

Action code: **WHEN CONVENIENT**

**Laying up vessels
Updated recommendations**

SL09-502/SBJ
January 2009

Concerns

Owners and operators of MAN B&W two-stroke MC/MC-C, ME/ME-C and ME-B marine diesel engines

.....

Dear Sirs

Lately, we have received requests from shipowners about instructions for laying up vessels temporarily.

For this purpose, we have updated Recommendation No. 0743350-6, which is enclosed. The recommendation has been updated to cover laying-up of all MAN B&W low speed MC/MC-C, ME/ME-C and ME-B engine types.

If you have any questions or inquiries regarding the recommendations, please contact our Operation Department at leo@mandiesel.com

Yours faithfully


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20051207	PRR	FLK				0
20070502	PRR	CAA	Z3	ME engine types added in section 6. Connection of de-humidifier		1
20080422	PRR		Z3	In section 3; Protection of electronic equipment added		2
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This document is valid for existing engine types on order as of the date of this document:

MC, MC-C, ME, ME-C, ME-B.

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1. Scope and field of application

This recommendation deals with the procedure for laying-up vessels for an unspecified period, where qualified supervision is required for the engine room and the engines.

During the laying-up period, it is anticipated that the auxiliary engines will continue to generate electrical power and most likely operate on heavy fuel oil requiring pre-heating. Consequently, the auxiliary boiler must be operating and with it availability of keeping the main engine high temperature (HT) system heated.

The recommendations should be used as guidance only. Deviations from these recommendations may apply depending on the pipe systems, engine types, etc.

Note! We strongly recommend making a laying-up check list to ensure that laying-up maintenance diverting from “normal” port stay routines is performed correctly during the laying-up period and prior to the first engine start after the laying-up period.



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2. Prior to laying-up

2.1 Before stopping the engine

Fuel system

Operate the main engine on MDO (Marine Diesel Oil) at full load for one hour or at minimum 75% load for two hours before laying-up, by following the below steps;

- Follow the change-over procedure for changing from Heavy Fuel Oil (HFO) to MDO.
- When the change-over is complete, operate the main engine on MDO at full load for one hour or at minimum 75% load for two hours to flush out heavy fuel oil from the injection pumps, high pressure pipes and fuel injectors and to clean the exhaust system.

Turbocharger

- Soft blast clean the turbine side.
- Water wash the turbine side (if turbine shaft vibrations are observed during speed increase after the drying period: continue water washing)
If necessary: Soft blast clean the turbine side again.
- Clean the compressor wheel by water washing.

Scavenge air cooler

- Clean the scavenge air cooler air side as described in the instruction manual.

2.2 After stopping the engine

Keep the main lubricating oil pumps and the jacket cooling water pump running for about 15 minutes after stopping the engine. This will prevent overheating of the piston top and combustion chamber.

Ensure that the valves for the fuel oil inlet pipe and fuel oil outlet pipe from the main engine are closed and the by-pass valve is open.

The fuel oil system on the main engine is now filled with Marine Diesel Oil.

Secure the closed valves in locked position to prevent faulty operation during the laying-up period.

Close the ball shut-off valves for each fuel oil pump in the fuel oil pump inlet line.

The remaining fuel oil system supplying the auxiliary engines can then operate continuously on MDO or be changed over to operate on HFO.



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We **DO NOT** recommend overhauling and re-installing the fuel injectors one by one, for the following reasons:

- Overhaul of fuel injectors without engine operation shortly after will increase the risk of trapping air in the system. Trapped air causes internal corrosion.
- The fuel injectors can only be filled with oil after re-installation by opening the ball valve in the injection pump inlet line. If the fuel oil feed and circulation system is common for auxiliary engines and the main engine, HFO operation of the auxiliary engines will cause this fuel media to fill the just overhauled injectors of the main engine.
- Any leaks following injector overhaul or reinstallation may not be discovered during the laying-up period. The non-return valve located in the re-circulation line from each set of fuel injection valves is expected to make a tight closing, but in case of a leak, the closed ball shut-off valve in the fuel oil pump inlet line will prevent HFO to fill the fuel injectors during the laying-up period.

3. Engine room and control room

Keeping the recommended temperatures and humidity in the engine room and the control room will provide the best preservation of the mechanical and electronic equipment.

3.1 Engine room

Room temperature: Min 10°C

Humidity: Below 50% RH, if possible

Keep well-ventilated

3.2 Control room

Room temperature: 20-25°C

Humidity: 40-50% RH

Air condition: Permanently on

4. Main engine preservation

Main engine preservation must be performed immediately after laying-up the vessel.

Preservation maintenance must be performed regularly during the entire laying-up period.

The auxiliary engines and boiler should be operating during the laying-up period.

Use the waste heat from the auxiliary engine high temperature (HT) cooling water system, additionally the pre-heater, to keep the main engine permanently warm.

**MAN B&W****Recommendation**

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4.1 Preservation oil

All larger oil companies offer usable preservation oils. Some examples are listed below. Other preservation oils with corresponding qualities can be used.

It is of the utmost importance that the preservation oils can be dissolved in the main lubricating oil without damaging the properties of the lubricating oil. Please contact your main lubrication oil supplier for recommendations;

Esso Rust Ban 335

Tectyl 502-C, 930

Mobilarma 500

Dinitrol 40

BP Protective oil 0 - 30

Chevron EP Industrial oil 100 - 150

Shell Ensis Engine Oil SAE 30W

4.2 Main lubricating oil system

Start the main lubricating oil purifier and the purifier pre-heater 48 hours before turning of the crankshaft. Keep the main lubricating oil pumps running while turning.

Start the main lubricating oil system 12 hours before the monthly turning of the crankshaft. Keep the lubricating oil system running while turning.

Heating of the lubricating oil is not required during the laying-up period.

Once a month after stopping the purifier analyse a lubricating oil sample for water content (MAN Diesels' upper limit is 0.2%). Analyse onboard and keep a record of the water content level.

As an alternative it is recommended to use a laboratory to analyse the oil samples for water content.

4.3 Separate camshaft lubricating oil system and hydraulic power supply oil system

Once a month after stopping the purifier analyse a lubricating oil sample for water content (MAN Diesels' upper limit is 0.2%). Analyse onboard and keep a record of the water content level.

As an alternative it is recommended to use a laboratory to analyse the oil samples for water content.

4.4 Cylinder Oil lubricators

Shut off the cylinder oil inlet supply to the lubricator(s).



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4.5 Exhaust valves

Keep the exhaust valves closed during the entire laying-up period.

Once a month, operate the exhaust valves by opening and closing the valve spindle a couple of times.

Open the exhaust valves one by one by puncturing the air spring chamber (remove the air supply line and puncture the non-return valve). Keep the exhaust valve spindle open for a minimum of two minutes to allow the system oil to fill the lower part of the air spring chamber (this oil will lubricate the surface of the chamber, as the valve will close at reconnection of the spring air supply, preventing damage to the air piston sealing ring). The lubricating oil pumps must be running during this procedure.

4.6 Mechanical governor

Follow the governor manufacturer's preservation instructions.

If no preservation instructions are available, the following instructions can be used, for guidance only:

Exchange the lubricating oil in the governor with new lubricating oil with same property specifications.

4.7 Reciprocating parts on the outside of the engine

Apply rust preservation oil onto all reciprocating parts on the outside of the engine (fuel index rods, VIT index rods and fuel-rack links, etc).

4.8 Outside machined surfaces

Apply Tectyl 502C onto all machined surfaces on the outside of the engine.

4.9 Pneumatic system, safety air and control air

Drain the system for any condensate water. To ensure proper function of the various components in the pneumatic manoeuvring system, the control air supply to the engine must be operating continuously.

4.10 Cooling water system for air cooler

If the air cooler is cooled by sea water, we recommend closing the sea water inlet and outlet valves to the cooler and dismantling the pipes to the cooler.

Connect hoses for fresh water flushing to the flanges of the cooler. When the cooler has been flushed sufficiently with fresh water, fill the cooler with fresh water with rust inhibitor added, and seal off the flanges.

4.11 Jacket cooling water system.

Keep the jacket cooling water system pre-heated to keep the main engine warm. Use the waste heat from the auxiliary engine high temperature (HT) cooling water system and/or the pre-heater, to keep the main engine permanently warm.



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4.12 Piston rod stuffing boxes

Clean the scavenge air compartments underneath the liners and the air receiver itself shortly after laying-up. To neutralise any condensed acid in the oil trapped in the stuffing boxes, pour cylinder lubricating oil into each stuffing box while turning the crankshaft.

4.13 Components inside the engine

When carrying out preservation of the inside of the engine, keep the main lubricating oil pumps and camshaft oil pumps (if any) running until turning of the crankshaft is completed.

Before carrying out the first preservation: Open up the scavenge air receiver and ventilate for minimum one hour. Clean the scavenge air chamber before starting preservation.

Preservation of the scavenge air chamber, including cylinder liners, pistons rods and piston crowns

Spray preservation oil onto the cylinder liner walls and piston crown top through the scavenge air ports when the piston is in bottom position.

Spray preservation oil onto the piston rings while turning the crankshaft. Repeat once for each cylinder. From start to finish of this procedure, the crankshaft must be turned exactly $3\frac{1}{4}$ revolutions in all.

Stop lubricating oil pumps and camshaft oil pumps (if any). Let the lubricating oil in the crankcase drain off for minimum two hours before preservation of the crankcase.

Preservation inside the crankcase

Spray preservation oil onto the surfaces of the inside reciprocating parts, guide rails, chain drive, chain wheels, etc.

Preservation of camshaft housing

Spray preservation oil onto the camshaft including cams, rollers and roller guides.

4.14 Main engine exhaust pipe and crankcase venting pipe

Cover the main engine exhaust pipe in the top of the funnel during the laying-up period to protect against rain and dust.

Insert a blind flange between the crankcase and the crankcase venting pipe.

4.15 Starting Air distributor

Dismantle the starting air distributor and apply lithium grease onto of the inside parts for preservation. Assemble the starting air distributor according to the instruction manual.

4.16 Main starting air pipe

Keep the main starting air pipe dry: Remove the end cover of the pipe, insert de-humidifying vapour powder into the pipe and remount the end cover.



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4.17 Exhaust gas receiver

Place a bag of 0.5-1.0 kg silica gel (depending on engine size) at each cylinder.

Blank off the connection between the compensator and the turbocharger turbine inlet with a steel plate of 2-3 mm thickness.

4.18 Connection and operation of dehumidifier

Connect a dehumidifier to the engine with flexible hoses for drying and circulating the air in the scavenge air space, crankcase through thrust bearing/chain case housing and camshaft housing.

The dehumidifier must have sufficient capacity to keep the humidity below 50% RH under all temperature conditions. The dehumidifier must operate continuously.

On daily basis record the humidity, temperature and hour counter of the dehumidifier readings in the maintenance log book (see fig. 2, Recording sheet).

For operation and maintenance of the dehumidifier, follow the manufacturer's instructions.

Mount hygrometers in dummy covers to measure the humidity in the scavenge air space, camshaft housing (if any) and crankcase and thrust bearing/chain case.



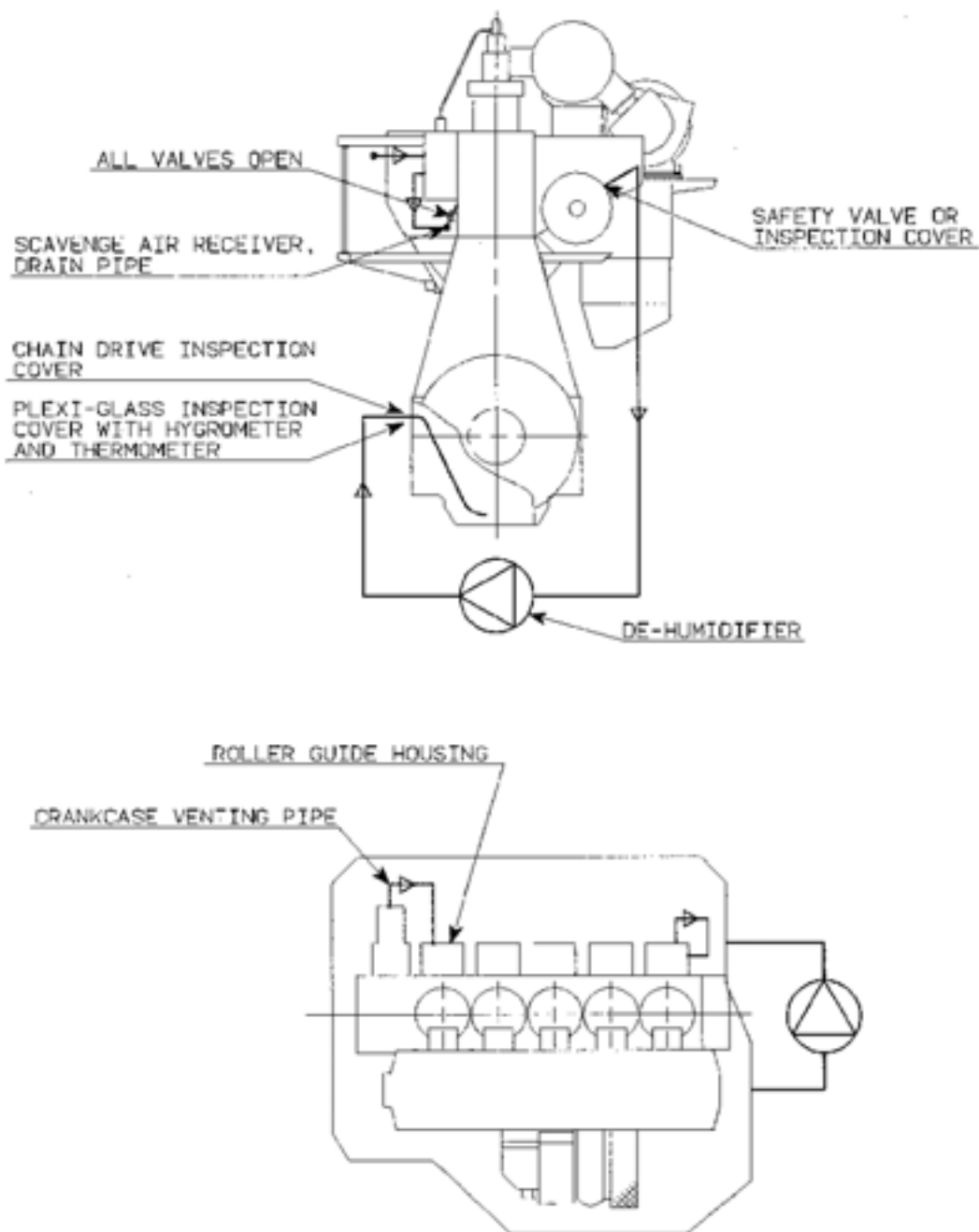
MAN B&W

Recommendation

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Figure 1 Diagram of connection of dehumidifier.





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4.19 Turbocharger and exhaust pipe

Blank off the connections between the exhaust gas receiver compensator and turbocharger turbine inlet and turbocharger outlet to the exhaust pipe with steel plates of 2-3 mm thickness. The purpose of these steel plates is to avoid turbine shaft rotation (if rotor is kept in the housing) and to protect the engine from rain water (if the exhaust system water traps fail) and dust. For turbocharger preservation, see section 7.

By blanking off the exhaust gas receiver, the receiver becomes a closed volume. This makes the dehumidifying process of the silica gel more efficient.

5. Preservation maintenance

Regular preservation maintenance is necessary during the entire laying-up period.

5.1 Visual inspection (weekly)

Inspect the entire engine inside and outside, without turning the crankshaft, to reveal any corrosion or water contamination. Remove signs of corrosion, if any. Clean up after removing. Apply preservation oil to the inspected components.

Inspect the engine components for corrosion, particularly cylinder liners, piston rods, cross head, guide rails and chain drive. Remove signs of corrosion, if any. Clean up after removing. Apply preservation oil to the inspected components.

Inspect the upper parts of piston crowns, piston ring packs and cylinder liner from the inside of the scavenge air receiver through the scavenge air ports.

Inspect the inside of the camshaft housing, camshaft, cams, rollers and roller-guides.

5.2 Engine components and turning of crankshaft (monthly)

Inspect the entire inside of the engine before starting the main lubricating oil pumps and camshaft lubricating oil pumps (if any). Cold oil, 12 hours before turning the crankshaft.

To prevent corrosion of engine components which are not directly accessible for visual inspection, i.e. bearings, journals, cylinder liners, piston rings, etc., and to avoid the crankshaft to settle in the same position, turn the crankshaft 3¼ revolutions once a month.

Operate the exhaust valves by opening and closing the valve spindle a couple of times. Open the exhaust valves one by one by puncturing the air spring chamber (remove the air supply line and puncture the non-return valve). Keep the exhaust valve spindle open for a minimum of two minutes to allow the system oil to fill the lower part of the air spring chamber (this oil will lubricate the surface of the chamber, as the valve will close at reconnection of the spring air supply, preventing damage to the air piston sealing ring). The lubricating oil pumps must be running during this procedure.

The main lubricating oil system must be operated for 12 hours, lubricating oil purifiers and pre-heaters for 48 hours before the crankshaft is turned.



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Note! Stop the dehumidifier ONLY during crankcase inspection before turning and when turning the crankshaft. Restart the dehumidifier immediately after applying preservation oil and closing the crankcase doors.

Preservation of the scavenge air chamber, including cylinder liners, pistons rods and piston crowns

Spray preservation oil onto the cylinder liner walls and piston crowns through the scavenge air ports when the pistons are in bottom position.

Fill the top of the piston crowns with a special type of vaporising preservation oil. This will protect the inside of the cylinder covers.

Spray preservation oil onto the piston rings when passing the scavenge air ports while turning the crankshaft.

Repeat once for each cylinder. From start to finish of this procedure, the crankshaft must be turned exactly 3¼ revolutions in all.

After the turning is completed, spray the piston rods, stuffing boxes and the outside of the cylinder liner with preservation oil.

Preservation inside the crankcase

Stop the main lubricating oil pumps and purifiers after completing crankshaft turning. Let the lubricating oil drain off for minimum two hours. Spray preservation oil onto the surfaces of inside reciprocating parts, guide rails, chain drive, chain wheels, etc. Close the crankcase doors tightly.

Preservation of camshaft housing

Inspect the camshaft before starting the camshaft lubricating oil pumps prior to preservation of the components inside the engine.

If the engine has a separate camshaft lubricating oil system, run the camshaft lubricating oil pump (cold oil) to circulate the lubricating oil through the system while the main lubricating oil pumps are running (12 hours). Do not stop the pumps until the crankshaft turning procedure is completed.

Let the lubricating oil drain off for minimum two hours after stopping the lubricating oil pumps. Dismantle the camshaft housing covers and spray rust preventing oil onto the camshaft including cams, rollers and roller-guides. Remount the housing covers.

After completing the monthly turning and preservation procedure

After stopping the purifier analyse oil samples from main lubricating oil and camshaft lubricating oil / hydraulic power supply oil (ME/ME-C/ME-B) for water content (MAN Diesels' upper limit is 0.2%). Analyse onboard and keep a record of the water content level.

As an alternative it is recommended to use a laboratory to analyse the oil samples for water content.



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5.3 Hydraulic power supply oil system

ME/ME-C and ME-B engines:

- During the monthly running of main lubricating oil pumps, run the start-up pumps (cold oil) for one hour to pressure rise the lubricating oil in the HPS system. Make a visual inspect of the HPS system.

5.4 Reciprocating parts on the outside of the engine (monthly or as required)

Apply rust preservation oil onto all reciprocating parts on the outside of the engine (fuel index rods, VIT index rods and fuel-rack links, etc).

5.5 Outside machined surfaces (monthly or as required)

Apply Tectyl 502C onto all machined surfaces on the outside of the engine.

5.6 Main starting air pipe (monthly or as required)

Replace the dehumidifying vapour powder in the main starting air pipe.

5.7 Exhaust gas receiver (weekly, monthly)

Weekly!

Inspect the exhaust gas receiver.

Monthly!

Replace the silica gel bags at least once a month.

5.8 Dehumidifier (daily, monthly)

Daily!

Record the humidity, temperature and hour counter of the dehumidifier, readings for the scavenge air space, crankcase and thrust bearing/chain case, and camshaft housing (if any) in the maintenance log book.

If the humidity inside the engine exceeds 50% RH, check the dehumidifier.

For operation and maintenance of the dehumidifier, follow the manufacturer's instructions.

Diagram for connection of dehumidifier and recording sheet, see fig. 1 and fig. 2

Monthly!

Calibrate the hygrometers.

5.9 Spare parts and maintenance tools (as required)

Inspect spare parts and maintenance tools regularly.

5.10 Intermediate shaft and stern tube bearings (monthly)

Prior to the monthly crankshaft turning, ensure that all bearings in the propeller shaft system are lubricated.



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6. Protection of electronic equipment

It is recommended to keep the cabinets for electronic equipment closed during the laying-up period to protection against, mechanical damage of the electronics, dirt and static electricity.

Improper protection of the electronic equipment may cause damage or reduced lifetime of the equipment.

6.1 Electronic equipment on the main engine

Vapour corrosion control must be applied inside all cabinets for electronic equipment. Install capsules according to lifespan and protective range of a capsule, see figure 3.

All cabinets for electronic equipment must be closed and cable glands must be tight. Open holes in cabinets must be sealed air tight.

6.2 Electronic equipment in the control room

Air conditioning must be permanently operating to keep the temperature between 20 - 25 °C. The humidity of the air should be kept between 40 – 50 % RH.

6.3 Examples of vapour corrosion control suppliers

www.cortecvci.com

Model: Cortec VpCI 101

Description: Impregnated foam device

Silica gel desiccant packs

www.zerust.co.uk

Model: Zerust Capsules, see lifespan and protective range figure 3.

Description: Designed to protect electronic components inside of enclosures

6.4 Protection during maintenance and repair works

All cabinets for electronic equipment must be closed and holes sealed air tight when grinding, welding, painting or cleaning on the engine or close to the engine is carried out.

If welding on the engine is necessary the ground clamp cable must have good electrical contact and placed as close to the welding arc as possible. The welding power supply must have an adequate earthing device.



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Figure 3

ZERUST® interior surface protection

How ZERUST® Vapor Capsules work

Corrosion protection for metals in switch gearboxes, electronic cabinets and other enclosures.

- When removed from its sealed package and placed in an enclosure, a capsule will saturate the surrounding atmosphere with an invisible, odourless, non toxic vapour. The ZERUST® vapour molecules will then form a protective corrosion inhibiting layer on all exposed metal surfaces in a cabinet, package or container.
- Upon removal of the capsule, the protective layer will revapourise, leaving all surfaces clean, dry, and without any residues.

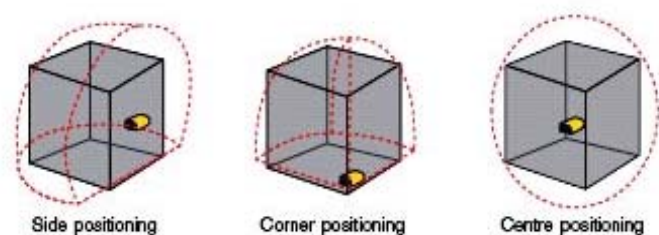


<p>Installation</p> <p>ZERUST® Vapor Capsules are easily installed in a few seconds without tools or specialised labour. Simply peel the cover tape from the adhesive backing to attach to most surfaces.</p>	<p>Reduce maintenance costs</p> <p>ZERUST® Vapor Capsules prevent the oxidation that causes increasingly higher levels of electrical resistance. This, as well as the longevity of the capsule, allows for fewer maintenance checks, reduced down time and component failures, in comparison to alternative protection methods.</p>	<p>Use ZERUST® capsules</p> <ul style="list-style-type: none"> • During shipment and initial storage, often combined with ZERUST® Valeno packaging. • During normal operation. • During closure, storage or shutdown.
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ZERUST® Capsules offer Multi-Metal protection:
Steel and iron, zinc and galvanized steel, copper, brass, bronze, aluminium (and its alloys), nickel, tin, solder.

Lifespan and protective range of a ZERUST® Capsule

Item	Protective radius	Protective volume	Protective lifetime
VC0.5-1	30 cm	0.1 m ³	1 year
VC1-1	30 cm	0.1 m ³	1 year
VC2-1	60 cm	1.0 m ³	1 year
VC2-2	60 cm	1.0 m ³	2 years
VC5-1	180 cm	25.0 m ³	1 year
VC5-2	180 cm	25.0 m ³	2 years





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7. Turbocharger preservation

Follow the turbocharger manufacturer's recommendations. The following is for guidance only.

7.1 Preservation

Close lubricating oil inlet valve or blank off inlet pipe to the turbocharger.

Disassemble the turbocharger gas inlet pipe and silencer, dismantle the rotor and the nozzle ring.

Remove deposits in all gas spaces and turbine inlets, outlets and on the intermediate wall.

Clean the rotor and the nozzle ring with boiling water until all deposits are removed.

Apply preservation oil to the rotor and the nozzle ring. Be particularly careful with the bearing journals and stuffing box journals. All surfaces must be dry before applying the preservation oil.

Store the rotor and the nozzle ring next to the turbocharger in a plywood box with cover.

Apply preservation oil onto the bearings and inside of the casing.

Blank off the turbine and the compressor flanges of the casing with steel plates of 2-3mm thickness.

Inspect on weekly basis the turbocharger casing, bearings, rotor and nozzle ring. If necessary apply preservation oil. The preservation oil must be soluble in the lubricating oil.

7.2 Preparation of turbocharger before recommencing service

Clean out the preservation oil and inspect the casing and bearings.

Apply lubricating oil onto the bearings and mount the rotor and nozzle ring according to the instruction manual.

Assembly the turbocharger gas inlet pipe and silencer

Reconnect the lubricating oil inlet.



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8. Starting the main engine after the laying-up period

Before starting the engine after the laying-up period, clean out any rust preventing oil deposits in the scavenge boxes, scavenge air receiver and the piston crowns.

Clean the top of the piston crowns. Check carefully that any preservation oil residuals are removed from the piston crown tops before starting the engine

Clean, inspect, and pressure test the fuel valves. Inspect the fuel pumps.

Reassemble the turbocharger according to the instruction manual.

Remove the steel blanking plates from the exhaust gas receiver outlet and turbocharger gas outlet to funnel.

Remove the cover from the top of the funnel.

Uninstall the dehumidifier. Remove the dehumidifying vapour powder from the main starting air pipe and the silica gel bags from the exhaust gas receiver.

All items in the “laying-up check list” (as mentioned in paragraph 1.) must be brought back to normal service condition prior to start of the engine.

Reference is also made to our instruction manual, particularly the chapters “Check during stand still periods” and “Preparations for starting”.