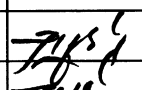
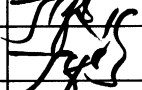
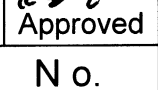


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(Volume IV)

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 HSD ENGINE	Client	Daewoo Shipbuilding & Marine Engineering Co., Ltd.				
	Hull Number	5258				
	Engine Type	HSD - MAN B&W 5S70MC (Mk-6)				
Subject : Specification of Main Engine						
Note :						
Attachments :						
5						
4						
3						
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Design Team 1			Documentation No.			
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HSD ENGINE CO., LTD. – DESIGN TEAM 1



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1. General

1-1. Make

HSD ENGINE CO., LTD.

1-2. Trade mark

HSD - MAN B&W

1-3. Model

5S70MC (Mk-6)

1-4. Design & Construction

- 1) In accordance with the requirements of Classification Society, Det Norske Veritas, prevailing at the date of contract.
- 2) Based on licensor's latest design as agreed upon, by/between seller and buyer.
- 3) Some practical modifications from licensor's design shall be incorporated, due to adoption of KS/JIS, difference of manufacturing facilities, and improvement based on the builder's experience, etc.

1-5. Execution

HSD - MAN B&W 5S70MC standard starboard engine with modifications as specified in the contract



2. Engine Data

2-1. Name of plants

DAEWOO Hull No. 5258

2-2. Number of engines

One (1) per plant

2-3. Engine type

Two stroke, single acting, direct reversible, crosshead type marine diesel engine with constant pressure turbocharging.

2-4. Number of cylinders

Five (5)

2-5. Cylinder bore

700 mm

2-6. Stroke length

2,674 mm

2-7. Direction of rotation, ship ahead

Clockwise, seen from aft, for FPP

2-8. Engine performance

(1) Engine to be delivered with rated output as follows ;

- Specified MCR : 19,100 BHP x 91.0 rpm
- Optimized rating : 16,240 BHP x 86.2 rpm (85% SMCR)

(2) The above BHP refers to metric horse power.

(3) The above ratings are based on ;

① Tropical conditions

- Max. fresh water temperature to air cooler : 36°C
- Blower inlet temperature : 45°C
- Blower inlet pressure : 1000 mbar
- Relative humidity : 60 %

② Fuel oil consumption

At 16,240 BHP output at 86.2 rpm, the guaranteed specified fuel oil consumption is 121.5 g/BHP_h with a tolerance of + 5 %.

The above guaranteed specific fuel oil consumption is valid under the following



reference conditions :

a) ISO ambient conditions, ISO 3046/1-1995(E) :

- Scavenge air coolant temperature : 25°C
- Ambient air pressure : 1000 mbar
- Ambient air temperature at turbocharger intake : 25°C

b) Lower calorific value of fuel : 42,700 kJ/kg (10,200 kcal/kg)

③ HSD-MAN B&W conversion formula

For other reference conditions, the following corrections of the specific fuel oil consumption apply at retained cylinder max. pressure :

- Scavenge air coolant temperature	per 10°C rise	+ 0.60 %
- Blower inlet temperature	per 10°C rise	+ 0.20 %
- Blower inlet pressure	per 10mbar rise	- 0.02 %
- Fuel oil lower calorific value	rise 1 % (42,700 kJ/kg)	- 1.00 %

2-9. Cooling systems

- (1) Cylinder unit : fresh water
- (2) Piston : lube oil
- (3) Air cooler : fresh water

2-10. Starting air system

Compressed air, 30 kg/cm²

2-11. Power source

- (1) 3 phase : 440 V AC, 60 Hz
- (2) 1 or 3 phase : 220 V AC, 60 Hz
- (3) for safety system : 24 V DC

2-12. Instruction scale

Metric = °C, kg/cm²

2-13. Name plates & caution plates

Language : English,

2-14. Drawing and instructions

- (1) Approval drawings : 10 copies of each drawing per project
- (2) Working drawings : 10 copies per project
- (3) Instruction books : 6 sets for hull No. 5258
- (4) Language : English
- (5) The engine will be delivered with all necessary certificates, in accordance with the



requirements of the Classification Society.

- (6) The drawings and instructions are for the purchaser and owner and their staff only, and must not in any form be handed over to a third party.

2-15. Standards

- (1) Internal on the engine : ISO, KS/JIS/DIN
- (2) External pipe connection : KS/JIS

2-16. Dispatch

- (1) The engine will be delivered in section by section disassembled condition and delivery pattern is subject to negotiation between shipyard and engine builder.
- (2) Detailed proposal is shown in separate drawing " Packing scheme " of MA11-1258.

2-17. Classification Society

Det Norske Veritas.



3. Fuel Oil Specification

3-1. The main diesel engine is designed to be capable of burning fuel oil with a viscosity of a maximum of 130 cSt / 80°C (700 cSt / 50°C, 7000 sec RW / 100°F), and also designed capable of operation at manoeuvring conditions with hot engines when burning bunker fuel of 130 cSt at 80°C within the following specification or of better quality.

(1) Density	≤	*991 kg/m ³ at 15°C
(2) Flash point	≥	60°C
(3) Pour point	≤	30°C
(4) Carbon residue	≤	22 % weight
(5) Ash	≤	0.15 % weight
(6) Total sediment after ageing	≤	0.10 % weight
(7) Water	≤	1.0 % volume
(8) Sulphur	≤	5.0 % weight
(9) Vanadium	≤	600 mg/kg
(10) Aluminum + Silicon	≤	80 mg/kg

* May be increased to 1.010 provided adequate cleaning equipment is installed, i.e. modern type of centrifuges.

3-2. The above data refer to the oil as supplied to the vessel.

3-3. Treatment of the fuel oil by separators, before use, must be in accordance with engine builder's recommendations.

4. Guarantee of Quality

These shall be in accordance with the related articles, which are noted in the Contract.



5. Inspection and Test

5-1. Inspection

All inspections and tests of the engine are carried out in accordance with the rules of the Classification Society and the engine builder's inspection practice and standard.

5-2. Shop trial

- (1) Before leaving the factory, the engine is to be carefully tested on fuel oil in the presence of representatives of Yard, Shipowner, Classification Society.
- (2) The purchaser or a person authorized by him, and a representative from the Shipowner shall, during the shop trial, have the right to inspect the engine visually, and the engine builder shall grant free access to the right to make his comments to the Yard (purchaser).
- (3) If defective parts are found, such parts are to be replaced or repaired, and any necessary adjustments are to be made.
- (4) A notice, together with a test program, shall be given to the yard fourteen (14) days before the testing.

(5) The test program is to include as follows.

① Starting and manoeuvring test at no load

② Load test

- 0.5 hour running at 25 % of specified MCR
- 0.5 hour running at 50 % of specified MCR
- 0.5 hour running at 75 % of specified MCR
-  - 1.0 hour running at 85 % of specified MCR
- 1.0 hour running at 100 % of specified MCR
- 0.5 hour running at 110 % of specified MCR

* Test program is subject to acceptance from Classification Society.

③ Governor test

④ Minimum RPM test

⑤ Shut down test

⑥ Starting and reversing test

⑦ Astern test

⑧ Turning gear blocking device test

⑨ Emergency running test

⑩ Start, stop and reversing from emergency manoeuvring console on engine

 ⑪ Exhaust gas NOx emission measurement test *including 85% load* (for NB.5258)

Note> Provisional manoeuvring console and auxiliary machinery in engine builder's works are to be used.

- (6) Engine readings are taken at all loads, i.e., full set of observations including fuel consumption test. (Before taking measurements, condition is to be steady.)



- (7) Fuel oil analysis is to be presented.
- (8) All tests are to be carried out on heavy diesel oil.
- (9) Details are specified in separate drawing, " Plan of shop test " of MA02-1258.
- (10) Fuel oil consumption.

The amount of fuel used during predetermined period at a contracted load is measured by measuring device equipped at builder's work shop.

The guaranteed specific fuel oil consumption is valid under the following reference conditions with tolerance + 5 % (See item 2).

 (11) Vibration measurement (*including 85% load*)

At each load of load test program, vibration measurement shall be carried out by use of handi-vibrometer in accordance with maker's standard procedure, then the record shall be submitted to shipyard.

- (12) Alpha lubricator function test.

 (13) One(1) T/C cut-off test. (15% MCR power, 53% MCR rpm, 15 min.)

 (14) One(1) cylinder cut-off test. (63% MCR power, 86% MCR rpm, 15 min.)



5-3. Overhaul inspection

(1) Parts to be ready for visual inspection after shop trial.

No.	Overhaul items	Quantity	Inspection
1	Crankshaft	Partial for one cylinder	Appearance inspection for one crank pin and one main journal without lifting up from bed plate (remained in engine)
2	Main bearing	1 bearing	Appearance inspection for bearing surface (dismantled from engine)
3	Crank pin bearing	1 bearing	Appearance inspection for bearing surface (remained in engine)
4	Cylinder cover	1 cylinder	Appearance inspection for combustion surface (dismantled from engine)
5	Cylinder liner		Appearance inspection for liner inner surface (remained in engine)
6	Crosshead bearing		Appearance inspection for bearing surface with connecting rod by lifting up crosshead pin (remained in engine)
7	Crosshead pin and guide rail		Appearance inspection for surface by lifting up crosshead pin (remained in engine)
8	Piston complete		Appearance inspection for piston complete (dismantled from engine)
9	Camshaft driving chain & wheel	1 engine	Appearance inspection (remained in engine)
10	Fuel & exhaust cam	All cylinder	Appearance inspection through inspection cover (remained in engine)
11	Exhaust valve	1 cylinder	Spindle surface inspection from underside (without dismantling from the cylinder head)

➤ Fuel injection valve : If the exhaust gas temperature deviation is over 50℃ or max. cylinder combustion pressure deviation is over 3 bars, then the overhaul inspection of the fuel injection valve of the cylinder in question to be carried out.

(2) All the items of the above inspection are limited to one particular cylinder determined by the classification society's or the owner's representative. Overhaul of main bearing and crankpin bearing can be done other cylinder in order to avoid delay of inspection.



6. Description of Engine

6-1. Bedplate and Main bearing

- (1) The bedplate can be divided into sections of suitable size, in accordance with the production facilities available. It consists of high welded longitudinal girders and welded cross girders with cast steel bearing supports.
- (2) The bedplate is made without taper for mounting on epoxy chocks.
- (3) The oil pan, which is integrated in the bedplate, collects the return oil from the forced lubricating and cooling oil system. The oil outlets from the oil pan are vertical and are provided with gratings.
- (4) The main bearings consist of thick walled steel shells lined with white metal. The bottom shell can, by means of special tools, be rotated around and in. The shells are kept in position by a bearing cap and are fixed by long elastic studs with nuts tightened by hydraulic tools.
- (5) The chain drive is integrated with the thrust bearing in the aft end of the engine.

6-2. Thrust Bearing

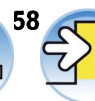
- (1) The thrust bearing is of the B&W-Michell type, and consists, primarily, of a thrust collar on the crankshaft, bearing supports, and segments of cast iron with white metal. The thrust shaft is thus an integrated part of the crankshaft.
- (2) The propeller thrust is transferred through the thrust collar on the crankshaft, the segments, and the bedplate, to the engine seating and end chocks.
- (3) The thrust bearing is lubricated by the engine's main lube oil system.

6-3. Turning Gear and Turning Wheel

- (1) The turning wheel has cylindrical teeth and is fitted to the thrust shaft. The turning wheel is driven by a pinion on the terminal shaft of the turning gear, which is mounted on the bedplate.
- (2) The turning gear is driven by an electric motor with built-in gear and chain drive with brake. The electric motor is provided with insulation class B and enclosure IP44. The turning gear is equipped with a blocking device that prevents the main engine from starting when the turning gear is engaged. Engagement and disengagement of the turning gear is effected manually by an axial movement of the pinion.
- (3) A control device for turning gear, consisting of starter and manual remote control box, which cable of 15 meters is provided.

6-4. Frame Box

- (1) The frame box is of welded design and can be divided into sections of suitable size, determined by the production facilities available. On the exhaust side, it is provided with



relief valves for each cylinder while, on the camshaft side, it is provided with a large hinged door for each cylinder.

- (2) The crosshead guides are bolted or welded to the frame box, depending on the production facilities available.
- (3) For each cylinder, a slotted pipe for collecting part of the cooling oil outlet from the piston for visual control and flow alarm is bolted into the frame box.
- (4) The frame box is connected to the bedplate with bolts. The stay bolts are made in one part and are tightened hydraulically with the use of jacks.

6-5. Cylinder Frame, Cylinder Liner, and Stuffing Box

- (1) The cylinder frame units are of cast iron. Together with the cylinder liners they form the scavenge air space and the cooling water space. At the chain drive, the upper part of the chain wheel frame is fitted.
- (2) On the camshaft side of the engine, the cylinder frame units are provided with access covers for cleaning the scavenge air space and for inspection through the scavenge ports.
- (3) The roller guide housings and the gallery brackets are bolted onto the cylinder frame units. Furthermore, the outer part of the telescopic pipe is fitted for the supply of piston cooling oil and lubricating oil.
- (4) A piston rod stuffing box for each cylinder unit is fitted at the bottom of the cylinder frame. The stuffing box is provided with Heco sealing rings for scavenge air, and with oil scraper rings to prevent oil from entering the scavenge air space.



- (5) The cylinder liner is made of alloyed cast iron (*Tarkalloy-C*) and is suspended in the cylinder frame with a low-situated flange. The top of the liner is bore cooled and just below a short cooling jacket is fitted. The cylinder liner has scavenge ports and drilled holes for cylinder lubrication.

6-6. Cylinder Cover

- (1) The cylinder cover is of forged steel, made in one piece, and has bores for cooling water. It has a central bore for the exhaust valve and bores for fuel valves, safety valve, starting valve and indicator valve.
- (2) The cylinder cover is attached to the cylinder frame with studs and nuts tightened by a separate hydraulic tool.

6-7. Exhaust Valve and Valve Gear

- (1) The exhaust valve consists of a housing with gas channel and spindle guide. The housing is water cooled and made of cast iron. Between the cylinder cover and housing there is a bottom piece.
- (2) The bottom piece is made with hardened face for spindle seat, and is water-cooled on its outer surface.



- (3) The valve spindle is of the Nimonic type and is provided with a small vane wheel on which the exhaust gas acts during operation, thus making the spindle rotate slightly.
- (4) The hydraulic system consists of an actuator, activated by a cam on the camshaft, a high-pressure pipe and an oil cylinder for the exhaust valve spindle mounted on top of the housing. The hydraulic system opens the exhaust valve, while the closing force is provided by an air spring. The closing of the exhaust valve is damped by means of an oil cushion on top of the spindle.
- (5) Air sealing of the exhaust valve spindle guide is provided.

6-8. Fuel Valves, Starting Valve, Safety Valve and Indicator Valve



- (1) Each cylinder cover is equipped with two fuel valves (*Slide type*), one starting valve, one safety valve and one indicator valve. The opening of the fuel valve is controlled by the fuel oil high pressure created by the fuel pumps, and the valve is closed by a spring.
- (2) An automatic vent slide allows circulation of fuel oil through the valve and high pressure pipes, and prevents the compression chamber from being filled up with fuel oil in the event that the valve spindle is sticking when the engine is stopped. Oil from the vent slide and other drains is led away in a closed system.
- (3) The starting valve is opened by control air from the starting air distributor and is closed by a spring.
- (4) The safety valve is spring-loaded.

6-9. Indicator Drive

- (1) One indicator drive is fitted for each cylinder.
- (2) The indicator drive consists of a cam fitted on the camshaft and a spring -loaded spindle with roller, which moves up and down, corresponding to the movement of the piston within the engine cylinder. At the top, the spindle has an eye to which the indicator cord is fastened after the indicator has been mounted on the indicator valve.

6-10. Crankshaft

- (1) The crankshaft is of the semi-built type made from forged steel throws or cast steel throws and main journals are of forged steel.
- (2) The crankshaft is made in one part.
- (3) The crankshaft is built integral with the thrust shaft and is, on the aft end, provided with a flange for the turning wheel and for coupling to the intermediate shaft. At the fore end of crankshaft, a flange will be only provided in the event that T/V damper, tuning wheel and second order moment compensator (fore) are to be installed.

6-11. Axial Vibration damper

- (1) The engine is fitted with an axial vibration damper, which is mounted on the fore end of the crankshaft.



- (2) The damper consists of a piston and a split-type housing located forward of the foremost main bearing. The piston is made as an integrated collar on the main journal, and the housing is fixed to the main bearing support. A mechanical device for check of the functioning of the vibration damper is fitted.
- (3) On 5 cylinder engines an electronic axial vibration monitor is provided.

6-12. Connecting Rod

- (1) The connecting rod is made of forged steel and provided with bearing caps for the crosshead and crankpin bearings.
- (2) The crosshead and crankpin bearing caps are secured to the connecting rod by studs and nuts, which are tightened by hydraulic jacks.
- (3) The crosshead bearing consists of a set of thin-walled steel shells, lined with bearing metal. The crosshead bearing cap is in one piece, with an angular cut-out for the piston rod.
- (4) The crankpin bearing is provided with thin-walled steel shells, lined with bearing metal. Lube oil is supplied through ducts in the crosshead and connecting rod.



6-13. Piston, Piston rings (*Al-Bronze coating*), Piston Rod and Crosshead

- (1) The piston consists of a piston crown and piston skirt. The piston crown is made of heat-resistant steel and has four ring grooves, which are hard-chrome plated on both the upper and lower surfaces of the grooves. The piston crown is with "high topland", i.e. the distance between the piston top and the upper piston ring has been increased.
- (2) The upper piston ring is a CPR type (Controlled Pressure Relief) whereas the other three piston rings are with an oblique cut. The uppermost piston ring is higher than the lower ones. The piston skirt is of cast iron and provided with bronze bands.
- (3) The piston rod is of forged steel and is surface-hardened on the running surface for the stuffing box. The piston rod is connected to the crosshead with four studs. The piston rod has a central bore which, in conjunction with a cooling oil pipe, forms the inlet and outlet for cooling oil.
- (4) The crosshead is of forged steel and is provided with cast steel guide shoes with white metal on the running surface.
- (5) A bracket for oil inlet from the telescopic pipe and another for oil outlet to a slotted pipe are mounted on the crosshead.

6-14. Fuel Pump and Fuel Oil High Pressure Pipes

- (1) The engine is provided with one fuel pump for each cylinder. The fuel pump consists of a pump housing of nodular cast iron, a centrally placed pump barrel, and plunger of nitrated steel. In order to prevent fuel oil from mixing with lubricating oil, the pump actuator is provided with umbrella type sealing arrangement.
- (2) The pump is activated by the fuel cam, and the volume injected is controlled by turning



the plunger by means of a toothed rack connected to the regulating mechanism.

- (3) The fuel pumps incorporate Variable Injection Timing (VIT) for optimized fuel economy at part load. The VIT principle uses the fuel regulating shaft position as the controlling parameter.
- (4) Adjustment of the pump lead is effected by a threaded connection, operated by a toothed rack.
- (5) The roller guide housing is provided with a manual lifting device which, during turning of the engine, can lift the roller guide free of the cam.
- (6) The fuel oil pumps are provided with a puncture valve, which prevents high pressure from building up during normal stopping and shut down.
- (7) The fuel oil high-pressure pipes are equipped with protective hoses and are neither heated nor insulated.

6-15. Camshaft and Cams

- (1) The camshaft consists of a number of sections. Each section consists of a shaft piece with exhaust cams, fuel cams, indicator cams and coupling parts.
- (2) The exhaust cams and fuel cams are of steel, with a hardened roller race, and are shrunk on to the shaft. They can be adjusted and dismantled hydraulically.
- (3) The cam for indicator drive can be adjusted mechanically. The coupling parts are shrunk on to the shaft and can be adjusted and dismantled hydraulically.
- (4) The camshaft bearings consist of one lower half shell mounted in a bearing support which is attached to the roller guide housing by means of hydraulically tightened studs.

6-16. Chain Drive

The camshaft is driven from the crankshaft by a chain drive. The engine is equipped with a mechanical chain tightener. The long free lengths of chain are supported by guidebars.

6-17. Reversing

- (1) Reversing of the engine takes place by means of an angular displaceable roller in the driving mechanism for the fuel pump of each engine cylinder. The reversing mechanism is activated and controlled by compressed air supplied to the engine.
- (2) The exhaust valve gear is not reversible.

6-18. 2nd Order Moment Compensators

The engine shall be equipped with 2nd order moment compensator which is mounted on the aft end of the engine, driven by the main chain drive and also mounted on the front end, driven from the crankshaft through a separate chain drive.



6-19. Tuning Wheel

None.

6-20. Torsional Vibration Damper

Torsional vibration damper is to be fitted on engine fore end.

6-21. Governor



- (1) The engine is to be provided with an electronic governor of *NABCO, MG-800*.
- (2) The governor actuator is connected to the fuel regulating shaft by means of a mechanical linkage.
- (3) The governor control unit provides electric output (on-off) for load change dependent lubricators.
- (4) The electronic governor consists of the following parts.
 - ① Actuator
 - ② Revolution transmitter (pick-ups)
 - ③ Pressure transmitter for scavenge air
 - ④ Control unit
- (5) The actuator, revolution transmitter and pressure transmitter are mounted on the engine.

6-22. Cylinder lubricators

- (1) The Alpha lubrication system is based on a high pressure injector which injects a specific volume of oil into each cylinder for every fourth revolution.
- (2) The oil to the injector is pressurized by pump(s). The system is controlled by a computer in such a way that the oil can be introduced to the individual cylinder at any piston position but, preferably, when the piston rings are adjacent to the lubricating quills.
- (3) The injection function is controlled by the computer sending an on/off signal to a solenoid valve. After a predetermined time interval, the computer transmits an "off" signal to the solenoid valve, which shuts off the system pressure and opens the return oil system.
- (4) Oil dosage can be adjusted by adjusting e.g. the injection to every fifth, sixth, etc. revolution.
- (5) In the event of a malfunctioning solenoid valve or transducer. The oil dosage will automatically be increased to the maximum volume on the other lubricator. If the oil pressure fails, the computer will start a stand by pump and close down the faulty pump.

6-23. Manoeuvring System (prepared for bridge control)

- (1) The engine is provided with a pneumatic/electric manoeuvring and fuel oil regulating system. The system transmits orders from the separate manoeuvring console to the engine.



- (2) The regulating system makes it possible to start, stop, and reverse the engine and to control the engine speed. The speed control handle on the manoeuvring console gives a speed-setting signal to the governor, dependent on the desired number of revolutions. At a shut down function, the fuel injection is stopped by activating the puncture valves in the fuel pumps, independent of the speed control handle's position.
- (3) Reversing is effected by moving the telegraph handle from "Ahead" to "Astern" and by moving the speed control handle from "STOP" to "START" position. Control air then moves the starting air distributor and, through an air cylinder, the displaceable roller in the driving mechanism for the fuel pump, to the "Astern" position.
- (4) The engine is provided with a side mounted emergency control console and instrument panel.
- (5) As to the bridge control system, see separate drawing, " M/E Bridge Manoeuvring System" of EA05-1258.

6-24. Gallery Arrangement

- (1) The engine is provided with gallery brackets, stanchions, railings and platforms (exclusive of ladders). The brackets are placed at such a height that the best possible overhauling and inspection conditions are achieved. Some main pipes of the engine are suspended from the galley brackets.
- (2) The upper gallery brackets on each end of the engine are provided with lifting holes for dismantling of the auxiliary blowers, and the upper gallery platform on the camshaft side is provided with overhauling holes for piston. The number of holes depends on number of cylinders.
- (3) The engine is prepared for hydraulic top bracing (Yard's supply) on the exhaust side.

6-25. Scavenge Air System

- (1) The air intake to the turbocharger takes place directly from the engine room through the intake silencer of the turbocharger. From the turbocharger, the air is led via the charging air pipe, air cooler and scavenge air receiver to the scavenge ports of the cylinder liners.
- (2) The charging air pipe between the turbocharger and the air cooler is provided with a compensator and is heat insulated on the outside.

6-26. Exhaust Turbocharger

- (1) The engine is fitted with one (1) turbocharger of NA70/T09, arranged on the exh. side.
- (2) The turbocharger is provided with :
 - ① Equipment for water washing of the compressor side and turbine side
 - ② Equipment for dry cleaning of the turbine side
- (3) The turbocharger is equipped with an electronic tachometer system with pick-ups, converter and indicator for mounting in the engine control room.



6-27. Scavenge Air Cooler

- (1) The engine is fitted with one (1) air cooler of the monoblock type for a central fresh water cooling system of maximum 4.5 bar working pressure.
- (2) The end covers are of coated cast iron.
- (3) The cooler is provided with equipment for cleaning of
 - ① Air side : Standard showering system
(Cleaning pump unit including tank and filter to be of Yard's supply)
 - ② Water side : Cleaning brush
- (4) The cleaning is to take place only when the engine is stopped.
- (5) A water mist catcher of the through-flow type is located in the air chamber after the air cooler.

6-28. Exhaust Gas System

- (1) From the exhaust valves, the gas is led to the exhaust gas receiver where the fluctuating pressure from the individual cylinder is equalized, and the total volume of gas led further on to the turbochargers at a constant pressure. After the turbocharger, the gas is led to the external pipe system. (Yard's supply)
- (2) Compensators are fitted between the exhaust valves and the receiver, and between the receiver and the turbocharger.
- (3) For quick assembling and disassembling of the joints between the exhaust gas receiver and the exhaust valves, clamping bands are used.
- (4) The exhaust gas receiver and exhaust pipes are provided with insulation, covered by galvanized steel plating.
- (5) There is a protective grating between the exhaust gas receiver and the turbocharger.

6-29. Auxiliary Blower

- (1) The engine is provided with two (2) electrically-driven blowers. The suction side of the blowers is connected to the scavenge air space after the air cooler.
- (2) Between the air cooler and the scavenge air receiver, non-return valves are fitted which automatically close when the auxiliary blowers supply the air.
- (3) Both auxiliary blowers will start operating before the engine is started and will ensure sufficient scavenge air pressure to obtain a safe start.
- (4) During operation of the engine, all auxiliary blowers will start automatically each time the engine load is reduced to about 30 - 40 %, and they will continue operating until the load again exceeds approximately 40 - 50 %.
- (5) In cases where one of the auxiliary blowers is out of service, the other auxiliary blower will automatically compensate without any manual readjustment of the valves, thus avoiding any engine load reduction. This is achieved by the automatically working non-return valves in the pressure side of the blowers.



- (6) The electric motors are of the totally enclosed, fan-cooled, single speed type, with insulation min. class B and enclosure min. IP44. .

6-30. Piping Arrangements

- (1) The engine is delivered with piping arrangements for ;
- ① Fuel oil
 - ② Heating of fuel oil pipes
 - ③ Main lubricating oil and piston cooling oil pipes
 - ④ Cylinder lubricating oil
 - ⑤ Air cooler cooling water
 - ⑥ Fresh cooling water
 - ⑦ Cleaning of scavenge air cooler
 - ⑧ Cleaning of turbocharger
 - ⑨ Fire extinguishing for scavenge air space
 - ⑩ Starting air
 - ⑪ Control air / Safety air / Spring & sealing air - exhaust valve
 - ⑫ Pressure gauge
 - ⑬ Various drains
- (2) All arrangements are made of steel piping, except the control air, safety air, sealing air, steam heating of fuel pipes and jacket water heating of pipes, which are made of copper.
- (3) The pipes for cooling water to the air cooler are of steel.
- (4) The pipes are provided with sockets for local instruments, alarm and safety equipment and, furthermore, with a number of sockets for supplementary signal equipment and supplementary remote instruments.
- (5) The inlet and return fuel pipes (except branch pipes) are heated with steam tracing.
- (6) The fuel oil drain pipe is heated and insulated by fresh cooling water.
- (7) The above heating pipes are normally delivered with insulation.
- (8) The engine's external pipe connections are in accordance with KS and JIS standards.
- (9) A fire extinguishing system for the scavenge air box will be provided based on steam.

6-31. Starting Air Pipes

- (1) The starting air system comprises a main starting valve, a non-return valve, a bursting disc for the branch pipe to each cylinder, a starting air distributor, and a starting valve on each cylinder. The main starting valve is connected with the manoeuvring system, which controls the start of the engine.
- (2) The starting air distributor regulates the supply of control air to the starting valves so that they supply the engine cylinders with starting air in the correct firing order.
- (3) The starting air distributor has one set of starting cams for "Ahead" and one set for "Astern", as well as one control valve for each cylinder.



6-32. Oil Mist Detector

The engine shall be provided with an oil mist detector as follows.

- (1) Make : Graviner
- (2) Type : Mark 6



7. Extent of Delivery

The following items according to HSD STANDARD SPECIFICATION and specifically required by the shipyard are to be supplied with and/or applied to the engine.

Some parts and arrangements described in this specification may be mentioned more than once and in more than place. The delivery comprises, however, only one such piece/set/part /arrangement.

7-1. Exhaust Gas Turbocharger

- (1) Turbocharger type : one (1) set of NA70/T09 turbocharger
- (2) The cooled, external lubricating oil lubrication.
- (3) With soft blasting device for turbine side.
- (4) With water washing device for blower side and turbine side.
- (5) Without conical piece of exhaust gas outlet.
- (6) The turbocharger is to be arranged on the exhaust side of the engine.

7-2. Air Cooler : one (1) set.

(1) Materials

- ① end cover : cast iron coated with rust resisting paint
- ② cooling tube : copper nickel alloy with round shaped

(2) Cleaning device

- ① air side : showering system is to be incorporated

(Cleaning pump unit including tank and filter are to be provided by shipbuilder)

- ② water side : with cleaning bar

- (3) Condensed water separator shall be provided just after the cooler.

7-3. Thrust Shaft and Thrust Collar (incorporated type)

- (1) The coupling bolts' holes of thrust shaft (crankshaft) aft flange shall be bored with finishing allowance of 1.5 mm in diameter.
- (2) The bolts, nuts and other materials shall be provided by shipbuilder.

7-4. Auxiliary Blowers

(1) Electric motors (to be of builder's standard)

- ① totally enclosed (IP44), fan cooled, squirrel-caged
- ② continuous rating, insulation class F
- ③ electric source : AC 440 V x 60 Hz x 3 Phase
- ④ without space heater



(2) Starter (to be of builder's standard)

- ① wall mounting type with drip proof (IP23)
- ② direct on line
- ③ automatic start/stop control by detecting scavenging air pressure
- ④ with running hour meter
- ⑤ with collar coaming type cable entry
- ⑥ with ammeter
- ⑦ with Under Voltage Release
- ⑧ control source : AC 220 V x 60 Hz x 1 Phase

(3) The blowers shall be installed at builder's standard position.

7-5. Turning gear

(1) Electric motor (to be of builder's standard)

- ① totally enclosed (IP44), fan cooled, single speed type
- ② one hour rating, insulation class F
- ③ electric source : AC 440 V x 60 Hz x 3 Phase
- ④ without space heater

(2) Starter (to be of builder's standard)

- ① wall mount type with drip proof (IP23)
- ② direct on line starting type
- ③ with coaming type cable entry
- ④ with ammeter
- ⑤ without running hour meter
- ⑥ control source : AC 220 V x 60 Hz x 1 Phase

(3) With portable control box including captive cord of 15 meter length, one plug and two (2) receptacles.

(4) The turning gear with motor shall be installed at builder's standard position.

7-6. Turning (fly) wheel excluding cover : Standard turning wheel

7-7. Cylinder lubricators : "Alpha", 1 engine set

7-8. Governor

Lyngso Marine make, EGS-2000 electronic speed control governor with actuator shall be applied to the engine speed control system

7-9. Variable injection timing device : 1 set

7-10. Indicator valve per each cylinder : 1 set

(with indicator gear)



7-11. Main starting valve with non-return valve : 1 set
(with slow turning)

7-12. Bursting cap for starting air pipes : 1 engine set

7-13. Axial vibration damper (integrated type) : 1 set
(with electronic axial vibration monitoring)

7-14. Relief valve for crankcase : 1 engine set

7-15. Relief valve for scavenge air receiver : 1 engine set

7-16. Safety cut-out device : 1 engine set

In case of following conditions, the engine shall be stopped by this device.

- (1) Overspeed
- (2) Main bearing L.O inlet low pressure
- (3) Thrust pad high temperature
- (4) Turbocharger L.O inlet low pressure

7-17. Piping

Builder's standard piping for cooling fresh water, lubricating oil, cooling oil, fuel oil, starting air, control air and drain : 1 engine set

- (1) with copper heating tube and builder's standard insulation for fuel pipe
- (2) with fire extinguishing steam piping of scavenging box
- (3) without flanges, bolts, nuts and gaskets for connecting to ship side pipes
(excluding special counter flanges and connectors)

7-18. Engine platforms : 1 engine set

- (1) with brackets, plate, frame and hand rails
- (2) without ladder among upper and lower platform and base floor

7-19. Turning gear interlocking device preventing engine from unintended starting : 1 set



7-20. Main engine bridge control system of *NABCO make, M-800*

(including telegraph system and safety system) : 1 set

Details are specified in separate drawing, " M/E bridge manoeuvring system " of EA05-1258.

7-21. IMO rule NOx measuring test (for first engine only) : 1 engine set



7-22. Jacking bracket each main bearing center on bedplate (P& S) : 1 engine set

7-23. Pads for flywheel cover : 1 engine set

7-24. Preheated drain box with level switch for fuel H.P pipe leakage : 1 set

7-25. Slow turning device : 1 engine set

7-26. Bedplate platform (Port & Std side) for crankcase access : 1 engine set

7-27. Reduction station for control and safety air : 1 set

7-28. Hydraulic jack for engine seating : each 1 set for H/D & E/C bolts

7-29. Tool panels : 1 engine set

7-30. Trolley for con-rod overhaul : 1 set

7-31. Electric cabling and junction boxes on engine side : 1 engine set

7-32. Lighting for engine side (50 lux) : 1 engine set

7-33. Oil mist detector : 1 set

Graviner make, Mark-6 type oil mist detector and its piping and wiring shall be provided.

7-34. Main bearing temperature monitoring : 1 engine set

(1) main bearing ----- 6 sets

(2) thrust bearing radial ----- 1 set

7-35. Provision work for MIP : 1 engine set



8. Instruments and signal equipment (switches, sensors, etc.) on engine

Explanation of symbols

TI = Temperature indicator

PI = Pressure indicator

PDI = Pressure difference indicator

8-1. The engine is provided with the following local instruments.

Q'ty	Symbol	Description
(1) Fuel oil system		
1	TI	Fuel oil inlet main
1	PI	*1) Fuel oil inlet main
(2) Lube oil system		
1	TI	Lube oil inlet (system oil)
1	TI	Piston cooling oil outlet / cyl.
1	PI	Piston cooling oil inlet
1	PI	Lube oil inlet to main bearings and thrust bearing
1	TI	*2) Thrust bearing segment, head
1	TI	Lube oil inlet to cam shaft
1	PI	Lube oil inlet to cam shaft
1	TI	Lube oil outlet from cam shaft / cyl.
1	PI	Turbocharger L.O inlet / TC
1	TI	Turbocharger L.O inlet
1	TI	Turbocharger L.O outlet / TC
(3) Cooling water system		
1	TI	Air cooler cooling water inlet
1	TI	Air cooler cooling water outlet / AC
1	TI	Fresh cooling water inlet
1	PI	Fresh cooling water inlet
1	PI	Air cooler cooling water inlet
1	PI	T/C cleaning water inlet
1	TI	Fresh cooling water outlet / cyl.
1	TI	Turbocharger cooling water outlet / TC
(4) Air system		
1	PI	Exh. valve spring air
1	PI	Starting air to main starting valve
1	PI	Control air pressure
1	PI	Safety air pressure
1	PI	VIT actuator air



1	PI	T/C cleaning air inlet
1	TI	Scavenge air before air cooler / AC
1	TI	Scavenge air after air cooler / AC
1	TI	Scavenge air receiver
1	PI	Scavenge air receiver
1	PI	Scavenge air & exh. gas receiver
1	PDI	Pressure drop across air cooler / AC
1	PDI	Pressure drop across before filter / TC
1	TI	*3) Exhaust gas before turbocharger / TC
1	TI	*3) Exhaust gas after valve / cyl.
1	TI	*3) Exhaust gas after turbocharger / TC

*1) : with separation chamber

*2) : remote reading dial type

*3) : direct reading dial type

8-2. Extend of sensors and electrical signal equipment on engine

See separate drawing " Wiring diagram with cable route plan " of EA01-1258.

8-3. Safety system

(1) Explanation of symbols

- ① PS-SHD = Pressure switch for shut down
- ② TS-SHD = Temperature switch for shut down
- ③ SS-SHD = Speed switch for shut down

(2) Shut down functions for unattended machinery spaces

- ① The engine is equipped with an independent safety system which will stop (shut down) the engine in emergency situations.
- ② All shut down functions are indicated individually.
- ③ Sensors and safety panel are delivered for the following shut down functions, including pick-ups for overspeed.

(Ref. item 13, " Sensors on engine ")

- SS-SHD : Engine overspeed
- PS-SHD : Lube oil to main bearing and thrust bearing
- TS-SHD : Thrust bearing segment
- PS-SHD : Lube oil inlet to turbocharger

(3) Slow down functions for unattended machinery spaces

Automatic slow down is carried out by means of the bridge control system.



9. Component for manoeuvring console and emergency console

9-1. Manoeuvring console in control room

(1) The following components are supplied.

1	Manoeuvring unit (for electric governor)
1	Tachometer for T/C
1	Fuel pump mark indicator (for control room console)
1	Electric governor control panel
1	Safety system unit
1 set	Bridge control system components

(2) The manoeuvring console is yard supply.

9-2. Emergency console on engine

(1) The emergency console is equipped with the following pneumatic components.

Q'ty	Designation
1	Fuel regulating device with hand wheel
1	Valve for change-over remote-emergency
1	Valve for reversing ahead-astern
1	Button for stop
1	Button for start

(2) Furthermore, an instrument panel containing the following instruments is mounted close to the emergency console.

Q'ty	Designation
1	Tachometer for main engine
1	Lamp for engine side control
1	Lamp for control room control (remote)
1	Lamp for bridge control (remote)
1	Lamp for "Ahead"
1	Lamp for "Astern"
1	Lamp for auxiliary blower running
1	Lamp and buzzer for wrong way alarm
1	Lamp for turning gear engaged
1	Lamp for "Shut down"
1	Push button and lamp for canceling "Shutdown"
1	Push button and lamp for "Emergency stop"
1	Push button for lamp test



10. Spares

The engine's spare parts are supplied in accordance with builder's standard.
Details are shown in separate drawings, " List of spare parts " of MA12-1258.

11. Tools

The engine is delivered with the necessary special tools for overhaul.
Details are shown in separate drawings, " List of tools " of MA13-1258.



12. Specification for painting

Components	Type of paint	Stage	Thick	Color
Components, Inside Unmachined surfaces all over, cast Type crankshaft throws, main bearing Cap, crosshead bearing cap, crankpin Bearing cap, pipe inside crankcase, etc.	Epoxy primer	1st	30 μm	Brown
	High built epoxy Finish	2nd	60 μm	White Munsell N 9.3
Component, Outside Engine body, pipes, gallery brackets, air cooler, scavenge receiver, etc.	Epoxy primer	1st	30 μm	Brown
	Alkyd primer	2nd	30 μm	Green
	Enamel alkyd Finish	3rd	30 μm	Blue green Munsell 7.5BG7/2
Exhaust pipes	Heat resistant paint (min600°C)	1st	20 μm	Silver
		2nd	20 μm	Silver
Tools Unmachined surfaces all over	Epoxy primer	1st	30 μm	Brown
	Alkyd primer	2nd	30 μm	Green
	Enamel alkyd Finish	3rd	30 μm	Orange red Munsell 7.5R6/12
Tool panels	Epoxy primer	1st	30 μm	Brown
	Alkyd primer	2nd	30 μm	Green
	Enamel alkyd finish	3rd	30 μm	Light gray Munsell N 7.5
Purchased equipment and instruments	maker's standard			



13. Sensors on engine

13-1. Alarm : Normally closed contacts

13-2. Automatic shut down : Normally open contacts with resistor across

13-3. Automatic slow down : Normally open contacts with resistor across

13-4. Some of the sensors are to be finally adjusted by the engine builder.

13-5. Some of the sensors are commonly used for remote indication, alarm and slow down purposes, than the signals for each purpose are to be prepared by shipyard.

13-6. Detail of sensors are shown in separate drawing, “ Wiring diagram with cable route plan “ of EA01-1258.





HSD ENGINE

SLIENT : DAEWOO SHIPBUILDING & MARINE ENGINEERING CO.,LTD.
 HULL NO. : 5258
 ENGINE TYPE : HSD-MAN B&W 5S70MC(Mk-6)

SUBJECT :

ENGINE OUTLINE DRAWING

Notes :

Enclosure :

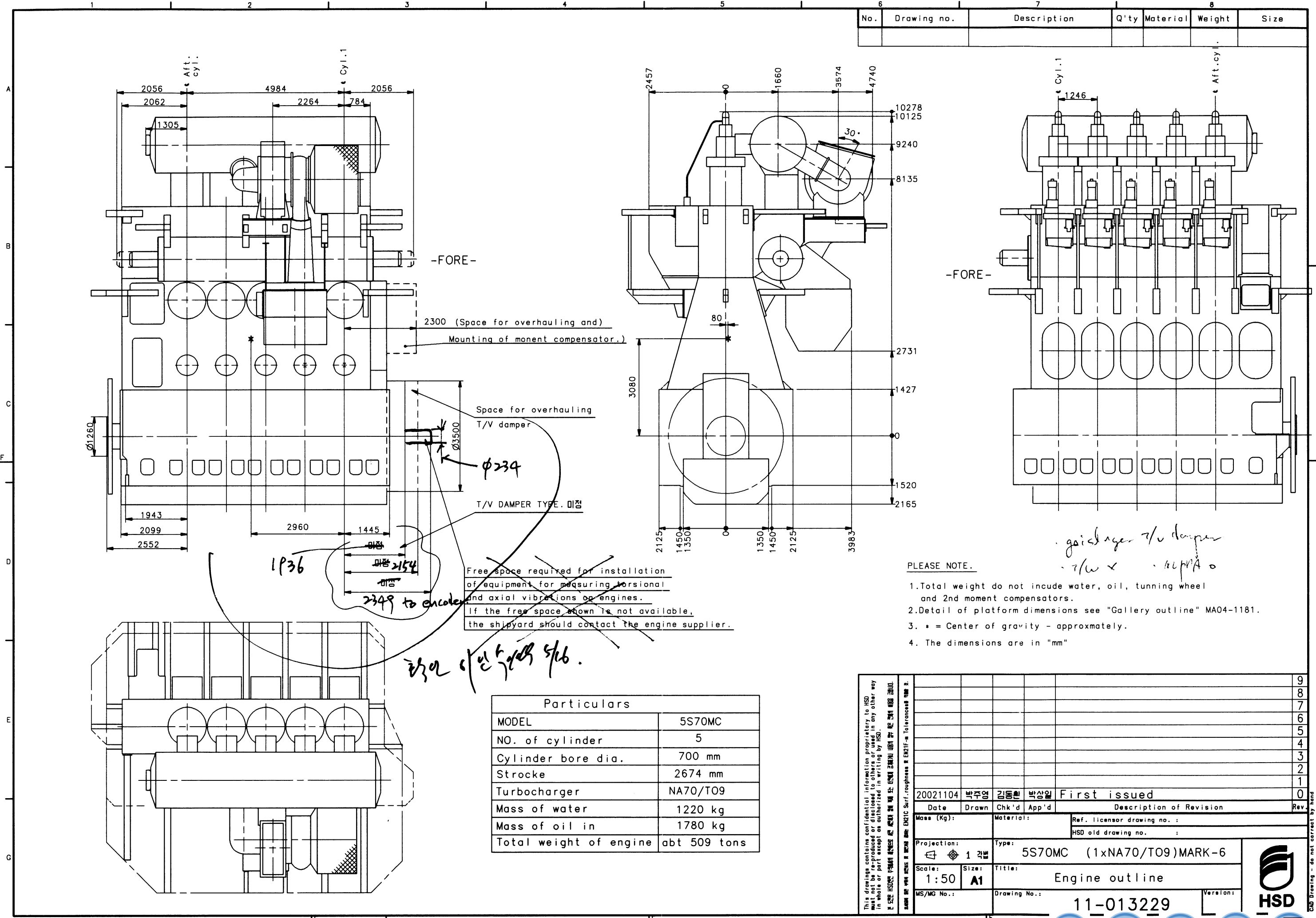
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0	Fisrt prepared	02'11.05	<i>Cen</i>	<i>JH</i>	<i>[Signature]</i>
Rev	Description	Date	Prepared	Reviewed	Approved

Design Team 1
 (Tel.+82 55 260-6708. FAX, +82 55 260-6800)
 HSD ENGINE CO.,LTD.

Drawing Number

MA03-1258



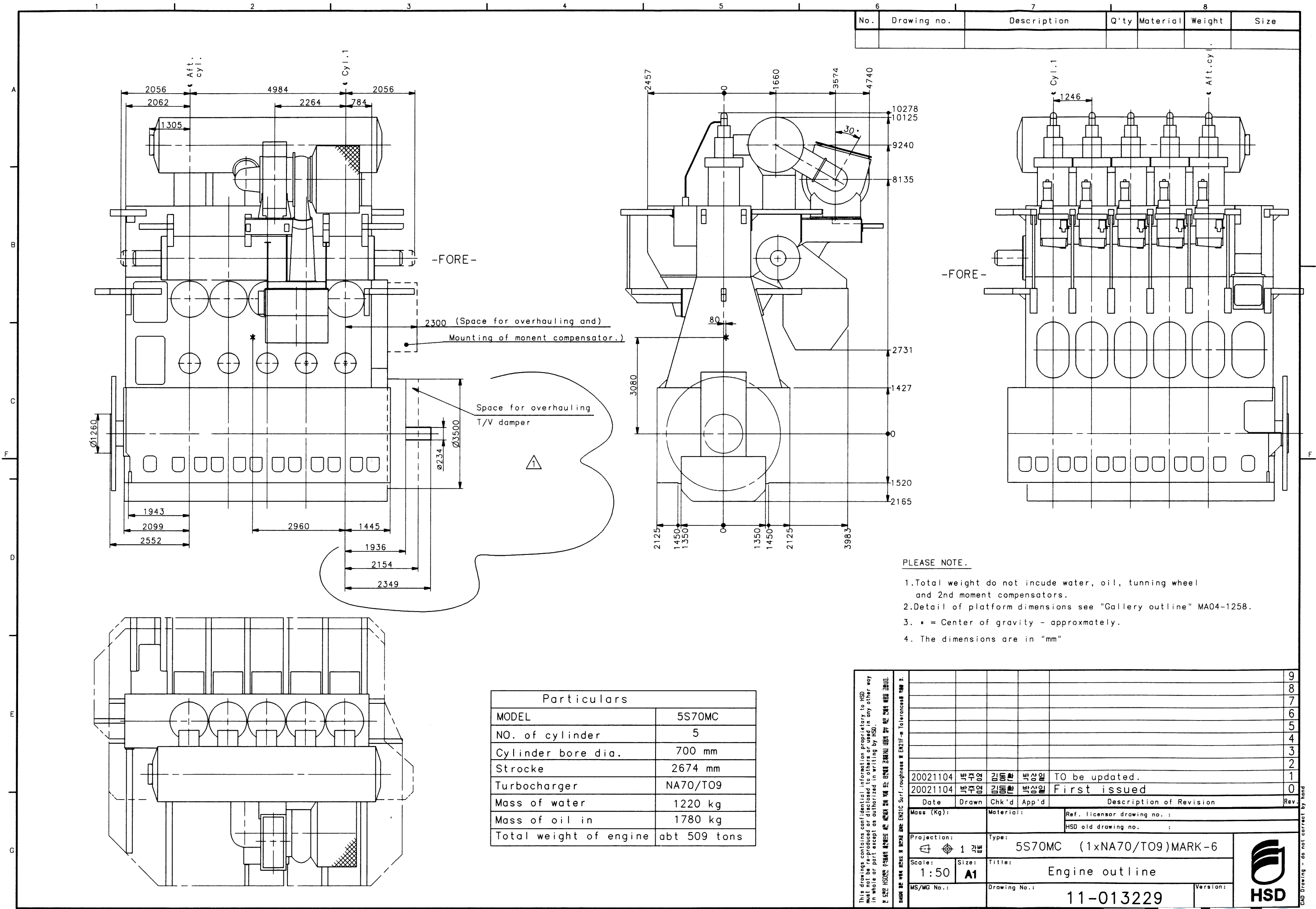


Particulars	
MODEL	5S70MC
NO. of cylinder	5
Cylinder bore dia.	700 mm
Stroke	2674 mm
Turbocharger	NA70/T09
Mass of water	1220 kg
Mass of oil in	1780 kg
Total weight of engine	abt 509 tons

- PLEASE NOTE.
- 1.Total weight do not include water, oil, tuning wheel and 2nd moment compensators.
 - 2.Detail of platform dimensions see "Gallery outline" MA04-1181.
 3. * = Center of gravity - approximately.
 4. The dimensions are in "mm"

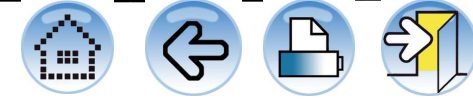
This drawing contains confidential information proprietary to HSD must not be re-produced or disclosed to others or used in any other way in whole or part except as authorized in writing by HSD.				9
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Description of Revision				6
Mass (Kg):				5
Material:				4
Ref. licensor drawing no. :				3
HSD old drawing no. :				2
Projection: 1 각법				1
Type: 5S70MC (1xNA70/T09)MARK-6				0
Scale: 1:50 Size: A1				
Title: Engine outline				
MS/MG No.:				
Drawing No.: 11-013229				
Version:				





No.	Drawing no.	Description	Q'ty	Material	Weight	Size

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First issued						0
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				HSD old drawing no. :		
Projection:		Type:		5S70MC (1xNA70/TO9)MARK-6		
Scale:		Size:		Title:		
1:50		A1		Engine outline		
MS/MG No.:		Drawing No.:		Version:		
		11-013229				





HSD ENGINE

Client : Daewoo Shipbuilding & Marine Engineering Co., Ltd.
 Hull Number : HN 5258(UNIQ)
 Engine Type : HSD - MAN B&W 5S70MC (MK 6)

Subject :

ARRANGEMENT OF PIPE CONNECTION

Note :

Turbocharger type : NA57/T9X1Set

Attachments : 11-013276-20

5					
4					
3					
2					
1	Rev.:Direction of AC1,AC2	2003.01.14	Y.S.Ahn	S.T.Kim	
0	First issued.	2002.11.11	D.B.Song		C.S.Chung
Rev.	Description	Date	Prepared	Reviewed	Approved
Design Team 2 Tel. +82 55 260 6750 Fax. +82 55 260 6640 HSD ENGINE CO., LTD. PLANT 2		Documentation No. M A 05 - 1258			





HSD ENGINE

Client : Daewoo Shipbuilding & Marine Engineering Co., Ltd.
 Hull Number : HN 5258(UNIQ)
 Engine Type : HSD - MAN B&W 5S70MC (MK 6)

Subject :

PIPING DIAGRAM

Note :

Turbocharger type : NA57/T9X1Set

Attachments :

Refer to contents ----- 14-013932-01

5					
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3					
2					
1	Rev.page : 2,15	2003.01.14	Y.S.Ahn	S.T.Kim	
0	First issued.	2002.11.11	D.B.Song		C.S.Chung
Rev.	Description	Date	Prepared	Reviewed	Approved
Design Team 2 Tel. +82 55 260 6750 Fax. +82 55 260 6640 HSD ENGINE CO., LTD. PLANT 2		Documentation No. M A 06 - 1258			



Submittal Drawing

DRAWING NO. 1 4 - 0 1 3 9 3 2 - 0 1 PAGE : 2

CONTENTS

NO	TITLE	DWG.NO.	REV	SHT	ISSUED				WORK'G
					1st	2nd	3rd	4th	
3	SPECIFICATION FOR PIPING SYS.	14-013934	0.0	1					
4	SPECIFICATION FOR PIPING SYS.	14-013935	0.0	1					
5	TABLE OF THERMOMETER WITH ENG.	14-011921	1.0	1					
6	TABLE OF PRESS. GAUGE WITH ENG.	14-012329	0.0	1					
7	TABLE OF SYMBOL	14-010449~451	0	3					
	P & ID FOR ENGINE								
10	FUEL OIL PIPE	13-014583	0.0	1					
11	FUEL OIL DRAIN PIPE	13-014584	2.0	1					
12	FUEL OIL PIPE HEATING	13-014585	0.0	1					
13	LUB.& COOL.OIL PIPE	13-014586	0.0	1					
14	CAMSHAFT LO PIPE	13-014587	1.0	1					
15	CYL.LO PIPE	12-013886	0.0	1					
16	STUFFING BOX DRAIN PIPE	13-014589	0.0	1					
17	A/C COOLING PIPE	13-014590	1.0	1					
18	C.F.W PIPE	13-014591	0.0	1					
19	STARTING AIR PIPE	13-014592	0.0	1					
20	SEALING AIR PIPE - EXH.V/V	13-016029	2.0	1					
21	SCAVENGE AIR PIPE	13-014594	0.0	1					
22	SCAVENGE AIR SPACE DRAIN PIPE	13-014595	0.0	1					
23	A/C CLEANING PIPE-1T/C	13-014596	0.0	1					
24	STEAM EXTING.IN SCAV.BOX	13-014597	0.0	1					
25	EXHAUST GAS PIPE	13-014598	1.0	1					
26	DRY CLEAN.PIPE-1T/C	13-014599	0.0	1					
27	WATER CLEAN.PIPE-1T/C	13-014600	0.0	1					
28	BEDPLATE DRAIN PIPE	13-014601	0.0	1					
29	T/C L.O. INLET & DRAIN PIPE	13-017237	1.0	1					

TOTAL 21 SHEETS



Submittal Drawing

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SPECIFICATION FOR PIPING SYSTEM(1/2)

SYSTEM		FLUID COND.		CONNECTION PIPE				PIPE CONN.		REM.
		PRESS. KG/CM ²	TEMP. °C	N.DIA. (JIS)	SCH. NO.	MAT'L (JIS)	T/P KG/CM ²	TYPE	MAT'L (JIS)	
F.O.INLET & RETURN PIPE		10	MAX. 150	80A	40	HBP-12	24	JIS 16K	HBF22	INS.
				50A						
				40A						
F.O.DRAIN PIPE				32A	40	STPG370		JIS 5K	SS400	INS.
				25A						
F.O.HEATING PIPE				ø10	1.5T	C1220T -1/2H		BITE TYPE JOINT	COPPER ALLOY	INS.
				ø15	2.0T					
LUB. & COOL. OIL PIPE		3	60	250A	40	STPG370		JIS 5K	SS400	
				200A						
				125A						
CAMSHAFT L.O PIPE		3	70	50A	40	STPG370		JIS 5K	SS400	
CYL. L.O PIPE				32A	40	STPG370		JIS 5K	SS400	
				25A						
STUFFING BOX DRAIN PIPE				32A		SGP		JIS 5K	SS400	
A/C COOLING PIPE		2.5	36	200A		STPG370		JIS 5K	SS400	
F/W COOL. PIPE	INLET & OUTLET	2.7~ 4.5	90	100A	40	STPG370		JIS 5K	SS400	
	DRAIN			32A		STPG370				

HSD ENGINE CO., LTD.



Submittal Drawing

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SPECIFICATION FOR PIPING SYSTEM(2/2)

SYSTEM		FLUID COND.		CONNECTION PIPE			PIPE CONN.		REM.	
		PRESS. KG/CM ²	TEMP. °C	N.DIA. (JIS)	SCH. NO.	MAT'L (JIS)	T/P KG/CM ²	TYPE		MAT'L (JIS)
STARTING AIR PIPE		30		150A	40	HBP-12	70	JIS 30K WN.RF	HBF22	
SEALING AIR PIPE FOR EXH. V/V		7		ø15	2.0T	C1220T -1/2H		BITE TYPE JOINT	COPPER ALLOY	
SCAV. AIR SPACE DRAIN PIPE		3		65A		SGP		JIS 5K	SS400	
A/C CLEANING PIPE				50A	40	STPG370		JIS 5K	SS400	GAL.
				25A		STPG370				
STEAM EXT. IN SCAV. BOX		7		40A	40	STPG370		JIS 10K	SS400	GAL. INS.
T/C CLEANING PIPE	DRY CLEANING	3.5-7		25A	40	STPG370		JIS 10K	SS400	
	WATER CLEANING		25A	STPG370		JIS 5K		SS400		
	DRAIN		32A	STPG370						
BEDPLATE DRAIN PIPE				32A		SGP		JIS 5K	SS400	
T/C L.O. INLET & DRAIN		0.9~ 2.0	90	100A	40	STPG370		JIS 5K	SS400	
				65A						
PIPING FOR PRESS GAUGE SWITCH & SENSOR	S.A. F.O. L.O.			ø10	1.5T	STS410S		BITE TYPE JOINT	FORGED ALLOY	
	THE OTHERS			ø10	1.5T	C1220T -1/2H			COPPER ALLOY	

HSD ENGINE CO., LTD.



Submittal Drawing

DRAWING NO. 1 4 - 0 1 7 8 4 4 - 0 0 PAGE : 3

SPECIFICATION FOR PIPING SYSTEM(1/2)

SYSTEM	FLUID COND.		CONNECTION PIPE				PIPE CONN.		REM.
	PRESS. KG/CM ²	TEMP. °C	N.DIA. (JIS)	SCH. NO.	MAT'L (JIS)	T/P KG/CM ²	TYPE	MAT'L (JIS)	
F.O.INLET & RETURN PIPE	10	MAX. 150	80A	40	HBP-12	24	JIS 16K	HBF22	INS.
			50A						
			40A						
F.O.DRAIN PIPE			32A	40	STPG370		JIS 5K	SS400	INS.
			25A						
F.O.HEATING PIPE			ø10	1.5T	C1220T -1/2H		BITE TYPE JOINT	COPPER ALLOY	INS.
			ø15	2.0T					
LUB. & COOL. OIL PIPE	3	60	250A	40	STPG370		JIS 5K	SS400	
			200A						
			125A						
CAMSHAFT L.O PIPE	3	70	50A	40	STPG370		JIS 5K	SS400	
CYL. L.O PIPE			32A	40	STPG370		JIS 5K	SS400	
			25A						
STUFFING BOX DRAIN PIPE			32A		SGP		JIS 5K	SS400	
A/C COOLING PIPE	2.5	36	200A		STPG370		JIS 5K	SS400	
F/W COOL. PIPE	INLET & OUTLET	2.7~ 4.5	90	40	STPG370		JIS 5K	SS400	
	DRAIN		32A		STPG370				

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Submittal Drawing

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SPECIFICATION FOR PIPING SYSTEM(2/2)

SYSTEM		FLUID COND.		CONNECTION PIPE			PIPE CONN.		REM.	
		PRESS. KG/CM ²	TEMP. °C	N.DIA. (JIS)	SCH. NO.	MAT'L (JIS)	T/P KG/CM ²	TYPE		MAT'L (JIS)
STARTING AIR PIPE		30		150A	40	HBP-12	70	JIS 30K WN.RF	HBF22	
SEALING AIR PIPE FOR EXH. V/V		7		ø15	2.0T	C1220T -1/2H		BITE TYPE JOINT	COPPER ALLOY	
SCAV. AIR SPACE DRAIN PIPE		3		65A		SGP		JIS 5K	SS400	
A/C CLEANING PIPE				50A	40	STPG370		JIS 5K	SS400	GAL.
				25A		STPG370				
STEAM EXT. IN SCAV. BOX		7		40A	40	STPG370		JIS 10K	SS400	GAL. INS.
T/C CLEANING PIPE	DRY CLEANING	3.5-7		25A	40	STPG370		JIS 10K	SS400	
	WATER CLEANING		25A	STPG370		JIS 5K		SS400		
	DRAIN		32A	STPG370						
BEDPLATE DRAIN PIPE				32A		SGP		JIS 5K	SS400	
T/C L.O. INLET & DRAIN		0.9~ 2.0	90	100A	40	STPG370		JIS 5K	SS400	
				65A						
PIPING FOR PRESS GAUGE SWITCH & SENSOR	S.A. F.O. L.O.			ø10	1.5T	STS410S		BITE TYPE JOINT	FORGED ALLOY	
	THE OTHERS			ø10	1.5T	C1220T -1/2H			COPPER ALLOY	

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Submittal Drawing													
DRAWING NO.	1	4	-	0	1	1	9	2	1	-	1	0	PAGE : 5
2. TABLE OF THERMOMETER WITH ENGINE													
NO.	ITEM					TYPE			Q'TY		REMARK		
1	EXH. GAS EACH CYL. OUTLET					PF3/4 x 650 °C x 250			1xCYL.NO.		DIAL TYPE		
2	EXH. GAS T/C INLET					PF3/4 x 650 °C x 250			1xT/C NO.		DIAL TYPE		
3	EXH. GAS T/C OUTLET					PF3/4 x 650 °C x 250			1xT/C NO.		DIAL TYPE		
4	SCAV. AIR MANIFOLD					PF3/4 x 160 °C x 250			1				
5	SCAV. AIR INLET OF A/C					PF3/4 x 320 °C x 200			1xT/C NO.				
6	SCAV. AIR OUTLET OF A/C					PF3/4 x 160 °C x 250			1xT/C NO.				
7	MAIN L.O. INLET					PF3/4 x 100 °C x 120			1				
8	P.C.O. OUTLET					PF3/4 x 100 °C x 120L			1xCYL.NO.				
9	F.O. INLET					PF3/4 x 200 °C x 100			1				
10	CAMSHAFT L.O. INLET					PF3/4 x 100 °C x 80			1				
11	CAMSHAFT L.O. OUTLET					PF3/4 x 100 °C x 80			1xCYL.NO.				
12	A/C C.F.W. INLET					PF3/4 x 100 °C x 120			1				
13	C.F.W. EACH CYL. OUTLET					PF3/4 x 150 °C x 80			1xCYL.NO.				
14	C.F.W. OUTLET OF T/C					PF3/4 x 150 °C x 80			1xT/C NO.		DIAL TYPE		
15	T/C L.O. OUTLET					PF3/4 x 160 °C x 120			1xT/C NO.				
16	T/C L.O. INLET					PF3/4 x 100 °C x 80			1xT/C NO.				
17	THRUST PAD					SENSOR PF1/2 D/TYPE			1		DIAL TYPE		
18	A/C C.F.W. OUTLET					PF3/4 x 100 °C x 120			1				
19	C.F.W. INLET					PF3/4 x 100 °C x 120			1				



Submittal Drawing													
DRAWING NO.	1	4	-	0	1	2	3	2	9	-	0	0	PAGE : 6
3. TABLE OF PRESSURE GAUGE WITH ENGINE													
NO.	ITEM					TYPE			Q'TY		REMARK		
1	P.C.O. INLET					BVS 3/8 x 100 x 4K			1				
2	MAIN BRG. L.O. INLET					BVS 3/8 x 100 x 4K			1				
3	F.O. INLET					BVS 3/8 x 100 x 15K			1				
4	CLEANING WATER INLET OF T/C					BVS 3/8 x 100 x 6K			1				
5	SCAV.AIR-off- EXH. GAS MANIFOLD					BVS 3/8 x 150 x 4K			1				
6	CLEANING AIR INLET OF T/C					BVS 3/8 x 100 x 10K			1				
7	CONTROL AIR					BVS 3/8 x 75 x 15K			1				
8	SAFETY AIR					BVS 3/8 x 75 x 15K			1				
9	EXH. V/V SPRING AIR					BVS 3/8 x 75 x 15K			1				
10	BEFORE A/C AFTER A/C								1 x A/C		U-TUBE MANOMETER		
11	T/C AIR FILTER PRESS.DROP								1 x T/C		U-TUBE MANOMETER		
12	T/C L.O. INLET					BVS 3/8 x 100 x 4K			1 x T/C				
13	A/C C.W. INLET					BVS 3/8 x 100 x 6K			1 x A/C				
14	CAMSHAFT L.O. INLET					BVS 3/8 x 100 x 6K			1				
15	SCAV.AIR RECEIVER					BVS 3/8 x 100 x 4K			1				
16	C.F.W INLET					BVS 3/8 x 100 x 10K			1				
17	STARTING AIR INLET					BVS 3/8 x 100 x 50K			1				
18	T/V DAMPER INLET					BVS 3/8 x 100 x 4K			1				



Submittal Drawing

DRAWING NO. 1 4 - 0 1 0 4 4 9 - 0 0 PAGE : 7

TABLE SYMBOL 1/3

NO.	SYMBOL	SYMBOL DESIGNATION	NO.	SYMBOL	SYMBOL DESIGNATION
1. GENERAL CONVENTIONAL SYMBOLS			2.16		PENETRATION NON WATER TIGHT
1.1		PIPE	2.17		PIPE GOING UPWARDS
1.2		PIPE WITH INDICATION OF DIRECTION OF FLOW	2.18		PIPE GOING DOWNWARDS
1.3		VALVES, GATE VALVES, COCKS AND FLAPS	2.19		ORIFICE
1.4		APPLIANCES	2.20		REDUCER (CONNETRIC & ECCENTRIC)
1.5		INDICATING AND MEASURING INSTRUMENTS	2.21		DISCHARGE / DRAIN
2. PIPES AND PIPE JOINT			3. VALVES, GATE VALVES, COCKS AND FLAPS		
2.1		NOT CONNECTED CROSSING PIPE	3.1		VALVE, STRAIGHT THROUGH
2.2		CROSSING PIPES, CONNECTED	3.2		VALVE, ANGLE
2.3		TEE PIPE	3.3		VALVE, 3-WAY
2.4		FLEXIBLE HOSE JOINT	3.4		NON-RETURN VALVE (FLAP), STRAIGHT
2.5		BELLOWS TYPE EXPANSION JOINT	3.5		NON-RETURN VALVE (FLAP), ANGLE
2.6		SCREWED JOINT	3.6		NON-RETURN VALVE (FLAP), STRAIGHT, SCREW DOWN
2.7		FLANGE JOINT	3.7		NON-RETURN VALVE (FLAP), ANGLE, SCREW DOWN
2.8		SLEEVE JOINT	3.8		FLAP STRAIGHT THROUGH
2.9		JOINT, QUICK-RELEASING	3.9		FLAP ANGLE
2.10		EXPANSION JOINT WITH GLAND	3.10		REDUCING, VALVE
2.11		EXPANSION PIPE	3.11		SAFETY VALVE
2.12		CAP NUT	3.12		ANGLE SAFETY VALVE
2.13		BLIND FLANGE	3.13		SELF-CLOSING VALVE
2.14		SPECTACLE FLANGE (O : OPEN , ● : SHUT)	3.14		QUICK-OPENING VALVE
2.15		PENETRATION (WATER TIGHT)	3.15		QUICK-CLOSING VALVE

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기계-연진-006 A4(95.11)



Submittal Drawing

DRAWING NO. 1 4 - 0 1 0 4 5 0 - 0 1 PAGE : 8

TABLE SYMBOL 2/3

NO.	SYMBOL	SYMBOL DESIGNATION	NO.	SYMBOL	SYMBOL DESIGNATION
3.16		REGULATING VALVE	4.9		MEMBRANE
3.17		BALL VALVE (-COCK)	4.10		ELECTRIC MOTOR
3.18		BUTTERFLY VALVE	4.11		ELECTRO-MAGNETIC
3.19		GATE VALVE	5. APPLIANCES		
3.20		DOUBLE-SEATED CHANGEOVER VALVE	5.1		MUD BOS
3.21		DOUBLE-SEATED CHANGEOVER VALVE, STRAIGHT	5.2		FILTER OR STRAINER
3.22		DOUBLE-SEATED CHANGEOVER VALVE ANGLE	5.3		MAGNETIC FILTER
3.23		COCK, STRAIGHT THROUGH	5.4		SEPARATOR
3.24		COCK, ANGLE	5.5		STEAM TRAP
3.25		COCK, 3-WAY, L-PORT IN PLUG	5.6		CENTRIFUGAL PUMP
3.26		COCK, 3-WAY, T-PORT IN PLUG	5.7		GEAR OR SCREW PUMP
3.27		COCK, 4-WAY, STRAIGHT THROUGH IN PLUG	5.8		HAND PUMP (BUCKET)
4. CONTROL AND REGULATION PART			5.9		EJECTOR
4.1		Y-TYPE FILTER	5.10		VARIOUS ACCESSORIES (TEXT TO BE ADDED)
4.2		SCREWED Y-TYPE FILTER	5.11		PISTON PUMP
4.3		HAND-OPERATED	5.12		CONDENSATE TRAP
4.4		REMOTE CONTROL	5.13		SIGHT GLASS
4.5		SPRING	6. FITTING		
4.6		MASS	6.1		FUNNEL
4.7		FLOAT	6.2		BELL-MOUTHED PIPE END
4.8		PISTON	6.3		AIR VENT PIPE
			6.4		AIR VENT PIPE WITH NET

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기계-엔진-006 A4(95.11)



Submittal Drawing

DRAWING NO. 1 4 - 0 1 0 4 5 1 - 0 0 PAGE : 9

TABLE SYMBOL 3 / 3

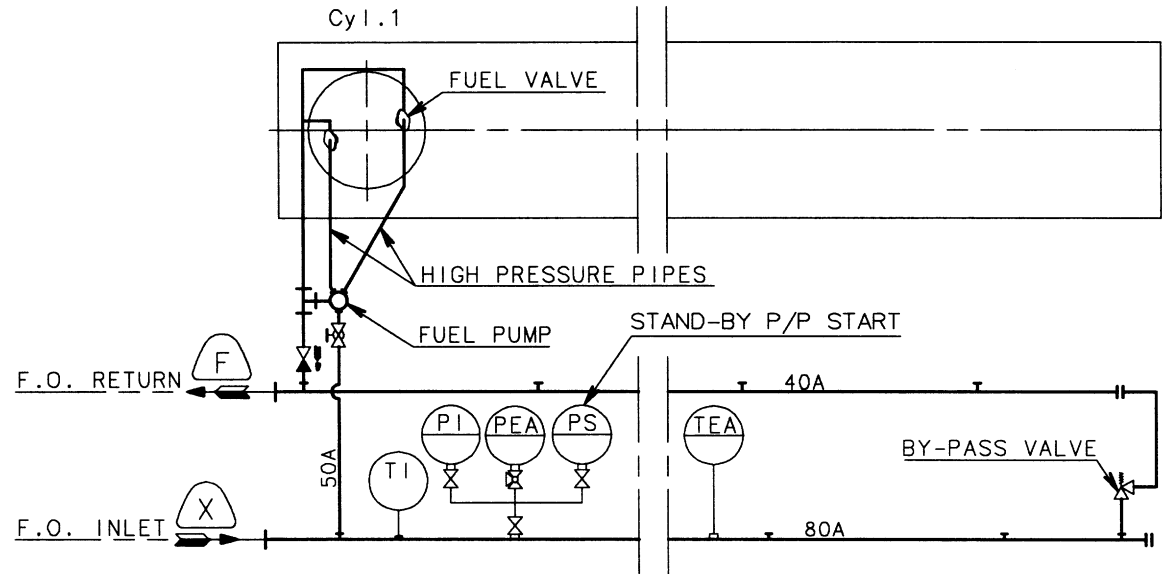
THE MEASURING INSTRUMENTS ARE IDENTIFIED BY A COMBINATION OF SYMBOLS
FOLLOWED BY POSITION NUMBER, THE SYMBOLS REPRESENT :

DSA	DENSITY SWITCH FOR ALARM	TI	TEMPERATURE INDICATOR
DS- SLD	DENSITY SWITCH FOR SLOW DOWN	TSA	TEMPERATURE SWITCH FOR ALARM
E	ELECTRIC DEVICE	TSC	TEMPERATURE SWITCH FOR CONTROL
EV	SOLENOID VALVE	TS- SHD	TEMPERATURE SWITCH FOR SHUT DOWN
ESA	ELECTRIC SWITCH FOR ALARM	TS- SLD	TEMPERATURE SWITCH FOR SLOW DOWN
FSA	FLOW SWITCH FOR ALARM	TE	TEMPERATURE SENSOR (ANALOGUE)
FS- SLD	FLOW SWITCH FOR SLOW DOWN	TEA	TEMPERATURE SENSOR FOR ALARM (ANALOGUE)
LSA	LEVEL SWITCH FOR ALARM	TEI	TEMPERATURE SENSOR FOR REMOTE INDICATION (ANALOGUE)
PDI	PRESSURE DIFFERENCE INDICATOR	TE- SLD	TEMPERATURE SENSOR FOR SLOW DOWN (ANALOGUE)
PDAS	PRESSURE DIFFERENCE SWITCH FOR ALARM	VE	VISCOSITY SENSOR (ANALOGUE)
PDT	PRESSURE DIFFERENCE TRANSMITTER	VI	VISCOSITY INDICATOR
PI	PRESSURE INDICATOR	ZE	POSITION SENSOR
PS	PRESSURE SWITCH	ZS	POSITION SWITCH
PS- SHD	PRESSURE SWITCH FOR SHUT DOWN	WEA	VIBRATION SIGNAL FOR ALARM (ANALOGUE)
PS- SLD	PRESSURE SWITCH FOR SLOW DOWN	WI	VIBRATION INDICATOR
PSA	PRESSURE SWITCH ALARM	WS- SLD	VIBRATION SWITCH FOR SLOW DOWN
PSC	PRESSURE SWITCH FOR CONTROLLING		
PE	PRESSURE SENSOR (ANALOGUE)		
PEA	PRESSURE SENSOR FOR ALARM (ANALOGUE)		
PEI	PRESSURE SENSOR FOR REMOTE INDICATION (ANALOGUE)	THE SYMBOL ARE IN A CIRCLE INDICATING	
PE- SLD	PRESSURE SENSOR FOR SLOW DOWN (ANALOGUE)	○	INSTRUMENT LOCALLY MOUNTED
SE	SPEED SENSOR (ANALOGUE)	⊖	INSTRUMENT MOUNTED IN PANEL ON ENGINE
SSA	SPEED SWITCH FOR ALARM	⊖	CONTROL PANEL MOUNTED INSTRUMENT
SS- SHD	SPEED SWITCH FOR SHUT DOWN		

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기계-엔진-006 A4(95.11)





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Projection:		Type:			
Scale:		Title:			
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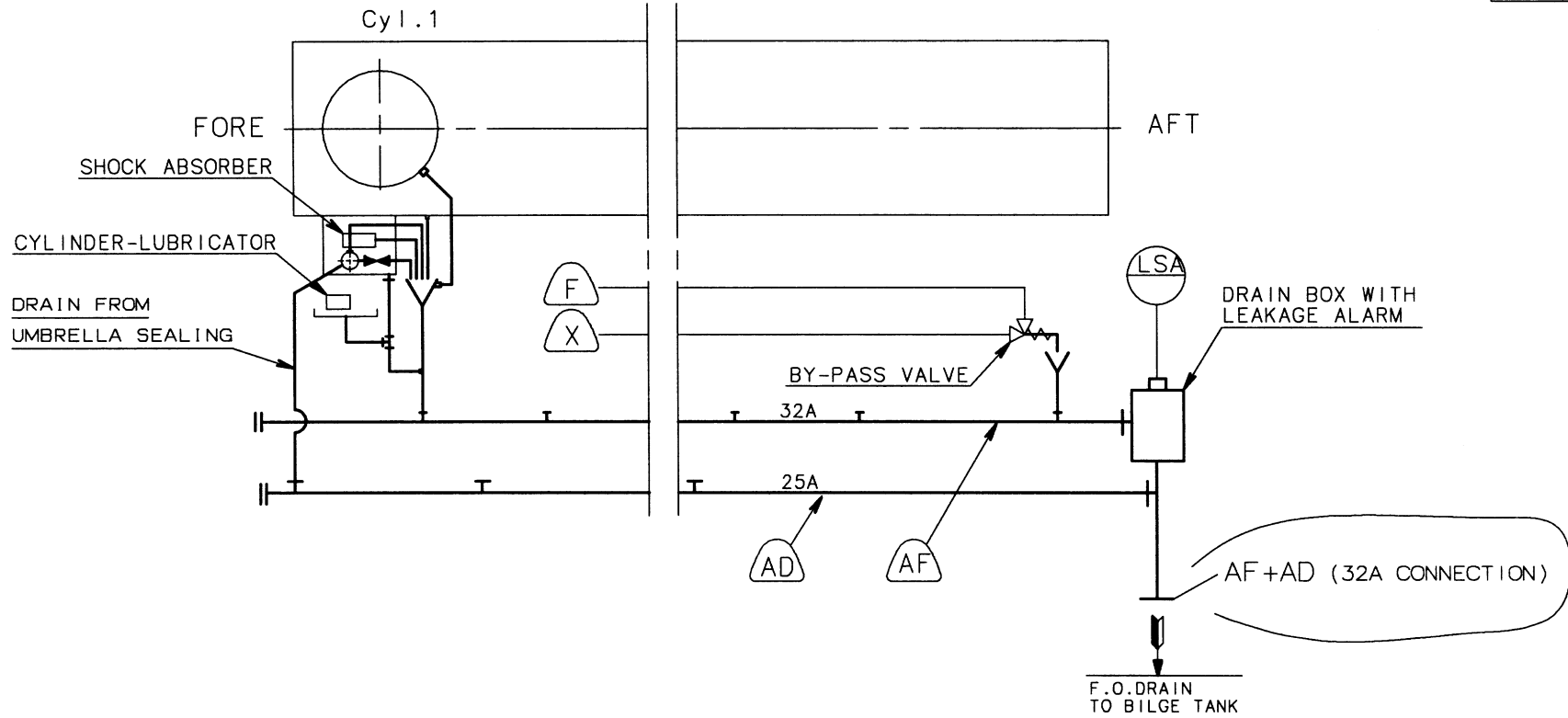
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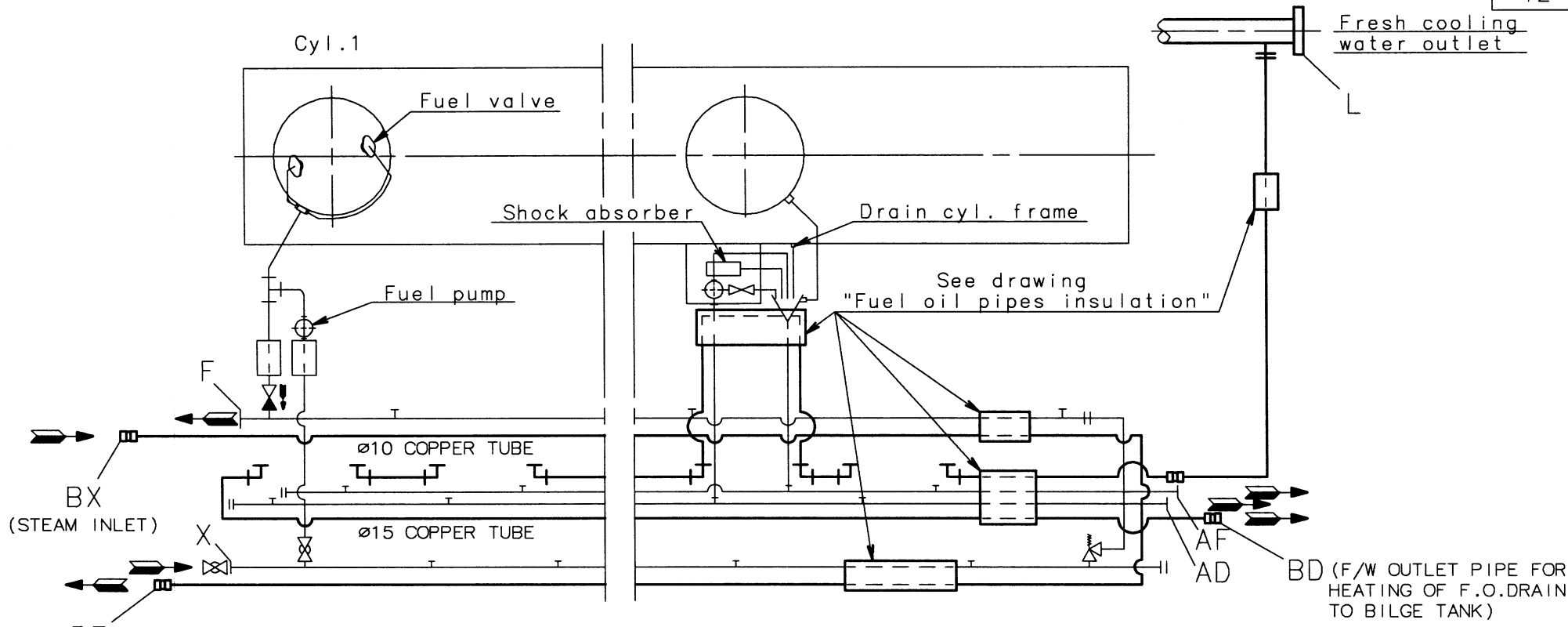




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CAD Drawing - do not correct by hand



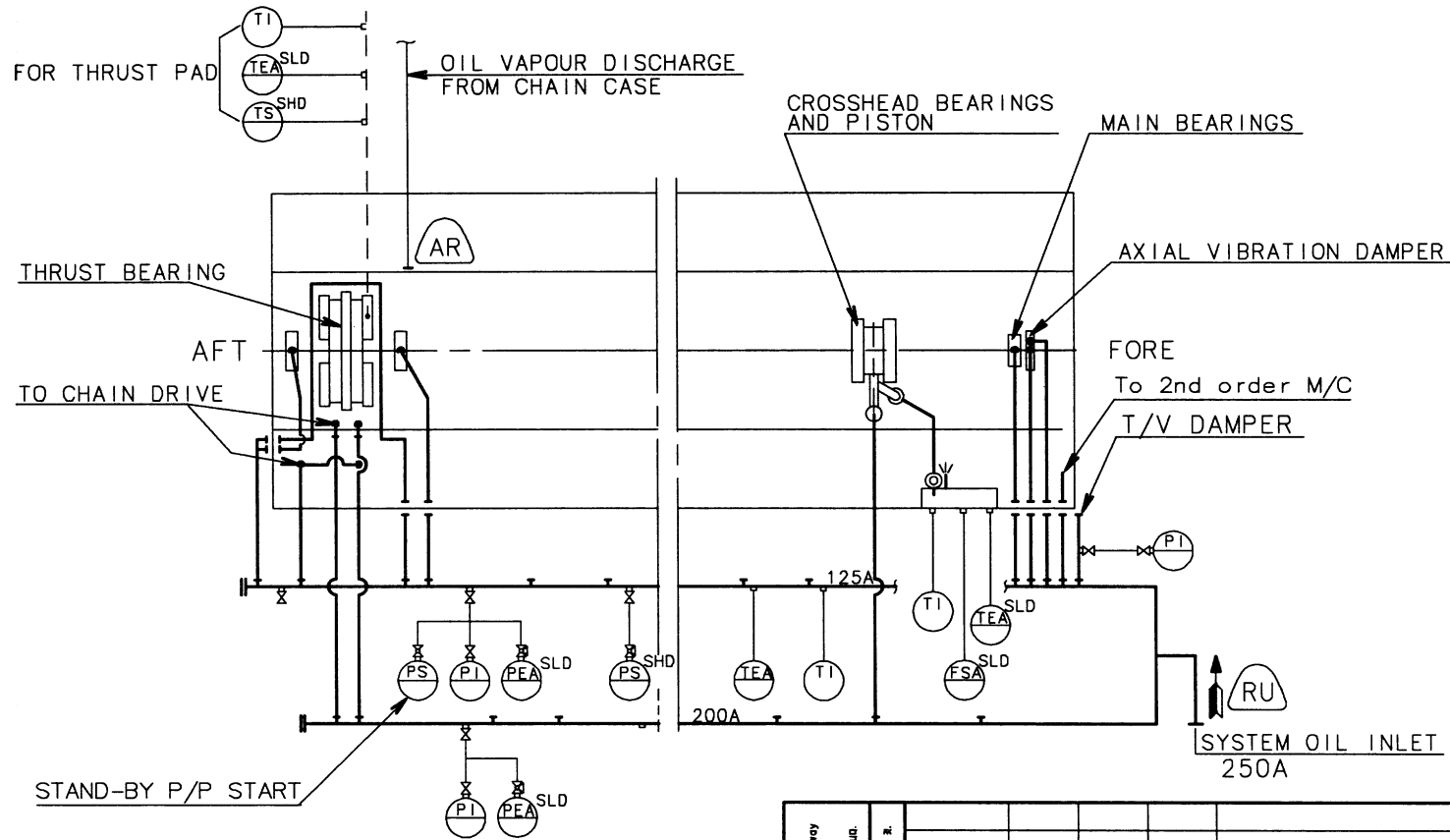


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CAD Drawing - do not correct by hand



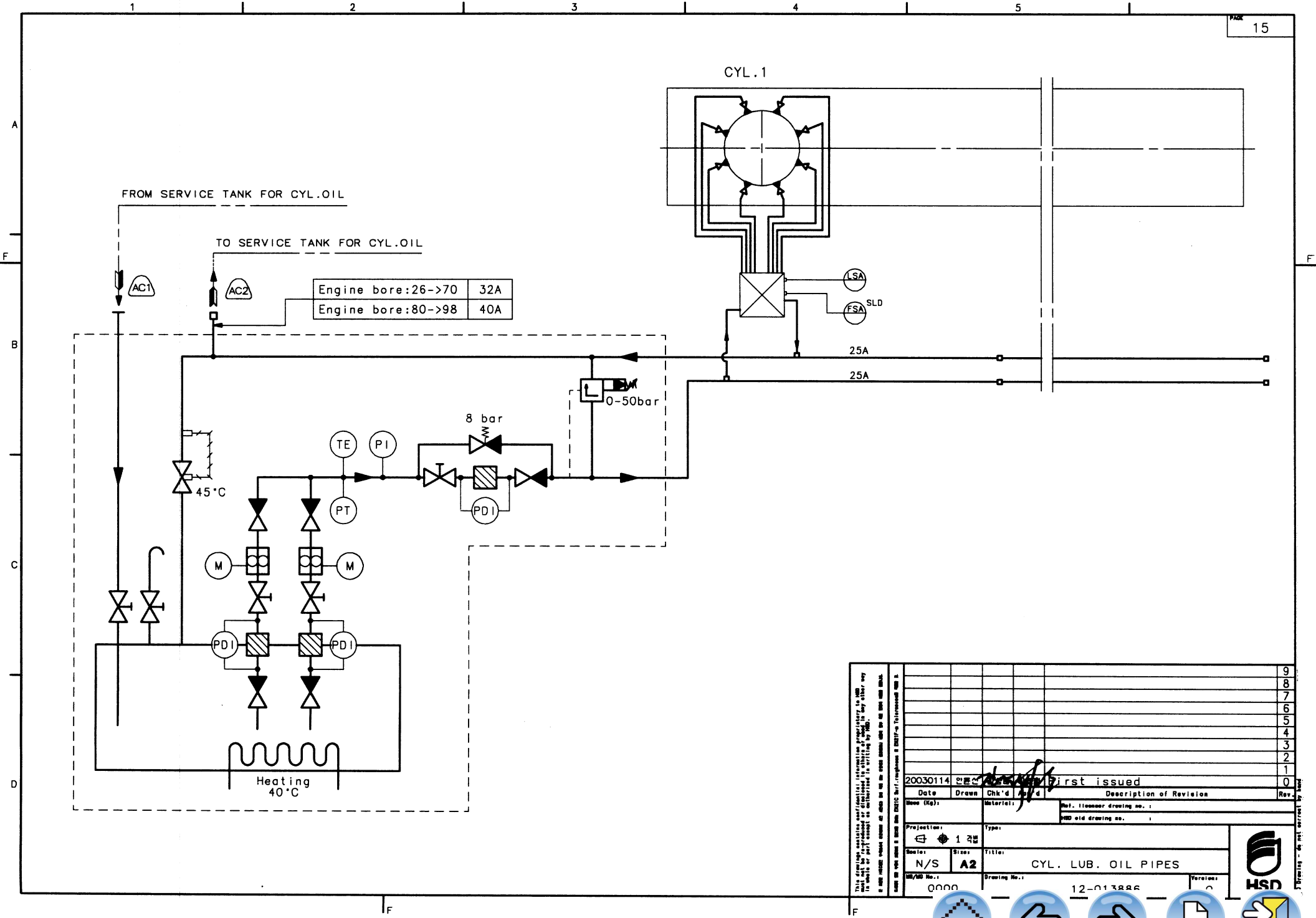


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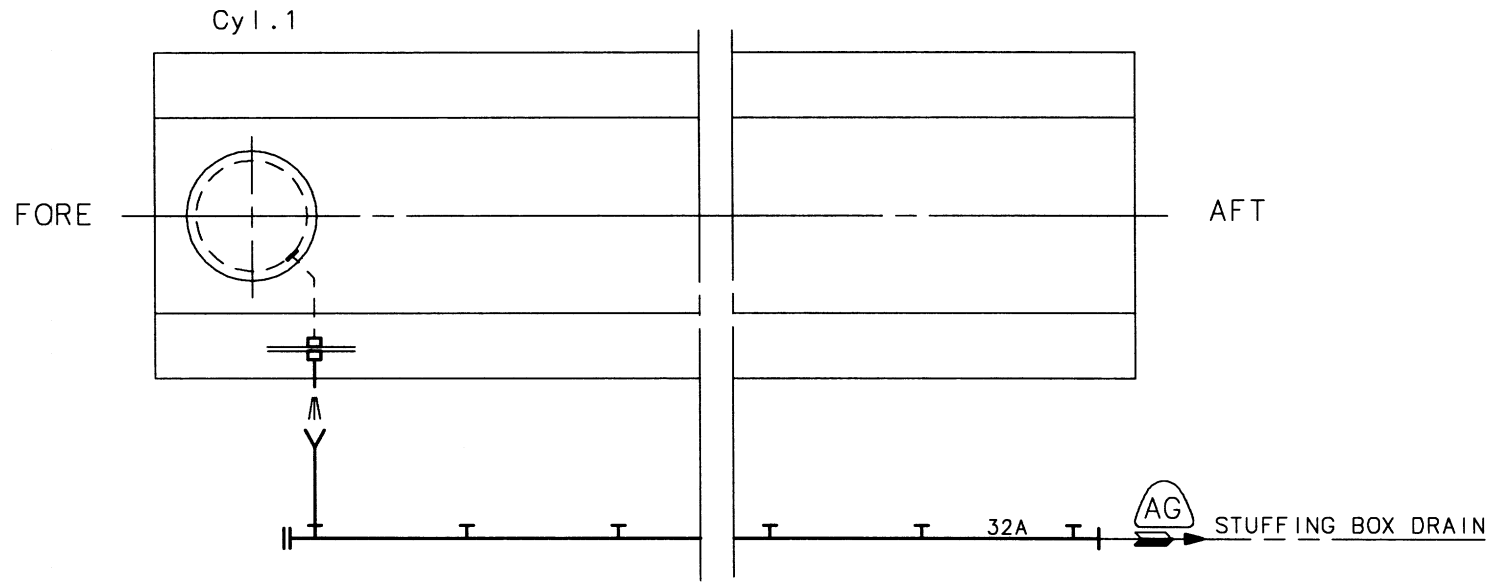
CAD Drawing - do not correct by hand





20030114		first issued		9
Date	Drawn	Chk'd	Rev	8
Description of Revision			7	
Rev (No.)	Material	Ref. to previous drawing no.	6	
HSD old drawing no.			5	
Projection	Type	4		
Scale	Size	3		
N/S	A2	2		
Title: CYL. LUB. OIL PIPES			1	
Drawing No.: 12-013886			0	
Version			9	



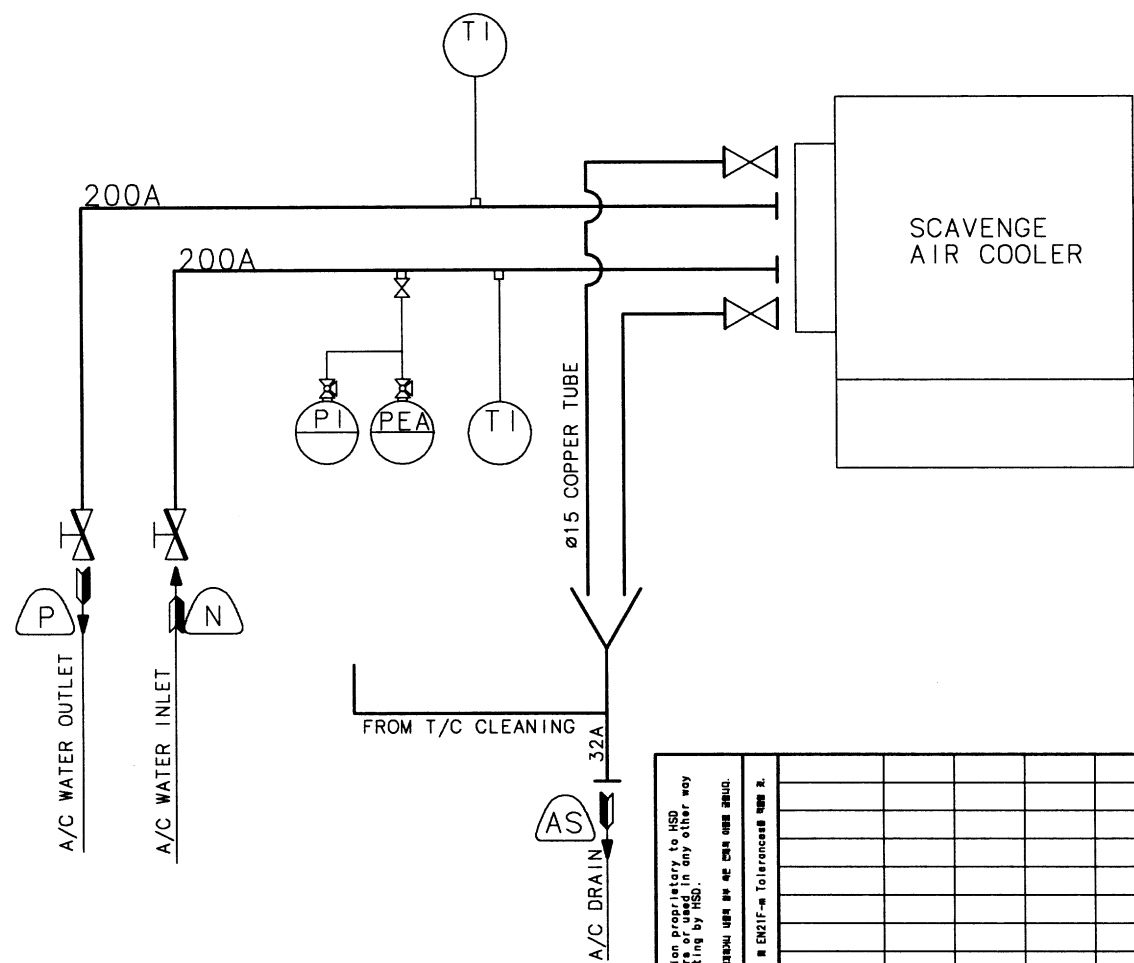


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					20020112
Date	Drawn	Chk'd	App'd	Description of Revision	Rev.
Mass (Kg):		Material:		Ref. licensor drawing no. :	
				HSD old drawing no. :	
Projection:		Type:			
Scale:		Size:		Title:	
N/A		A3		STUFFING BOX DRAIN PIPE	
MS/NO No.:		Drawing No.:		Version:	
0000		13-014589		0	



CAQ Drawing - do not correct by hand





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20021111	송동민	이호철	First issued	0
Date	Drawn	Chk'd	App'd	Description of Revision
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Projection:		Type:		
Scale:		Size:		
N/A		A3		
MS/MS No.:		Drawing No.:		Version:
0000		13-014590		1
Title:				
A/C COOLING PIPES				

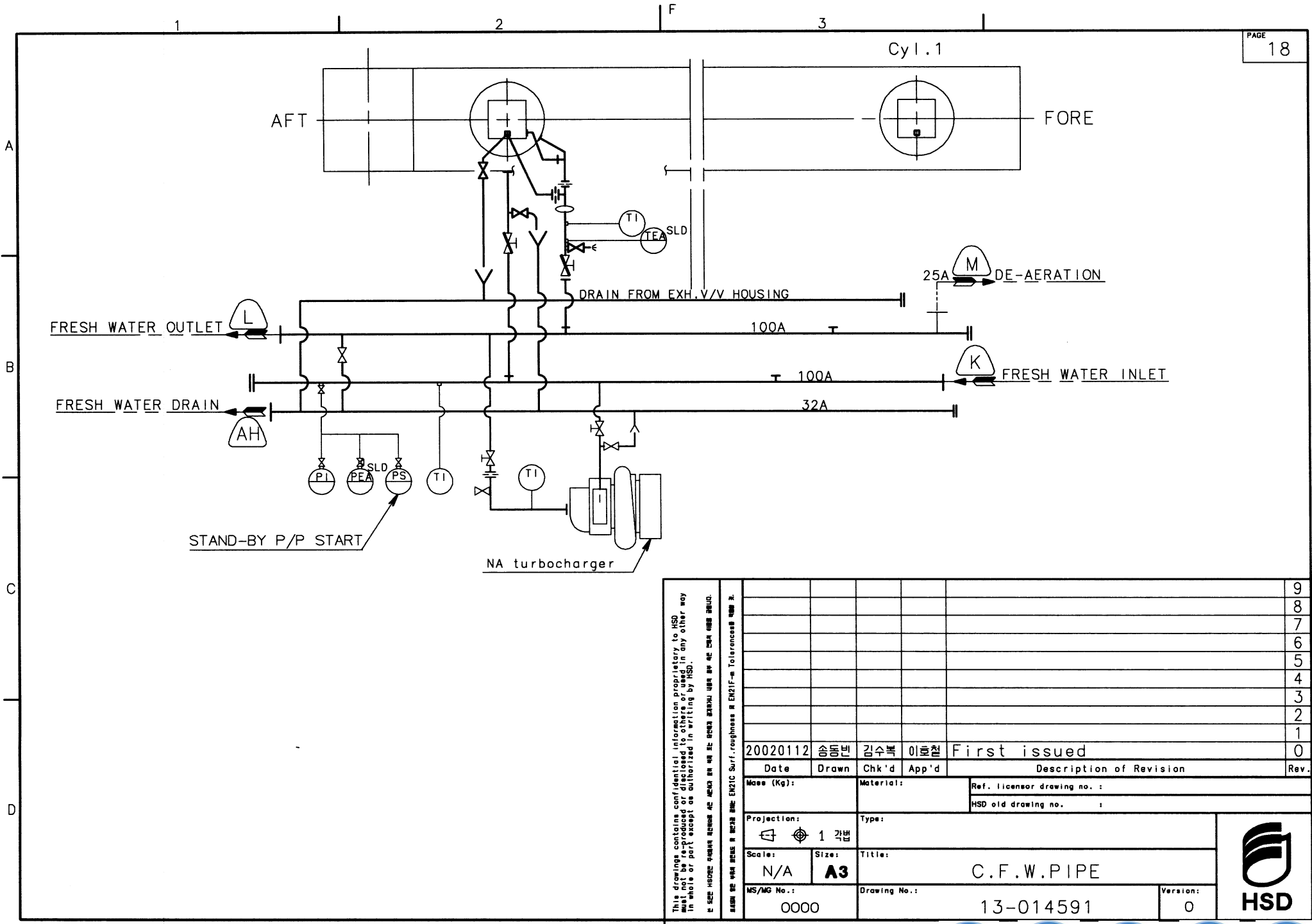
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CAD Drawing - do not correct by hand





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은 모든 HSD로만 사용되며, HSD로만 사용될 수 있는 HSD로만 사용					

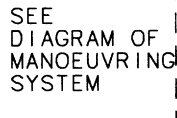
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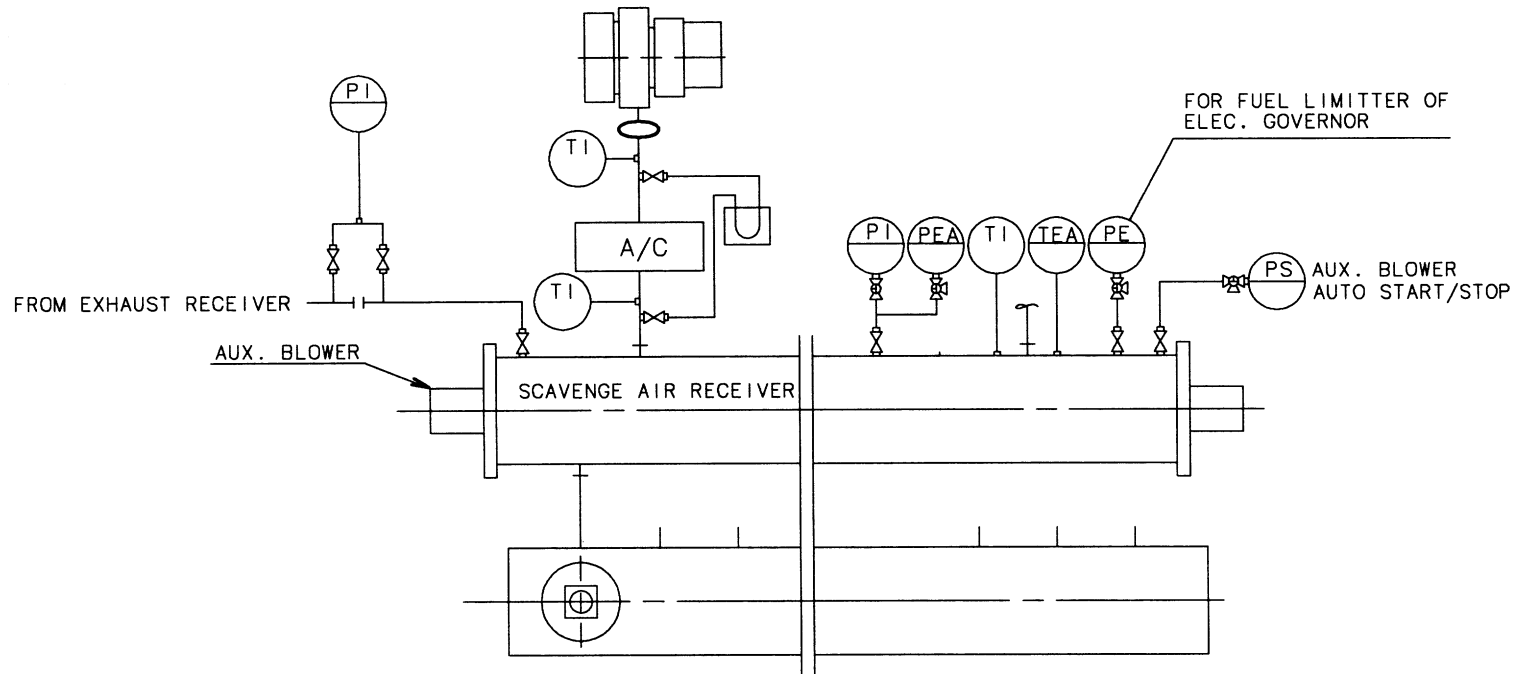
CAD Drawing - do not correct by hand





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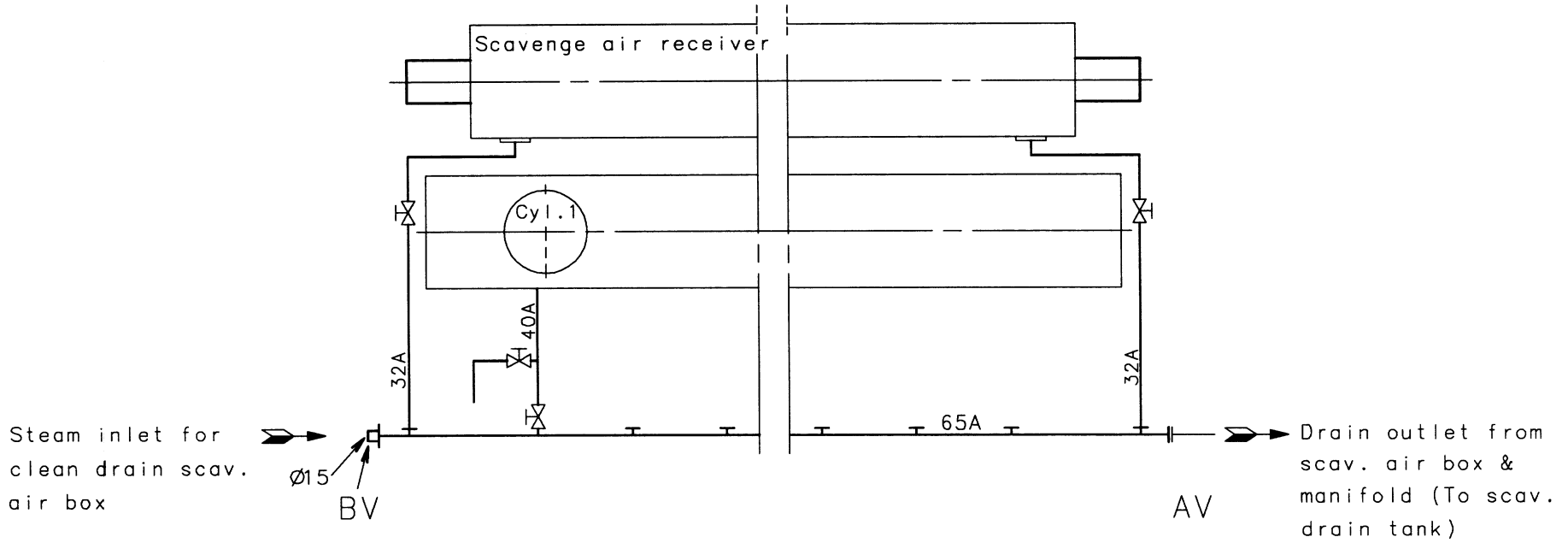
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20020112	송동빈	김수복	이호철	First issued		0
Date	Drawn	Chk'd	App'd	Description of Revision		Rev.
Mass (Kg):		Material:		Ref. licensor drawing no. :		
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Projection:		Type:				
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Scale:	Size:	Title:				
N/A	A3	SCAVENGE AIR PIPE				
MS/MG No.:		Drawing No.:			Version:	
0000		13-014594			0	


HSD



CAD Drawing - do not correct by hand





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20020112	송동빈	김수복	이화진	First issued	0
Date	Drawn	Chk'd	App'd	Description of Revision	Rev.
Mass (Kg):		Material:		Ref. licensor drawing no. :	
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Projection:		Type:			
Scale: N/A		Size: A3			
MS/MG No.: 0000		Drawing No.: 13-014595			Version: 0
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CAU Drawing - do not correct by hand



Inlet cleaning
to A/C

AK 25A

LSA

BUTTERFLY VALVE WITH Ø10 HOLE
CLOSE : Ø10 HOLE
OPEN : FULL OPEN

50A

AL

Water drain outlet
From mist catcher
(To bilge)

50A

AM

Chemical cleaning outlet
From A/C
(To chemical cleaning tank)

Water mist catcher

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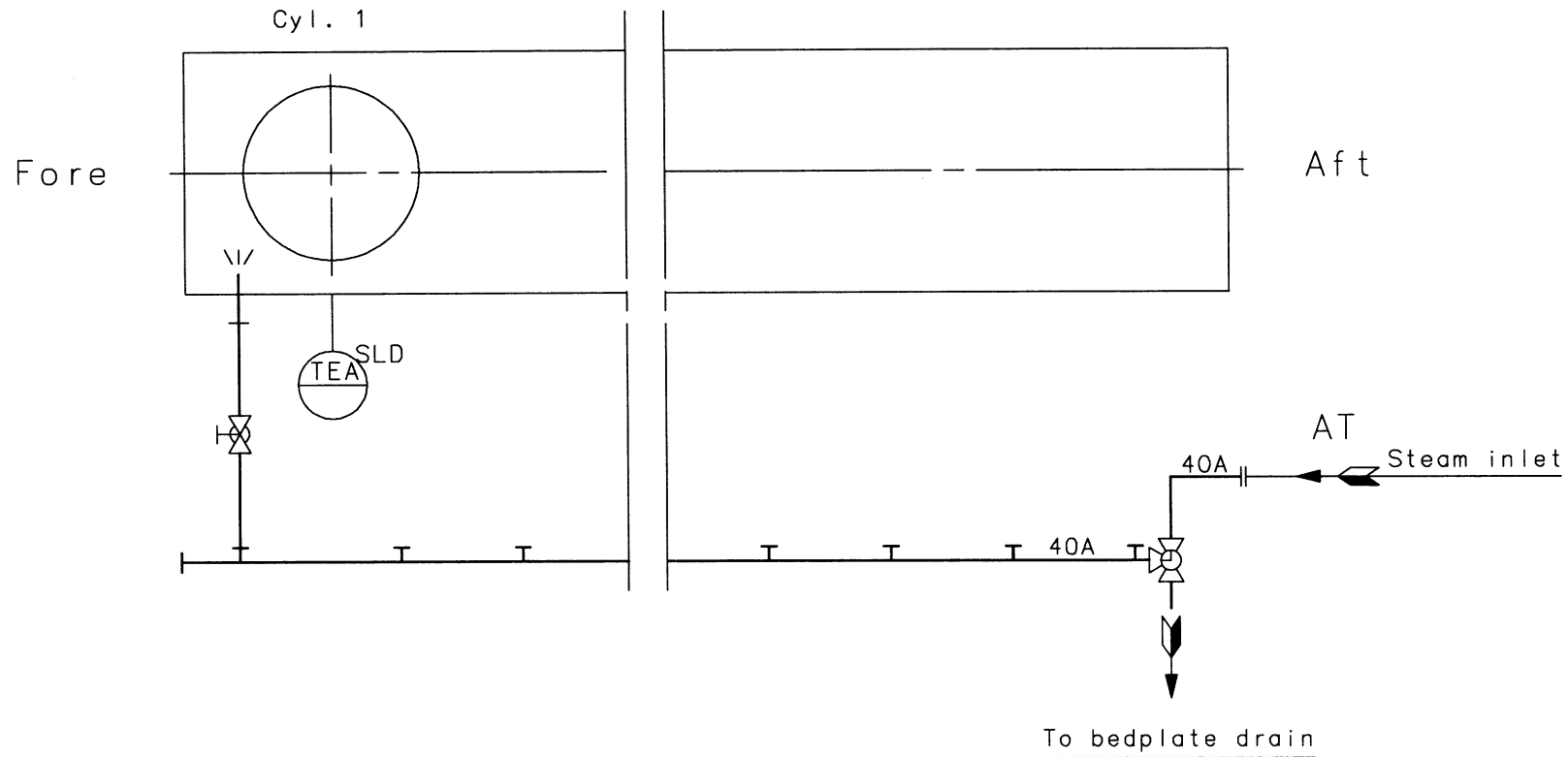
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Date	Drawn	Chk'd	App'd	Description of Revision		Rev
Mass (Kg):		Material:		Ref. licensor drawing no. :		
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 1 각법						
Scale:	Size:	Title:				
N/A	A3	A/C CLEANING PIPE-1 T/C				
MS/MG No.:		Drawing No.:			Version:	
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HSD



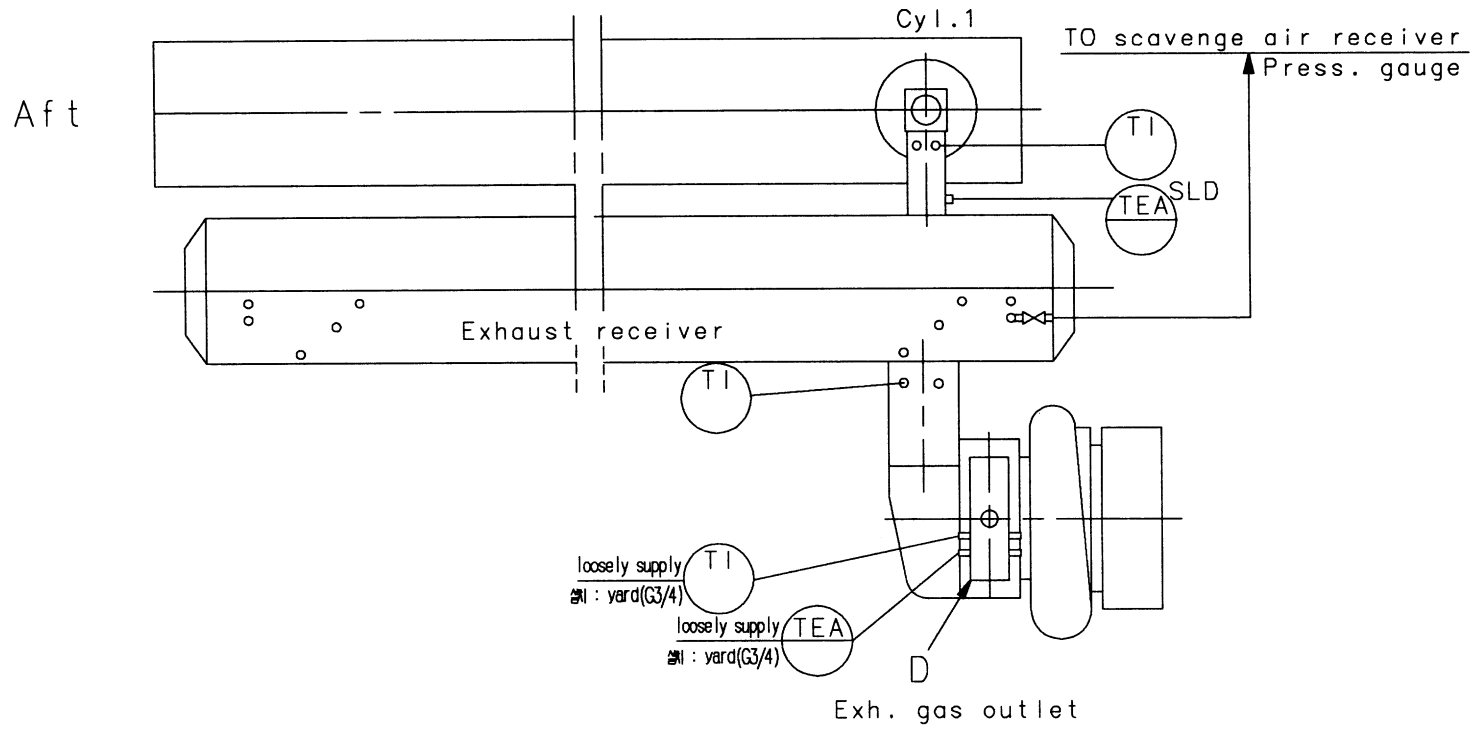
CAD Drawing - do not correct by hand





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20020112	송동빈	김수복	이훈철	First issued	0
Date	Drawn	Chk'd	App'd	Description of Revision	Rev.
Mass (Kg):		Material:		Ref. licensor drawing no. :	
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Projection:		Type:			
Scale: N/A		Size: A3			
MS/MG No.: 0000		Drawing No.: 13-014597		Version: 0	
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0000		13-014598		1

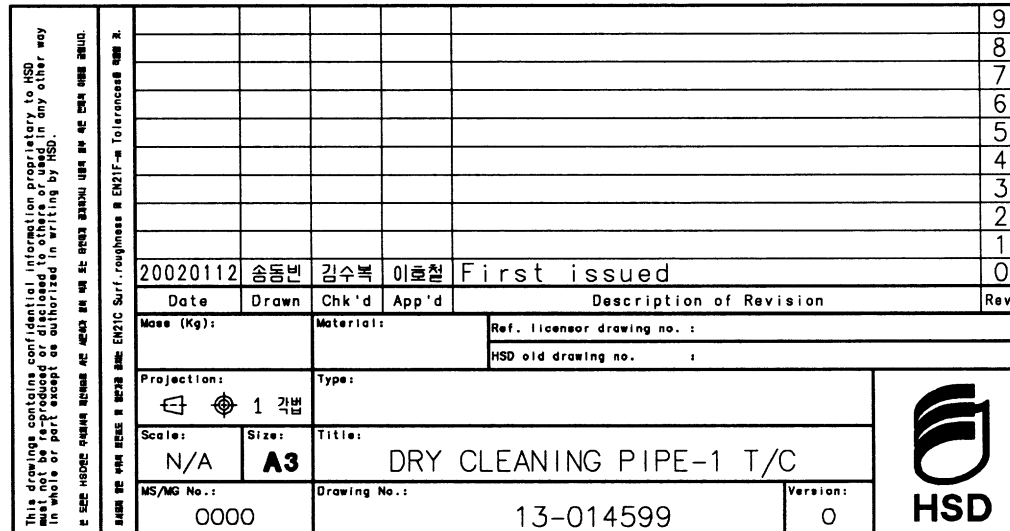
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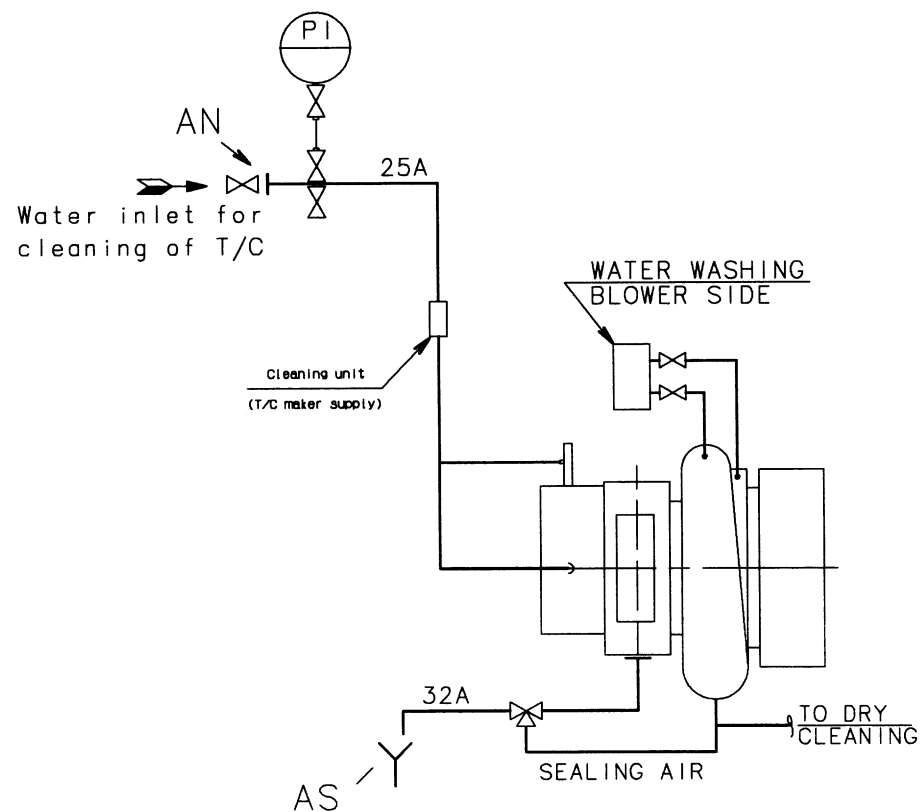
E SIZE HSD의 기밀인쇄물로서 무단으로 복제, 배포, 전수 또는 기타 방법으로
 제3자에게 제공하면 법적 처벌을 받습니다.

HSD의 기밀인쇄물로서 무단으로 복제, 배포, 전수 또는 기타 방법으로
 제3자에게 제공하면 법적 처벌을 받습니다.

CAD Drawing - do not correct by hand





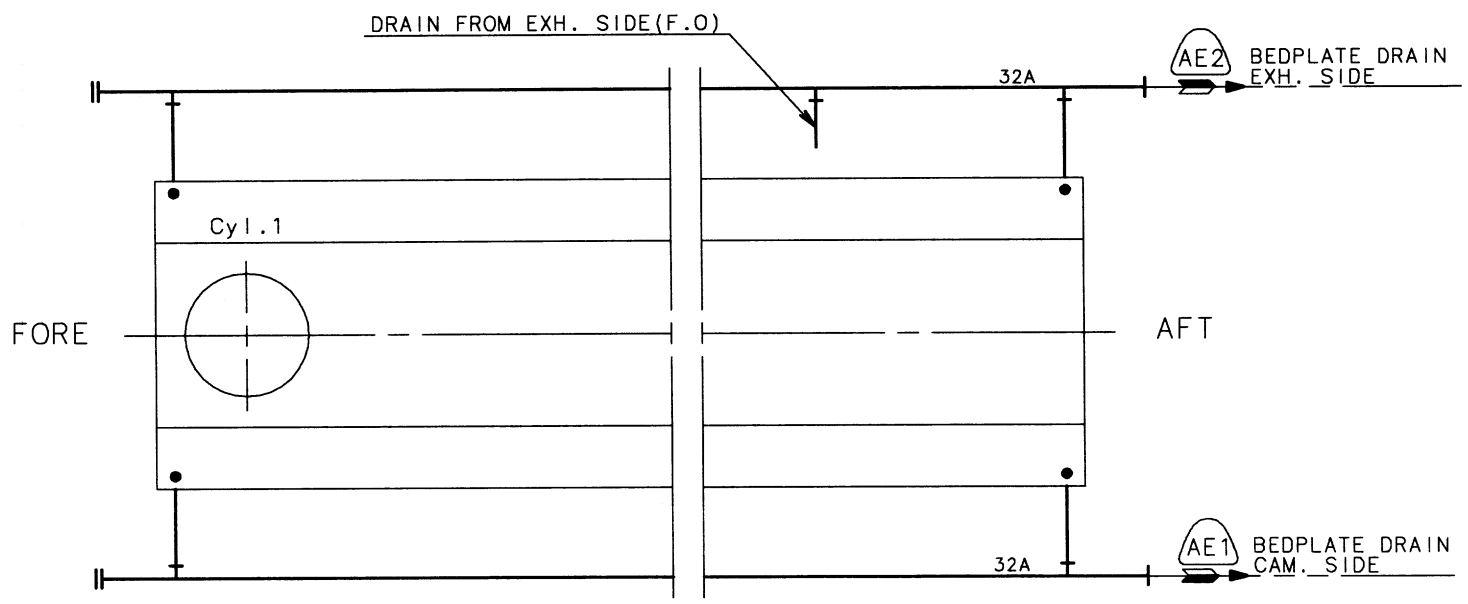


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20020112	송동빈	김수복	이훈철	First issued	0
Date	Drawn	Chk'd	App'd	Description of Revision	Rev.
Model (Kg):		Material:		Ref. licensor drawing no. : HSD old drawing no. :	
Projection:  1 각법		Type:			
Scale: N/A	Size: A3	Title: WATER CLEANING PIPE-1 T/C			
MS/MG No.: 0000		Drawing No.: 13-014600		Version: 0	



CAD Drawing - do not correct by hand



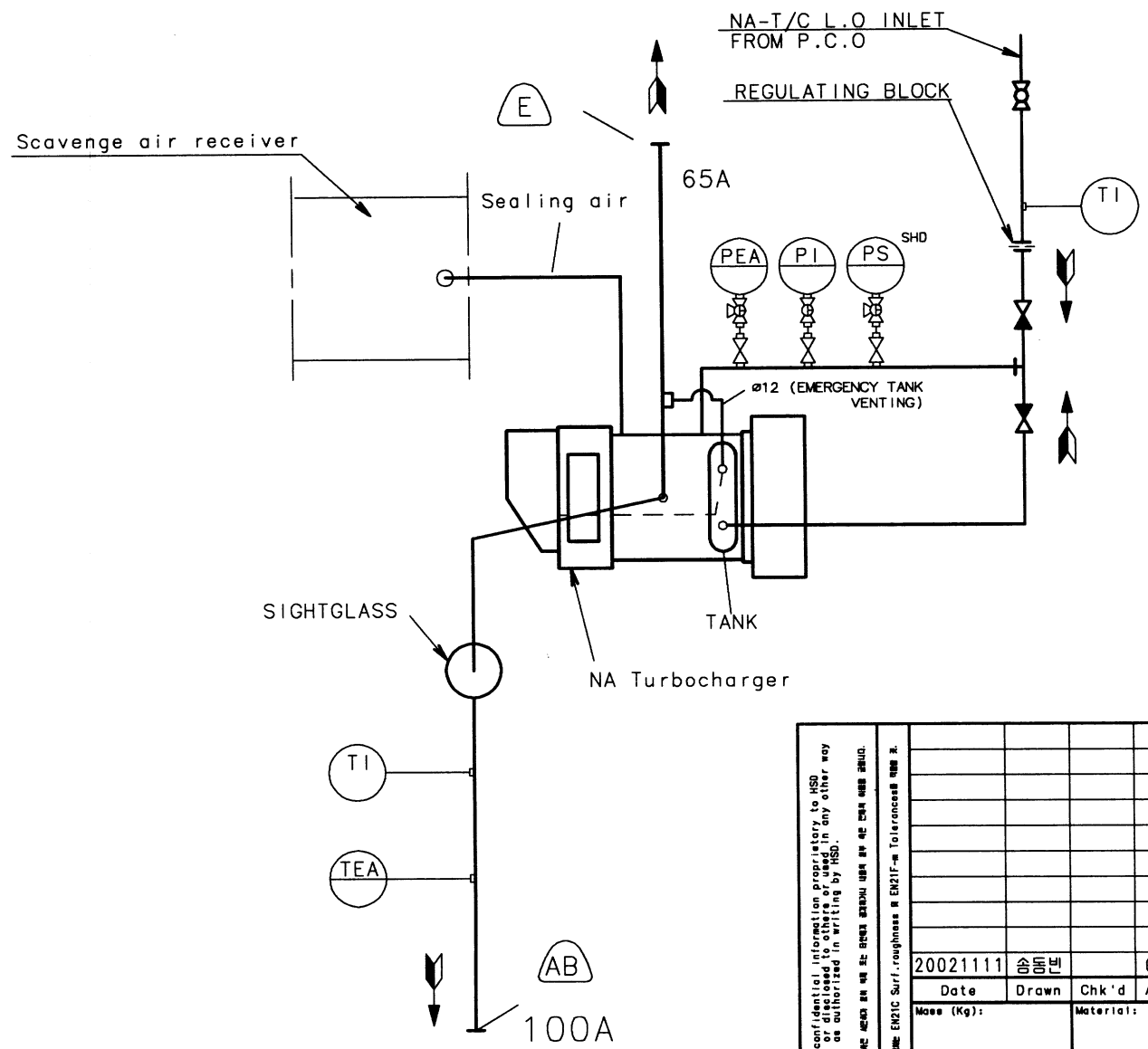


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Date	Drawn	Chk'd	App'd	Description of Revision	Rev.
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Projection:		Type:			
Scale:		Title:			
N/A		BEDPLATE DRAIN PIPE			
MS/MG No.:		Drawing No.:		Version:	
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				HSD old drawing no. :
Projection:		Type:		
Scale: N/S		Size: A3		Title: T/C L.O. INLET & DRAIN PIPE
MS/MG No.: 0000		Drawing No.: 13-017237		Version: 1

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CUSTOMER

HSD ENGINE IND.

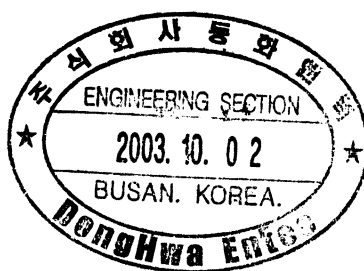
USED FOR

HSD-MAN B&W 5S70MC-MK6 MAIN DIESEL ENGINE

SUBJECT

FOR FINAL

1051.4 M² AIR COOLER
(SHIP NO. UNIQ5258)



DongHwa Entec

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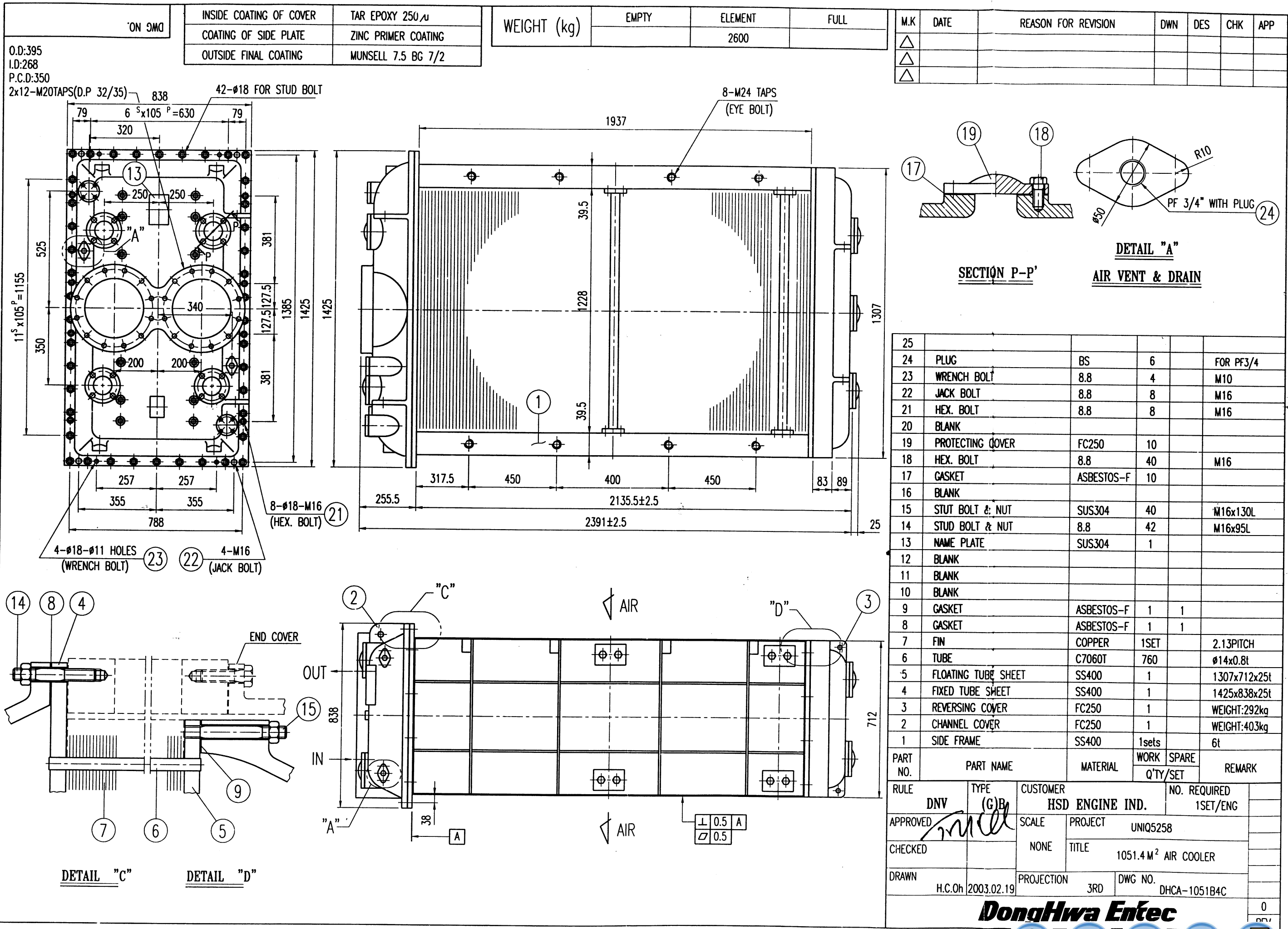
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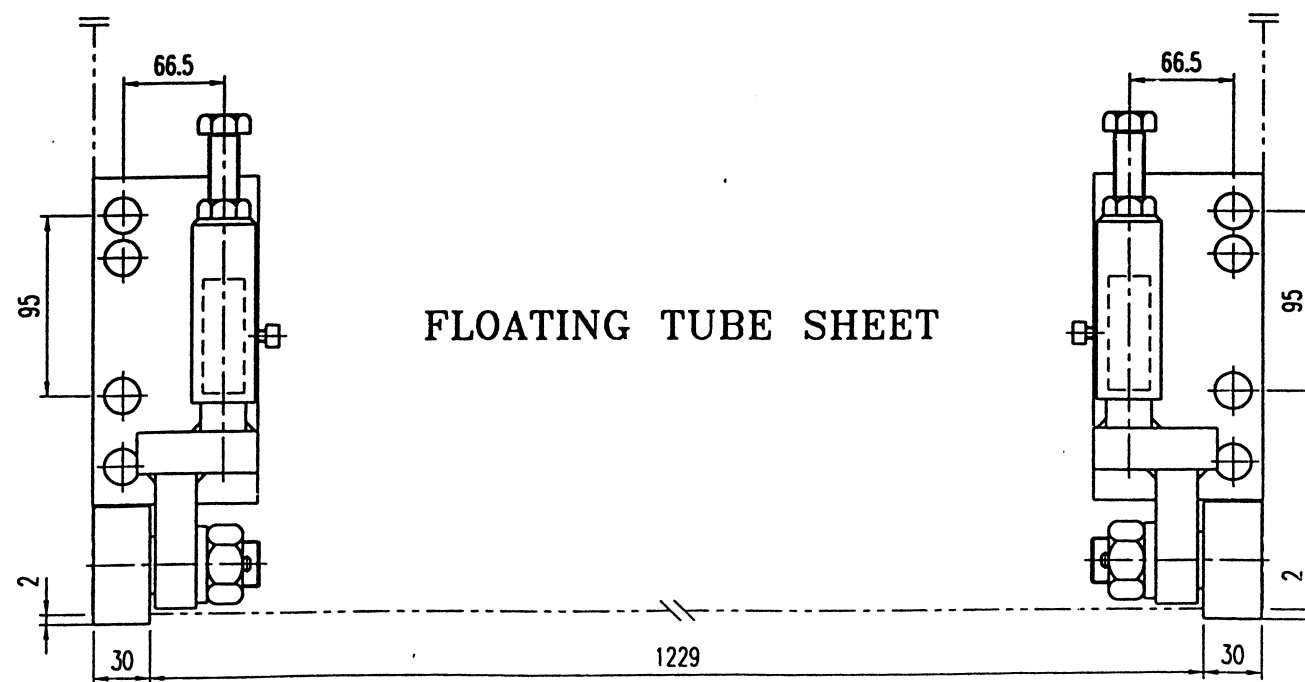
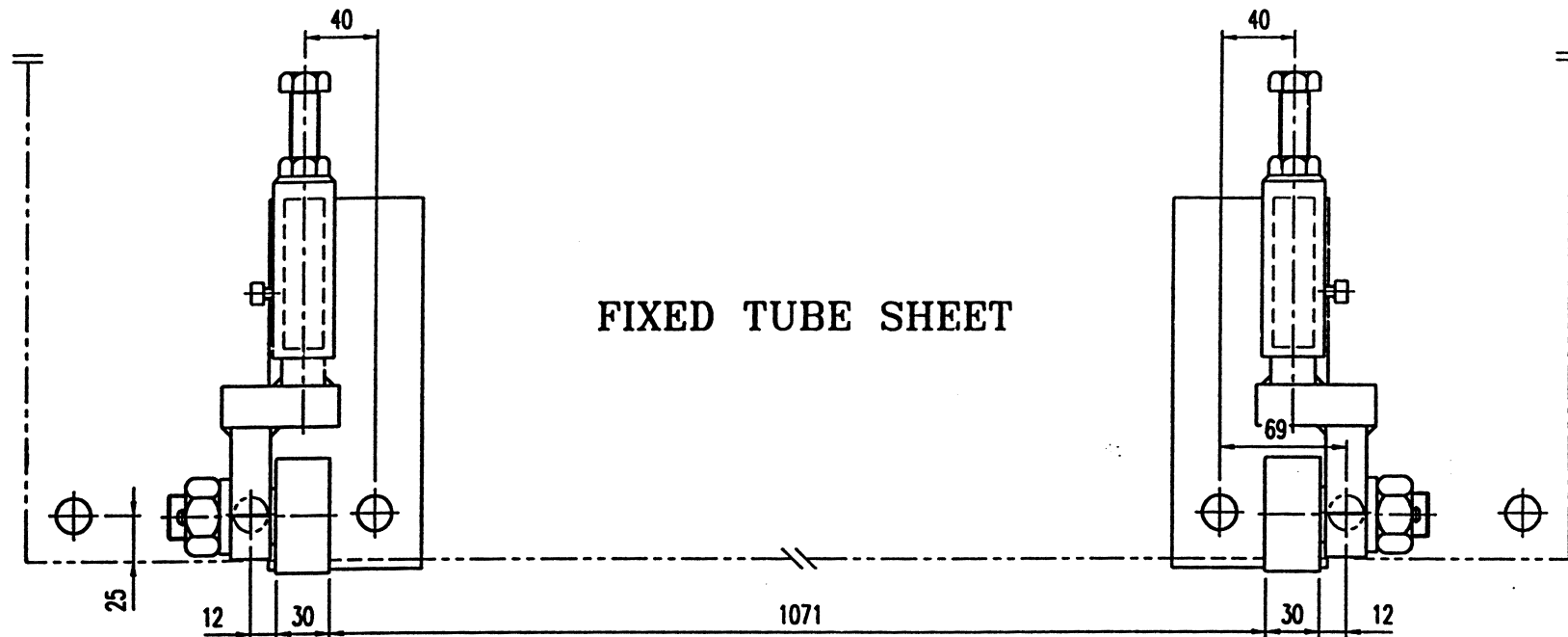
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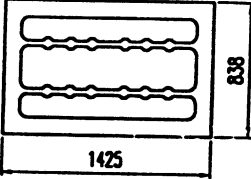
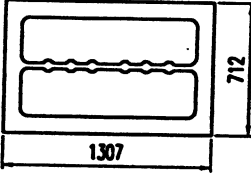
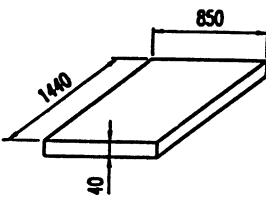
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M.K	DATE	REASON FOR REVISION	DWN	DES	CHK	APP
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DWN	H.S. No. H	2001. P. 20	SCALE	TYPE	(G)/A/B/C/N
DES			NONE	TITLE	ROLLER PITCH of AIR COOLER INSERT
CHK	F. H.	2001. P. 20	PROJECTION	3RD	STD. NO. A00-GA-01A
APP	S. H. Hong	2001. P. 20			
DongHwa Entec					REV



		SPARE PARTS LIST FOR AIR COOLER				PAGE		USED FOR	
						BOX NO.			
NO.	NAME	SKETCH	MATERIAL	SUPPLY per COOLER		DRAWING		REMARK	
				WORK	SPARE	NO.	PART NO.		
1	GASKET FOR CHANNEL COVER	 TH'K 1.5t	ASBESTOS-FREE	1	1	DHCA-1051B4C	8		
2	GASKET FOR REVERSING COVER	 TH'K 1.5t	ASBESTOS-FREE	1	1	DHCA-1051B4C	9		
3	SPARE GASKET BOX FOR SPARE PARTS NO. 1 - 2		WOOD	1				per SHIP	
4									
MFR'S NAME		DongHwa Entec							

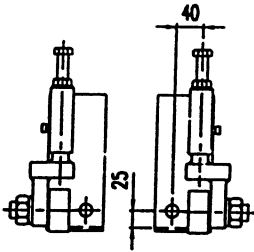
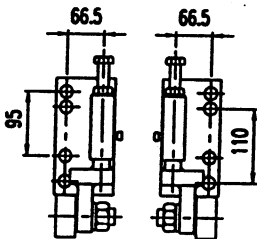
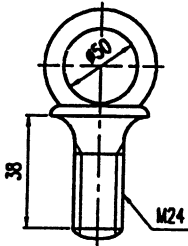
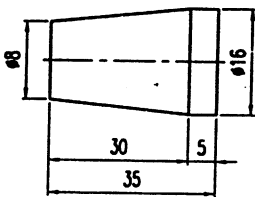


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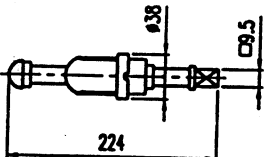
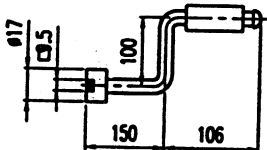
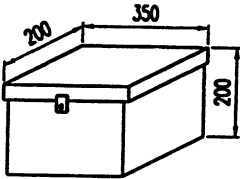


01



STD.NO. A00-TA-01A						PAGE		A - 2					
TOOLS LIST FOR AIR COOLER										USED FOR		LKM-(G)A/B/C/D E/H	
										BOX NO.			
NO.	NAME	SKETCH	MATERIAL	SUPPLY per ship		DRAWING		REMARK					
				WORK	SPARE	NO.	PART NO.						
2	ROLLER FOR FIXED SIDE		STEEL	1set									
3	ROLLER FOR FLOATING SIDE		STEEL	1set									
4	EYE BOLT		STEEL	8									
5	PLUG		BRASS	60									
MFR'S NAME		DongHwa Entec											



STD.NO. A00-TA-02B		PAGE		A - 3				
TOOLS LIST FOR AIR COOLER						USED FOR	LKM-A/B/C/D/E /F/G/H/K/L/M/N	
						BOX NO.		
NO.	NAME	SKETCH	MATERIAL	SUPPLY per ship		DRAWING		REMARK
				WORK	SPARE	NO.	PART NO.	
1	TUBE EXPANDER	CB-107  MIN11.6~MAX13.5	SKS ₃ SCM ₅ SUJ	1				
2	S-HANDLE		S20C	1				
3	TOOL BOX		STEEL	1				
MFR'S NAME		DongHwa Entec						



AM



2B



DWG NO.

125		4-Ø3.5
117		
A		72 80
SHIP NO.	B	
PART NO.	C	
CLASSIFICATION SOCIETIES	D	
WATER SIDE INLET WORKING PRESS (kg/cm ²)	E	
WATER SIDE HYDRO TEST PRESS (kg/cm ²)	F	
COOLING SURFACE AREA (m ²)	G	
MFG. NO.	H	
WEIGHT EMPTY (kg)	I	
DATE	J	
Donghwa Entec Web Site : www.dh.co.kr		

A	AIR COOLER FOR 5S70MC-MK6 ENGINE		
B	UNIQ5258		
C	DHCA-1051B4C		
D	DNV		
E	4.5		
F	8.25		
G	1051.4		
H	DHE30300A		
I	2600		
J	2003.07.		

RULE	DNV	CUSTOMER	HSD ENGINE	NO. REQUIRED	
				1SET/ENG	
APPROVED		SCALE	PROJECT	UNIQ5258	
CHECKED		NONE	TITLE	NAME PLATE	
DRAWN	H.C.Oh	PROJECTION	3RD	DWG NO.	DHCA-1051B4C
	2003.02.19				

Donghwa Entec



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AIR COOLER INSTRUCTION MANUAL

DongHwa Entec



CONTENTS

I DESCRIPTIONS

II STRUCTURES

III OPERATION

**IV MAINTENANCE AND INSPECTION
DURING OPERATION**

V CLEANING

**VI PURCHASE SPARE PARTS
FOR MAINTENANCE**



I . Description

The Donghwa air cooler is a heat exchanger cooling the air supplied diesel engine to the specified temperature for improvement the performance of engine. It is called fin & tube type heat exchanger and used for MAN B&W and SULZER MAIN DIESEL ENGINE.

The heat removed from air is carried away by the cooling water (sea water or fresh water). The cooling water flows on the inside of the fin-tube, while air flows along the outside of the fin-tube.

We call a cooling water side as Water Side and fin-tube side as Air Side. The cooling methods of water side are differential into F.W(Fresh Water) cooling & S.W (Sea Water) cooling, and Central cooling system.

II. STRUCTURES

Air cooler mainly consists of cooler insert and casing. Cooler insert is made up of tube bundle and water cover.

II-1. Tube bundle

The bundle has several multi-finned tube block arranged in the direction of the air flow. According the cooler capacity, the number of block and size of each tube block are decided.

Both ends of the finned tubes are installed in the tubesheets by tube expansion with mechanical tube expander. And special hydraulic ball expander is used for the preference adherence of fin and tube. Fin-tube block is immortally fixed at tubesheet so that is unable to take apart each other.

The two side plates serve for protecting the finned-tube and for reinforcing the cooler performance by preventing air by-pass.

The channel cover is securely bolted to tubesheet and all bolt is tag-welded, while the reversing cover is only supported by stud bolt with clearance for absorbing thermal expansion of tubes and stud bolt is fixed with wire.

At side plate, lifting bosses are welded on for eye bolt and these make easier handling of unit. The supporting bars bolted on side plate serve for supporting tube bundle and for preventing the damage from a abnormal vibration. And also all bolts are tag-welded to prevent unlocking.



II-2 WATER COVER

Water cover has water inlet & outlet nozzle, partition plate for controlling water pass, air vent & water drain connection and chemical cleaning. And there is two jack bolt to easily detach cover from bundle for cleaning. Two water covers, the channel and reversing cover, are tightly bolted to corresponding tubesheet with gasket. Here water inlet & outlet nozzle detached cover is called channel cover and the opposite cover is called reversing cover. When the cooling medium is sea water, there is zinc anode or soft iron on water cover inside to protect cover from corrosion. The corrosion protecting medium, zinc anode or soft iron, is connected as flange type to exchange it when it was wear away and is bolted with gasket to water cover.

III OPERATION

III-1 Cooling Water Side

The bundle is to be filled with water and at the same time the air vent valve is to be opened so that the air in the bundle can escape through it. There is no more air bubbles in the escaping cooling water (it means air vented completely and the bundle has been filled with water), close the air vent valve tightly. If air remains in the tubes, which will not only deteriorate the performance, but also may cause accidents during operation, so that special care is required. After the cooler is filled with water completely, it may be O.K to operate the air cooler. When the pressure and temperature reach the normal operating condition, confirm that there are no abnormalities in regard to bolts, nuts, and gaskets. If water should be leaking from the gaskets, retighten the bolts and nuts. Continuously water leak even after retightening, the gasket should be exchanged for a spare gasket.

During operation, do not exceed the permitted condition. If do exceed, contact us and consider the operation condition. If you don't, we don't take the responsibility of resulting problem.

III-2 Air Side

Make sure that the operation on the cooling water side is normal, and then the cooler is fed with air. When the operating temperature has been reached, check on the air leakage. The charged air temperature inlet and outlet of the cooler is checked up and the cooling water quantity is to be corrected, if required. After operation start



for the air side, once more confirm that the connections of the cooling water side and the air side are secure.

III-3 Operation Stop

When stop the operation, first stop the air side and then the cooling water side.

When stop period will continue several days, open the drain valve in the cover and drain all water from the cooler to prevent from corrosion and freezing during the winter.

III-4 Cooling Water Velocity

Cooling water velocity is limited in view of erosion, corrosion, and fouling so that do operate over the minimum velocity. And the best tube inside velocity is staying the recommended velocity range.

Material	Recommended velocity (m/sec)	Minimum velocity (m/sec)
Copper	1.0 ~ 1.5	1.0
Al-Brass	1.4 ~ 2.0	1.0
Copper-Nickel (9:1)	1.8 ~ 2.5	1.0
Copper-Nickel (7:3)	2.4 ~ 3.5	1.0
Steel	1.5 ~ 3.0	1.0

※Note : Please never operate at the minimum velocity for the prolonged periods to prevent causing serious fouling.

IV Maintenance and Inspection during operation

IV-1 Cooling Management

- (1) With use for a long time, various contaminations are deposited inside of tubes and fins. It cause to deteriorate the performance of the air cooler, so following items should be checked during operation

- Temperature difference between inlet and outlet side of air and water
- Pressure loss for air and water

When a pressure loss has been doubled of initial condition, execute washing and cleaning.

- (2) When running the engine at part loads as well as during maneuvering or



running in winter season, the temperature or the amount of cooling water passing through the air coolers should be regulated so that the air temperature at the outlet of the cooler does not drop too low. If the air is cooled down to a dew point temperature, considerable amount of condensed water will collect in the air receiver. If the charged air temperature is above the dew point, condensates will form only where the air comes in contact with surface whose temperature is below the dew point. At this time, it is advisable to control the cooling water source temperature by adjusting circulation valve but inevitably if the cooling water quantity for the air cooler is controlled, the outlet valve should be throttled.

IV-2 Electrochemical Corrosion Protecting Metal

When the cooling water is sea water, a protection metal is installed inside the cover of the air cooler to protect the cooler from corrosion.

In order to protect the electrochemical corrosion of the cooler, the anode plates are installed in the cover. When operation is continued after the protection metal has been used up, notable corrosion will occur for the cover in case of standard equipment or for the tubes and tube plates when the cover is equipped with anticorrosion rubber lining etc., so that this metal should be periodically and should be replenished as required. The anode plate has to be exchanged for new one regularly. Generally the consumption of the anode plate in new cooler is very fast. So the first exchanging has to be done within 3 months. After that time the exchanging intervals are decided in accordance with the degree of the consumption on the last inspection.

Care should be taken that the surface of the protection metal and the threaded part are free of oil, paint, etc.

IV-3. Cover Coating Management

At the inside of the cover is coated with tar epoxy resin, neoprene lining, etc to protect the cover from corrosion by the cooling water, the inside coating should be inspected when the cover detached for inspection, cleaning, etc. If there is any damage, it should be repaired immediately. If you don't, local corrosion will occur at the damaged part, and finally the cover will be destroyed.



And also when you detach the cover, careful handling is required so that the surface will not be damaged.

IV-4. Use of the plug

When the tubes are broken because of corrosion or for some other reason, use the accessory plugs to plug both ends of the tube. The plug should be installed according to the followings

- (1) Drain the water completely from the cover.
- (2) Detach the cover installation bolts and nuts, and detach the cover. When it is difficult to detach the cover from the casing, the jack bolts should be used.
- (3) Drive the plug into both ends of the broken tube.

IV-5 Inspection

Normal hydro test pressure of water side is 6Kg/cm^2 . And air side test is done during operation whether leak or not. and general test pressure is 3Kg/cm^2 .

The holding time of air side and water side pressure test is 30 minutes. Only clean fresh water is used for the water pressure test of the cooler. Add soluble ferrous sulphate($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) to stimulate generating the protective film at new cooler. The quantity of soluble ferrous sulphate is 1ppm per hour.

It takes a time to be generating the protective film at new cooler tubes. So it is very harmful directly to contact tube with dirty harbour water. If dirty harbour water contact, the dirt film immediately generate on tube and will hinder the build-up of a protective layer.

V Cleaning

Use the cooler for a long time, various contaminations are deposited inside of tubes and fins. It cause to deteriorate the performance of the cooler. Check the cooler outlet air temperature and if it is increased considerably , and water side pressure loss is doubled when compared initial condition, you must execute cleaning.

Water side cleaning of the bundle should be carried out, if a considerable increase in air temperature measured at the outlet of the cooler. Keep in mind that a slight fouling at the water side is too much influencing to air cooler performance. Air side cleaning of the bundle should be carried out if the pressure loss of the cooler has



been about double of the initial condition.

V-1. Water side Cleaning

(1) Use Brushing Tools

- ① Turn off the blower
- ② Close the cooling water supplying valves and discharge pipe valves
- ③ Open the drain valve so that the bundle is to be empty.
- ④ Disconnect pipelines, and take off the both water covers using the jack bolts, if necessary.
- ⑤ If the unit comprises zinc protection plates or soft iron, these should be examined for their condition when water covers are detached. Damaged or wore down zinc plates or soft iron have to be exchanged new ones. The cover has to be sandblasted and given a new coat of tar epoxy, if the damaged cover area is large. Covers made of bronze or gunmetal don't need protective coats of paint and zinc protection plates but at that case soft iron is usually used for generating protective film on the tube surface.
- ⑥ Using the provided nylon brush tool, clean all tubes while they are still wet.
- ⑦ Rinse each tube with water to remove the brushed off dirt.
- ⑧ And then it is make sure that the tube inside is clean, and replace the covers and gasket after checking up the water side connections again.
- ⑨ After completely reassembled, operate water pump and do hydrotest to check leaking.
- ⑩ All work is done, open valves and operate the cooler.

(2) Chemical cleaning

When it is impossible to remove the fouling with tube brush, it is effective to circulate chemical cleaning solution. But, it take a considerable cautions, because if chemical cleaning fails, the tubes and others will be damaged, resulting in shortening the life of apparatuses remarkably. After finishing chemical cleaning, circulate fresh water so that cleaning solution is not remain in the cooling water. If you have no experience in chemical cleaning, consult the manufacturer.

Chemical cleaning should be carried out by circulating method as built-in or by dipping the bundle into some cleaning solution after pull out it from the casing



or between the air ducts. Working methods are following

- ① Turn off the blower
- ② Close the cooling water supplying valves and discharge pipe valves
- ③ Open the drain valve so that the bundle is to be empty.
- ④ Mix the chemical solution with water to specific concentrate, and sufficient amount as calculated water side volume.
- ⑤ Connect circulation pump and chemical tank at chemical connection on water cover. And then run pump and circulate solution.
- ⑥ When chemical cleaning has been done, stop pump and drain the solution through drain valve.
- ⑦ After solution draining, add neutralizer at chemical tank and neutralizing the remained solution.
- ⑧ Finish all of above steps, check again and run the cooler.

V - 2. The Air Side Cleaning

- (1) At moderation condition, it is possible to clean out by washing with hot water and compressed air.
- (2) But there are some deposits such as oil, grease, carbon, etc., it is preferable to clean it with steam blasts(3~7 kgf/cm², 150℃ of less) or hot water and compressed air.
- (3) It is impossible to clean by above, chemical cleaning must be carried out. Detach the bundle from the casing and dip it in cleaning solution. Chemical cleaning method is available as built-in by circulation of solution, when the cleaning system is equipped on board. After the bundle has been cleaned, it should be thoroughly flushed, dried, and properly reassembled.

Consideration should be taken to choose the chemical solution and cleaning process and must follow the guidance of chemical supplier not to attack tube or fin material.
- (4) When all work is done, you should add neutralizer and dissolve the remaining solution



V-3. Recommended chemical agent and supplier

	Chemical	Supplier
FOR WATER SIDE	SAF-ACID	= Drew Ameroid Japan Co., Ltd. Minato Ise Bldg. 12-1, 3-Chome, Kaigan-Dori, Naka-ku, Yokohama-si, Kanagawa-Ken, 231, Japan Phone : 045 - 212 - 4741 Faxsimile : 045 - 212 - 4754 = Drew-Chemical
FOR AIR SIDE	ACC9	= Drew Ameroid Japan Co., Ltd. = Drew Chemical Co. New York, USA

※ Please consult chemical supplier's description.

VI Purchase Spare Parts for Maintenance

During operation period, exchanging from old parts into new ones is necessary for maintenance. For purchase, you know the detail structures and if necessary, refer to section II Structures and attached drawing.

The air cooler's parts names are tube bundle, water cover, gasket or packing, bolt, nut, anode, anode cover.

The ordering methods are following

- 1) See the nameplate and write down followings

SHIP NO., MANUFACTURE NO.

MANUFACTURING DATE, CLASS

If there is not name plate or hard to see, you can also find at left or right side of tubesheet.

- 2) Check 1) and numbers and names that you need parts.
- 3) Contact us by in person, mail, telephone, or fax and inform us.
- 4) Reconfirm your ordering list.

Tel. +82 - 051 - 970 - 1110, +82 - 051 - 970 - 1114

Fax. +82 - 051 - 970 - 1111



PUMP STATION

FOR ALPHA LUBRICATION SYSTEM



3 x 440 V, 60 Hz
Drawing No. 0785240-8
Part No. 1890776-0
Flow 0.8 m3/h

Serman & Tipsmark A/S
Maltvej 12 • 9700 Brønderslev • Denmark
Tel. +45 70 10 09 11 • Fax +45 98 80 09 08
E-mail: info@serman-tipsmark.dk
www.serman-tipsmark.dk



**Serman
&
Tipsmark**



TECHNICAL SPECIFICATIONS FOR PUMP STATION FOR ALPHA LUBRICATION SYSTEM

UNIT SIZE.
VOLTAGE/FREQUENCY.
OIL TYPE

According to order sheet.
3X440V/60Hz / 3X380V/50Hz
SAE 50

Type	Flow m³/h	Pump size 50Hz	Motor size 50Hz	Motor rev.	Pump size 60Hz	Motor size 60Hz	Motor rev.	Connection*			
								R	T	P	S
1	0.4	5.5ccm	2.2kW	1410	4ccm	2.2kW	1700	½"RG	1"RG	¾"RG	42L
2	0.8	11ccm	2.2kW	1410	8ccm	2.2kW	1700	½"RG	1"RG	¾"RG	42L
3	1.3	16ccm	3.0kW	1440	14ccm	3.0kW	1730	½"RG	1"RG	¾"RG	42L

* See. §4.3.

1. MAIN COMPONENTS POS

DENOMINATION

1.1 Circulating Pumps.

Flow according to above scheme, m³/h per pump at 50 bar, 50cSt.
Max. viscosity 12cSt to 800 cSt at start-up/250cSt at 40°C.
Make: Bosch
2 PCs self-priming displacement gear-wheel pumps, one operating, one stand-by.

1.2 Electric motors

See above scheme. B14A/B3 flange.
3-Phase Squirrel cage induction motors. IP 54 Enclosure according to IEC 34-5. Insulation class F.
Allow pumping up to 50 Bar.
Make: Bevi

1.3 Heater

500W, 1W/cm² at 3x440V60Hz.
Thermostat 5°-85°C 110°C fuse, pre-set to 40°C
IP 54 Enclosure.

1.4 Pressure setting

Pressure relief valve. Pre-set to 45 bar. Max set: 50 Bar
Cartridge valve M30x1.5.

1.5 Valve for change of filter element

Pressure filter: Valve placed on front of Manifold.
Lever horizontal: filtration.
Lever vertical: by-pass; element change possible.
Suction filter: Valve placed on pipe to pump.
Lever vertical: open.
Lever horizontal: suction closed; element change possible



2. CONTROL AUTOMATIC AND STARTERS

POS

DENOMINATION

- 2.1 Motor starters for both Operating and stand-by motor
Contact for heater
Pressure transmitter
PT100 sensor

3. INSTRUMENTS

POS

DENOMINATION

- 3.1 Pressure gauge Gauge 0-60 Bar Ø63
Visual control of pressure setting.
- 3.2 Pressure Transducers Pressure transducer for alarm, low pressure.
4-20mA at range 0-100 bar. 24VDC supply.
- 3.3 Test point M16x2.0 test point for pressure setting
- 3.4 PT100 sensor Standard PT100 sensor. DIN Class 1. 2-wire
- 3.5 Filter indicator, suction filter Visual indicator for Filter change of suction filter.
Indicator -1.0 to +0.6 bar.
Recommended change of element at -0.25 Bar
- 3.6 Filter indicator, pressure filter Visual indicator for Filter change of pressure filter.
Pop-up indicator with manual reset.
Before filter change press at top for control.
Recommended change of element when indicator pops up.

4. MATERIALS

POS

DENOMINATION

- 4.1 Steel All steel parts of St.37.2, sand blasted and painted.
Colour RAL 6019 Light Green.
- 4.2 Piping Tubes of Seamless chromed steel St.37.4. DIN 2391
- 4.3 Fittings BSP thread (parallel) according to DIN/ISO 228
Pipe fittings according to DIN 2353
Connection R according to EN8U16/1 and ½"RG
Connection P according to EN8U28/1 and 1"RG
Connection T according to EN8U22/2 and ¾"RG
Connection S according to EN362F0042. DN32 flange.
- 4.4 Components All hydraulic components made for Oil.
- 4.5 Oil reservoir Tank: Drain plug ½"RG.
Tray: Drain plug 3/8"RG.



5. MAINTENANCE

POS

DENOMINATION

5.1 Filter elements

High pressure filter. When the filter indicator pops up the element must be changed. Press on top of indicator to verify that the element needs to be changed. If indicator pops again up the element needs to be changed. After changing, the indicator must be reset by pressing the top of the indicator.

Inspection interval; Daily.

Suction filters. When the indicator on side of the element enters the red zone the element must be changed.

Inspection interval; Daily.

5.2 External leaks

If any of the hydraulic components leaks, the seals for this component should be changed.

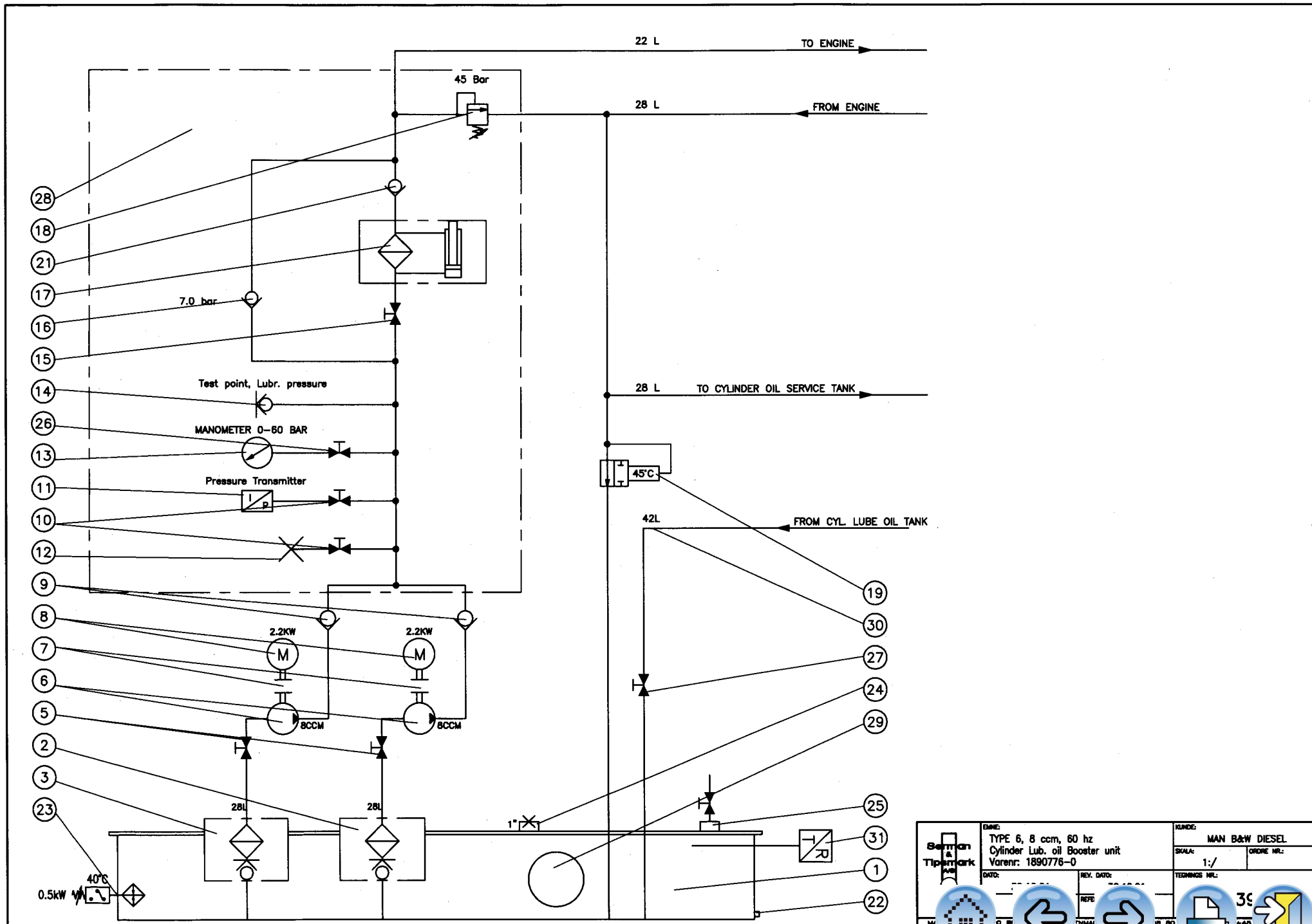
Inspection interval; Weekly.

5.3 Noises/Vibrations

If any unusual vibrations or noises occur this must be investigated.

Inspection interval; Daily





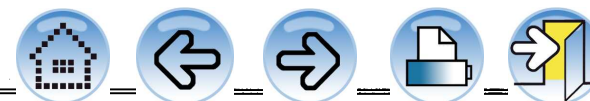
	DATE:	TYPE 6, 8 ccm, 60 hz Cylinder Lub. oil Booster unit Varenr: 1890776-0	REVISION:	MAN B&W DIESEL
	SCALE:	1:1	ORDER NR.:	
	DATE:		REV. DATE:	

PARTLIST

Customer: MAN B&W KØBENHAVN A/S
 Project No.: 17392
 Date: 17.01.02
 Ours Ref.: ehl
 Revision: 0
 Deliver: 20.09.01
 Page: 1 af 5

TYPE 6, 8 ccm, 60 hz
 Varenr: 1890776-0

Pos	Pcs.	Description	Trade No.	Type	Remarks
1	1,00	Tank, special	ST 30484	For MAN BW Booster unit	
1	1,00	Buttomplate for lubrica.stat.	ST 30370	plade 1700x780x10	
1	1,00	Drip tray	ST 30783	770x300x50	
1	1,00	Pipe	ST 30797	Rør f. Kabelføring	
2	1,00	Suction filter	IN 480002	TSW.210.250G.6.P	
2	1,00	Element for suction filter	IN 320075	01.TS.250G.-.8.	
2	1,00	Clogging indikator for filter	IN 301722	Visuel; -1.0-0.6 Bar; 1/8"RG	
2	1,00	Mounting flange	ST 30002	For filter TEF 210.	
3	1,00	Suction filter	IN 480002	TSW.210.250G.6.P	
3	1,00	Element for suction filter	IN 320075	01.TS.250G.-.8.	
3	1,00	Clogging indikator for filter	IN 301722	Visuel; -1.0-0.6 Bar; 1/8"RG	

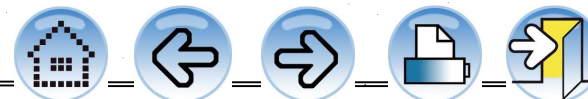


PARTLIST

Customer: MAN B&W KØBENHAVN A/S
Project No.: 17392
Date: 17.01.02
Ours Ref.: ehl
Revision: 0
Deliver: 20.09.01
Page: 2 af 5

TYPE 6, 8 ccm, 60 hz
Varenr: 1890776-0

Pos	Pcs.	Description	Trade No.	Type	Remarks
3	1,00	Mounting flange	ST 30002	For filter TEF 210.	
5	2,00	Ball valve, pipemounted	RØ 100023	2-vejs 1" BSP	
6	2,00	Pump, fixed displacement	BO 0 510 425 009	Tandhjulspumpe 8 ccm	
6	2,00	Flange, suction	HA WF 40LK-L28-100KM	Bosch sugeflange for 28 L	
6	2,00	Flange, pressure	HA WF 35LK-L18-250KM	Bosch trykflange for 18 L	
7	2,00	Coupling, motor	HBE 6301	Softex 24/30B- 28H7 alu	
7	2,00	Spider	HBE 6250	Softex 24/30 92°	
7	2,00	Konsol	HBE 4085	PE 160/105/70	
7	2,00	Coupling, pump	HBE 6359	Softex 24/30A-B17 Alu	
8	2,00	Motor	BEV 100L-4S3x230B314	2,2 KW,B3/B14,3x230/400	For 3x440VAC/60Hz
9	2,00	Check valve	SA 0768689	RHZ-18LREDA3C	



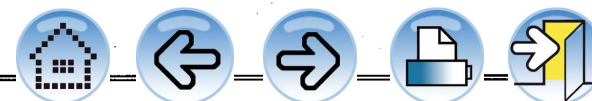
PARTLIST

Customer MAN B&W KØBENHAVN A/S
Project No. 17392
Date 17.01.02
Ours Ref. ehl
Revision 0
Deliver 20.09.01
Page 3 af 5

TYPE 6, 8 ccm, 60 hz

Varenr: 1890776-0

Pos	Pcs.	Description	Trade No.	Type	Remarks
10	2,00	Needle valve	DE 86020169	PB-NVA-OO	
10	2,00	Handle for cabinet	DE 22020058	Knop til Deltaventiler	
11	1,00	Pressure transmitter	DA 060G3131	MBS 33M 0-100 Bar	
12	1,00	Plug	SA 0408013	1/4"RG med pakning	
13	1,00	Manometer	JØ 123 0-60	0-60 Bar, Ø63, 1/4"RG	
14	1,00	Minimess M16x2.0	HYDA 680107	1/4"RG	
15	1,00	Ball valve, manifold mounted	RØ 106024	DN 20; PN500; 6 STK M10	
16	1,00	Check valve	IM 200014	CV1-16N-P-O-100; 7 Bar	
17	1,00	Pressure filter	IN 430318	FHP.60.130G.30.E Flangemontage	
17	1,00	Element f. pressure filter	IN 320136	01.E.60.130G.30.E.P	
17	1,00	Clogging indicator visual	IN 318528	AOC.5,0.P.- SPECIEL	

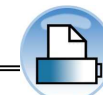


PARTLIST

Customer: MAN B&W KØBENHAVN A/S
Project No.: 17392
Date: 17.01.02
Ours Ref.: ehl
Revision: 0
Deliver: 20.09.01
Page: 4 af 5

TYPE 6, 8 ccm, 60 hz
Varenr: 1890776-0

Pos	Pcs.	Description	Trade No.	Type	Remarks
18	1,00	Pressure relief valve	BO 0 532 002 012	15-50 Bar; M30x1.5	Set 45 Bar
19	1,00	Thermostat	NIS 220216	3/4"RG, 45°C	
21	1,00	Check valve	DE 87410001	SJ-CVA-00-0010; 0.7 Bar	
22	1,00	Flange	ST 30008	1/2"RG, svejset gennemføring	
22	1,00	Plug	SA 0408047	VSTI R1/2-ED, plug 1/2"	
23	1,00	Heating element	DE-VI 92201904	500W, 1W/cm², 3x400VAC	For 3x440VAC/60Hz
23	1,00	Coupling box for heater	DE-VI 19900471	2" Glat låg	Set 40°C
23	1,00	Flange	ST 30016	2"RG varmeelement flange	
24	1,00	Flange	ST 30010	1"RG, svejset gennemføring	
24	1,00	Plug	SA 0408112	VSTI R1-ED, plug 1"	
25	1,00	Air valve	SA 0370700	1/2" Luftskrue	



PARTLIST

Customer: MAN B&W KØBENHAVN A/S
Project No.: 17392
Date: 17.01.02
Ours Ref.: ehl
Revision: 0
Deliver: 20.09.01
Page: 5 af 5

TYPE 6, 8 ccm, 60 hz
Varenr: 1890776-0

Pos	Pcs.	Description	Trade No.	Type	Remarks
25	1,00	Flange	ST 30008	1/2"RG, svejset gennemføring	
26	1,00	Manometervalue	DA SL-257050	FT 290	
27	1,00	On/off valve	SA 0518613	1½" RG	
27	1,00	Fittings	ST 30012	Svejseflange 1 1/2".	
27	1,00	Fittings	SA 000092111	Vinkel,nippel/muffe 1 1/2"Sort	
28	1,00	Manifold	ST 30475	For MAN Lub. Oil unit Type 2	
29	1,00	Cleaning cover	HBE 3097	Alu 250-4,med logo S&T	
29	1,00	Gasket	HBE 3091	D168 NBR RD 250	
30	1,00	Fittings	ST 30796	Bøjning DN 32 - 1 1/2"	
31	1,00	Temperature transmitter	DA 084Z8012	MBT 5250,PT100,100 mm.1/2"	



DIRECTIONS FOR THE MAINTENANCE OF HYDRAULIC SYSTEMS

Revision: 2
Date: 10.01.99
Page 1 of 3

Control Point.	Control Interval
1.0 Mechanical Maintenance. 1.1 Pipe Assemblings. All screw connections have to be tightened-up. At the same time they have to be controlled for leakages. In case of a leakage the cause has to be found and corrected. 1.2 Tube connections. All tube connections have to be inspected for leakages, and the tubes have to be controlled. The tubes have to be intact without any sign of mechanical wear or other faults in the tube surface. Has such a fault been found, the tube may have to be replaced. But at least it has to be considered, how the fault came into existence, and it has to be secured that it will not be repeated. Leaking tubes have to be replaced. 1.3 Screw Gaskets. All screw gaskets have to be tightened-up, and the parts that the connection holds have to be inspected for leakages. The tightening-up has to be effected in accordance with an accepted standard. 1.4 Mechanical Securing of Hydraulic Components. All connections that hold, carry or support hydraulic components have to be controlled. This is especially important where the hydraulic components are parts that move or are subject to vibrations. Therefore also pipe and tube holders have to be controlled. 1.5 Lubrication of Guides. All guides have to be greased with fat or oil that is suited for the purpose. The guidelines of the supplier regarding frequency, fat/oil type, quantities and places have to be followed. 2.0 Hydraulic Maintenance. 2.1 Inspection of the Filter. 2.1.1 Filters without Supervision. With filters without supervision it is essential to pay thorough attention to the regulations for the inspection and to the intervals of replacement. 2.1.2 Filters with Supervision. When the indicator shows an excessive pressure, the element have to be replaced. 2.1.3 Breathing Filters. Have to be cleaned or replaced.	Every Month. Every Month. Every Month. Every Month. Daily or in accordance with the guidelines of the supplier. After 1 week. Thereafter the condition has to be controlled every month. After 1 week. Then on indication. Every 3 month



DIRECTIONS FOR THE MAINTENANCE OF HYDRAULIC SYSTEMS

Revision: 2
Date: 10.01.99
Page: 2 of 3

Control Point.	Control Interval
2.2 The Hydraulic Fluid. 2.2.1 The Condition of the Hydraulic Fluid. The hydraulic fluid has to be controlled for dirt, water and other impurities. In case that the fluid is considered to be not suitable, it has to be replaced or cleaned. Depending on the impurity, the system has to be found and repaired. 2.2.2 The Level of the Fluid. The level of the fluid has to be controlled. Maybe the hydraulic fluid will have to be replenished. 2.2.3 The Working Temperature of the Hydraulic Fluid. Once you have started to work the system it is necessary that you frequently control that the max. temperature of the fluid is not exceeded. 2.3 Gaskets. The Gaskets have to be replaced. This goes for both sealing gaskets between valves and for gaskets in assembling. 2.4 Cylinders. The cylinders have to be inspected for seizing on the tube and around the stuffing box. The cylinders have to be cleaned around the tube. 2.5 Settings of the Pressure. All pressure settings valves have to be controlled, reset if necessary and then sealed. In case of resetting af pressure valve the control interval has to start from the beginning. 2.6 Accumulators. The muzzle pressure has to be examined and the accumulator has to be visually controlled for defects. In case that the muzzle pressure has to be reset, or it becomes necessary to replenish, the control interval has to start from the beginning. 2.7 Flow Settings. Flow valves has to be examined and reset if necessary, and then sealed. In the case of a resetting the control interval has to start from the beginning. 2.8 Air Coolers. The fins and ventilators have to be cleaned and controlled. 2.9 Water Coolers. The cooler has to be thoroughly rinsed and cleaned from the inside. It has to be controlled that there are no corrosion between water and oil side.	After 1 month Hereafter every 6 months. Daily. Before starting to work the system. Daily, when starting the system. Then every 1 month. Every year. Every 3 month. 1 st control after 1 week. 2nd control after 3 months. Then yearly. 1 st control after 1 week. 2nd control after 3 months. Then yearly. 1 st control after 1 week. 2nd control after 3 months. Then yearly. Every 3 month. Every year.



DIRECTIONS FOR THE MAINTENANCE OF HYDRAULIC SYSTEMS

Revision: 2
Date: 10.01.99
Page: 3 of 3

Control Point.	Control Interval
3.0 Others. 3.1 Safety. All functions of safety have to be controlled. The re-starting procedure has to be followed. 3.2 Cabeling. Electrical wiring to and from the control panel have to be controlled. It has to be secured that the wires are properly protected and in a perfect condition. In the of doubts the wires have to be replaced. 3.3 Valve functions. All valve functions have to be controlled in order to secure a correct functioning. 3.4 Cleaning. The area around the machine has to be clean and free of objects that may be of hindrance for the movements of the machine Likewise the area has to be free of objects that may present danger to an operator. 3.5 Emergency stop. Every emergency stop button have to be tested. Is one of the buttons defect, the machine is not to be worked untill the button has been put right or the defect has been repaired in another satisfactory way. 3.6 Leakage. A control has to be carried through regarding leaking oil. In the case of leakage, they have to be repaired as soon as possible.	Daily - Before starting the system. Daily - Before starting the system. Daily - Before starting the system. Daily - Before starting the system. Daily - Before starting the system. Daily - Before starting the system.



Guidelines for Tightening of Bolt connections

Enclosure 1 acc. to Part 1.3 Bolt connections.

Revision: 1
Date: 10.01.99
Page: 1 OF 1

Nm			Nm		
Tube	Thread	Moment	Thread	Moment	Series
6	G1/8"	25	M10x1	25	L Light
8	G1/4"	50	M12x1.5	30	
10	G1/4"	50	M14x1.5	50	
12	G3/8"	80	M16x1.5	80	
15	G1/2"	160	M18x1.5	90	
18	G1/2"	105	M22x1.5	160	
22	G3/4"	220	M26x1.5	285	
32	G1"	370	M33x2	425	
35	G1 1/4"	600	M42x2	600	
42	G1 1/2"	800	M48x2	800	
6	G1/4"	60	M12x1.5	35	S Heavy
8	G1/4"	60	M14x1.5	60	
10	G3/8"	110	M16x1.5	95	
12	G3/8"	110	M18x1.5	120	
14	G1/2"	170	M20x1.5	170	
16	G1/2"	140	M22x1.5	190	
20	G3/4"	320	M27x2	320	
25	G1"	380	M33x2	500	
30	G1 1/4"	600	M42x2	600	
38	G1 1/2"	800	M48x2	800	



Cleaning instructions

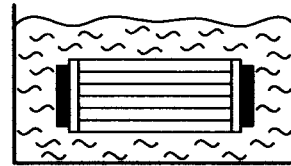
for INTERNORMEN filter elements of wire mesh

Sheet No.
21070-4 B

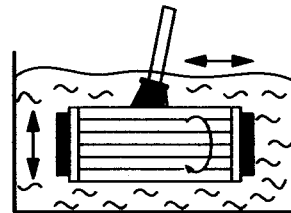
1. Before starting the cleaning process,
close the clean side of the filter element.



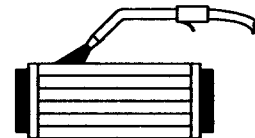
2. Lay the filter element into a vessel. According to the contamination level soak the coarse contamination for about 30 minutes. As cleansing liquor we recommend petrol, trichlorethylene, escabon or hot water.



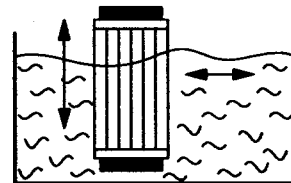
3. Remove the soaked contamination with a soft brush, while spinning the filter element.
(For filter elements with a micron size rating of $< 25 \mu\text{m}$, we recommend the cleaning in an ultrasonic bath).



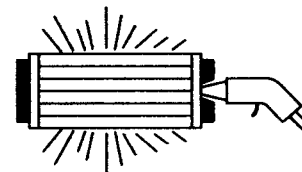
A steam jet can also be used →



4. After precleaning wash the filter element up in a
clean liquid.

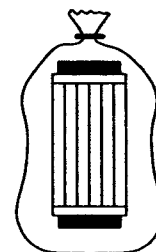


5. After cleaning blow out the filter element from
inside to outside with compressed air or steam jet.



6. Check the filter element optical (back light),
whether the pores are open.

7. a) Reinstall the cleaned filter element
(check the seal)
or
b) restore it carefully in a dustfree bag.



8. Service life:

In course of time the efficiency of cleaning will become worse due to the contamination level and the cleaning intervals become shorter. This results in a limited life also for the cleanable filter elements. After several cleanings more and more fiber particles and debris stick to the wire mesh, which hardly can be removed. This is perceptible in shorter standing times.

EDV 07/00



INTERNORMEN-Filter

D-68804 ALTLUSSHEIM Phone 0 62 05 / 20 94 - 0 F



**MANUFACTURING DRAWINGS
FOR
PLANETARY TURNING GEARS
FOR DIESEL ENGINES**

MODEL TYPE : WT-3700



WOOAM MACHINERY CO.

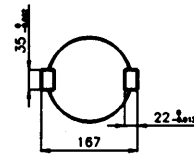
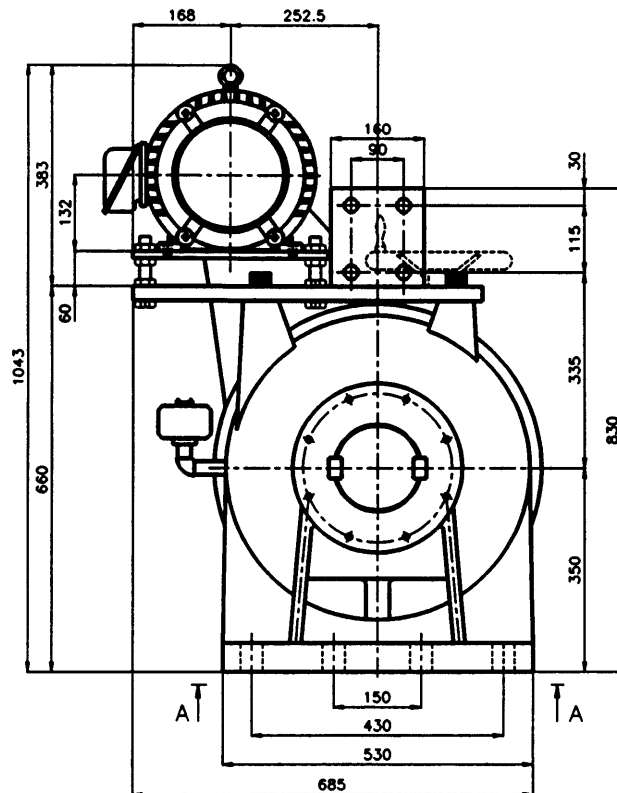
**#1017 Naesam-Ri Juchon-Myun Kimhae-City
Kyung Nam Korea**

TEL : +82-55-329-1963/73/83

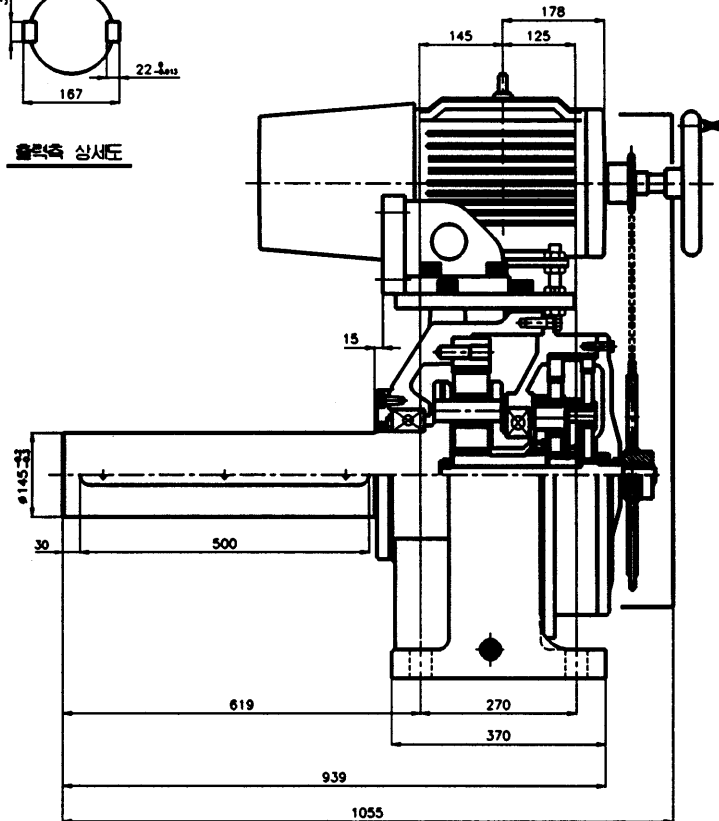
FAX : +82-55-329-1959



NO	NAME	MAT'L	QTY	REMARK



출력측 상세도

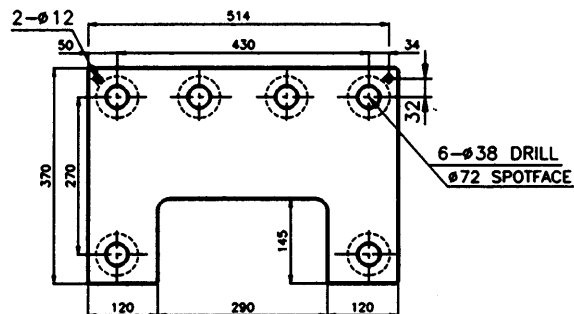


SPECIFICATION

1. TRANSMITTING POWER : 5.5kw
2. HIGH SPEED SHAFT : 1200 rpm
3. LOW SPEED SHAFT : 1.028 rpm
4. GEAR RATIO : 1:1167.15
5. OUTPUT TORQUE : 3700 kg-m
6. MAX OUTPUT TORQUE : 6300 kg-m
7. LUBRICATION OIL : GREASE OIL
8. RECOMMEND TENSIL STRENGTH
OF FOUNDATION BOLT--MIN 85kg/m²

INDUCTION MOTOR

- 1.MANUFACTURED BY HYUNDAI MOTOR
2.TYPE : HK-x\$D
3.OUTPUT : 5.5kw
4.VOLTAGE : AC 440V
5.POLES : 6P
6.WITH DC MAGNETIC BRAKE

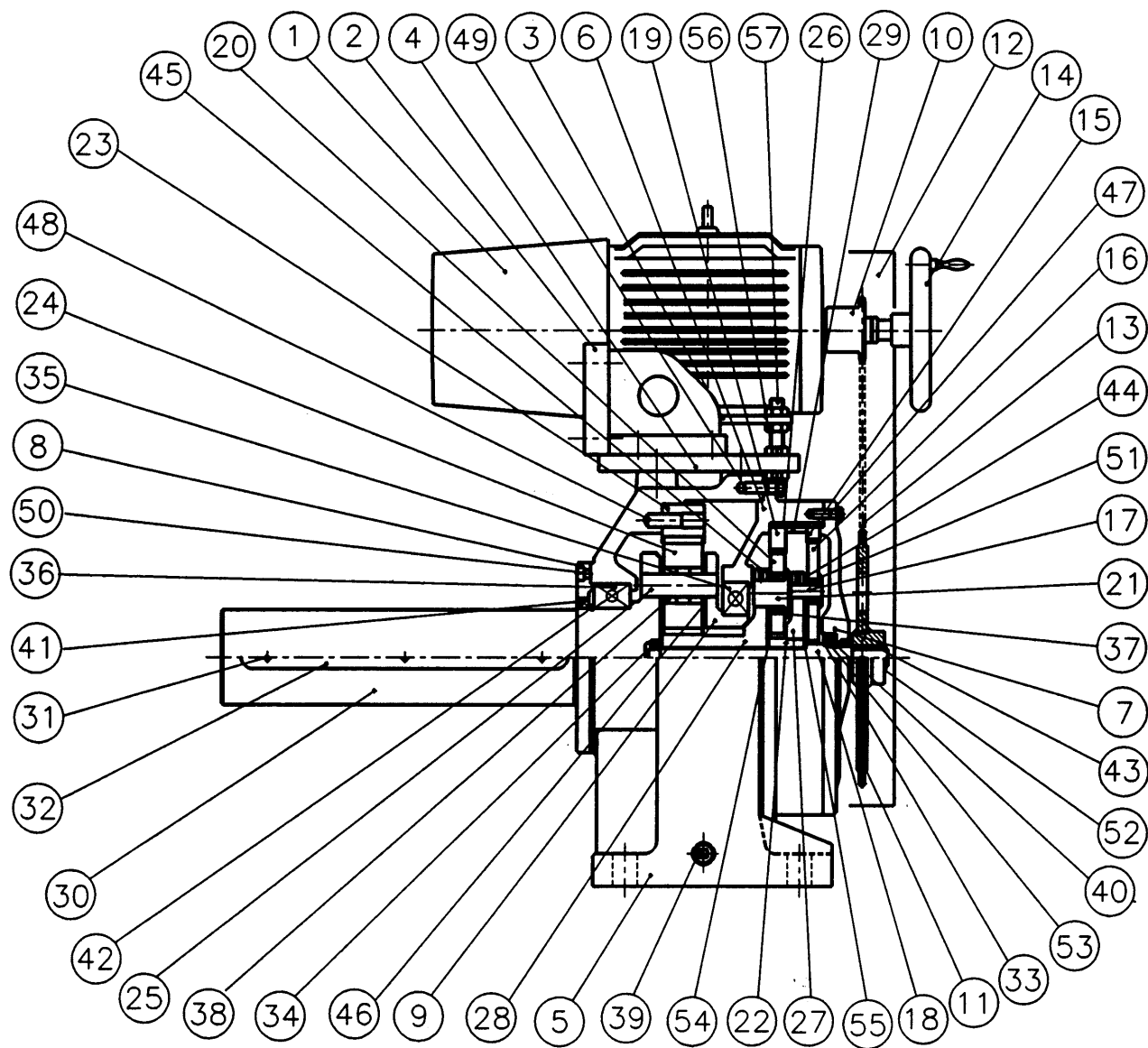


VIEW A-A



HANDLE 보관상세도

REV:	DATE	PREPARED BY	REVIEWED BY	APPROVED BY	
ITEM NAME		TURNING GEAR WITH MOTOR			
PART NAME		OUT LINE			
	S = /		in	DATE: . . .	
	WOO AM MACHINERY CO.				
DWG. NO.		WT-371001			



REV.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
ITEM NAME		TURNING GEAR REDUCER		
PART NAME		ASSEMBLY DRAWING		
 		S = /	 in	DATE: . .
		WOO AM MACHINERY CO.		
DWG. NO.		WT-371002		

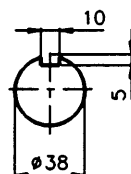
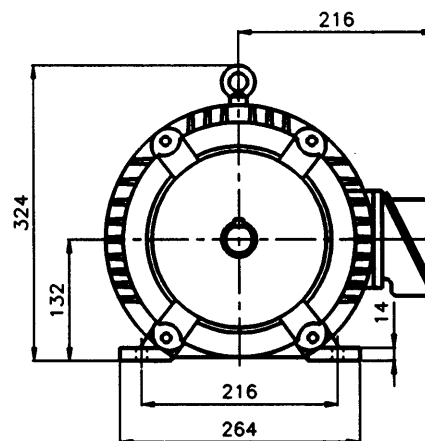
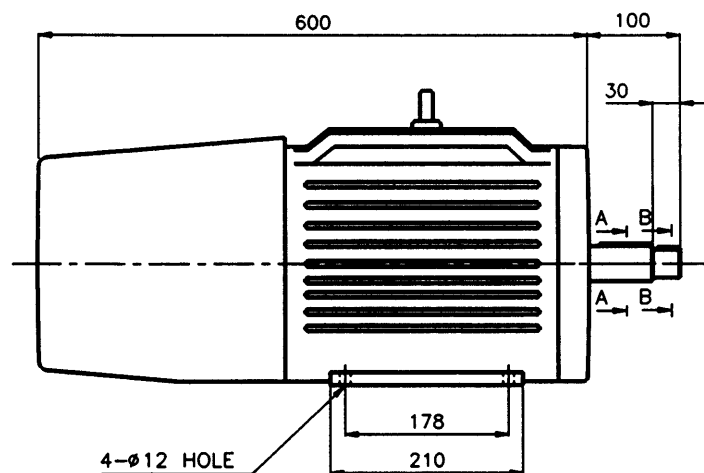


WT-372003

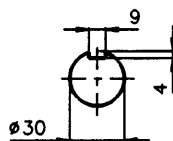
DWG. NO.

NO	NAME	MAT'L	QTY	REMARK

①



SECTION A-A



SECTION B-B

— SPECIFICATION —

MOTOR	
MAKER	HYUNDAI
TYPE	HK-X\$D
POLES	6P
DUTY	1HR
OUTPUT	7.5HP, 5.5KW
WEIGHT	110KG
BEARING	DE 6208ZZ
	ODE 6208ZZ
FREQUENCY	60Hz
ENCLOSURE	IP54
CABLE GLAND	20C, 15C, 10A x1
TERMINAL BLOCK	20A . 6P
RATED VOLTAGE	440V
INSULATION CLASS	F
COOLING METHOD	IC0141(FC)
SPEED AT RATED LOAD	1170RPM
RATED LOAD CURRENT	11.2A

MAGNETIC BRAKE	
MAKER	NAM KWANG ELECTRIC CO
TYPE	NKSB-15S
TORQUE	12kg-m
VOLTAGE	DC 90V
AMPS	1.28A
WATTS	115W
WEIGHT	25kg

REV. NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
ITEM NAME		TURNING GEAR WITH MOTOR		
PART NAME		MOTOR OUTLINE		
		S = /	 in	DATE: . .
 WOOW AM MACHINERY CO.				
DWG. NO.		WT-372003		

PARTS LIST (TURNING GEAR WITH MOTOR)

WT-3700

SHEET NO. 1/2

1	MOTOR OUT LINE	MAKER	1		WT-252003
2	BRACKET	SS400	1		WT-253532
3	MOTOR BASE	SS400	1		WT-253531
4	BASE	SS400	1		WT-253530
5	HOUSING	FCD500	1		WT-373101
6	GEAR HOUSING	FCD500	1		WT-253105
7	BEARING HOUSING	FCD500	1		WT-253106
8	BEARING COVER	SS400	1		WT-373102
9	CARRIER PLATE	SC460	1		WT-253107
10	CHAIN SPROCKET(소)	S45C(H)	1	RS50 X 18T	WT-253220
11	CHAIN SPROCKET(대)	S45C(H)	1	RS50 X 76T	WT-253219
12	CHAIN COVER	SS400	1		WT-253535
13	CHAIN		1	RS50	
14	HANDLE	FC25	1		WT-253533
15	1st RING GEAR	S45C(H)	1		WT-253209
16	1st IDLE GEAR	SCM415	3		WT-253210
17	1st PIN SHAFT	S45C(H)	3		WT-253323
18	1st INPUT SHAFT	SCM415	1		WT-253215
19	2nd RING GEAR	S45C(H)	1		WT-253211
20	2nd IDLE GEAR	SCM415	4		WT-253212
21	2nd PIN SHAFT	S45C(H)	4		WT-253324
22	2nd SUN GEAR	SCM415	1		WT-253216
23	3rd RING GEAR	S45C(H)	1		WT-253213
24	3rd IDLE GEAR	SCM415	4		WT-253214
25	3rd PIN SHAFT	S45C(H)	4		WT-253325
26	KEY	S45C(H)	1		WT-253429
27	1st SPIDER	S45C(H)	1		WT-253218
28	3rd SUN GEAR	SCM415	1		WT-253217
29	SPACER	SGP	1		WT-253534
30	OUTPUT SHAFT	SF45C(H)	1		WT-373301
31	WRENCH BOLT	8.8	3	M10X25L	
32	KEY	S45C(H)	2	35X22X500L	WT-373401
33	BALL BEARING	MAKER	1	#6207	
34	BALL BEARING	MAKER	1	#6205	
35	BALL BEARING	MAKER	1	#6226	
36	ROLL BEARING	MAKER	1	#23030	
37	NEEDLE BEARING	MAKER	4	NA4908	



PARTS LIST (TURNING GEAR WITH MOTOR)

WT-3700

SHEET NO. 2/2

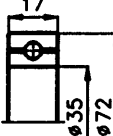
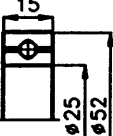
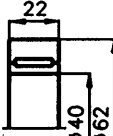
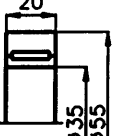
38	NEEDLE BEARING	MAKER	12	NA4907	
39	DRAIN PLUG		1	PT1"	
40	OIL SEAL	MAKER	1	35X55X11	
41	OIL SEAL	MAKER	1	150X180X14	
42	SNAP RING	MAKER	1	S-140	
43	KEY	S45C(H)	1	8X7X40L	
44	1st SIDE WASHER	SACM645	3		WT-253428
45	2nd SIDE WASHER	SACM645	4		WT-253427
46	3rd SIDE WASHER	SACM645	8		WT-253426
47	HEX BOLT	8.8	8	M16X45L	
48	PIN	S45C(H)	2	Ø 20X60L	
49	HEX BOLT	8.8	8	M16X50L	
50	WRENCH BOLT	8.8	8	M12X40L	
51	NEEDLE BEARING	MAKER	3	NA4904	
52	SNAP RING	MAKER	1	S-30	
53	SNAP RING	MAKER	1	S-35	
54	WASHER	SACM645	2	Ø 50X2.4T	
55	WASHER	SACM645	1	Ø 38X2.4T	
56	NUT	8	16	M20	
57	BOLT	S45C(H)	4	M20	



SPARE PARTS LIST

WT-3700

1/2

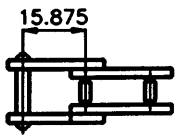
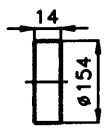
DESCRIPTION			TURNING GEAR WITH MOTOR			
NO	PARTS NAME	SKETCH	QUANTITY		PARTS	REMARKS
			UNIT	SPARE		
1	BALL BEARING #6207		1	1	33	
2	BALL BEARING #6205		1	1	34	
3	NEEDLE BEARING NA4904		3	1	51	
4	NEEDLE BEARING NA4908		4	1	37	
5	NEEDLE BEARING NA4907		12	1	38	
6	OIL SEAL D355511		1	1	40	
7	OIL SEAL D15018014		1	1	41	
NOTE						



SPARE PARTS LIST

WT-3700

2/2

DESCRIPTION			TURNING GEAR WITH MOTOR			
NO	PARTS NAME	SKETCH	QUANTITY		PARTS	REMARKS
			UNIT	SPARE		
8	ROLLER CHAIN RS50		1	RINK 6	13	
9	INNER DISK		2	1		
10	SPARE BOX		1			
NOTE						



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2. GENERAL CONSTRUCTION OF REDUCTION GEAR -----	1
3. CHECKING POINT -----	1
4. LUBRICATING OIL -----	2
5. MANUAL OPERATION -----	2
6. REPLACEMENT OF COMPONENTS -----	3
7. DISASSEMBLY AND ASSEMBLY -----	3
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9. MAINTENANCE AND SERVICING PROCEDURES -----	5
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1. SPECIFICATION

Input speed	: 1200rpm
Input power	: 5.5kw
Gear ratio	: 1:1167.15
Output speed	: 1.028rpm
Output torque(Normal)	: 3700kg-m
Output torque(max.)	: 6300kg-m

2. GENERAL CONSTRUCTION OF REDUCTION GEAR

Turning gear with motor made by WOOAM adopts a planetary gear mechanism for gaining high torque at output shaft. The output shaft of turning gear with motor can be rotated either way, clockwise or anti-clockwise, and also handled easily by unskilled operator

However, improper handling may cause an unexpected troubles, therefore, read this manual carefully and use it correctly.

Turing gear with motor should be used below the rated torque. But, for an instant, it can be used 170% above the rated torque. However, continuous using it above the rated torque may be shorten the service life time of gears, bearings, moto etc, and sometimes a cause of other problems.

3. CHECKING POINT

Check for loosening bolts and nuts from time to time and also check, before start, the oil gauge if the level of oil is within the oil level gauge. During the turning gear with motor is running, pay attention to the external temperature, noise and vibration is arise or is not.

The external temperature of the casing may rise to 10℃ to 40℃ above the ambient temperature but, it will reach a constant temperature while the turning gear is being used. In the event of excessive heat generation, noise or vibration during operation, immediately stop the operation and examine its cause carefully.



4. LUBRICATING OIL

For the reducing gear, the oil bath lubricating method is adopted and roller chain is adopted grease lubricating system. The most important thing for maintenance of turing gear is the replacement of lubricating oil and supply of appropriate quantity. The change of lubricating oil have to be carried out when the reduction gear is not running condition due to an agitation of the lubricating oil by means of reduction gear. The replace oil should be used a designated lubricating oil in this manual.

The method to replace oil loosen the drain plug (39) and drain all old oil out from the gear case. After completely extracts an old lubricating oil, supply new oil through the oil inlet hole observing the oil gauge.

LUBRICATING OIL TABLE

	QUANTITY OF LUBRICATING OIL	LUBRICATING METHOD	LUBRICATING INTERVAL
GEAR	APPROX 18LITER	Oil bath	Once a year
CHAIN	APPROX 250 g	Grease	Once a year

Maker	Lubricating Oil	Grease
Esso	EP Lubricant R220	Beacon Grease EP2
Shell Oil	Shell Tellus Oil C220	Shell Alvania Grease No.2
Idemitsu kosan	Daphne Mechanic Oil 220	Daphne Cordoned Grease No.2
Mobil Oil	Mobil DTE Oil BB	Mobilux No.2
Maruzen Oil	Swallub RO 220	Maruzen Grease Limax No.2
FAMM	Meropa 220	Multifak EP2

5. MANUAL OPERATION

When manual operation is necessary follow the below procedure.

- 5-1 Remove the handle which is fasten to the motor base.
- 5-2 Fix the handle to the end of motor shaft.
- 5-3 Before turning of the handle, the handle for motor brake move "out" position.
- 5-4 After manual operation is completed, remove the handle and return it to original position, and the handle for motor brake move "in" position



6. REPLACEMENT OF COMPONENTS

6-1 There is some problems in each gears, please ask us for any requirements because the gears are specially designed and manufactured in this company.

6-2 The most of the bearings are applied standard which are obtainable in the market.

6-3 The oil seals deterioration is depending on circumstance, temperature and lubricant dirt therefore check it carefully and replace it periodically.

7. DISASSEMBLY AND ASSEMBLY

When disassembling and assembling becomes necessary for periodical check or malfunction, be sure to perform carefully according to following notice.

7-1 Disassembly

- 1)** Start disassembling with understanding of the WOOAM structure with the attached sectional drawing which is attached to this manual.
- 2)** Make clear the purpose of disassembly and give consideration so that the parts to be disassembled are kept to the minimum.
- 3)** if there is no alignment mark in the part to be disassembled, attempt disassembly after marking.
- 4)** Do not, under any circumstance, attempt to strike vigorously or pull forcibly each part.
- 5)** Taps are provided in the disassembly surface to facilitate disassembly and transportation.
- 6)** If disassembling is found difficult during the course of work, examine and try it again.



7-2. ASSEMBLY

- 1) Keep always clean.**
- 2) Each component should thoroughly washed with cleaning oil and make assembly after applying oil or lubricating oil.**
- 3) Check alignment mark.**
- 4) Uniformly apply a liquid packing (Three Bond No. 1215 or equivalent) to the external part of tightening surface and take care not to cause oil leaks.**
- 5) Once assembly is completed, attempt to turn the high speed shaft by hand and make sure that it rotates lightly.**

8. INSTALLATION

The WOOAM should be installed on a strongly-built board; mount bolts and nuts should be tightened thoroughly. Note that improper installation may cause excessive noise or vibration resulting in a considerable decrease in the service life of gears and mating equipment as well. It is also important to make arrangement so that oil level gauge, oil inlet(air vent) and outlet can be inspected with ease.



9. MAINTENANCE AND SERVICING PROCEDURES

items	Check Points	Job Description	Remedies	interval
Lubricating oil	Quantity of oil	Check if the level of oil is within the oil level gauge when the gear is not operated (2spots)	If it is below the level, supply oil	As occasion demands
	Temperature (Note 1)	Check for excessive heat generation (Casing surface)	In case of excessive heat generation, stop the operation immediately and examine its cause	As occasion demands
	Degree of cleaning	Discharge a proper amount of oil from the outlet and check its deterioration	Replace lubricating oil	As occasion demands
	Oil leakage	Check for oil leakage from the shaft parts and joining parts	(shaft part) Replace the oil seal (Joining parts) apply liquid packing	As occasion demands
others		Excessive noise or vibrations observed	Stop the operation immediately	As occasion demands

Note 1) The critical operating temperature of the WOOAM planetary Turning Gears is about 80 °c on its casing surface.

2) Apply degreasing once a year to chain reduction parts.



10. BRAKE

1. Structure & Operating Principles

Magnet Flange magnetized by electricity make a gap between Disk Flange and Lining(hereinafter refer to as "GAP") then the brake is putted off and makes Motor Shaft turning possible.

If electricity cut off, Magnet Flange comes off from Magnet and Magnet Spring pushes Magnet Flange. Then Turning Board sticks to Friction Board and Motor is put on the brake.

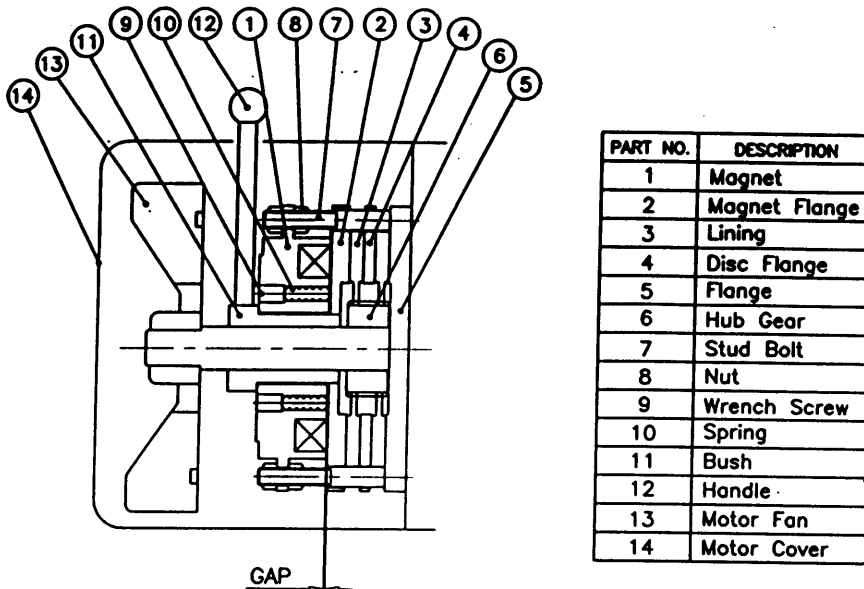


Fig.1

2. Dismounting & Mounting

A. Dismounting

- Dismount the Handle(12)
- Dismount the Motor Cover(14)
- Dismount the Motor Fan(13)
- Dismount the Bush(11)
- Dismount the Nut(8)
- Dismount the Magnet(1)
- Dismount other parts in due sequence

B. Mounting

Mount the parts in opposition to the dismounting after cleaning. The Gap to be adjusted in accordance with the "Gap Adjust Manual" hereinafter.

3. Gap Adjust Manual

Worn out Lining cause a wide Gap and a slip of lining when put on the brake. In that case the Gap th be adjusted in accordance with the folling precedure. Even if the brake is normal condition, the Gap to be checked and adjusted at least once a year.



- A. Dismount the Handle(12)
- B. Dismount the Motor Cover(14)
- C. Check the gap between Magnet and Magnet Flange by Gap Gauge (refer to Fig.1). Adjust the gap between Magnet and Magnet Flange by loosening or tightening the Nut(8). The gap to be 0.3mm–0.5mm.

4. Hand operated opening

In case that the Handle(12) moves to the position "Open"(refer to Fig.2), the Turning Gear can be operated manually by Manual Handle fitted on the Housing of Turning Gear.

5. Brake character of each brake capacity.

Brake capacity	Motor capacity	BRAKE CHARACTER				
		STATIC TORQUE	VOLTAGE	AMPERE	WATT	GAP
DB-15	3.7 KW	7.2 kgf-m	DC. 90V	0.7 A	64	0.3 – 0.5 mm
	5.5 KW	10.7 kgf-m				
DB-30	7.5 KW	14.7 kgf-m		0.86 A	77.5	
	11 KW	21.5 kgf-m				
DB-50	15 KW	29.3 kgf-m		0.98 A	88	

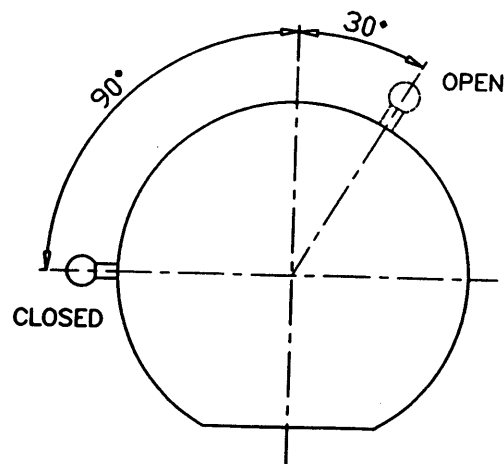


Fig.2



RENOLD

Marine Diesel Engine Camshaft and Auxiliary Drives



RENOLD



CONTENTS**Notes of the Maintenance of
Chains and Chain Wheels****1. CHAIN**

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(c)	Wear and Measurement	1
(d)	Adjustment	1
(e)	Shortening the Chain	2
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2. SPROCKETS

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3. TOOLS

3.1	Extractor Tools .75" to 4.5" pitch	4
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4. HEALTH AND SAFETY 5

1. CHAIN

Camshaft drive inspection should be made at regular intervals. As the working conditions of blower and balancers are far more severe than camshaft drives, more frequent checks may be required. In addition, it is important to carry out periodic checks on any flexible couplings to ensure that they are functioning correctly.

1.1 CHAIN - INSPECTION

(a) General

Check for any damage which may have occurred due to abnormal conditions, e.g. cracks or breakages of the rollers or side plates, stiff joints, seized rollers, marking or wear of the ends of the bearing pins or of the link plate edges fouling an obstruction, or marking of the inner surfaces of the link plates due to malalignment of the sprockets. The causes of such conditions must be removed and scrapped. Note that circumferential marking of diesel chain rollers sometimes noticed after a few hours running does not indicate chain damage. This marking is merely the result of initial contact between machining marks on wheel tooth flanks and Renold ground alloy steel rollers, which are heat-treated for toughness and durability rather than extreme hardness, to prevent cracking in service. Marking is superficial and will not have the slightest effect on future drive performance.

(b) Life

Assuming normal conditions during service, the possibility exists of chains developing incipient faults from repeated stressing over long periods. It is therefore advisable to replace camshaft and blower chains after eight years or 50,000 hours and five years or 35,000 hours service respectively, regardless of their apparent condition.

(c) Wear

The amount of wear which has taken place is directly proportional to the percentage elongation and may be ascertained as described below. In general, an elongation of 2% is regarded as representing the end of the useful life of the chain, but to ensure reliability we recommend that they are replaced at 1.2% extension. Whether full advantage can be taken of this depends on the amount of adjustment provided. On very long chains, the adjustment provided may only permit an elongation equal to two pitches of the chain and this may be much less than the figure of 1.2% given.

The reason for limiting the adjustment is that the chain, having extended an amount equal to two pitches, an inner and outer link can be removed to restore the chain to its original length and the adjustment is then returned to its original setting. (See page opposite).

Measurement of extension due to wear:-

Lay the chain, which should terminate at each end with an inner link (No. 4) on a flat surface. Anchor at one end and attach a turnbuckle at the other.

Tension the chain until all the clearances have been taken up.

Measure the length between centres of end bearing pins and calculate percentage elongation by the formula:-

$$\text{Percentage elongation} = \frac{100 (M - XP)}{XP}$$

Where M = length measured in inches

X = number of pitches of chain in measurement M

P = pitch of chain in inches

Should it prove inconvenient to remove the chain from the drive, an approximate wear figure may be obtained as follows:-

Draw the chain taut by use of turning gear or similar means to take up clearances.

Measure accurately over the longest convenient length between bearing pin centres.

Calculate percentage elongation from formula quoted above.

If uneven wear is suspected, this procedure should be carried out over different portions of the chain.

(d) Adjustment

Care should be taken to ensure that the chains are correctly adjusted, as excessive tension results in overloading the chain and shaft bearings, thus causing unnecessarily rapid wear.

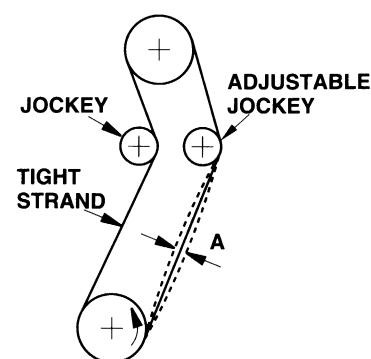
Chain adjustment should be measured on the longest readily accessible strand between two sprockets (preferably the strand containing the adjustable jockey) and the following procedure adopted:

Turn engine with the turning gear so that the strand on which adjustment is to be measured is on the unloaded (slack) side of the drive.

Adjust the chain by means of the adjustable jockey until the total movement 'A' at the mid point of the strand when swung to and fro by hand is approximately one pitch measured normal to the strand.

It is important to follow detailed instructions as given in the engine maintenance manual.

FIG. 1



CHAIN ADJUSTMENT

On modern, larger engines where vibration dampers are employed on long free lengths of chain, it is important that builders' instructions are carefully followed in adjustment of chain and subsequent adjustment of damper faces to chain rollers. Drive inspection should include examination of these strips for signs of damage to the damper face strip. Replacement of strip is recommended if such damage is very evident - usually at the "lead-in" end.

(e) **Instructions for removing two links from chain**

- (i) Before taking any action ensure that an unused spare outer link (No. 107) of the chain is available for rejoining.
- (ii) The most convenient point to carry out the task is on the section of chain between the adjustable jockey and camshaft.
- (iii) Remove top cover of drive casing.
- (iv) Prevent disengagement of the chain from the crankshaft wheel by secure lashing on both sides at points approximately level with the engine staging.
- (v) Lightly punch identical recognition mark on a link plate and its mating tooth on the camshaft wheel at any point where the chain gears with the sprocket.
- (vi) Slightly slacken chain by the jockey adjusting screw.
- (vii) Using the appropriate Renold extractor, remove the outer plate from two adjacent outer links. This should be done at a point approximately midway between the adjustable jockey and the camshaft sprocket.
- (viii) Before finally removing these links from the chain, place Renold chain cramp (Cat. No. 314 035) in position as shown in figure 8, page 4.
- (ix) Set selecting lever of cramp to position 1 and tighten sufficiently to retain the chain ends. Remove completely the extracted links and their joining inner link.
- (x) Simultaneously remove all adjustment at the jockey screw and operate the chain cramp to draw together the free ends of the chain.
- (xi) Insert the new outer link from the engine side of the chain. Drive the loose outer plate (Renold name facing outwards) to the shoulders of the bearing pins. Rivet over both bearing pins.
- (xii) Remove chain cramp and lashings.
- (xiii) Re-adjust chain.
- (xiv) Finally check that no error has arisen in engine timing.

1.2 **CHAIN - Lubrication**

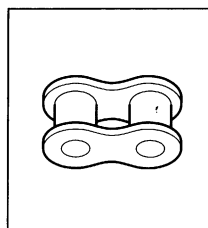
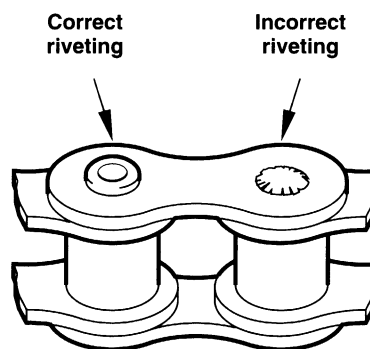
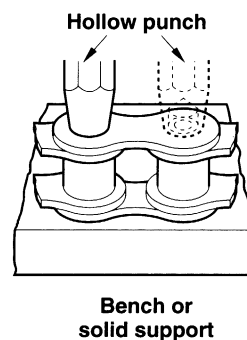
Periodically inspect all oil channels, galleries and jets to ensure they are free from obstructions and check that the oil jets will impinge on the chain under running conditions. Check security of pipe brackets.

1.3 **CHAIN - Joining Links**

Whilst a slip fit connection link No. 11 may be used for temporarily joining chain during short duration test running, a No. 107 riveting link must always be fitted for normal service. The No. 107 link consists of two bearing pins already riveted at one end to an outer plate, intermediate plates on duplex and triplex chains, and one loose outer plate. The loose outer plate must be tapped on to the ends of the bearing pins and finally driven up to the shoulders. The bearing pins should then be riveted to the same extent as those adjacent.

During fetching-up and riveting, the pins should be adequately supported from behind (see Fig. 4).

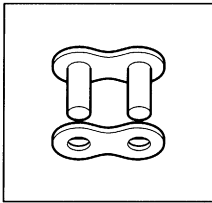
FIG. 4



No. 4 Roller Link

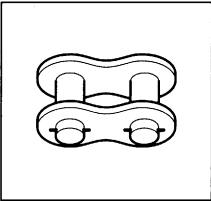
For all sizes of chain. These are complete assemblies with sideplates pressed onto the bushings carrying the rollers. The same links are used for single and multiple strand chains.





No. 107 Pin Link

For all sizes of riveted chains where optimum security is desired. Supplied with the two pins riveted in one sideplate. The other sideplate is a press fit on the pins. Pin ends should be riveted over after the sideplate is fitted.



No. 11 Connecting Link - Slip Fit

For riveted chains from 1.50" pitch and above. Supplied with two pins riveted into one sideplate. The other sideplate is a slip fit on the pins and is retained by a cotter through each pin.

It should be specially noted that a particular feature of the chain is the force fit between bearing pin and outer plate and that the plate holes or pin ends should on no account be tampered with or eased in any way whatsoever. For this reason of good force fit, riveting need not be excessive.

If at any time it is necessary to remove a riveted outer link, it is obvious that by forcing the riveted pin end through the outer plate the force fit will be destroyed and we recommend, therefore, that a new No. 107 part should be used for re-joining, the old outer link being discarded.

If Renold extractor No: 311503 is to be used to break 3.5", 4.0" or 4.5" pitch chains, the bearing pin rivet swell must first be removed by chisel or similar means.

When replacing an inner link (No. 4) it is necessary to replace the two adjacent outer links (No. 107).

To shorten a worn chain by two pitches, it is necessary to remove two adjacent outer or riveted links with inner link between them and re-rivet by one new outer link (No. 107). (See page 2).

1.4 CHAIN - Multi-Strand Drives

Erection of new drives:-

The satisfactory operation of multi-strand drives depends on equal sharing of load between the individual strands. Chain for multi-strand drives are specially matched for length. The end outer links at one end of matched chains are a different colour from the rest of the chain, and are stamped with a number and an arrow.

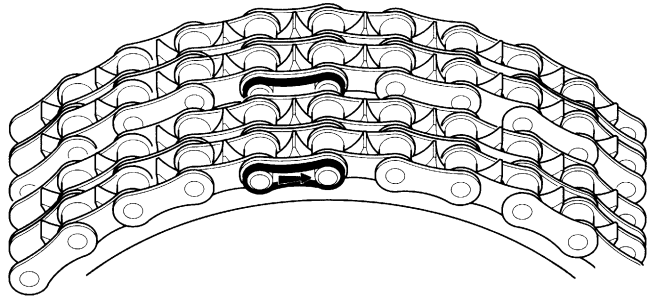
When assembling matched chains upon the wheels see that:-

All the chains are stamped with the same number.

The marked plates of all the chains are in line across the sprockets.

The arrows stamped upon the plates all point in the same direction (not necessarily the direction of the drive). Rivet the chains endless in this position.

FIG. 5



DISMANTLING AND RE-ERECTION:

If a multi-strand drive is to be dismantled for any reason, the chain must not be broken at the marked link. Any other outer link may be used but it is preferable to break at the hand riveted joint adjacent to the marked link. This will facilitate re-erection. On re-assembly, strict adherence to the instructions indicated above is again essential.

Replacement:-

If replacement of chains is necessary, all the strands of a matched set must be replaced simultaneously. Where spare sets are carried, e.g. as on ships, each spare set must comprise a complete independently matched set.

2. SPROCKETS

2.1 Wear

Examination of the tooth flanks will give an indication of the amount of wear which has occurred and this will, under normal conditions, take the form of a polished worn strip above the circular root. If the depth of this wear has reached an amount X shown in Table 1 then steps should be taken to replace the sprocket when the chain becomes due for renewal

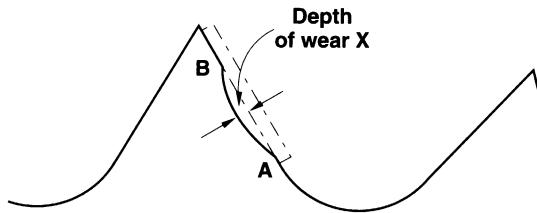
TABLE 1

Chain pitch in.	Wear mm
1.0	0.9
1.25	1.1
1.50	1.4
1.75	1.5
2.0	1.6
2.5	2.3
3.0	2.5
3.5	3.0
4.0	3.6
4.5	4.1



An easy method of measuring the amount of wear is, as shown in Fig. 6, by using a short straight edge contacting the edge of the worn area at A and the tooth flank at B when dimension X can readily be obtained. New chain on such worn sprockets will produce rapid chain wear, although it is stressed that under normal conditions the amount of wear X will not occur until several chains have been used.

FIG. 6



With new drives there will be a certain amount of "accommodation" wear on the tooth flanks and this will be noticeable in the early stages of running and must not be confused with the actual tooth wear due to prolonged service.

Burrs on the edge of the teeth indicate rather soft sprocket material, excessive chain tensioning or vibration of chain strands at certain engine speeds. Burrs should be removed if prominent.

2.2 Mounting

A check should be made to see that the sprockets are rigidly supported on their shafts and that they are free from excessive wobble or eccentricity. Jockey brackets should be inspected to ensure rigidity and security in locked position.

2.3 Alignment

Shafts must be parallel to each other and the sprocket teeth in correct alignment. Provided the sprockets are free from wobble, their alignment may be checked by means of a suitable straight edge placed against the machined faces of the rims.

Malalignment is clearly shown by wear or severe cutting of the inside faces of the inner links by the sprocket teeth, according to the degree of malalignment. Some scoring and polishing is often found even with reasonable alignment and is normal.

3. TOOLS

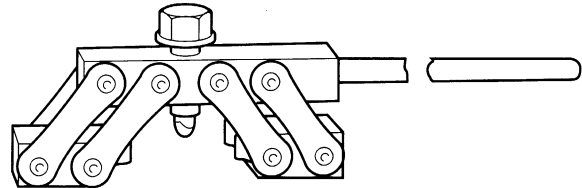
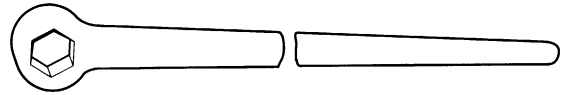
3.1 Bearing Pin Extractor (Fig. 7)

Cat. No. 10102 for chains	0.75" pitch to 1.0" pitch
Cat. No. 311502 for chains	1.25" pitch to 2.0" pitch
Cat. No. 311503 for chains	2.0" pitch to 4.5" pitch

(See page 3)

OPERATION

FIG. 7



2.0" to 3.0" pitch chains

Open the jaws, place the tool over the chain and allow the jaws to close inwards against the roller. Operate the screw until the tip contacts the chain bearing pin, continue operation forcing the chain pin halfway through the plate. Transfer to second pin and force out. Return to first pin and force out completely.

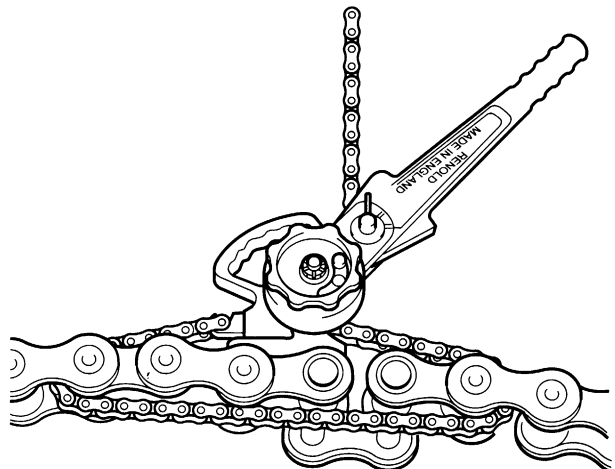
3.5" to 4.5" pitch chains

Before using the extractor, the bearing pin rivet swell must first be removed by chisel or similar means. Procedure is then as for 2.0" pitch to 3.0" pitch chains.

3.2 Chain Cramp (Fig. 8)

Cat. No. 314035. For drawing together ends of heavy chain (1.75" pitch to 4.5" pitch) prior to insertion of connecting joint No. 107.

FIG. 8



CONTENTS**Notes of the Maintenance of
Chains and Chain Wheels****1. CHAIN**

1.1	Inspection	
(a)	General	1
(b)	Life	1
(c)	Wear and Measurement	1
(d)	Adjustment	1
(e)	Shortening the Chain	2
1.2	Lubrication	2
1.3	Joining Links	2
1.4	Multi-Strand Drives	3

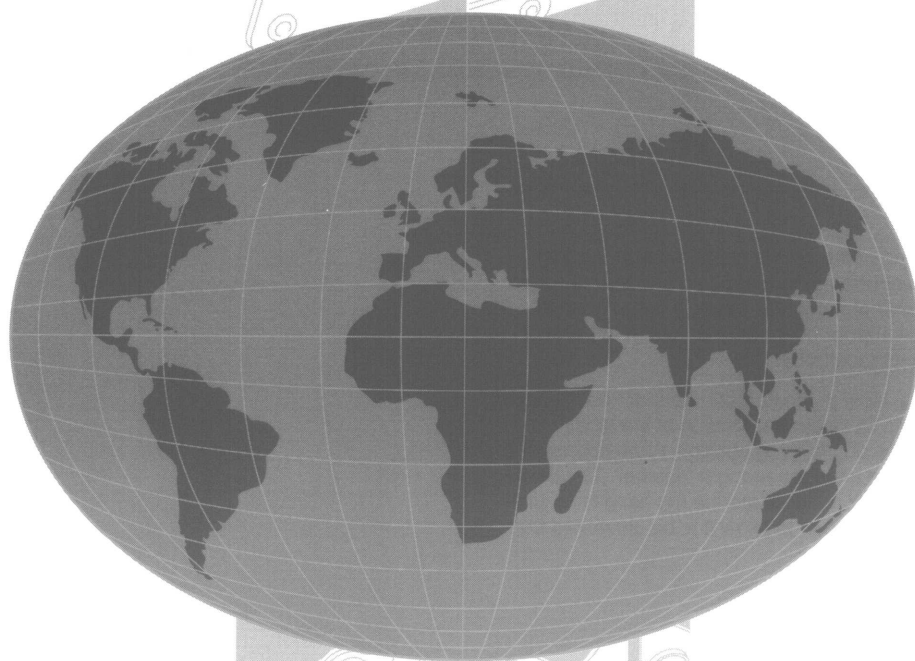
2. SPROCKETS

2.1	Wear	3
2.2	Mounting	4
2.3	Alignment	4

3. TOOLS

3.1	Extractor Tools .75" to 4.5" pitch	4
3.2	Chain Cramp	4

4. HEALTH AND SAFETY 5



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RENOLD





HSD ENGINE

CLIENT : D.S.M.E CO.,LTD
 HULL NO. : 5258
 ENGINE TYPE : HSD-MAN B&W 5S70MC(MK6)

SUBJECT :

LIST OF SPARE PART

Notes :

1. THE COLUMN OF "SUPPLY PER SHIP" IN THIS LIST IS
"N" MEANS CYLINDER NUMBERS OF MAIN ENGINE
2. THE COLUMN OF NO IN THIS LIST IS
1) "H" MEANS ENG. ROOM INSTALLATION.

ENCLOSURE :

5					
4					
3					
2					
1	To be added. (Page 0099-01 ~19)	20030516	<i>Cepo</i>	<i>AM</i>	<i>[Signature]</i>
0	Fisrt prepared	20021204	<i>Cepo</i>	<i>[Signature]</i>	<i>[Signature]</i>
REV	DESCRIPTION	Date	Prepared	Reviewed	Approved

DESIGN TEAM 1
 (Tel. +82 55 260-6708. FAX. +82 55 260-6800)
 HSD ENGINE CO.,LTD.

DRAWING NUMBER

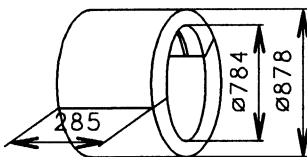
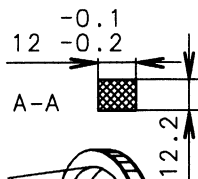
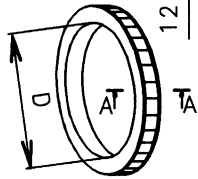
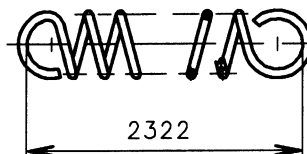
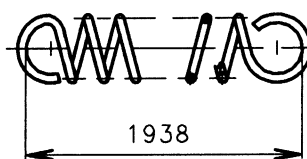
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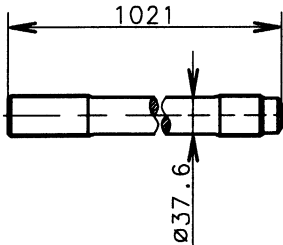
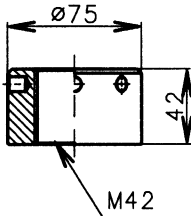
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4	FRAME BOX -----	0002-02
5	CHAIN DRIVE UPPER PART -----	0003-01
6	CYLINDER LINER -----	0005-01
7	CYLINDER LINER -----	0005-02
8	CYLINDER LINER -----	0005-03
9	CYLINDER COVER COMPLETE -----	0006-01
10	CONNECTING ROD COMPLETE -----	0008-01
11	CONNECTING ROD COMPLETE -----	0008-02
12	PISTON COMPLETE -----	0010-01
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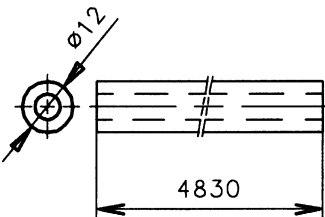
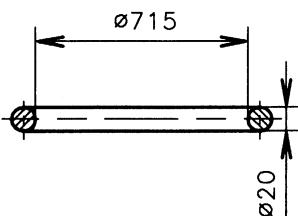
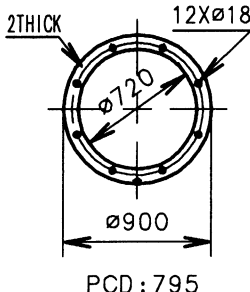
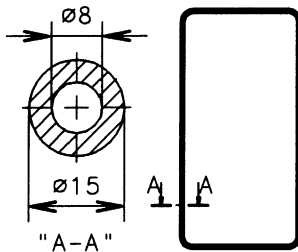
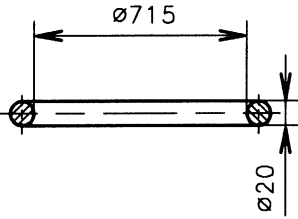


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK	
			W'T(kg)	WORKING	SPARE		NO	ITEM NO		
					STD	ADD				
1	MAIN BEARING SHELLS		STEEL WHITE METAL	N+2	1		91210-102	086	P/NO: 1502S 14-001958	
			240.5						BOX NO	
2	OIL SEAL FOR AXIAL VIBRATION DAMPER		D= Ø1010 TEFLON + MoS2	1	1		91211-44	176	P/NO: D601S 13-003075	
			8.03						BOX NO	
	OIL SEAL FOR AXIAL VIBRATION DAMPER		D= Ø784 TEFLON + MoS2	2	1		91211-44	164	P/NO: D602S 13-003076	
				6.223						BOX NO
3	TENSION SPRING FOR AXIAL VIBRATION DAMPER		SWO-V	1	1		91211-44	056	P/NO: D301S 13-003078	
			0.28						BOX NO	
4	TENSION SPRING FOR AXIAL VIBRATION DAMPER		SWO-V	2	1		91211-44	044	P/NO: D302S 13-003077	
			0.24						BOX NO	
SPARE		TYPE ; S70MC					HSD - MAN B&W			
MS NO. 0001		Description : MAIN BEARING AND A/V DAMPER					Ident no :			

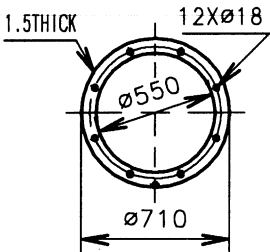
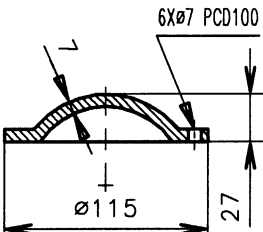
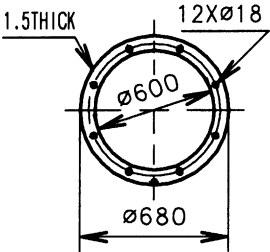
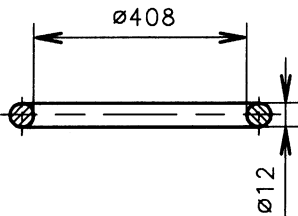
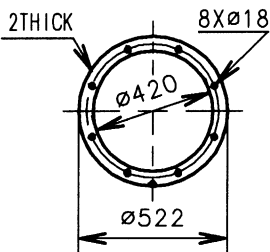


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			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
5	STUD FOR MAIN BEARING (AFT SIDE)		SPECIAL STEEL	4N+8	4		91210-102	387	P/NO: 1503S 12-001176
			9.2						BOX NO
6	NUT FOR MAIN BEARING (AFT SIDE)		SPECIAL STEEL	4N+8	4		91210-102	373	P/NO: 1504S 13-002896
			1						BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0001		Description : MAIN BEARING AND A/V DRIVE					Ident no :		

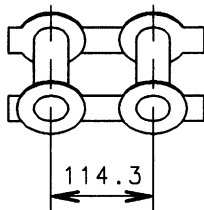
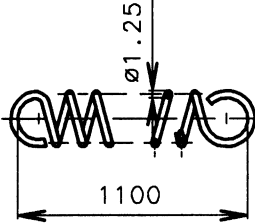
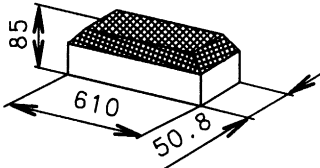
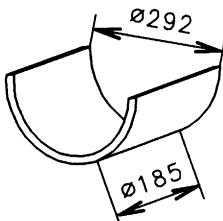
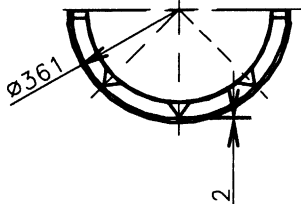


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	SEALING RING FOR FRAME BOX DOOR		NBR	N+1	2		91205-111	496	P/NO: 1801S 14-013254
			0.27						BOX NO
2	O-RING FOR RELIEF VALVE		NBR	N	2		91102-07		P/NO: 1201S 13-001687
			0.3						BOX NO
3	PACKING ROUND FOR RELIEF VALVE		JIC6000	N	2		91102-07	041	P/NO: S601S 14-013246
			0.6						BOX NO
4	PACKING MATERIAL-ROUND FOR FRAME DOOR REAR		NBR	1	1		91205-111	244	P/NO: S610S 14-013839
			0.76						BOX NO
5	O-RING FOR RELIEF VALVE OF FORE COVER		NBR	1	1				P/NO: 1203S 13-001687
			0.1						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0002		Description : FRAME BOX					Ident no :		

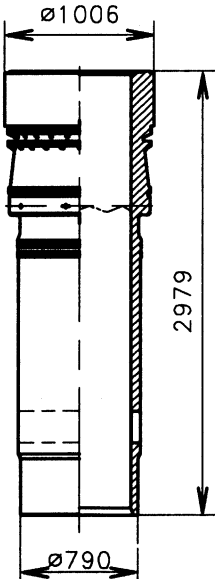
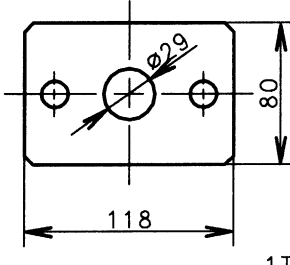
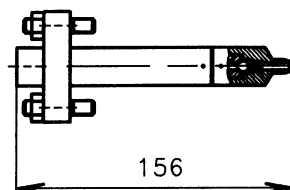
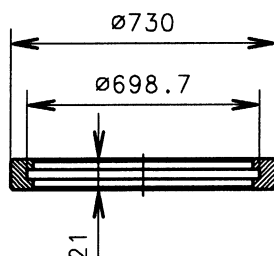


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T (kg)	WORKING	STD	ADD	NO	ITEM NO	
6	PACKING FOR RELIEF VALVE OF FORE COVER	 1.5THICK 12XØ18 Ø550 Ø710 PCD:615	JIC6000	1	1				P/NO: S603S 14-012276
			0.2						BOX NO
7	SIGHT GLASS	 6XØ7 PCD100 Ø115 27	ACRYL	N	1		91207-51	054	P/NO: S901S 13-014433
			0.1						BOX NO
8	PACKING FOR CLEANING COVER	 1.5THICK 12XØ18 Ø600 Ø680 PCD:640	JIC6000	N	2		91205-111	244	P/NO: S611S 14-012282
			0.5						BOX NO
9	O-RING FOR RELIEF VALVE OF CHAIN CASE REAR COVER	 Ø408 Ø12	NBR	1	1		91102-07		P/NO: 1205S 13-001687
									BOX NO
10	PACKING FOR REFLIEF VALVE OF CRANK CASE	 2THICK 8XØ18 Ø420 Ø522 PCD:465	JIC6000	1	1		91102-07	041	P/NO: S605S 14-012285
			0.3						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0002		Description : FRAME BOX					Ident no :		

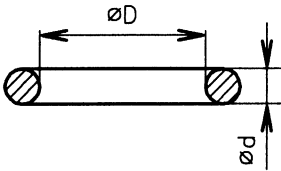


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
1	ROLLER CHAIN FOR CAMSHAFT DRIVE	 PITCH : 4.5"	SPECIAL STEEL	91x2 (LIN -KS)	PIN LINK 6 ROL LER LINK 6		90601-98	028 041	P/NO: 2202S 2203S 14-002000 14-002001
			13.6						
2	PACKING FOR SCRAPER RING COVER (TENSION SPRING)		SWO-V	1	1		90613-81	549	P/NO: D301S EN36C1, 251100
			0.165						
3	RUBBER PIECE FOR GUIDE WAY		NBR + STEEL	4	2		90601-98	100	P/NO: 2601S 13-010534
			14.5						
4	BEARING SHELLS FOR CAMSHAFT		STEEL WHITE METAL	4	2		90610-79	076	P/NO: 2502S 10-010058
			5.4						
5	GUIDE DISC FOR BEARING SHELL		STEEL WHITE METAL	4	4		90610-79	243	P/NO: 2602S 12-002606
			1.5						
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0003		Description : CHAIN DRIVE UPPER P					Ident no :		

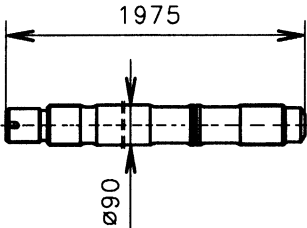
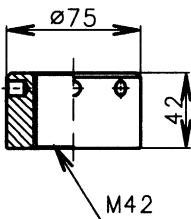
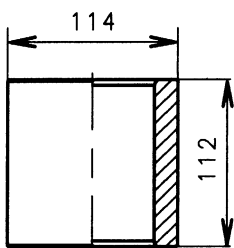
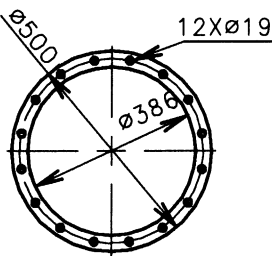


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
1	CYLINDER LINER COMPLETE		SPECIAL	N	1		90302-124	129	P/NO: 2401S
			CAST IRON						10-002208
			4241						BOX NO
2	PACKING FOR COOLING WTER CON.		JIC6000	8N	10		90302-120	142	P/NO: D602
			1T						0.01
									BOX NO
3	NON-RETURN VALVE CYLINDER LINER		STEEL	8N	8		90302-120	010	P/NO: 2301T
			SPRING STEEL						13-003884
			0.911						BOX NO
4	PISTON CLEANING RING		SPECIAL	N	1		90302-120		P/NO: 2502S
			FIRGED STEEL						11-010094
			5.15						BOX NO
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0005		Description : CYLINDER LINER					Ident no :		

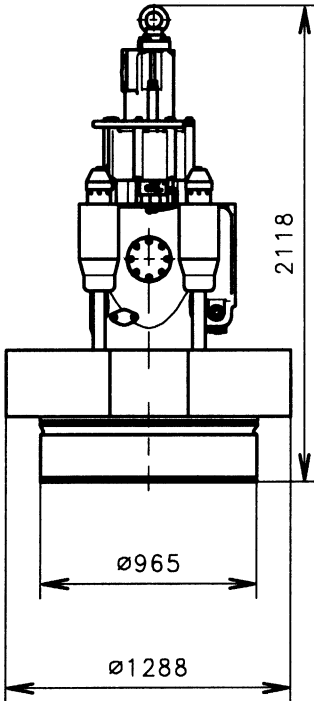
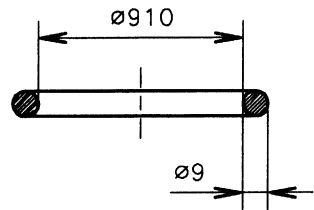
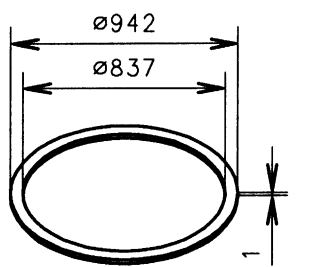


NO	DESCRIPTION		SKETCH		MAT'L	Q'TY/ENG			PLATE		REMARK
						WORKING	SPARE		NO	ITEM NO	
					W'T(kg)		STD	ADD			
	O-RING										
			øD	ød							
5	CYLINDER LINER	COOLING JACKET	910	8.4	VITON	3N	9		90302-120	071	P/NO: D601S 14-010668
					0.465						BOX NO
6	CYLINDER LINER	CYLINDER FRAME	785	7	VITON	2N	6		90302-120	083	P/NO: D604S 14-003817
					0.22						BOX NO
7	COOLING WATER CONNECTING PIPE CYLINDER FRAME LINER		39.2	5.7	VITON	20N	25		90302-120	201	P/NO: D603S 14-003816
					0.005						BOX NO
8	O-RING FOR CYLINDER COVER STUD		79.3	5.7	VITON	8N	8		90301-109	231	P/NO: D607S EN17Q680
					0.016						BOX NO
9	O-RING FOR PROTECTIVE TUBE		104.5	3	VITON	N	2		90301-109	255	P/NO: D606S 14-003821
					0.002						BOX NO
SPARE		TYPE ; S70MC							HSD - MAN B&W		
MS NO. 0005		Description : CYLINDER LINER							Ident no :		

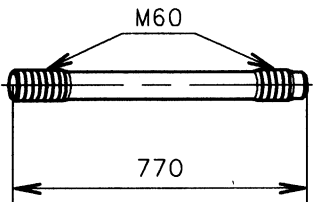
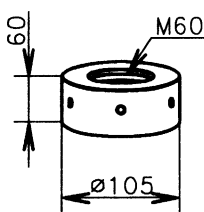
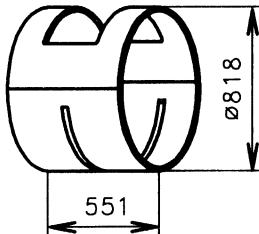
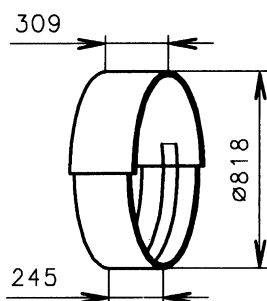
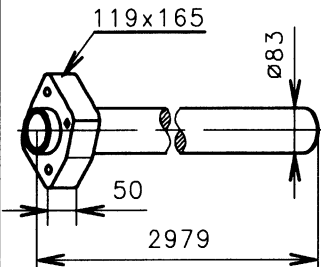


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
10	STUD FOR CYLINDER COVER		SPECIAL STEEL	8N	4		90301-109	243	P/NO: D109S 11-002803
			96						
11	NUT FOR CYLINDER COVER		SPECIAL STEEL	8N	4		90301-109	637	P/NO: D110S EN73R90
			9.9						
12	BUSH FOR TELESCOPI PIPE		M6	N	1		90301-109	206	P/NO: 2604S 14-003820
			4.5						
13	PACKING FOR CLEANING COVER	 PCD: 450 1.5T	JIC6000	N	2		90301-109	409	P/NO: D605S 12-002585
			0.29						
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0005		Description : CYLINDER LINER					Ident no :		

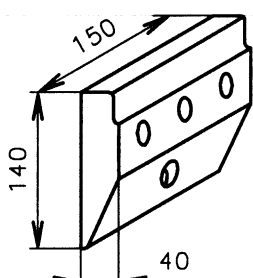
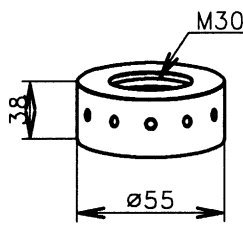
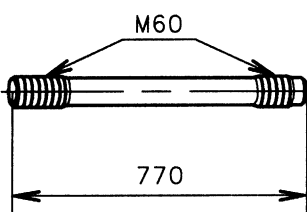
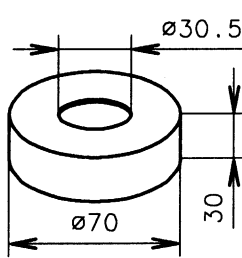


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG		PLATE		REMARK	
			W'T (kg)	WORKING	SPARE	STD	ADD		NO
1	CYLINDER COVER COMPLETE WITH STUDS & NUTS INCLUDING VALVE (EXHAUST VALVE FUEL VALVE STARTING VLAVE SAFETY VALVE COMPLETE)		Cr-Mo STEEL	N	1		90101-101		P/NO: 0006-3401T 12-000902
			CARBON STEEL				BOX NO		
			CAST IRON				90801-154		P/NO: 0012-3200T 10-010095
			STAIN-LESS STEEL				BOX NO		
							90910-68		P/NO: 0017-3301T 12-000150
							BOX NO		
						90704-42		P/NO: 0019-3301T 11-013015	
							BOX NO		
							91101-30		P/NO: 0020-3301T 14-001338
								BOX NO	
			4218						
2	O-RING FOR CYLINDER COVER		VITON 70 SH	2N	4		90101-101	126	P/NO: C601S 14-001480
			0.465						BOX NO
3	GASKET BETWEEN CYLINDER COVER AND LINER		MILD STEEL (SPCC-SB)	N	5		90101-101	210	P/NO: C602S 14-001481
			1.15						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0006		Description : CYLINDER COVER COMPLETE					Ident no :		

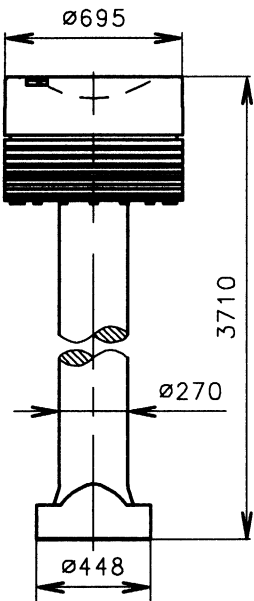
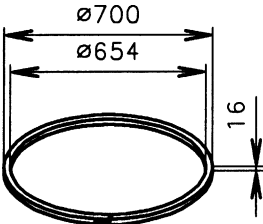
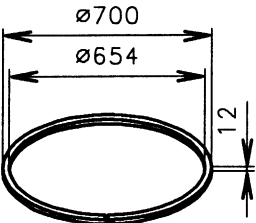
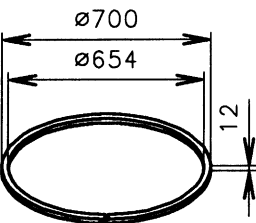


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T (kg)	WORKING	STD	ADD	NO	ITEM NO	
1	STUD FOR CONNECTING ROD		Ni-Cr-Mo STEEL	8N	8		90401-134	509	P/NO: D102S 13-004581
			12.4						BOX NO
2	NUT FOR CONNECTING ROD		CARBON STEEL	8N	8		90401-134	402	P/NO: D101S EN73R60
			2.8						BOX NO
3	BEARING SHELL CROSSHEAD		WHITE METAL + STEEL	N	1		90401-134	260	P/NO: 2503S 10-000413
			164						BOX NO
4	BEARING SHELL CRANKPIN		WHITE METAL + STEEL	N	1		90401-134	343	P/NO: 2504S 10-000414
			95						BOX NO
5	TELESCOPE PIPE		CARBON STEEL TUBE ROLLED STEEL	N	1		90401-134	139	P/NO: 2506S 13-012121
			48						BOX NO
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0008		Description : CONNECTING ROD COMPLETE					Ident no :		

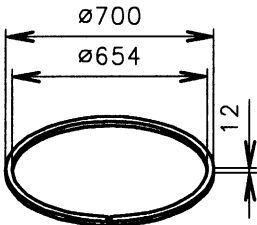
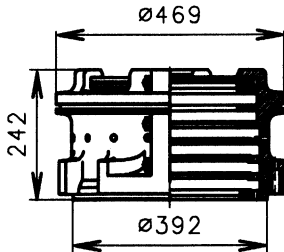
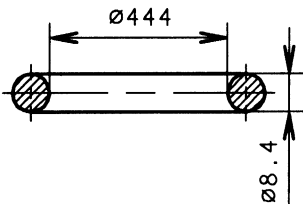
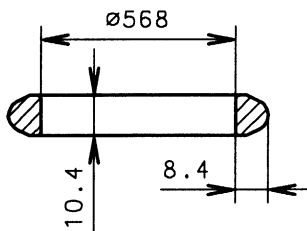
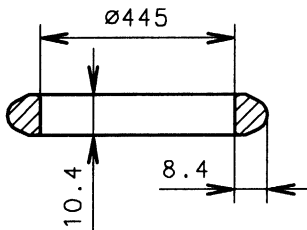


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
				W'T (kg)	WORKING	SPARE		NO	
			STD			ADD			
6	THRUST PIECE		CAST IRON	2N	2		90401-134	331	P/NO: 2603S
			4.8						13-002136
7	HYDR. NUT FOR PISTON ROD & X-HEAD		CARBON STEEL	4N	4		90401-134	235	P/NO: D107S
			0.505						EN73R30
8	STUD FOR PISTON ROD & X-HEAD		Ni-Cr-Mo STEEL	4N	4		90401-134	379	P/NO: D108S
			1.72						13-005019
9	WASHER FOR PISTON ROD & X-HEAD		Cr-Mo STEEL	4N	4		90401-134	318	P/NO: D106S
			0.74						13-012123-008
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0008		Description : CONNECTING ROD COMPLETE					Ident no :		

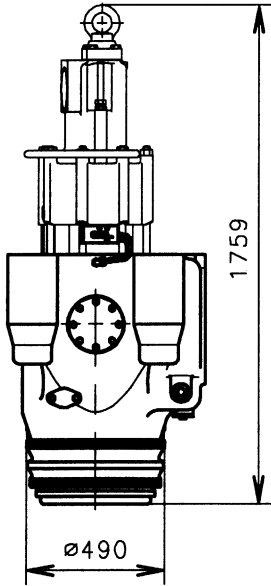
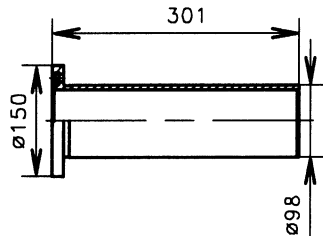
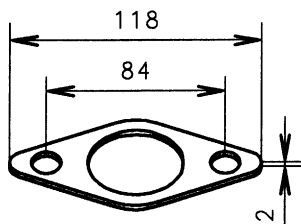
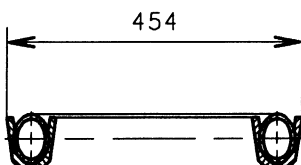


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	STD	ADD	NO	ITEM NO	
1	PISTON COMPLETE WITH PISTON ROD SKIRT AND OTHER ALL FITTINGS (EXCEPT STUFFING BOX & PISTON RINGS)		CAST STEEL CARBON STEEL Cr-Mo STEEL VITON NBR	N	1		90201-181		P/NO: 2401T 2501T 2502T 2701T D602T D603T D102T D103T D901T D104T 11-001913
			2160						BOX NO
2	PISTON RING (TOP)		CAST IRON	N	2		90201-181	072	P/NO: 2503S 12-010223
			6.2						BOX NO
3	PISTON RING (#2)		CAST IRON	N	2		90201-181	084	P/NO: 2504S 13-010608
			4.5						BOX NO
4	PISTON RING (#3)		CAST IRON	N	2		90201-181	096	P/NO: 2505S 13-010607
			4.5						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0010		Description : PISTON COMPLETE					Ident no :		

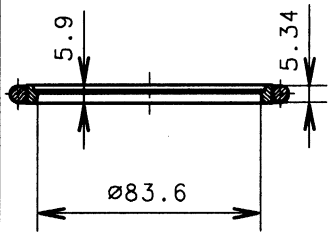
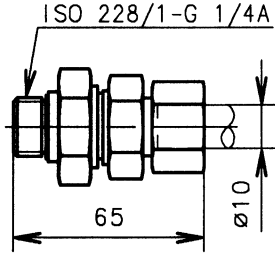
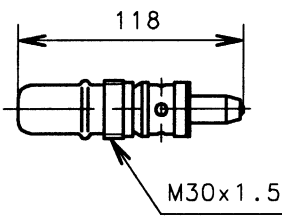
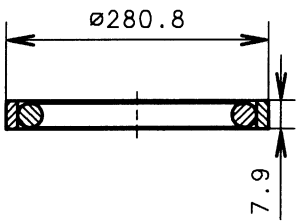
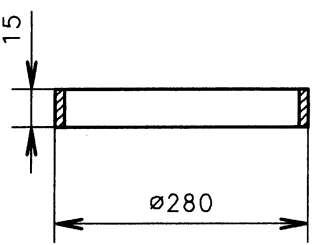


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
5	PISTON RING (#4)		CAST IRON	N	2		90201-181	106	P/NO: 2506S 13-010608
			4.5						BOX NO
6	STUFFING BOX COMPLETE WITHOUT FLANGE		CAST IRON	N	1		90205-91		P/NO: 2201T 12-001983
			BRONZE SPRING STEEL						BOX NO
7	O-RING FOR STUFFING BOX		nbr 70	N	5		90205-91	013	P/NO: D601S 14-001928
			0.095						BOX NO
8	D-RING FOR PISTON CROWN/ PISTON SKIRT		VITON 70 SH	N	2		90201-181	179	P/NO: D602S 13-008804 -015
			0.313						BOX NO
9	D-RING OR PISTON SKIRT/ PISTON ROD		VITON 70 SH	N	2		90201-181	167	P/NO: D603S 13-008804 -020
			0.246						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0010		Description : PISTON COMPLETE					Ident no :		

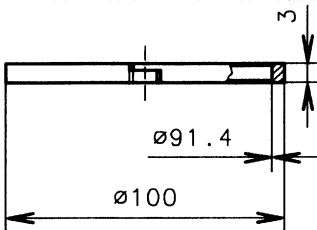
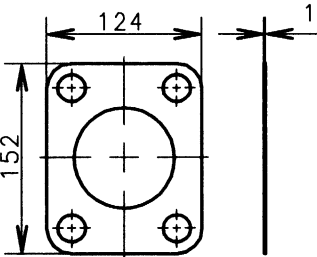
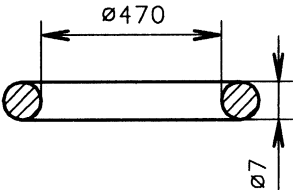


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG		PLATE		REMARK	
			W'T (kg)	WORKING	SPARE		NO		ITEM NO
1	EXHAUST VALVE COMPLETE		CAST IRON	N	2		90801-154		P/NO: 3200S 10-010095 O-RING ON BOTTOM PIPE TO BE SUPPLIED SEPARATELY (REFER TO NO.4,12)
			Ni-Cr STEEL CARBON STEEL VITON						
2	BUSHING IN EXHUST VALVE HOUSING ① -3		CAST IRON (C3)	N	1		90801-154	647	P/NO: 3201S 12-000935
			5.7						
3	PACKING FOR EXHAUST VALVE HOUSING ① -13		JOINT SHEEL (JIC6000)	N	2		90801-154	901	P/NO: 3603S 14-001634
			0.01						
4	O-RING(U-TYPE) FOR BOTTOM PIECE (LOWER) ⑤		MAKER	N	2 + (2)		90801-154	336	P/NO: 3204S 14-010242 () FOR EXH.V/V COMPLETE (REFER TO NO.1)
			0.117						
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0012		Description : EXHAUST VALVE					Ident no :		

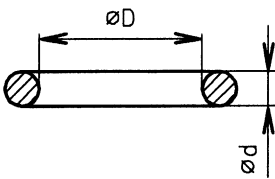


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T (kg)	WORKING	SPARE		NO	ITEM NO	
5	SEALING RING FOR EXHAUST VALVE SPINDLE (11)		TEFLON + VITON (MAKER) 0.022	2N	4		90801-154	611	P/NO: 3206S 14-001532 BOX NO
6	NON-RETURN VALVE FOR SEALING AIR CONTROL UNIT (18) -6		MAKER 0.085	N	2		90802-25	211	P/NO: 3302S EN206A10,105 BOX NO
7	SAFETY VALVE FOR EXHAUST VALVE (21)		STEEL (MAKER) 0.212	N	2		90801-154	419	P/NO: 3301S 14-011835 BOX NO
8	SEALING RING FOR AIR PISTON OF EXHAUST VALVE (24)		TEFLON + VITON (MAKER) 0.08	N	2		90801-154	385	P/NO: 3214S 14-001537 BOX NO
9	SEALING RING FOR AIR PISTON OF EXHAUST VALVE (25)		TEFLON (MAKER) 0.15	N	2		90801-154	373	P/NO: 3215S 14-001538 BOX NO
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0012		Description : EXHAUST VALVE COMPL ---					Ident no :		

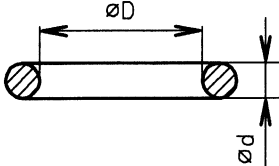


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T (kg)	WORKING	STD	ADD	NO	ITEM NO	
10	PISTON RING FOR EXHAUST VALVE (31)		CAST IRON (MAKER) 0.05	2N	4		90801-154	361	P/NO: 3202S 14-000490 BOX NO
11	PACKING RECTANGLE FOR EXHAUST VALVE (41)		JOINT SHEEL (JIC6000) 0.03	N	2		90801-154	049	P/NO: 3217S 14-001547 BOX NO
12	FOR BOTTOM PIPE (UPPER) (4)		VITON 70 SH 0.132	N	2 + (2)		90801-154	312	P/NO: 3203S 14-001529 () FOR EXH. VALVE COMPLETE (REFER TO NO.1) BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ;	S70MC				HSD - MAN B&W		
MS NO. 0012		Description :	EXHAUST VALVE COMPLETE				Ident no :		

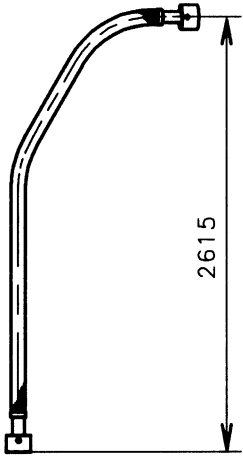
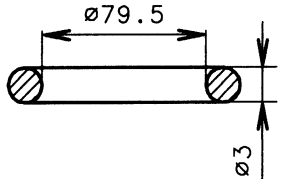


NO	DESCRIPTION	SKETCH		MAT'L	Q'TY/ENG		PLATE		REMARK
				W'T(kg)	WORKING	SPARE	NO	ITEM NO	
	O-RING								
		ØD	Ød						
13	FOR FLANGE OF AIR CYLINDER (10)	129.3	5.7	VITON 70 SH 0.014	N	2	90801-154	576	P/NO: 3205S EN17Q6130 BOX NO
14	FOR BETWEEN HOUSING & AIR CYLINDER (14)	189.3	5.7	VITON 70 SH 0.035	N	2	90801-154	564	P/NO: 3207S 14-001533 BOX NO
15	FOR SEALING AIR CONTROL UNIT (18) -1-5	22.5	3	VITON 70 0.001	N	2	90801-154	260	P/NO: C601S EN17R323 BOX NO
16	FOR SEALING AIR CONTROL UNIT (18) -1-6	7.3	2.4	VITON 70 0.005	N	2	90802-25	235	P/NO: 3208S 14-000725 BOX NO
17	FOR SEALING AIR CONTROL UNIT (18) -1-7	5.3	2.4	VITON 70 SH 0.001	2N	4	90802-25	093 020	P/NO: 3209S 14-001224 BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0012		Description : EXHAUST VALVE					Ident no :		

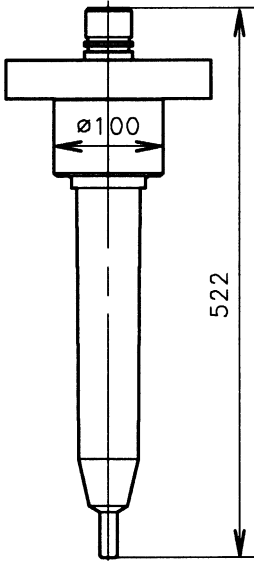
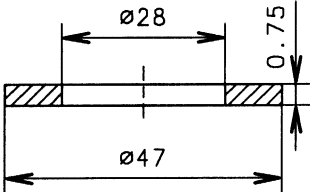


NO	DESCRIPTION	SKETCH		MAT'L	Q'TY/ENG			PLATE		REMARK
				W'T(kg)	WORKING	SPARE		NO	ITEM NO	
						STD	ADD			
	O-RING									
		øD	d							
18	FOR SEALING AIR CONTROL UNIT (18) -1-8	16.3	2.4	VITON 70 SH	N	2		90802-25	103	P/NO: 3210S 14-001225
	0.01			BOX NO						
19	FOR SAFETY VALVE (20)	23.3	2.4	VITON 70 SH	N	2		90801-154	407	P/NO: 3212S 14-001233
	0.001			BOX NO						
20	FOR PISTON (23)	84.1	5.7	VITON 70 SH	N	2		90801-154	887	P/NO: 3213S 14-001536
	0.014			BOX NO						
21	FOR OIL CYLINDER (36)	326	5.7	NBR 70	N	2		90801-154	481	P/NO: C602S 14-001542
	0.034			BOX NO						
22	FOR ROD LIFT (40) -4	9	2	NBR 70	N	2		90801-154	826	P/NO: 3216S 14-001247
	0.001			BOX NO						
SPARE		TYPE ; S70MC							HSD - MAN B&W	
MS NO. 0012		Description : EXHAUST VALVE							Ident no :	



NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
23	HYDRAULIC PIPE COMPLETE FOR EXHASUT VALVE DRIVING		STEEL PIPE CARBON STEEL	N	1		90806-61	237	P/N0: AA21-0100T 12-001365
			62						
24	O-RING FOR HYDRAULIC PIPE COMPLETE		VITON	4N	8		90806-61	022	P/N0: AA21-0200S EN17M380
			0.002						
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0012		Description : EXHAUST VALVE COMPLETE					Ident no :		

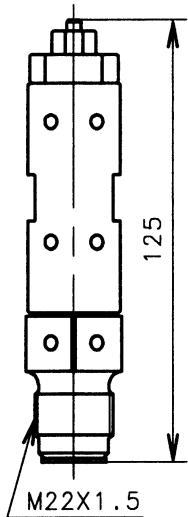
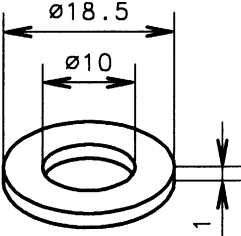


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	STD	ADD	NO	ITEM NO	
1	FUEL VALVE COMPLETE		SPECIAL STEEL	2N	10		90910-128		P/NO: 3301T 12-013473
			RUBBER 14.778						
2	DISC		STEEL		7		90910-128	950	P/NO: 3309S 14-013688
			0.01						
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0017		Description : FUEL VALVE COMPLETE					Ident no :		

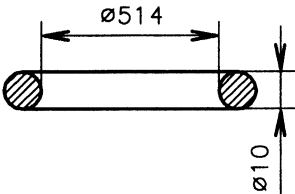
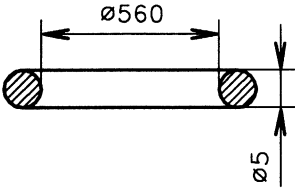
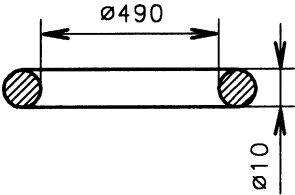


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	STARTING AIR VALVE COMPLETE		STAIN- LESS STEEL CARBON STEEL BRONZE SPRING STEEL	N	1		90704-42		P/NO: 3301T 11-013015 O-RING TO BE SUPPLIED SEPARATELY (REFER TO NO.2)
			57.6						BOX NO
2	O-RING FOR STARTING VALVE		SILICONE -RUBBER	N	2 + (1)		90704-42	148	P/NO: 3302S EN17L6105 ()FOR NO.1
			0.011						BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0019		Description : STARTING AIR VALVE					Ident no :		



NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	SAFETY VALVE COMPLETE		STAIN- LESS STEEL	N	1		91101-30		P/NO: 3301T 14-001338 O-RING TO BE SUPPLIED SEPARATELY (REFER TO NO.2)
			CARBON STEEL						
			0.386						BOX NO
2	PACKING BETWEEN SAFETY VALVE AND CYLINDER COVER		MILD STEEL (SPCC-SB)	N	2 + (1)		91101-30	105	P/NO: 3302S 14-001342 ()FOR NO.1
			0.002						BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0020		Description : SAFETY VALVE COMPLETE					Ident no :		

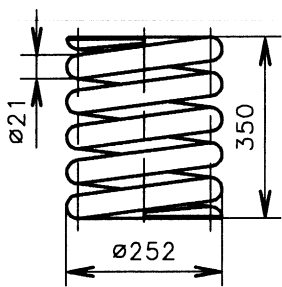
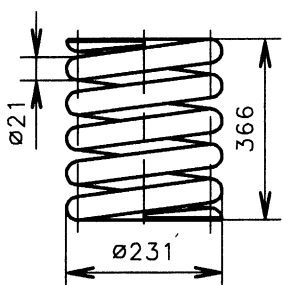
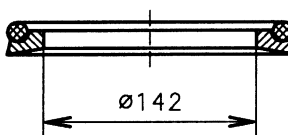
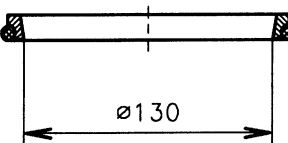
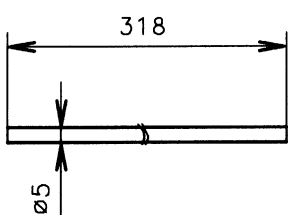


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	CAMSHAFT		NBR	2N-2	4		90611-109	058	P/NO: C601S 14-000238
			0.18						
2	CAMSHAFT		NBR	2N-2	4		90611-109	129	P/NO: C602S 14-000239
			0.05						
3	CAMSHAFT		NBR	1	1		90611-109	154	P/NO: C603S 14-000243
			0.1						
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0029		Description : CAMSHAFT					Ident no :		

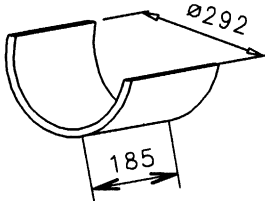
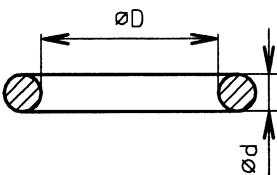


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	VALVE GEAR COMPLETE		SPECIAL STEEL	N	1		90805-88	160 172 184 302 314 389 390	P/NO: 3203T 11-002989
			CAST IRON						
			RUBBER						
			155.535						BOX NO
2	ROLLER FOR EXHAUST ROLLER GUIDE		Ni-Cr STEEL	N	1		90805-88	088 111 123 040 052 064	P/NO: 3207T 14-001385
			CAST IRON						
			TIN-BRONZE						
			32.68						BOX NO
3	ROLLER FOR FUEL ROLLER GUIDE		Ni-Cr STEEL	N	1		90902-130	036 048 085 097 107 119	P/NO: 3208T 14-001387
			CAST IRON						
			AL-BRONZE						
			32						BOX NO
4	PISTON RING FOR VALVE GEAR		CAST IRON	2N	4		90805-88	172	P/NO: 3204S 14-000490
			0.05						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0030		Description : FUEL AND EXHAUST GEAR					Ident no :		

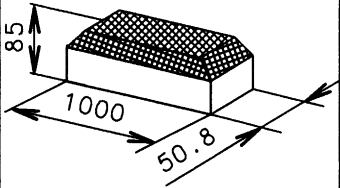
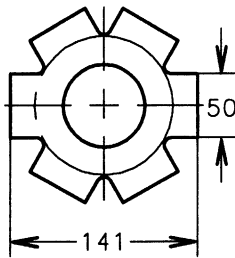


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
5	SPRING FOR FUEL PUMP ROLLER GUIDE		SPRING STEEL	N	1		90902-130	587	P/NO: 3209S 14-000495
			15						
6	SPRING FOR EXHAUST VALVE ROLLER GUIDE		SPRING STEEL	N	1		90805-88	196	P/NO: 3211S 14-000496
			12.5						
7	SCRAPER RING -AXIAL FOR CAP		TEFLON VITON (MAKER)	N	2		90902-130	418	P/NO: 3404S 14-000511
			0.01						
8	SCRAPER RING FOR UMBRELLA CAP		TEFLON VITON (MAKER)	N	2		90902-130	443	P/NO: 3405S 14-000512
			0.01						
9	RUBBER RING FOR CAMSHAFT COVER		NBR	2N-2	4		90613-81	072	P/NO: 3701S 14-000516
			0.12						
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0030		Description : FUEL AND EXHAUST GEAR					Ident no :		

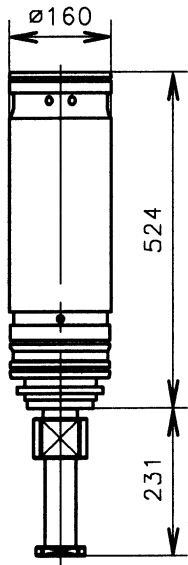
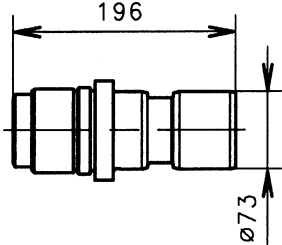
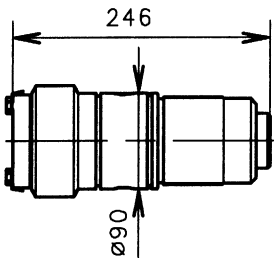
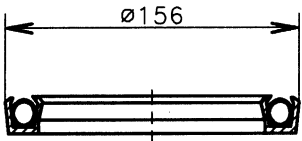


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
10	BEARING SHELL FOR CAMSHAFT		CABRBON STEEL WHITE METAL (MAKER)	N	1		90613-81	214	P/NO: 3403S 10-000207
			5.4						
	O-RING								
			ØD						
11	FOR CAP	104.5	5.7	VITON	N	2	90902-130	372	P/NO: 3212S EN17Q6105
				0.021					
12	FOR LIFTING DEVICE	89.5	5.7	SIR	N	2	90903-24	102	P/NO: 3202S EN17L690
				0.01					
13	FOR PUNCTURE VALVE	29.5	3	NBR	N	2	90805-88	401	P/NO: 3214S EN17M330
				0.001					
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0030		Description : FUEL AND EXHAUST GE					Ident no :		

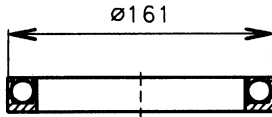
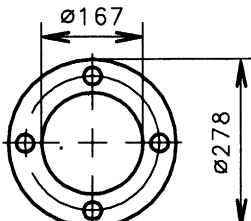
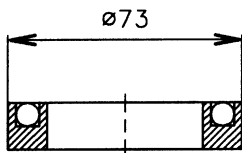
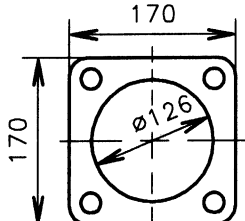
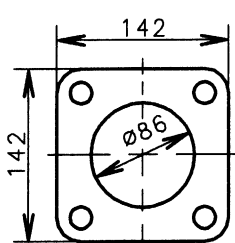


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	STD	ADD	NO	ITEM NO	
1	GUIDE BAR		SS400 + NBR	4	2		90601-98	232	P/NO: 2601S 11-001238
			22						BOX NO
2	LOCKING PLATE	2T 	SPCC-A	2	2		90603-100	316	P/NO: D190S 14-004246
			0.18						BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0032		Description : CHAIN DRIVE LOWER P.D.T					Ident no :		

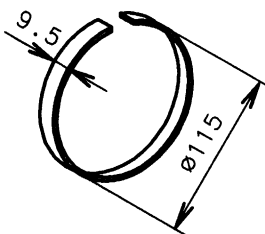
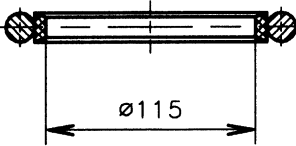
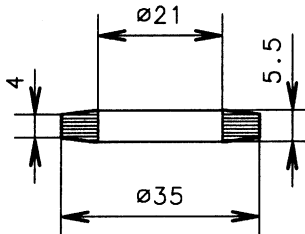
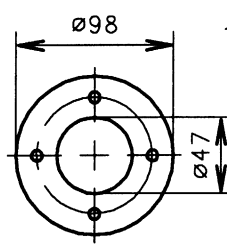
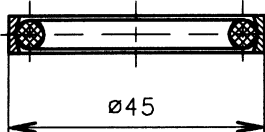


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	PUMP BARREL COMPLETE WITH PLUNGER		SPECIAL STEEL STEEL RUBBER	N	1		90901-158	448	P/NO: 3201T 12-000235
			74.6						BOX NO
2	SUCTION VALVE COMPLETE		SPECIAL STEEL	N	1		90901-158	377	P/NO: 3202T 13-000674
			5.95						BOX NO
3	PUNCTURE VALVE COMPLETE		SPECIAL STEEL SPRING STEEL	N	1		90901-158	532	P/NO: 3203T 13-002329
			12						BOX NO
4	SEALING RING OF PUMP BARREL FOR FUEL PUMP		SPECIAL RUBBER	2N	4		90901-158	664	P/NO: 3205S 14-000252
			0.013						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0036		Description : FUEL PUMP					Ident no :		

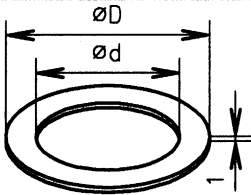


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG		PLATE		REMARK	
			W'T (kg)	WORKING	SPARE		NO		ITEM NO
					STD	ADD			
5	SEALING RING OF PUMP BARREL		SPECIAL RUBBER	N	2		90901-158	424	P/NO: 3206S 14-000253
			0.013						BOX NO
6	PACKING FOR TOP COVER	 PCD: 224	MAKER	N	2		90901-158	029	P/NO: 3207S 13-000673
			0.03						BOX NO
7	SEALING RING OF SUCTION VALVE		SPECIAL RUBBER	N	2		90901-158	400	P/NO: 3208S 14-001473
			0.01						BOX NO
8	PACKING -RECTANGLE FOR SHOCK ABSORBER	 PCD: 184	MAKER	N	2		90904-24	121	P/NO: 3209S 14-001475
			0.02						BOX NO
9	PACKING -RECTANGLE FOR SHOCK ABSORBER	 PCD: 145	MAKER	N	2		90904-24	170	P/NO: 3210S 14-000376
			0.02						BOX NO
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0036		Description : FUEL PUMP					Ident no :		

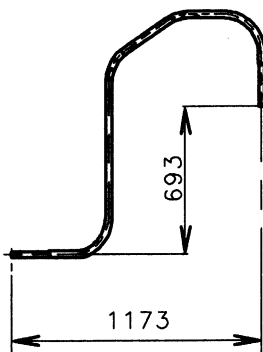
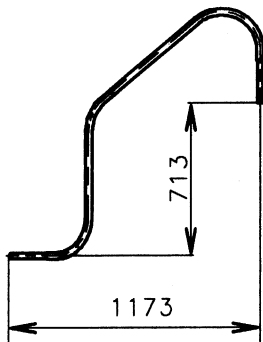
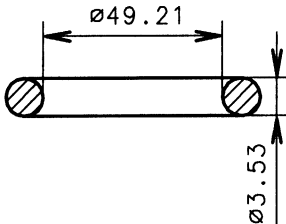
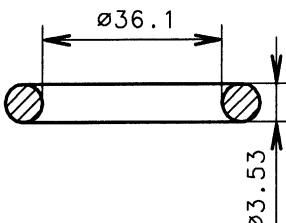


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
10	WEARING FOR SHOCK ABSORBER		MAKER	N	2		90904-24	194	P/NO: 3211S
			0.02						BOX NO
11	SEALING RING OF SHOCK ABSORBER		MAKER	N	2		90904-24	133	P/NO: 3212S
			0.05						BOX NO
12	FELT SEAL FOR TOOTHED BAR		FELT	2N	4		90904-24	348	P/NO: 3214S
			0.1						BOX NO
13	PACKING FOR PUNCTURE VALVE		JIC6000	N	2		90901-158	556	P/NO: 3215S
			0.02						BOX NO
14	SEALING RING FOR PUNCTURE VALVE		SPECIAL STEEL	N	2		90901-158	519	P/NO: 3216S
			0.1						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0036		Description ; FUEL PUMP					Ident no :		

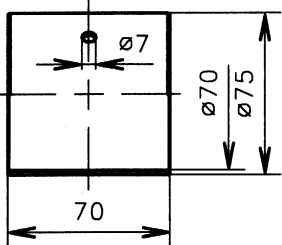
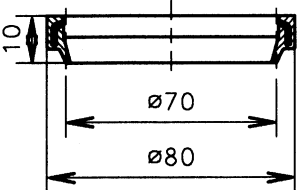


NO	DESCRIPTION	SKETCH		MAT'L	Q'TY/ENG			PLATE		REMARK	
				W'T(kg)	WORKING	SPARE		NO	ITEM NO		
						STD	ADD				
	PACKING										
		øD	ød								
17	PACKING FOR PLUG SCREW OF HOUSING	61	73	MAKER	3N	6		90901-158	042	P/NO: 3204S	
				0.002						14-000248	
										BOX NO	
18	PACKING FOR BOTTOM FLANGE OF SHOCK ABSORBER	23	13	MAKER	N	2		90904-24	049	P/NO: C601S	
				0.001						EN14AJ1323	
										BOX NO	
19	PACKING FOR GUIDE SCREW OF HOUSING	41	28	SPCC-A	N	2		90901-158	174	P/NO: 3213S	
				0.001						14-000393	
										BOX NO	
20	PACKING FOR CIROUATION ORIFICE OF HOUSING	41	28	SPCC-A	N	2		90901-158	652	P/NO: 3219S	
				0.005						14-000393	
										BOX NO	
SPARE		TYPE : S70MC							HSD - MAN B&W		
MS NO. 0036		Description : FUEL PUMP							Ident no :		

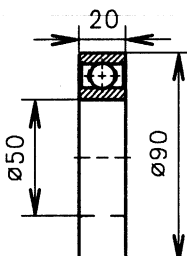
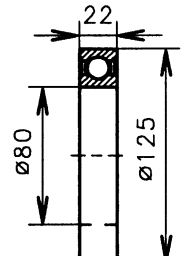
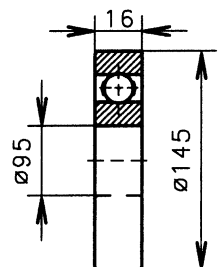
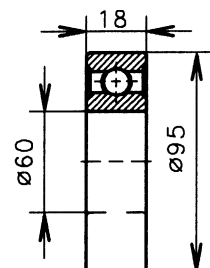
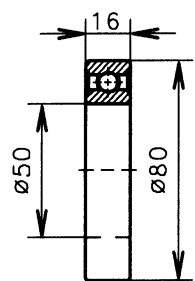


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
1	FUEL OIL HIGH PRESSURE PIPE COMPLETE		STEEL STEEL PIPE	N	1		90913-89	012	P/NO: EF20-0100T 11-001391
			16.57					BOX NO	
2	FUEL OIL HIGH PRESSURE PIPE COMPLETE		STEEL STEEL PIPE	N	1		90913-89	132	P/NO: EF20-0200T 11-001355
			16.57					BOX NO	
3	FOR F.O HIGH PRESSURE PIPE		VITON	2N	10		90913-89	119	P/NO: AA20-0103S 13-003300
			0.002					BOX NO	
4	FOR F.O HIGH PRESSURE PIPE		VITON	2N	8		90913-89	097	P/NO: AA20-0106S 13-003297
			0.001					BOX NO	
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0037		Description : FUEL OIL HIGH PRESS. PIPE					Ident no :		

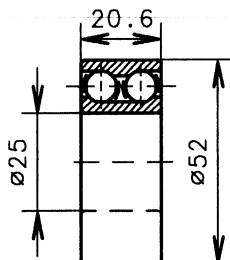
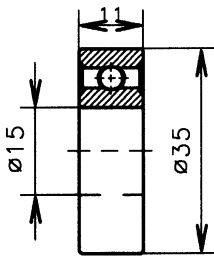
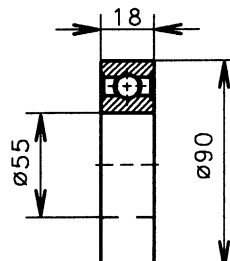
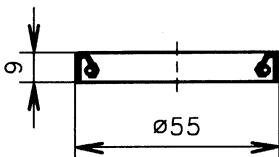


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	BUSHING FOR REGULATING SHAFT		MAKER	N	1		90618-92	259	P/NO: 3302S 14-003827
			0.3						BOX NO
2	SEALING RING FOR BRACKET		MAKER	2N	4		90618-92	260	P/NO: 3303S 14-003829
			0.02						BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0040		Description : REGULATING SHAFT					Ident no :		

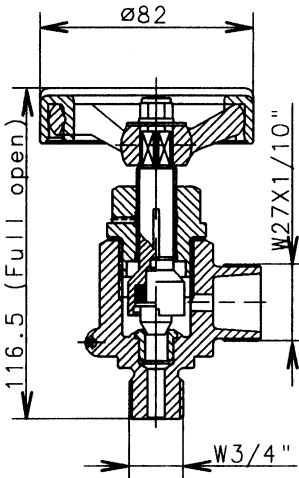
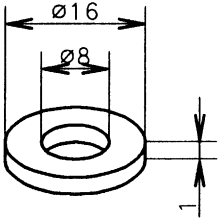
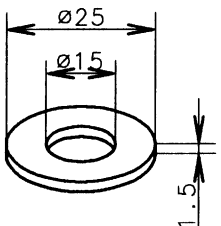
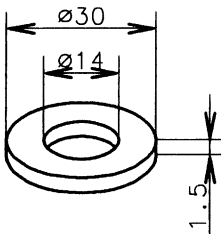


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK	
			W'T(kg)	WORKING	SPARE		NO	ITEM NO		
					STD	ADD				
1	BALL BEARING FOR EMERGENCY CONSOLE TYPE: 6210-2Z		STEEL (MAKER)	1	1		90622-53	191	P/NO: C201S 1-22	
			0.46						BOX NO	
2	BALL BEARING FOR EMERGENCY CONSOLE TYPE: 6016-2Z		STEEL (MAKER)	1	1		90622-53	404	P/NO: C202S 1-23	
			0.85						BOX NO	
3	BALL BEARING FOR EMERGENCY CONSOLE TYPE: 16019		STEEL (MAKER)	1	1		90622-53	548	P/NO: C203S 1-29	
			0.89						BOX NO	
4	BALL BEARING FOR EMERGENCY CONSOLE TYPE: 6012-2RS1		STEEL (MAKER)	1	1		90622-53	740	P/NO: C204S 1-32	
			0.42						BOX NO	
5	BALL BEARING FOR EMERGENCY CONSOLE TYPE: 6010-2RS1		STEEL (MAKER)	1	1		90622-53	918	P/NO: C205S 1-36	
			0.26						BOX NO	
SPARE		TYPE : S70MC					HSD - MAN B&W			
MS NO. 0045		Description : EMERGENCY CONSOLE					Ident no :			

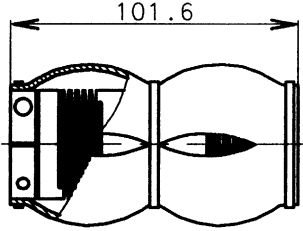
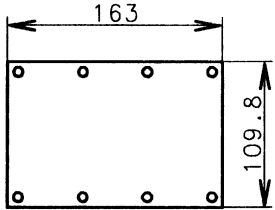


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T (kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
6	BALL BEARING FOR EMERGENCY CONSOLE TYPE : 3205		STEEL (MAKER)	1	1		90622-53	249	P/NO; C206S 1-66
			0.19						BOX NO
7	BALL BEARING FOR EMERGENCY CONSOLE TYPE : 6202-2RS1		STEEL (MAKER)	1	1		90622-53	859	P/NO; C207S 1-72
			0.045						BOX NO
8	BALL BEARING FOR EMERGENCY CONSOLE TYPE : 6011-2RS1		STEEL (MAKER)	2	1		90621-60	088	P/NO; C208S 1-75
			0.39						BOX NO
9	SEALING RING FOR EMERGENCY CONSOLE		RUBBER SPRING STEEL (MAKER)	2	1		90622-53	262	P/NO; C601S 14-001719
			0.1						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0045		Description : EMERGENCY CONSOLE					Ident no :		

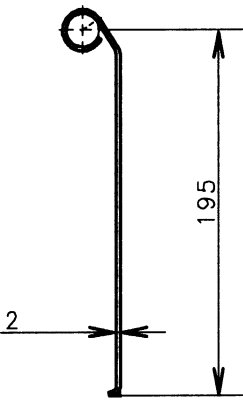


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK	
			W'T (kg)	WORKING	SPARE		NO	ITEM NO		
					STD	ADD				
1	INDICATOR VALVE		CARBON STEEL	N	2		90612-45	232	P/NO: 3602S	
			SPRING STEEL						13-001917	
			SAIN-LESS STEEL							
			0.8						BOX NO	
2	PACKING FOR INDICATOR VALVE		COPPER (C1221P)	N	2		90612-45	220	P/NO: C603S	
									14-001318	
			0.002						BOX NO	
3	PACKING FOR INDICATOR VALVE		MILD STEEL (SPCC-A)	N	2		90612-45	197	P/NO: C601S	
									14-001317	
			0.1						BOX NO	
4	PACKING FOR INDICATOR VALVE		MILD STEEL (SPCC-A)	N	2		90612-45	016	P/NO: C602S	
									14-001316	
			0.1						BOX NO	
SPARE		TYPE ; S70MC					HSD - MAN B&W			
MS NO. 0054		Description : INDICATOR VALV					Ident no :			

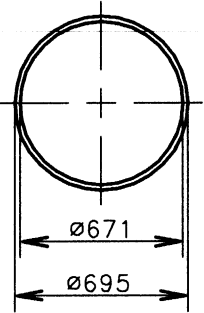
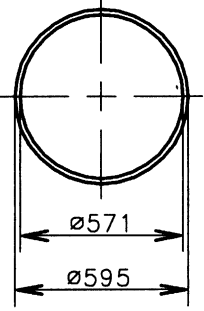
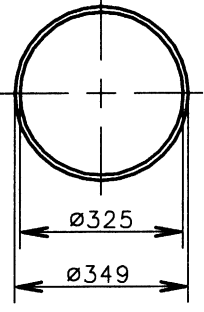
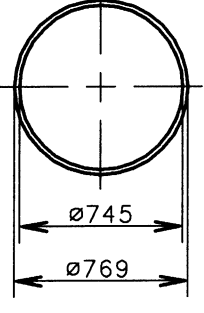
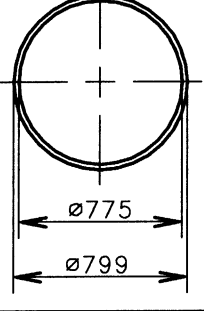


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	STD	ADD	NO	ITEM NO	
5	HELICAL FLEXBLE SHAFT COUPLING FOR ENCODER		MAKER	1	1				P/NO: 3304S 13-016926
			0.286						BOX NO
6	PACKING FOR ENCODER		NON-ASBESTOS	1	1		90618-117	499	P/NO: 3304S 13-013962
			0.03						BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0054		Description : INDICATOR VALV					Ident no :		

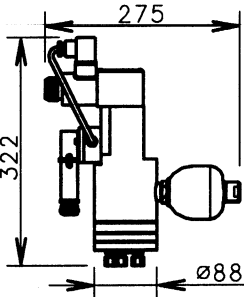
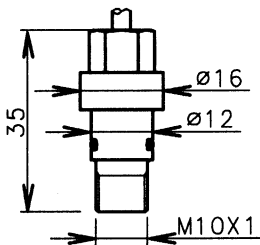
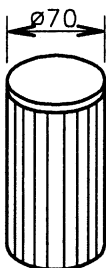
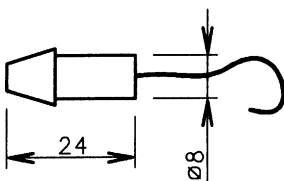


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	VALVE FLAP		SUS304	N	2		91001-43	257	P/NO: 4203S
			1.2						13-000513
									BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0056		Description : SCAV.AIR RECEIVER					Ident no :		

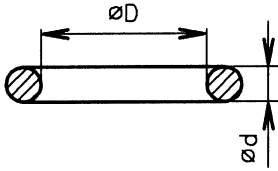


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T (kg)	WORKING	STD	ADD	NO	ITEM NO	
1	PACKING -EXHAUST GAS. FOR EXH.GAS.REC. MANHOLE		STAINLESS -STEEL	1	1				P/NO: G625S 14-001819
			0.4						BOX NO
2	PACKING -EXHASUT GAS FOR EXH.GAS RECEIVER INLET COMPENSATOR		STAINLESS -STEEL	5	2				P/NO: G621S 14-002801
			0.4						BOX NO
3	PACKING -EXHASUT GAS FOR EXH.RECEIVER INLET COMPENSATOR		STAINLESS -STEEL	5	2				P/NO: G622S 14-002802
			0.4						BOX NO
4	PACKING -EXHASUT GAS FOR T/C INLET COMPENSATOR		STAINLESS -STEEL	1	1				P/NO: G623S 14-010988
			0.4						BOX NO
5	PACKING -EXHASUT GAS FOR GAS INLET BOLTED CONN.		STAINLESS -STEEL	2	1				P/NO: G624S 14-010989
			0.4						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0057		Description : EXHAUST RECEIVER					Ident no :		

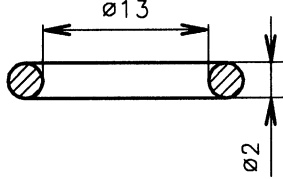
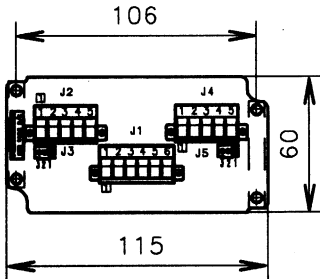


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG		PLATE		REMARK	
			W'T(kg)	WORKING	SPARE		NO		ITEM NO
					STD	ADD			
1	LUBRICATOR		MAKER	2N	2		90307-04	199	P/NO: 3202T 10-011358
			9.7						BOX NO
2	INDUCTIVE SENSOR FOR LUBRICATOR		MAKER	2N	2		90307-04	378	P/NO: 3203S 13-012613
			0.042						BOX NO
3	FILTER FOR BOOSTER PUMP		MAKER	2	2		SPARE KIT FOR BOOSTER PUMP		P/NO: 3215S EN17M375
			0.1						BOX NO
4	FILTER FOR BOOSTER PUMP		MAKER	2	2		SPARE KIT FOR BOOSTER PUMP		P/NO: 3214S EN17M390
			0.1						BOX NO
5	LIGHT EMITTING DIODE LUBRICATOR TERMINAL BOX	 CABLE : 150mm		2N	2		SPARE KIT FOR TERMINAL BOX		P/NO: 3204S 13-014943
			0.022						BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0063		Description : CYLINDER LUBRICATOR					Ident no :		

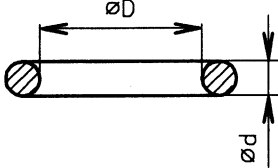
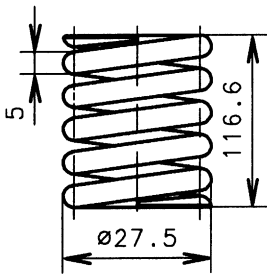


NO	DESCRIPTION	SKETCH		MAT'L	Q'TY/ENG			PLATE		REMARK
				W'T(kg)	WORKING	STD	ADD	NO	ITEM NO	
	O-RING									
		ØD	Ød							BOX NO
6	FOR INDUCTIVE SENSOR	9	1.5	VITON	2N	4		90307-04	366	P/NO: 3209S 14-011614
				0.005						BOX NO
7	FOR LUBRICATOR	61.6	2.62	VITON	2N	4		90307-04	570	P/NO: 3210S 14-011339
				0.002						BOX NO
8	FOR LUBRICATOR	10	2	VITON	2N	4		90307-04	594	P/NO: 3211S 14-011340
				0.003						BOX NO
9	FOR LUBRICATOR	15	1.5	VITON	16N	32		90307-04	474	P/NO: 3212S 14-011337
				0.003						BOX NO
SPARE		TYPE ; S70MC							HSD - MAN B&W	
MS NO. 0063		Description : CYLINDER LUBRICATOR							Ident no :	

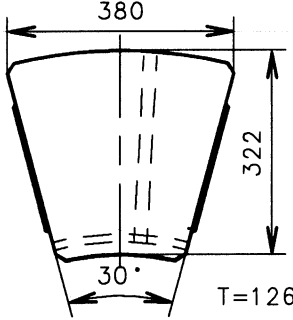


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
10	BETWEEN LUBRICATOR & BLOCK		VITON	4N	8		90307-04	295	P/NO: 3213S 14-011343
			0.001						BOX NO
11	PRINTED CIRCUITBOARD			N	1				P/NO: 3206S 13-017176
			0.104						BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0063		Description : CYLINDER LUBRICATOR					Ident no :		

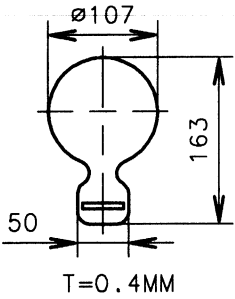


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
	O-RING								
		øD ød							BOX NO
1	FOR BY-PASS VALVE OF F.O RETURN PIPE LINE	34.5 3.0	SPECIAL RUBBER	2	1		90915-19		P/NO: AP51-2415S EN17R345
									BOX NO
2	FOR BY-PASS VALVE OF F.O RETURN PIPE LINE	44.5 3.0	SPECIAL RUBBER	2	1		90915-19	086	P/NO: AP51-2416S EN17R335
									BOX NO
3	SPRING FOR BY-PASS VALVE		SWO-V	1	1		90915-19	037	P/NO: AM51-2403S 123-5001161
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0070		Description : FUEL OIL PIPING					Ident no :		

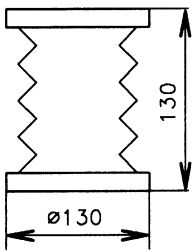


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	THRUST BEARING SEGMENT		CAST IRON + WHITE METAL	15	7				P/NO: 1502S 11-001311
				1	1				P/NO: 1503S 11-001310
			83						
									BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0071		Description : THRUST BEARING					Ident no :		

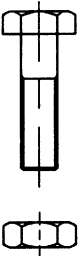


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	BURSTING DISC FOR BURSTING CAP		COPPER PLATE	N	2		91104-46	174	P/N0: AV60-0001S 13-001281
			0.01						BOX NO
									BOX NO
									BOX NO
									BOX NO
									BOX NO
									BOX NO
									BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0076		Description : VARIOUS PIPE-CYL.CO					Ident no :		

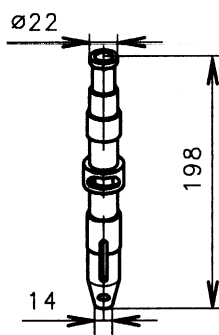
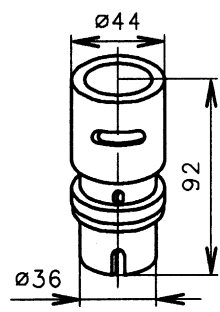
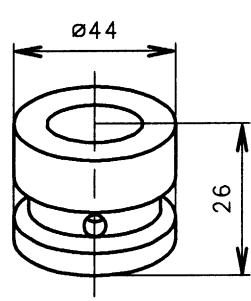
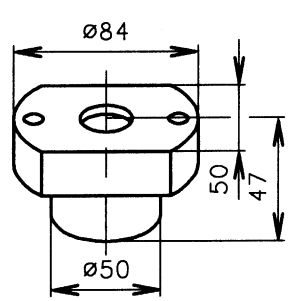
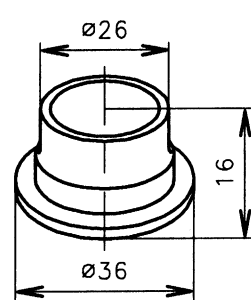


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	FLEXIBLE JOINT FOR COOLING FRESH WATER PIPE		SUS304	N	1		90810-35	252	P/NO: AX70-0100S 13-007742
									BOX NO
									BOX NO
									BOX NO
									BOX NO
									BOX NO
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SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0079		Description : FRESHQATER PIPE-OUTLET					Ident no :		

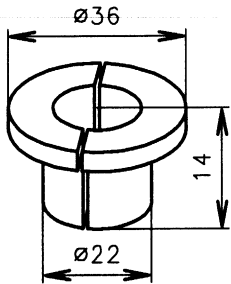
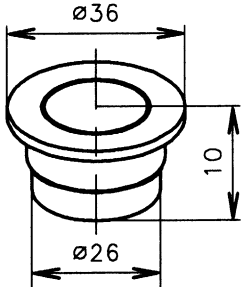
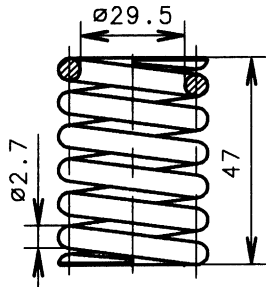
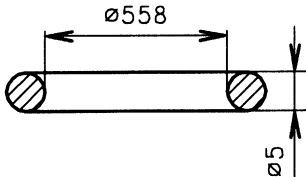
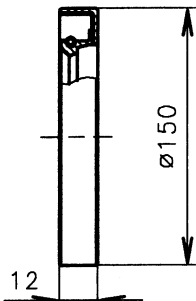


NO	DESCRIPTION	SKETCH		MAT'L	Q'TY/ENG			PLATE		REMARK
				W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	BOLT & NUT OF EACH SIZE		M10X30			EACH 20				
			M12X40							
			M16X50							
			M20X60							
			M24X75							
			M30X90							BOX NO
										BOX NO
										BOX NO
										BOX NO
SPARE		TYPE ; S70MC							HSD - MAN B&W	
MS NO. 0083		Description : BOLT & NUT							Ident no :	

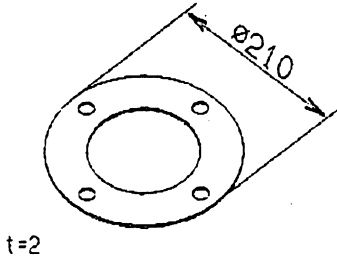
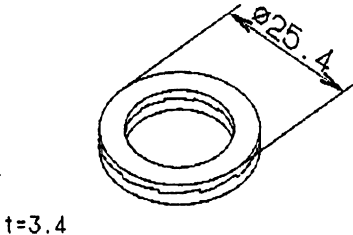
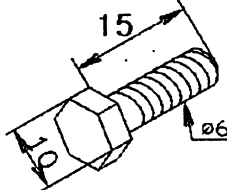
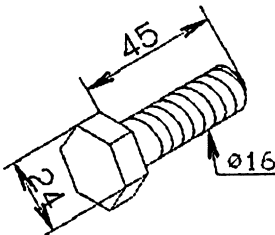
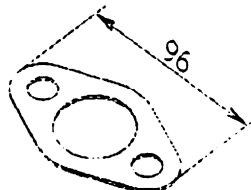


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
1	PISTON VALVE (2)		STAINLESS STEEL 0.36	N	1		90703-79	010	P/NO: 3205T 13-003707 BOX NO
2	SLEEVE (4)		LBC2 0.57	N	1		90703-79	022	P/NO: 3206S 13-003594 BOX NO
3	SLEEVE (5)		LBC2 0.3	N	1		90703-79	250	P/NO: 3207S 14-002423 BOX NO
4	DISC SPECIAL (6)		SS400 0.3	N	1		90703-79	201	P/NO: 3208S 13-003599 BOX NO
5	DISC SPECIAL (7)		SS400 0.048	N	1		90703-79	249	P/NO: 3209S 14-002424 BOX NO
SPARE		TYPE ; S70MC					HSD - MAN B&W		
MS NO. 0098		Description : STARTING AIR DISTRIBUTOR					Ident no :		

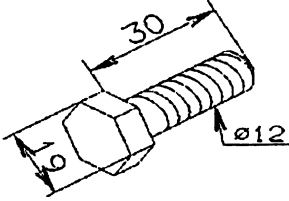
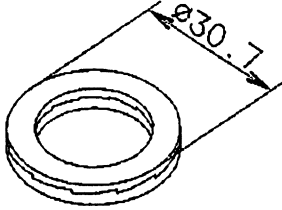
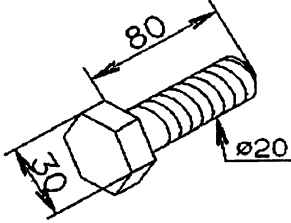
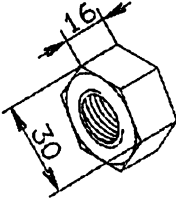
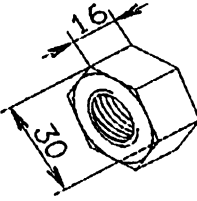
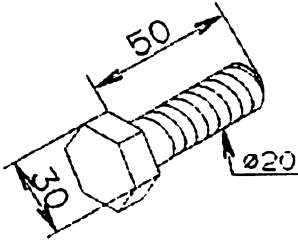


NO	DESCRIPTION	SKETCH	MAT'L	Q'TY/ENG			PLATE		REMARK
			W'T(kg)	WORKING	SPARE		NO	ITEM NO	
					STD	ADD			
6	SLEEVE - CYLINDER WITH COLLAR 8		SS400	N	1		90703-79	213	P/NO: 3210S 14-002425
			0.036						
7	DISC SPECIAL 9		SS400	N	1		90703-79	225	P/NO: 3211S 14-002426
			0.036						
8	PRESSURE SPRING (RIGHT-H) 12		SPRING STEEL	N	1		90703-79	237	P/NO: 3212S 13-003600
			0.03						
9	O-RING FOR BEARING BRACKET 28		NBR	1	1		90705-08	118	P/NO: 3213S 14-003876
			0.1						
10	SEALING RING 30		MAKER	1	1		90705-08	060	P/NO: 3214S 14-002430
			0.1						
SPARE		TYPE : S70MC					HSD - MAN B&W		
MS NO. 0098		Description : STARTING AIR DISTRIBUTOR					Ident no :		

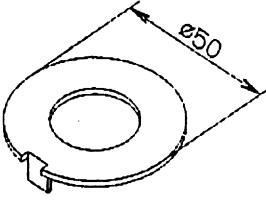
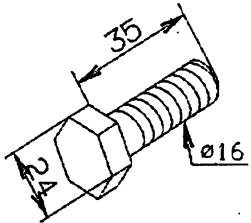
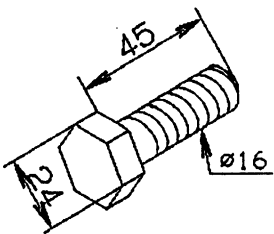
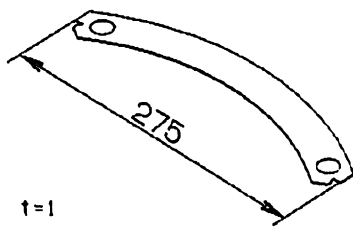
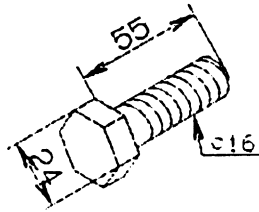


SAMSUNG-MAN B&W		SPARE PART LIST NA - 70		Ship No	
				Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
506.027 -	Dichtung Gasket		1		
506.056 506.237 509.015 513.014 513.024 546.074	Keil-Sicherungsscheibe Thrust washer		66		
506.061	Sechskantschraube Hex. head screw		24		
506.066 513.013	Sechskantschraube Hex. head screw		10		
506.071	Dichtung Gasket		1		

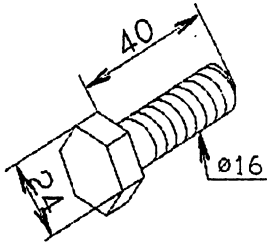
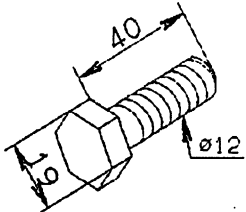
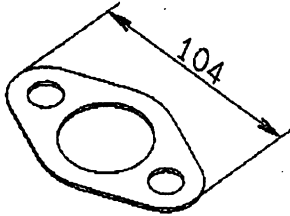
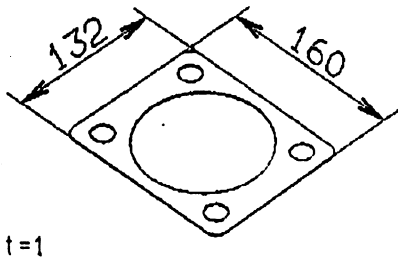
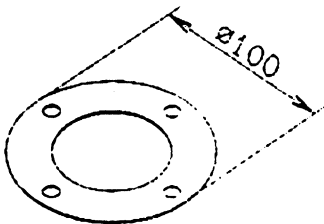


SAMSUNG-MAN B&W		SPARE PART LIST	Ship No
		NA - 70	Engine No
Order No	Name	Sketch (Mass-kg)	Quantity
506.073	Sechskantschraube Hex. head screw		2
506.100 506.231 544.202 546.099	Keil-Sicherungsscheibe Thrust washer		94
506.102	hex. head screw		12
506.104	Sechskantmutter Hex. nut		6
506.105	hex. nut		12
506.106	Sechskantschraube Hex. head screw		12

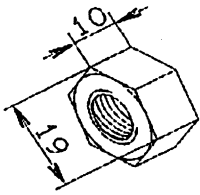
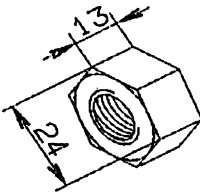
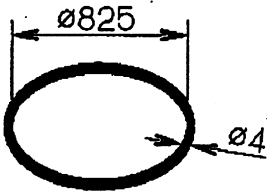
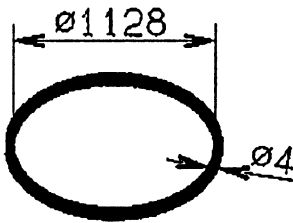
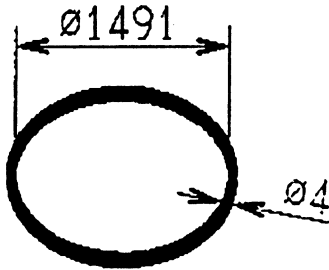


SAMSUNG-MAN B&W		SPARE PART LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
506.233 -	Sicherungsblech Lock washer			2	
509.012	Sechskantschraube Hex. head screw			3	
509.013	Sechskantschraube Hex. head screw			6	
509.016	Sicherungsblech Lock washer			3	
513.012	Sechskantschraube Hex. head screw			6	

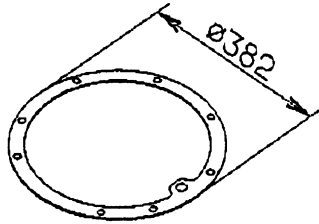
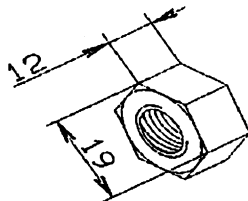
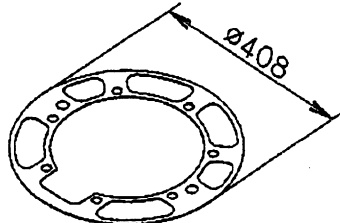
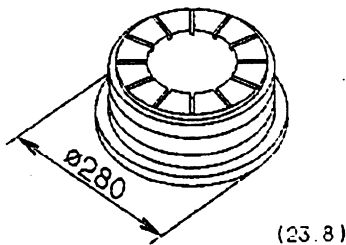
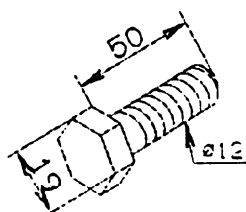


SAMSUNG-MAN B&W		SPARE PART LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
513.022	Sechskantschraube Hex. head screw			6	
517.024	Sechskantschraube Hex. head screw			4	
517.025	Dichtung, oval Gasket, oval			4	
517.026	Dichtung Gasket			1	
517.027	Dichtung Gasket			1	

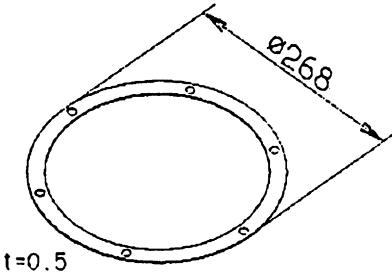
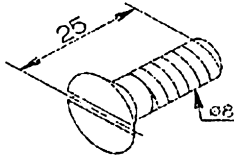
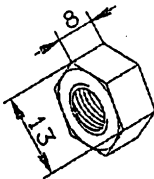
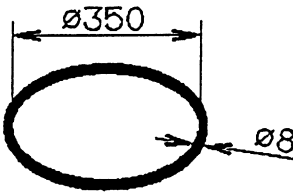
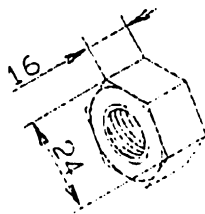


SAMSUNG-MAN B&W		SPARE PART LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
517.039 -	Sechskantmutter Hex. nut			8	
517.040	Sechskantmutter Hex. nut			4	
517.061	Runddichtring O-ring seal			1	
517.062	Runddichtring O-ring seal			1	
517.063	Runddichtring O-ring seal			1	



SAMSUNG-MAN B&W		SPARE PART LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
517.066 -	Dichtring, turbineseitig Sealing ring, turbine side		1		
517.068	Sechskantmutter Hex. nut ,self locking		8		
517.070	Dichtring, turbineseitig Gasket, turbine side		1		
517.075	Führungslager Guide bearing		1		
517.079	Sechskantschraube Hex. head screw		2		

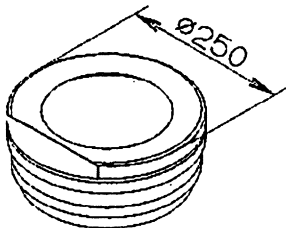
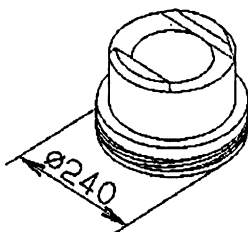
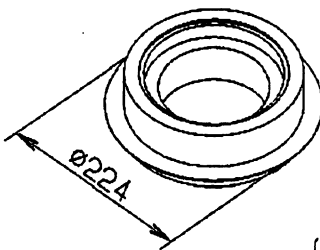
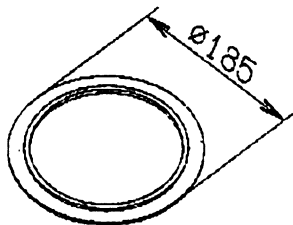
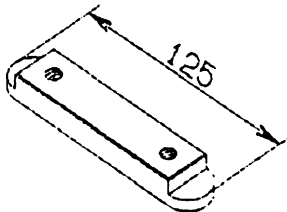


SAMSUNG-MAN B&W		<u>SPARE PART LIST</u> NA - 70		Ship No	
				Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
517.085	Dichtung, verdichterseitig Sealing ring,compressor side -		1		
517.087	- Senkschraube Countersunk screw		6		
517.088	Sechskantmutter Hex. nut		6		
517.092	Runddichtring O-ring seal		1		
517.094	Sechskantmutter Hex. nut self, locking		13		

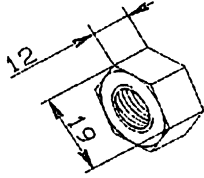
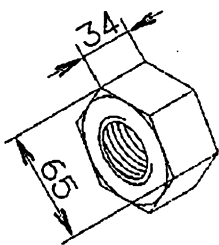
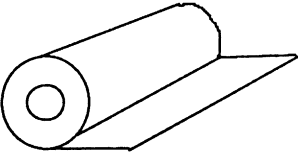
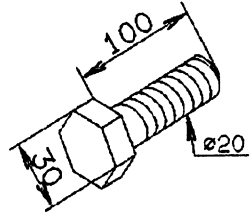
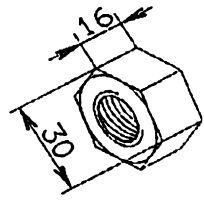
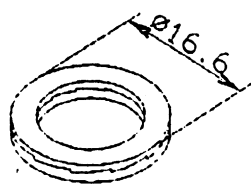
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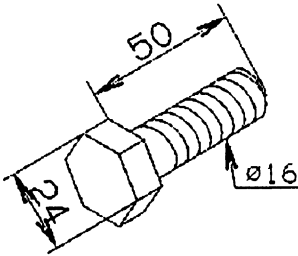
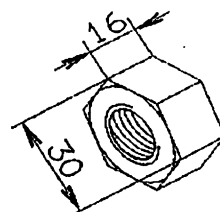
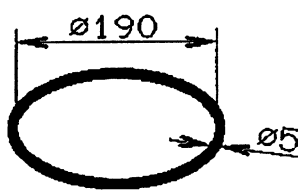
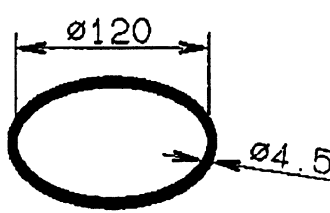
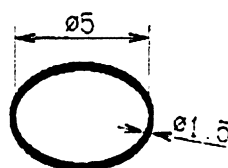


SAMSUNG-MAN B&W		<u>SPARE PART LIST</u> NA - 70		Ship No	
				Engine No	
Order No	Name	Sketch (Mass-kg)			Quantity
517.355 —	Gleitlager mit schwimmender Buchse, Plain bearing with floating bush	 (22.0)			1
520.028	Laufring Running ring	 (23.8)			1
520.035	Spurring Guide ring	 (6.2)			1
520.039	Zwischenring Intermediate ring				1
520.056	Paßfeder Adjust spring				2

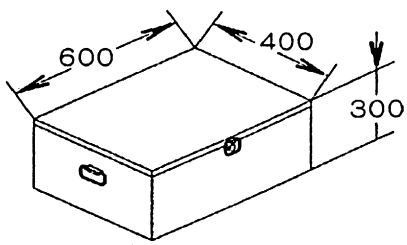


SAMSUNG-MAN B&W		SPARE PART LIST	Ship No	
		NA - 70	Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity	
544.064	Sechskantmutter Hex. nut		11	
544.071	Sechskantmutter Hex. nut		5	
544.150	Luftfiltermattee Air filter mat	 Only for replacement before ship delivery, not standard spare.	1	
544.200	Sechskantschraube Hex. head screw		7	
544.201	Sechskantmutter Hex. nut		7	
546.046	Keil-Sicherungsscheibe Thrust washer		4	

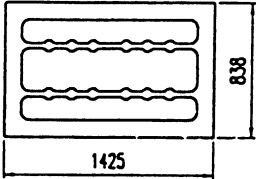
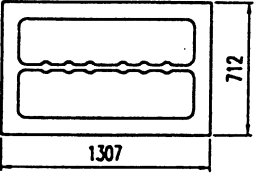
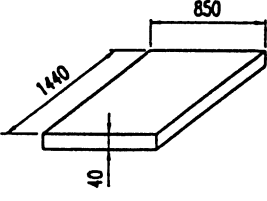


SAMSUNG-MAN B&W		SPARE PART LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
546.073	Sechskantschraube Hex. head screw		6		
546.098	Sechskantmutter Hex. nut		8		
596.048	Runddichtring O-ring seal		4		
596.049	Runddichtring O-ring seal		2		
596.061	Runddichtring O-ring seal		4		



SAMSUNG-MAN B&W		SPARE PART LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)			Quantity
595.001 —	Reserveteilkiste Spare parts box				1



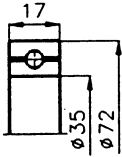
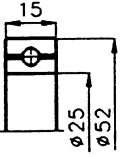
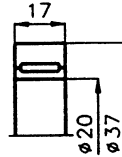
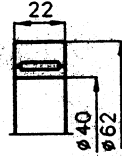
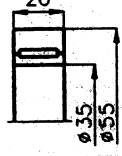
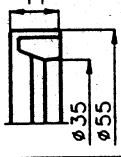
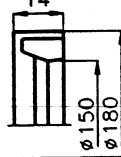
				PAGE				
SPARE PARTS LIST								USED FOR
FOR AIR COOLER								BOX NO.
NO.	NAME	SKETCH	MATERIAL	SUPPLY per COOLER		DRAWING		REMARK
				WORK	SPARE	NO.	PART NO.	
1	GASKET FOR CHANNEL COVER	 TH'K 1.5t	ASBESTOS-FREE	1	1	DHCA-1051B4C	8	
2	GASKET FOR REVERSING COVER	 TH'K 1.5t	ASBESTOS-FREE	1	1	DHCA-1051B4C	9	
3	SPARE GASKET BOX FOR SPARE PARTS NO. 1 - 2		WOOD	1				per SHIP
4								
MFR'S NAME		DongHwa Entec						



SPARE PARTS LIST

WT-3700

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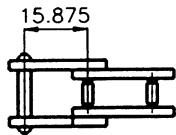
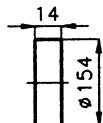
DESCRIPTION			TURNING GEAR WITH MOTOR			
NO	PARTS NAME	SKETCH	QUANTITY		PARTS	REMARKS
			UNIT	SPARE		
1	BALL BEARING #6207		1	1	33	
2	BALL BEARING #6205		1	1	34	
3	NEEDLE BEARING NA4904		3	1	51	
4	NEEDLE BEARING NA4908		4	1	37	
5	NEEDLE BEARING NA4907		12	1	38	
6	OIL SEAL D355511		1	1	40	
7	OIL SEAL D15018014		1	1	41	

NOTE

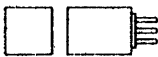
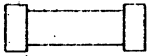
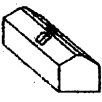
SPARE PARTS LIST

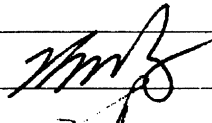
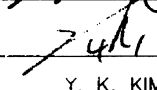
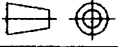
WT-3700

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DESCRIPTION			TURNING GEAR WITH MOTOR			
NO	PARTS NAME	SKETCH	QUANTITY		PARTS	REMARKS
			UNIT	SPARE		
8	ROLLER CHAIN RS50		1	RINK 6	13	
9	INNER DISK		2	1		
10	SPARE BOX		1			
NOTE						

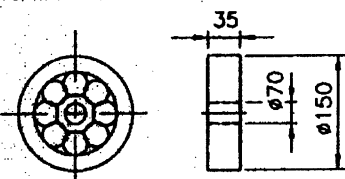
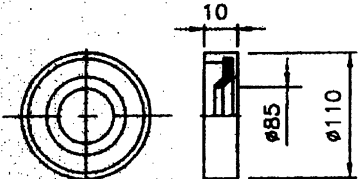
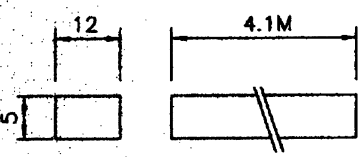
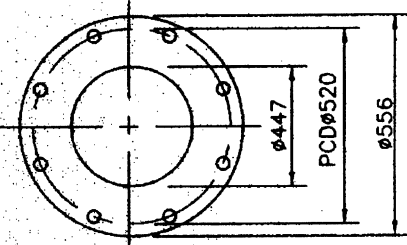
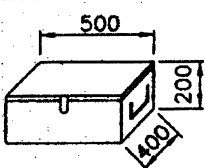


NO	NAME	SKETCH	TYPE	QUANTITY		REMARKS
				WORKING	SPARE	
1	MAGNETIC SWITCH		GMC-150 AC220V, 60HZ	2	1	
2	EOCR 		EOCR-SS-05	2	1	
3	CONTROL RELAY		SZR-MY4N AC220V, 60HZ	10	1	
4	TIME RELAY		KTM-3M AC220V, 60HZ	6	1	
5	FUSE		SB-C1, 10A	4	4	
			SB-C1, 5A	2	2	
			SB-C1, 3A	2	2	
6	GLOVE FOR SIGNAL LAMP		GLOVE , 25ø	2	1	WHITE
			GLOVE , 25ø	2	1	GREEN
			GLOVE , 25ø	2	1	RED
7	BULB FOR SIGNAL LAMP		E-12 (24V 1W)	6	6	
8	SPARE BOX		NP=SPARE BOX		1	

1	2003.03.27	FOR WORKING	APD		SHEET NO. 13
0	2002.11.19	FOR APPROVAL	CHK		SCALE N / S
REV	DATE	DESCRIPTION	DWN	Y. K. KIM	
 SinSueng Electric Co., Ltd. TEL : +82-55-231-6707~8, FAX : -6709			TITLE : 5258 AUX.BLOWER STARTER SPARE PART LIST		

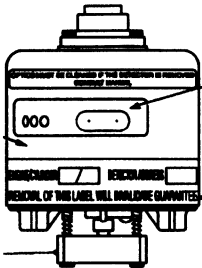
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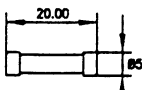
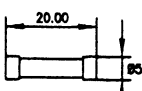
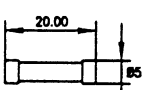
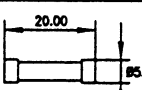
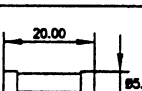
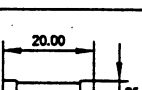
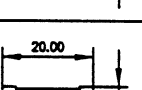
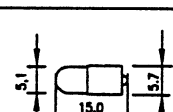
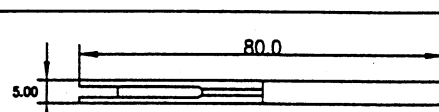
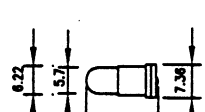


U S E		SPARE PART LIST		A M E N D	REV.	DATE	NOTE
NO.1~2 AUX. BLOWER							
ITEM NO.	NAME OF PARTS	OUT LINE	QUANTITY			REMARK	
			WORKING		SPARE		
			PER BL SET	PER ENG.			
1	BEARING		2	4	2	△ NO. 6314 C3 63Kw x 2P MOTOR	
2	GASLOCK SEAL		2	4	2	THERMOELASTIC SEAL	
3	GASKET		1	2	1	5t NBR	
4	GASKET		1	2	1	5t NBR	
	SPARE PART BOX				1	WITH KEY AND LOCK	
 HMMCO Hyundai Marine Machinery Co., Ltd. Inchon Korea			APPROVED  03. 3. 25 KIM		CHECKED  03. 3. 25 KIM	DRAWN  2003. 3. 25 KIM	
DRAW NO.		H-0207P	REVISION NO.		1		



SPARE FOR OIL MIST DETECTOR

ITEM NO.	DESCRIPTION	OUTLINE	QUANTITY		REMARK
			WORK	SPARE	
1	DETCETOR HEAD		7	1	
2	DETECTOR HEAD REPAIR KIT			1	

Item no.	Description	Outline	Number:	Working Units	Remarks:
1	Fuse 500mA ceramic type: 062.480.124		10	3	Placed in panels
2	Fuse 1A ceramic type: 062.480.128		10	5	Placed in IOM402 RM401
3	Fuse 2A ceramic type: 062.480.129		10	10	Placed in Main Fuses: F11, F12, F13 F23, F24
4	Fuse 3.15A ceramic type: 062.480.131		10	2	Placed in DZM402 IFM401: F2
5	Fuse 5A ceramic type: 062.480.133		10	3	Placed in IFM401: F1, F3, F4
6	Fuse 2A ceramic type: 062.480.186		10	1	Placed in ZM411 (GAMMA MICRO)
7	Fuse 1.6A ceramic type: 088.632.140		10	9	Placed in F30-36 F40, F41
8	Lamp 28V 1,2 W, T5,5 type: 088.642.010		10	25	Placed in ECR Indication Panel
9	Lamp extractor type: 062.532.598		1		
10	Lamp 28 V 40 mA type: 062.452.314		10	2	Placed in Stork Kwant Bridge Telegraph
11					

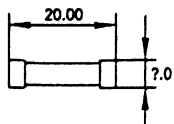
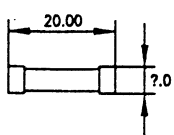
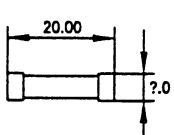
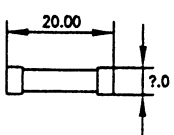
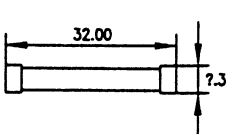
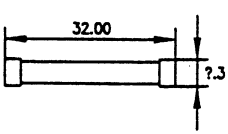
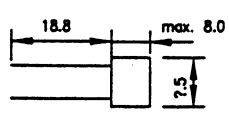
Type no. for all items: 921.244.200

Ver.	File	Drw	Date	Chk.	Date	Ver.	File	Drw	Date	Chk.	Date
1	921244201	HAK	00.05.03			4					
2	921244202	HAK	00.08.02			5					
3	921244201	HAK	01.02.22			Original 921244201		Date 00.05.03			

Spare Parts List
DMS2100i and DPS2100
with Stork Kwant Telegraph

 **Lyngsø Marine**



Item no.	Description	Drawing no.	Outline	Number	Working Units	Remarks:
1	Fuse 10A glas type: 062.480.108	960.201.03		10	1	Placed in TB1/9,10&11
2	Fuse 1A ceramic type: 062.480.128	960.170.17 960.201.21 960.201.22 960.201.23 960.201.24 960.201.25		20	6	Placed in control unit, DI-CB DO-CB AI-CB EGS-CB BASIS-CB
3	Fuse 6.3A ceramic type: 062.480.132	960.201.25		10	1	Placed in BASIS-CB & TB1 -/ 3
4	Fuse 2.5A ceramic type: 062.480.139	960.201.51		10	1	Placed in Powerdrive Electronic
5	Fuse 15A ceramic type: 062.480.281	960.201.51		10	1	Placed in Powerdrive Electronic
6	Fuse 25A ceramic type: 062.480.283	960.201.51		10	1	Placed in Powerdrive Electronic
7	Fuse 1A type: 062.480.595	960.201.51		10	1	Placed in Powerdrive Electronic
			Type no. for all items: 960.180.900			

Spare Parts List for EGS 2000



TSA/ELG 11.1.91 ESB/MSS 01.12.94

TSA/PBN 22.3.91





HSD ENGINE

Client : DAEWOO Shipbuilding & Marine Engineering Co.,Ltd.

Hull Number : 5258

Engine Type : HSD-MAN B&W 5S70MC (Mk.6)

SUBJECT :

List of tools for main engine

NOTES : -THE ITEMS MARKED WITH "H" IN THIS LIST ARE TO BE
ARRANGED AT THE HULL SIDE AND THE STEEL BOX FOR STORING
THEM ARE NOT SUPPLIED

PANEL NO.: 901-910
STEEL BOX: MT
ENG. ROOM: H
TOOL NO. : SEE MAINTENANCE BOOK

ATTACHMENTS : SEE INDEX OF MAIN ENG. TOOL LISTS

5					
4					
3					
2	Page 902-3, 905-3/5, 906-3, 912-1 , 913-4, 924-1 corrected.	20031002	S.C.K		
1	Page 902-1, 909-2/3, 913-4 corrected & 990-1~994-1 page added	20030417	H.S.J		
0	First issued	20021203	H.S.J		
Rev.	Description	Date	Pre.	Rev.	Appd.
Design Team 1		Documentation No.			
TEL.+82 55 260 6715 FAX.+82 55 260 6800		MA13-1258			
HSD ENGINE CO., LTD.					

HSD ENGINE CO., LTD.

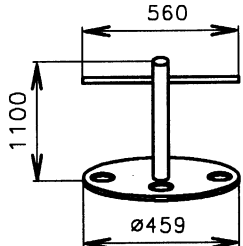
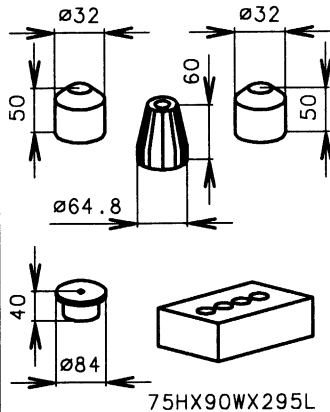
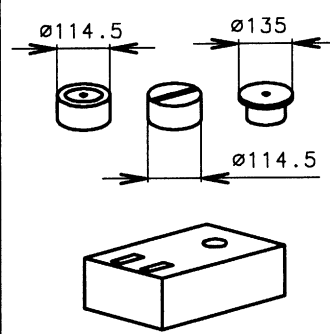
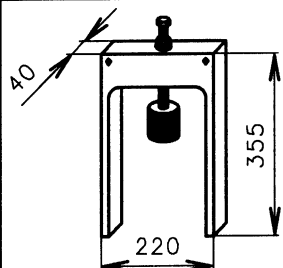


***** CONTENTS *****

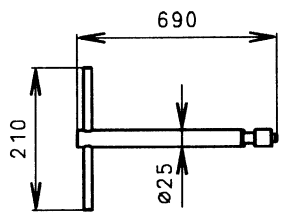
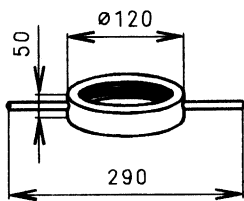
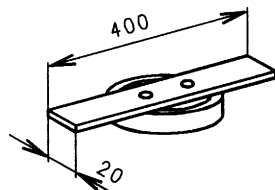
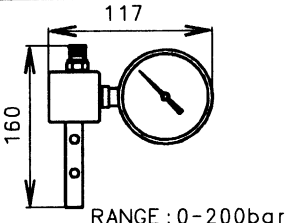
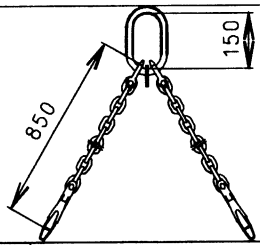
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1	900	INDEX OF MAIN ENG. TOOL LISTS	1
2	901	TOOLS FOR CYLINDER COVER	4
3	902	TOOLS FOR PISTON ROD AND CYLINDER LINER	6
4	904	TOOLS FOR CROSSHEAD WITH CONN. ROD	4
5	905	TOOLS FOR CRANKSHAFT AND MAIN BEARING	6
6	906	TOOLS FOR CHAIN DRIVE AND CAMSHAFT	4
7	908	TOOLS FOR EXHAUST VALVE	5
8	909	TOOLS FOR FUEL OIL SYSTEM	6
9	910	TOOLS FOR TURBOCHARGER AND AIR COOLER SYSTEM	2
10	912	TOOLS FOR STAY BOLT	1
11	913	GENERAL TOOLS	13
12	915	PANELS OF MAIN ENGINE TOOL	2
13	924	TOOLS FOR ENGINE SEATING	2
14	990	TOOLS FOR EXH. V/V GR. M/C(MAKER:KOKACO)	2
15	991	TOOLS FOR FUEL VALVE TESTER-(MAKER:HANMI)	4
16	992	TOOLS FOR TURBOCHARGER-(TYPE:NA70/T09)	12
17	992	TOOLS FOR AIR COOLER-(MAKER:DONGHWA)	3
18	992	TOOLS FOR AUX. BLOWER-(MAKER:HMMCO)	1

TOOL	Type : 5S70MC (NA70/T09x1)	HSD - MAN B&W
Info. no.	Description : INDEX OF MAIN ENG. TOOL LISTS	Ident.no.: MA13-1258

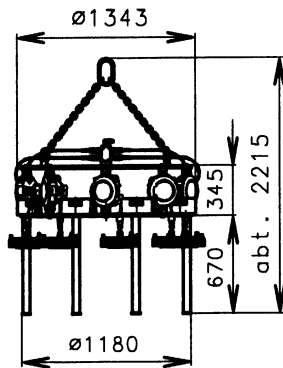
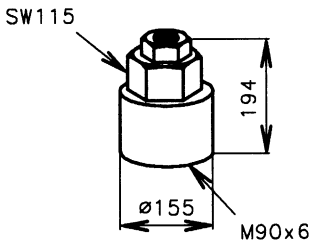
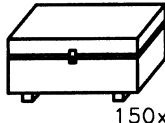
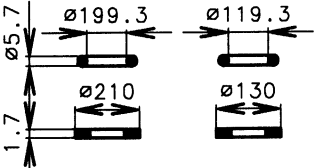
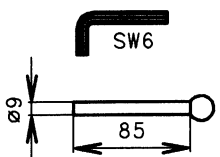
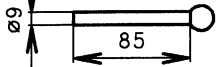


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			W.T (kg)	STD.	ADD.			
046	GRINDING TOOL FOR EXH. VALVE SEAT		CAST-IRON, STEEL	1		901-9821	0937660-9.1	
P901			30.608				BOX NO.	
058	MILLING AND GRINDING WHEEL FOR FUEL VALVE SEAT		TOOL STEEL, CAST-IRON, WOOD	1		901-9622	0916742-3.0	
P901			2.156				BOX NO.	
060	MILLING AND GRINDING WHEEL FOR STARTING VALVE SEAT		TOOL STEEL, CAST-IRON, WOOD	1		901-9621	0937676-6.0	
P901			8.200				BOX NO.	
071	DISMANTING LEVER FOR FUEL VALVE		STEEL	1		901-9822	3126987-6.0	
P901			8.385				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
				*				0
20020408		HSJ	LYS	LYS	First issued			
TOOL		Type :				L/S70MC		HSD - MAN B&W
Info. no. 901		Description :				TOOLS FOR CYLINDER COVER		Ident.no.: -

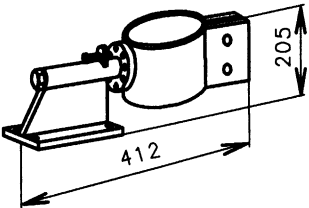
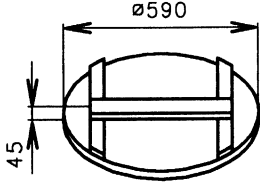


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
083	HANDLE FOR SUNDRY TYPE		STEEL	1		901-9823	0955990-2.3	
P901			2.810				BOX NO.	
095	GRINDING RING FOR STARTING VALVE		CAST-IRON, STEEL	1		901-9623	0937679-1.0	
P901			1.594				BOX NO.	
105	PIN WRENCH FOR STARTING VALVE		STEEL	1		901-9824	0937680-1.0	
P901			0.488				BOX NO.	
117	TESTING DEVICE FOR SAFETY VALVE		STEEL	1		901-9222	0964747-1.1	
P901			2.210				BOX NO.	
	BLANK						BOX NO.	
172	LIFTING CHAIN FOR CYL. COVER		STEEL	2		901-9921	0980084-2.2	
H			5.620				BOX NO.	
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
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				*				4
				*				3
				*				2
				*				1
20020508	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 901		Description : TOOLS FOR CYLINDER COVER				Ident.no. : -		

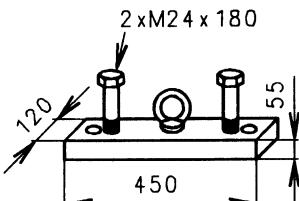
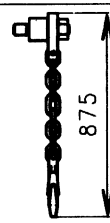
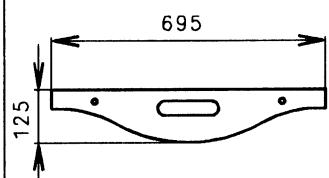
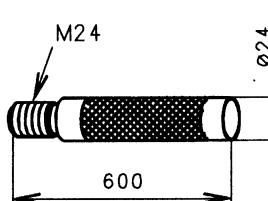
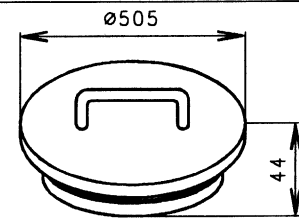
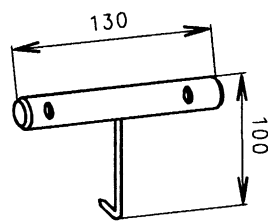


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
015	TIGHTENING TOOL FOR CYL. COVER		MAKER	SET 1		901-9221	3101197-9.2	
	448.401				BOX NO.			
H	STUD SETTER		STEEL	1			3101250-6.0	
	17.240				BOX NO.			
015S	SPARE PARTS FOR TIGHTENING TOOL		STEEL	1		901-9223	STEEL BOX	
			NBR TEFLON	EACH 8			1209834-9.1 1209817-1.1	
			MAKER	4			QUICK COUPLING-MALE	
			MAKER	2			HEX. SOCKET SCREW KEY	
			MAKER	2			BALL HANDLE	
			COPPER	15			DISC	
			MAKER	4			VENT SCREW	
		MT-01						
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 901		Description : TOOLS FOR CYLINDER COVER				Ident.no. : -		



TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS			
			W.T (kg)	STD.	ADD.					
102	DISMANTLING STAND FOR STARTING VALVE		STEEL	1		901-9825				
H			10.130				BOX NO.			
103	COVER FOR EXH. VALVE BORE		WOOD	2		901-9922				
H			2.500				BOX NO.			
	BLANK									
							BOX NO.			
	BLANK									
							BOX NO.			
	BLANK									
							BOX NO.			
Similar no. :			Ship no. :		Scale : NONE		Mass.(kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R	
				*					5	
				*					4	
				*					3	
				*					2	
				*					1	
20020408	HSJ	LYS	LYS	*	First issued				0	
TOOL		Type :				L/S70MC				HSD - MAN B&W
Info. no. 901		Description :				TOOLS FOR CYLINDER COVER				Ident.no. : —

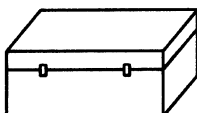
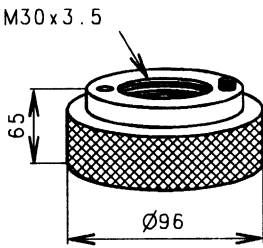
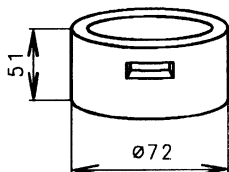
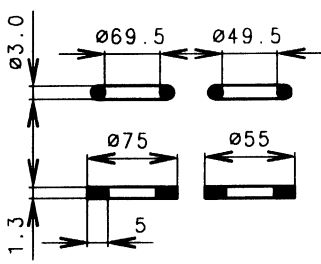
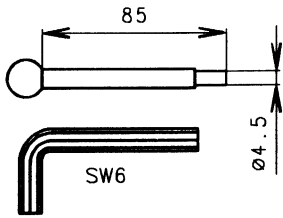


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
040	LIFTING FOR PISTON ROD FOOT		STEEL	1		902-9821	3128026-6.0
P902			21.577				BOX NO.
051	LIFTING AND TILTING SCREW		STEEL	2		902-9621	3128660-3.0
P902			9.227				BOX NO.
075	TEMPLATE FOR PISTON TOP		STEEL	1		902-9640	1394709-6.2
P902			1.196				BOX NO.
087	DISTANCE PIECE FOR STUFFING BOX		STEEL	2		902-9624	1262301-7.0
P902			2.130				BOX NO.
099	COVER FOR STUFFING BOX HOLE		ALUMINIUM RUBBER	1		902-9650	0937670-5.1
P902			9.869				BOX NO.
109	MOUNTING TOOL FOR STUFFING BOX SPRING		STEEL	2		902-9822	0993230-1.1
P902			0.210				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
20030103	HSJ	LYS	LYS		Tool No. 040 corrected		
20020408	HSJ	LYS	LYS		First issued		
TOOL		Type : L/S70MC				HSD - MAN B&W	
Info. no. 902		Description : TOOLS FOR PISTON AND CYLINDER LINER				Ident.no. : -	

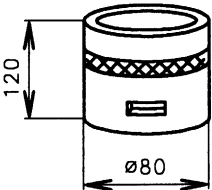
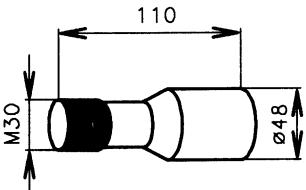
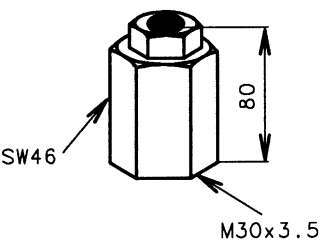


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
110	PRESSURE TEST TOOL FOR PISTON		STEEL	1		902-9222	0937669-5.0	
P902			12.591				BOX NO.	
122	WORKING TABLE FOR STUFFING BOX		STEEL COPPER	1		902-9823	0916896-8.1	
P902			19.926				BOX NO.	
134	EXPANDER FOR PISTON RING		STEEL	1		902-9730	3101070-8.1	
P902			5.192				BOX NO.	
158	GUIDE SCREW FOR PISTON CROWN		STEEL	1		902-9625	1395334-9.0	
P902			1.060				BOX NO.	
160	HEX BOLT FOR PISTON SKIRT DISMANTLING		STEEL	2		902-9622	EN61V12150	
P902		M12x150	0.005				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type :				L/S70MC		HSD - MAN B&W
Info. no.		Description :				Ident.no.:		
902		TOOLS FOR PISTON AND CYLINDER LINER						

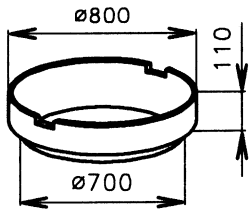
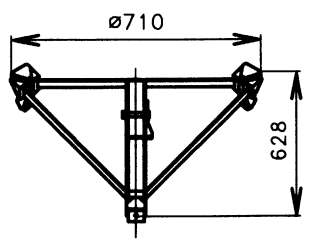
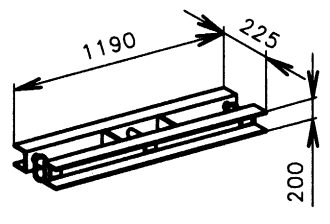
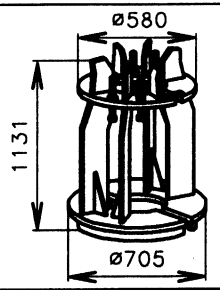


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
ARR. - TOOLS			W.T (kg)	STD.	ADD.		
087	STEEL BOX FOR HYD. JACK		STEEL	1		902-9221	0938414-8.0
MT-02		150HX400WX400L	-				BOX NO.
038	HYDR. JACK FOR PISTON ROD		MAKER	2			WORKING PRESS : 900bar 0938412-4.0
			2.989				BOX NO.
051	SUPPORT FOR HYDR. JACK		SPECIAL STEEL	2			0976530-4.1
			0.586				BOX NO.
014 026	SPARE O-RING WITH BACK-UP RING		NBR TEFLON	EACH 4			1209783-3.1 1209778-6.1
			0.131				BOX NO.
237 321	KEY AND BALL HANDLE FOR HYD. JACK		STEEL	EACH 1			0955786-6.0 EN549A6
			0.12				BOX NO.
Similar no. :			Ship no. :		Scale : NONE	Mass.(kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
				*			
				*			
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : L/S70MC				HSD - MAN B&W	
Info. no. 902		Description : TOOLS FOR PISTON AND CYLINDER LINER				Ident.no. : -	

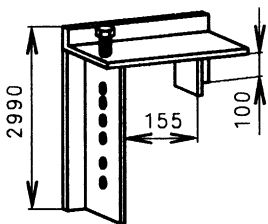
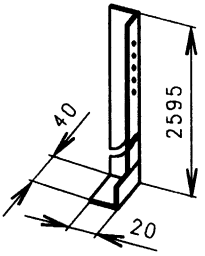
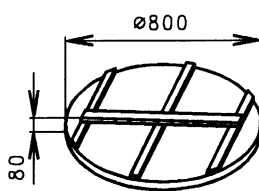
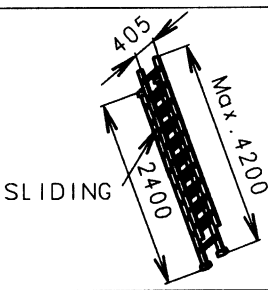
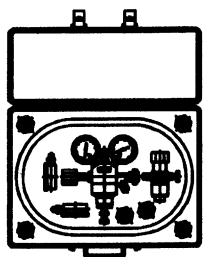


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
063	SUPPORT FOR AX. VIB. DAMPER HYDR. JACK		STEEL	2		902-9221	0938413-6.1		
			2.336				BOX NO.		
075	EXTENSION STUD FOR HYDR. JACK AX. VB. DAMPER STUD		STEEL	2			1760641-3.0		
			0.760			BOX NO.			
095	STUD SETTER FOR PISTON ROD/CROWN AX. VB. DAMPER FOR HYDR. JACK		STEEL	1		0993890-2.1			
			0.885			BOX NO.			
	BLANK						BOX NO.		
	BLANK						BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				L/S70MC			HSD - MAN B&W
Info. no. 902		Description :				TOOLS FOR PISTON AND CYLINDER LINER			Ident.no.: —

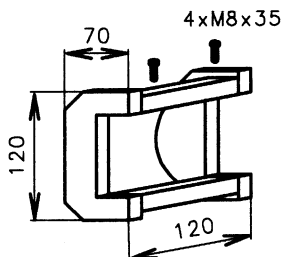
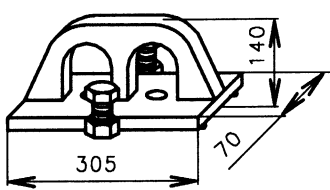
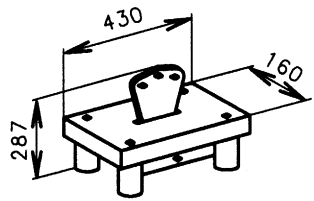
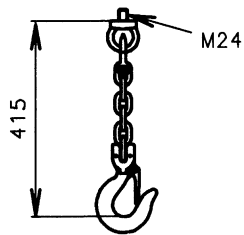
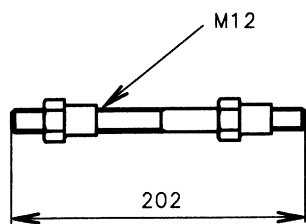


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
019	GUIDE RING FOR PISTON		STEEL	1		902-9731	1263178-8.0		
H			46.145				BOX NO.		
020	LIFTING TOOL FOR PISTON		STEEL	1		902-9732	0937658-7.0		
H			42.222				BOX NO.		
032	CROSS BAR FOR CYL. LINER		STEEL	1		902-9827	3128587-3.0		
H			66.130				BOX NO.		
	BLANK						BOX NO.		
056	SUPPORT IRON FOR PISTON		STEEL	1		902-9826	3101096-1.0		
H			105.144				BOX NO.		
Similar no. :			Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				L/S70MC			HSD - MAN B&W
Info. no. 902		Description :				TOOLS FOR PISTON AND CYLINDER LINER			Ident.no. : —



TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
036	MEASURING ROD FOR CYL. LINER		STEEL	1		902-9740	3102407-2.0		
H			3.759				BOX NO.		
048	MEASURING ROD FOR CYL. LINER		STEEL	1		902-9741	3102406-0.0		
H			2.887				BOX NO.		
201	COVER FOR CYL. BORE		WOOD	2		902-9921			
H			7.400				BOX NO.		
202	LADDER FOR CYL. BORE CHECKING		ALUMINIUM	1		902-9922			
H			14.500				BOX NO.		
205	TEST EQUIP. FOR LUBRICATOR		MAKER	1		0902-9322	1226533-4.0		
MT-18			2.030				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R
									5
									4
									3
									2
									1
20020408	HSJ	LYS	LYS		First issued				0
TOOL		Type : S70MC				HSD - MAN B&W			
Info. no. 902		Description : TOOLS FOR PISTON AND PISTON ROD				Ident.no. : -			

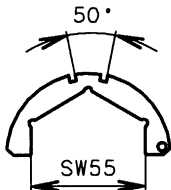
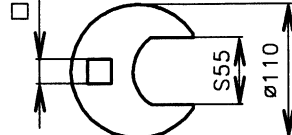
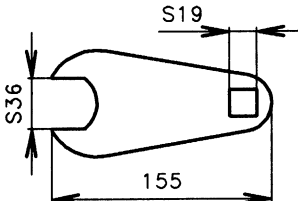
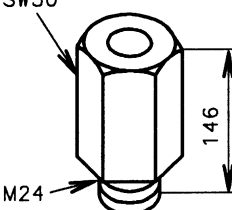
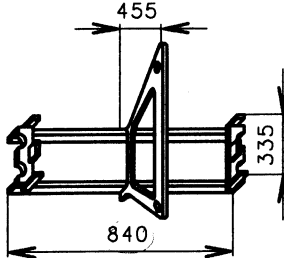


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
047	WIRE GUIDE		STEEL	1		904-9822	0980077-1.0		
P904			1.678				BOX NO.		
059	LIFTING ATTACHMENT FOR CONN. ROD		STEEL	4		904-9823	3127618-1.0		
P904			8.732				BOX NO.		
060	LIFTING TOOL FOR CROSSHEAD		STEEL	1		904-9721	0937908-1.0		
P904			30.766				BOX NO.		
072	CHAIN FOR SUSPENDING PISTON		STEEL	2		904-9921	0976392-5.2		
P904			2.650				BOX NO.		
084	RETAINING TOOL FOR TELESCOPE PIPE		STEEL	2		904-9622	0984499-8.0		
P904			0.304				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408					HSJ	LYS	LYS	First issued	0
TOOL		Type : L/S70MC				HSD - MAN B&W			
Info. no. 904		Description : TOOLS FOR CROSSHEAD AND CONNETING ROD				Ident.no. : —			

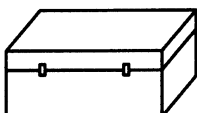
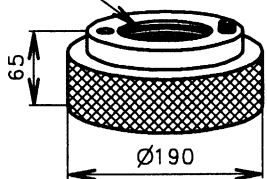
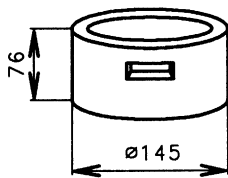
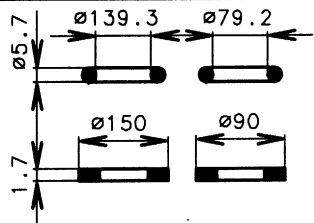
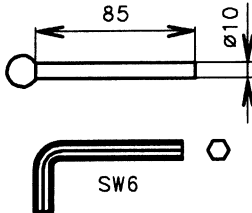
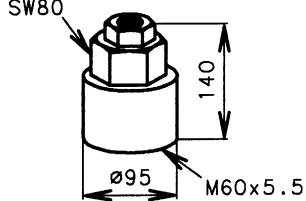


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
096	BRACKET FOR SUPPORT OF CROSSHEAD		STEEL	2		904-9730	0992348-3.1		
P904			6.738				BOX NO.		
106	BRACKET FOR SUPPORT OF CROSSHEAD		STEEL	2		904-9731	0992349-5.1		
P904			6.738				BOX NO.		
118	RUBBER COVER FOR CROSSHEAD		NBR	1		904-9922	1395252-2.0		
P904			2.670				BOX NO.		
120	RUBBER COVER FOR CROSSHEAD		NBR	1		904-9923	1395210-3.1		
P904			2.500				BOX NO.		
131	DRAWING TOOL FOR BELL SHAPED		STEEL	1		904-9821	0976408-4.3		
P904			0.400				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R
				*					5
				*					4
				*					3
				*					2
				*					1
20020408HSJ LYS LYS *					First issued				0
TOOL		Type : L/S70MC				HSD - MAN B&W			
Info. no. 904		Description : TOOLS FOR CROSSHEAD WITH CONN. ROD				Ident.no. : —			

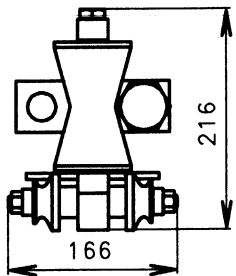
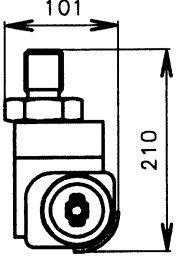
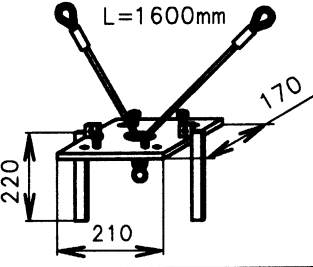
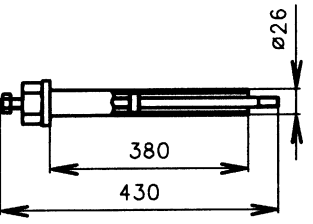
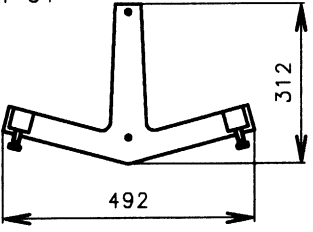


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
ARR.-TOOLS			W.T (kg)	STD.	ADD.		BOX NO.		
143	TIGHTING TEMPLATE FOR LUB. OIL INLET BEND	t=2 	STEEL	1		904-9640	1395394-7.1		
P904			0.050				BOX NO.		
155	CROWFOOT SPANNER	T=22 	STEEL	1		904-9630	0694115-9.3		
P904			0.900				BOX NO.		
167	CROWFOOT WRENCH HEAD		STEEL	1		904-9631	1288499-9.0		
P904			1.260				BOX NO.		
202	SCREW WITH SPECIAL HEAD	SW50 	STEEL	2		904-9623	1395174-3.2		
P904			1.830				BOX NO.		
072	LIFTING TOOL FOR CRANK PIN SHELL		STEEL	1		904-9825	0992353-0.0		
H			12.448				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R
				*					5
				*					4
				*					3
				*					2
				*					1
20020408	HSJ	LYS	LYS	*	First issued				0
TOOL		Type : S70MC				HSD - MAN B&W			
Info. no. 904		Description : TOOLS FOR CROSSHEAD AND CONNECTING ROD				Ident.no. : —			

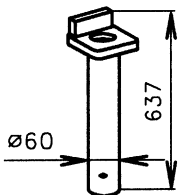
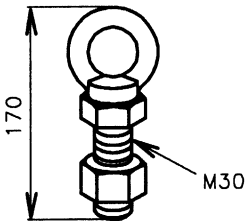
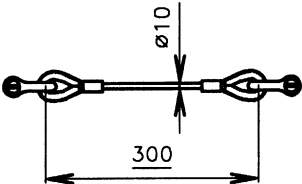
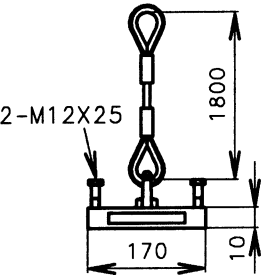
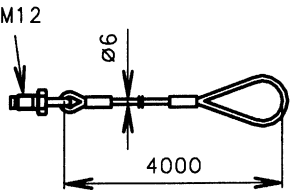


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
065	STEEL BOX FOR HYDR. JACK		STEEL	2		904-9221	0937749-8.3	
MT-04		200Hx400x400	-				BOX NO.	
041	HYDR. JACK FOR CROSSHEAD STUD /CONN. ROD STUD		MAKER	4			WORKING PRESSURE : 900bar	
			11.191				0937750-8.0	
							BOX NO.	
053	SUPPORT FOR HYDR. JACK		SPECIAL STEEL	4			0937868-4.1	
			4.226			BOX NO.		
016 028	SPARE O-RING WITH BACK-UP RING		NBR TEFLON	EACH 8			1209821-7.1 1209808-7.1	
			-			BOX NO.		
237 345	KEY AND BALL HANDLE FOR HYD. JACK		STEEL	EACH 2			0955789-1.0 EN549A6	
			-			BOX NO.		
167	STUD SETTER		STEEL	1			0937958-3.1	
			4.680			BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 904		Description : TOOLS FOR CROSSHEAD AND CONNECTING ROD				Ident.no. : -		

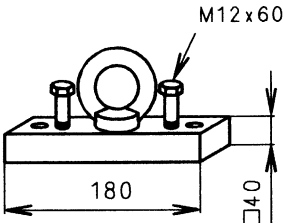
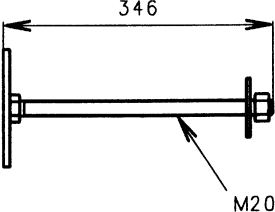
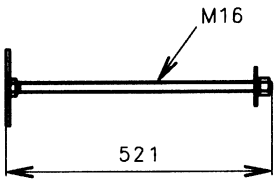
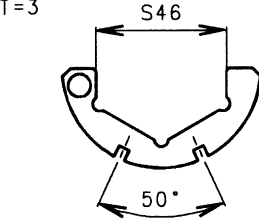
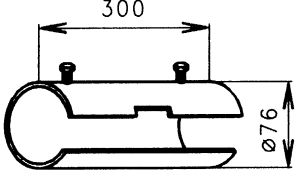


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
040	PULLEY FOR WIRE OF MAIN BRG. CAP DISMANTLING		STEEL	1		905-9621	3128890-3.0	
P905			11.320				BOX NO.	
064	PULLEY FOR WIRE OF MAIN BEARING CAP DISMANTLING		STEEL	1		905-9623	3127190-0.1	
P905			3.822				BOX NO.	
076	LIFTING TOOL FOR MAIN BRG.		STEEL	1		905-9624	0937971-3.1	
P905			4.458				BOX NO.	
084	EXTRACTOR FOR MAIN BEARING VERTICAL PIN		STEEL	1		905-9730	3101746-8.3	
P905			0.215				BOX NO.	
100	TOOL FOR TURN OUT SEGMENT		STEEL	1		905-9821	0937979-8.1	
P905			7.756				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 905		Description : TOOLS FOR CRANKSHAFT AND MAIN BEARING				Ident.no. : —		

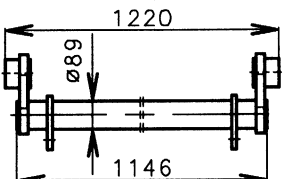
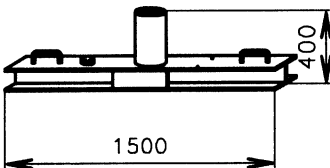
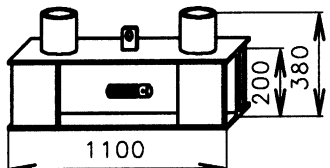


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
123	RETAINING TOOL FOR MAIN BEARING SHELL		STEEL	2		905-9822	0937939-2.0
P905			4.510				BOX NO.
159	EYE BOLT		STEEL	1		905-9521	3127668-3.0
P905			1.299				BOX NO.
160	WIRE ROPE FOR MAIN BR'G SHELL LIFTING		STEEL	1		905-9922	3102867-2.0
P905			1.678				BOX NO.
184	WIRE ROPE FOR MAIN BR'G SHELL LIFTING		STEEL	1		905-9625	3100612-1.0
P905			0.450				BOX NO.
218	WIRE FOR DISMANTLING FOR MAIN BEARING SHELL		STEEL	1		905-9921	3100612-1.0
P905			0.450				BOX NO.
Similar no. :			Ship no. :		Scale : NONE	Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		R
				*			5
				*			4
				*			3
				*			2
				*			1
20020408	HSJ	LYS	LYS	*	First issued		0
TOOL		Type : L/S70MC				HSD - MAN B&W	
Info. no. 905		Description : TOOLS FOR CRANKSHAFT AND MAIN BEARING				Ident.no. : -	

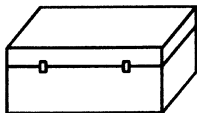
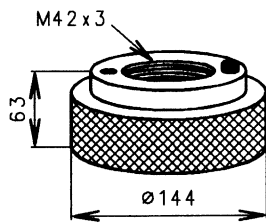
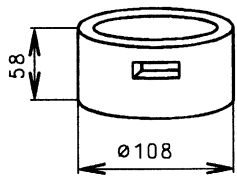
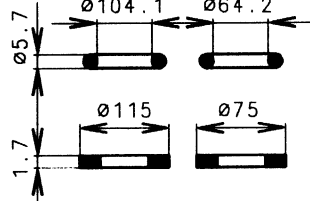
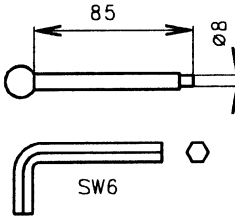
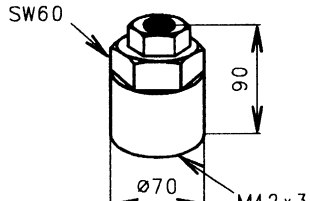


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
111	LIFTING TOOL FOR AXI. V. DAMPER		STEEL	1		905-9627	3128097-2.0
P905			2.650				BOX NO.
135	LIFTING TOOL FOR CRANKCASE RELIEF VALVE(2)		STEEL	1		905-9823	0955736-4.0
P905			1.226				BOX NO.
147	LIFTING TOOL FOR CRANKCASE RELIEF VALVE(1)		STEEL	1		905-9824	0955734-0.0
P905			0.985				BOX NO.
196	TIGHTING TEMPLATE FOR AXI. V. DAMPER		STEEL	1		905-9641	1760593-3.0
P905			0.021				BOX NO.
220	WIRE GUIDE FOR MAIN BEARING		STEEL	1		905-9827	3128285-3.0
P905			1.895				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
20030526	HSJ	LYS	LYS	*	Tool No. 202 added		
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : L/S70MC				HSD - MAN B&W	
Info. no. 905		Description : TOOLS FOR CRANKSHAFT AND MAIN BEARING				Ident.no. : -	

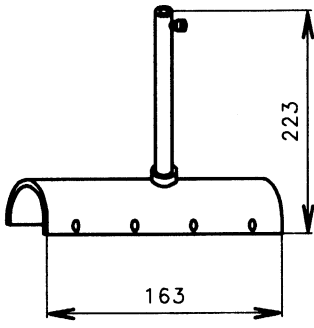
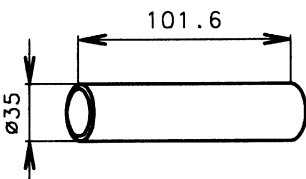


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
015	CROSS BAR FOR LIFTING OF SEGMENT STOPPER		STEEL	1		905-9826	0937950-9.0		
H			23.380				BOX NO.		
039	LIFTING TOOL FOR THRUST SHAFT		STEEL	1		905-9825	3128269-8.0		
H			66.903				BOX NO.		
040	LIFTING TOOL FOR CRANK SHAFT		STEEL	1		905-9721	3102085-8.3		
H			97.500				BOX NO.		
	BLANK								
							BOX NO.		
	BLANK								
							BOX NO.		
Similar no. :			Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R
				*					5
				*					4
				*					3
				*					2
				*					1
20020408			HSJ	LYS	LYS	First issued		0	
TOOL		Type : S70MC				HSD - MAN B&W			
Info. no. 905		Description : TOOLS FOR CRANKSHAFT AND MAIN BEARING				Ident.no. : -			

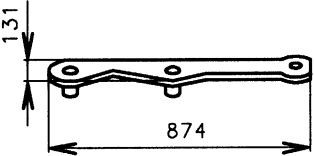
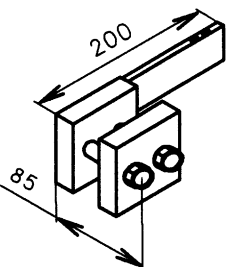
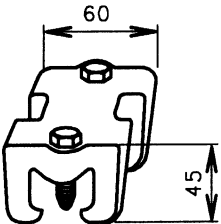
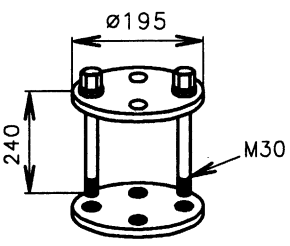
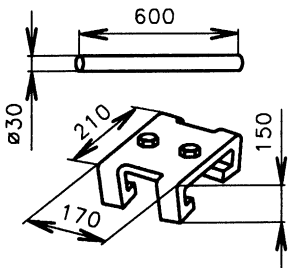


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
ARR. - TOOLS			W.T (kg)	STD.	ADD.			
069	STEEL BOX FOR HYDR. JACK	 150Hx400x400	STEEL	1		905-9221	3101175-2.0	
MT-04			-				BOX NO.	
045	HYDR. JACK FOR MAIN BEARING		MAKER	4			WORKING PRESSURE : 900bar	
			6.588				0938505-9.0	
057	SUPPORT FOR HYDR. JACK		SPECIAL STEEL	4			0937946-3.0	
			1.856				BOX NO.	
021 033	SPARE O-RING WITH BACK-UP RING		NBR TEFLON	EACH 8			1209813-4.1	
			-				1209805-1.1	
321 333	KEY AND BALL HANDLE FOR HYD. JACK		STEEL	EACH 2			0955787-8.4	
			-				EN549A6	
112	STUD SETTER		STEEL	1			0937910-3.0	
			1.880			BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
20031002	SCK	LYS	LYS	*	Tool no. 069 Q'TY 2->1			1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L / S70MC				HSD - MAN B&W		
Info. no. 905		Description : TOOLS FOR CRANKSHAFT AND MAIN BEARING				Ident.no. : -		

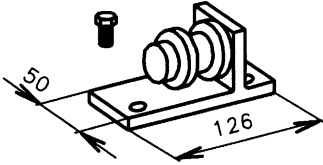
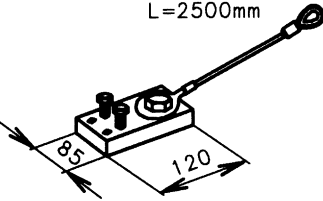
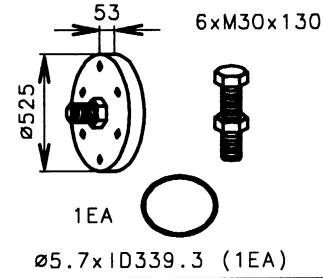


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
016	MEASURING TOOL FOR AXIAL		STEEL	1		905-9640	1142104-1.0	
MT-03			1.835				BOX NO.	
016a	HANDLE FOR MOUNTING OF SHAFT		STEEL	1		905-9642	1142419-3.2	
MT-03			0.950				BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
Similar no. :			Ship no. :		Scale : NONE		Mass.(kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20021104	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S-MC				HSD - MAN B&W		
Info. no. 905		Description : TOOLS FOR CRANKSHAFT AND MAIN BEARING				Ident.no. : —		

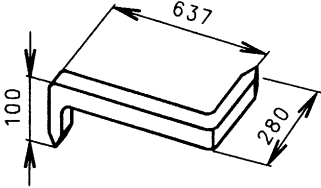
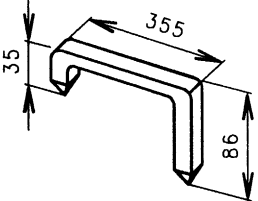
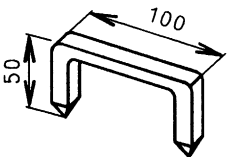


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
044	FACE IMPACT WRENCH FOR FUEL CAM ADJUSTMENT		STEEL	1		906-9740	0937953-4.0
P906			13.290				BOX NO.
056	CHAIN ASSEMBLING TOOL (1")		STEEL	1		906-9730	3100546-2.0
P906			1.012				BOX NO.
068	CHAIN DISASSEMBLING TOOL (1")		STEEL	1		906-9731	3127475-3.1
P906			0.594				BOX NO.
070	CHAIN ASSEMBLING TOOL (4.5")		STEEL	1		906-9732	0955711-2.1
P906			12.320				BOX NO.
081	CHAIN DISASSEMBLING TOOL (4.5")		STEEL	1		906-9733	0955721-9.0
P906			22.700				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
				*			
				*			
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : K/L/S-MC (4.5")				HSD - MAN B&W	
Info. no. 906		Description : TOOLS FOR CHAIN DRIVE AND CAMSHAFT				Ident.no. : —	

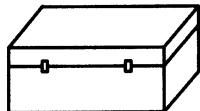
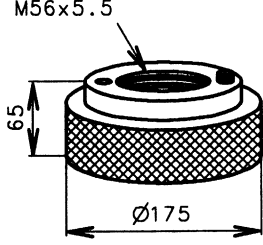
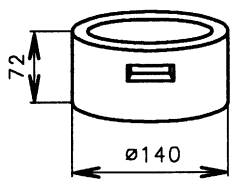
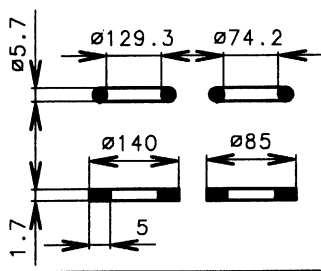
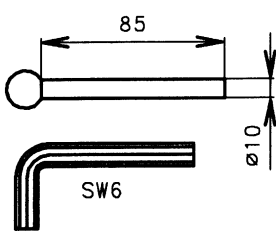


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
127	PULLEY FOR WIRE FOR CAMSHAFT BEARING		STEEL	2		906-9821	0980055-5.1	
P906			1.051				BOX NO.	
139	LIFTING ATTACHMENT FOR CAMSHAFT AND BEARING		STEEL WIRE-ROPE	2		906-9622	0980056-7.0	
P906			1.916				BOX NO.	
140	HYDR. TOOL FOR CAMSHAFT COUPLING WITH O-RING		STEEL RUBBER	1		906-9222	0992630-9.1 EN17M6340	
P906			89.886				BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 906		Description : TOOLS FOR CHAIN DRIVE AND CAMSHAFT				Ident.no. : —		

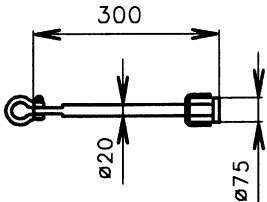
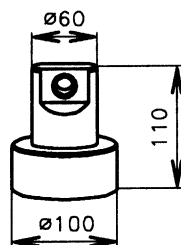
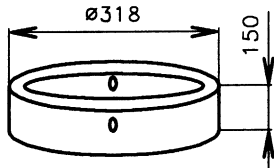
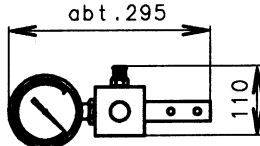
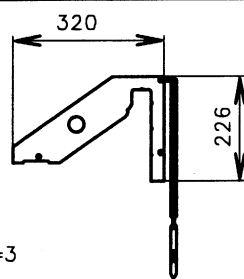


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
050	PIN GAUGE FOR CRANKSHAFT		STEEL	1		906-9742	1395248-7.0		
H		CONTROL MEAS=703	1.330				BOX NO.		
025	PIN GAUGE FOR CAMSHAFT		STEEL	1		906-9741	1395345-7.2		
MT-03		CONTROL MEAS=355	0.376				BOX NO.		
030	PIN GAUGE FOR CAMSHAFT		STEEL	1		906-9743			
MT-03		CONTROL MEAS=100	-				BOX NO.		
	BLANK								
							BOX NO.		
	BLANK								
							BOX NO.		
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R
									5
									4
									3
									2
20031002	SCK	LYS	LYS		Tool no. 030 Added.				1
20020408	HSJ	LYS	LYS		First issued				0
TOOL		Type :				L/S70MC		HSD - MAN B&W	
Info. no. 906		Description :				TOOLS FOR CHAIN DRIVE AND CAMSHAFT		Ident.no. : -	

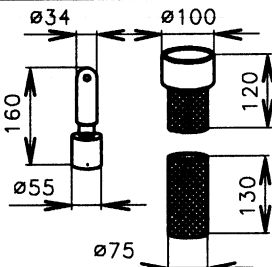
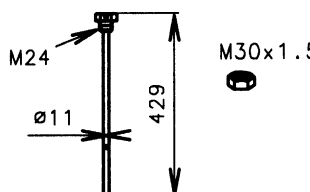
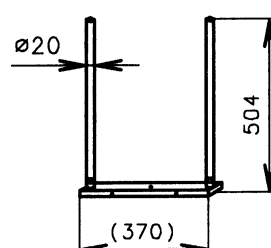
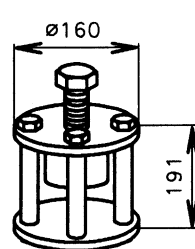
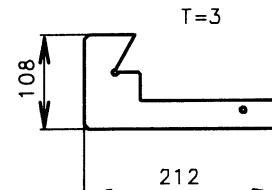


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
ARR. - TOOLS			W.T (kg)	STD.	ADD.			
056	STEEL BOX FOR HYD. JACK		STEEL	1		906-9221	0992211-6.0	
MT-06		150HX400WX400L	-				BOX NO.	
032	HYDR. JACK FOR CAMSHAFT STUD		STEEL	2			working press.: 900bar	
			9.151				0937753-3.0	
							BOX NO.	
044	SUPPORT FOR HYDR. JACK		STEEL	2			0937767-7.0	
			3.906				BOX NO.	
019 020	SPARE O-RING WITH BACK-UP RING		NBR TEFLON	EACH 4			1209819-5.1 1209807-5.1	
			-				BOX NO.	
237 345	KEY AND BALL HANDLE FOR HYD. JACK		STEEL	EACH 1			0955789-1.0 EN549A6	
			-				BOX NO.	
Similar no. :			Ship no. :		Scale : NONE	Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 906		Description : TOOLS FOR CHAIN DRIVE AND CAMSHAFT				Ident.no. : -		

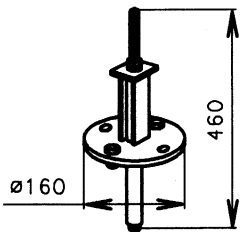
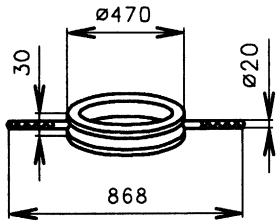


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
053	LIFTING TOOL FOR ROLLER GUIDE		STEEL	1		908-9821	0980120-2.3
P908			1.310				BOX NO.
065	LIFTING TOOL FOR EXH. VALVE		STEEL	1		908-9621	0980080-5.2
P908			2.640				BOX NO.
077	CONE RING FOR PNEUMATIC PISTON		STEEL	1		908-9622	1395010-2.0
P908			13.370				BOX NO.
089	TEST EQUIPMENT FOR EXH. VALVE		STEEL	1		908-9222	0976309-0.1
P908		RANGE=0-50 bar	5.004				BOX NO.
090	GAUGE FOR EXH. VALVE SPINDLE		STEEL	1		908-9640	0992380-4.1
P908		T=3	0.817				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass.(kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
20020527	HSJ	LYS	LYS	*	Tool No. 053,065 corrected		
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : L/S70MC/-C				HSD - MAN B&W	
Info. no. 908		Description : TOOLS FOR EXHAUST VALVE				Ident.no. : —	

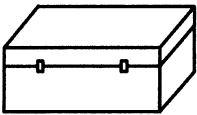
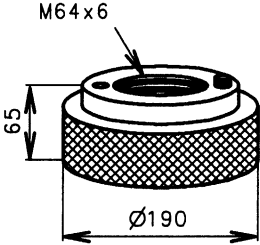
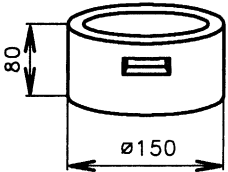
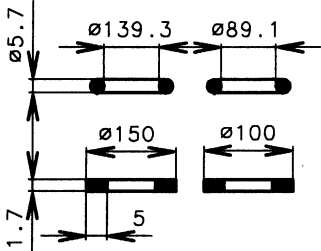
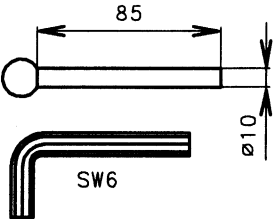


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
ARR.-TOOLS			W.T (kg)	STD.	ADD.		
112	GRINDING TOOL FOR HIGH PRESSURE PIPE		STEEL	1		908-9624	0980082-9.0
P908			5.588				BOX NO.
124	TOOL FOR EMERG. OPEN EXH. VALVE OPEN		STEEL	1		908-9650	0937887-5.2
P908			0.465				BOX NO.
136	BRIDGE GAUGE FOR EXH. VALVE		STEEL	1		908-9643	0938805-5.3
P908			4.580				BOX NO.
148	TOOL FOR HYDR. PISTON		STEEL	1		908-9625	0939024-7.1
P908			8.834				BOX NO.
150	GAUGE FOR EXH. V/V BOTTOM PIECE		STEEL	1		908-9641	1395214-0.4
P908			0.128				BOX NO.
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
				*			
				*			
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : L/S70MC-C				HSD - MAN B&W	
Info. no. 908		Description : TOOLS FOR EXHAUST VALVE				Ident.no. : -	



TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
173	LIFTING TOOL FOR ROLLER GUIDE OF EXH. VALVE		STEEL	2		908-9822	0938014-6.1	
P908			4.226				BOX NO.	
185	GRINDING RING FOR EXH. VALVE BOTTOM		STEEL	1		908-9626	3101767-2.0	
P908			8.554				BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC/-C				HSD - MAN B&W		
Info. no. 908		Description : TOOLS FOR EXHAUST VALVE				Ident.no. : —		

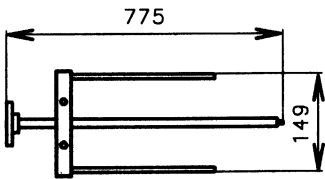
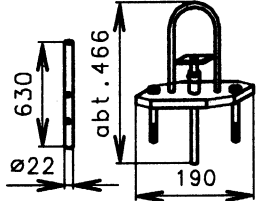
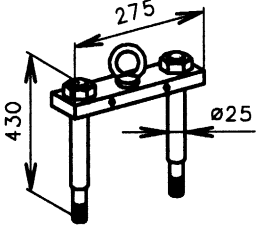
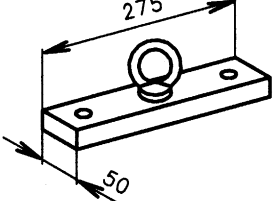
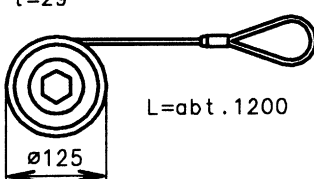
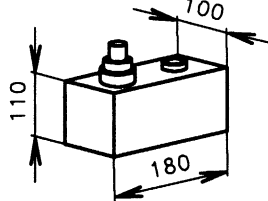


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
ARR.- TOOLS			W.T (kg)	STD.	ADD.		
065	STEEL BOX FOR HYD. JACK		STEEL	2		906-9221	0976500- 5.0
MT-08		150HX400WX400L	-				BOX NO.
041	HYDR. JACK FOR EXHAUST VALVE STUD		STEEL	4			working press.: 900bar
			11.212				0976501- 7.1
							BOX NO.
053	SUPPORT FOR HYDR. JACK		STEEL	4			0976502- 9.0
			5.114				BOX NO.
016 028	SPARE O-RING WITH BACK-UP RING		NBR TEFLON	EACH 8			0573667- 7.3
			-				0573656- 9.3
							BOX NO.
237 345	KEY AND BALL HANDLE FOR HYD. JACK		STEEL	EACH 2			0955789- 1.0
			-				EN549A6
							BOX NO.
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
				*			
				*			
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : L/S70MC				HSD - MAN B&W	
Info. no. 908		Description : TOOLS FOR EXHAUST VALVE				Ident.no. : -	



TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
046	EXH. VALVE SPINDLE AND SEAT GRINDING MACHINE		MAKER	1		908-9101	MAKER: KOKACO TYPE: NKK70BG POWER SOURCE: ELECTRIC AC440V/60Hz /ø3 1395161-1.2	
H			320.000				BOX NO.	
011	DISMANTLING STAND FOR EXHAUST VALVE		MAKER	1		908-9824	WHEEL TYPE 1395240-2.0	
H			250.000				BOX NO.	
802	PISTON RING OPENER FOR EXH. VALVE		STEEL	1		908-9823		
MT-03			0.620				BOX NO.	
	BLANK						BOX NO.	
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 908		Description : TOOLS FOR EXHAUST VALVE				Ident.no. : —		

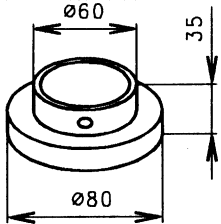
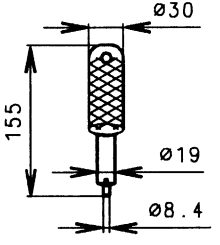
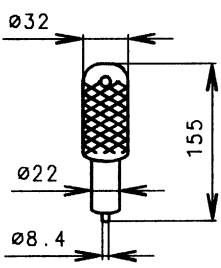
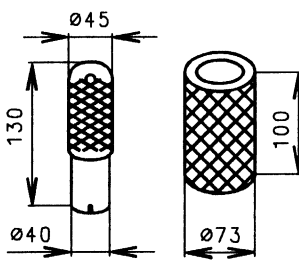
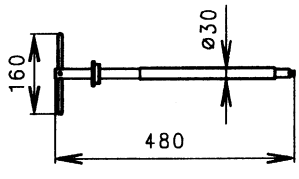


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
045	MEAS.TOOL FOR FUEL PUMP LEAD		STEEL	1		909-9641	3127249-0.0	
P909			2.060				BOX NO.	
069	LIFTING TOOL FOR FUEL PUMP		STEEL	1		909-9823	3102479-0.0	
P909			7.429				BOX NO.	
057	LIFTING TOOL FOR FUEL PUMP		STEEL	1		909-9821	3102078-7.0	
P909			7.429				BOX NO.	
070	LIFTING TOOL FOR FUEL PUMP HOUSING		STEEL	1		909-9822	3101004-0.0	
P909			3.160				BOX NO.	
082	LIFTING TOOL FOR ROLLER GUIDE		MAKER	1		909-9721	0992127-8.0	
P909			1.547				BOX NO.	
094	MILLING TOOL SEAT FOR FUEL OIL PIPE		SPECIAL-STEEL, WOOD	1		909-9621	0980311-9.0	
P909		110WX100HX180L	3.049				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408HSJ LYS LYS *					First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 909		Description : TOOLS FOR FUEL OIL SYSTEM				Ident.no. : -		

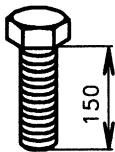
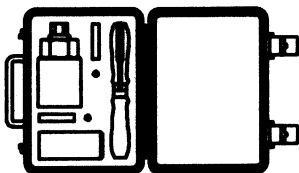
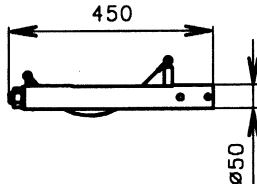
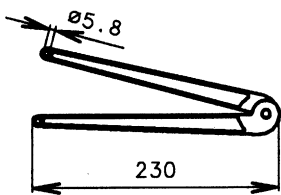
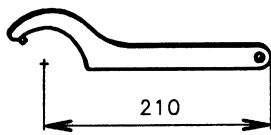
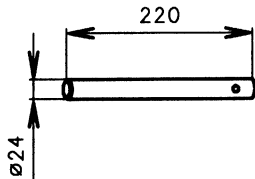


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
104	MILLING TOOL FOR FUEL OIL PIPE	M25x1.5/58" 80WX220HX155L	SPECIAL-STEEL, WOOD	1		909-9622	3100820-5.1	
P909			1.534				BOX NO.	
116	CROWFOOT SPANNER FOR PUNCTURE V/V	t=22 25 100 210	SPECIAL STEEL	1		909-9631	1770619-2.0	
P909			4.120				BOX NO.	
128	CROWFOOT SPANNER FOR SUCTION VALVE	t=22 25 75 155	SPECIAL STEEL	1		909-9632	1395073-6.0	
P909			2.135				BOX NO.	
130	CROWFOOT SPANNER FOR FUEL OIL PIPE	t=22 19 60 130	SPECIAL STEEL	1		909-9633	1383963-6.1	
P909			1.580				BOX NO.	
141	CROWFOOT SPANNER FOR FUEL OIL PIPE	t=15 19 41 105	SPECIAL STEEL	1		909-9635	1395241-4.0	
P909			1.100				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
20030416	HSJ	LYS	LYS	*	Tool No. 116/128/141 --> 141/116/128			1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 909		Description : TOOLS FOR FUEL OIL SYSTEM				Ident.no. : -		

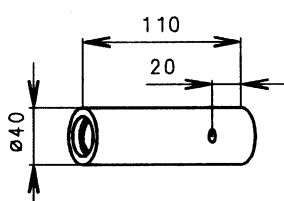
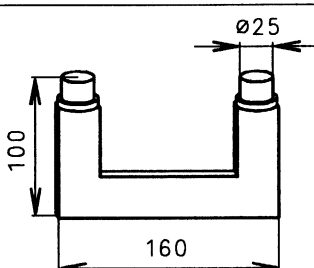
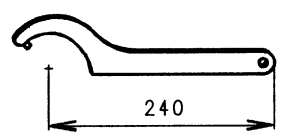


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
153	FLANGE DISM. NON RETURN V/V		STEEL	1		909-9628	1770517-3.0
P909			0.495				BOX NO.
165	GRINDING MANDREL FOR VALVE HEAD		SPECIAL STEEL	1		909-9624	0937096-6.0
P909			0.534				BOX NO.
177	GRINDING MANDREL FOR THRUST SPINDLE		SPECIAL STEEL	1		909-9625	0937947-5.0
P909			0.635				BOX NO.
189	GRINDING MANDREL FOR HOLDER-OUTSIDE		SPECIAL STEEL	1		909-9626	0980110-6.0
P906			2.955				BOX NO.
190	GRINDING MANDREL FOR HOLDER INSERT		SPECIAL STEEL	1		909-9623	1733639-4.1
			1.936				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
20030416	HSJ	LYS	LYS	*	Tool No. 189,190 dim corrected		
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type :	L/S70MC			HSD - MAN B&W	
Info. no. 909		Description :	TOOLS FOR FUEL OIL SYSTEM			Ident.no. : —	

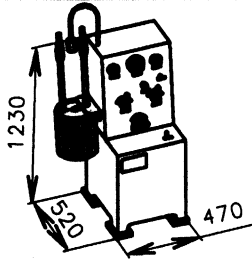
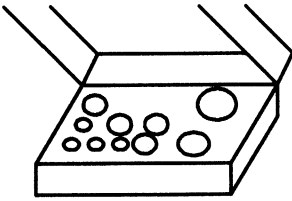
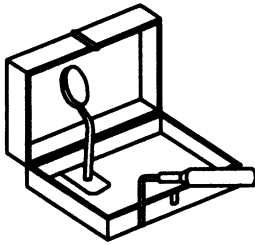
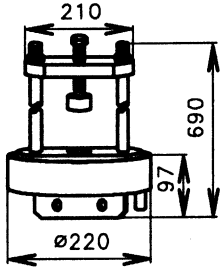


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
200	HEXAGON SCREWS FOR DISMANTLING OF TOP COVER		STEEL	2		909-9521	EN61V16150	
P909		M16x150	0.237				BOX NO.	
212	CLEANING TOOL FOR AUTOMIZER		STEEL, SPECIAL STEEL	1		909-9321	3102468-2.2	
MT-14			3.380				BOX NO.	
224	PULLING TOOL FOR P. MAX RACK		STEEL	1		909-9824	0992196-0.0	
P909			3.154				BOX NO.	
236	PIN WRENCH SPECIAL		STEEL	1		909-9636	1383803-2.1	
P909			0.275				BOX NO.	
248	HOOK WRENCH		SPECIAL STEEL	1		909-9637	0825308-3.1	
P909		TYPE = A68-75	0.200				BOX NO.	
250	DRIFT FOR SPINDLE GUIDE		COPPER	1		909-9630	1770602-3.1	
P909			0.840				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408HSJ LYS LYS *					First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 909		Description : TOOLS FOR FUEL OIL SYSTEM				Ident.no. : -		



TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
				W.T (kg)	STD.			ADD.
273	DRIFT FOR NON RETURN V/V		BRASS	1		909-9627	1770516-1.0	
P909			0.840				BOX NO.	
297	ASSEMBLING TOOL FOR FUEL VALVE		STEEL	1		909-9827	3128600-5.0	
P906			1.030				BOX NO.	
307	HOOK WRENCH	 TYPE = B95-100	SPECIAL STEEL	1		909-9638	1423812-8.1	
P909			0.300				BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
P909							BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type : L/S70MC				HSD - MAN B&W		
Info. no. 909		Description : TOOLS FOR FUEL OIL SYSTEM				Ident.no. : -		

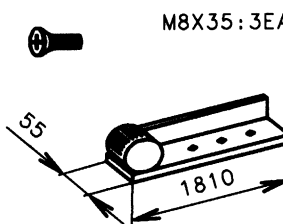
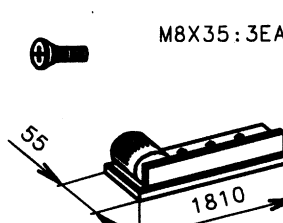
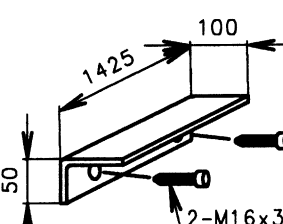


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
014 038 051 063	TESTING DEVEICE FOR FUEL VALVE		MAKER	1		909-9101	WOO AM: WBT789(N) 3100661- 1.0		
H			175.000				BOX NO.		
082 165 261 319	TOOLS MOUNTING OF SEALING FOR FUEL PUMP		MAKER	1		909-9650	3133355- 0.0		
MT-08			18.000				BOX NO.		
075	PROBE LIGHT		MAKER	1		909-9421	1750635- 0.0		
MT-09			1.100				BOX NO.		
901	DISMANTLING STAND FOR FUEL VALVE		STEEL	1		909-9825			
H			9.450				BOX NO.		
	BLANK								
							BOX NO.		
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				L/S70MC			HSD - MAN B&W
Info. no. 909		Description :				TOOLS FOR FUEL OIL SYSTEM			Ident.no. : —

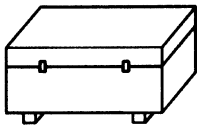
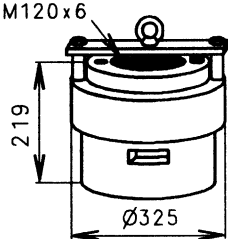
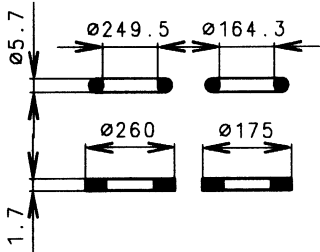
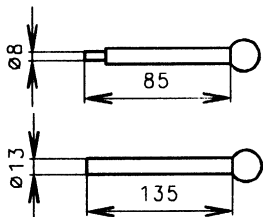
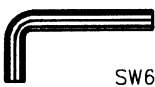


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
212	PULLING TOOL FOR COMPENSATOR		STEEL	3		910-9621	3102097-8.0		
P910			0.415				BOX NO.		
224	LIFTING EYE BOLT		SPECIAL STEEL	2		910-9521	EN69R12		
P910			0.200				BOX NO.		
	BLANK						BOX NO.		
171 183 195 205	ADJUSTMENT TOOL FOR EXPANSION JOINT		STEEL	1		910-9821	0983538-9.1		
P910			0.650				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	JSM	LYS	LYS	*	First issued			0	
TOOL		Type :				L/S70MC			HSD - MAN B&W
Info. no. 910		Description :				TOOLS FOR TURBOCHARGER AND AIR COOLER SYSTEM			Ident.no. : —

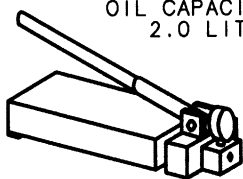
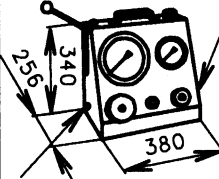
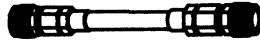
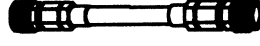
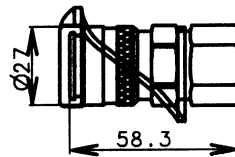
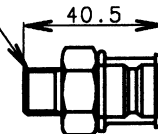


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
087 109	RAILL(1) FOR OVERHAULING TOOL FOR AIR COOLER		STEEL	1		910-9823 T122	0985110- 9.3 EN59S835		
H			4.909				BOX NO.		
099 109	RAILL(2) FOR OVERHAULING TOOL FOR AIR COOLER		STEEL	1		910-9824 T122	0985111- 0.3 EN59S835		
H			4.909				BOX NO.		
146 158	SECTIONAL IRON		STEEL	1		910-9822 T121	1388588- 9.1 EN61T1630		
H			15.800				BOX NO.		
	BLANK						BOX NO.		
	BLANK						BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20021202	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				K/L/S-MC (LKM-B/D/H)			HSD - MAN B&W
Info. no. 910		Description :				TOOLS FOR TURBOCHARGER AND AIR COOLER SYSTEM			Ident.no. : —

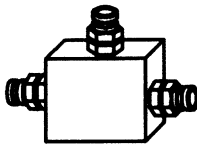
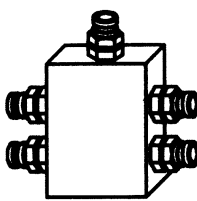
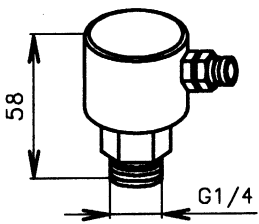
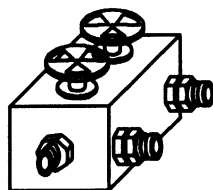


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
			W.T (kg)	STD.	ADD.		
059	STEEL BOX FOR HYD. JACK		STEEL	1		912-9221	0976430-9.0
MT-10		400Hx400Wx800L	28.100				BOX NO.
035 047	HYD. JACK FOR STAY BOLT		MAKER	2			WORKING PRESS: 900bar
			35.476				0937938-0.0
							BOX NO.
011 023	SPARE FOR O-RING WITH BACK-UP RING		NBR TEFLON	EACH 4			1209839-8.1 1209826-6.1
			-				BOX NO.
333 357	BALL HANDLE FOR HYD. JACK		STEEL	EACH 2			0955787-8.0 0955785-4.0
			-				BOX NO.
237	KEY FOR HYD. JACK		STEEL	1			EN549A6
			-				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass.(kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		R
				*			5
				*			4
				*			3
				*			2
20030526	HSJ	LYS	LYS	*	Tool No. 059 Size 300Hx400Wx700L ----> 400Hx400Wx800L		1
20020408	HSJ	LYS	LYS	*	First issued		0
TOOL		Type : L / S70MC				HSD - MAN B&W	
Info. no. 912		Description : TOOLS FOR STAY BOLT				Ident.no. : -	

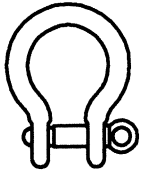
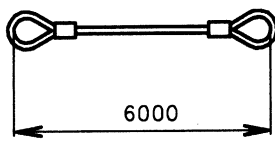
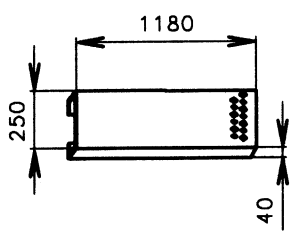


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
262	HYD. PUMP HAND OPERATED		MAKER	1		913-9222	1825069-9.4		
H		MAX. PRESS. : 1500bar	12.200				BOX NO.		
274	PNEUMATIC HYD. HIGH PRESSURE PUMP		MAKER	1		913-9221	TYPE : HPU1500-2 1383880-8.0		
H		H.P OUTLET: ISO 228/1-G1/4	20.000				BOX NO.		
010	FLEXIBLE HOSE FOR HYDR. TOOL (HIGH PRESSURE)		MAKER	4		913-9223	3102954-6.0		
MT-11		WORKING PRESS. =1500bar	0.706				BOX NO.		
022	FLEXIBLE HOSE FOR HYDR. TOOL (HIGH PRESSURE)		MAKER	1		913-9224	0693574-2.2		
MT-11		WORKING PRESS. =1500bar	1.256				BOX NO.		
192	QUICK COUPLING COMPLETE		MAKER	2		913-9231	0693565-8.5		
MT-11		WORKING PRESS.=1500bar	0.100				BOX NO.		
250	QUICK COUPLING MALE		MAKER	2		913-9230	0586183-2.7		
MT-11		WORKING PRESS.=1500bar	0.060				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				K/L/S-MC			HSD - MAN B&W
Info. no. 913		Description :				TOOLS GENERAL TOOLS			Ident.no. : —

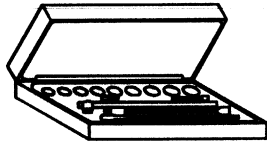


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
046	DISTRIBUTOR PIECE COMPLETE (3-WAY)		MAKER	2		913-9226	0693577- 8.2		
MT-11			0.689				BOX NO.		
058	DISTRIBUTOR PIECE COMPLETE (5-WAY)		MAKER	1		913-9227	0693579- 1.3		
MT-11			1.015				BOX NO.		
	BLANK						BOX NO.		
142	ANGLE UNION (90°)		MAKER	2		913-9229	0955624- 9.1		
MT-11			0.325				BOX NO.		
178	DISTRIBUTOR PIECE WITH NEEDLE VALVE (0-15)		MAKER	1		913-9228	0955979- 6.0		
MT-11			3.460				BOX NO.		
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408HSJ				LYS	LYS	* First issued		0	
TOOL		Type :				K/L/S-MC			HSD - MAN B&W
Info. no. 913		Description :				TOOLS GENERAL TOOLS			Ident.no. : —

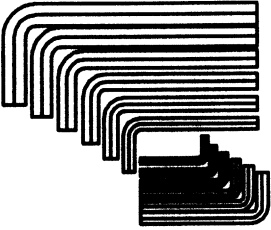
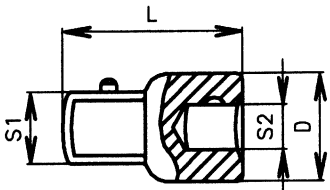
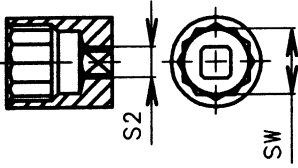


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS								
			W.T (kg)	STD.	ADD.										
911	SHACKLE	 <table border="1"> <tr><th>SIZE</th></tr> <tr><td>10</td></tr> <tr><td>12</td></tr> <tr><td>16</td></tr> <tr><td>20</td></tr> <tr><td>24</td></tr> <tr><td>30</td></tr> <tr><td>33</td></tr> </table>	SIZE	10	12	16	20	24	30	33	STEEL	EACH 4 M33 2		913-9521	0992308- 8.1 EN518E
SIZE															
10															
12															
16															
20															
24															
30															
33															
MT-11			-				BOX NO.								
912	EYE BOLT	 <table border="1"> <tr><th>SIZE</th></tr> <tr><td>10</td></tr> <tr><td>12</td></tr> <tr><td>16</td></tr> <tr><td>20</td></tr> <tr><td>24</td></tr> <tr><td>30</td></tr> <tr><td>36</td></tr> </table>	SIZE	10	12	16	20	24	30	36	STEEL	4 4 4 4 8 4 4		913-9521	0992308- 8.1 EN69R
SIZE															
10															
12															
16															
20															
24															
30															
36															
MT-11			-				BOX NO.								
018	WIRE ROPE		STEEL-WIRE	1		913-9921	0582845- 0.0								
H		SWL: 5800KG	12.000				BOX NO.								
043	FOOT GRATING		ALUMINIUM-ALLOY	6		913-9922	1395162- 3.2								
H			5.070				BOX NO.								
114	PULL LIFT		MAKER	3		913-9522	1383926- 6.0								
H		MAX. 3000Kg	16.300				BOX NO.								
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)								
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R							
				*				5							
				*				4							
				*				3							
				*				2							
				*				1							
20020408	JSM	LYS	LYS	*	First issued			0							
TOOL		Type :				L/S70MC			HSD - MAN B&W						
Info. no. 913		Description :				TOOLS GENERAL TOOLS			Ident.no. : -						

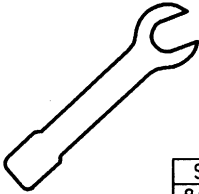
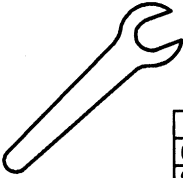
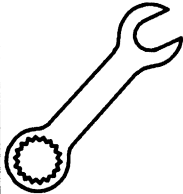
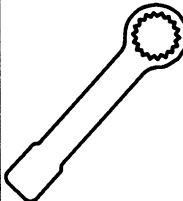
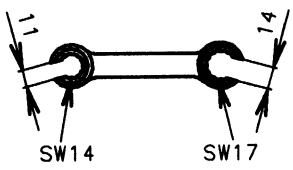
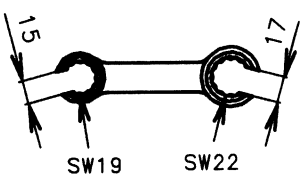


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
914	SOCKET WRENCH SET EN563H1 (12.5 MM) RATCHET HANDLE HANDLE WITH SLIDING PIESE UNIVERSAL JOINT EXTENDER BOX SPANNER BOX SPANNER FOR INSIDE HEXAGON BOX FOR TOOL SET	 EN506B 12.5 EN506A 12.5 EN506P 12.5 EN506F 12.5 125 EN506F 12.5 250 EN506L 10 EN506L 13 EN506L 16 EN506L 18 EN506L 21 EN506G 5 EN506G 6 EN506G 7 EN506G 8 EN506G 10 EN506G 12 EN563G 1	SPECIAL STEEL	1 SET		913-9524	3102527-0.4	
			5.400				BOX NO.	
	EN563H2 (20.0 MM) RATCHET HANDLE HANDLE WITH SLIDING PIESE UNIVERSAL JOINT EXTENDER BOX SPANNER BOX SPANNER FOR INSIDE HEXAGON BOX FOR TOOL SET	EN506B 20.0 EN506A 20.0 EN506P 20.0 EN506F 20.0 200 EN506F 20.0 400 EN506L 24 EN506L 27 EN506L 30 EN506L 34 EN506L 36 EN506L 41 EN506G 14 EN506G 17 EN506G 19 EN563G 2	SPECIAL STEEL	1 SET		913-9525	3102527-0.4	
			13.900				BOX NO.	
MT-12								
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
20031002	SCK	LYS	LYS	*	En563H2 (20.0 MM) Box Spanner Size changed.			2
20030320	HSJ	LYS	LYS	*	Tool No. 914 corrected.			1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type :				K/L/S-MC		HSD - MAN B&W
Info. no.		Description :				Ident.no.:		
913		TOOLS GENERAL TOOLS						-

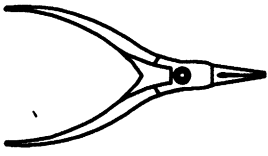
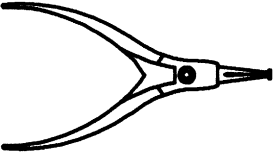


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS															
			W.T (kg)	STD.	ADD.																	
915	SOCKET WRENCH KEY SET FOR INTERNAL HEX.		SPECIAL STEEL	1 SET		913-9526																
		<table border="1"> <tr> <td rowspan="3">SIZE</td> <td>1.5</td> <td>2</td> <td>2.5</td> <td>3</td> <td>4</td> </tr> <tr> <td>5</td> <td>6</td> <td>7</td> <td>8</td> <td>10</td> </tr> <tr> <td>12</td> <td>14</td> <td>17</td> <td>19</td> <td></td> </tr> </table>	SIZE	1.5	2	2.5	3	4	5	6	7	8	10	12	14	17	19					3102527- 0.4
SIZE	1.5	2		2.5	3	4																
	5	6		7	8	10																
	12	14	17	19																		
MT-12			2.000				BOX NO.															
016 028	ADAPTER FOR SOCKET WRENCH		SPECIAL STEEL	EACH 1		913-9527 9528																
		<table border="1"> <tr> <td rowspan="3">SIZE</td> <td>S1</td> <td>S2</td> <td>L</td> <td>D</td> </tr> <tr> <td>20</td> <td>12.5</td> <td>50</td> <td>30</td> </tr> <tr> <td>12.5</td> <td>10</td> <td>38</td> <td>23</td> </tr> </table>	SIZE	S1	S2	L	D	20	12.5	50	30	12.5	10	38	23				0820113- 7.1			
SIZE	S1	S2		L	D																	
	20	12.5		50	30																	
	12.5	10	38	23																		
MT-12			-				BOX NO.															
1317 1318 1319 1320	SOCKET SPANNER		SPECIAL- STEEL	EACH 1		913-9529 -9530 -9531 -9532																
		<table border="1"> <tr> <td rowspan="2">SW</td> <td>36</td> <td>46</td> <td>60</td> <td>80</td> </tr> <tr> <td>S2</td> <td>3/4"</td> <td>3/4"</td> <td>1"</td> </tr> </table>	SW	36	46	60	80	S2	3/4"	3/4"	1"				EN506L46							
SW	36	46		60	80																	
	S2	3/4"	3/4"	1"																		
MT-12			-				BOX NO.															
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)																
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R														
				*				5														
				*				4														
				*				3														
				*				2														
				*				1														
20020408	HSJ	LYS	LYS	*	First issued			0														
TOOL		Type :				HSD - MAN B&W																
Info. no. 913		Description :				Ident.no.:																
		TOOLS GENERAL TOOLS				-																

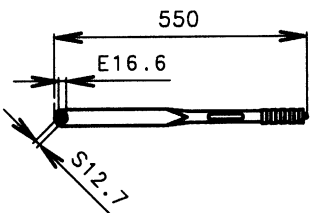
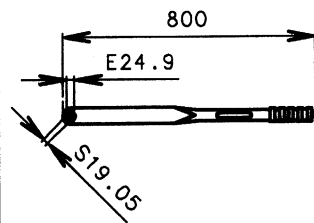
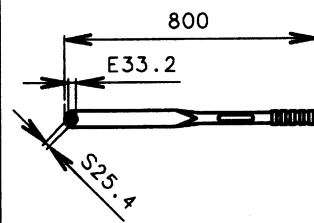
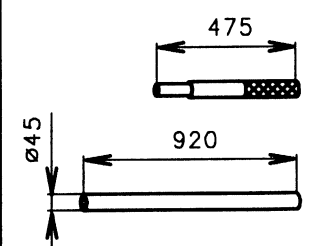


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
916	SINGLE OPEN ENDED IMPACT WRENCH		SPECIAL-STEEL	EACH 1		913-9535	0937929-6.1		
MT-13		SIZE(SW) 85 95 -	13.300				BOX NO.		
917	SINGLE OPEN ENDED WRENCH		SPECIAL-STEEL	EACH 1		913-9533	0937935-5.1		
MT-12		SIZE(SW) 65 75 85 95 - -	14.462				BOX NO.		
919	COMBINATION WRENCH		SPECIAL-STEEL	EACH 1		913-9523	3102526-9.0		
MT-12		SIZE(SW) 10 11 12 13 14 15 16 17 18 19 21 22 24 27 30 32 34 36 41 46 50 55 60 -	22.775				BOX NO.		
920	RING IMPACT WRENCH		SPECIAL-STEEL	EACH 1		913-9534	3102840-7.0		
MT-13		SIZE(SW) 30 32 34 36 41 46 50 55 60 65 70 75 80 85 95 100 115 -	49.750				BOX NO.		
011	SPECIAL WRENCH		SPECIAL-STEEL	1		913-9536	0555607-0.2		
MT-12			0.100				BOX NO.		
023	SPECIAL WRENCH		SPECIAL-STEEL	1		913-9536	1281330-7.2		
MT-12			0.250				BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				L/S70MC			HSD - MAN B&W
Info. no.		Description :				Ident.no.:			
913		TOOLS GENERAL TOOLS							

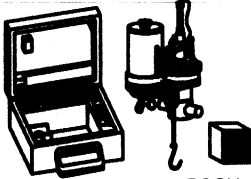
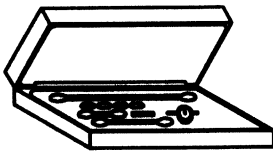
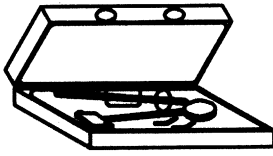
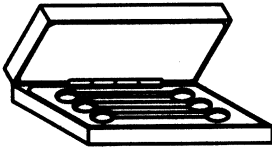
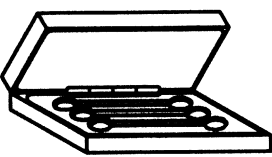
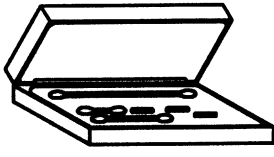


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
072 084 096 106 118	PLIER FOR RETAINING RING -SHAFT TYPE		MAKER	EACH 1		913-9537	3102471- 6.0		
MT-12		TYPE 072 084 096 106 118 D05 D10 D19 D32 D85	-				BOX NO.		
131 143 155 167	PLIER FOR RETAINING RING -HOLE TYPE		MAKER	EACH 1			3102471- 6.0		
MT-12		TYPE 131 143 155 167 H10 H19 H32 H85	-				BOX NO.		
	BLANK						BOX NO.		
	BLANK						BOX NO.		
	BLANK						BOX NO.		
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
20020408	HSJ	LYS	LYS	*	First issued			0	
TOOL		Type :				L/S-MC/-C			HSD - MAN B&W
Info. no. 913		Description :				TOOLS GENERAL TOOLS			Ident.no. : -

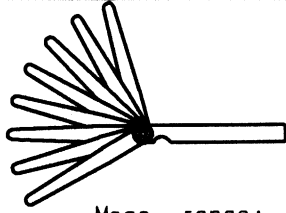
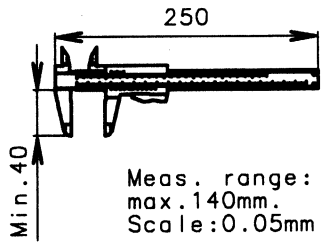


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
047	TORQUE WRENCH (40-200Nm)		MAKER	1		913-9540	0694471-6.2	
MT-12			1.400				BOX NO.	
059	TORQUE WRENCH (140-760Nm)		MAKER	1		913-9541	0535518-6.5	
H			5.000				BOX NO.	
060	TORQUE WRENCH WITH EXTENSION (750-2000Nm)		MAKER	1		913-9542	0404364-1.5	
	SLIDING EXTENSION BAR						BOX NO.	
H			11.100					
	BLANK						BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type :				HSD - MAN B&W		
Info. no.		Description :				Ident.no.:		
913		GENERAL TOOLS				-		

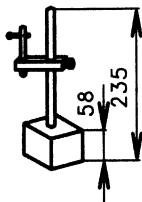
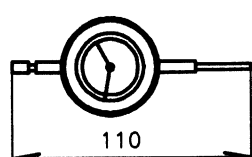
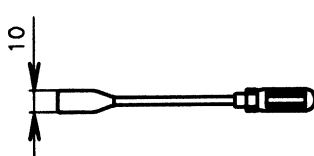
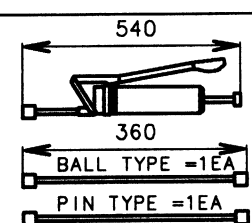
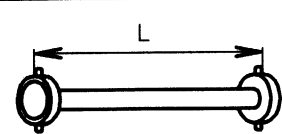


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
012 036	INDICATOR WITH CARD	 TYPE=50Z 50SH x 5BLOCK	MAKER	1		913-9421	1326573- 2.2 0690188- 0.3	
MT-09			4.600				BOX NO.	
024	MEASURING TOOL FOR CRANK SHAFT		MAKER	1		913-9321	0547209- 8.4	
MT-09			0.457				BOX NO.	
048	PLANIMETER COMPLETE	 HAFF NO : 317	MAKER	1		913-9422	0437324- 0.3	
MT-09			0.800				BOX NO.	
073	FEELER GAUGE FOR MAIN BRG.	 THICKNESS=0.05-0.35mm	MAKER	1		905-9321	3128237- 5.0	
MT-09			2.389				BOX NO.	
085	FEELER GAUGE FOR MAIN BRG.	 THICKNESS=0.40-0.70mm	MAKER	1		905-9322	3128245- 8.0	
MT-09			2.389				BOX NO.	
061	MICROMETER PIN GAUGE SET	 MEASURING LENGTH L=50-1000mm	MAKER	1		902-9321	0479105- 2.2	
MT-09			1.915				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HJSJ	LYS	LYS	*	First issued			0
TOOL		Type :				K/L/S-MC		HSD - MAN B&W
Info. no. 913		Description :				TOOLS GENERAL TOOLS		Ident.no. : —

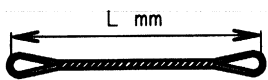
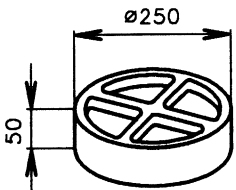
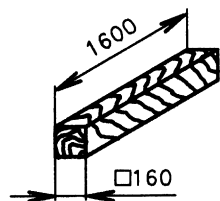
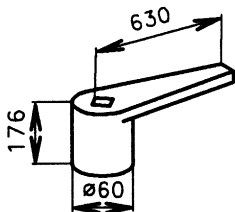
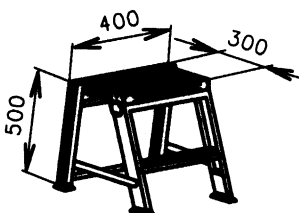
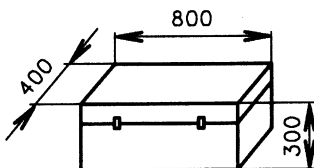


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
ARR.-TOOLS			W.T (kg)	STD.	ADD.			
065	FEELER GAUGE SET	 Meas. range: 0.05-1.0mm	MAKER	1		913-9322	1414820-1.0	
MT-09			0.090				BOX NO.	
067	SLIDE CALIPER	 Meas. range: max. 140mm. Scale: 0.05mm	MAKER	1		913-9323	1414821-3.0	
MT-09			0.153				BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type :				HSD - MAN B&W		
Info. no. 913		Description :				Ident.no.:		
		TOOLS GENERAL TOOLS				—		

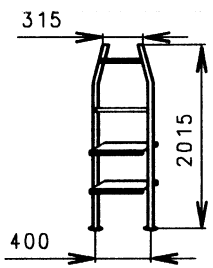
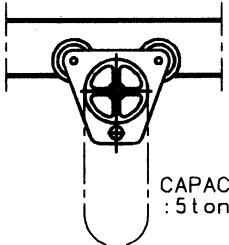


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
1301	MAGNET BASE		MAKER	1		913-9325		
MT-09			1.600				BOX NO.	
1302	DIAL GAUGE	2046E-08 	MAKER	1		913-9326		
MT-09			0.380				BOX NO.	
1304	SCREW DRIVER	 SIZEP:10	MKAER	1		913-9538		
MT-12			0.400				BOX NO.	
1305	GREASE GUN		MAKER	1		913-9543		
MT-11			1.500				BOX NO.	
1306	CARBORUNDUM	No.1000  No.80 	MAKER	EACH 1		913-9924		
MT-11			0.800				BOX NO.	
1307 1308 1316	AIR HOSE	 SIZE (L=m) 5 10 20	MAKER	EACH 1		913-9240 9241 9242		
H			-				BOX NO.	
Similar no. :		Ship no. :		Scale : NONE		Mass.(kg)		
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
20020824	HSJ	LYS	LYS	*	Tool No. 1302 corrected			1
20011220	HSJ	LYS	LYS	*	First issued			0
TOOL		Type :				HSD - MAN B&W		
Info. no. 913		Description :				Ident.no.:		
		TOOLS GENERAL TOOLS				-		

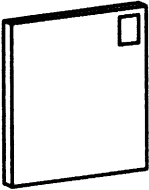
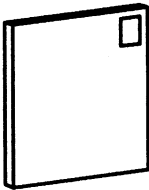
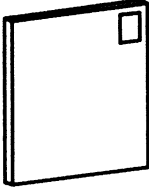
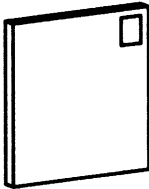
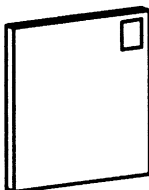


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS								
			W.T (kg)	STD.	ADD.										
1309 1310	WIRE ROPE		MAKER	EACH 2		913-9924 -9925									
H		<table border="1"> <tr> <td rowspan="3">SIZE</td> <td>L mm</td> <td>SWL: Kg</td> </tr> <tr> <td>3000</td> <td>1600</td> </tr> <tr> <td>3000</td> <td>2400</td> </tr> </table>	SIZE	L mm	SWL: Kg	3000	1600	3000	2400	-				BOX NO.	
SIZE	L mm	SWL: Kg													
	3000	1600													
	3000	2400													
1311	SURFACE PLATE		MAKER	1		913-9621									
MT-11			8.500				BOX NO.								
1312	SLEEPER		MKAER	4		913-9926									
H			1.800				BOX NO.								
1313	LEVER FOR MAIN STARTING VALVE		MAKER	1		913-9821	TO BE ASSEMBLED THE MAIN ENG.								
H			3.160				BOX NO.								
1317	SPECIAL LADDLE		MAKER	1		913-9927									
H			2.500				BOX NO.								
250	STEEL BOX FOR GENERAL TOOLS/ SPARE PART PACKING		MAKER	1		913-9830									
H			-				BOX NO.								
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)									
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R						
				*					5						
				*					4						
				*					3						
				*					2						
				*					1						
				*					0						
20020408		HSJ	LYS	LYS	*	First issued									
TOOL		Type :				K/L/S-MC		HSD - MAN B&W							
Info. no. 913		Description :				TOOLS GENERAL TOOLS		Ident.no. : -							

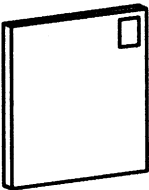
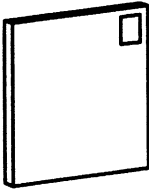
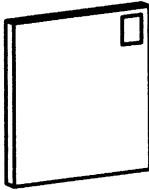


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
1320	LADDER FOR LUBRICATOR		STEEL	1		913-9928	ASSEMBLED THE MAIN BODY		
H			25.100				BOX NO.		
1315	GEARED TROLLEY FOR CON. ROD OVERHAULING (5ton)		MAKER	1		913-9552	ASSEMBLED THE MAIN BODY		
H			52.000				1072127-8.0	BOX NO.	
	BLANK						BOX NO.		
	BLANK						BOX NO.		
	BLANK						BOX NO.		
	BLANK						BOX NO.		
Similar no. :			Ship no. :			Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:				R
				*					5
				*					4
				*					3
				*					2
				*					1
20020506	HSJ	LYS	LYS	*	First Issued				0
TOOL		Type :				K/L/S70MC/-C		HSD - MAN B&W	
Info. no. 913		Description :				TOOLS GENERAL TOOLS		Ident.no. : —	

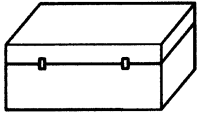
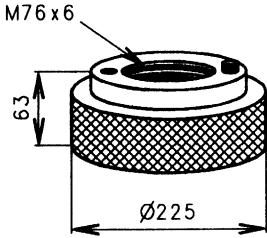
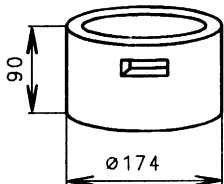
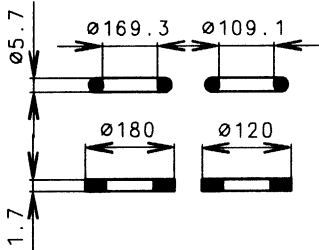
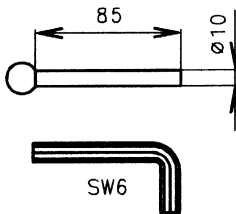


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
901	TOOL PANEL FOR CYL. COVER (MS901)		STEEL		1	901-9830	3127814-5.0	
H		SIZE = 25TX900X1350	43.784				BOX NO.	
902	TOOL PANEL FOR PISTON AND STUFFING BOX (MS902)		STEEL		1	902-9830	3127815-7.0	
H		SIZE = 25TX900X1800	55.994				BOX NO.	
904	TOOL PANEL FOR CON. RON AND CROSS HEAD (MS904)		STEEL		1	904-9830	3128255-4.0	
H		SIZE = 25TX900X1350	50.685				BOX NO.	
905	TOOL PANEL FOR CRANKSHAFT AND MAIN BEARING (MS905)		STEEL		1	905-9830	3102430-4.1	
H		SIZE = 25TX900X1350	29.239				BOX NO.	
906	TOOL PANEL FOR CHAIN DRIVE (MS906)		STEEL		1	906-9830	0937976-2.0	
H		SIZE = 25TX900X900	31.000				BOX NO.	
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408	HSJ	LYS	LYS	*	First issued			0
TOOL		Type :				S70MC		HSD - MAN B&W
Info. no. 915		Description :				TOOLS PANELS OF MAIN ENGINE		Ident.no. : —

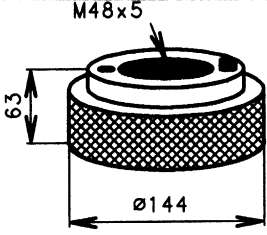
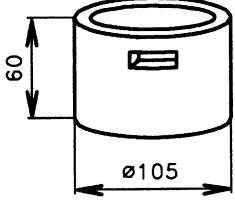
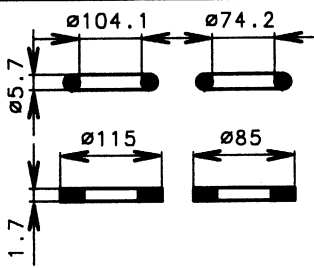


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS	
			W.T (kg)	STD.	ADD.			
908	TOOL PANEL FOR EXH. VALVE (MS908)		STEEL		1	908-9830	3102411-8.4	
H		SIZE = 25TX900X1350	45.594				BOX NO.	
909	TOOL PANEL FOR FUEL OIL SYSTEM (MS909)		STEEL		1	909-9830	3127295-7.0	
H		SIZE = 25TX900X1350	46.950				BOX NO.	
910	TOOL PANEL FOR T/C SYSTEM (MS910)		STEEL		1	910-9830	3127973-7.0	
H		SIZE = 25TX900X450	15.211				BOX NO.	
	BLANK						BOX NO.	
	BLANK						BOX NO.	
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)	
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R
				*				5
				*				4
				*				3
				*				2
				*				1
20020408 HJSJ LYS LYS *					First issued			0
TOOL		Type : S70MC				HSD - MAN B&W		
Info. no. 915		Description : TOOL PANELS OF MAIN ENGINE				Ident.no. : -		

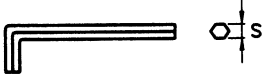
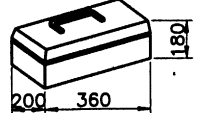
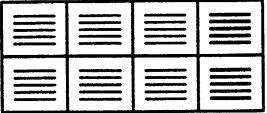


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS
ARR. - TOOLS			W.T (kg)	STD.	ADD.		
132	BOX FOR HYD. JACK		STEEL		1	924-9221	3100854-1.0
MT-14		150HX400WX400L	14.270				BOX NO.
120	HYD. JACK FOR END CHOCK BOLT		MAKER		1		WORKING PRESS: SEE MAINTENANCE BOOK 3100892-3.1
			15.610				BOX NO.
119	SUPPORT FOR HYDR. JACK		SPECIAL STEEL		1		0980304-8.0
			7.214				BOX NO.
097 107	SPARE FOR O-RING WITH BACK-UP RING		NBR TEFLON		EACH 4		1209827-8.1 1209814-6.1
			-				BOX NO.
237 345	KEY AND BALL HANDLE FOR HYD. JACK		STEEL		EACH 1		0955789-1.0 EN549A6
			-				BOX NO.
Similar no. :			Ship no. :		Scale : NONE		Mass. (kg)
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:		
				*			
				*			
				*			
				*			
				*			
20030526	HSJ	LYS	LYS	*	Tool No. 132 Size 150Hx400Wx600L ---> 150Hx400Wx400L		
20020408	HSJ	LYS	LYS	*	First issued		
TOOL		Type : L/S70MC				HSD - MAN B&W	
Info. no. 924		Description : TOOLS FOR ENGINE SEATING				Ident.no. : -	

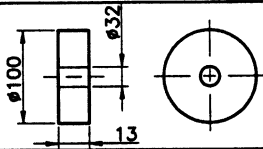
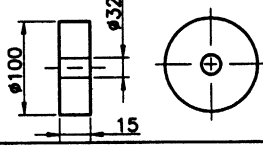
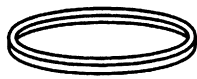


TOOL NO.	DESCRIPTION	SKETCH	MATERIAL	Q'TY/SHIP		P-NO.	REMARKS		
			W.T (kg)	STD.	ADD.				
048	HYDR. JACK FOR HOLDING DOWN BOLT		MAKER	1		924-9221	WORKING PRESS: 900bar 3100843-3.0		
			6.169				BOX NO.		
061	JACK HYDRAULIC SUPPORT		SPECIAL STEEL	1				0938346-5.0	
			1.906			BOX NO.			
012 036	SPARE FOR O-RING WITH BACK-UP RING		NBR TEFLON	EACH 4			1209813-4.1 1209807-5.1		
			-			BOX NO.			
	BLANK								
						BOX NO.			
	BLANK								
						BOX NO.			
Similar no. :		Ship no. :		Scale : NONE		Mass. (kg)			
Date	Des.	Chk.	Appd.	A.C	Replace by Ident.no.:			R	
				*				5	
				*				4	
				*				3	
				*				2	
				*				1	
				*				0	
20020408		HSJ	LYS	LYS	*	First issued			
TOOL		Type :				L/S70MC			HSD - MAN B&W
Info. no. 924		Description :				TOOLS FOR ENGINE SEATING			Ident.no. : —



TOOLS					<table border="1"> <tr> <td>PAGE</td> <td>990-1</td> </tr> <tr> <td>BOX NO.</td> <td>MT-15</td> </tr> </table>		PAGE	990-1	BOX NO.	MT-15
PAGE	990-1									
BOX NO.	MT-15									
B&W 70MC/MC-C MAIN ENGINE					SHIP NO					
					BOX NO					
EXH. VALVE GRINDING MACHINE					MODEL NO : NKK 70BG					
NO	NAME	SKETCH	MATE- RIAL	SUPPLY PER MACHINE		DRAWING NO	REMARKS			
				WORK	SPARE					
1	LIFTING TOOL FOR EXH. V/V SPINDLE		TOOL STEEL	1	—					
2	HEX. WRENCH		TOOL STEEL	EACH 1	—		1.5,2 2.5,3,3.5,4 5,6,8,10			
3	+ DRIVER		MAKER	1	—					
4	DIAL GAUGE		MAKER	1	—		0.01~ 10mm			
5	MAGNET STAND		MAKER	1	—					
6	TOOL BOX		MAKER	1	—					
7	SURFACE TESTER		MAKER	1	—					
MFR'S NAME			KOKACO CO., LTD.							



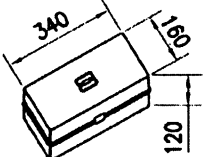
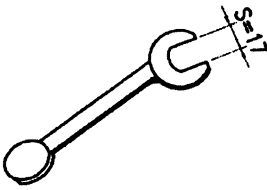
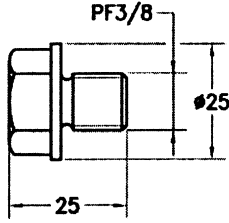
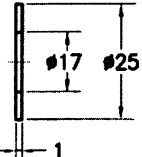
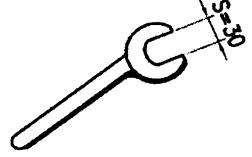
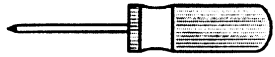
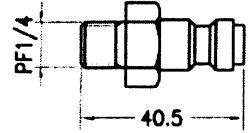
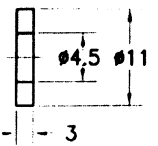
SPARES				<table border="1"> <tr> <td>PAGE</td> <td>990-2</td> </tr> <tr> <td>BOX NO.</td> <td>MT-15</td> </tr> </table>		PAGE	990-2	BOX NO.	MT-15
PAGE	990-2								
BOX NO.	MT-15								
B&W 70MC/MC-C MAIN ENGINE				SHIP NO					
				BOX NO					
EXH. VALVE GRINDING MACHINE				MODEL NO : NKK 70BG					
NO	NAME	SKETCH	MATE- RIAL	SUPPLY PER MACHINE		DRAWING NO	REMARKS		
				WORK	SPARE				
1	GRINDING STONE (ROUGH)		PA54L35S	1	2				
	GRINDING STONE (FINE)		PVA150	1	1				
2	V - BELT		MAKER	2	2		GATES 5M615		
				1	1		B 50		
				1	1		A 26		
3	LAPPING OIL		MAKER	1	-		HANCUT A-60H HANYOUNG CHEMICAL		
MFR'S NAME		KOKACO CO., LTD.							



FUEL VALVE TEST DEVICE
TYPE : VTU-1100N-Mk.2

PAGE
10

SHIP NO :

NO.	NAME	SKETCH	MATERIAL	SUPPLY PER SHIP			DRAWING NO.	REMARK
				STAND- -ARD	ADDIT- -ION	TOTAL		
1	BOX		PLASTIC	1	-	1		
1-1	COMBINATION SPANNER		TOOL STEEL	1	-	1		
1-2	HEXAGON HEAD PLUG WITH FLANGE AND GASKET		STEEL	1	-	1		
				1	-	1		
1-3	SINGLE OPEN ENDED SPANNER		TOOL STEEL	1	-	1		
1-4	+ DRIVER		-	1	-	1		
1-5	MALE COUPLER		STEEL	1	-	1		
1-6	DISC		COPPER	1	-	6		

MANUFACTURER'S NAME



HANMI HYDRAULIC MACHINERY CO., LTD.



SPARE

PAGE 991-2

BOX NO. MT-15

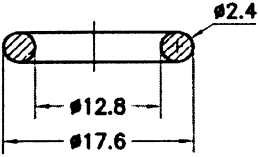
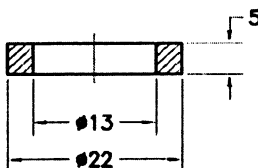
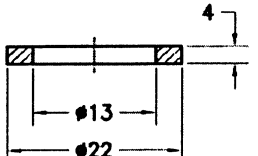
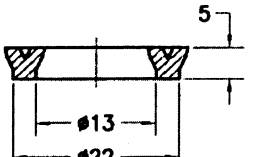
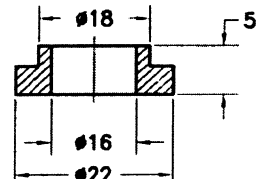
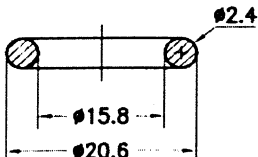
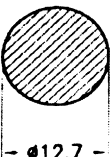
FUEL VALVE TEST DEVICE

PAGE

11

TYPE : VTU-1100N-Mk.2

SHIP NO :

NO.	NAME	SKETCH	MATERIAL	SUPPLY PER SHIP			OLD DWG NO.	NEW DWG NO.	REMARK
				STAND- ARD	ADDITION	TOTAL			
1-7	O-RING		N.B.R	1	-	1	AP1100-09	12-1109-0	
1-8	SPACER		BC3	1	-	1	AP1100-11	12-1111-0	
1-9	BACK-UP RING		TEFLON	1	-	1	AP1100-12	12-1112-0	
1-10	PACKING SEAL		URETANE	1	-	1	AP1100-13	12-1113-0	
1-11	SUPPORT RING		BC3	1	-	1	AP1100-14	12-1114-0	
1-12	O-RING		N.B.R	2	-	2	AP1100-19	12-1119-0	
1-13	BALL		STEEL	2	-	2	AP1100-21	12-1121-0	

MANUFACTURER'S NAME



HANMI HYDRAULIC MACHINERY CO., LTD.



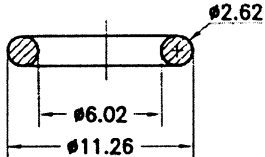
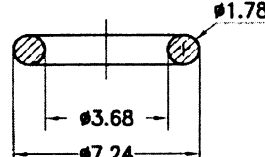
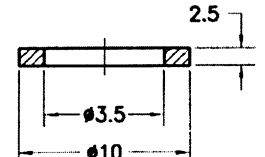
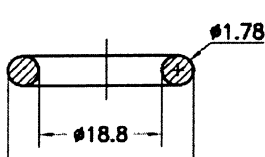
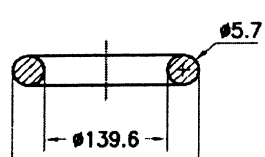
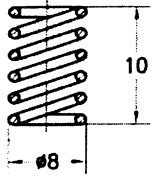
SPARE

FUEL VALVE TEST DEVICE

TYPE : VTU-1100N-Mk.2

PAGE
12

SHIP NO :

NO.	NAME	SKETCH	MATERIAL	SUPPLY PER SHIP			OLD DWG NO.	NEW DWG NO.	REMARK
				STAND- -ARD	ADDIT- -ION	TOTAL			
1-14	O-RING		N.B.R	2	-	2	AP1100-31	12-1131-0	
1-15	O-RING		N.B.R	2	-	2	AP1100-32	12-1132-0	
1-16	WASHER		Bc3	2	-	2	AP1100-33	12-1133-0	
1-17	O-RING		N.B.R	8	-	8	AP1100-45	12-1145-0	
1-18	O-RING		N.B.R	1	-	1	AP1100-48	12-1148-0	
1-19	SPRING		SUP10	2	-	2	AP1100-64	12-1164-0	

MANUFACTURER'S NAME



HANMI HYDRAULIC MACHINERY CO., LTD.



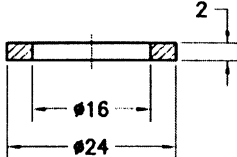
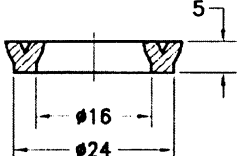
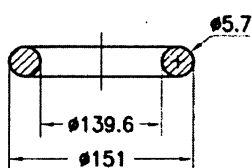
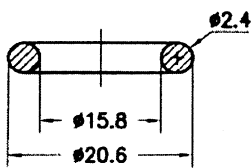
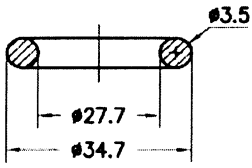
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FUEL VALVE TEST DEVICE

PAGE
13

TYPE : VTU-1100N-Mk.2/ACCUMULATOR

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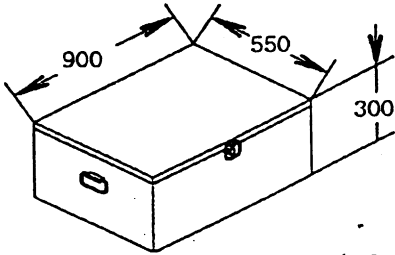
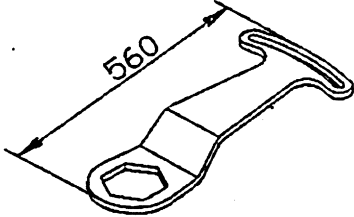
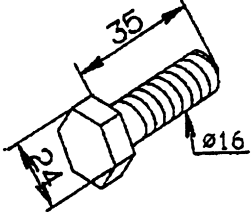
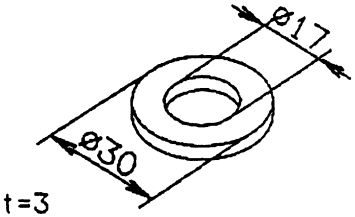
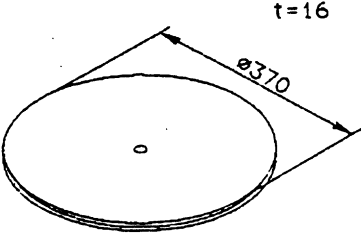
NO.	NAME	SKETCH	MATERIAL	SUPPLY PER SHIP			DRAWING NO.	REMARK
				STAND- -ARD	ADDIT- -ION	TOTAL		
1-20	BACK-UP RING		TEFLON	1	-	1	12-2111-0	
1-21	PACKING SEAL		URETANE	1	-	1	12-2112-0	
1-22	O-RING		N.B.R	1	-	1	12-2117-0	
1-23	O-RING		N.B.R	1	-	1	12-2120-0	
1-24	O-RING		N.B.R	1	-	1	12-2121-0	

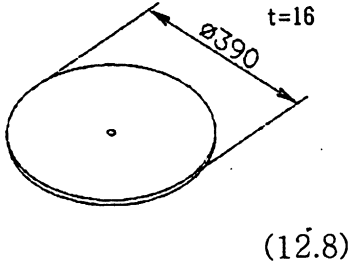
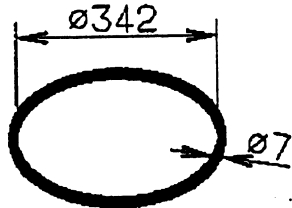
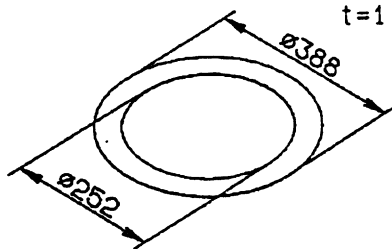
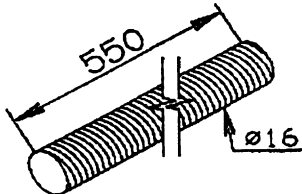
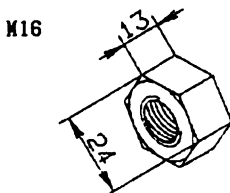
MANUFACTURER'S NAME

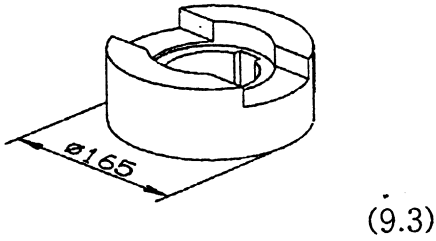
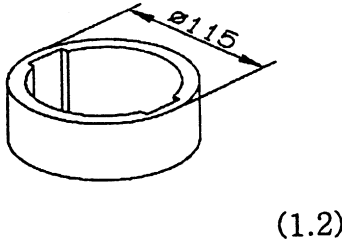
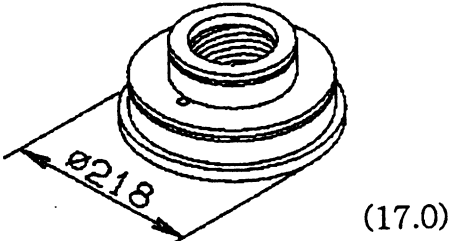
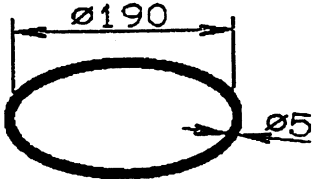
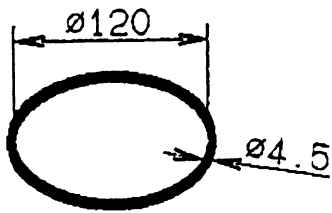


HANMI HYDRAULIC MACHINERY CO., LTD.

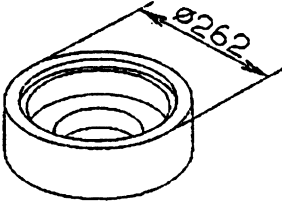
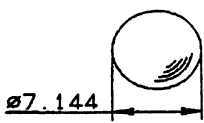
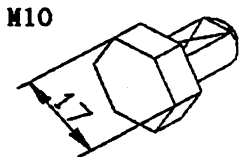
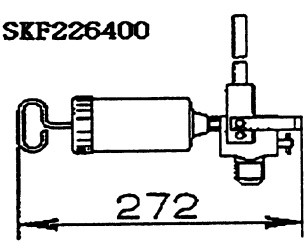
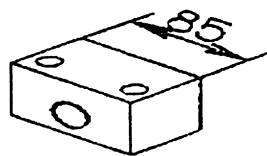


SAMSUNG-MAN B&W		TOOL LIST	Ship No	
		NA - 70	Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity	
596.001	Werkzeugkiste Tool box	 (10.0)	1	
596.018	Festhal teschlüssel Holding key	 (4.0)	1	
596.021	Sechskantschraube Hex. head screw		2	
596.022	Schiebe Disc		2	
596.027	Verschußdeckel, verdichterseitig Closing cover,compressor side	 (13.0)	1	

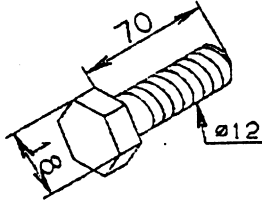
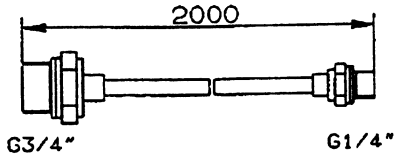
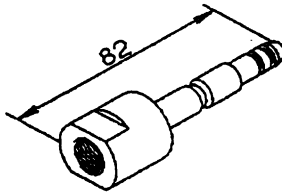
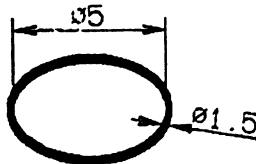
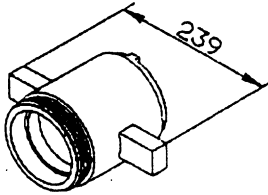
SAMSUNG-MAN B&W		TOOL LIST NA - 70	Ship No	
			Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity	
596.028	Verschlußdeckel, turbineseitig Closing cover, turbine side		1	
596.029	Runddichtring Round seal ring		1	
596.030	Dichtung, turbineseitig Gasket, turbine side		1	
596.031	Gewindestange Threaded bar		1	
596.032	Sechskantmutter Hex. nut		3	

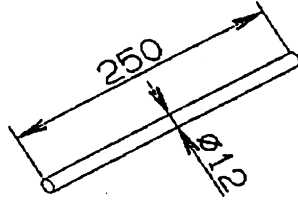
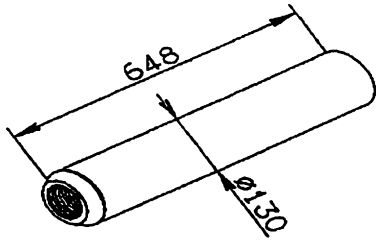
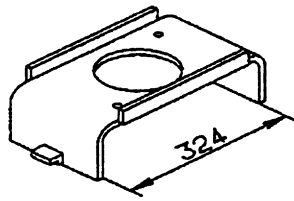
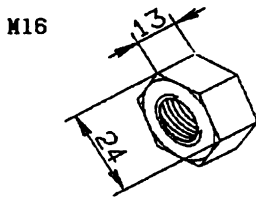
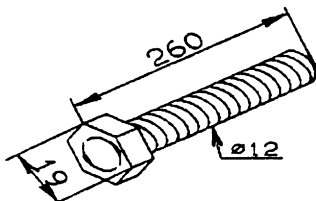
SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
(596.045)	Fixierring Locating ring			(1) assembled to 596.503	
(596.046)	Druckring Thrust ring			(1) assembled to 596.503	
(596.047)	Stempelführung Plunger guide			(1) assembled to 596.501	
(596.048)	Runddichtring Round seal ring			(1) assembled to 596.501	
(596.049)	Runddichtring Round seal ring			(1) assembled to 596.501	



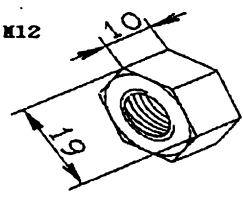
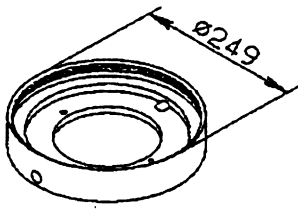
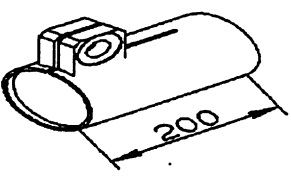
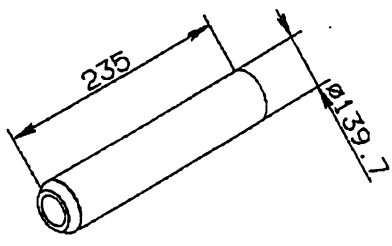
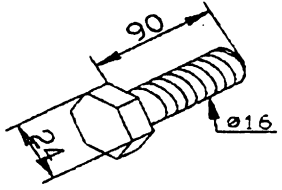
SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
(596.050)	Stempel Plunger	 (13.5)		(1) assembled to 596.501	
(596.051)	Stahlkugel Steel ball	 		(1) assembled to 596.501	
(596.052)	Entluftungsschraube Venting screw	 		(1) assembled to 596.501	
596.053	Olpumpe Oil pump	 (2.7)		1	
596.054	Verbindungsstück Connection piece	 (1.5)		1	



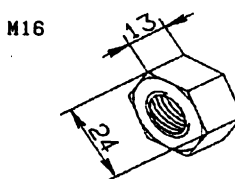
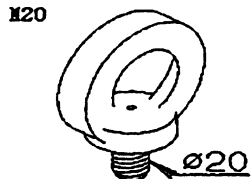
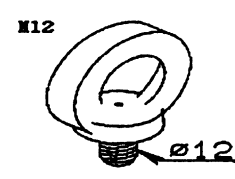
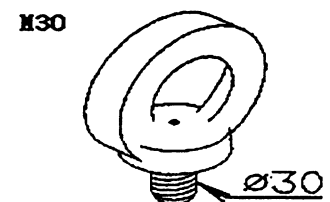
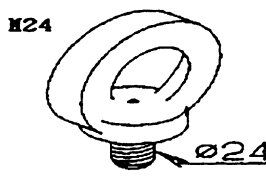
SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
596.056	Sechskantschraube Hex. head screw			2	
596.057	Biegsames Hochdruckrohr Flexible high pressure pipe			1	
(596.060)	-Abdichthulse Sealing sleeve			(1) assembled to 596.502	
(596.061)	Runddichtring Round seal ring			(2) assembled to 596.502	
596.065	Klauenschlüssel Claw spanner			1	

SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
596.071	Drestift Turning pin	 (0.2)	1		
596.075	Schutzhulse Protection sleeve	 (10.2)	1		
596.076	Brücke Bridge	 (7.4)	1		
596.080	Sechskantmutter Hexagon nut		2		
596.081	Sechskantschraube Hexagon head screw	 (0.2)	2		

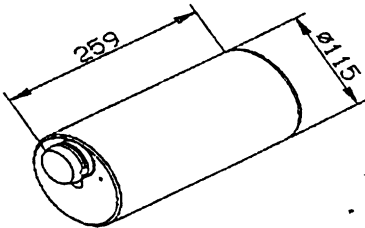
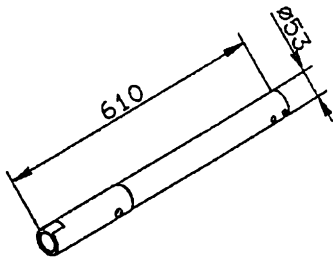
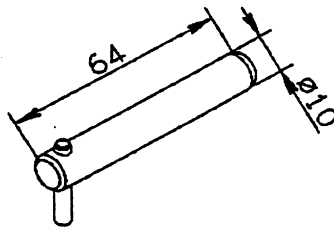
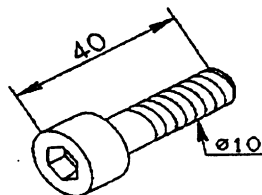
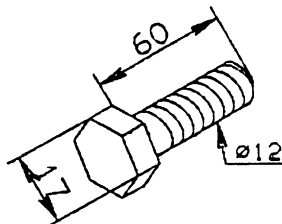


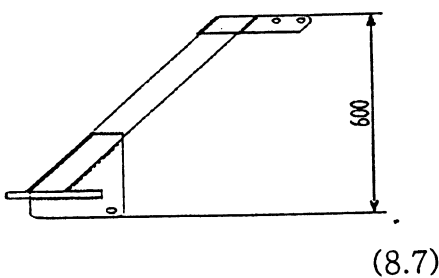
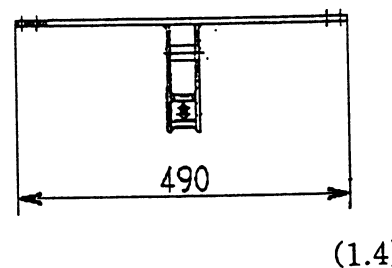
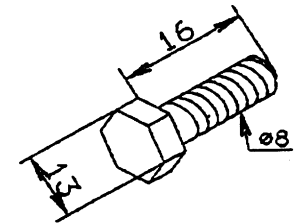
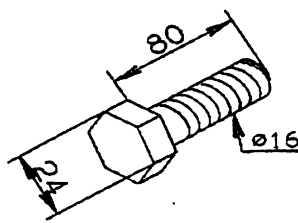
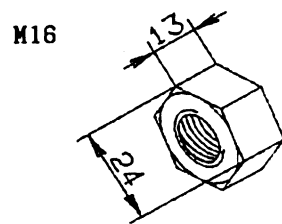
SAMSUNG-MAN B&W		TOOL LIST	Ship No	
		NA - 70	Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity	
596.084	Sechskantmutter Hexagon nut		2	
596.086	Montagering Assembly ring	 (6.5)	1	
(596.092)	Klemmhulse Clamping sleeve	 (2.6)	(1) assembled to 596.504	
596.095	Einführungshulse Insertion sleeve	 (8.4)	1	
(596.124)	Sechskantschraube Hex. head screw		(1) assembled to 596.504	

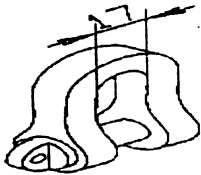
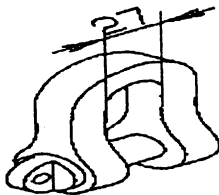
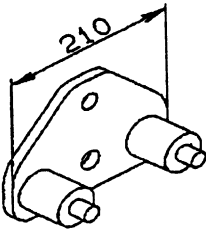
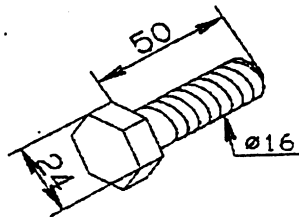
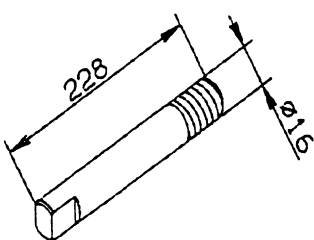


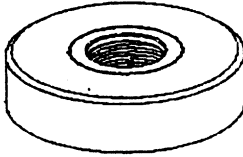
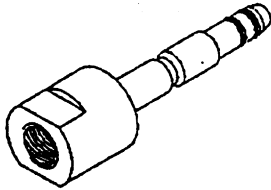
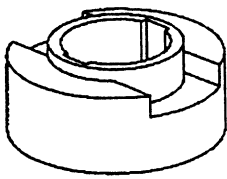
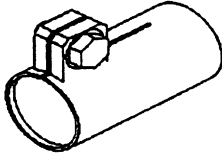
SAMSUNG-MAN B&W		TOOL LIST NA - 70		Ship No	
				Engine No	
Order No	Name	Sketch (Mass-kg)			Quantity
(596.125)	Sechskantmutter Hex. nut				(1) assembled to 596.504
596.135	Ringschraube Eye bolt	 (0.5)			4
596.136	Ringschraube Eye bolt	 (0.2)			2
596.137	Ringschraube Eye bolt	 (1.7)			2
596.139	Ringschraube Eye bolt	 (0.7)			1

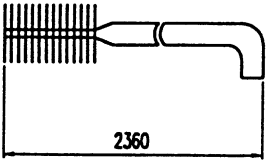
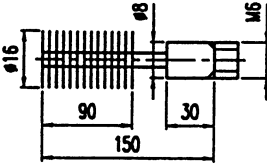
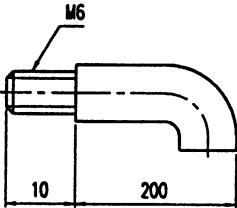
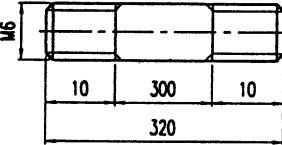
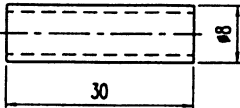


SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
596.155	Schutzhulse Protection sleeve	 (8.4)	1		
596.160	Tragrohr Pipe	 (6.0)	1		
596.164	Bolzen Bolt		1		
596.167	Zylinderschraube Socket head cap screw		1		
596.168	Sechskantschraube Hex. head screw		4		

SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
596.170	Trager Support			1	
596.180	Leiste Ledge			1	
596.196	Sechskantschraube Hex. head screw			2	
596.197	Sechskantschraube Hex. head screw			1	
596.198	Sechskantmutter Hex. nut			1	

SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)	Quantity		
596.208	Schaekel Shackle	 (0.2)	1		
596.210	Schaekel Shackle	 (0.8)	2		
596.225	Anhängeplatte Suspension plate	 (1.8)	1		
596.230	Sechskantschraube Hex. head screw	 (0.4)	1		
596.256	Montagestift Mounting pin	 (0.4)	2		

SAMSUNG-MAN B&W		TOOL LIST		Ship No	
		NA - 70		Engine No	
Order No	Name	Sketch (Mass-kg)		Quantity	
596.501 (596.047) (596.048) (596.049) (596.050) (596.051) (596.052)	Aufpreßvorrichtung Pressing on device			1	
596.502 (596.060) (596.061)	Abziehvorrichtung Pulling device			1	
596.503 (596.045) (596.046)	Druckring/Fixierring Thrust ring/Locating ring			1	
596.504 (596.092) (596.124) (596.125)	Klemmhulse Clamping sleeve			1	

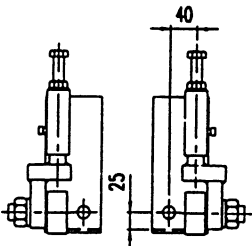
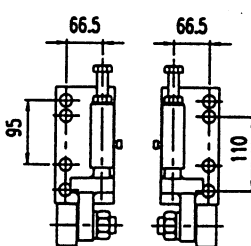
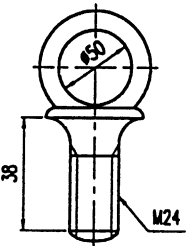
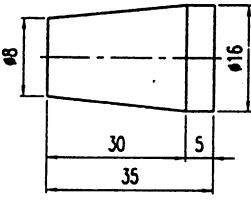
STD.NO. A00-TB-01		TOOLS LIST FOR AIR COOLER				PAGE		A - 1	
						USED FOR		LKM-B/D/H	
						BOX NO.			
NO.	NAME	SKETCH	MATERIAL	SUPPLY per ship		DRAWING		REMARK	
				WORK	SPARE	NO.	PART NO.		
1	NYLON BRUSH		NYLON & SS400	1					
-a	NYLON BRUSH		NYLON & SS400	1		THIS TOOL TO BE USED TOGETHER WITH OTHER H/EX AND ASSEMBLED WITH ITEM a.b.c.d			
-b	HANDLE		SS400	1					
-c	BAR		SS400	6					
-d	JOINT		SS400	7					
MFR'S NAME			DongHwa Entec						



STD.NO. A00-TA-01A

PAGE	A - 2
USED FOR	LKM-(G)A/B/C/D E/H
BOX NO.	

TOOLS LIST
FOR AIR COOLER

NO.	NAME	SKETCH	MATERIAL	SUPPLY per ship		DRAWING		REMARK
				WORK	SPARE	NO.	PART NO.	
2	ROLLER FOR FIXED SIDE		STEEL	1set				
3	ROLLER FOR FLOATING SIDE		STEEL	1set				
4	EYE BOLT		STEEL	8				
5	PLUG		BRASS	60				
MFR'S NAME		DongHwa Entec						

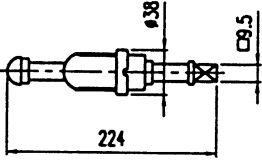
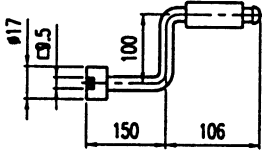
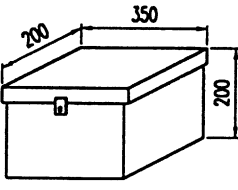
SAVE NAME:A00TA01A



STD.NO. A00-TA-02B

PAGE	A - 3
USED FOR	LKM-A/B/C/D/E /F/G/H/K/L/M/N
BOX NO.	

TOOLS LIST
FOR AIR COOLER

NO.	NAME	SKETCH	MATERIAL	SUPPLY per ship		DRAWING		REMARK
				WORK	SPARE	NO.	PART NO.	
1	TUBE EXPANDER	CB-107  MIN11.6~MAX13.5	SKS ₃ SCM ₅ SUJ	1				
2	S-HANDLE	 S20C	S20C	1				
3	TOOL BOX		STEEL	1				
MFR'S NAME		DongHwa Entec						



U S E		TOOL LIST	A M E N D	REV.	DATE	NOTE
NO.1~2 AUX. BLOWER						
ITEM NO.	NAME OF PARTS	OUT LINE	Q'TY	REMARK		
1	IMPELLER TOOL		1			
2	BEARING TOOL		1	12"		



HMMCO Hyundai Marine Machinery Co., Ltd.
Inchon Korea

APPROVE

J.H
3.25
KIM

CHECK

J.S
3.25
KIM

DRAWN

J.H
3.25
KIM

DRAW NO.

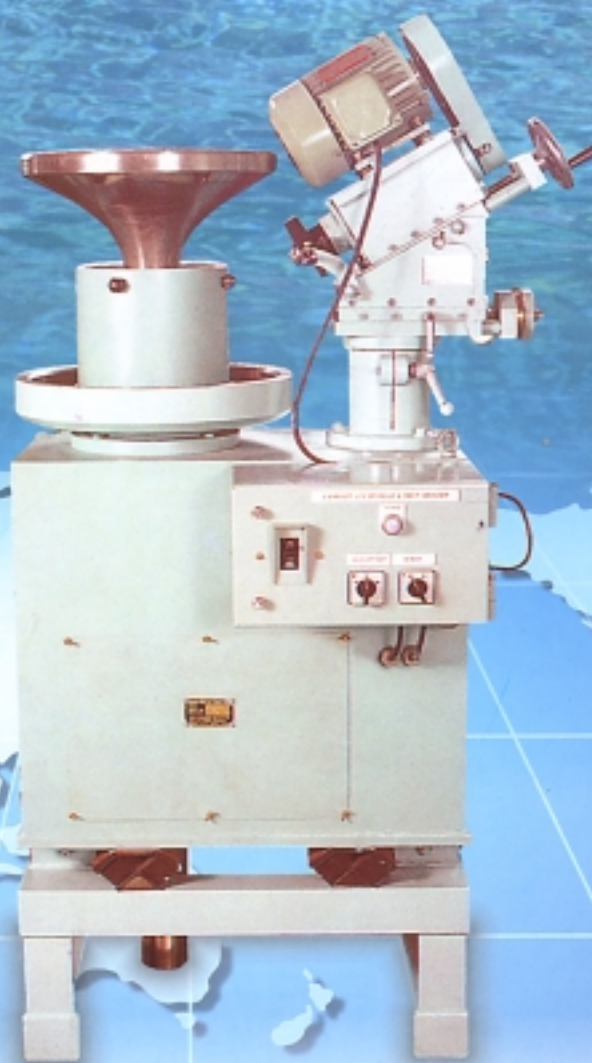
H-0207T

REVISION NO.

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KOKACO SYSTEM EXH' VALVE SPINDLE & BOTTOM PIECE GRINDING MACHINE



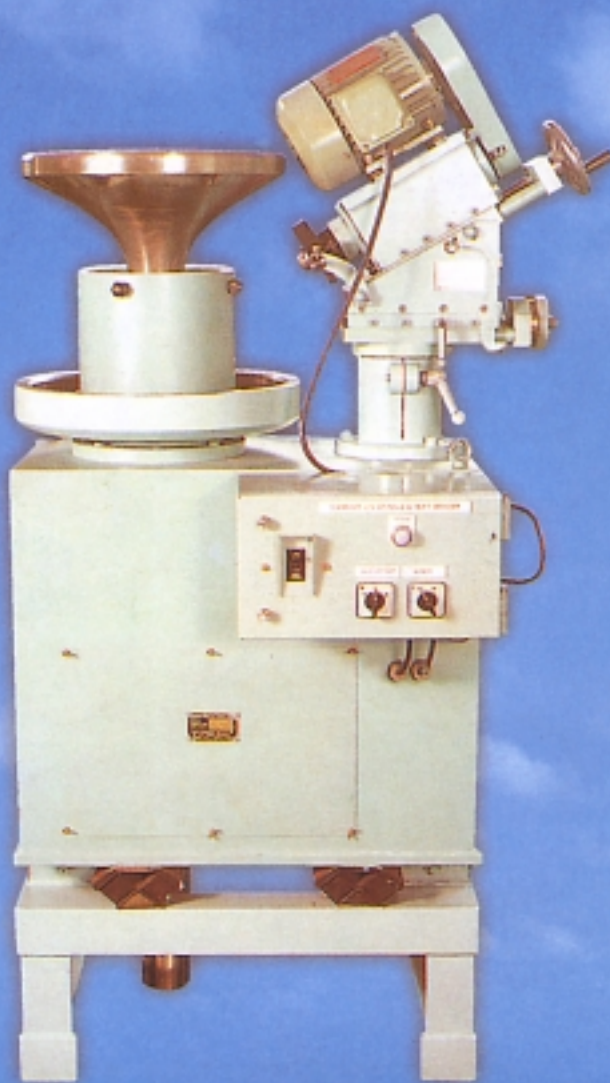
OPERATION MANUAL (MODEL: NKK - TYPE)



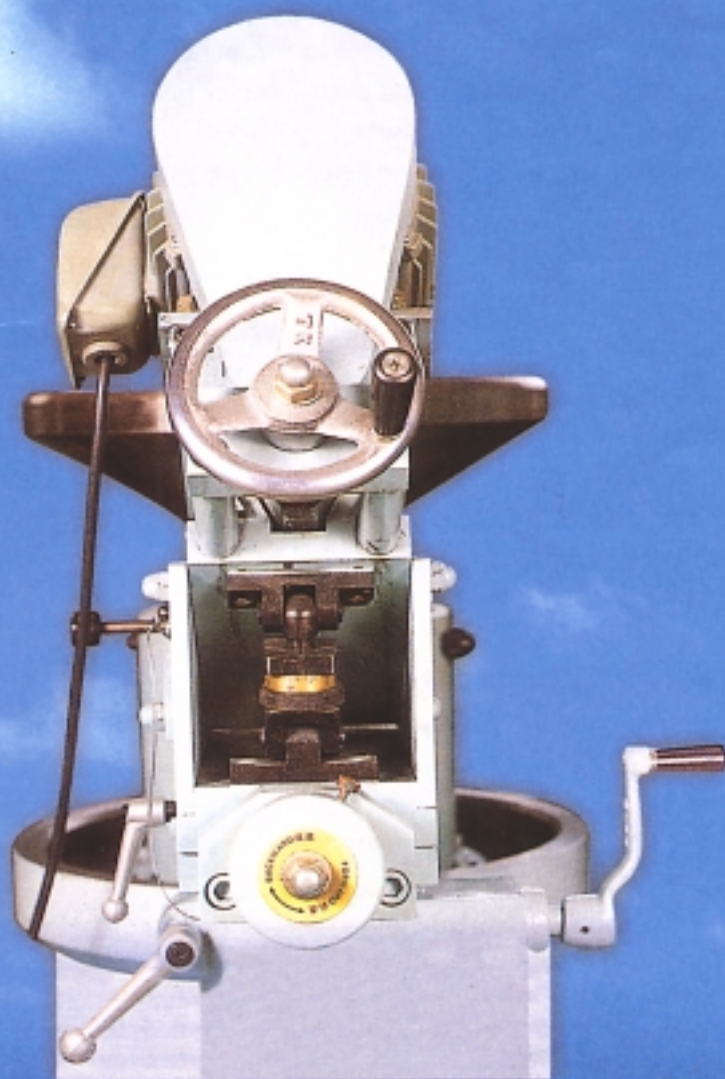
BEST QUALITY
KOKACO CO., LTD.



KOKACO



CO., LTD.



BRIEF HISTORY

Dec. 27, 1988	Founded Korea Kawamura Seiki Co., Ltd.
Feb. 1, 1989	Exported to Japan Kawamura Seike Seisakusho Co., Ltd.
Jul. 20, 1989	Supplied Grinding M/Cs to Ssangyong Heavy Industry Co., Ltd.
Dec. 24, 1990	Developed the EXH' Valve/Seat Grinder and designated by the Ministry of Commerce & Industry.
Jun. 26, 1991	Supplied Grinding M/Cs to Hyundai Heavy Industry Co., Ltd.
Nov. 27, 1991	Supplied Grinding M/Cs to Korea Heavy Industry Co., Ltd.
Feb. 13, 1992	Patented Fuel Valve Lapping M/Cs.
Mar. 9, 1992	Started Fuel Valve Reconditioning & Repairs.
Jan. 10, 1993	Started F.O. Pump & Plunger, Barrel Repairs.
Jul. 4, 1997	Supplied Grinding M/Cs to Samsung Heavy Industry Co., Ltd.
Feb. 1, 2000	Transferred into Korea Kwawamura Co., Ltd.
Dec. 19, 2000	Obtained Approval of Manufacture from MAN B&W.
Jul. 1, 2001	Transferred into KOKACO Co., Ltd.
Apr. 4, 2001	Patented EXHAUST VALVE SPINDLE/SEAT GRINDING MACHINE(NKK-TYPE)
Apr. 30, 2001	Achieved Company-ISO 9002 : 1994 Certification

ADDRESS : #189-4 DONGSAM-DONG YONGDO-GU PUSAN KOREA

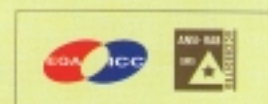
REPRESENTATIVE : KIM, JUNG MYUNG

TEL : +82-51-403-4114~6, +82-51-403-6247

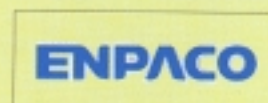
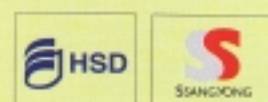
FAX : +82-51-403-6990

E-MAIL : kksco@unitel.co.kr

HOMEPAGE : kokaco.co.kr



ISO 9002



Entrust EXH'V SPINDLE & BOTTOM PIECE GRINDING M/Cs from small engine to Extra large Engine to KOKACO Co., Ltd. from today.

ENGINE TYPE

HANSHIN, B&W, MAKITA, NIIGATA, UEC, YANMAR

AKASAKA, UEC, HANSHIN

B & W 26MC

B & W 60MC

B & W 35MC

B & W 70MC

B & W 42MC

B & W 80MC

B & W 46MC

B & W 90MC

B & W 50MC

B & W 98MC

PC2-2, PC2-5, PC4, MITSUI M42, KAWASAKI MAN, MITSUBISHI MAN

SULZER RTA48

SULZER RTA52

SULZER RTA62

SULZER RTA72

SULZER RTA84

VALVE SEAT 38-160mm ϕ , VALVE STEM 10-25mm ϕ PC, MAN, GENERATOR FOR SHIP

VARIOUS TYPES OF FUEL INJECTOR

· We have already developed the Pneumatic Type most recently.



Technical Information

The KOKACO grinding machine is air driven or electrically driven.
Patented anti-vibration system and adjustable grinding angles system.
This KOKACO grinding machine is designed and manufactured to simply adjust to operating work with effort to safely and trust for high quality grinding successfully.
The machine is used for grinding of valve spindle seat and bottom piece of large bore diesel engines.



1. GRINDING ACCURACY

- ① angle accuracy.....± 0.2 minutes
- ② eccentricity.....max 0.02mm
- ③ ovality.....max 0.003mm
- ④ surface fineness.....N6 = Ra 0.8 μm.
- ⑤ run out.....0.02mm

2. MACHINE DATA

- ① machine capacity : up to 700mm diameter an valve spindle & bottom piece.
- ② grinding stone size : rough grinding stone : Ø100 × Ø32 × 13mm
fine grinding stone : Ø100 × Ø32 × 15mm
- ③ normal grinding time : 50 ~ 60 minutes
- ④ weight : 300 ~ 570 kgs
- ⑤ power supply : 3ph 220 ~ 440V 50/60hz
- ⑥ grinding stone speed : 2355m/MIN
- ⑦ grinding object speed : 3.0 ~ 4.0 rpm.



Warning – Read these instruction carefully

Transportation and installation

- ① Ensure that the machine is transported safely, and do not carry loads above people.
- ② The machine has prepared holes for four lift eye bolts.
Always use these when the machine is lifted.
- ③ Make sure the lift eye bolts are undamaged and adequately fastened.
- ④ Only use undamaged and correctly sized lifting equipment.

Installation

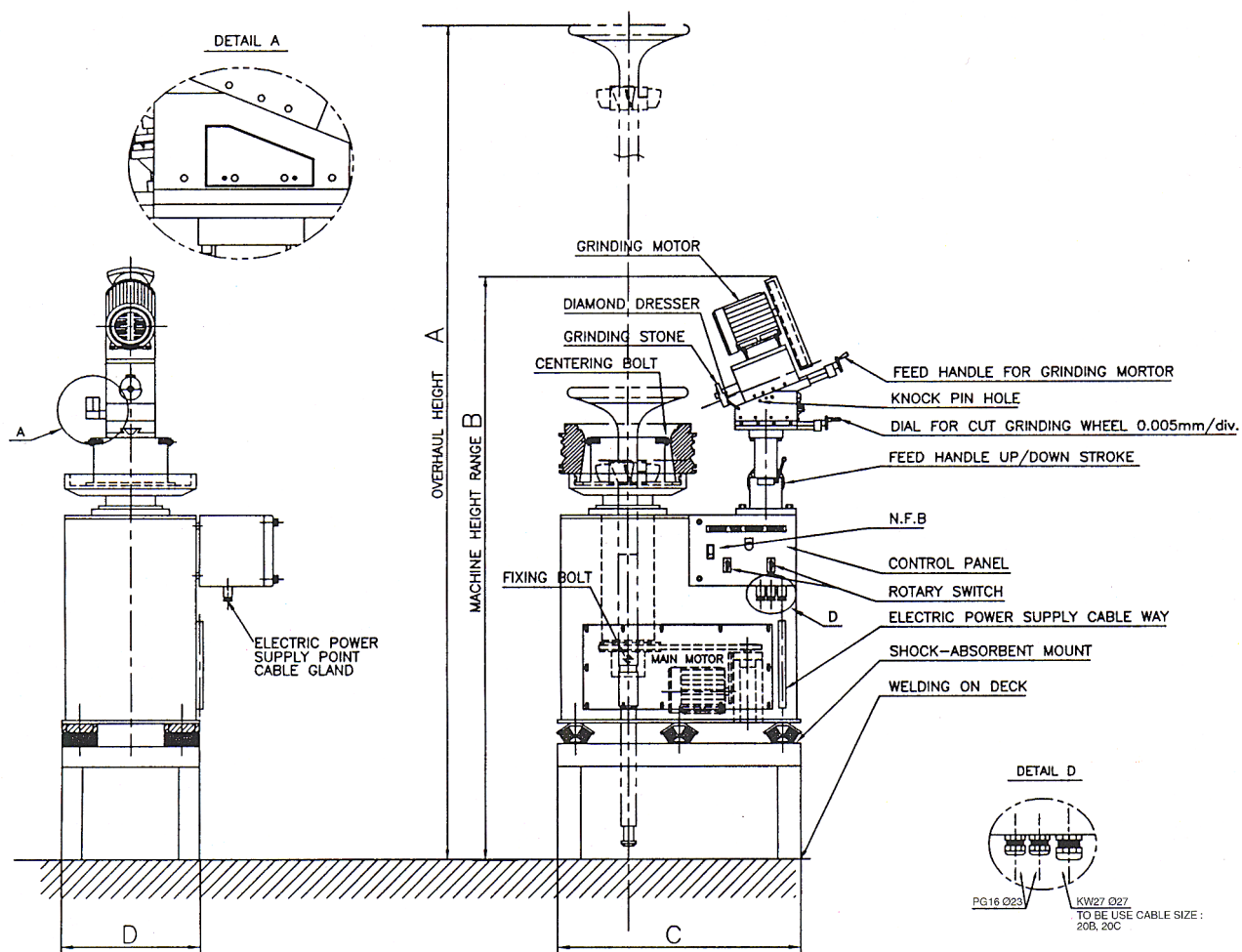
At delivery the grinding machine is assembled all parts and metal parts are coated to prevent corrosion.

1) LOCATION FOR THE EQUIPMENT

Carefully consider the following points when deciding where to install the KOKACO NKK-TYPE grinding machine

- ① Avoid any area with excessive engine vibrations 8mm/s or 286mm/s in a RMS of ISO regulation.
- ② Availability of lifting facilities and necessary lifting headroom.
- ③ KOKACO NKK-TYPE grinding machine has been installed angle bed on grinding machine for struture welding work use.





Specification

ELECTRIC MAIN POWER SOURCE : AC 440V, 60Hz, Ø3

TURNING MOTOR : AC 440V, 60Hz, Ø3, 400W(*JP44, INS.CLASS "F")

*EQUIVALENT TO JP44 = IP44

AMBIENT TEMP : 50°C

GRINDING MOTOR : AC 440V, 60Hz, 750W, 3350RPM

GRINDING RATE : 0.005 mm/div

WHEEL INCLINING ANGLE RANGE : FIXED TYPE

WHEEL SIZE : Ø100 × W13 × Ø32

PAINT COLOR : MAKER STANDARD(7.5BG 7/2)

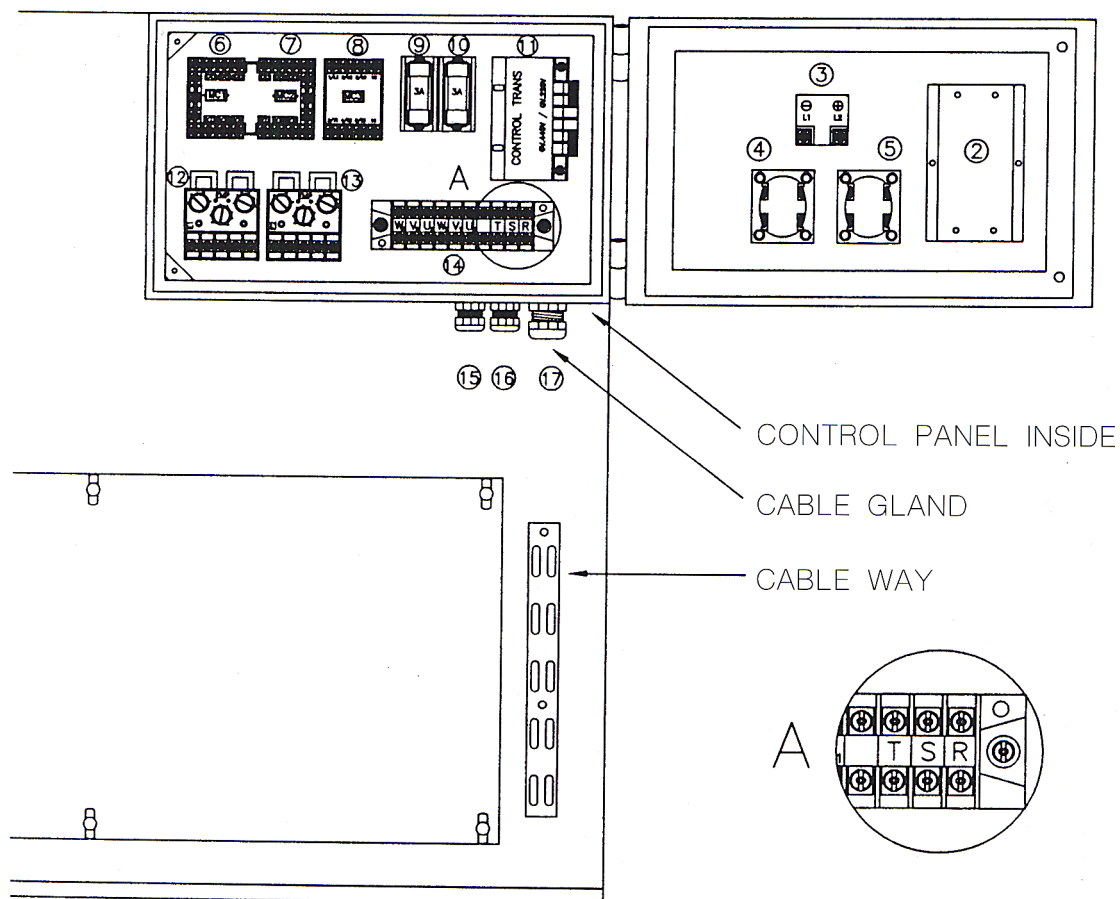
MAIN MOTOR : RATING CURRENT 1.2A, STARTING CURRENT 17A

GRINDING MOTOR : RATING CURRENT 1.45A, STARTING CURRENT 8A

	A	B	C	D	WEIGHT
B & W 42MC/-C	1997mm	1530mm	680mm	390mm	300Kg
B & W 46MC/-C	1997mm	1530mm	680mm	390mm	300Kg
B & W 50MC/-C	1997mm	1530mm	680mm	390mm	300Kg
B & W 60MC/-C	1997mm	1530mm	680mm	390mm	310Kg
B & W 70MC/-C	2561mm	1835mm	680mm	390mm	320Kg
B & W 80MC/-C	2906mm	1980mm	790mm	490mm	450Kg
B & W 90MC/-C	3373mm	2240mm	860mm	570mm	550Kg
B & W 98MC/-C	3533mm	2344mm	860mm	570mm	570Kg

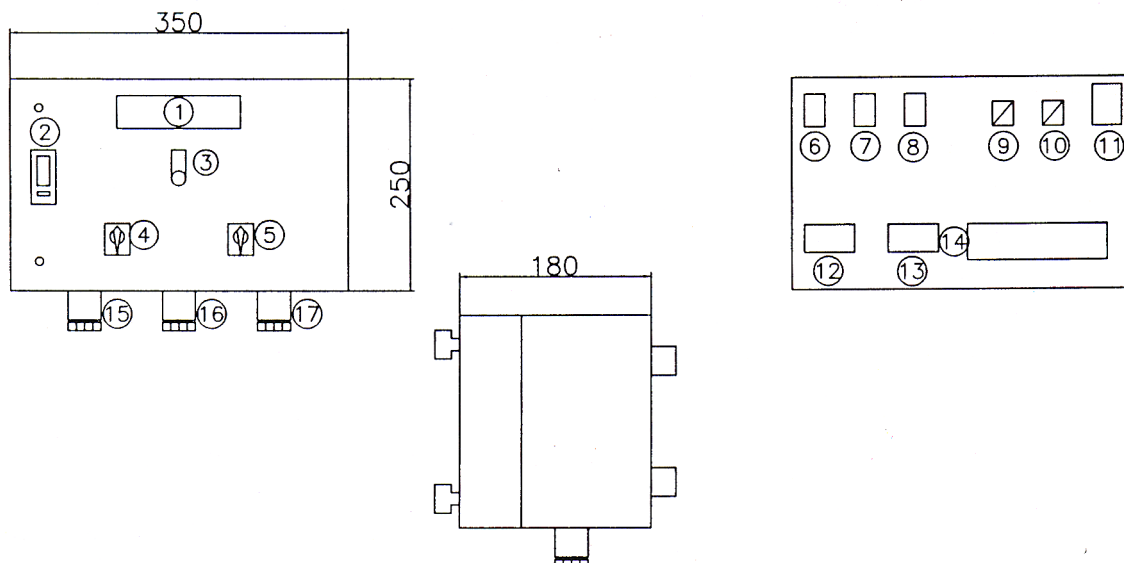


POWER CONNECTION



*Connect the power cable from on cable way to terminal A,
The power supply with 3ph 220V 50/60Hz, or 3ph 440V 50/60Hz



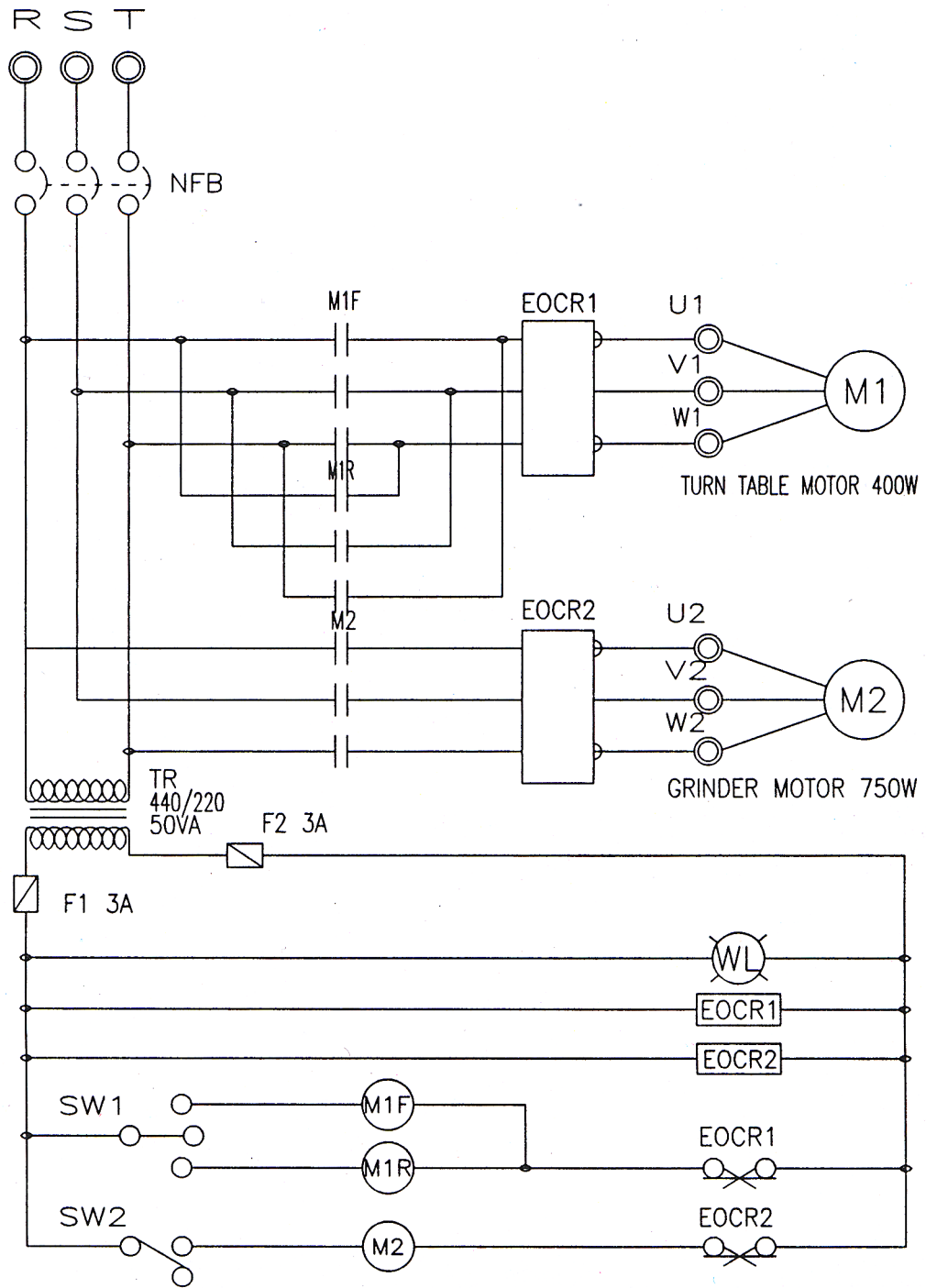


17	CABLE GLAND	KW-27 27Ø	
16	CABLE GLAND	PG16 23Ø	
15	CABLE GLAND	PG16 23Ø	
14	TERMINAL	15A 9P	
13	ELEC. OVER CURRENT RELAY(EOCR2)	GMP60T 0.5-6A 220V	
12	ELEC. OVER CURRENT RELAY(EOCR1)	GMP60T 0.5-6A 220V	
11	TRANSFORMER	440/220V 50VA	
10	FUSE	3A	
9	FUSE	3A	
8	MAGNETIC CONTACTOR (M2)	SMC-10P 220V	
7	MAGNETIC CONTACTOR (M1R)	SMC-10P 220V	
6	MAGNETIC CONTACTOR (M1F)	SMC-10P 220V	
5	ROTARY SWITCH	25Ø 2 DAN 1a1b	
4	ROTARY SWITCH	25Ø 3 DAN 1a1b	
3	SOURCE LAMP	25Ø 220V	
2	NO FUSE BRAKE	33C 30/10A	
1	NAME PLATE		
NO	DESCRIPTION	DESCRIPTION	REMARKS

CONTROL PANEL

	DRAW	CHECKD	APPRVD	DESCRIPTION
TITLE CONTROL PANEL				
KOKACO CO., LTD.				DWG NO. NKK - BG - 2





W2	V2	U2	W1	V1	U1	T	S	R
----	----	----	----	----	----	---	---	---

	DRAW	CHECKD	APPRVD	DESCRIPTION
TITLE CONTROL PANEL				
KOKACO CO., LTD.				DWG NO. NKK-BG-2

Important safety guide for grinding machine users

DO...

1. Do always handle and store grinding stone in a careful manner.
2. Do visually inspect all grinding stone before mounting to grinding machine.
3. Do check maximum operating speed worked on for grinding stone against machine speed.
4. Do check mounting flanges for equal and correct diameter.
5. Do be sure work rest for floor stand grinder is properly adjusted
6. Do allow newly mounted grinding stone to run at operating speed with guard in place for at least one minute before grinding.
7. Do always wear safety glasses or some type of eye protection when grinding.

DON'T...

1. Don't use a grinding stone that has been shocked.
2. Don't force a grinding stone onto the machine or alter the size of the mounting hole if wheel won't fit the machine, get one that will.
3. Don't ever exceed maximum operating speed established for the grinding stone.
(Machine's rated speed : 5400r.p.m)
4. Don't use mounting flanges which are warped, nicked, sprung or dirty.
5. Don't tighten the mounting nut excessively. On multiple screw mountings tighten opposite screws to 20 foot-pounds and do this a minute of 3 times. Recheck at the end of 8 hours running.
6. Don't grind the object with the side face of grinding stone.
7. Don't start the machine until the grinding stone guard is in place.
8. Don't stand directly in front of a rotating direction for grinding stone whenever a grinder is started.
9. Don't grind material for which the grinding stone is not designed.

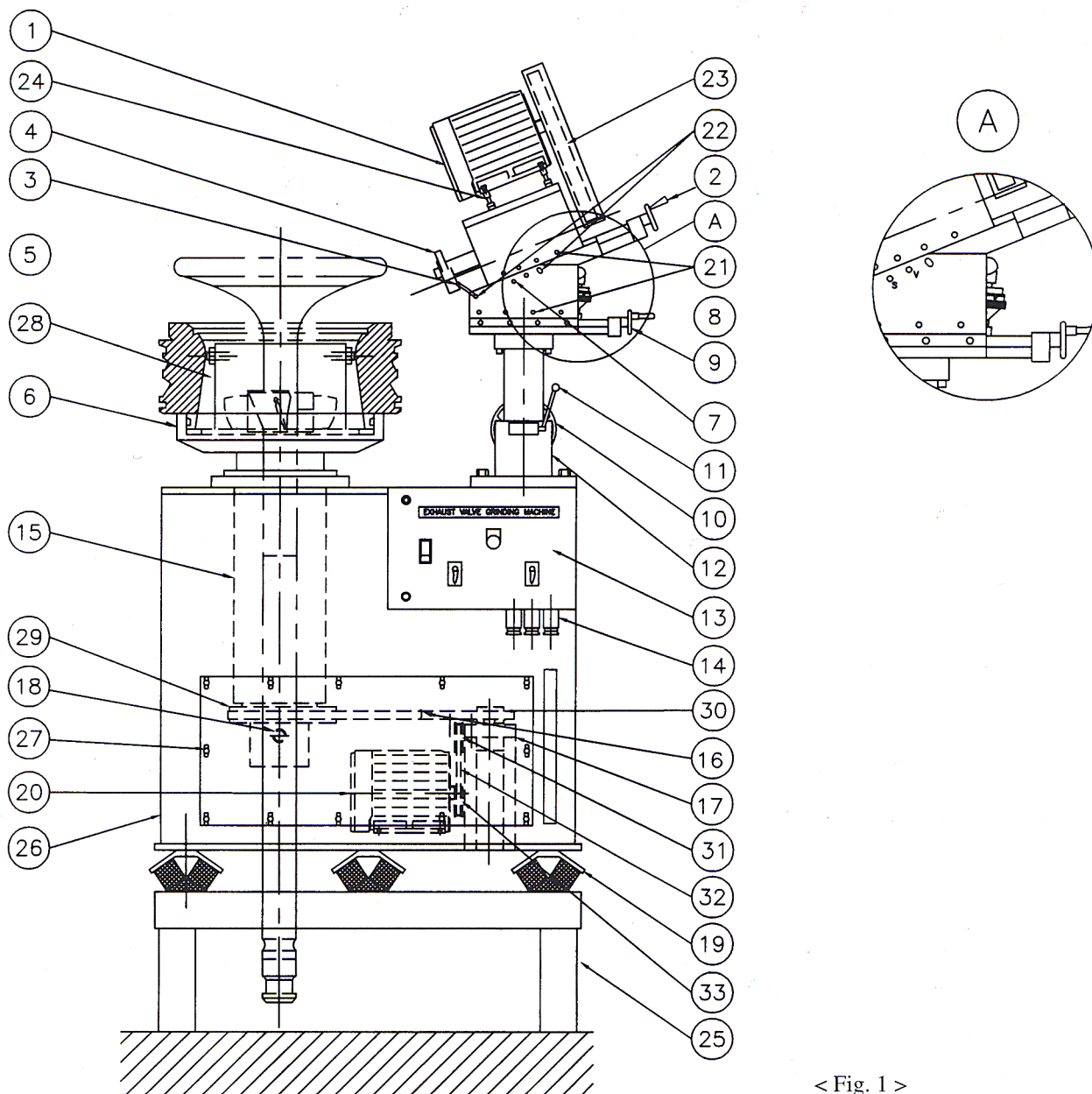
Precaution in operating the grinding machine.

Erroneous operation might be hazardous during grinding generally.

It is advisable to secure safe operation as followings;

1. If possible, the grinding machine has to be placed at safe area where personnels are not endangered even in case of destruction for grinding stone.
2. When a new grinding stone is used, carry out the idle operation for 1 minute at least and check the machine for any abnormality and sound.
3. Before every operation of grinding machine, carry out the idle running for 1 minute at least to check any abnormality.
4. Depth of cutting and feed rate should be kept as specified.
If not, abnormal abrasion of grinding stone and abnormal ground quality on workpiece may be occurred, and, in severe case, grinding stone may be broken to bits.
5. If it is hard to move feed handle, adjust the liner stopper with set screw on upper slide unit.
6. Don't use when a circumferential vibration of Grinding M/C exceeds 8mm/s or 286mm/s^2 in a RMS of ISO regulation or in a stormy weather voyage.
7. Stop operating in case weather has not an effect on grinding operation.
8. Grinding should be operated by a skilled engineer only who is well aware of this operation manual.
9. Complete works after checking whether a roughness degree of surface is less than $N_6(Ra\ 0.8)$ that is compared with a table RUGO TESTER of roughness after operations.
10. To only reduce dust induced and to make surface roughness good in grinding operation, we recommend to apply cutting oil on a ground surface.



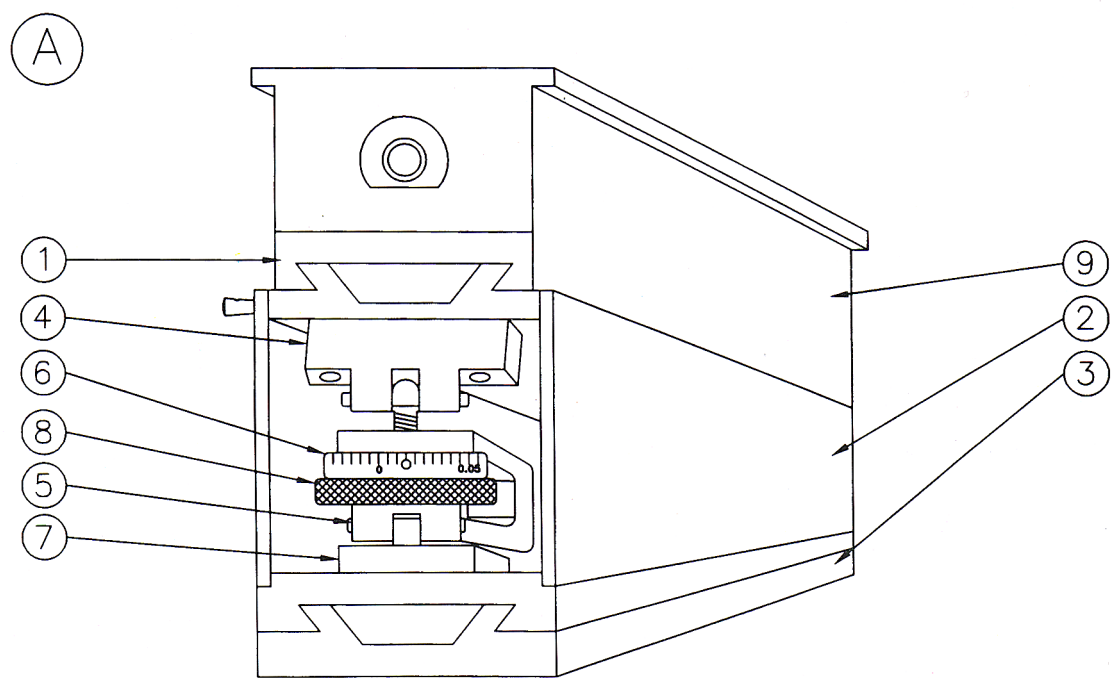


< Fig. 1 >

No	NAME
FIGURE 1	
1	GRINDING MOTOR
2	FEED HANDLE FOR GRINDING MOTOR
3	DIAMOND DRESSER
4	GRINDING STONE
5	CENTERING BOLT
6	TURN TABLE
7	KNOCK PIN HOLE
8	UPPER SLIDE UNIT
9	DIAL PLATE FOR CUT GRINDING STONE 0.005mm/div
10	SLIDE HANDLE UP/DOWN, STROKE-280mm
11	CLAMPING LEVER
12	LOWER SLIDE UNIT
13	CONTROL PANEL
14	GLAND FOR MAIN POWER SOURCE

No	NAME
15	BEARING CASE
16	V-BELT
17	REDUCER
18	FIXING BOLT
19	SHOCK-ABSORBENT MOUNT
20	MAIN MOTOR
21	SCREW
22	FIXING BOLT FOR ANGLE ADJUSTMENT
23	V-BELT
24	SHOCK-ABSORBENT MOUNT FOR MOTOR
25	ANGLE STAND
26	MACHINE BODY
27	FRONT PANEL
28	CENTERING CAP
29	MAIN PULLEY

No	NAME
30	PULLEY FOR REDUCER
31	PULLEY FOR MAIN MOTOR
32	V-BELT
33	MAIN MOTOR PULLEY
34	CENTERING BUSH
FIGURE 2 UPPER SLIDE UNIT	
1	SADDLE FOR SHAFT CASE OF GRINDER
2	SIDE PLATE
3	SADDLE FOR UPPER SLIDE
4	FIX PLATE FOR ANGLE ADJUSTMENT UNIT
5	BODY FOR ANGLE ADJUSTMENT UNIT
6	DIAL MEMORY
7	FIX PLATE FOR ANGLE ADJUSTMENT UNIT
8	HANDLE FOR ANGLE ADJUSTMENT
9	SHAFT CASE OF GRINDER



< Fig. 2 >

SPECIFICATION

ANGLE TABLE

ENGINE MODEL	MODEL NAME	ROTATION OF TURN TABLE	THE ANGLE OF GRINDING		ROTATION OF GRINDER SHAFT	SIZE OF GRINDER STONE	MOTOR	
			VALVE SPINDLE	BOTTOM PIECE			GRINDER	TURN TABLE
B&W 42MC/C	NKK 42BG	4.0 RPM	30.3° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$	3,350RPM	ROUGH Ø100×Ø32×W13 FINE Ø100×Ø32×W15	750W	400W
B&W 46MC/C	NKK 46BG	4.0 RPM	30.4° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
B&W 50MC/C	NKK 50BG	4.0 RPM	① 30.4° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
			② 30.5° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
B&W 60MC/C	NKK 60BG	4.0 RPM	30.3° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
B&W 70MC/C	NKK 70BG	4.0 RPM	30.4° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
B&W 80MC/C	NKK 80BG	3.0 RPM	30.5° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
B&W 90MC/C	NKK 90BG	3.0 RPM	30.7° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				
B&W 98MC/C	NKK 98BG	3.0 RPM	30.7° $\begin{smallmatrix} +0.1^\circ \\ 0 \end{smallmatrix}$	30° $\begin{smallmatrix} 0 \\ -0.1^\circ \end{smallmatrix}$				

① Angle for Nimonic spindle

② Angle for alloy cladding spindle

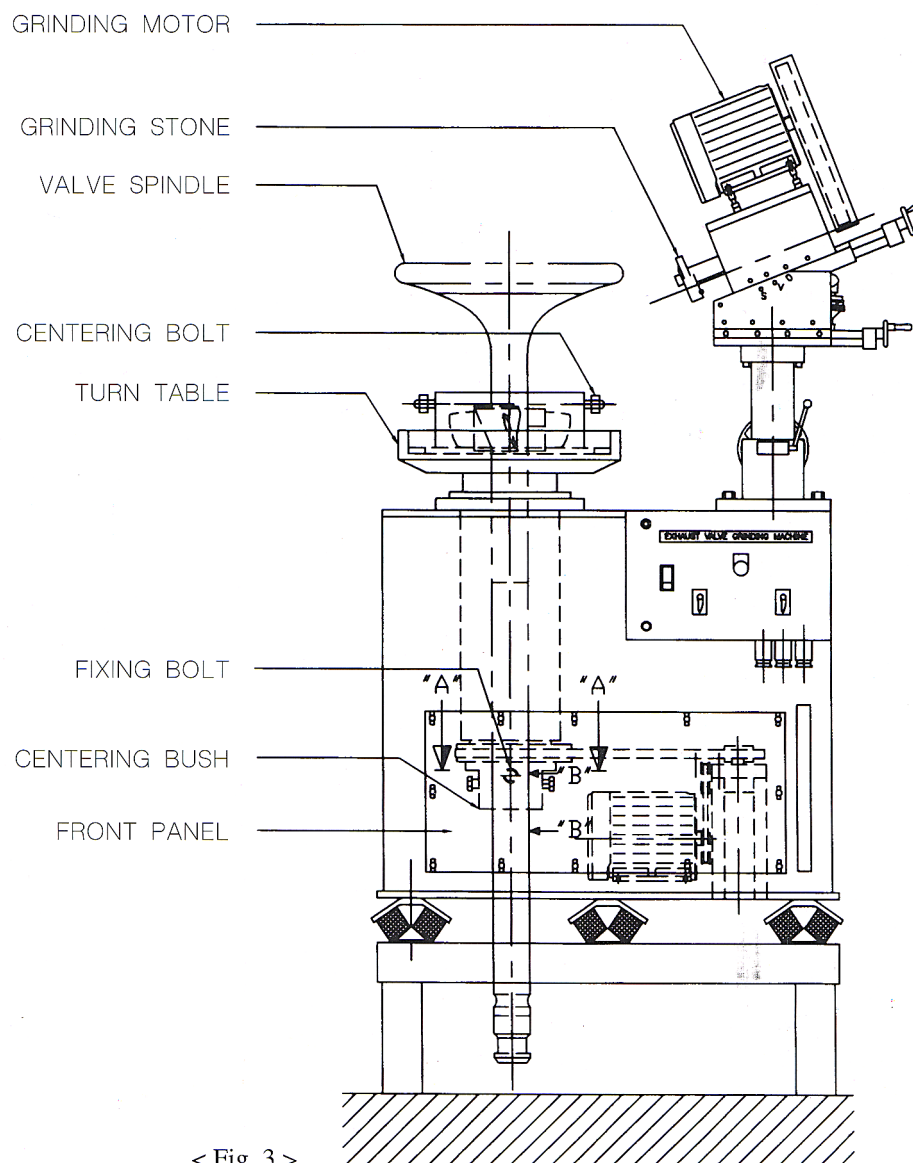


GRINDING PROCEDURE

1. VALVE SPINDLE

1-1) MOUNTING THE VALVE SPINDLE ON GRINDING MACHINE:(Refer to fig.3)

- Remove the carbon stuck on the valve spindle using Light oil initially.
- Detach the front panel No.27 from the machine.
- Confirm the fixing bolt No.18 is loosened in order not to obstruct the insertion of valve spindle.
- Insert the valve spindle into Centering Bush No.34 as figure.
- Tighten the valve spindle by fixing bolt No.18.
- Refer to Fig. 6 on page 7, How to set Run-Out exactly.
- Place the dial gauge on the top of machine body and adjust the centering by centering bolt No.5 to obtain run out within 0.02 mm.



1-2) GRINDING THE VALVE SPINDLE

- a) Loosen the two bolts for grinding stone cover and place the cover correctly.
- b) Set the grinding angle to V(Valve spindle) with knock-pin.
- c) Set grinding stone for rough grinding(PA 54L). (an installed stone in delivery)
- d) Push the "power on" switch on the front of the control panel.
- e) Before grinding the valve spindle, please check the grinding stone condition.
(Refer to page 11 and item 3, dressing for grinding stone)
- f) Move grinding stone to the under side of the valve spindle by turning clockwise the feed handle for grinder.
- g) Select the "valve" switch for valve driver. (turn table)
- h) Select the "motor on" switch for grinding drive. (grinding stone)
- i) Raise the upper slide unit No.8 by turning slide handle No.10 clockwise grinding stone come into just contact with valve spindle.

NOTE : After adjustment the height of grinding stone, Lock slide unit (8, 12) with the clamping lever No.11 to prevent any movement during grinding.

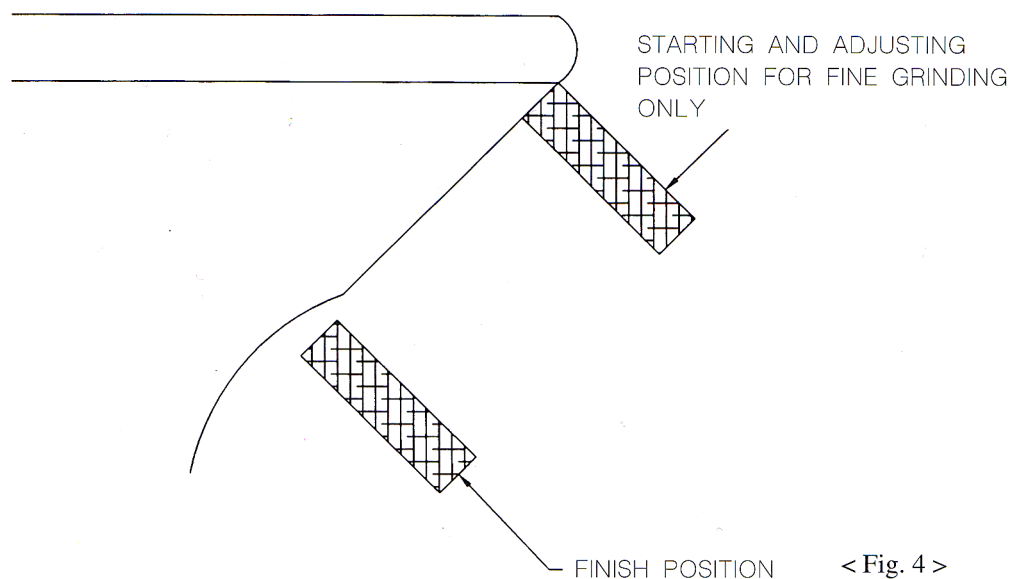
- j) Set the scale of dial plate No.9 to zero at the position where grinding stone contact with the valve seat and fix the dial plate by set screw.
- k) The depth of cut scale plate is graduated in 0.005mm/div. Set the depth of cut to 0.02mm(four graduation) or less and perform several coarse grinding by operation of the feed handle for grinder sliding back and forth. During coarse grinding, the feed handle (2) has to be turned by 1 revolution per every 1 turning of valve spindle or bottom piece.

NOTE : All cutting operations must be done within the valve seat surface.

- l) When grinding is finished, switch off all motor after whole surface of grinding stone is detached from the valve seat area.
- m) Check the entire seat surface has been coarsely ground.
- n) Replace the Rough Grinding stone with Fine Grinding stone.
- o) Select the power "on" switches for all motor and place the grinding stone to be matched fully with valve spindle. (Refer to following sketch)
- p) Set the depth of cut to 0.03mm(six graduation) and perform the fine grinding by slow moving the grinder.
- q) In the final works for Fine Grinding, put the cutting oil fully so that it makes wet grinding on the surface, then the surface clean and fine.

NOTE : For starting the grinding, all width of grinding stone has to be matched with grinding object and finishing has to be done at fully detached state as shown on fig 4.



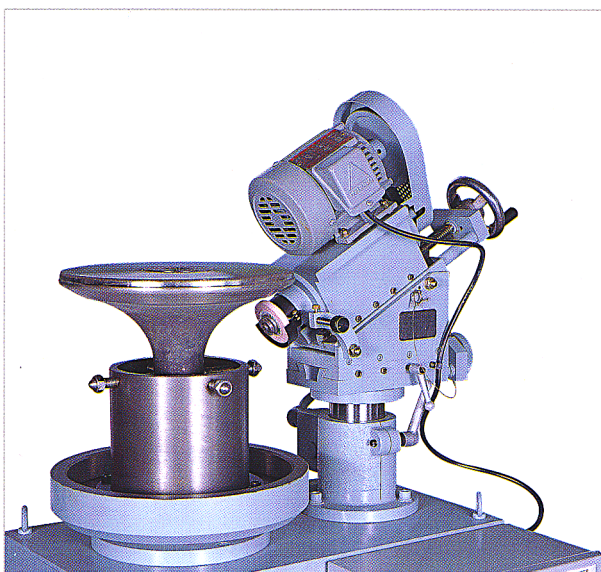


Attention

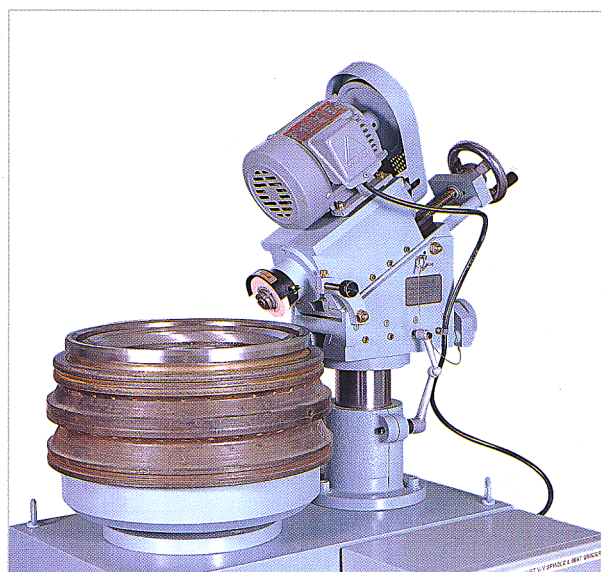
To get a good grinding surfaces, we recommend to keep optimum standard feed time of 1 pass with about 5 minutes or more.

For example, 0.2mm cutting of the seat surface:

1. Coarse grinder : 9 passes for 45 minutes
And for fine grinding, the feed handle has to be turned by half(1/2) revolution per every 1 turning of valve spindle or bottom piece.
2. Fine grinding : 3 passes about 15 minutes
3. Total grinding times : about 60 minutes



To grind the valve SPINDLE



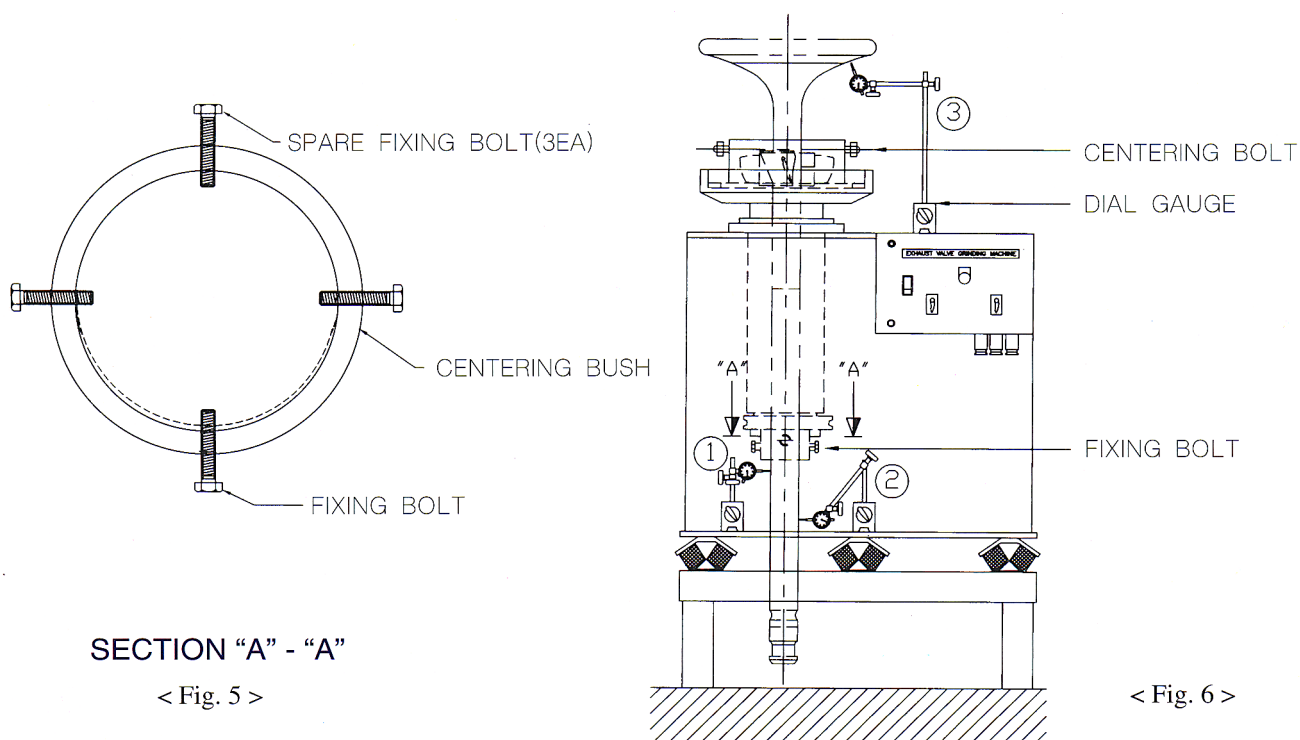
To grind the BOTTOM PIECE

1-3) CONFIRMING THE CENTER DEFLECTION

This machine is designed so that the deflection of core (run out of the stem for valve spindle) is within 0.01mm and delivered after adjustment, but check once more to make sure before grinding as follows:

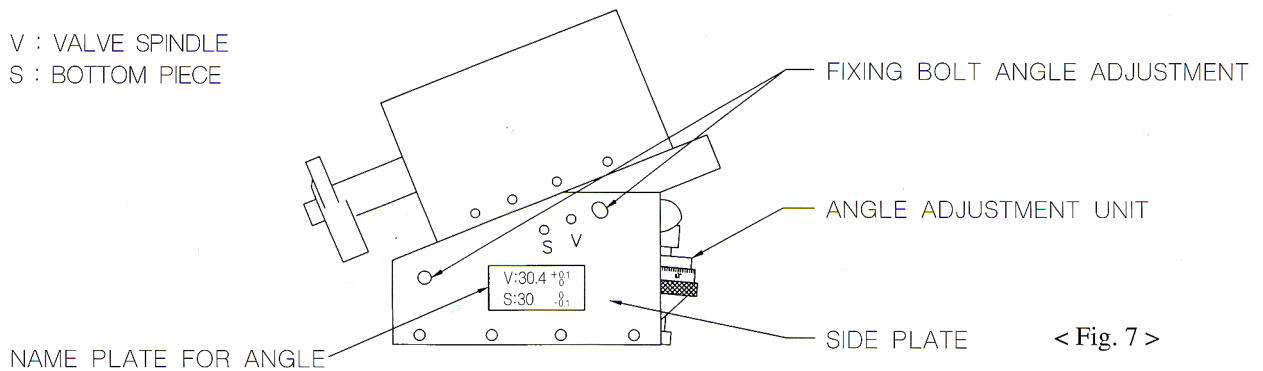
- Set the dial gauge at the lower part of valve stem.
(Fig. 6 ①, ②)
- Select the "valve" switch for valve drive(turn table) and check the run out on valve stem.
- If the run out is larger than 0.01mm for gauge ①, please insert the spare fixing bolts into centering bush as shown on the below figure.
- Please don't use spare fixing bolts when center deflection(run out) is normal condition.
- After setting of Dial Gauge ① below 0.01mm, check Dial Gauge ② and, if the valve exceeds 0.01mm, adjust the run-out by centering bolts of turn table.
- After setting of both Dial Gauge ① and ② below 0.01mm, check the Dial Gauge ③ which measures run-out 0.05mm on valve seat area. If it exceeds 0.3mm, the lopsidedness of Valve Spindle has problem, then contact with the specialized engine manufacturer.

HOW TO CHECK THE RUN OUT OF VALVE SPINDLE



1-4) THE ANGLE OF GRINDING SLIDE TABLE

V : VALVE SPINDLE
S : BOTTOM PIECE



NOTE : The angle of grinding slide table is different between valve spindle and bottom piece.

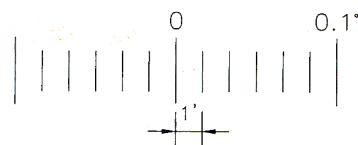
If grinding object is changed, readjust the grinding angle according to following procedure.

1. Loosen two screws for angle adjustment and lift up the grinder fitting table.
2. Insert the knock pin into hole for V (Valve spindle) or S (Bottom piece).
3. Tighten four screws for angle adjustment.

1-5) METHOD OF ADJUSTMENT FOR GRINDING ANGLE OF VALVE SPINDLE & BOTTOM PIECE

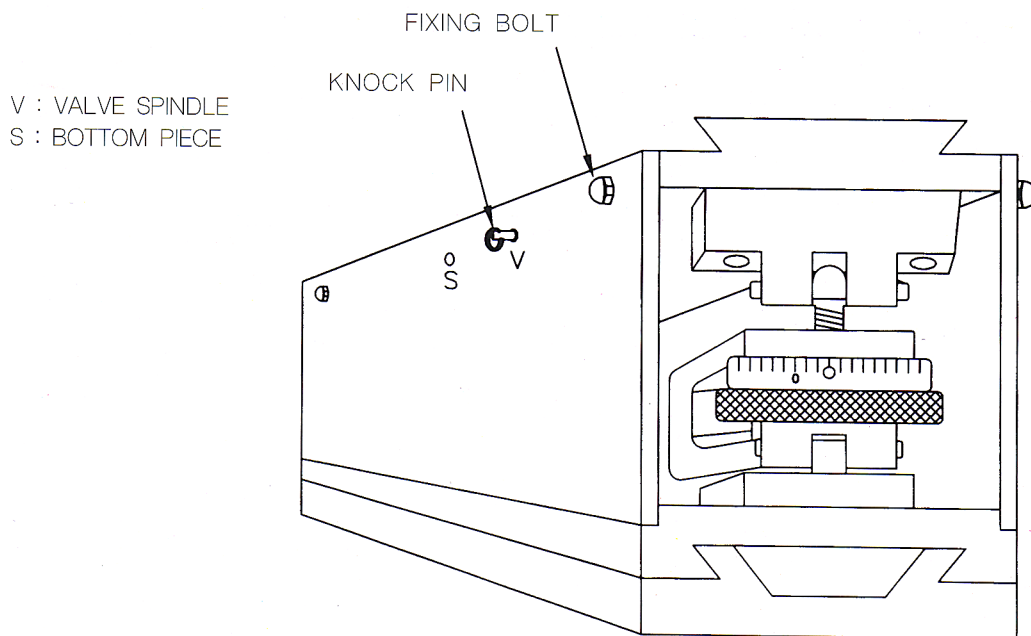
This grinding machine is designed and manufactured to adjust the angle simply to valve spindle and bottom piece mentioned on page 3 (SPECIFICATION/Angle Table) with knock pin "V" and "S". If the valve spindle and bottom piece should be adjust with mentioned angle on page 2, below mentioned procedure should be taken.

- 1) Unscrew both fixing bolts on upper slide. (Fig. 8)
- 2) Adjust the saddle to coincide the knock pin hole with the hole on side plate. (Refer to Fig. 8)
- 3) Put the knock pin to the hole with "V" for valve spindle or "S" for bottom piece.
- 4) Tighten both fixing bolts on upper slide.
- 5) Release both fixing bolts fixed on the upper slide. (Fig. 8)
- 6) Check if knock-pin is exactly located at bottom piece or valve spindle.
- 7) Set Dial memory at "O" with set screw when knock-pin is placed at the grinding angle of bottom piece or valve spindle, then pull out knock-pin.
- 8) Turn the dial memory to requested angle.
- 9) A small scale is 1' and a big scale is 0.1°, when turn dial memory to counter-clockwise with a scale at "O" setting point.
- 10) When an adjustment of angle is set, fix and fasten bolts of upper slide
- 11) Limits for the adjustment of angle : 29.0°~31.0°



Indication of scale



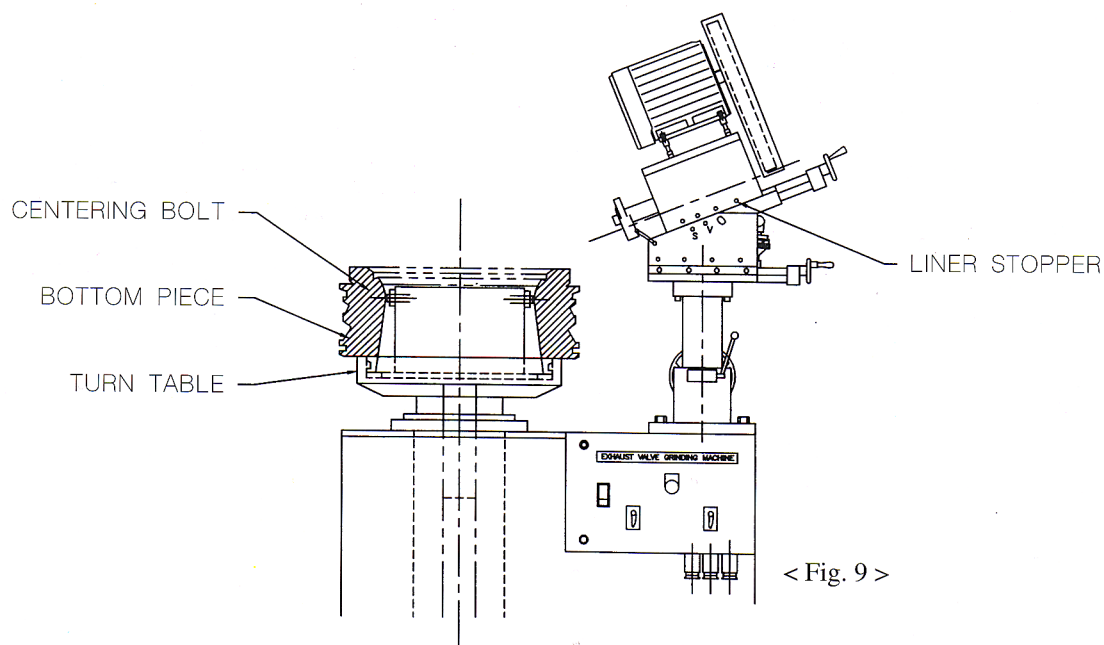


< Fig. 8 >

2. BOTTOM PIECE

2-1) MOUNTING THE BOTTOM PIECE

- Clean the Bottom piece thoroughly with light oil.
- Mount the Bottom piece on the turn table as shown on below figure. (Fig. 9)
- Place the dial gauge on the slide unit and seat area for Bottom Piece and adjust the centering by centering bolts to obtain a run out within 0.02mm.
- This machine is designed so that deflection of the core(Run out) for Bottom Piece is within 0.02mm. If diflection(Run out) exceeds 0.02mm, clean the contact area between the Bottom Piece and turn table.



< Fig. 9 >

2-2) GRINDING FOR BOTTOM PIECE

- a) Loosen two bolts for cover of grinding stone and place the cover correctly.
- b) Set the grinding angle to S(Bottom Piece) with knock pin.
- c) Set grinding stone for rough grinding. (PA 54L) (An installed stone in delivery)
- d) Push the "power on" switch on the control panel.
- e) Select the "SEAT" switch for turn table.
- f) Select the "motor on" switch for grinder drive. (grinding stone)
- g) Before grinding the Bottom Piece, please check the grinding stone condition.
(Refer to page 11 and item 3, Dressing for grinding stone)
- h) Move grinding stone to the upper side of seat area for Bottom Piece by turning the feed handle.
- i) Lower the slide by turning slide handle where grinding stone is just contact with seat area and set the dial at zero on the scale.
- j) Set the depth of cut to 0.02mm(four graduations) or less and perform several coarse grinding by operation of the feed handle for grinder sliding back and forth.

NOTE : All cutting operation should be done by moving the grinding stone up and down.

- K) Check the entire seat surface has been coarsely ground.
- l) When grinding is finished, switch off all motor after whole surface of grinding stone is detached from the seat area.
- m) Replace the Rough Grinding stone with the Fine Grinding stone.
- n) Select the switches on all motors and place the grinding stone to be fully contacted with seat area. (Refer to procedure for valve spindle)
- o) Set the depth of cut to 0.03mm(Six graduation) and perform the fine grinding by moving slowly the grinding stone.
- p) In the final works for Fine Grinding, put the cutting oil fully so that it makes wet grinding on the surface, then surface clean and fine.

2-3) THE ANGLE OF GRINDING SLIDE TABLE ; PLEASE REFER TO 1-4).

2-4) METHOD OF ADJUSTMENT FOR GRINDING ANGLE ; PLEASE REFER TO 1-5).



3. DRESSING FOR GRINDING STONE

3-1) DRESSING IS REQUIRED IN THE FOLLOWING CASES :

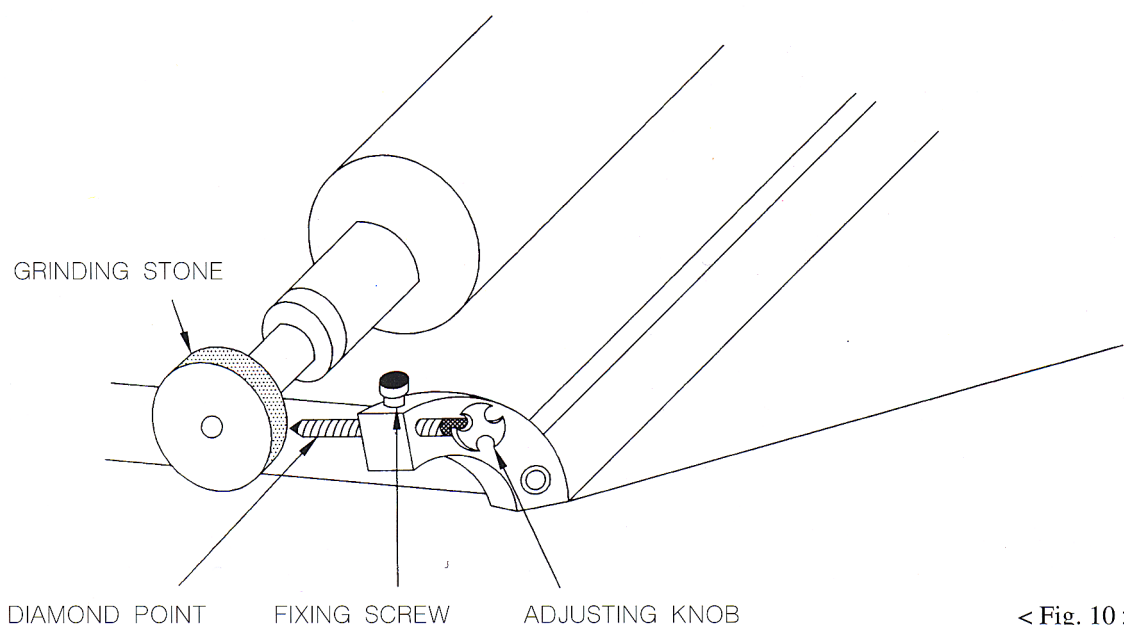
- a) When the grinding stone is changed.
- b) when the grinding stone is retightened.
- c) When the grinding stone becomes blocked.

NOTE : "BLOCKED" means that the grinding surface of stone turned brown for rough stone and clogged for fine stone during grinding.

3-2) DRESSING PROCEDURE :

- a) Move the feed handle for grinder forward.
(Move the grinding stone up to the dresser diamond point)
- b) Adjust the contact of the diamond point and the surface of the grinding stone with the dresser adjusting knob.
- c) Select the grinding motor switch on.
- d) Fix the dresser with the fixing screw, after adjusting the contact.
- e) Turn the feed handle slowly up and down few times.
- f) After dressing, the motor should be "off" and the diamond point should be retarded and locked at original position.

NOTE : Impacts against the diamond point or excess corrective machining allowance will damage the diamond point and cause abnormal wear of the grinding stone.



< Fig. 10 >



4. How to measure an angle with an Angle Tool Piece

Setting an "Angle Tool Piece", measure an exact angle by following methods.
(In case of B & W 70MC)

SPECIFICATION

ANGLE TABLE

ENGINE MODEL	MODEL NAME	ROTATION OF TURN TABLE	THE ANGLE OF GRINDING		ROTATION OF GRINDER SHAFT	SIZE OF GRINDER STONE	MOTOR	
			VALVE SPINDLE	BOTTOM PIECE			GRINDER	TURN TABLE
B&W 42MC/-C	NKK 42BG	4.0 RPM	$30.3^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$	3,350RPM	ROUGH $\varnothing 100 \times \varnothing 32 \times W13$ FINE $\varnothing 100 \times \varnothing 32 \times W15$	750W	400W
B&W 46MC/-C	NKK 46BG	4.0 RPM	$30.4^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
B&W 50MC/-C	NKK 50BG	4.0 RPM	① $30.4^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
			② $30.5^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
B&W 60MC/-C	NKK 60BG	4.0 RPM	$30.3^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
B&W 70MC/-C	NKK 70BG	4.0 RPM	$30.4^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
B&W 80MC/-C	NKK 80BG	3.0 RPM	$30.5^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
B&W 90MC/-C	NKK 90BG	3.0 RPM	$30.7^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				
B&W 98MC/-C	NKK 98BG	3.0 RPM	$30.7^{\circ} \begin{smallmatrix} +0.1^{\circ} \\ 0 \end{smallmatrix}$	$30^{\circ} \begin{smallmatrix} 0 \\ -0.1^{\circ} \end{smallmatrix}$				

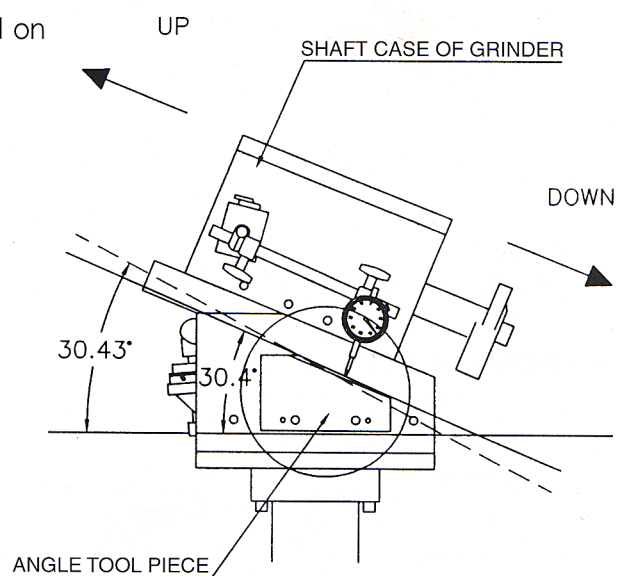
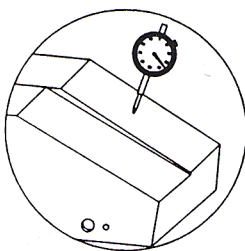
① Angle for Nimonic spindle

② Angle for alloy cladding spindle

4-1) SPINDLE ANGLE SETTING

The exact angle of "Angle tool piece" is marked on individual product. At first, angle tool piece for valve spindle & Bottom piece should be placed on the position of the view (Fig.1).

Move upper slide by 50mm and then check the difference of indication with dial gauge.



< Fig. I >

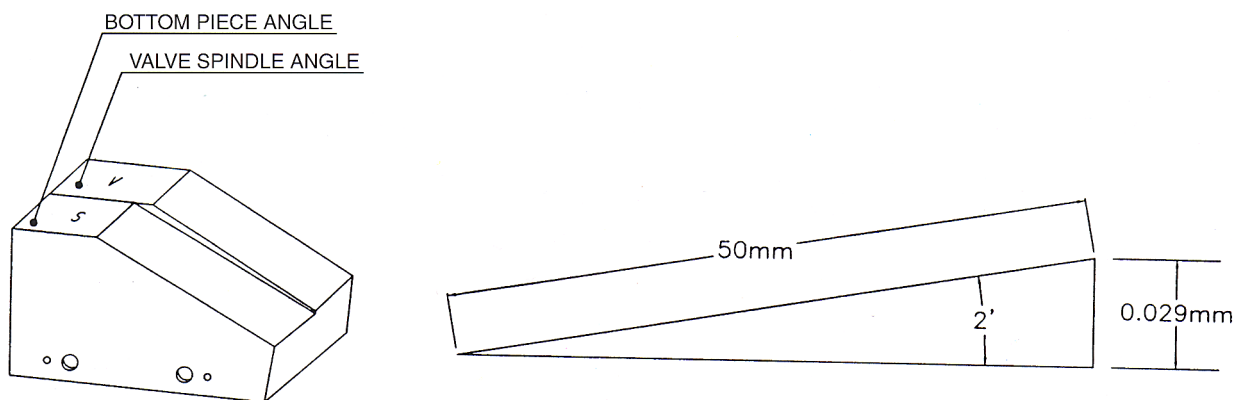
If the difference is "0" then the up (=grinding angle) inclination is quite same with "angle tool piece".



If the indication with dial gauge at upper position is bigger than lower position, the calculated angle should be added to the angle of "angle tool piece" and vice versa.

For example the tool piece angle is 30.40° and the measuring result is as following, then the angle can be calculated as ;

$$\sin^{-1} (0.029/50) = 0.03323^\circ \div 0.033^\circ$$

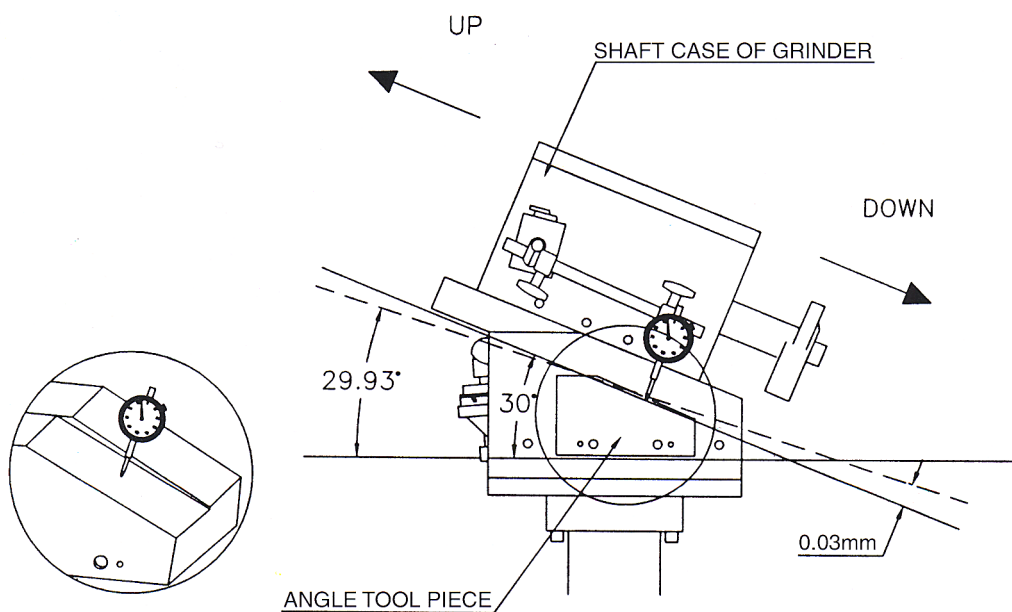


< Fig. II >

Setting angle becomes $30.4^\circ + 0.033^\circ = 30.433^\circ$

4-2) BOTTOM PIECE ANGLE SETTING

: Measuring and calculation method are quite with valve spindle case.

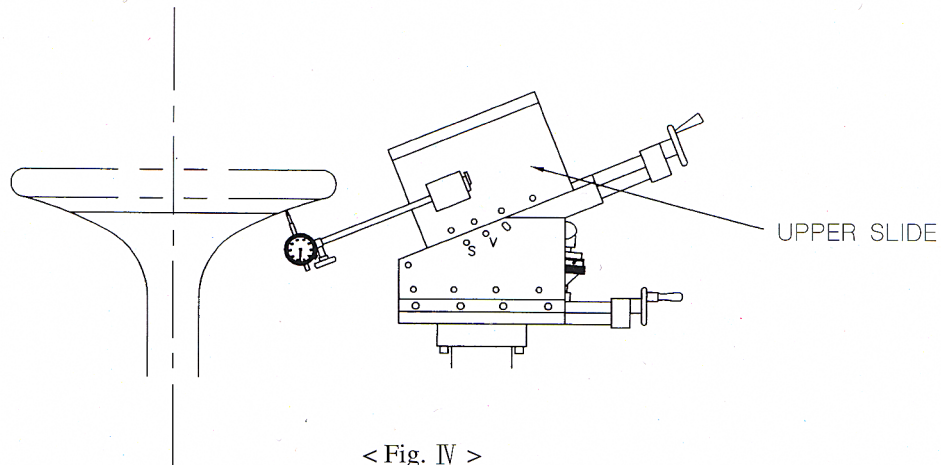


ANGLE TOOL PIECE FOR VALVE SPINDLE

< Fig. III >

5. MEASUREMENT OF FLATNESS

Checking after grinding, using the Dial Gauge. (Refer to Fig.)



After completing all works, install the Dial Gauge Set as Fig. then, check a scale while turning the Upper Slide up and down.

As this point, Do not exceed 0.01mm of scale.

6. CONFIRMATION OF ROUGHNESS

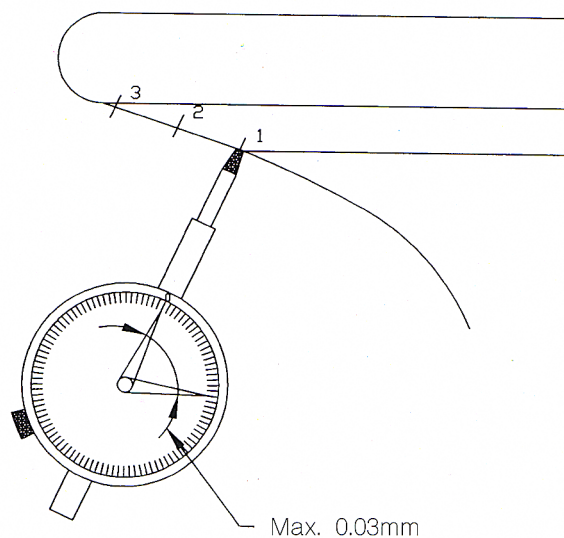
IT should be confirmed by comparing the ground surface and "Rugo tester" supplied.

Surface requirement : R_a 0.8(=N6)

7. MEASUREMENT OF RUN-OUT

Measure while putting V/V Spindle or Bottom Piece on the Grinder and the Dial Gauge on the seat of Spindle or Bottom Piece.

Do adjust between Min. 0.01mm and Max 0.03mm. Refer to Fig. V



TOOLS LIST

PAGE

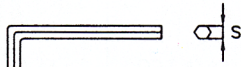
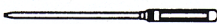
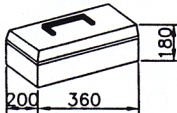
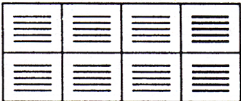
B & W 42MC/-C ~ 98MC/-C MAIN ENGINE

SHIP NO

BOX NO



MODEL : NKK - TYPE

NO	NAME	SKETCH	MATERIAL	SUPPLY PER MACHINE		DRAWING NO	REMARKS
				WORK	SPARE		
1	LIFTING TOOL FOR EXH. V/V SPINDLE		TOOL STEEL	1	-		
2	HEX. WRENCH		TOOL STEEL	EACH 1	-		1.5, 2, 2.5 3, 3.5, 4 5, 6, 8, 10
3	+ DRIVER		MAKER	1	-		
4	DIAL GAUGE		MAKER	3	-		
5	MAGNET STAND		MAKER	3	-		0.01 ~ 10mm
6	TOOL BOX		MAKER	1	-		
7	SURFACE TESTER		MAKER	1	-		
MFR'S NAME		KOKACO CO., LTD.					



SPARE

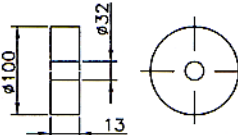
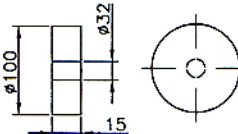
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B & W 42MC/-C ~ 98MC/-C MAIN ENGINE

SHIP NO

BOX NO

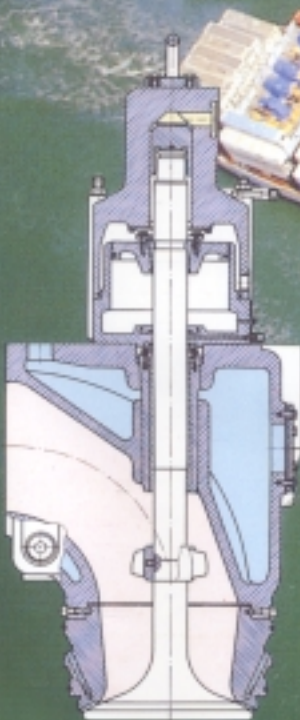
MODEL : NKK - TYPE

NO	NAME	SKETCH	MATERIAL	SUPPLY PER MACHINE		DRAWING NO	REMARKS
				WORK	SPARE		
1	GRINDING STONE (ROUGH)		PA54L35S	1	2		
	GRINDING STONE (FINE)		PVA150	1	1		
2	LAPPING OIL		MAKER	1	-		HANCUT A-60H HANYOUNG CHMICAL
3	V - BELT		MAKER				
		ENGINE MODEL	MODEL NAME	KIND OF BELT		QUANTITY	
						WORK	SPARE
		B&W 42MC/-C ~ 70MC/-C	NKK 42BG ~ NKK 70BG	5M615		2	2
				A26		1	1
				B50		1	1
		B&W 80MC/-C	NKK 80BG	5M615		2	2
				A26		1	1
				B52		1	1
		B&W 90MC/-C ~ 98MC/-C	NKK 90BG ~ NKK 98BG	5M615		2	2
				A26		1	1
				A33		1	1
				B59		1	1

MFR'S NAME

KOKACO CO., LTD.





KOKACO
CO., LTD.



BEST QUALITY

KOKACO CO., LTD.

ADDRESS : #189 - 4 DONGSAM - DONG
YONGDO - GU PUSAN KOREA

REPRESENTATIVE : KIM, JUNG MYUNG

TEL : + 82 - 51 - 403 - 4114 ~ 6,
+ 82 - 51 - 403 - 6247

FAX : + 82 - 51 - 403 - 6990

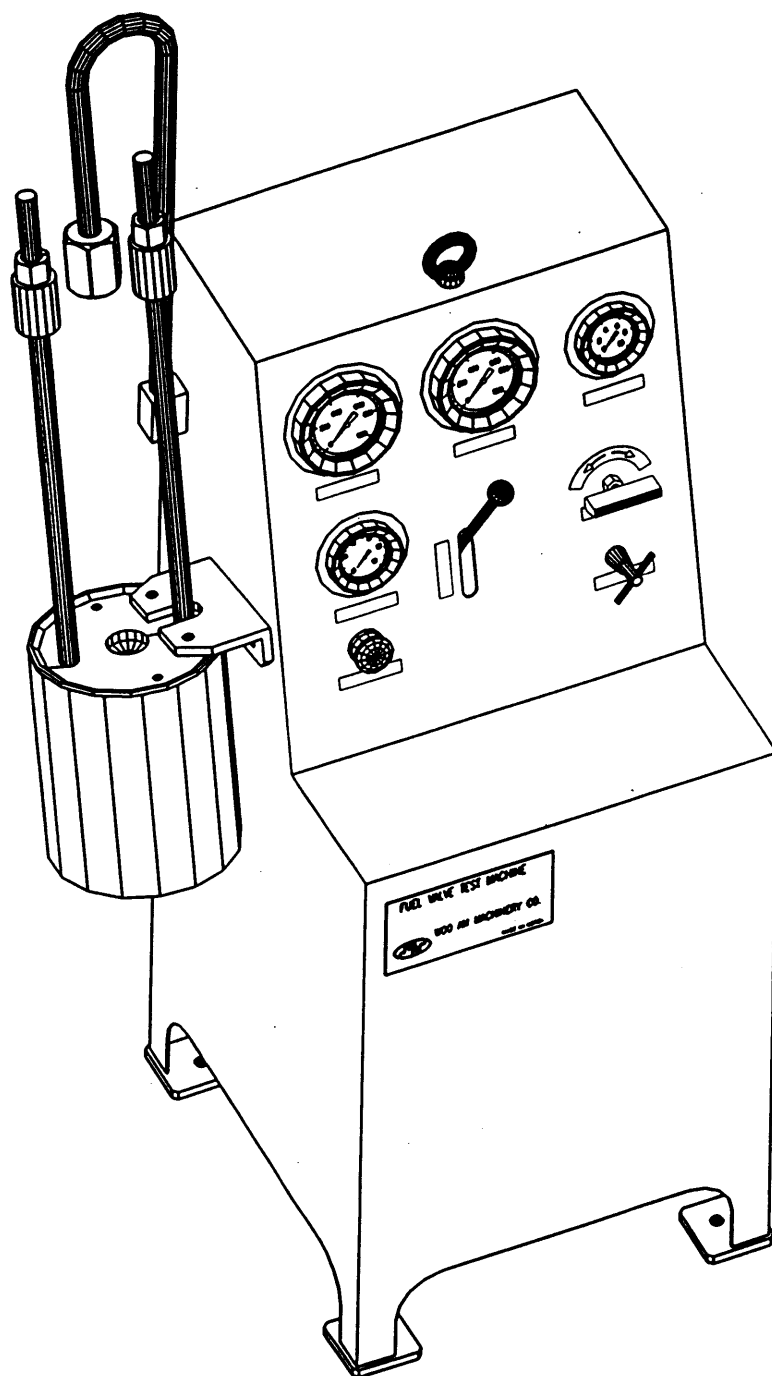
E-MAIL : kksco@unitel.co.kr

Homepage : kokaco.co.kr



INSTRUCTIONS FOR USE OF FUEL VALVE TESTER

FUEL VALVE TESTER FOR B&W TYPE ENGINES.



WOO AM MACHINERY CO



INSTRUCTION FOR USE OF FUEL VALVE TESTER

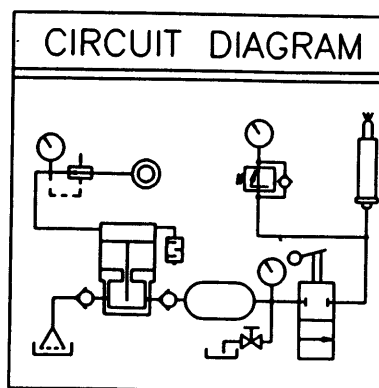
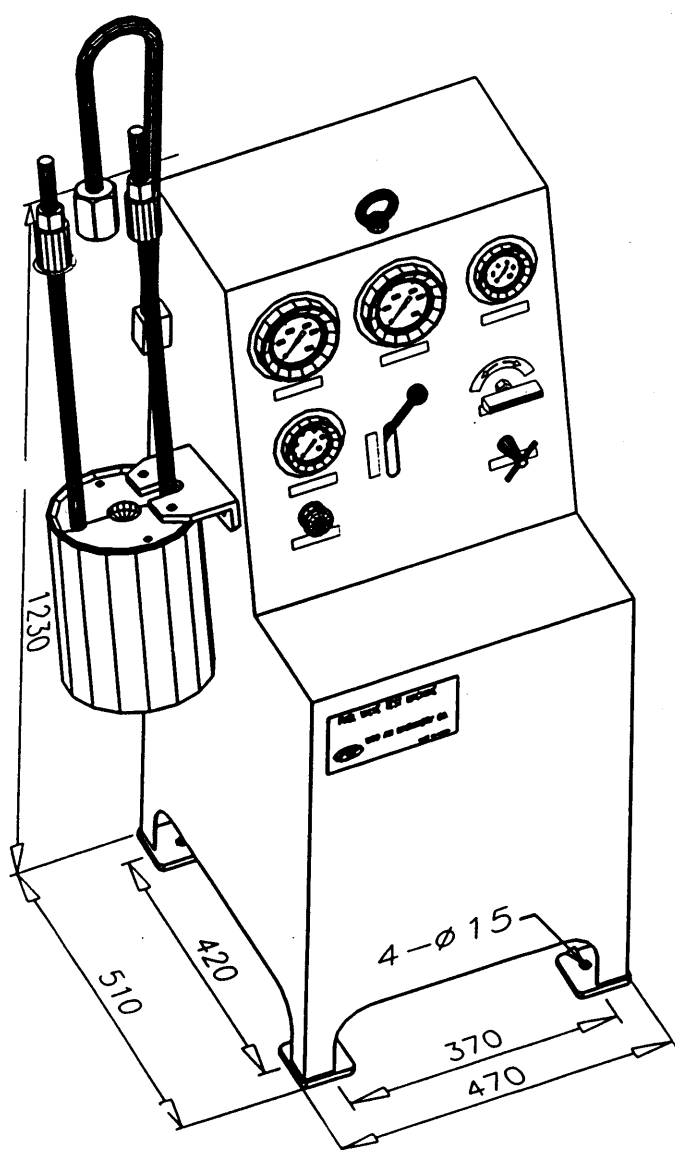


WOO AM MACHINERY CO

- This manual describes the operation and special notes for Fuel Valve Tester to check the quality of Fuel Valve, manufactured by WOO AM MACHINERY CO.
- This manual includes Code Nos. and names each parts (Gauges, Lever etc.) to help users understand.
- Please read this manual carefully before use and follow the instruction to operate.

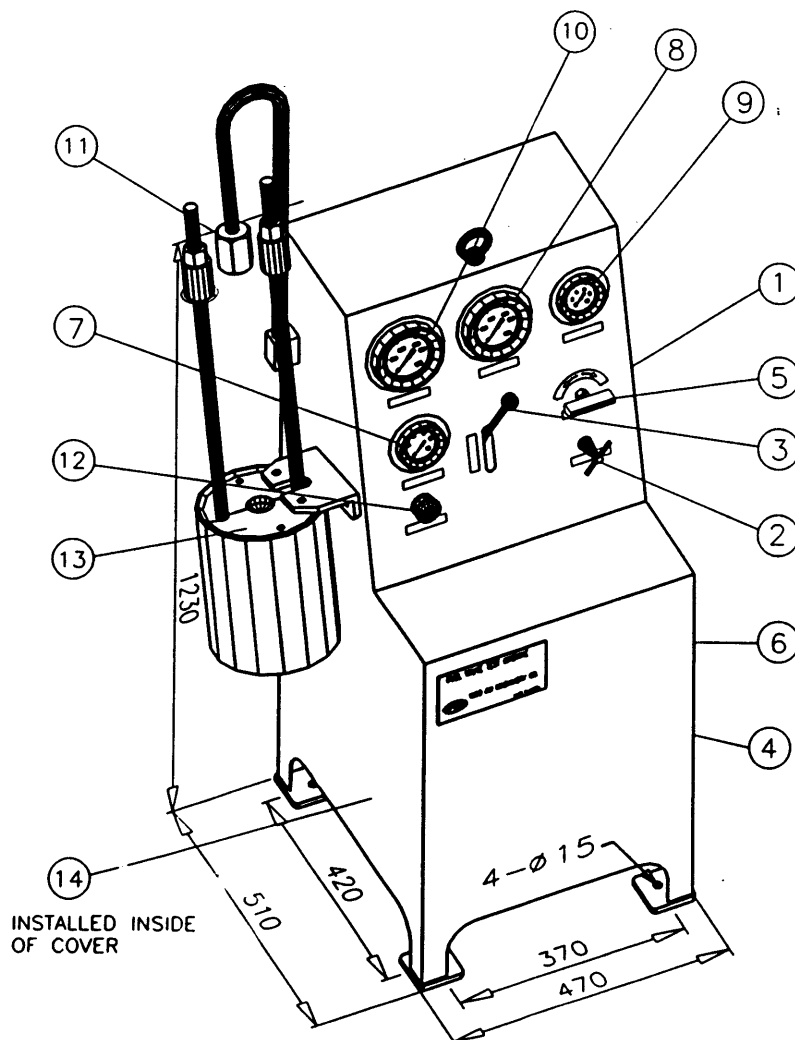
SPECIFICATION

- Working air pressure : 7 bar
- Air consumption : 2.6m³/min. at 7 bar
- Oil volume : min 20cc/1 stroke
(WBT560N) (50MC/60MC)
- Oil volume : min 40cc/1 stroke
(WBT789N) (70MC/80MC/90MC)
- Oil quantity : min. 1.2 l /min. at 7 bar
in and 300 bar out.
- Atomizing pressure : min. 800 bar at 7 bar
air pressure.
- Oil tank capacity : 8 l
- Weight : 135kg(with oil)
- Paint color : 7.5BG7/2



Preparation

- Before connection this Fuel Valve Tester to air hose, air regulator(2) and selection lever(3) are closed(the former to the left and the latter in the close position)
- Fill oil tank with about 7 liter of oil(viscosity 7-10 cst at 50℃) through oil inlet hole(6) watching oil lever gauge(4) carefully.
- Connect air hose to air inlet(1).
- Open return valve(5) to the left and turn air regulator(2) to the right slowly.
Scale in air pressure gauge(9) will increase gradually and booster(14) will start to operate.
- Keep air pressure gauge(9) at 3bar for 5 minutes.
- Close air regulator(2) by turning to the right.
- Connect fuel valve clamber(11) to hose, keep selection lever(3) at open position, then close return valve(5) by turning to the right.
- Open air regulator(2) to the right and keep operating it until oil without air is coming in fuel valve clamber(11).
- Once oil tank is emptied or when you start new operation, steps 4)-8) should be repeated before use this fuel valve tester to remove the air in every oil line.



- ① AIR INLET
- ② AIR REGULATOR
- ③ SELECTION LEVER
- ④ OIL LEVER GAUGE
- ⑤ RETURN VALVE
- ⑥ OIL INLET HOLE
- ⑦ PRESSURE GAUGE FOR VENTING FUNCTION
- ⑧ PRESSURE GAUGE FOR WORKING
- ⑨ PRESSURE GAUGE FOR AIR
- ⑩ PRESSURE GAUGE FOR OPENING
- ⑪ FUEL VALVE CLAMPER
- ⑫ FULL STROKE BUTTON
- ⑬ FUEL VALVE HOLDER
- ⑭ BOOSTER



Test procedure of fuel valve

Leak test and venting function

- Check the above preparation was done properly.
- Fix fuel valve to fuel valve holder(13) as the picture shown below, and connect the fuel valve clamber(11).
- Set selection lever(3) to open.
- Turn air regulator(2) to the right slowly until pressure gauge(8)(10) reads 200bar. Pressure gauge(7) will shown about 20-25bar.
- Check the leakage in atomizer visually in the above step.
- Position selection lever(3) to close, and watch slide valve of fuel valve opening at about 10bar in pressure gauge(7)(10). Sudden drop in pressure gauge(7) will indicate this function.

Opening pressure check

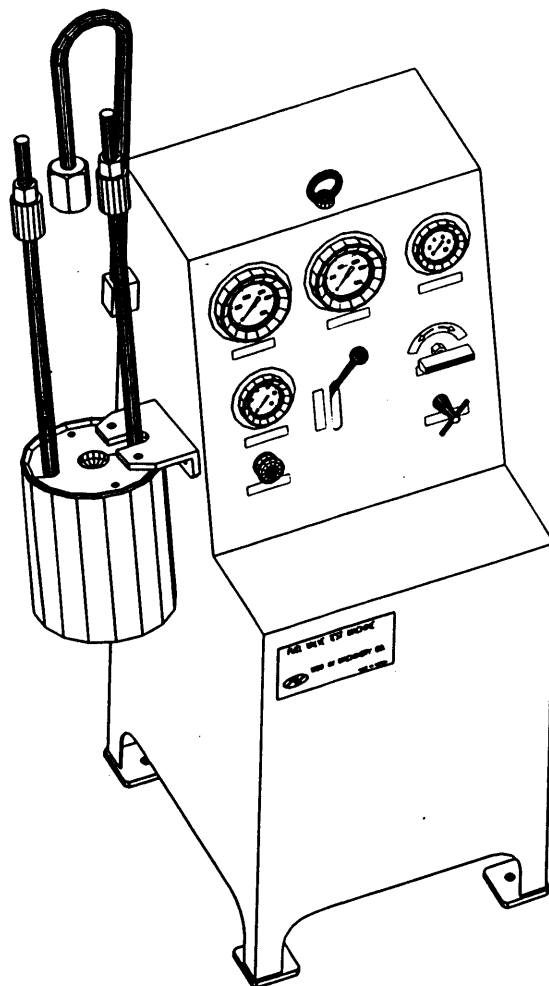
- Refer to fuel valve section in B&W instruction book for the opening pressure of fuel valve.
- Set selection lever(3) to open.
- Turn air regulator(2) to the right and read pressure gauge(10). Oil will come through atomizer.

Atomizing check

- Set selection lever(3) to close.
- Turn air regulator(2) to the right to the maximum(600bar) of pressure gauge(8).
- Press full stroke button(12) to set the piston of booster (14) to top point.
- Open selection lever(3) by sudden hitting with the palm, and watch atomizing condition at the same time.
- Repeat step 1)-4) and check atomizing condition. This repetition should be done only after pressure gauge(7)(10) shows 0 bar.
- To finish atomizing test, air regulator(2) to the left until pressure gauge(9) shows 0 bar.
- Turn return valve(5) to the left, when pressure gauge(8) shows "0" bar, and turn again to the right.

O-Ring seal test

- Block vent hole of fuel valve.
- Set selection lever(3) to open.
- Turn air regulator(2) to the right until pressure gauge(8)(10) reads 100bar.
- Set selection lever(3) to close and check the leakage of oil in the head of fuel valve visually.



INSTRUCTION FOR USE OF FUEL VALVE TESTER



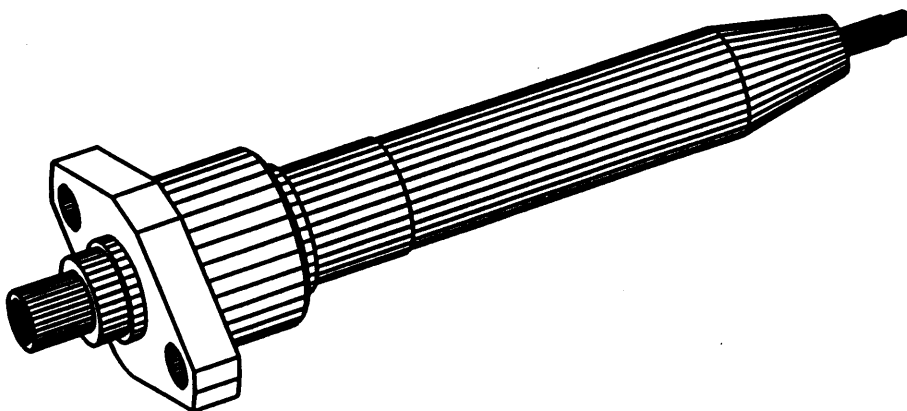
WOO AM MACHINERY CO

Caution

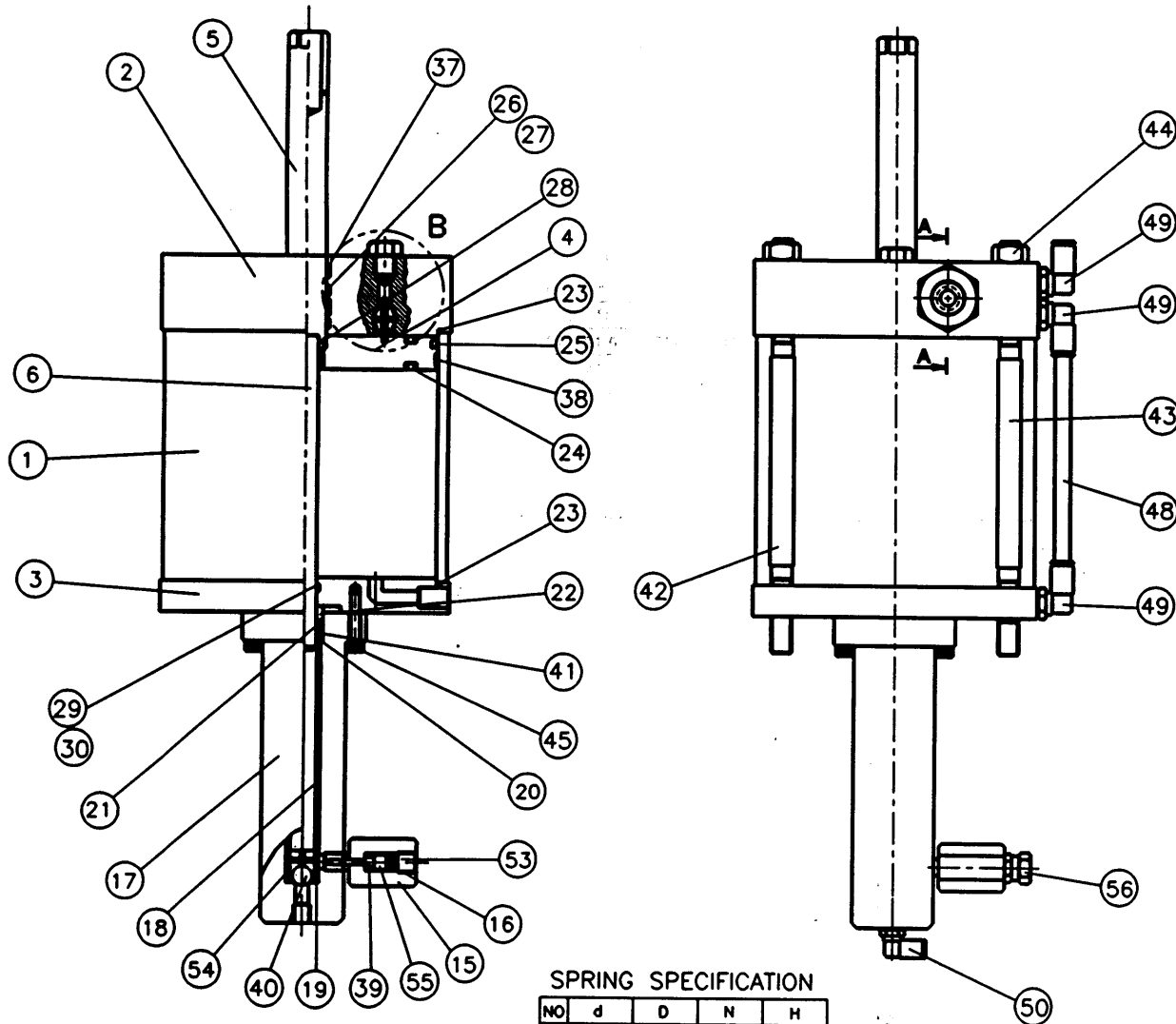
- After the test of fuel valve, turn air regulator(2) and return valve(5) to the left make pressure gauge(8) 0bar.
- Set selection lever(3) to close, remove fuel valve from this fuel valve tester.
- Remove and clean oil filter in the outlet of oil tank often, and replace it when needed (this is equipped inside of the fuel valve tester).
Replacement should be within every 6 months. Extra filter is included as spare part at the purchase of this fuel valve tester.
- To maintain efficient filtering, remove the humidity of air filter by pressing the button in the bottom of the filter regularly. Never fill the filter with oil.
- When you need to reassemble booster(14), grease inside of cylinder, plunger, and O-Ring with the best quality grease for the smooth operation between cylinder and piston.
- Regular check is important for the maintenance of this fuel valve tester.

Others

- Codes Nos of important parts(e. g. Booster(14)) are listed and are available at the listed address for sale.
- Standard spare parts are included and separately packed with the spare list.

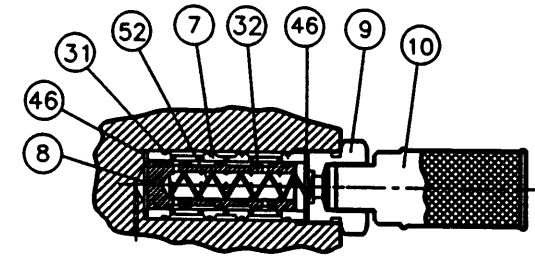


NO	NAME	MAT'L	QTY	REMARK

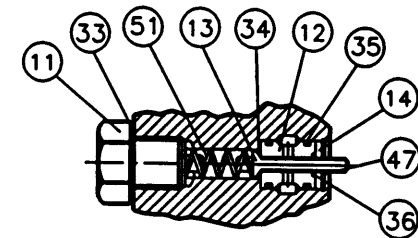


SPRING SPECIFICATION

NO	d	D	N	H
51	Ø1	Ø8	7	30
52	Ø1.6	Ø14	15	90
53	Ø1.2	Ø13	4	23
54	Ø0.5	Ø10.5	3	13
55	Ø0.3	Ø5.4	7	13



SECTION A-A



DETAIL B

REV	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
ITEM NAME		FUEL V/V TESTER FOR B&W TYPE		
PART NAME		BOOSTER ASSEMBLY		
S= /		DATE:		
 WOO AM MACHINERY CO.				

■ BOOSTER

NO	DESCRIPTION	MATERIAL	Q'TY	SPARE	REMARKS
0	BOOSTER		1SET		
1	CYLINDER	STKM	1EA		
2	TOP COVER	AL7075	1EA		
3	BOTTOM COVER	SS400	1EA		
4	PISTON	SS400	1EA		
5	LOAD	S45C	1EA		
6	PLUNGER	S45C	1EA		
7	SPOOL	BC	1EA		
8	SPOOL	AL7075	1EA		
9	SILENCER CAP	SS400	1EA		
10	SILENCER	MAKER	1EA		PT3/4
11	POINT CAP	SS400	1EA		
12	SLEEVE	BC	1EA		
13	POINT	S45C	1EA		
14	BUSH	BC	1EA		
15	CHECK VALVE	S45C(H)	1EA		
16	SLEEVE	SS400	1EA		
17	CHECK VALVE	S45C(H)	1EA		
18	BUSH	SS400	1EA		
19	SLEEVE	SS400	1EA		
20	SLEEVE	BC	1EA		
21	PACKING	TEFLON	1EA		
22	BUSH	BC	1EA		
23	O-RING	NBR	2EA		Ø 196.4X2
24	O-RING	NBR	2EA		P150A
25	O-RING	NBR	1EA	1EA	G190
26	O-RING	NBR	1EA		G30
27	BACK UP RING	MAKER	2EA		G30
28	O-RING	NBR	1EA		P24
29	O-RING	NBR	2EA		P18
30	BACK UP RING	MAKER	4EA		P18
31	O-RING	NBR	4EA	1EA	K028
32	O-RING	VITON	7EA	1EA	Ø 23.52X1.78
33	O-RING	NBR	1EA		P16
34	O-RING	NBR	1EA	1EA	P5
35	O-RING	NBR	2EA	1EA	K013
36	O-RING	NBR	1EA		K007



WOOAM MACHINERY CO



■ BOOSTER

NO	DESCRIPTION	MATERIAL	Q'TY	SPARE	REMARKS
37	WEAR RING	MAKER	1EA		10X2.5T
38	WEAR RING	MAKER	1EA		10X2.5T
39	BALL	MAKER	1EA		Ø 8
40	BALL	MAKER	1EA		Ø 15
41	U-PACKING	MAKER	1EA	1EA	KFU0182FO
42	SUPPORT BOLT	S45C	2EA		
43	SUPPORT BOLT	S45C	2EA		
44	NUT	SS400	4EA		M16
45	WRENCH BOLT	8.8	8EA		M8X35L
46	PACKING	TEFLON	2EA		
47	SNAP RING	MAKER	1EA		S-15
48	HOSE	MAKER	1EA		Ø 12
49	FITTING	MAKER	3EA		3/8"X Ø 12
50	FITTING	MAKER	1EA		1/4"X Ø 10
51	SPRING	SWP	1EA		SEE DWG
52	SPRING	SWP	1EA		SEE DWG
53	SPRING	SWP	1EA		SEE DWG
54	SPRING	SWP	1EA		SEE DWG
55	SPRING	SWP	1EA		SEE DWG
56	FITTING	MAKER	1EA		PT3/8X Ø 8
	OIL FILTER	MAKER	1EA	1EA	



WOOAM MACHINERY CO.



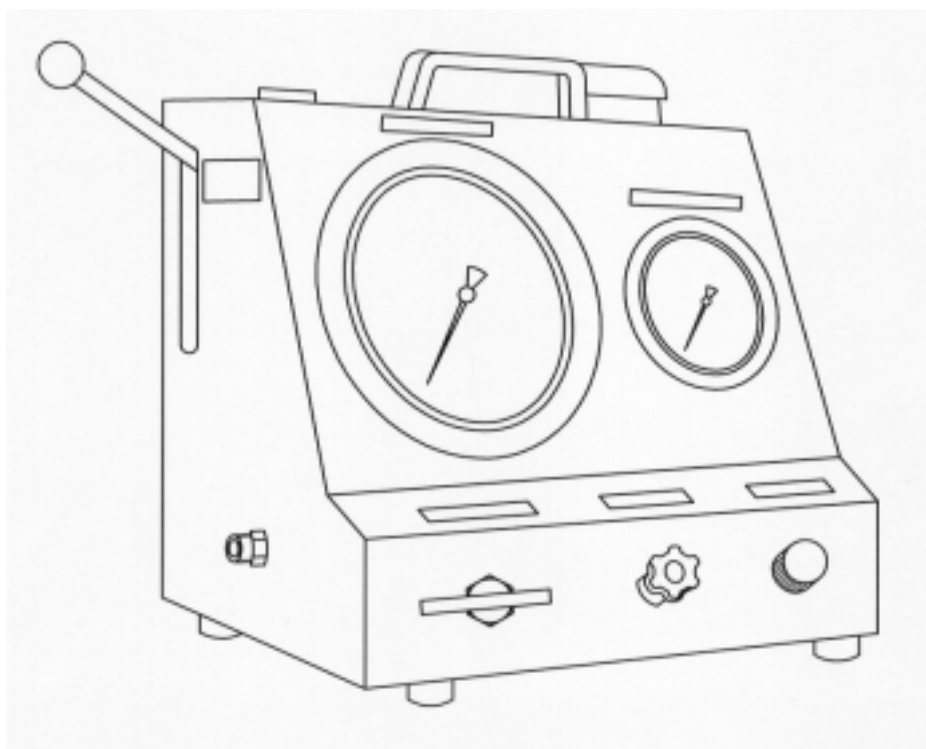
POWERMATE

MANUAL NO. : AHP1500-1.0

INSTRUCTION MANUAL

AIR DRIVEN HIGH PRESSURE PUMP

MODEL : AHP-1500



HANMI HYDRAULIC MACHINERY CO., LTD.

#715-14, MORA-DONG, SASANG-GU, BUSAN, KOREA

PHONE : (051) 305-2511~6

FAX : (051) 301-1721

HANMI



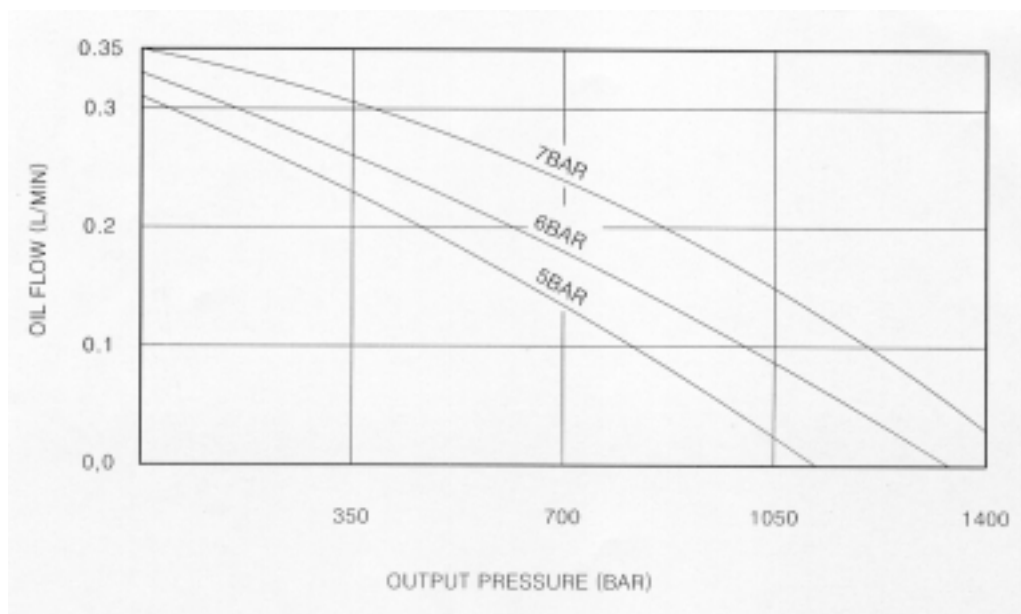
POWERMATE

SPECIFICATION

* * * HIGH PRESSURE PUMP UNIT * * *

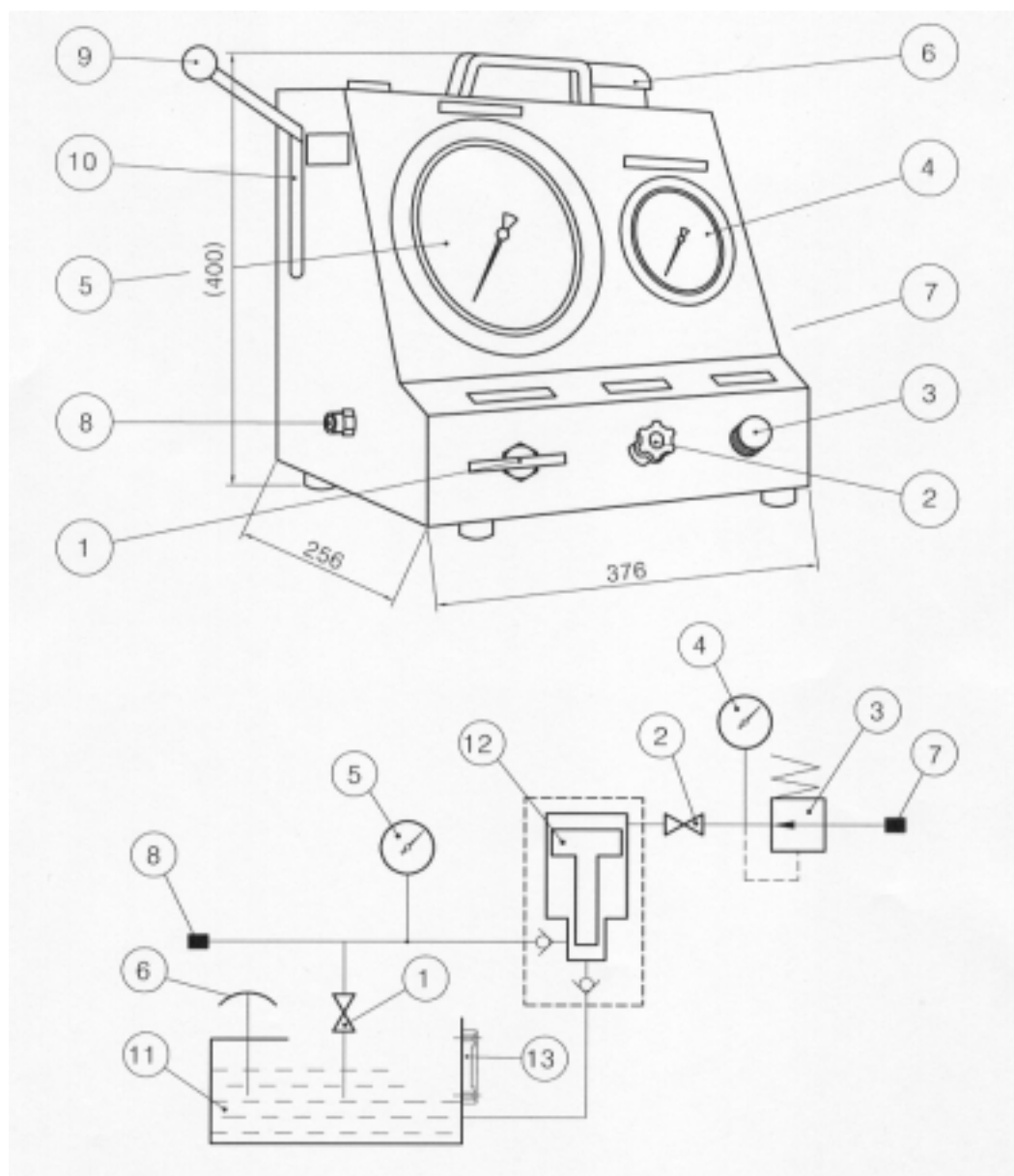
- | | |
|-----------------------------|--|
| 1. MODEL NO. | : AHP-1500 |
| 2. ACTUAL AREA RATIO | : 217 : 1 |
| 3. MAX. PRESSURE | : 1500 BAR |
| 4. AIR CONSUMPTION | : 420 LITERS/MIN. AT 7 BAR AIR INPUT |
| 5. PUMPING SPEED | : APPROX. 743 CYCLES/MIN. AT 7 BAR AIR INPUT |
| 6. DISPLACEMENT PER CYCLE | : 0.47 cm ³ |
| 7. MAX. FLOW AT NO PRESSURE | : APPROX. 0.35 LITERS/MIN. AT 7 BAR AIR INPUT |
| 8. TANK CAPACITY | : 3.5 LITER |
| 9. AIR INNER PORT | : 1/2" BSP FEMALE WITH INCREASE TO M42 ADAPTER |
| 10. LIQUID OUTLET PORT | : 1/4" MALE |
| 11. APPROX. DIMENSION | : 376×256×400 |
| 12. WEIGHT | : 16 Kg |

PERFORMANCE CURVES



POWERMATE

HIGH PRESSURE PUMP AHP-1500



- | | |
|--|---------------------------------|
| 1. OIL RETURN VALVE | 8. STUD MARKED |
| 2. STOP VALVE (CYCLING VALVE) | "HIGH PRESSURE OUTLET" |
| 3. PRESSURE CONTROL VALVE | 9. LEVER FOR HAND PUMP |
| 4. PRESSURE GAUGE FOR PRESSURE CONTROL | 10. SLOT WITH BUSHING FOR LEVER |
| 5. PRESSURE GAUGE FOR WORKING PRESSURE | 11. OIL TANK |
| 6. AIR BREATHER | 12. PUMP |
| 7. STUD MARKED "AIR INLET" | 13. OIL LEVEL GAUGE |

OPERATING MANUAL

HIGH PRESSURE PUMP AHP-1500

1. BEFORE OPERATING THE PUMP UNIT

- a) Oil tank is filled with any good hydraulic oil through the filler cap.
Hydraulic oil : ISO VG32 (MINERAL OIL)
- b) Open the release valve by anti-clockwise.
- c) The pressure control valve (air regulator) should be turned 4~5 turns anti-clockwise.
- d) Stop valve should be turned clockwise.

2. CONNECTION OF PUMP

- a) Air line is connected "AIR INLET" 7 on the right side of the unit.
- b) Hydraulic line is connected "HIGH PRESSURE OUTLET" 8 on the left side of the unit.
- c) The pump may also be operated by hand if compressed air is not available, the handle 9 is placed in the retainer on the top panel.
It may easily be filled to the pump through the slot in the left side plate by pressing it into the bushing found inside the slot.

3. OPERATION OF PUMP

- a) Stop valve 2 is turned slowly anti-clockwise, whereby compressed air enters into the pump unit, which commences to work, the stop valve 2 is also acting as a regular valve for the pumping speed.
- b) The regulator valve 3 which is used for adjusting the pressure may now be read on the manometer for pressure control 4.
This manometer show the hydraulic high pressure in rear.
- c) The oil return valve 1 is closed by turning the knob clockwise and then the oil will run from the oil tank into the hydraulic system has been filled, and the pump has stopped operating, the high pressure reached can be read at the manometer for working pressure 5 found on the left side of the instrument panel.
The pump stops automatically when the required high pressure has been established and holds it infinitely.
The pump starts automatically again if pressure drop occurs in the hydraulic system.



POWERMATE

- d) High pressure may be removed from the system by opening the release the release valve 1 (to be turned anti-clockwise).

The excessive oil in the secondary high pressure system will thereby return to the oil tank in the pump unit.

4. ENDING OF OPERATING

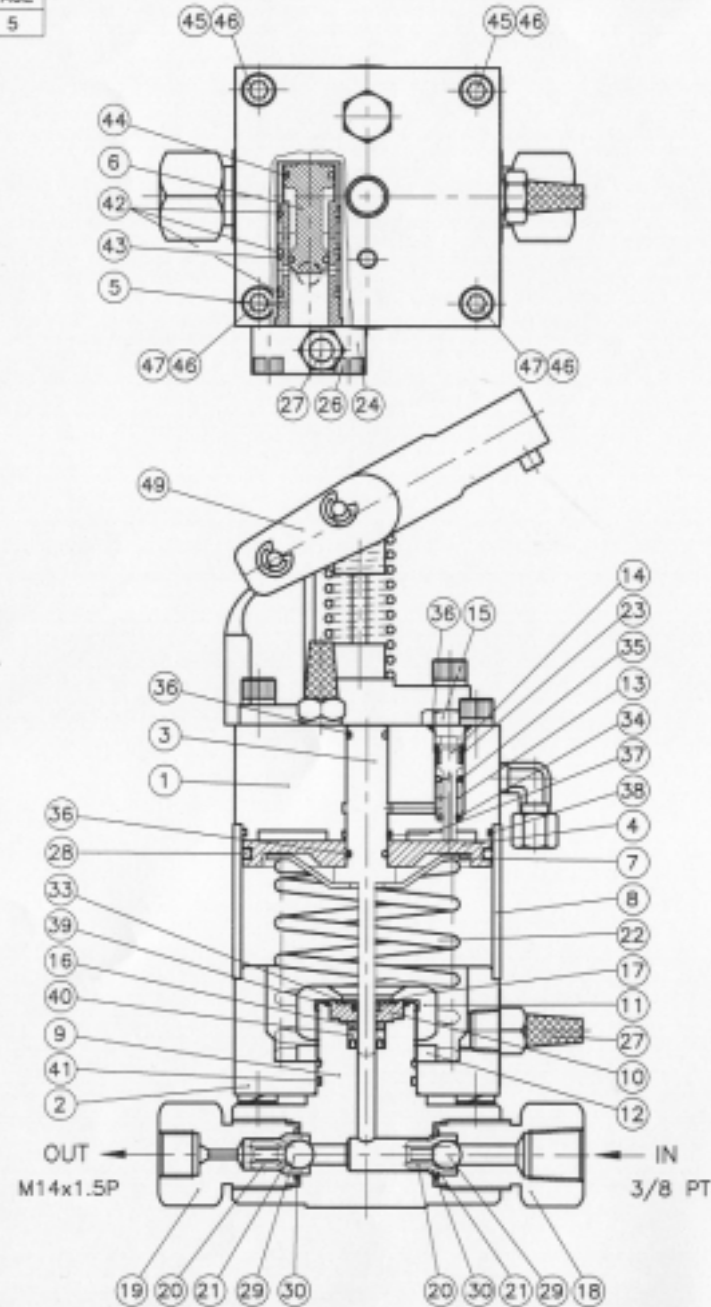
To avoid oil spillage, precautions should be taken to see that the oil is taken back into the oil tank before the connections on the high pressure side are disconnected.

This is done by turning the release valve 1 anti-clockwise.

Simultaneously the pump should be stopped by turning the stop valve 2 clockwise, and when this valve has been closed, the air hose may be removed, and the pump transferred to another job.

5. DATA FOR HIGH PRESSURE

The pump unit can deliver a maximum pressure of 1500 bar.

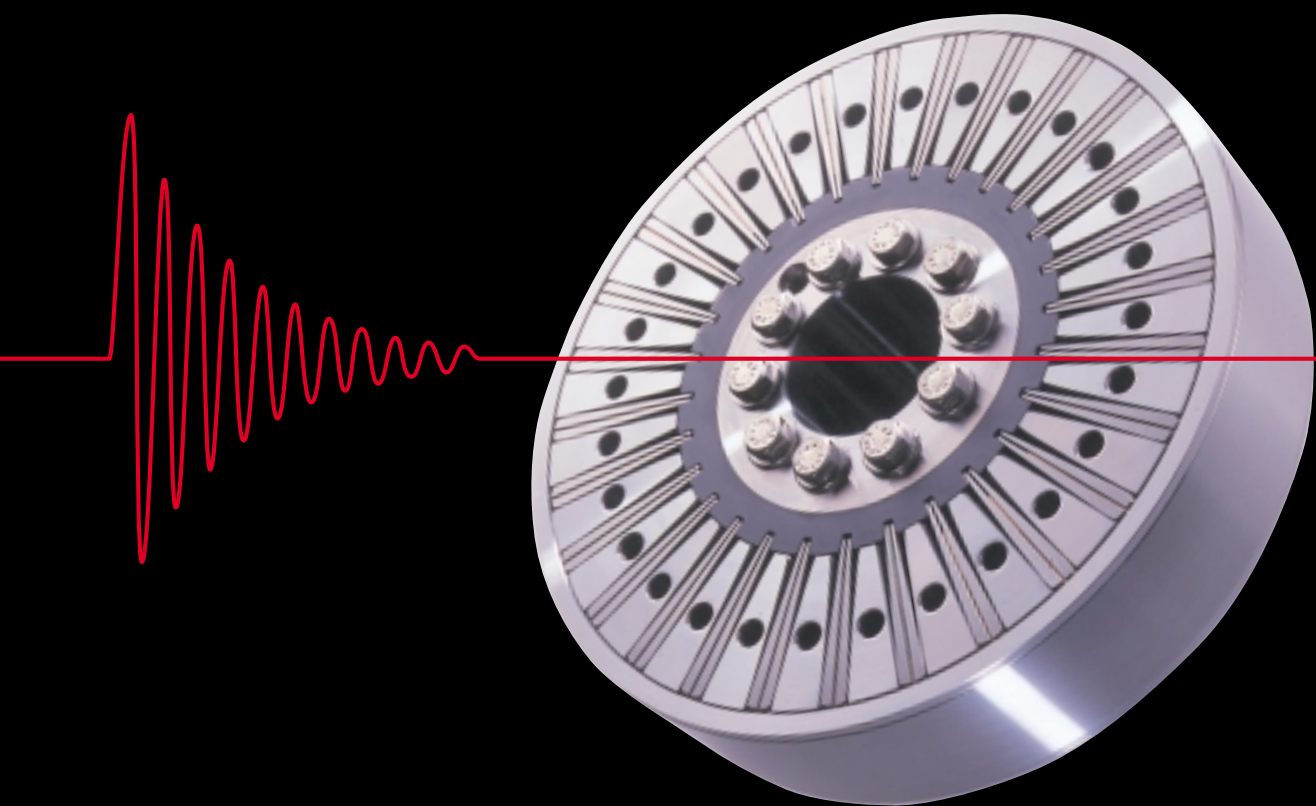
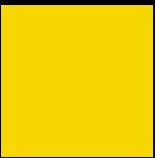


49	LEVER FOR HAND PUMPING	HM-S-200-49	10-1149-0	1	
48	PLUG	HM-S-200-48	10-1148-0	5	
47	WRENCH BOLT	HM-S-200-47	10-1147-0	2	
46	FLAT WASHER	HM-S-200-46	10-1146-0	4	
45	WRENCH BOLT	HM-S-200-45	10-1145-0	2	
44	O-RING	HM-S-200-44	10-1144-0	1	
43	O-RING	HM-S-200-43	10-1143-0	1	
42	O-RING	HM-S-200-42	10-1142-0	3	
41	O-RING	HM-S-200-41	10-1141-0	1	
40	U-PACKING	HM-S-200-40	10-1140-0	1	
39	O-RING	HM-S-200-39	10-1139-0	1	
38	O-RING	HM-S-200-38	10-1138-0	1	
37	O-RING	HM-S-200-37	10-1137-0	1	
36	O-RING	HM-S-200-36	10-1136-0	3	
35	O-RING	HM-S-200-35	10-1135-0	1	
34	O-RING	HM-S-200-34	10-1134-0	1	
33	O-RING	HM-S-200-33	10-1133-0	1	
32	HEX. NUT	HM-S-200-32	10-1132-0	4	
31	SPRING WASHER	HM-S-200-31	10-1131-0	4	
30	O-RING	HM-S-200-30	10-1130-0	2	
29	BALL	HM-S-200-29	10-1129-0	2	
28	O-RING	HM-S-200-28	10-1128-0	1	
27	SILENCER	HM-S-200-27	10-1127-0	2	
26	WRENCH BOLT	HM-S-200-26	10-1126-0	2	
25	NAME PLATE	HM-S-200-25	10-1125-0	1	
24	SPOOL COVER	HM-S-200-24	10-1124-0	1	
23	SPRING	HM-S-200-23	10-1123-0	1	
22	SPRING	HM-S-200-22	10-1122-0	1	
21	SPRING	HM-S-200-21	10-1121-0	2	
20	RETAINER	HM-S-200-20	10-1120-0	2	
19	OUTLET CHECK BODY	HM-S-200-19	10-1119-0	1	
18	INLET CHECK BODY	HM-S-200-18	10-1118-0	1	
17	SPACER	HM-S-200-17	10-1117-0	1	
16	BACK-UP RING	HM-S-200-16	10-1116-0	1	
15	PLUG	HM-S-200-15	10-1115-0	1	
14	PILOT VALVE	HM-S-200-14	10-1114-0	1	
13	TUBE	HM-S-200-13	10-1113-0	1	
12	GLAND NUT	HM-S-200-12	10-1112-0	1	
11	GLAND NUT	HM-S-200-11	10-1111-0	1	
10	BUSH	HM-S-200-10	10-1110-0	1	
9	H.P. CYLINDER	HM-S-200-09	10-1109-0	1	
8	AIR CYLINDER	HM-S-200-08	10-1108-0	1	
7	SPRING SUPPORT	HM-S-200-07	10-1107-0	1	
6	SPOOL	HM-S-200-06	10-1106-0	1	
5	SLEEVE	HM-S-200-05	10-1105-0	1	
4	AIR PISTON	HM-S-200-04	10-1104-0	1	
3	H.P. PISTON	HM-S-200-03	10-1103-0	1	
2	BOTTOM CAP	HM-S-200-02	10-1102-0	1	
1	TOP CAP	HM-S-200-01	10-1101-0	1	

NO.	DESCRIPTION		OLD DWG. NO.	NEW DWG. NO.	Q'TY	REMARK
APPROVED Y.K.JUN	SCALE N/S	PROJECT AIR DRIVEN HYD' PUMP-S(SS)TYPE			PROJECTION	
CHECKED M.H.CHOI	DATE 99.7.5	TITLE ASSEMBLY DWG.				
DESIGNED D.H.KOO		HANMI HYDRAULIC MACHINERY CO., LTD.			DRAWING NO. 10-1100-0	



Geislinger Damper



COUPLINGS AND DAMPERS. BUILT TO LAST.

GEISLINGER



ATTENTION !

PRIOR TO UNPACK the product
READ this **INSTRUCTION HANDBOOK !**

OBEY ALL INSTRUCTIONS STRICTLY
as stated in the manual !

Added drawings

Assembly

G0 01526- G0 01527-

Parts list

G4 13430-

INSTRUCTION HANDBOOK

Nº. : 2001...,EN /Hull No. 5258

Type

D 270/13

ARRANGEMENT



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1. APPLICATION OF THE GEISLINGER DAMPER

This product is a Geislinger torsional vibration damper.

It is specially designed and keyed to suit the designated machinery only.

Improper or faulty installation may reduce the expected life time of the product.

ATTENTION

The installation of the damper in other machinery than the designated machinery can cause damage to the machinery and to the damper.



2. SAFETY INSTRUCTIONS

Any kind of work on or around the product must only be performed

- by skilled personnel
- when the machinery is at a standstill
- in accordance with the valid instructions for
 - safety regulations
 - accident prevention.

The product must only be lifted and handled by personnel

- who have the required license
 - to work with cranes
 - to drive industrial trucks
- who know the additional transport and lifting instructions
 - according to the operating manual
 - and the assembly drawing.



3. TRANSPORT AND LIFTING INSTRUCTIONS

3.1. Transport instructions

- Only move the product horizontally
- Do not tilt the case or pallet
- Avoid hard shocks during transport
- Maximum lifting speed is 50 m/min
- Do not damage packaging and protective materials

3.2. Lifting appliances

3.2.1. High-strength lifting appliances

They are:

- delivered with the product
- painted red
- capable of being loaded in all directions
- to be used according to the instructions
 - on the assembly drawing
 - or on the lifting diagram (see chapter 3.4).

3.2.2. Eyebolts according to DIN 580

They are:

- **not** included in the delivery
- **not** capable of being loaded perpendicular to the ring plane
- to be used according to the instructions
 - of DIN 580
 - on the assembly drawing
 - or the lifting sketch.

3.2.3. Lifting links

They are:

- delivered with the product
- **capable of being loaded in all directions**
forbidden to lift shunt loads and rope inclination angles (β) greater than 45°!
- always screwed on using all of the fixing screws (for minimum quantity, see parts list)



- to be used according to the instructions
 - on the assembly drawing
 - or the lifting diagram.

The cross hole provided must be completely filled by the through bolts of the lifting appliance (shackle) to be attached.

3.2.4. Supporting beams

They are:

- a special type of construction
- delivered with the product
- always screwed on using all of the fixing screws (minimum quantity see parts list)
- **capable of being loaded in all directions**
forbidden to lift shunt loads and rope inclination angles (β) greater than 45°!
- to be used according to the instructions
 - on the assembly drawing (mounting)
 - or the lifting diagram.

3.3. Tapped holes for lifting purposes

These are indicated on the assembly drawing by



3.3.1. General purpose tapped holes

They are both tapped holes for screws for other uses and tapped holes for lifting.

Use:

- Remove the bolt from the general purpose tapped hole
- Mount the lifting appliances and lift the coupling
- After the lifting operation, remove the lifting appliances and mount the bolt again in accordance with
 - the tightening torques
 - the tightness instructions
 - and safety measures

Reassemble according to the assembly drawing.



3.4. Lifting instructions

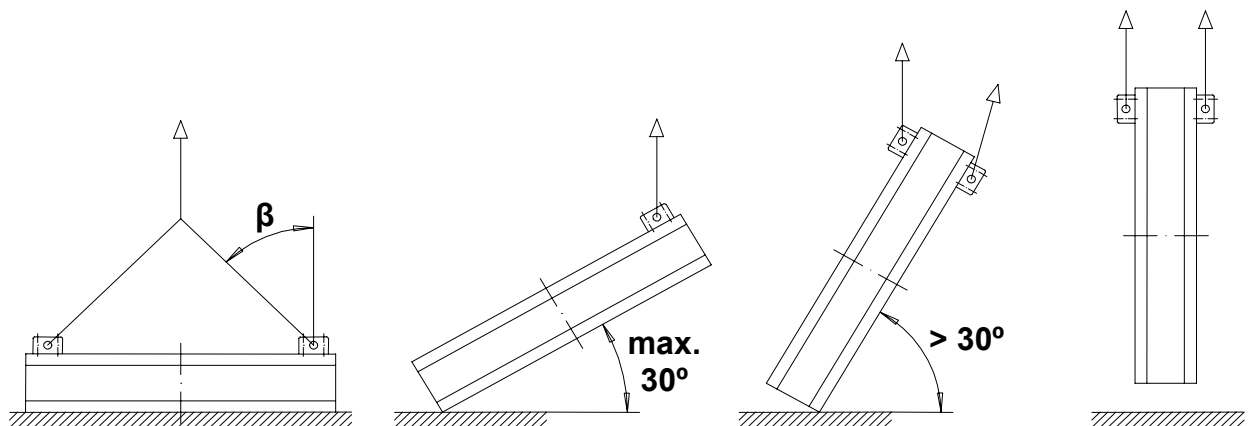
Only lift the product

- with the lifting appliances provided (see chapter 3.2)
- with adequate and approved lifting devices of any other kind (cables, chains, carrying straps) if necessary
- after mounting the lifting appliances in accordance with the regulations
- at the tapped holes specified on the assembly drawing (see chapter. 3.3)
- always at two points at the same time (if not otherwise stated)
- with the best possible equal load distribution

Lifting diagram

$\beta = \max. 45^\circ$

For restrictions regarding special lifting appliances, see assembly drawing !



Caution ! Never lift the product with only one lifting appliance!



4. PACKAGING AND STORAGE

4.1. Original packaging

All metal parts are:

- protected against corrosion
- wrapped in rust-inhibiting paper
- sealed in a polyethylene sheet

All parts are packed in soft wood cases or on wooden pallets.

Disposal of packaging

The packaging can be recycled.

4.2. Storage instructions

- Do not damage packaging or protective material
- Do not stack the products on top of one another or place heavy objects on the product
- Store the product dry; The max. permissible relative humidity is 85%
- Avoid more than 25° Celsius variations in temperature

Attention

If the packaging of the parts is damaged or the parts are unpacked, the parts must be

- either installed within the next 100 hours
- or replaced in the protective materials and repacked.



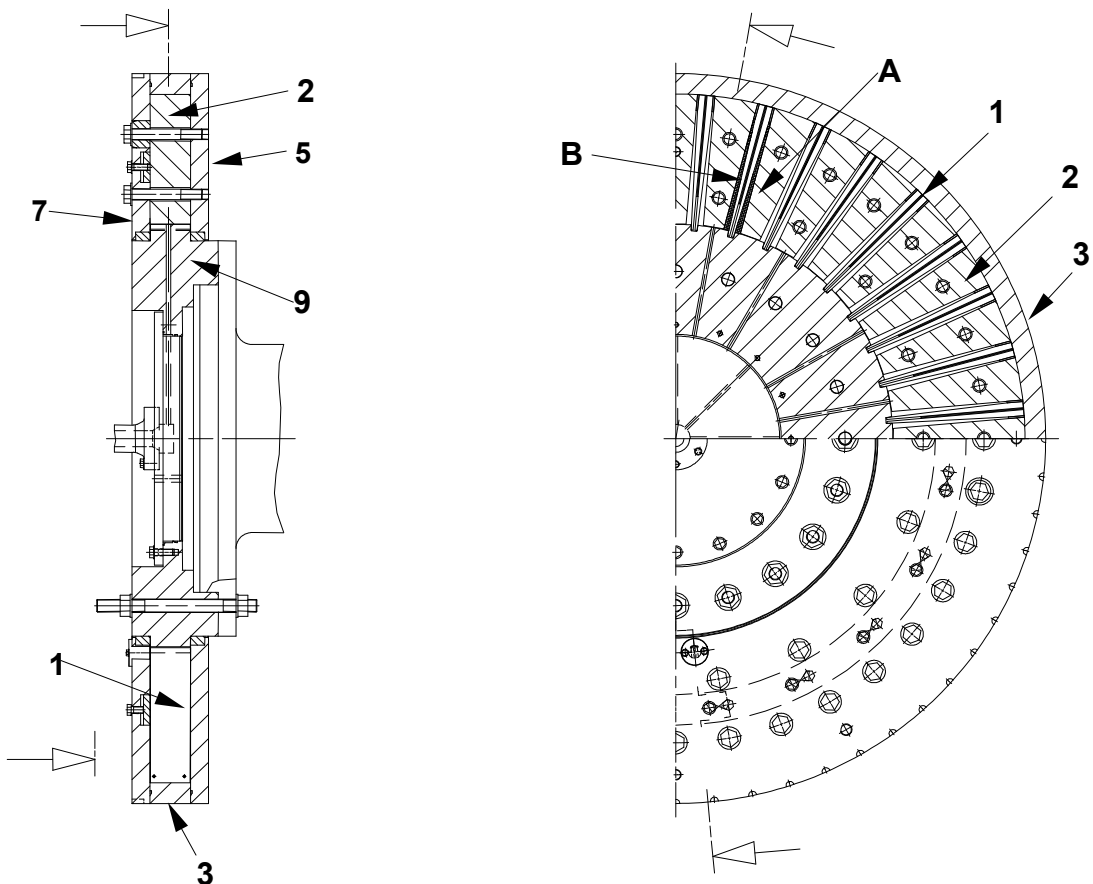
5. PRODUCT DESCRIPTION

The Geislinger vibration damper is a spring-coupled torsional damper with hydraulic attenuation.

Radially-arranged leaf springs (1) transmit the elastic torque from the damper inner member to the damper outer member. At the same time, torsional vibrations which cause oil to be transported between spring chambers are damped.

The leaf springs (1) and the intermediate pieces (2) are clamped by a press fitted clamping ring (3). The inner ends of the spring packs (1) reach into the axial grooves of the inner star (9), thus engaging the inner and outer member of the coupling. The chambers A and B which are formed by the intermediate pieces (2) and the spring packs (1) are filled with oil. If the damper is subject to increased torque, the two damper members (outer and inner members) are twisted against one another. At the same time, the leaf springs (1) are deflected. This causes a change in the volume in chambers A and B. The oil is transported from one chamber to the next chamber via a gap between the intermediate pieces (2) and the inner star, or via the adjustable damping gap. The oil flow resistance retards the relative movements of the two coupling members and dampens the vibration amplitudes.

Both plates (5, 7) of the damper outer member and the sealings inserted in them hold the oil in the damper so that the required oil pressure can be built up.



6. PREPARATIONS PRIOR TO INSTALLATION

6.1. Unpacking

- Unpack the damper out of the wooden crate
- Remove the polyethylene sheet and rust-inhibiting paper from the damper.

NOTE

Do not throw away any loose parts (e.g. bolts, lifting appliances, sealings, etc...), which are enclosed in the packaging with the packing material!



7. DAMPER MOUNTING INSTRUCTIONS

7.1. Preparations prior to assembly

- Check the damper for any damage that may have occurred during transport.
- Mount the lifting appliances (730) according to the lifting appliance mounting instructions. Clean the underlying surfaces prior to mounting.
- First bring the damper into an upright position with the center line horizontal (hanging).

NOTE

Only place the damper on its external diameter with extreme caution, and only if it is absolutely necessary!

- Remove the rust inhibitor from all joint faces, i.e. centering shoulders/recesses.

NOTE

Do not scratch or damage the surfaces while cleaning them

- Oil supply holes on the damper and on the oil supply, as well as the oil outlet holes and bearing gap on the damper must be clean and free of dirt.
Remove any adhesive tape or other objects that may be present.
- Carefully oil the O-ring sealing surfaces to the crankshaft or to the external oil supply with motor oil.

7.2. Installation

7.2.1. Installing the damper

- Mount the damper as shown on the assembly drawing.
- Ensure that:
 - the existing positional markings (e.g. angular position of the damper to the crankshaft when the counterweight is attached) are precisely kept
 - the centering shoulders and sealing surfaces are not damaged during attachment!
The mounting instructions according to the assembly drawing are precisely kept
 - the lifting devices are properly mounted
 - the lifting load is as evenly distributed as possible during the raising and vertical installation of the damper.

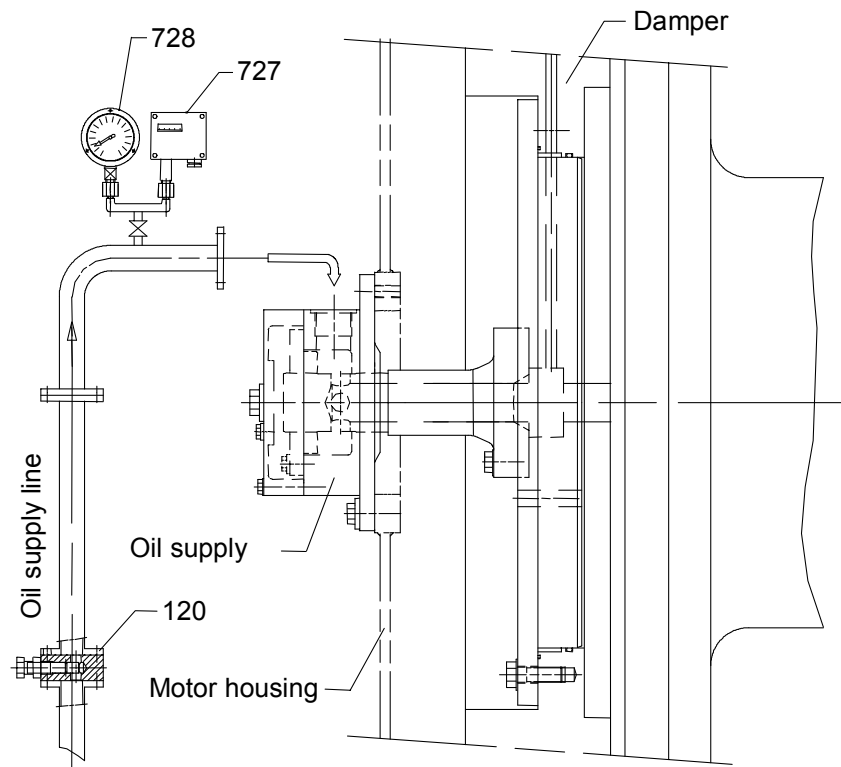
7.2.2. Installation of an external oil supply (if available)

If the damper is not supplied with pressure oil by the crankshaft, an external oil supply must be attached to the damper inner star. This oil supply provides the required oil pressure and the amount of oil that the damper requires for operation.

A damped manometer (728) and an alarm pressure switch (727) must be installed in the pressure oil line to the damper (see figure).

An adjustable choke (120) can be installed in the oil line for pressure reduction if required. Depending on specifications, this may already have been delivered by Geislinger (see figure).





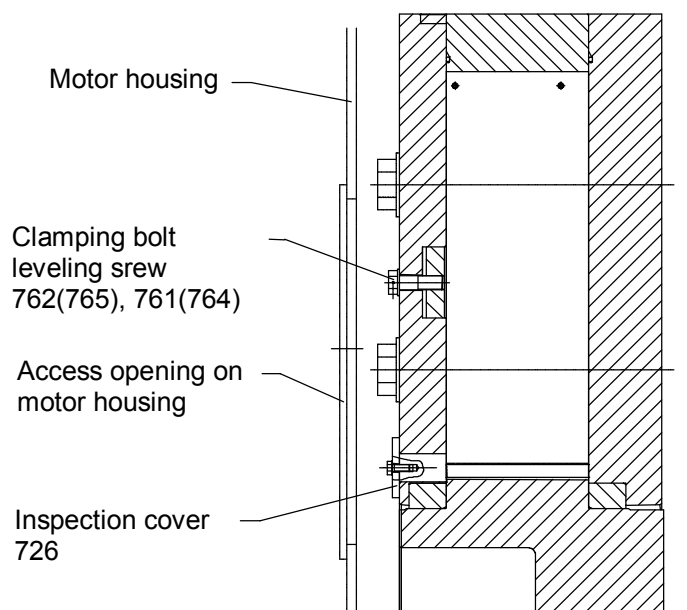
Furthermore, the installation of a stopcock just before the damper is recommended (not supplied by Geislinger). This prevents unnecessary leakage of oil out of the damper during any manipulation of the oil supply line.

7.2.3. Access openings on the damper housing

The entire damper housing cover cannot be removed for adjustments or inspection activities. Thus, access openings must be installed:

- in the vicinity of the inspection cover (726),
- and the setscrews (clamping bolt (762(765)) or leveling screw (761(764)))

Installing the access openings.



8. COMMISSIONING THE DAMPER

8.1. Checks to be made before the first trial run

- Check the minimum distance of the damper - 10 mm on all sides - to neighboring parts. At the same time, note any protruding bolt heads.
- Check the oil pressure.
The required minimum oil pressure values (see chapter 15) must be reached. Note that the oil pressure can still sink until the operating temperature is reached.

NOTE

Only the measured or control values are allowed for evaluating the functional safety. These must be determined in the normal operating mode and at the normal operating temperature. If the required minimum values for the oil pressure are not achieved, the manufacturing company must be informed. **Do not put the system into operation until the cause has been determined!**

- Visual check of the oil outlet:
Supply the damper with pressure oil using the prelubricating pump until oil comes out of the bearing gap (between pos. 9 and pos. 5 or 7) and out of the oil outlet holes (if present).

NOTE

If no oil comes out of the bearing gap or out of the oil circulation holes, carry out the remedial measures according to chapter 14 !

8.2. Commissioning

8.2.1. De-aerating the damper

The damper is automatically de-aerated by the oil circulation provided through the bearing or oil outlet holes in the outer member (if available).

Put the oil circulation of the damper into operation before starting the motor to ensure that the damper is also filled with oil in the start-up phase.

Any quality motor lubricating oil of class SAE 30 or 40 is suitable for the damper.

8.2.2. Adjustment of the damper

Due to the torsional loading of the damper and shaft line, rotational speed exclusion bands have been calculated in advance. The values are taken as the basis of the torsional vibration calculation.

Attention

The values that were calculated in the torsional vibration calculation only apply to the main drive system.

In addition, restrictions are possible for optional auxiliary drives (e.g. PTO,...), but are not, however, taken into account in the above-mentioned values.

The specified exclusion bands must be kept to until the torsional vibration measurement is carried out.



In machinery using a newly constructed Geislinger damper (which has never been built until now), it is necessary to carry out a torsional vibration measurement in the first trial run before the final release for operation.

Geislinger recommends the following procedure if the machinery is equipped with a Geislinger damper which has never been previously used.

- Inform Geislinger of the type of machinery, the motor and the type of damper a few days before the measurement is due to be carried out.
- Geislinger will contact you and give you a telephone number which can be reached 24 hours, 7 days a week.
- Inform the workshop early enough so that additional torsional vibration measurements may be carried out if the first measurement during the trial run shows that the damping effect of the Geislinger damper needs to be readjusted.
This readjustment of the damper will take a max. of four hours.

NOTE

The motor must be stopped during this period.

The time period for readjusting the damper should always be included in the trial run schedule.

- Prepare a diagram with the calculated values according to the damper data provided by Geislinger that specifies the location at which the measurements are to be made.
- As previously specified, the torsional vibration measurements should be carried out at a very early stage of the trial run.
- The following measured values should be recorded.
 - Load curve: Motor power [kW] against the motor rotational speeds [RPM]
 - Amplitudes: Either the angle of vibration [mrad] at the free motor end or alternating voltages [N/mm²] in the propeller shaft line
- After the first measurement, the on-site readings should be analyzed as soon as possible. The synthesis which was measured over a large range of rotational speed is the most important information. Harmonic analysis, if possible, would be desirable.
- If the measurements agree with the calculations, the damper no longer needs to be re-adjusted. If the measurements and calculations show large differences, the results must be sent immediately from the plant to Geislinger by telex, telephone or, if possible, by telefax or Email.
- GEISLINGER will be ready with the information regarding the new setting of the damper within a max. of three hours, even at the weekend.
The setting of the damping effect must be carried out according to chapter 15.5. A time period of a max. of four hours should be planned for carrying out the setting.

NOTE

The motor must be stopped during the setting.

- When the setting has been carried out, the measurement and the analysis must be repeated. The torsional vibration amplitudes should now agree with the calculation.

AFTER FINAL ADJUSTMENT OF THE DAMPER HAS BEEN COMPLETED SUCCESSFULLY, THE FINAL EXCLUSION BANDS OF THE CLASSIFICATION CORPORATION MUST BE DETERMINED

By repairs to the same machinery, the measurement can be omitted.



8.3. Post-commissioning checks

- For details of how to check the oil filter, see chapter 12.5.
- Check the surface temperature at the points of support of the bearing bushes (15).
At temperatures above 120° C, the manufacturer must be informed.
- Check the oil supply line to the damper for leaks.



9. REMOVING THE DAMPER

Damper WITHOUT centering shoulders (pos. 17(18))

Dampers which have no centering shoulders (pos. **17(18)**) built into the lateral plate (7) must be removed from the system for a complete inspection or for repair.

Dampers WITH centering shoulders (pos.17(18))

Dampers with centering shoulders (pos. **17(18)**) only need to be dismantled to repair the crankshaft. Only the lateral plate has to be removed from the installed damper for inspection. For instructions on dismantling the lateral plate, see chapter 10.

Removing the damper

- Loosen the clamping bolts to the crankshaft (do not remove them)
- Mount the lifting appliances onto the damper and hang the damper on the crane
- Remove the crankshaft bolts
- Insert forcing bolts into the damper inner star (9) and push back the damper from the crankshaft flange slowly and evenly

ATTENTION Do not damage the centering shoulders and sealing surfaces while removing it!

- Place the damper so that the bolt heads face upwards (damper center line vertical).

ATTENTION

Taking the damper apart leads to loss of centricity of the outer members (flange – pos. 5, spring assembly – pos. 1,2,3 and lateral plate –pos. 7) to one another. Thus, any further taking apart of the damper must only be performed in the factory of the manufacturer, or by a Geislinger service station.



10. TAKING THE DAMPER APART FOR THE MAIN INSPECTION

Damper without separately mounted lateral plate – centering sleeves 17(18) not present

The damper must be removed from the system for a main inspection.

Taking the damper apart for the inspection is generally carried out by a Geislinger service station or by the Geislinger company itself.

Damper with separately dismountable lateral plate – centering sleeves 17(18) present

It is recommended to let a Geislinger service station or the Geislinger company itself carry out this work.

For the main inspection of the damper, the crankshaft stays attached to the damper. Only the lateral plate (7) must be dismantled as follows:

- Support the damper at the spring assembly (1,2,3) with the aid of a hydraulic piston
- Loosen all the main bolts (750(751)), with the exception of those that clamp down the centering shoulders (17(18))
- Mount the lifting devices on the lateral plate (7) according to the instructions
- Hang up the lateral plate (7) on the crane
- Remove the previously loosened main bolts (750(751))
- Remove the lateral plate (7) axially from the damper

In this state, an inspection of the front of the damper can be carried out.



11. REASSEMBLING THE DAMPER

11.1. Preparations prior to assembly

- Carefully clean the dismantled parts before reassembling them.

ATTENTION

All oil supply and venting holes must be clean and free of dirt

- Exchange all seals (O-rings...)
- Replace all the disk springs of the main bolts (750(751))
- Carefully grease the O-rings / O-ring grooves of pos. 851 with Shell ALVANIA G3 grease or equivalent
- Insert the O-ring (851) in the relevant groove of the lateral plate (7)
- Paint the bearing (15) and bearing running surfaces on the inner star (9) with Klüber PETAMO GHY 133N paste or equivalent.
In addition, after the bearing paint has dried, coat the bearings and bearing running surfaces with MOLYKOTE GN paste
- Coat the tapped holes of the main bolts (750(751)) with MOLYKOTE 1000 bolt paste or equivalent.

11.2. Assembly

- Mount the lifting appliances on the lateral plate (7) according to the instructions
- Hang up the lateral plate (7) on the crane
- Fit the lateral plate into the centering shoulders (17(18))

NOTE

Where the lateral plate is simultaneously used as a counterweight, note the correct position of the lateral plate (7) to the crankshaft when mounting!

For matching markings, see lateral plate (7) and inner star (9).

GMS grooves that may be present on the lateral plate (7) and inner star (9) have no precise correlation to one another.

- Apply sufficient LOCTITE 275 to both sides of the disk springs (810)

ATTENTION

The disk springs (810) and the corresponding seat-engaging surfaces must be dry and free of grease (oil)

- Mount the main bolts (750(751)) with disk springs (810) according to the mounting instructions specified in the assembly drawing.



12. INSPECTION

12.1. Intermediate inspection

Approx. every 20,000 operating hours	
Activities to be carried out	
Measure the bearing play	▶ For details of the measuring procedure, see chapter 13.2 ▶ For details of the amount of bearing play allowed, see enclosed installation drawing
Examine the wear on the spring leaf ends and the inner star grooves.	▶ Dismantle the inspection cover, pos. 726 ▶ Carry out an inspection according to chapter 13.1

12.2. Main inspections

Main inspections can be avoided if recent torsional vibration measurements have been made, or by installing a Geislinger monitoring system (GMS).
The measured values are compared with those of the calculation and the initial measurement. This provides a statement on the status of the machinery and the working order of the damper.

In damper types without a separately mounted lateral plate – no centering sleeves present, pos. 17(18)–, the main inspection must generally be carried out by the Geislinger company or by a Geislinger service station.

The Geislinger company recommends requesting assembly personnel from a Geislinger service station or from the Geislinger company itself to carry out the main inspection of the damper.

Approx. every 60,000 operating hours or if damage is suspected or if requested by an acceptance company	
Activities to be carried out	
Measure the bearing play	▶ For details of the measuring procedure, see chapter 13.2 ▶ For details of the amount of bearing play allowed, see enclosed installation drawing



Examine the wear on the spring leaf ends and the inner star grooves.	▶ Dismantle the damper according to chapter 10 ▶ For details of the measuring procedure, see chapter 13.1 ▶ For details of the amount of wear allowed, see enclosed installation drawing
Visual check	▶ Check the bearing running surfaces for grinding (fretting), corrosion, oxidation, discolorations as a result of increased bearing temperature, etc.

Attention

If the allowed wear within an inspection interval is exceeded by more than 50%, the subsequent inspection intervals must be correspondingly shortened!
A linear wear quotient is assumed.

The inspection intervals depend on the specific operating conditions.

NOTE

Regular inspection and supervision of the damper enables long-term planning and the timely ordering of replacement parts!

12.3. Complete inspections

If, in an intermediate inspection or in a main inspection, it is determined that the wear allowed according to chapter 13 (allowed wear) has been exceeded, a complete inspection of the damper must be carried out.

For a complete inspection, the damper must be dismantled from the crankshaft and completely taken apart.

Taking the damper apart is generally carried out by the Geislinger company, or by a Geislinger service station.

12.4. Oil quality / Changing the motor oil

Check the quality of the oil at regular intervals.

Bad oil quality, or too much water in the lubricating oil can:

- affect the damping
- cause damage to the damper bearings
- or cause damage to or increased wear of the inner ends of the spring leaves.

Thus, the functionality or lifetime of the damper is reduced. For details of the activities required if the oil quality is bad or for changing the motor oil, see chapter 14.

12.5. Checking the oil filter

Immediately after the initial commissioning and after approx. The first 300 operating hours, the oil filter must be checked for foreign particles (dirt, splinters, etc.).

If not otherwise specified by the motor manufacturer, further filter checks must be carried out at intervals of approx. 3,000 operating hours.

ATTENTION

If particles are present in the oil filter and on the floor of the damper housing, carry out the necessary activities according to chapter 14.

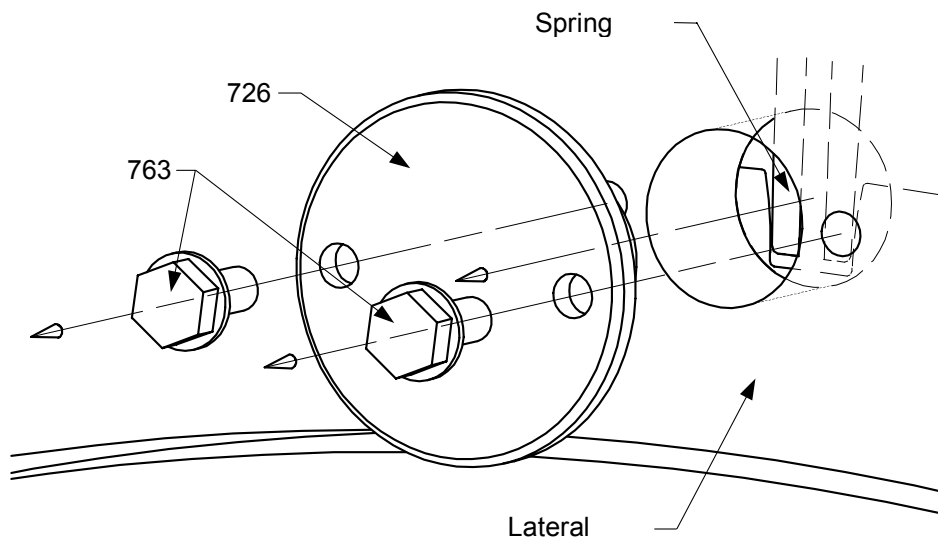


13. PERMISSIBLE WEAR OF THE DAMPER COMPONENTS

13.1. Inner star groove - spring leaf inner ends

The overall wear - inner star groove / spring leaf inner ends - may not exceed the wear dimension "w" specified on the assembly drawing or in the Appendix

To evaluate the amount of wear, it is not usually necessary to dismantle the damper or the damper lateral plate. The inspection cover 726 must be removed through the mounting opening after undoing the screws 763. Afterwards, the status of the spring leaf ends and the groove flanks can be determined. Endoscopy (if available) simplifies the evaluation.



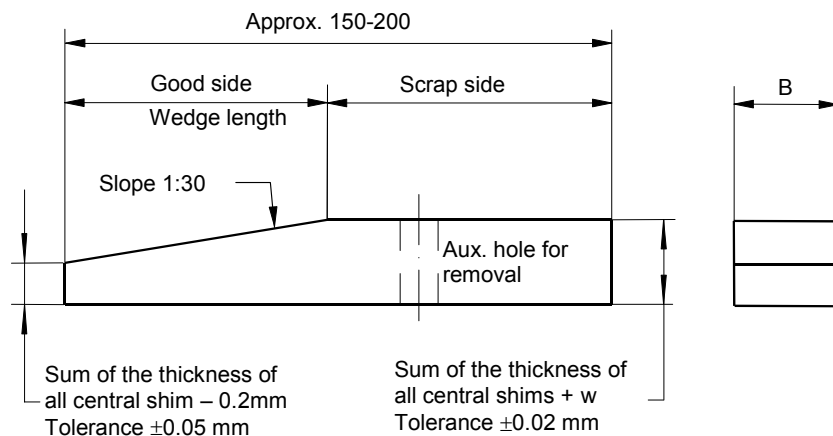
Measuring wedge method

With the damper lateral plate removed or by dismantling the inspection covers (726), the measuring wedge method can also be used for the inspection of wear. This is described as follows:

Testing tool

A measuring wedge is used as a testing tool. The measuring wedge must be produced by the customer if no measuring wedge is supplied by Geislinger.

Use the following sketch to make a measuring wedge.



The thickness of the central shim, wear dimension "w", and the measuring wedge breadth "B" are specified on the assembly drawing or in the Appendix of the operating manual.

Measuring wear

Measure approximately every fourth spring pack

Place the measuring wedge between the inner ends of the spring leaves, resting the wedge on the bottom of the groove.

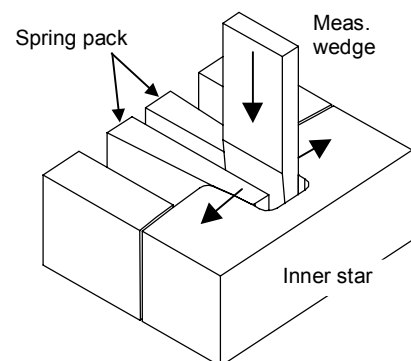
Press by hand, or use a soft hammer, to force the measuring wedge along the inner star groove until the spring tips rest on both groove faces.

The further the measuring wedge can be pressed between the spring leaves, the greater the wear of the inner star groove and the spring leaves.

NOTE

Half a wedge length means half worn, three-quarters of a wedge length means three-quarters worn, etc

Replace the inner star and spring packs if the measuring wedge can be pressed between the spring leaves for the total wedge length.



13.2. Bronze bearing

The value for the maximum allowed diameter play "Gmax" of the bronze bearing (15 or 16) is specified on the appropriate assembly drawing.

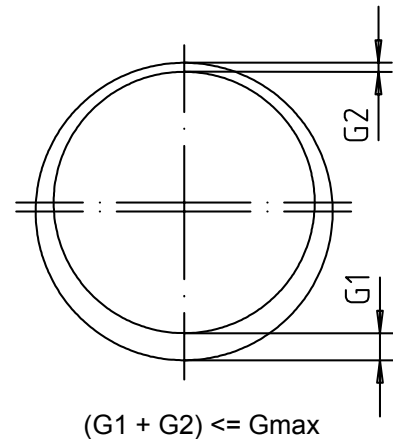
The bearing play is determined using a feeler gage.

The total bearing play is the sum of the bearing gaps G1 and G2, measured at two locations facing each other in the vertical direction - see figure.

The sum of the bearing gaps, **G1 + G2**, must not exceed the maximum allowed value, **Gmax**.

NOTE

If no maximum allowed bearing plays are specified on the assembly drawing, contact Geislinger or a Geislinger service station.



13.3. Other types of wear / damage

Any other types of damage or wear that occur must generally be clarified with the Geislinger company or with a Geislinger service station.



14. TROUBLESHOOTING

Inspected condition	Corrective measure
No oil coming out of the bearing gaps during oil supply by the prelubricating pump	Disassemble the damper oil feed; Check the oil supply holes on the damper and the oil supply for leakages.
Wear on the groove contact greater than the allowed wear dimension "w" or other damage to the spring leaves	Carry out a complete inspection. Contact the Geislinger company or a Geislinger service station
Bearing gap greater than allowed; For allowed value, Gmax, see assembly drawing	Carry out a complete inspection. Contact the Geislinger company or a Geislinger service station
Bad oil quality or more water content in the engine oil than permitted Effect: No damage to the engine bearings	Switch off the oil pump. Remove the lowest inspection cover (726). Empty the damper. Replace the inspection cover again. Rinse the damper with fresh oil. Rotate the damper by 180 degrees. Repeat the emptying - rinsing process. Repeat the complete emptying - rinsing process several times.
Bad oil quality or more water in the motor oil than allowed by the motor manufacturer. Motor or crankshaft bearing already damaged	Carry out main inspection according to chapter 12.2. Dampers without centering sleeves 17(18) on the lateral plate must be removed from the system, taken apart and inspected. Contact the Geislinger company or a Geislinger service station before doing so.
Signs of friction (Fretting) on the bearing running surfaces	Carry out a complete inspection. Contact the Geislinger company or a Geislinger service station
Steel or bronze particles that could come from the damper in the oil filter or on the floor of the damper housing	Contact the Geislinger company or a Geislinger service station; Do not put the damper into service until the cause has been determined. Carry out a complete inspection. Contact the Geislinger company or a Geislinger service station
Assemble the damper according to the mounting instructions given in chapter 11 (Assembly of the damper)	



15. OPERATING CONDITIONS

15.1. Oil pressure

Geislinger requires a continuous monitoring of the oil supply pressure pressure to the Geislinger damper by means of an alarm system. This alarm system should be integrated in a general alarm system. The alarm value and the determinations regarding the oil flow measurement through the Geislinger damper are described in the following sections.

15.1.1. Minimum oil pressure:

The oil pressure stated on the relevant assembly drawing is also the minimum oil pressure. This oil pressure is required by the damper during operation. The pressure values are absolute values!

NOTE

The manometer or pressure switch only indicates "pressure differences", and not "absolute pressures"!

The required pressure difference is calculated from absolute pressure minus 1 bar.

Example

2 bar (absolute) = 1 bar (pressure difference)

4 bar (absolute) = 3 bar (pressure difference)

15.1.2. Pressure indicating instruments:

The oil pressure must be monitored by a pressure switch (727) located immediately before the damper.

The pressure switch (727) must be electrically connected to an alarm system. If the minimum necessary oil pressure is undercut, an alarm is triggered and the system is switched off.

Actions required in case of alarm:

- Take the damper out of service (switch off motor)
- Determine the causes
- Inform the damper manufacturer

In addition to the alarm pressure switch (727), a damped manometer (728) must be provided in the oil supply line to the damper to display the existing pressure.

The oil pressure switch can either be supplied by Geislinger, or can be provided by the customer.

Pressure switch and manometer delivered by Geislinger:

The necessary pressure setting has already been made by Geislinger.

The threaded connections for the manometer (728) and for the pressure switch (727) are specified on the relevant assembly drawing.



Pressure switch and manometer provided by the customer:

The pressure switch must be set to the necessary minimum pressure by the customer himself. The pressure switch must be correctly triggered by "sinking" pressure.

As the minimum necessary oil pressure must be present "in the damper", these monitoring instruments must be placed immediately before the damper. Any loss of pressure from the measuring location up to the damper (e.g. through stopcocks) must also be taken into account.

15.1.3. Setting the oil pressure:

The actual oil supply pressure to the damper must be somewhat higher than the specified minimum oil pressure (according to the drawing). Slight deviations in pressure that are created by the damper itself are normal and should not lead to an alarm. As a result, the oil supply pressure should lie approx. 0.5 bar above the minimum oil pressure.

EXAMPLE:

Minimum oil pressure according to the drawing = 2 bar (abs.), which corresponds to 1 bar (pressure difference). Hence, the operating pressure should be approx. 1.5 bar (pressure difference), or greater.

The setting of a higher oil supply pressure is allowed but must not, however, exceed a maximum of 5 bar (abs). The greater amount of oil flow occurring as a result must be taken into account with regard to the available pumping capacity. See chapter 15.3.

If the existing oil pressure needs to be curbed in order to restrict the quantity of oil flow, an adjustable choke (601) must be inserted into the oil supply line. See chapter 15.3.

15.2. Oil temperature

Maximum oil temperature of 55° Celsius at the damper inlet.

ATTENTION

Monitor the oil temperature continuously.

If the maximum allowed oil temperature is exceeded, an alarm must be triggered. The damper manufacturer must be informed.

15.3. Amount of oil

The mean value of the expected amount of oil flow through the damper (liter/min) at the minimum oil pressure is specified on the assembly drawing.

The quantity of oil flow is dependent on:

- the oil viscosity
- the pressure difference
- and the flow cross-sections.

Due to tolerances and other effects, deviations of up to $\pm 50\%$ from the mean value can occur.



The approximate order of magnitude of the amount of oil flow is also determined by the pressure in the damper selected according to chapter 15.1.

If the oil pump is designed so that it can supply a higher quantity of oil flow (e.g. at full supply pressure) without any problem, the oil supply does not need to be throttled.

If the amount of oil flow calculated at full supply pressure is too high for the pump, the oil supply pressure before the damper may be reduced to the minimum oil pressure (plus 0.5 bar) by means of an adjustable choke (601). This choke (601) is delivered with the damper by Geislinger.

For converting the oil quantity for values other than those specified on the assembly drawing, the following formula applies:

$$Q2 = Q1 \times \frac{P2}{P1} \times \frac{V1}{V2}$$

Q1 = amount of oil according to specification in the assembly drawing

Q2 = newly calculated amount of oil at changed pressure and viscosity values.

p1 = pressure difference (specification on the assembly drawing minus 1 bar).

p2 = new pressure difference value.

v1 = viscosity according to specification on the assembly drawing.

v2 = new viscosity value.

An adjustable oil choke is (601) is delivered by Geislinger to reduce the oil pressure from the motor oil system to the damper oil system and, consequently, also to reduce the amount of oil. This choke (601) must be installed before both the manometer (728) and the pressure switch (727) in the oil supply line. The configuration principle is shown on the relevant assembly drawing.

To set up the pressure, proceed as follows:

- Undo the lock nut (800).
- Bring the leveling screw (757) into the first adjustment position (see assembly drawing).
- Switch on the oil pump and read the pressure on the manometer (728).
- If the displayed pressure is too high, screw the leveling screw (757) further in until the required pressure is reached. Unscrewing the leveling screw (757) causes the manometer display to increase.

Secure the leveling screw (757) in the required position by tightening the lock nut (800).

ATTENTION

Do not under any circumstances unscrew the leveling screw to more than the maximum value specified on the assembly drawing as long as the oil line is under pressure!

Danger of pressure oil leakage!



In order to carry out a more precise measurement of the oil quantity if required, an intermediate tube approx. 500 mm long should be placed in the oil supply line before the manometer (728). If required, this intermediate tube can be replaced by an oil quantity gage.

15.4. Ambient temperature

Maximum allowed ambient temperature: 140° C.

Geislinger recommends installing an oil mist detector in the damper housing in order to determine any overheating in this area early (danger of oil mist explosion).

15.5. Tuning the damper

The damper must be tuned to the system before the final commissioning. The instructions on possible existing rotational speed exclusion bands according to torsional vibration calculation (TVC) must be followed!

ATTENTION

Any change to the damping gap is only allowed after consultation with the manufacturer!

The damping gap "S" of each damper is set while being mounted in the factory so that the damping corresponds to the nominal value from the vibration calculation.

The adjusted damping gap "S" is stamped in the vicinity of the setscrews (clamping bolts pos.762(765) or leveling screws pos.761(764) (see note on the assembly drawing, sheet 1).

If torsional vibration measurements indicate that either more or less damping is required, this can be corrected by adjusting the damping ring (59).

The adjustment dimension "X" and the direction in which the damping ring (59) must be moved is provided by Geislinger after evaluation of the torsional vibration measurement.

ATTENTION

The new damping gap value "S" must be stamped again!

The original stamp must be made illegible!

If the damper has no adjustable damping gap (no pos. 59, 761(764), 762(765), etc.), chapters 15.5.1 and 15.5.2 do not apply. If, nevertheless, changes to the damping gap are necessary, the procedure must be obtained from Geislinger!

15.5.1. Setting up more damping

- a) Remove all locking wires (920)

ATTENTION

While doing so, do not twist the bolt heads (761,762,(764,765))!

- b) Turn one of the clamping bolts (762 (765)) - with washer (841) - by at least 2 counterclockwise rotations - see fig. 5
- c) Turn the neighboring leveling screw (761(764)) - without washer - clockwise by the angle of torsion "Alpha" - see fig. 6.
In order to change the damping gap by the adjustment dimension "X" mm, an angle of torsion of $\text{Alpha} = 360 \cdot X/P$ degrees is required for a bolt with a pitch of "P" mm
- d) Tighten up the clamping bolt (762(765)) again by turning it clockwise - see specification on the assembly drawing
- e) Points **b** to **d** must be carried out two-by-two for all clamping bolts or leveling screws



If the adjustment dimension "X" that is to be set up exceeds the value of "Xmax" millimeter ($X_{\max}$ = max. allowed axial adjustment per adjustment procedure), the readjustment procedure must be split into the appropriate sub-steps.

The value of $X_{\max}$ can be taken from the relevant assembly drawing.

After readjustment has been successfully completed, the relevant clamping bolts (762(765)) and leveling screws (761(764)) lying next to each other must be secured again by fixing them with locking wire (920).

ATTENTION

While doing so, do not turn the bolt heads 761(764) and 762(765) any further!

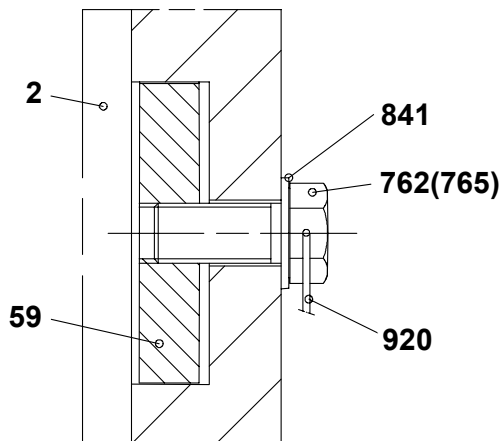


Fig. 5

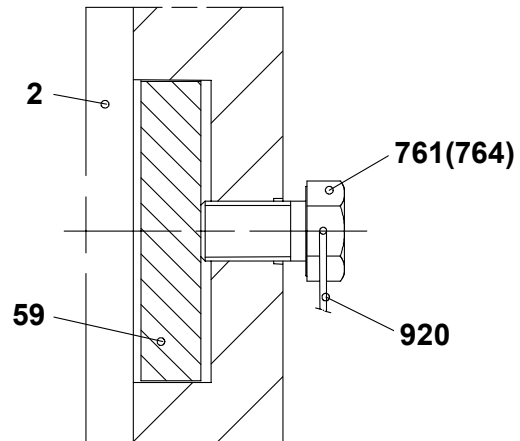


Fig. 6

15.5.2. Setting up less damping

- a) Remove all locking wires (920)

ATTENTION

While doing so, do not turn the bolt heads (761,762 (764,765))!

- b) Turn one of the clamping bolts (762 (765)) - with washer (841) - by at least 2 counterclockwise rotations - see fig. 7
- c) Turn the neighboring leveling screw (761(764)) - without washer - clockwise by the angle of torsion "Alpha" - see fig. 8.
In order to change the damping gap by the adjustment dimension "X" mm, an angle of torsion of $\text{Alpha} = 360 \cdot X/P$ degrees is required for a bolt with a pitch of "P" mm
- d) Tighten up the clamping bolt (762(765)) again by turning it clockwise - see specification on the assembly drawing
- e) Points **b** to **d** must be carried out two-by-two for all clamping bolts or leveling screws



If the adjustment dimension "X" to be set up exceeds the value of "Xmax" millimeter ($X_{\max} = \text{max. allowed axial adjustment per adjustment procedure}$), the readjustment procedure must be split into the appropriate sub-steps.

The value of $X_{\max}$ can be taken from the relevant assembly drawing.

After readjustment has been successfully completed, the relevant clamping bolts (762(765)) and leveling screws (761(764)) lying next to each other must be secured again by fixing them with locking wire (920).

ATTENTION

While doing so, do not turn the bolt heads 761(764) and 762(765) any further!

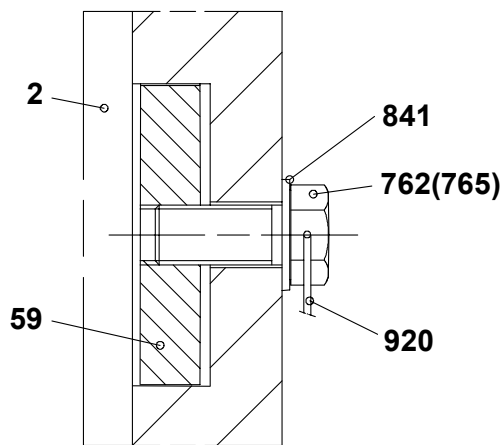


Fig. 7

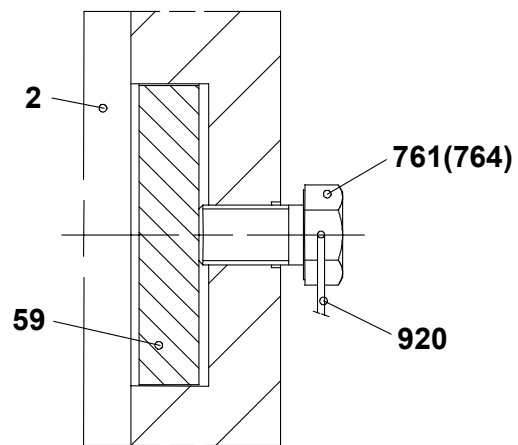


Fig. 8



16. ORDERING REPLACEMENT PARTS

ATTENTION

Only use original GEISLINGER replacement parts

Supply the following information to allow an exact identification of the product

- Type designation of the damper (→stamped on outer member or name plate)
- Serial number of the damper (→stamped on outer member or name plate)
- Drawing number of the parts list
- Item number of the replacement part
- Name of the replacement part
- Number of pieces required

Example

Designation	D 280/6
Works no.	OJY 001
Drawing number of the parts list	G4 10033
Item number of the replacement part	851
Number of replacement parts	2
Name of the replacement part	O-ring 10 x 2750 Viton



17. APPENDIX

This operating manual contains the following supplement :

- MANUFACTURER'S DECLARATION
- ASSEMBLY DRAWING
- PARTS LIST
- DATASHEET "WEAR OF SPRINGS AND INNER STAR GROOVE" (if no permissible wear of springs is stated on the assembly drawing)
- GUARANTEE
- LIST OF SERVICE STATIONS ⇒ www.geislinger.com (Geislinger homepage)



CONDITIONS OF GUARANTEE

The guarantee applies to defects which appear during the agreed warranty period under normal use of the coupling resp. damper and although all operation conditions have been strictly adhered to.

In particular the warranty does not apply if the installation was not built in according to the drawings by either the buyer or his representative or if the maintenance- or operating instructions were not observed or if the product was modified.

If parts or materials are used, not furnished by GEISLINGER, or which are not conform to the original specification, GEISLINGER is under no obligation of warranty.

The same applies if inadequate repair has been effectuated resp. if the repair was not done according to GEISLINGER's rule's of action and moreover if the repair was not announced to GEISLINGER in writing before starting it.

Normal wear and tear is not included in the guarantee.

During the warranty period only the buyer can bring forward claims, claims cannot be transferred to a third party.

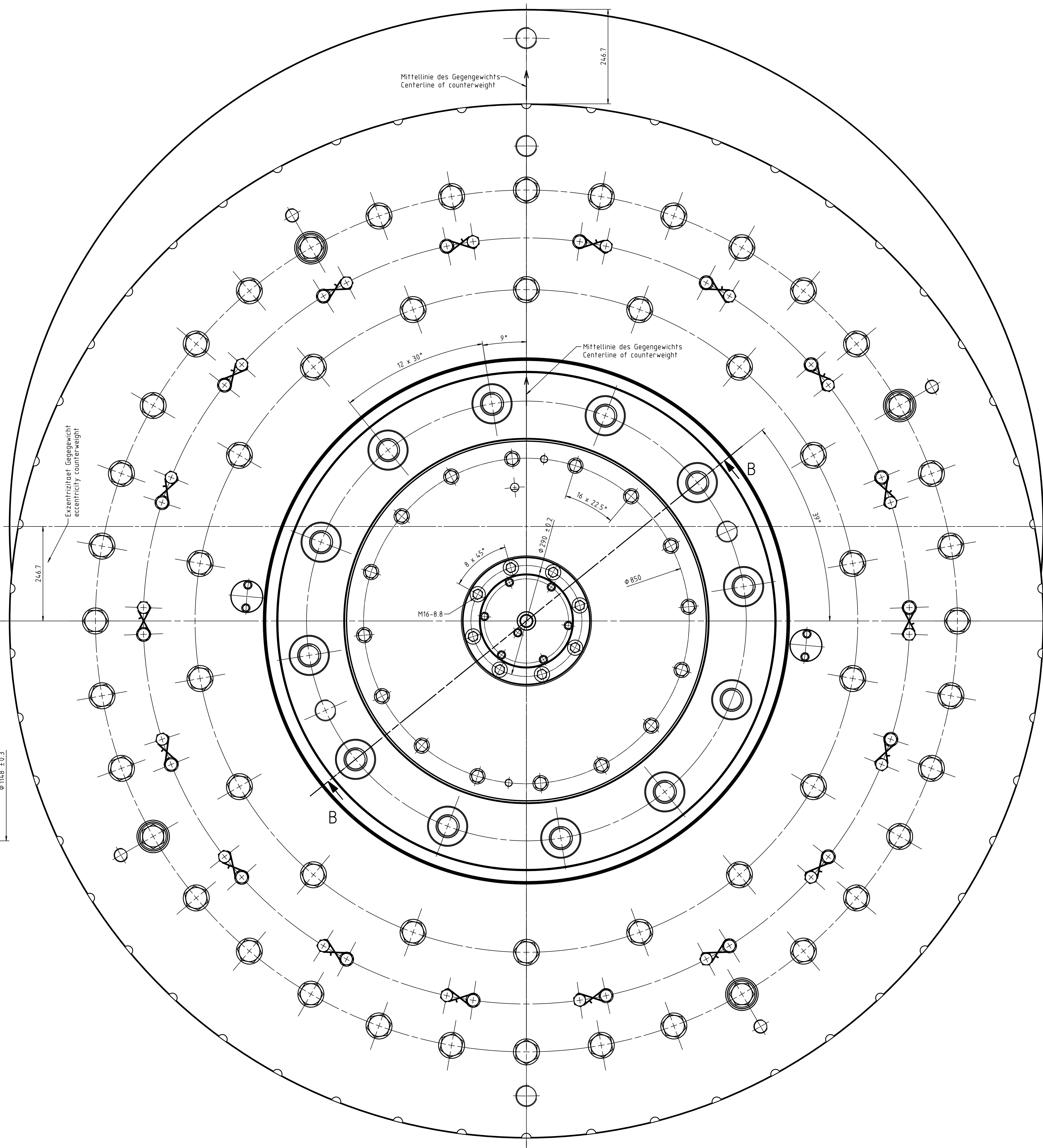
Storage until the installation goes into operation has to be in a dry place and in it's original packing material resp. casing.



Item	PCS	Part number	Description	Material
1	1	G413431 -	D 270/13 Damper	---
2	1	G413481 -	OS 412/940/850 Oil supply	---
4	1	G412994 -	Hydraulic Kit 25 B 90	---
5	1	G412941 -	IPV 1324-200-2 mounting tool; not supplied	---

		P A R T S L I S T Sheet I: G001526- Sheet II: drawn: 22.05.2003/JH checked: JH
Type: D 270/13 Arrangement 1		Number: G413430A

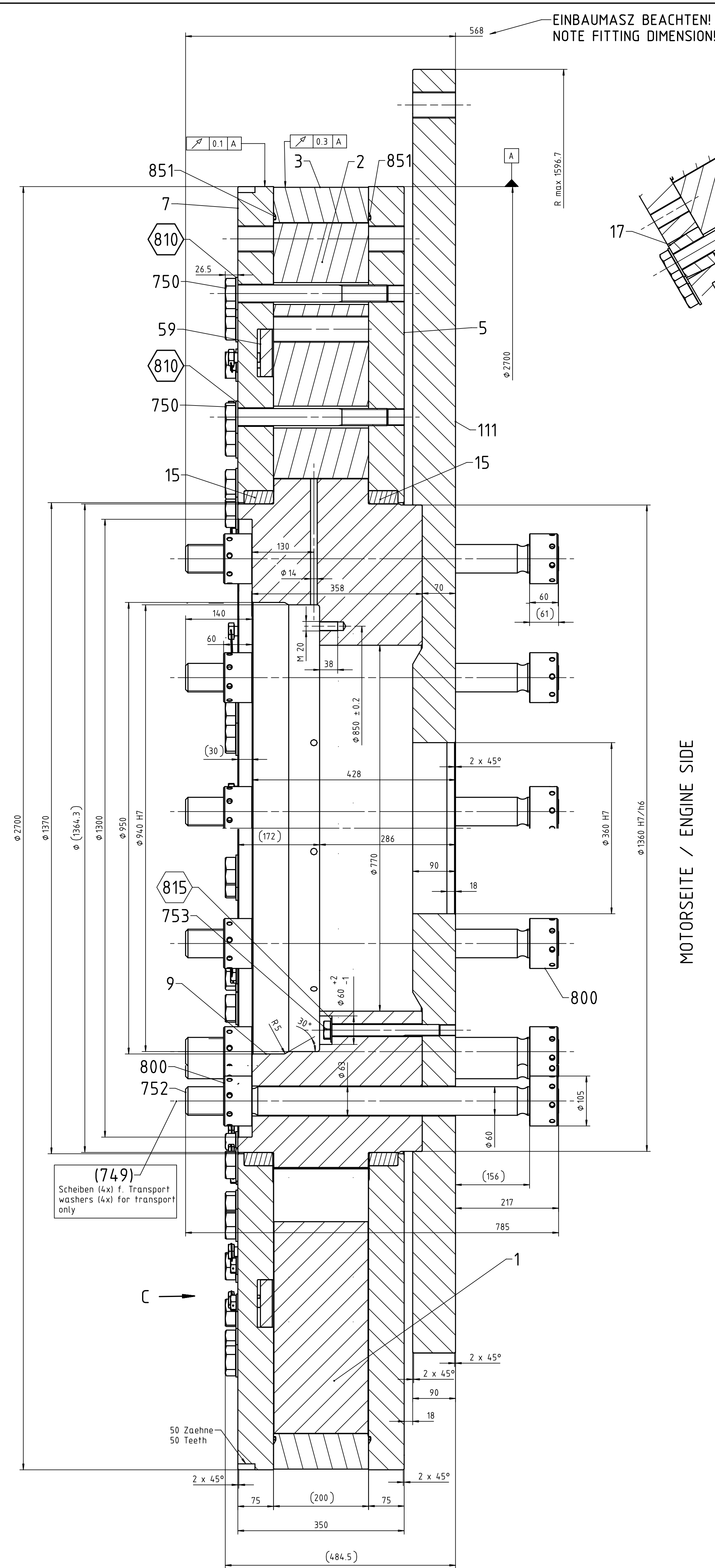




Schutzvermerk nach DIN 34 beachten
Allgemeintoleranzen nach DIN ISO 2768-mH

Copyright reserved
General tolerances acc. to DIN ISO 2768-mH

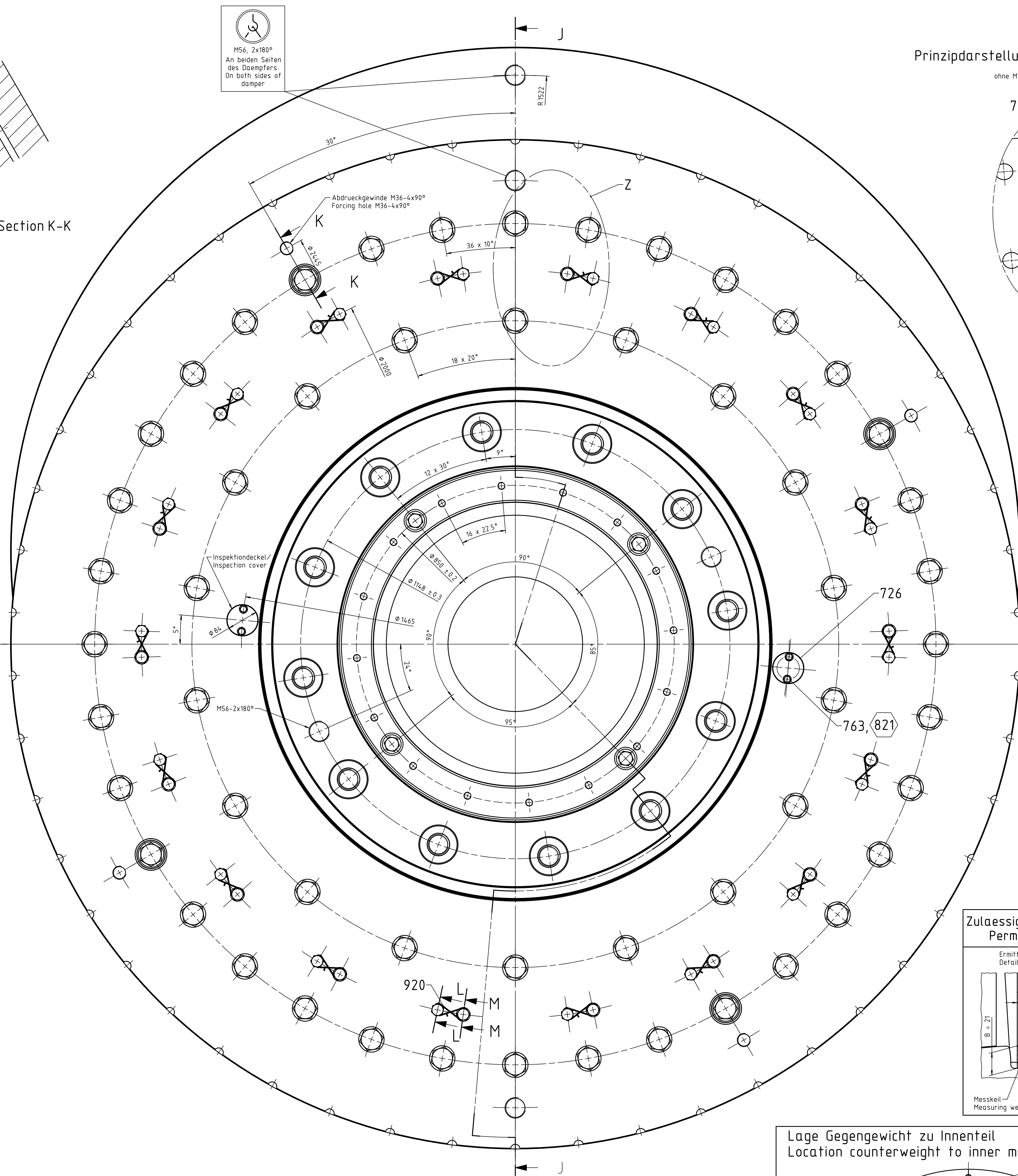
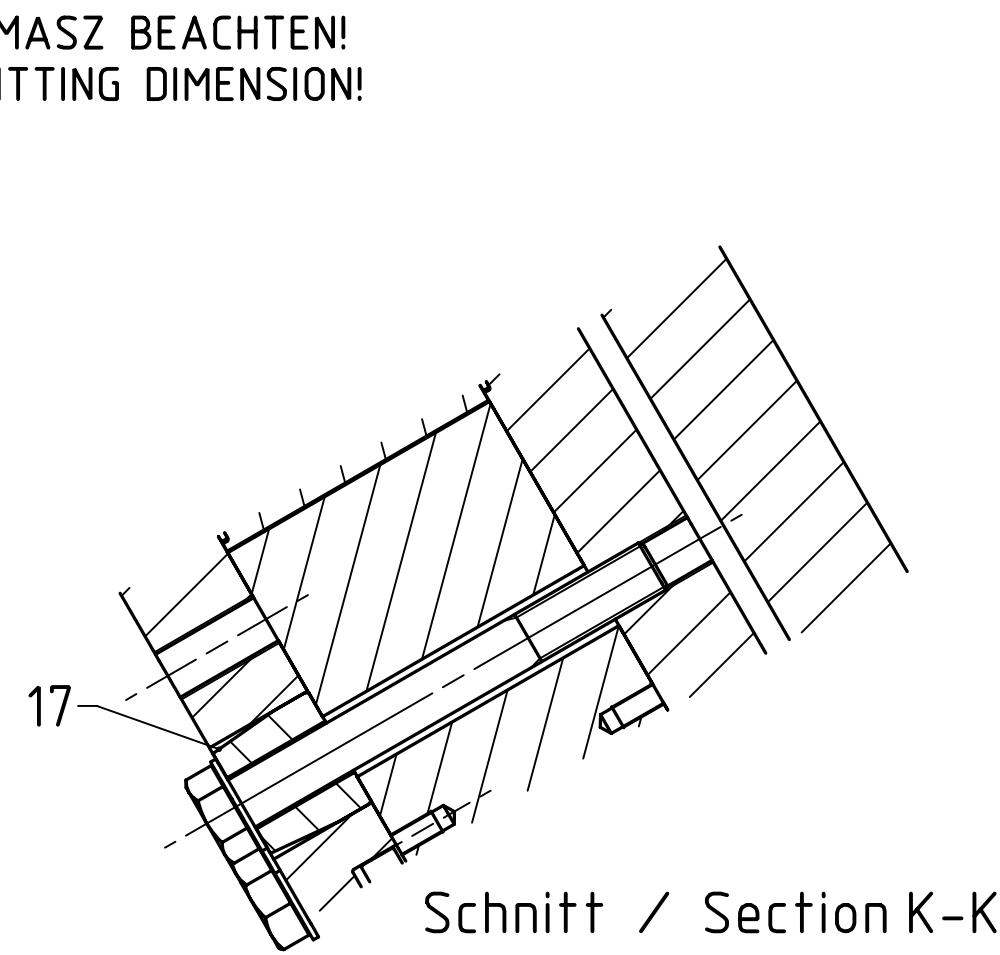
Teil / item 5: Montagevorrichtung IPV 1324-200-2 Mounting tool IPV 1324-200-2 (not supplied)
--



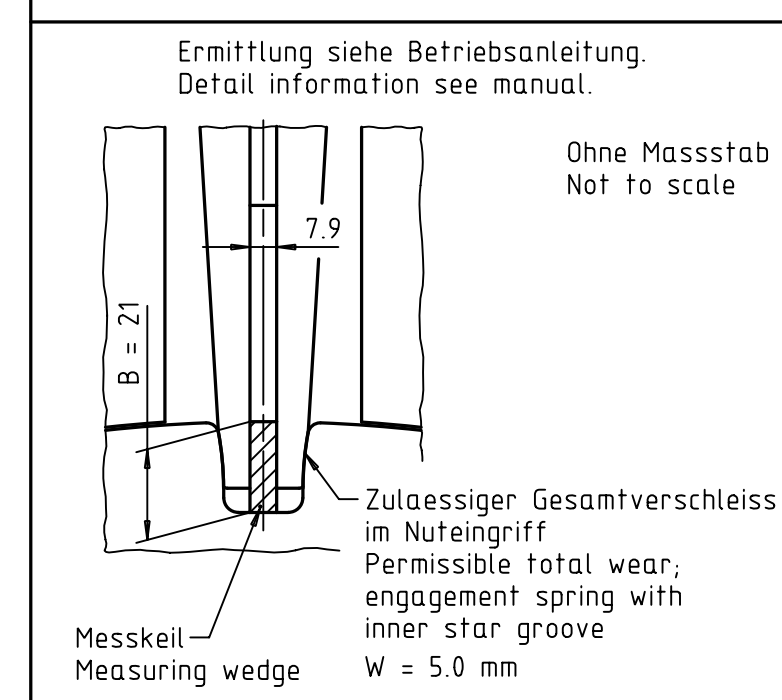
Schnitt / Section J-J

Schnitt / Section M-M

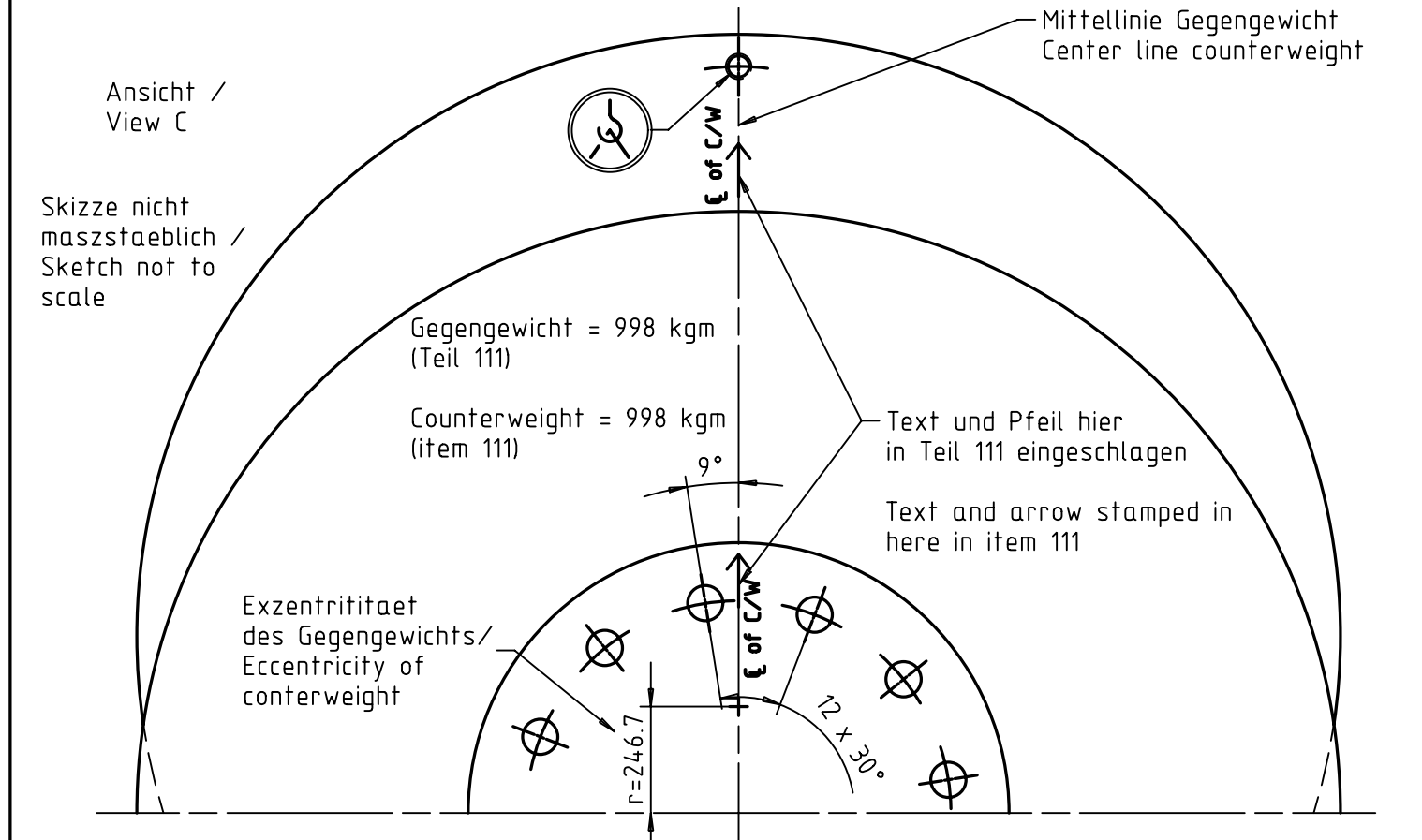
Schnitt / Section L-L



Zulaessiger Gesamtverschleiss Permissible total wear



Lage Gegengewicht zu Innenenteil Location counterweight to inner member



VERSCHLEISSGRENZEN FUER BRONZELAGER (Teil 15) WEAR LIMITS FOR BRONZE BEARINGS (item 15)

Ermittlung siehe Betriebsanleitung / Determination see instruction book	
G [mm]	
Lagerspiel G im Neuzustand Bearing clearance G in new condition	0.56 - 0.84
Zulaessiger Wert G _{max} fuer Lagerspiel Permissible value G _{max} for bearing clearance	1.00

part list D 270/13	
item no.	number designation
1	36 spring pack
2	36 intermediate piece
3	1 clamping ring
5	1 flange
7	1 slide plate
9	1 inner star
15	2 bearing bush
17	4 centering insert
59	1 adjustable damping ring
111	1 counterweight
700	36 bronze spacer
701	a.r. expansion shim
702	36 steel spacer
703	36 bronze spacer
726	2 inspection cover
729	2 RLD washer
730	2 lifting appliance
749	4 transport adaptor
750	54 hexagon bolt
752	12 stud
753	4 hexagon bolt
761	18 adjusting screw
762	18 fastener bolt
763	4 hexagon bolt
800	24 nut
810	54 disc spring
815	4 disc spring
821	4 disc spring
841	18 washer
851	2 o-ring string
920	a.r. securing wire

Daempfungspalt "S" bei Montage eingestellt. Markierung (Schrifthoehe = 8 mm) bei Pos. 761/762 eingeschlagen: "S" = ... mm
Bei Nachjustierung max. 155 mm pro Arbeitsgang verstellen (X _{max}) und den neuen Daempfungspalt einstampfen. Alten Wert unkenntlich machen.
Damping gap "S" set at assembly. Mark character size = 8 mm stamped in near item 761/762: "S" = ... mm
Setting step = max. 155 mm per damping gap adjusting operation (X _{max}) Stamp in new value of damping gap and cross out old value in case of adjusting.

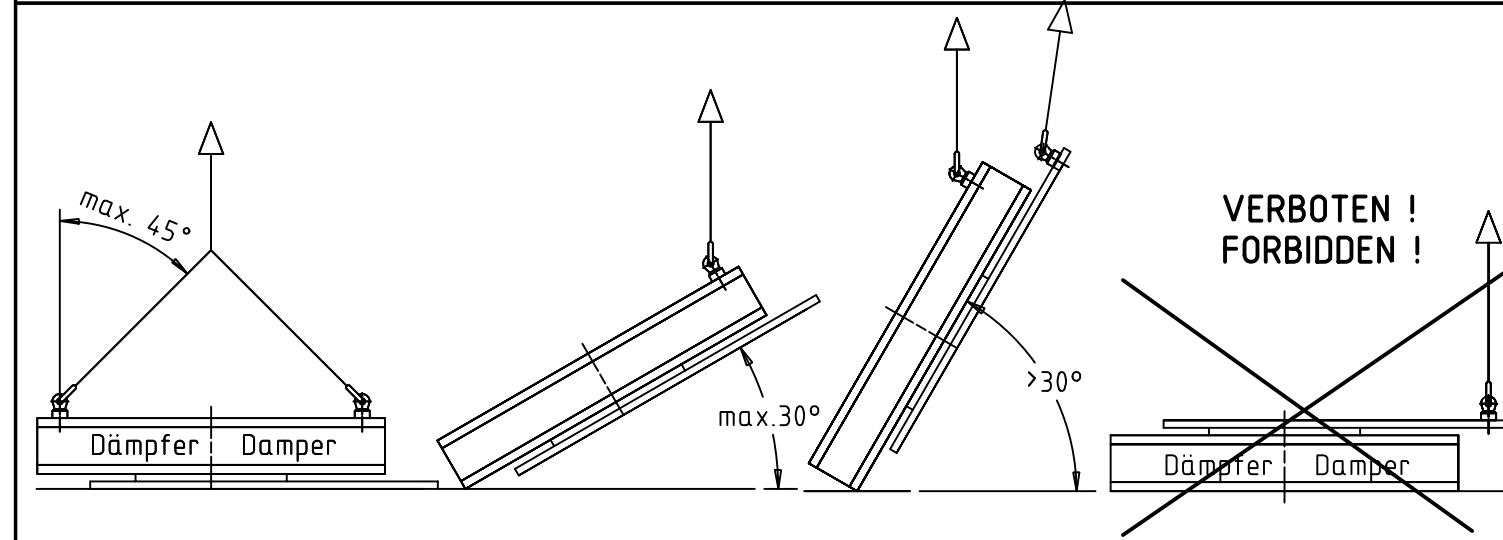
ROSTSCHUTZ/KONSERVIERUNG: nach/acc. to "QSV 4.5/9"
RUST INHIBITOR/PRESERVATION:

EINBAUVORSCHRIFTEN / INSTALLATION INSTRUCTION

VOR EINBAU- UND INBETRIEBNAHME IST DIE BETRIEBSANLEITUNG ZU LESEN UND DEREN ANWEISUNGEN ZU BEFOLGEN! READ AND OBEY THE INSTRUCTIONS AS STATED IN THE INSTRUCTION HANDBOOK BEFORE INSTALLATION AND INITIATION OF THE PRODUCT!	
ENTFERNE vor dem Einbau: - Saemtliche Klebbaender bei Gelzufuehrungen - Saemtliche Transportabdeckungen - Rostschutz von Anflanschaechen und Zentrierungen. Diese Flaechen muessen fettfrei und trocken sein!	REMOVE before installation: - Adhesive tapes from all oil holes - All transport covers - Rust protectives from all joint faces and centering shoulders. These faces must be degreased and dry!
ENTFERNE vor Inbetriebnahme: - Alle Anschlagmittel	REMOVE before initiation: - All lifting appliances

VERWENDUNG DER ANSCHLAGMITTEL USE OF LIFTING APPLIANCES

Zum Heben / For lifting	Ohne Massstab Not to scale	Im Betrieb / During service
* Nur das von Geislinger mitgelieferte Anschlagmittel (730) verwenden! * Gesamtgewicht nicht an einem Anschlagmittel alleine heben!		* Use only the lifting appliances (730) which are supplied by Geislinger! * Do not lift total mass on one lifting appliance only!



MONTAGEVORSCHRIFT FUER SCHRAUBEN MOUNTING INSTRUCTIONS FOR BOLTS

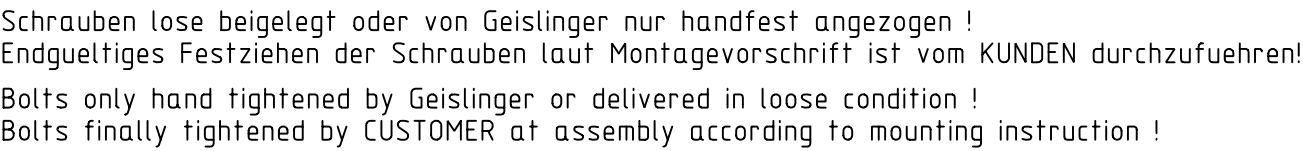
1. Kontaktfleachen reinigen (fettfrei) 2. Alle gekennzeichneten Tellerfedern (Scheiben) beidseitig ausreichend mit spezifiziertem LOCTITE versehen. Gewindebehandlung laut Tabelle.	1. Surfaces must be cleaned (degreased) 2. Enough specified LOCTITE must be applied to both sides of all marked disc springs (washers). Thread treatment according to table.
a.) bei Anzugsmoment: Schrauben laut Tabelle anziehen (TOLERANZ = 10%)	a.) If tightening torque is stated: Tighten bolts acc. to table (TOLERANCE = 10%)
b.) bei Verdrehwinkel: □ Schraube anziehen bis Tellerfeder flach aufliegt bzw. angegebenes Voranlegemoment erreicht ist. □ Danach Schraubenkopf um den angegebenen Verdrehwinkel weiterdrehen.	b.) If twist angle is stated: □ Tighten bolt until disc spring rests just flat on flange or use stated initial tightening torque. □ Then turn bolt head further through the stated twist angle.
ACHTUNG: Werte f. Anzugsmomente bzw. Voranlegemomente sind nur bei Oberflaechenbehandlung laut Tabelle gueltig!	

Teil Nr. Item no.	Anzugsmoment Tightening torque	Voranlegemoment Initial tightening torque	Verdrehwinkel Twist angle	Gewinde thread	Tellerfedern disc spring
750	-	-	60°-65°	MOLYKOTE 1000	LOCTITE 273
761/762	80-100 Nm	-	-	MOLYKOTE 1000	MOLYKOTE 1000
763	50 Nm	-	-	MOLYKOTE 1000	LOCTITE 275
753	(150 Nm)	-	43°-48°	LOCTITE 242	Loctite 275

TECHNISCHE DATEN / TECHNICAL DATA

Massen / Masses		Allgemeines / General	
Auflenteil Outer member	Massenträgheitsmoment Mass moment of inertia	Motorart Engine type	5 570 MC Mk6
Innenenteil Inner member	4920 kgm ²	Zul. elastisches Moment Perm. elastic torque	287 kNm
Gesamtmasse Total mass	17 550 kg	Moment am Anschlag Torque on buffer	431 kNm
Gesamte Unwucht Total unbalance	998 kgm	Zul. Daempfungsmoment pro bar Perm. damping torque per bar	155 kNm/bar
Einzelmassen / Mass of items		Zul. Verlustleistung Perm. thermal load	160 kW
Teil / item	Mass	Drehsteifigkeit Torsional stiffness	8.5 MNm/rad
1,2,3	5640	59	121
5/15	2485	111	3785
7/15	2285	752,800	280
9	2790		
Nur für dick gezeichnete Teile gueltig Only valid for parts drawn in thick lines		Min. erforderl. Öldruck Min. required oil pressure	1.5 bar abs. press 0.5 bar gauge

Massstab / Scale	Erstellt/drawn	Geändert/revised	Geprüft/checked	Stueckliste / Parts list
1:5	2003-04-02	2003-05-22	2003-05-22	G4 13431-
Benennung / Designation				Zeichn. Nr. / Dwg. Nr.
D 270/13 Daemper / Damper				GO 01527 A
Schutzvermerk nach DIN 24 beachten Allgemeintoleranzen nach DIN ISO 2768-mH				Copyright reserved General tolerances acc. to DIN ISO



ROSTSCHUTZ/KONSERVIERUNG: nach/acc. to "QSV 4.5/9"
RUST INHIBITOR/PRESERVATION:



Detail J
M 1:2

Oil supply
Ölzufuhr
oil supply

50
38
3
120°
M24

53
20
4
30
Rp 1 1/2" (DIN 2999) (ISO 7/1)
φ 60
121
φ (260)
φ 334
124
116
126
125
19
840
785
G 1 1/4"
G 3/8"
786
843
754
841
753
815
145
29
M 16, Güte/grade 8.8, 8 x 45°
Leckageölrücklauf
Leakage oil return
Einschweisflansch nicht von Geislinger geliefert. Durchmesser und Dicke dürfen vom Kunden abgeändert werden.
Welding flange not supplied by Geislinger. Diameters and thickness may be modified by customer according to his requirements.
8 x 45°
811
758
412
65
φ 195 H7/h6
φ 155 ± 0.2
8 x φ 18
115
Inne
Inne

* ... Fläche mit flüssigem Dichtmittel abdichten
treat surface with liquid sealing compound

Schrauben lose angelegt oder von Geislinger nur fest angezogen!
Endgültiges Festziehen der Schrauben laut Montagevorschrift ist vom KUNDEN durchzuführen!
Bolts only hand tightened by Geislinger or delivered in loose condition!
Bolts finally tightened by CUSTOMER at assembly according to mounting instruction!

part	list	oil supply
item	number	designation
115	1	oil distributor
116	1	seal-ring retainer
121	1	housing
122	1	oil-supply
124	1	cover
125	2	seal-ring
126	2	distance washer
753	6	hexagon bolt
754	6	hexagon bolt
757	8	hexagon bolt
758	8	hexagon bolt
759	16	hexagon bolt
785	1	hexagon head screw plug
786	1	hexagon head screw plug
811	8	disc spring
812	16	disc spring
815	6	disc spring
840	1	washer
841	6	washer
842	8	washer
843	1	washer
911	2	center clip
950	1	centering tool

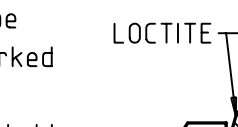
Massen / Masses	
Pos./item	[kg]
115	327
116	4
121	31
122	21.5
124	7.5

GESAMTMASSE / TOTAL MASS: 391 kg

MONTAGEVORSCHRIFT FUER SCHRAUBEN MOUNTING INSTRUCTIONS FOR BOLTS

1. Kontaktflächen reinigen (fettfrei)
2. Alle gekennzeichneten Tellerfedern (Scheiben) beidseitig ausreichend mit spezifiziertem LOCTITE versehen. Gewindebehandlung lt. Tabelle.
 - a.) bei Anzugsmoment :
Schrauben laut Tabelle anziehen
(TOLERANZ + 10%)
 - b.) bei Verdrehwinkel :
 - ☐ Schraube anziehen bis Tellerfeder flach aufliegt bzw. angegebenes Voranlegemoment erreicht ist.
 - ☐ Danach Schraubenkopf um den angegebenen Verdrehwinkel weiterdrehen.

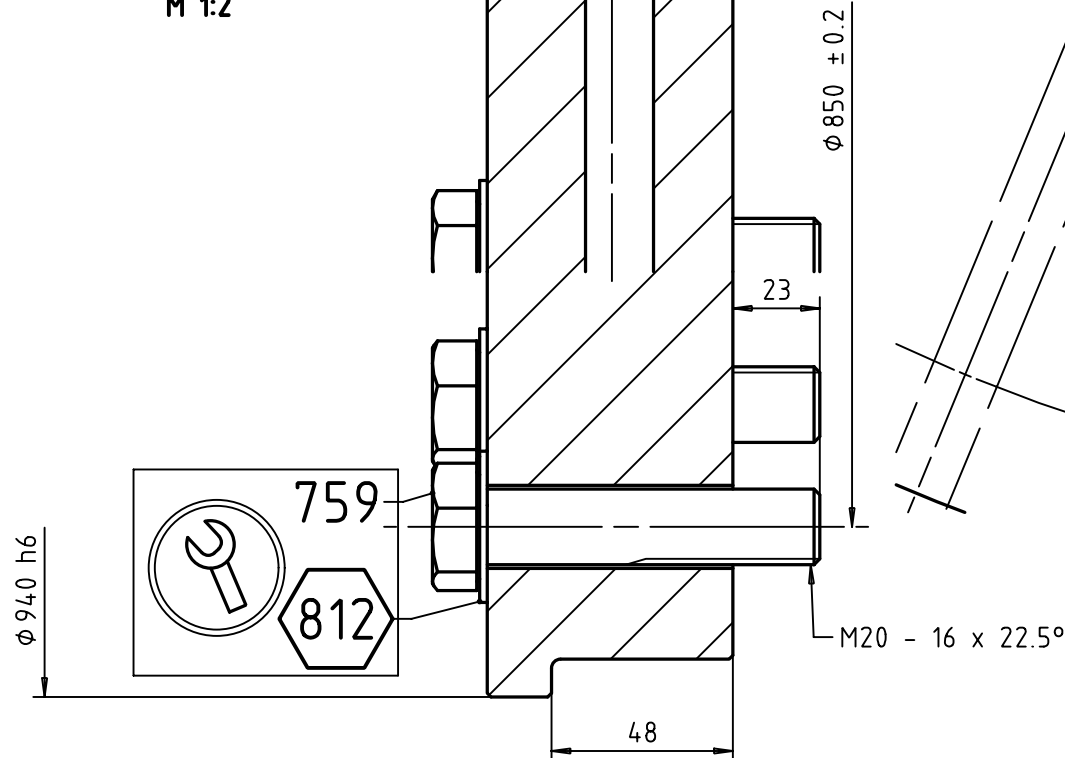
ACHTUNG: Werte f. Anzugsmomente bzw. Voranlegemomente sind nur bei Oberflächenbehandlung laut Tabelle gültig !

1. Surfaces must be cleaned (degreased)
2. Enough specified LOCTITE must be applied to both sides of all marked disc springs (washers).
Thread treatment according to table.
- a.) If tightening torque is stated :
Tighten bolts acc. to table
(TOLERANCE + 10%)
- b.) If twist angle is stated :
- ☐ Tighten bolt until disc spring rests just flat on flange or use stated initial tightening torque
☐ Then turn bolt head further through the stated twist angle
- 
- The diagram shows a cross-section of a bolt assembly. A bolt is passing through a flange, a disc spring (washer), and another flange. The disc spring is marked with a hexagonal symbol. A callout line points from this symbol to a table with two columns: 'Teil Nr.' and 'Item no.'. The word 'LOCTITE' is written above the disc spring, indicating where it should be applied.

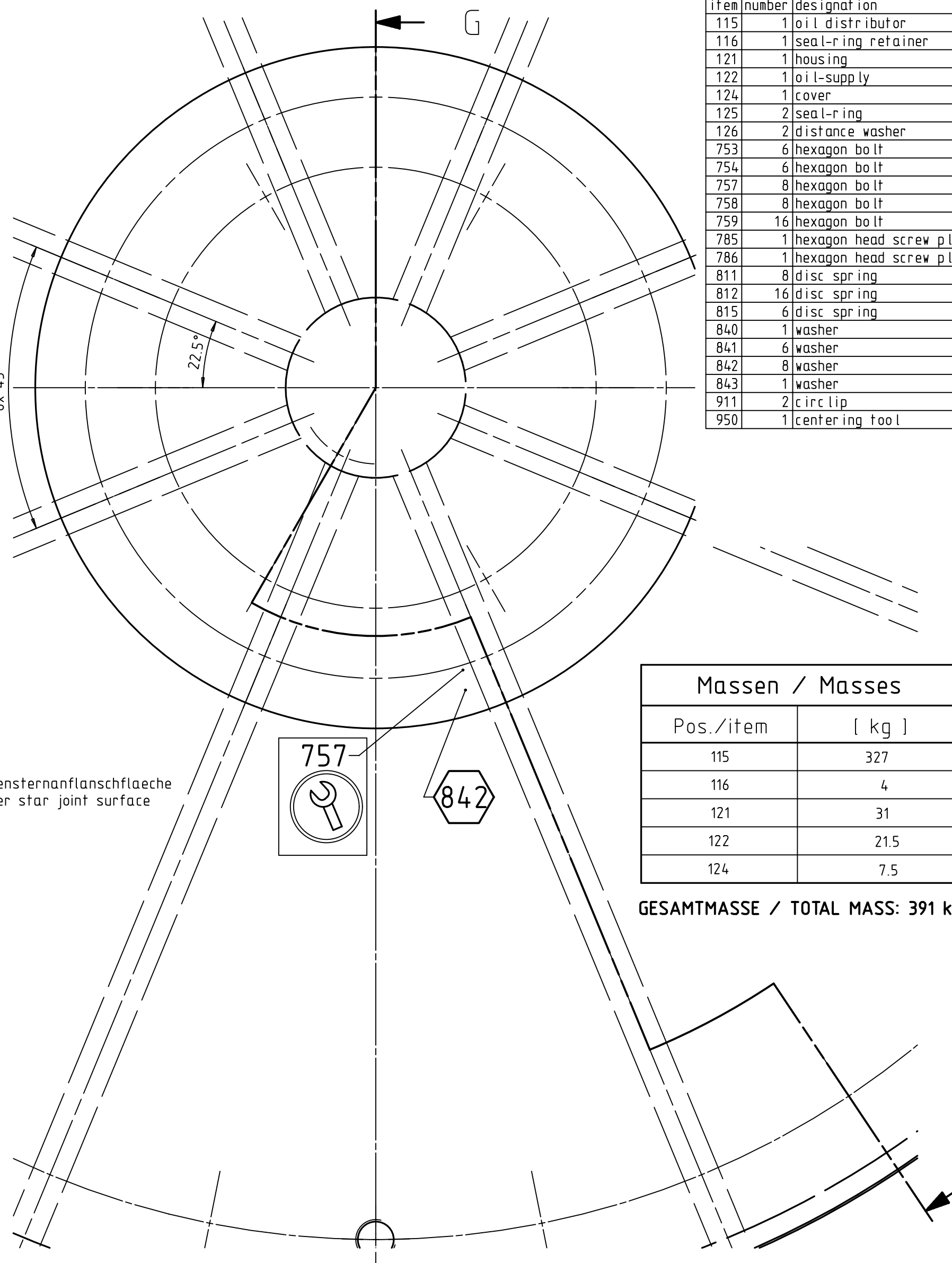
ATTENTION: Values for tightening torques (initial or final) are valid only if all surfaces are treated as stated below !

Teil Nr. Item no.	Anzugsmoment Tightening torque	Voranlegemoment Initial tightening torque	Verdrehwinkel Twist angle	Gewinde thread	Tellerfedern disc spring
753, 754	50 Nm	-	-	MOLYKOTE 1000	LOCTITE 275
757, 758	225 Nm	-	-	MOLYKOTE 1000	LOCTITE 275
759	440 Nm	-	-	MOLYKOTE 1000	LOCTITE 275

Schnitt G-G
M 1:2



Montageanweisung und Verlagerungswerte siehe : G2 05769-
Assembly instruction and misalignment capacities see

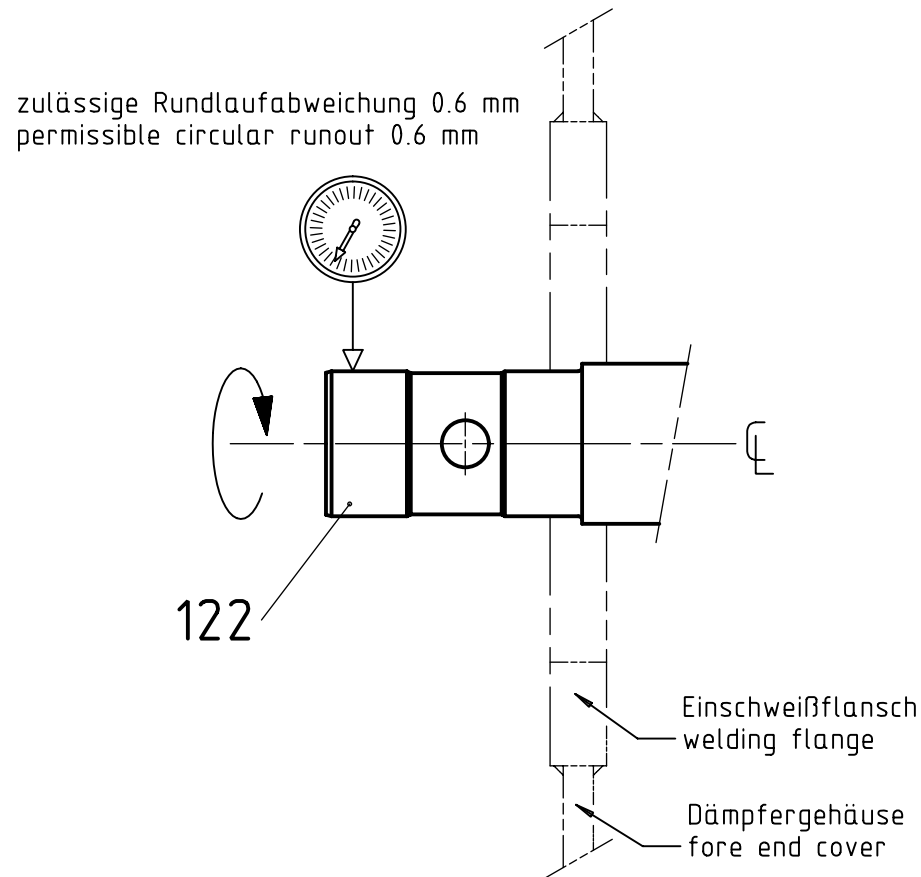


Massstab / Scale 1:2				Erstellt/drawn 2003-04-14 M. Walzer Geändert/revised 2003-05-22 M. Walzer Geprüft/checked 2003-05-22 J. Hagn		Stueckliste / Parts list G4 13481-	
Benennung / Designation OS 412/940/850 Oelzufuehrung / Oil supply						Zeichn. Nr. / Drg. Nr. G2 07689 A	
Schutzvermerk nach DIN 34 beachten Allgemeintoleranzen nach DIN ISO 2768-mH				Copyright reserved General tolerances acc. to DIN ISO			

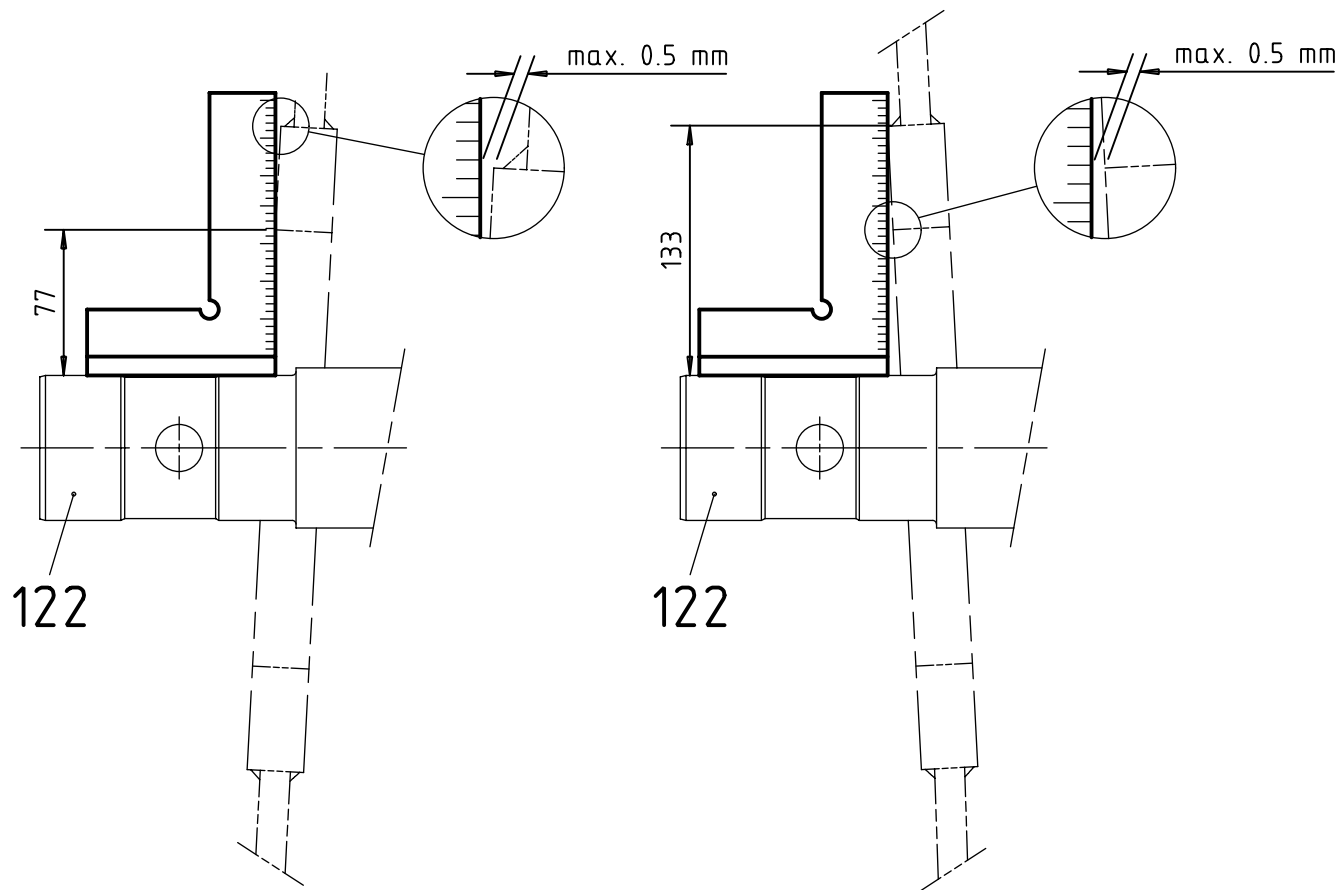
1 Montiere Ölverteiler (Pos.115) mit Schrauben (Pos.759) und Tellerfedern (Pos.812) am Dämpfer! (siehe Zusammenstellungszeichnung für Ölzuführung)
Mount oil distributor (item 115) with bolts (item 759) and disc springs (item 812) onto damper! (as shown on assembly drawing for oil supply)

2 Montiere Ölzuführung (Pos.122) mit Schrauben (Pos.758) und Tellerfedern (Pos.811) am Ölverteiler (Pos.115)! (siehe Zusammenstellungszeichnung für Ölzuführung)
Mount oil-supply (item 122) with bolts (item 758) and disc springs (item 811) onto oil distributor (item 115)! (as shown on assembly drawing for oil supply)

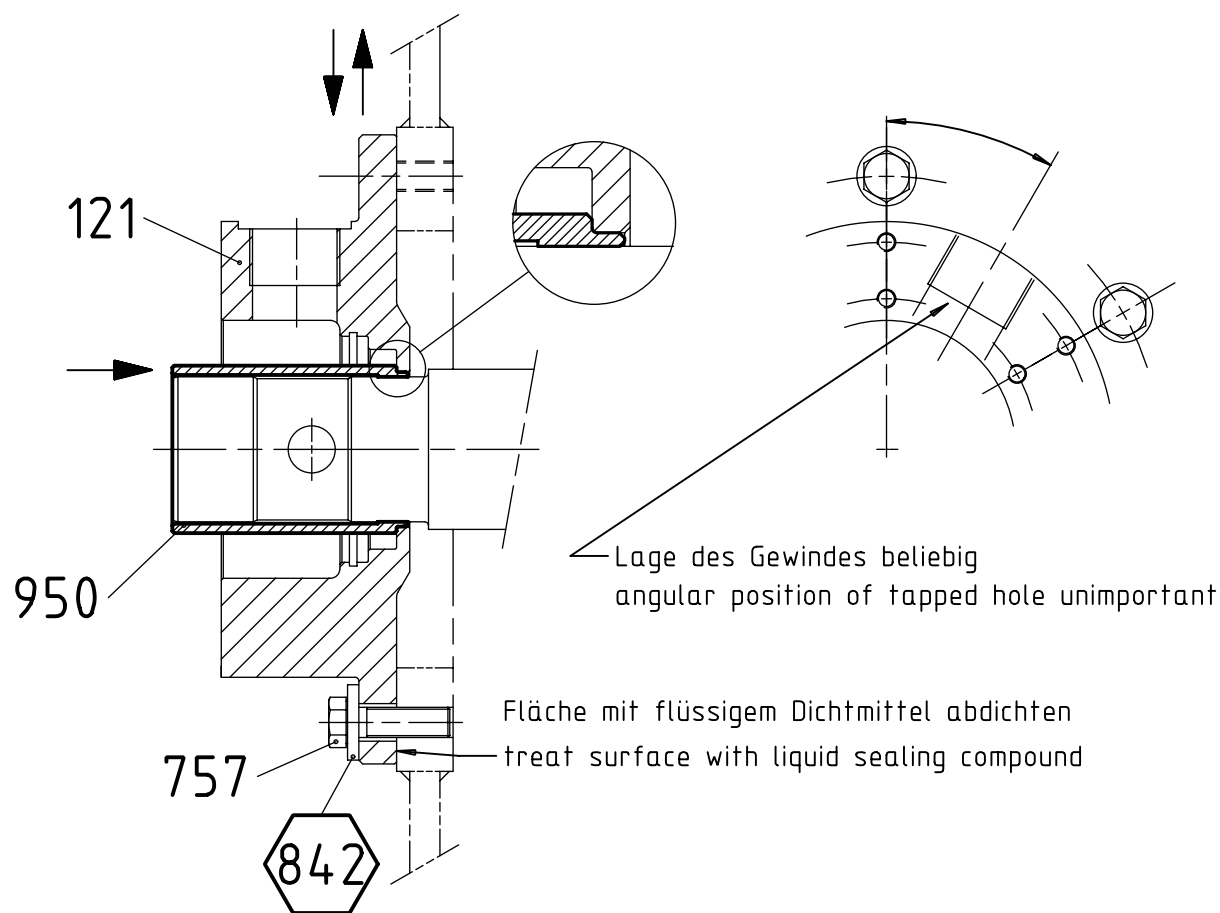
3 Überprüfe ob max. zulässiger Rundlauf nicht überschritten wird! (Gegebenenfalls neu einrichten!)
Check radial run-out! If it is exceeded, please readjust !



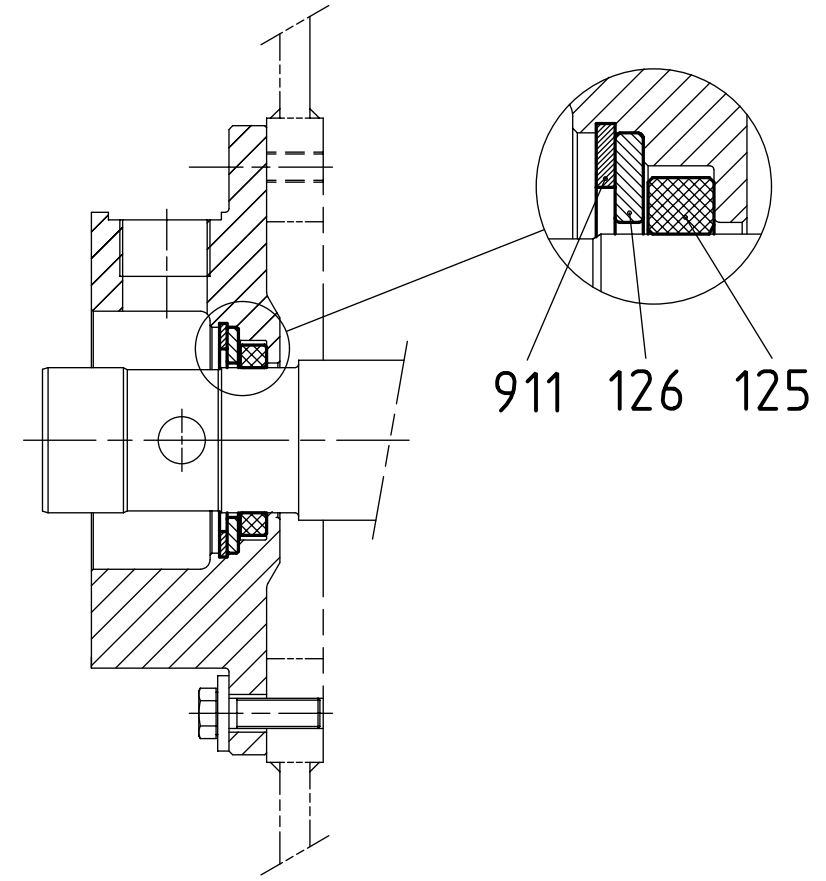
4 Überprüfe ob max. zulässige Rechtwinkeligkeit zwischen Einschweißflansch und Ölzuführung (Pos.122) nicht überschritten wird. (Gegebenenfalls Einschweißflansch einrichten!)
Check rectangularity between welding flange and oil supply (item 122) !
If it is exceeded, readjust welding flange!



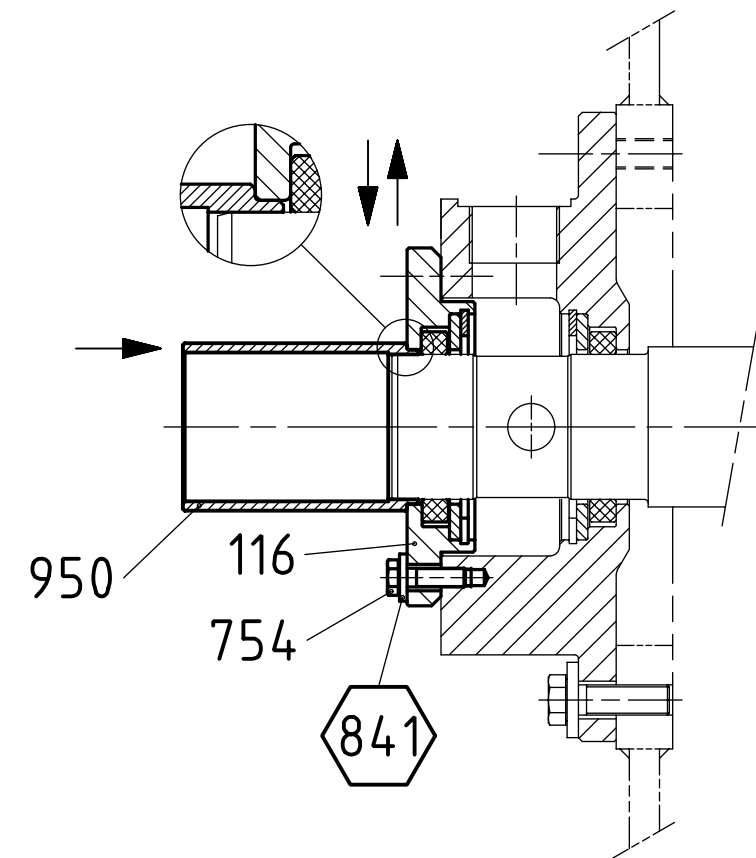
5 Gehäuse (Pos.121) mittels Zentrierwerkzeug (Pos.950) einrichten und mit Schrauben (Pos.757) und Scheiben (Pos.842) montieren! (Teilfläche mit flüssiges Dichtmittel abdichten!)
ACHTUNG! Zentrierwerkzeug (Pos.950) muß leichtgängig entfernbar sein!
Adjust housing (item 121) with centering tool (item 950) and secure it with bolts (item 757) and washers (item 842)! (Seal with liquid sealing compound!)
ATTENTION! Centering tool (item 950) must be easily removed!



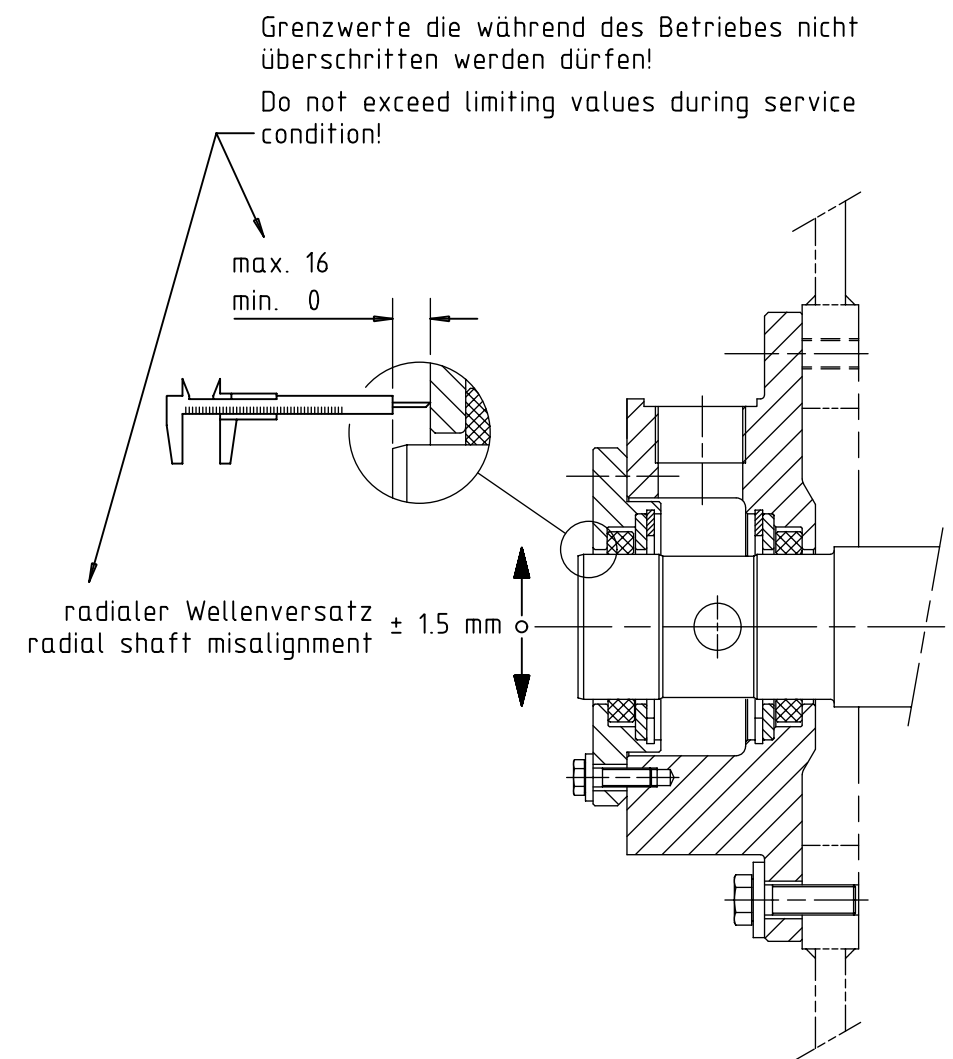
6 Montiere Dichtring (Pos.125), Distanzscheibe (Pos.126) und Sicherungsring (Pos.911)!
Fix seal-ring (item 125), distance washer (item 126) and circlip (item 911)!



7 Dichtringhalter (Pos.116) (inkl. Pos.125,126,911) mittels Zentrierwerkzeug (Pos.950) einrichten und mit Schrauben (Pos.754) und Scheiben (Pos.841) montieren!
ACHTUNG! Zentrierwerkzeug (Pos.950) muß leichtgängig entfernbar sein!
Adjust seal-ring retainer (item 116) (incl. item 125,126,911) with centering tool (item 950) and secure it with bolts (item 754) and washers (item 841)!
ATTENTION! Centering tool (item 950) must be easily removed!



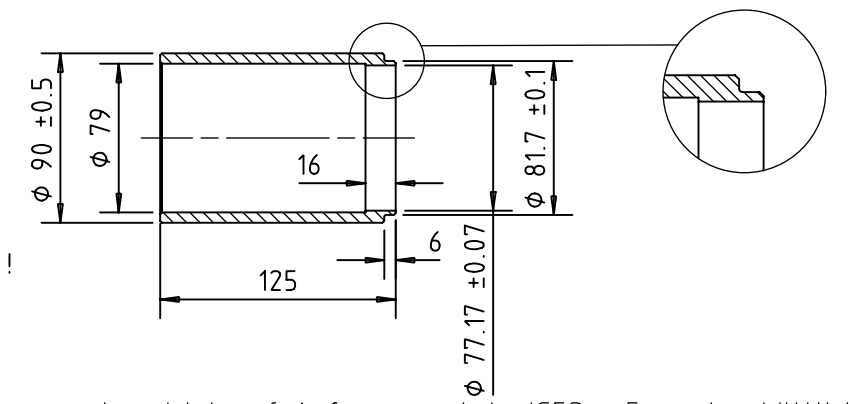
8 ZULÄSSIGE VERLAGERUNGEN / PERMISSIBLE MISALIGNMENTS



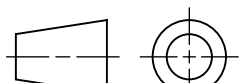
9 Montiere Deckel (Pos.124) mit Schrauben (Pos.753) und Tellerfedern (Pos.815) am Gehäuse (Pos.121)! (siehe Zusammenstellungszeichnung für Ölzuführung)
Fix cover (item 124) with bolts (item 753) and disc springs (item 815) onto housing (item 121)! (as shown on assembly drawing for oil supply)

Zentrierwerkzeug
Centering tool
(Pos./item 950)

zur Wiederverwendung aufbewahren !
store for future use !



Diese Zeichnung wurde mit UNIGRAPHICS II erzeugt und ist auf Anfrage auch im IGES - Format erhältlich.
This drawing was produced with UNIGRAPHICS II and is obtainable in IGES - format upon request.

CAD-Zeichnung		Zulässige Abweichungen für Maße ohne Toleranzangabe nach DIN ISO 2768-m				
Maßstab / Scale		Datum		Name		Stückliste / Parts list
		Bearbeitet	95-03-22	SEIDL Michael		
		Geprüft				
 Schutzvermerk DIN 34 beachten Copyright reserved		Benennung / Name				Zeichn. Nr. / Drg. Nr.
		Einbauanweisung für Ölzuführung Mounting instruction for oil supply				G2 05769
		Dr. Ing. Geislinger & Co. Schwing     				



Schutzvermerk
DIN 34 beachten
Copyright reserved



Geislinger Coupling



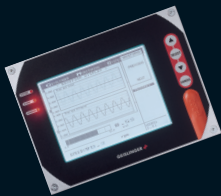
Geislinger Damper



Geislinger Gesilco



Geislinger Flexlink



Geislinger Monitoring



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