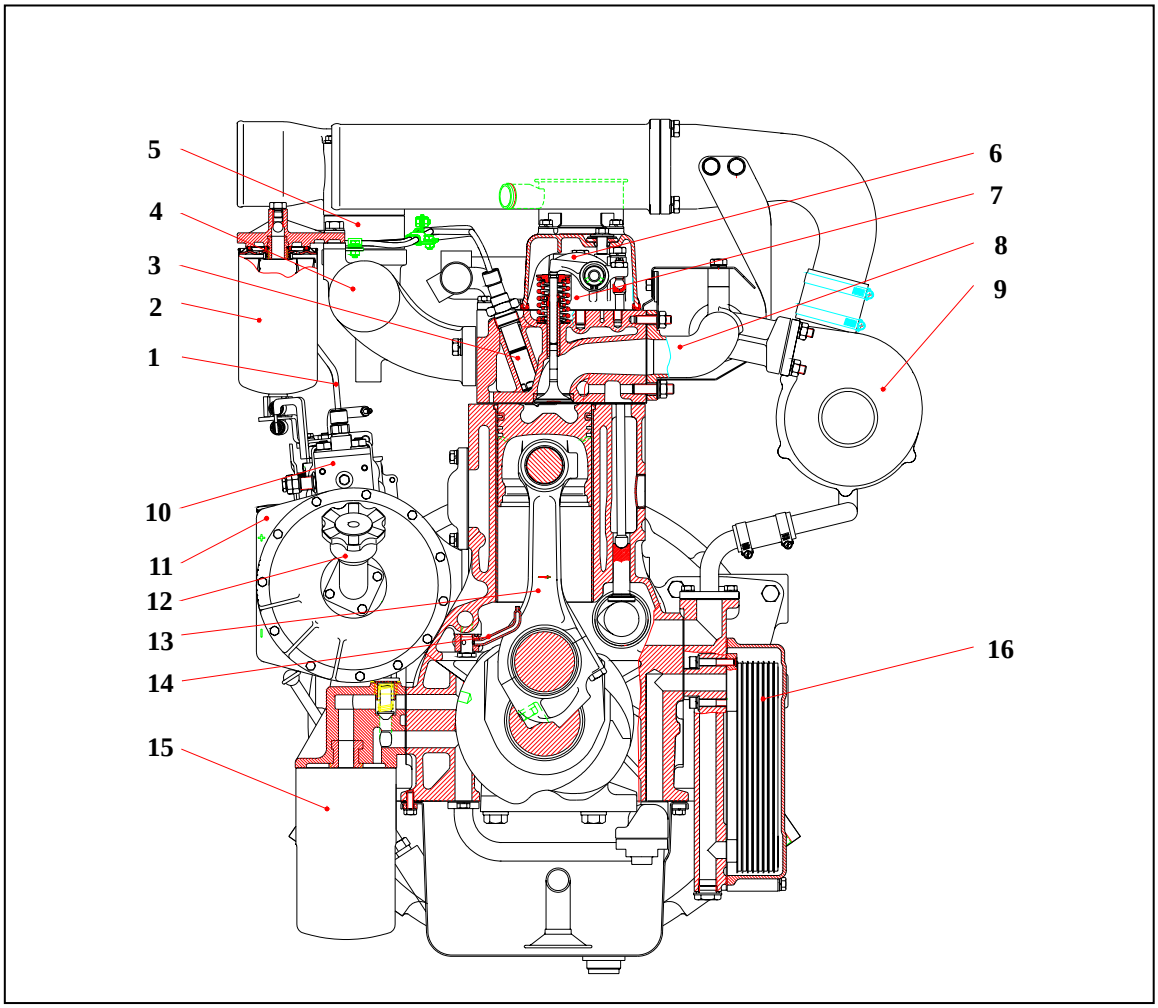
1. Before performing service operation, disconnect the grounding cable from the battery for reducing the chance of cable damage and burning due to short-circuiting.
2. Use covers for preventing the components from damage or pollution.
3. Engine oil and anti-freeze solution must be handled with reasonable care as they cause paint damage.
4. The use of proper tools and special tools where specified is important to efficient and reliable service operation.
5. Use genuine DAEWOO parts necessarily.
6. Used cotter pins, gaskets, O-rings, oil seals, lock washer and self-lock nuts should be discarded and new ones should be prepared for installation as normal function of the parts can not be maintained if these parts are reused.
7. To facilitate proper and smooth reassemble operation, keep disassembled parts neatly in groups. Keeping fixing bolts and nut separate is very important as they vary in hardness and design depending on position of installation.
8. Clean the parts before inspection or reassembly. Also clean oil ports, etc. using compressed air to make certain they are free from restrictions.
9. Lubricate rotating and sliding faces of parts with oil or grease before installation.
10. When necessary, use a sealer on gaskets to prevent leakage.
11. Carefully observe all specifications for bolts and nuts torques.
12. When service operation is completed, make a final check to be sure service has been done property.

1.3.4. Performance curve (DE08TIS – 240PS)



Performance		ISO 1585(SAE J1349)
Output	(max.)	176 kW (240PS) / 2,300 rpm
Torque	(max.)	882 N.m (90 kg.m) / 1,200 rpm
Fuel consumption	(min.)	192 g/kW.h (141 g / PS.h)

1.4.2. Engine sectional view (cross)



1	Fuel injection pipe	9	Turbo charger
2	Fuel filter	10	Fuel injection pump
3	Fuel injection nozzle	11	Timing gear case
4	Intake manifold	12	Oil filler cap
5	Air heater	13	Connecting rod
6	Rocker arm	14	Oil spray nozzle
7	Rocker arm bracket	15	Oil filter
8	Exhaust manifold	16	Oil cooler

Condition	Causes	Remedies
1) Starting difficult (1) Compression pressure lack	● Valve's poor shut, stem distortion	Repair or replace
	● Valve spring damage	Replace valve spring
	● Cylinder head gasket's leak	Replace gasket
	● Wear of piston, piston ring or liner	Adjust
2) Idle operation abnormal	● Injection timing incorrect	Adjust
	● Air mixing at injection pump	Remove air
3) Engine output insufficient (1) Continuous output insufficient	● Valve clearance incorrect	Adjust
	● Valve tightness poor	Repair
	● Cylinder head gasket's leak	Replace gasket
	● Wear, stick, damage of piston ring	Replace piston ring
	● Injection timing incorrect	Adjust
	● Fuel injection amount insufficient	Adjust injection pump
	● Nozzle injection pressure improper or stuck	Adjust or replace
	● Supply pump's function lowered	Repair or replace
	● Fuel pipe system clogged	Repair
	● Air suction amount insufficient	Clean or replace air cleaner
	● Turbocharger poor	Repair or replace
(2) Output insufficient when in acceleration	● Compression pressure insufficient	Disassemble engine
	● Injection timing incorrect	Adjust
	● Fuel injection amount insufficient	Adjust injection pump
	● Injection pump timer's function insufficient	Repair or replace
	● Nozzle infection pressure, infection angle improper	Repair, replace
	● Supply pump's function lowered	Repair or replace
	● Air intake amount insufficient	Clean or replace air cleaner
4) Overheating	● Engine oil insufficient or poor	Replenish or replace
	● Cooling water insufficient	Replenish or replace
	● Fan belt loosened, worn, damaged	Adjust or replace
	● Cooling water pump's function lowered	Repair or replace
	● Water temp. regulator's operation poor	Replace
	● Valve clearance incorrect	Adjust
	● Exhaust system's resistance increased	Clean or replace

3. MAINTENANCE

3.1. Engine Disassembly

3.1.1. Heed at disassembly

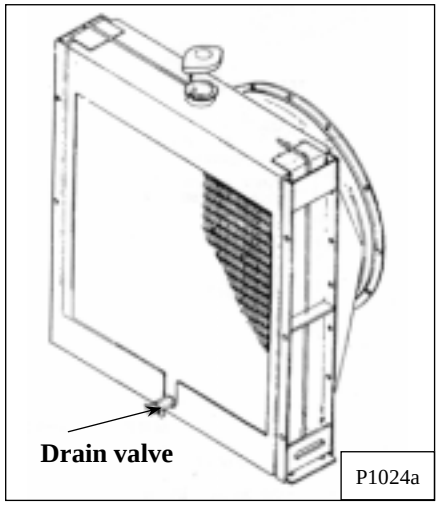
- Before disassembly, the part shelf should be prepared for various tools and repair parts.
- When assembling, clean empty hand should be used and clean environment maintained.
- In case of storing the disassembled parts, each part should not touch each other.
- In case of disassembly, the parts should be laid in order.

3.1.2. Oil level gauge

- Pull out the oil level gauge.

3.1.3. Cooling water

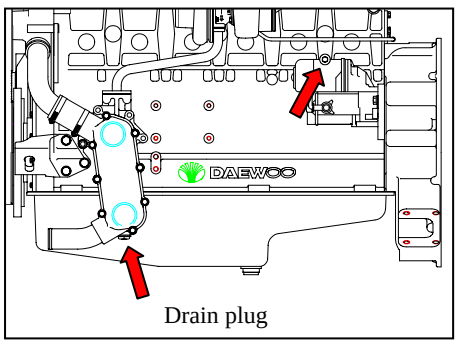
- Remove the radiator cap. Open the drain valve at the radiator lower part to drain the coolant as the right figure.



CAUTION:

When removing radiator filler cap while the engine is still hot, cover the cap with a rag, then turn it slowly to release the internal steam pressure. This will prevent a person from scalding with hot steam spouted out from the filler port.

- Remove the drain plug from the cylinder block and drain out the cooling water into a container.



3.2. Inspection and Measurement on Major Parts

3.2.1. Cylinder block

- Clean the cylinder block thoroughly, and check for any crack or damage.
- If there is any crack or severe damage, replace it and if there is minor one, correct it.
- Check for any clogging or corrosion in the oil passage and water passage.
- Carry out a leakage test for any crack or air leaking. (Hydraulic test)
- Plug each cylinder block's water and oil discharge ports, and apply the air pressure of about 4kg/cm^2 to intake port and soak it in water for about 1 minute to check if there is any leakage. (Water temperature : 70°C)

3.2.2. Cylinder head

(1) Cylinder head assembly & disassembly

1) Disassemble the cylinder assembly, and put it on the shelf for assembly or clean lathe.

CAUTION :
Prevent any damage to gasket's contact surface of the cylinder head.

2) Disassemble the cotter pin, spring, spring seat pushing valve spring by a special tool.

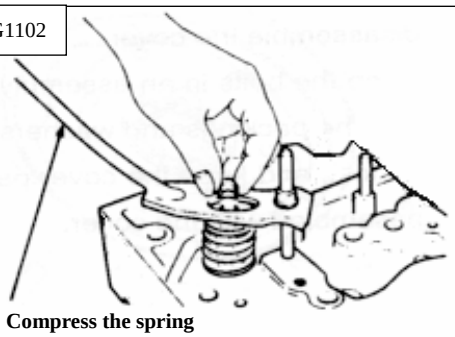
3) Pull out the intake and exhaust valves.

4) The disassembled parts are kept laid in turn.

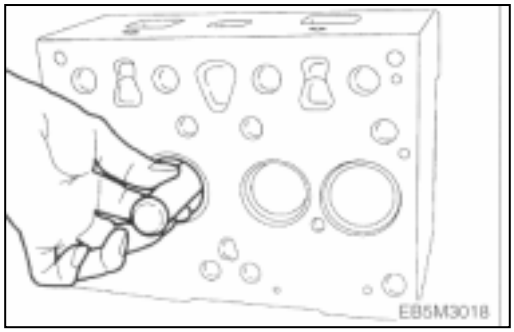
5) Disassemble the valve stem seal.

6) By means of the special tool, punch, pull out a valve guide.

G1102

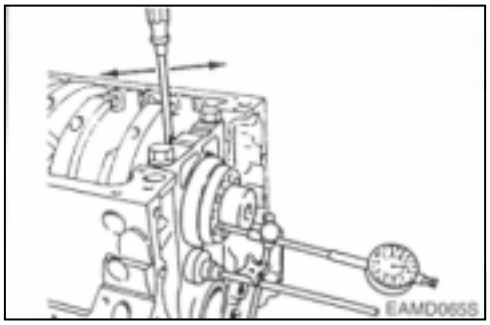


Compress the spring



5) Crank shaft end play

- Assemble the crankshaft to the cylinder block.
- With a dial gauge, measure crankshaft end play.



Standard	Limit
0.15 ~ 0.325 mm	0.5 mm

3.2.6. Piston assembly

(1) Disassemby of piston assembly

Disassemble piston according to the disassembly process.

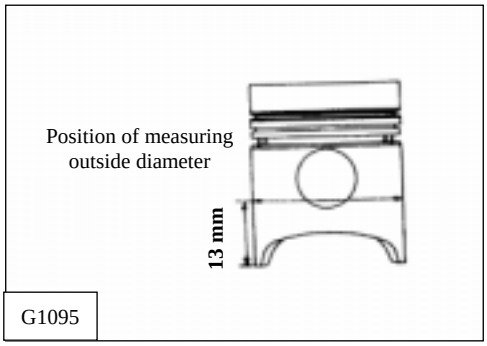
(2) Piston inspection

1) Visual check

Visually check the pistons for cracks, scuff or wear, paying particular attention to the ring groove.

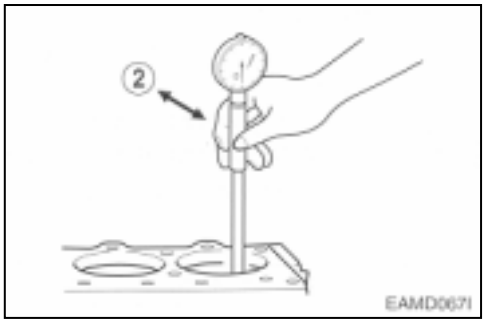
2) Clearance between the piston and cylinder liner

- With an outside micrometer, measure the piston outside diameter at a point 13mm away from the lower end of piston skirt in a direction at a right angle to the piston pin hole.



Standard	ϕ110.883 ~ ϕ110.897 mm

- Using a cylinder bore gauge, measure cylinder liner inside diameter at 3 points (cylinder top ring contacting face, middle, and oil ring contacting face on BDC) in a direction at an angle of 45°. Take the mean value with the largest and smallest values excepted.



3.4. Breaking in

3.4.1. Preparations for breaking-in

- Fill of new engine oil through the oil filler cap.
- When measuring the oil level with the oil level gauge with the engine mounted, the oil level must indicate about 10mm above the max. line.
- Connect water hoses and fill up cooling water.
- Connect the fuel hoses to the fuel tank and to top(radiator or surge tank).
  Check the air bleeding of the fuel system.
- Connect the electrical systems such as starter, air heater, etc. with power source.

3.4.2. Operation of a new engine (*Break-In*)

Because the sliding surfaces of a new engine are not lapped enough, the oil film can be destroyed easily by overload or overspeed and the engine life-time may be shortened.

Therefore the following things must be obeyed by all means.

Up to the first 1,000km(50 hours)

- ▲ Engine should be run at fast idling until the temperature of the engine becomes normal operating condition.
- ▲ Overload or continuous high speed operation should be avoided.
- ▲ High speed operation with no load should be prevented.
- ▲ Abrupt start and stop of the engine should be avoided.
- ▲ Engine speed must be under 70% of its maximum speed.
- ▲ Maintenance and inspection must be accomplished thoroughly.

3.4.3. Check points for break-in

During the *break-in* (the initial running of the engine) period, be particularly observant as follows:

a) Check engine oil level frequently. Maintain oil level in the safe range, between the "**min.**" and "**max.**" marks on dipstick.

4.2. Lubricating System

4.2.1. General descriptions and specifications

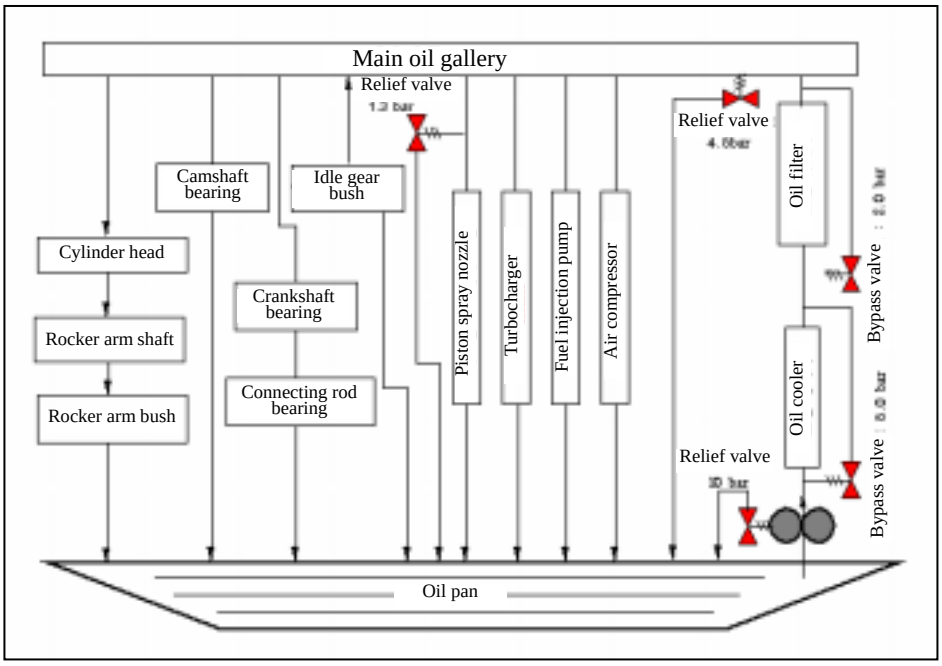
- **General descriptions**

  All the engine oil pumped up from the oil pan by the gear type oil pump is filtrated through the oil cooler and oil filter, and this filtrated oil is forced through the main oil gallery in the cylinder block from where it is distributed to lubricate the various sliding parts, and fuel injection pump in order to ensure normal engine performance.

- **Specifications**

Item	Specifications	Item	Specifications
Lubricating system	Forced pressure circulation	Oil filter type	Full flow
Oil pump type	Gear type	Bypass for filter element	
Relief valve opening pressure	10±1.5 kg/cm^2	Valve opening pressure	1.8 ~ 2.3 kg/cm^2
Bypass for oil cooler		Bypass for entire oil filter	
Opening pressure	5+1 kg/cm^2	Valve opening pressure	4.0 4.8 kg/cm^2
Adjusting valve for spray nozzle			
Opening pressure	1.5 ~ 1.8 kg/cm^2		

- **Diagram of lubricating system**



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2) D1146TI

(1) Injection pump ass'y : 65.11101-7298 (101701-9630 ZEXEL)
- Injection pump : KP-PE6AD100B412RS2 (101060-6541)
- Governor : KP-EP/RLD250-1400A1FXL (105932-3550)
- Timer : KP-EP/SA700-1100630DR (105644-0570)
- Fuel feed pump : KP-FP/KE-ADS (105210-5280)
- Coupling : 105662-1490
- Micro switch : 153169-3320
- Plunger & barrel : 131150-3120
- Delivery valve : 131160-8620

(2) Nozzle holder assembly : 65.10101-7293 (9134-153C LUCAS)

(3) Nozzle : 65.10102-6042 (9135-283 LUCAS)

(4) Injection pipe : 65.10301-7007

(5) Firing order: :1 – 5 – 3 – 6 – 2 – 4

(6) Injection timing : BTDC 9°

(A) Test condition for injection pump	Nozzle & Holder Ass'y	10101-7293	Opening pressure : 175 bar
	Injection pipe(ID ,OD ,L)	-	ϕ2.0 x ϕ6.0– 650 mm
	Test oil	ISO4113	Temperature :40 ±5°C
(B) Engine standard parts	Nozzle & holder Ass'y	65.10102-6042	Nozzle (5 x ϕ0.32)
		65.10101-7293	214 kg/cm^2
	Injection pipe(ID, OD ,L)	65.10301-7007	ϕ1.8 x ϕ6 - 550mm

Rack diagram and setting valve at each point

Power	Check point	Rack position (mm)	Pump speed (rpm)	Injection Q'ty on RIG (mm^3 / 1,000 st) (A) Test condition for inj. pump	(B) Engine standard parts	Press. (mmHg)
	H	≠9.7	300	8.5±1.5	-	-
	A	11.9	700	98.5±1.6	-	-
	B	12.3	1100	(106.5±2.0)	-	-
	C	11.7	500	(82±2.0)	-	-
	D	10.5	500	(58.7±2.0)	-	-
	P1	10.5	500	-	-	250
	P2	11.7	500	-	-	100

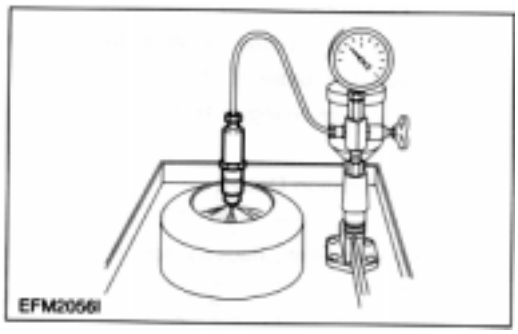
Governor weight	740 g	Idle spring		k=0.7+0.05 kgf/mm
Governor spring	k=1.0+0.6 kgf/mm	Boost spring		k=0.54 kgf/mm
Start spring	k=0.005 kgf/mm	Delivery Valve	retraction pressure	51mm^3/st , t=0.15
Plunger	ϕ10 Right hand 20+50lead		opening pressure	20.8 kgf/cm^2
Lever ratio(min/max)	1 : 1.15 / 1 : 3.9		spring	k=1.63kgf/mm

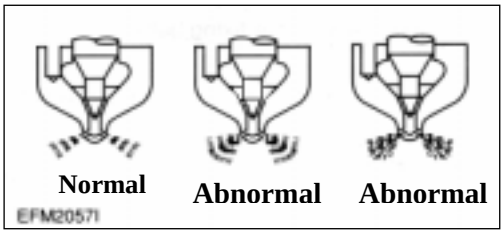
5) Reassembly

- After removing carbon deposit, submerge the nozzle in diesel oil and clean it.
- Replace all the seal rings with new ones.
- Assemble the parts and tighten them to specified torque.

6) Adjustment

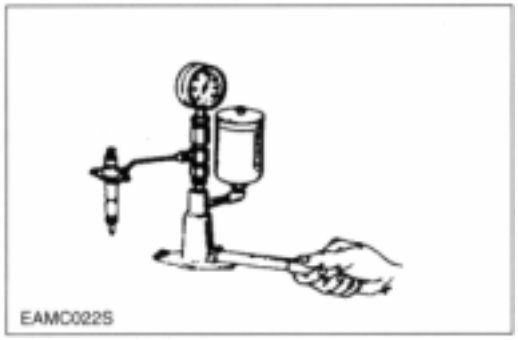
- After reassembly, install the nozzle on a tester.
- With the adjusting screw loosened, operate the nozzle 2 ~ 3 times to bleed it.
- Operate the nozzle tester lever at the specified rate.
- Adjust the injection pressure to the standard pressure by spring tension shims.
- After adjusting the injection pressure, tighten the cap nut to specified torque.
- Re-check the injection pressure and see if the spray pattern is normal. Spray pattern should be uniform and free of spattering.





7) Testing

With the nozzle assembled to a nozzle tester and specified pressure applied, check the nozzle for fuel leakage.



Engine Model	D1146	D1146TI	DE08TIS
Opening pressure	210 kg/cm^2	214 kg/cm^2	1st : 160 kg/cm^2 2nd : 220 kg/cm^2

4.4.5. Walk-around check and servicing

As the condition of turbocharger depends greatly on how well the engine is serviced, it is very important to maintain the engine in accordance with the specified maintenance procedure.

1) Intake system

Pay particular attention to the air cleaner when servicing the intake system.

In the case of wet-type air cleaner, if the level of oil surface is lower than specified, cleaning effect is poor; if too high, the cleaner draws in oil to foul the case.

Especially, if the rotor is fouled, the sophisticatedly-tuned balance is broken to create vibration and to cause seizure and unusual wear to the bearing.

Therefore, it is very important to use a good quality air cleaner all the time.

In the case of dry-type air cleaner, it is essential to clean it to reduce intake resistance as much as possible.

2) Exhaust system

Pay particular attention to prevent gas leaks and seizure when servicing the exhaust system because leakage of exhaust gas from discharge pipes, turbocharger fixing portions, etc. lowers charging effect.

As such components as turbine chamber that becomes red-hot during operation use heat resisting steel nuts, do not interchange these nuts with ordinary steel nuts. In addition, apply anti-seizure coating to fixing nuts on the portions as designated.

3) Fuel system

If the full load stopper regulating the maximum injection volume and the maximum speed stopper regulating the maximum speed in the fuel injection pump are adjusted without using a pump tester, the turbocharger rotates at excessively rapid speed and may suffer damage.

Besides of it, if spray pattern from the fuel injection nozzles is bad or the injection timing is incorrect, temperature of exhaust gas rises up to affect the turbocharger adversely. To avoid such trouble, be sure to make a nozzle test.

4) Lubricating system

Pay particular attention to oil quality and oil filter change intervals when servicing the lubricating system. Deteriorated engine oil affects adversely not only the engine but torso the turbocharger. Suggested engine oils for the turbocharger-mounted engine are as follows:

5. Special Tool List

No.	Part No.	Figure	Tool Name	Remark
1	EF.123-014		Injection pump setting ass'y	D1146/TI
	EF.123-015			DE08TIS
2	EF.123-127		Oil seal insert ass'y (Front)	CR : made USA (up to 2000. Apr.)
	EF.123-173			NOK : made Japan (From 2000. may)
3	EF.123-043		Oil seal insert ass'y (Rear)	CR : made USA (up to 2000. Apr.)
	EF.123-184			NOK : made Japan (From 2000. may)
4	EF.123-052		Oil seal puller ass'y (Front)	
5	EF.123-048		Oil seal puller ass'y (Rear)	
6	EU.2-0530		Cylinder pressure tester adapter	
7	EU.123-086		Cylinder liner puller ass'y	
8	EF.123-179		Valve stem seal punch	
9	EU.2-0131		Valve clearance adjust ass'y	

● Standard bolt tightening torque table

Refer to the following table for bolts other then described above

Diameter x pitch (mm)	Degree of strength										
	3.6	4.6	4.8	5.6	5.8	6.6	6.8	6.9	8.8	10.9	12.9
	(4A)	(4D)	(4S)	(5D)	(5S)	(6D)	(6S)	(6G)	(8G)	(10K)	(12K)
	Limit value for elasticity (kg/mm^2)										
	20	24	32	30	40	36	48	54	64	90	108
	Tightening torque (kg.m)										
M5	0.15	0.16	0.25	0.22	0.31	0.28	0.43	0.48	0.5	0.75	0.9
M6	0.28	0.30	0.45	0.4	0.55	0.47	0.77	0.85	0.9	1.25	0.5
M7	0.43	0.46	0.7	0.63	0.83	0.78	1.2	1.3	1.4	1.95	2.35
M8	0.7	0.75	1.1	1	1.4	1.25	1.9	2.1	2.2	3.1	3.8
M8x1	0.73	0.8	1.2	1.1	1.5	1.34	2.1	2.3	2.4	3.35	4.1
M10	1.35	1.4	2.2	1.9	2.7	2.35	3.7	4.2	4.4	6.2	7.4
M10x1	1.5	1.6	2.5	2.1	3.1	2.8	4.3	4.9	5	7	8.4
M12	2.4	2.5	3.7	3.3	4.7	4.2	6.3	7.2	7.5	10.5	12.5
M12x1.5	2.55	2.7	4	3.5	5	4.6	6.8	7.7	8	11.2	13.4
M14	3.7	3.9	6	5.2	7.5	7	10	11.5	12	17	20
M14x1.5	4.1	4.3	6.6	5.7	8.3	7.5	11.1	12.5	13	18.5	22
M16	5.6	6	9	8	11.5	10.5	17.9	18.5	18	26	31
M16x1.5	6.2	6.5	9.7	8.6	12.5	11.3	17	19.5	20	28	33
M18	7.8	8.3	12.5	11	16	14.5	21	24.2	25	36	43
M18x1.5	9.1	9.5	14.5	12.5	18.5	16.7	24.5	27.5	28	41	49
M20	11.5	12	18	16	22	19	31.5	35	36	51	60
M20x1.5	12.8	13.5	20.5	18	25	22.5	35	39.5	41	58	68
M22	15.5	16	24.5	21	30	26	42	46	49	67	75
M22x1.5	17	18.5	28	24	34	29	47	52	56	75	85
M24	20.5	21.5	33	27	40	34	55	58	63	82	92
M24x1.5	23	25	37	31	45	38	61	67	74	93	103

Others :

1. The above torque rating have been determined to 70% or so of the limit value for bolt elasticity.
2. Tension is calculated by multiplying tensile strength by cross section of thread.
3. Special screws should be tightened to 85% or so of the standard value.
   For example, a screw coated with MoS_2 should be tightened to 60% or so of the standard value.

● Tightening torque for hollow screw(4-hole)

Material	M8	M10	M12	M14	M16	M18	M22	M26	M30	M38
SM25C	-	1.6	2.5	3.5	4.5	5.5	9.0	13.0	18.0	30.0
★SUM22L	0.8	1.8	3.0	4.0	5.5	6.5	11.0	16.0	20.0	35.0
STS304	0.8	1.8	3.0	4.0	5.5	6.5	11.0	16.0	20.0	35.0

★ : Adopted in DAEWOO engine

Group	Part	Inspection Item	Stand value for assembly	Limit For use	Correction	Remark
Cooling system	Radiator	Radiator & water pump for corrosion, damage & improper connecting	-	-	Correct or replace	
		Test for leakage (air pressure) (kg/cm^2)	1.0	-	Submerge in water and replace if air bubbles found	
		Pressure valve for opening pressure (kg/cm^2)	0.5	-		
		Negative pressure valve for opening pressure (mmHg)	20	-		
	Water pump	Delivery volume l/min - Engine speed 2,700rpm - Water temp. 80°C - Pressure : 0.8 kg/cm^2	280	-	Check the water passage	For any restrictions
		Clearance between impeller & housing	0.35	-	Replace if impeller & housing are damaged	
		Perpendicularity of pulley	0.3		Adjust by a bench press	
		Fan belt depression(with thumb) mm	Approx. 15	-	Adjust	
	Cooling water temp	Operating temperature (permissible temp.) °C	79~95	-	Must not exceed this value	
		Permissible temperature in a short time °C	-	105		
	Thermostat	Thermostat opening temp. °C (under atmospheric pressure)	79	-	Replace	Type –II - Opening temp. : 83°C - Full opening temp.: 95°C
		Full opening temp. °C	94	-	Replace if defective Stroke : min. 8mm	
Fuel system	Piping & others	Fuel pipe, injection pipe & nozzle holder for damage, cracks, improper packing, etc.	-	-	Repair or replace	
		Fuel filter cartridge for damage or dimple	-	-	Replace cartridge	
	Injection pressure of injection nozzle (kg/cm^2)		D1146 : 210 D1146TI : 214 DE08TIS: 1st 160 2nd 220	-	Adjust by shim	
	Operating pressure of overflow valve (kg/cm^2)		1.0~1.5	-	Replace valve	
	Projection height of nozzle from the cyl. head surface(mm)		2.53	-	Replace seal ring	
Inspection at completion	Running-in the engine		-	-	Refer to supplement “running-in”	
	Cylinder pressure	Compression pressure of cylinder (kg/cm^2)	24 ~ 28	24 or more	Correct	at 200rpm or more (20°C)
		Compression pressure difference of each cylinder	±10% or less against average		Correct	