# Guideline for engine protection After shop test

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## 2 Introduction

This document is an overview guide line for the application of corrosion protection coating after shop test of RT-flex and X and DF engines as also for temporally undetermined storage at shipyard / final destination.

For the corrosion protection of the engine and its parts, as well as for the treatment of the cooling water circuits during engine assembling and shop test, the specification 107.215.543i and its amendments are still valid.

The way of application might differ and depend on the expected or agreed engine storage period and the conditions at final destination.

There are normally 3 different timeframes to which the coating thickness as also the regular main inspection intervals are referring.

- normal period storage (up to 6 months)
- long period storage (6 12 months)
- undefined period of storage due to unpredictable postponement of ship project (over 12 months)

This guide line covers re-coating after the shop test, as during final assembly of the engine parts and even more during engine running, most of the protective coating will have been flushed away. Therefore a proper re-coating after shop test is crucial.

It was chosen to divide this document in various chapters and sub-chapters in order to have separate steps, thus not losing the principal information by overloading the chapters.

# 3 Responsibility

The orderer specifies the duration of protection and the special requirements for transport and storage.

The engine manufacturer will be responsible that the specified corrosion protection is executed with care and that packaging is carried out in a professional manner.

Reliable preservation is assured if the drying time of the applied coating is observed and the processes and products described in the following are properly applied.

As transition area of taking over the responsibility for further proper storage and corrosion preservation of the engine, the chapters

9 - Final inspection before delivery (at engine maker)

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11 - Inspection upon arrival (at shipyard) and their sub-chapters have been written.

The manufacturers specifications and safety sheets for these cleaning and coating products must be strictly observed. Other processes and products may be applied if they meet the specified requirements.

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WinGD Switzerland Ltd. will not accept any liability or responsibility for damage to the engine and its parts which is or has been sustained due to the none-observance of these preserving instructions, e.g. due to insufficient preservation, unsuitable storage or damaged preservation material. Moreover, WinGD Switzerland Ltd will not accept any liability for preservation measures that are carried out by the manufacturer or a third party.

It is in any case the responsibility of the orderer to check the engine and its parts for any corrosive damage promptly upon arrival.

Unless agreed differently in the purchase contract, any claim due to corrosion damage of the engine and its parts has to be made in writing to WinGD Switzerland Ltd. within two weeks from the arrival of the engine and its parts to the final destination defined in the purchase contract.

Any claims made after the two weeks notice period shall not be taken into account. The orderer shall be responsible for the preservation of the engine and its parts for further transport and final storage.

# 4 Reason for proper corrosion protection

To give you an impression of corroded parts, respectively the possible or impossible access for repairing or replacing of them, the following short extract of pictures will illustrate the reasons for using proper corrosion protection.

Without access by crane, available normally just in engine room condition, or proper storage warehouse, no proper repair or replacement work of heavy parts can be done!

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# Consequences for fully assembled engines in storage without adequate use of corrosion protection

As e.g. the pistons and cylinder liners can be checked only through the scavenge air ports, a cleaning and possible recovery of the parts at time will not be possible. Further corrosion leads to such kind of material pitting that the parts must be exchanged at a later stage.



Heavily corroded: Cylinder liner and piston crown. At last the parts could be pulled or reached to be cleaned and judged for further procedure (replacement).



Repaired (cleaned of upper rust layer) cylinder liner (above) and piston crown (below) surface revealed that the pitting had been so heavy that the parts had to be replaced.



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Situation of parts access without crane available



Situation of cyl.liner & piston crown in fully assembled condition.

Be aware: These are just examples!

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# 5 Range of application: Engine delivery condition

The intention of this chapter is to provide an overview of different ways and engine stages the corrosion protection, the transport and the storage will be done, as this will affect either the way of corrosion protection application and even more the storage capabilities and additional re-coating work, which is required for long-term storage and unpredictable engine storage-time respectively.

Mainly for reasons of different crane capacities as also engine sizes either at engine maker or at shipyard, there are three different conditions of engine delivery:

- See 5.1: Engine delivered in fully assembled condition.
- See 5.2: Engine delivered in 3 major components (bedplate with crankshaft, column, cylinder jackets with cylinder liner installed).
- See 5.3: Engine fully dismantled after shop test.

## 5.1 Engine delivered in fully assembled condition



Engine delivered in fully assembled conditions.

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Engine stored in a tent-like warehouse.



Engine stored outside and covered with a waterproof tarpaulin.

It is recommended to install dehumidifiers for transportation already.
 It has to be assured that they are connected electrically at board side.

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## 5.2 Engine delivered in 3 pre-assembled major parts

In general it has to be mentioned that the storage of single parts, even major parts like bedplate with crankshaft, column with platforms as well as the cylinder jackets and all additional parts like pistons, connecting rods, etc. can be done with less expense of time and work if the protection and packing of the parts was properly done beforehand.

Dehumidifiers have to be placed at each single major part.



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Bedplates (2 parts) with crankshaft (in front) and column with fuel pumps (behind)



Cylinder jackets with scavenge air receivers



Connecting rods at cleaning stage at ship-yard. The sea-trial date is fixed.



Cylinder liners at cleaning stage at shipyard.



Main pistons and cylinder covers (still covered and exhaust cage closed by plate)



Turbocharger prepared (openings closed by wooden plates)

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# 5.3 Engine delivered in 3 pre-assembled major parts & crankshaft delivered separately

It quite often occur that the crankshaft has to be dismantled after shop test.

This is mostly the case with bigger bore engines, but it might also be required for medium or small bore engines. The principal reason is the crane load capacity either at engine maker or at the shipyard.

# 5.4 Engine delivered fully disassembled

Engine fully dismantled after shop test: All parts have been cleaned, protected and covered properly (bedplate, crankshaft, column, cylinder jacket as single components); all platforms and pipes are dismantled, all other parts like cylinder covers and exhaust valves, pistons, cylinder liners, connecting rods, crossheads and so on are packed and protected in wooden boxes.



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Example of connecting rod with crosshead at transport packaging stage.
Stored outside just after arrival at shipyard.

# 6 Climatic conditions for Cleaning – Coating – Storage

As many different climatic conditions are one of the major impacts in relation to the applicable corrosion protection work, this issue has to be clarified more closely.

High humidity conditions with humidity values as high as 80-85% over nearly the whole year
on the one hand, and the corrosion protection liquid properties on the other hand,
implicate the recommendation of preferably low humidity values, as otherwise the fast
accretion of moisture on the blank surfaces will complicate any proper procedure.

Therefore WinGD Switzerland Ltd. recommends a relative humidity value below 50% in general.

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## 6.1 For cleaning of machined surfaces – parts in general; before coating

The cleaning work has to be carried out in a well-ventilated room at a temperature between 15°C (min) and 35°C (max.). The relative humidity should be less than 50%.

## 6.2 For application of corrosion protection

The cleaning work has to be carried out in a well-ventilated room at a temperature between 15°C (min) and 35°C (max.). The relative humidity should be less than 50%.

## 6.3 For storage of engine or engine parts

The engine and its parts must be stored in well-ventilated rooms at a temperature between 15°C (min) and 35°C (max.). The relative humidity should be less than 50%.

# 7 Draining & cleaning of engine parts after shop test

The procedure described in this chapter has to be carried out according to chapter 8, taking into account that all painting work (coating of primer & top layer) has been done properly before engine assembly.

The application of corrosion protection has to be checked and renewed on all machined/blank surfaces, as the corrosion protection may be flushed due to the temperatures reached during engine running for shop test, or has melted away during the shop test itself or scraped away during assembly.

# As general summary of this chapter 7, the following rule has to be considered stringently:

The clean and dry condition of the machined/blank surfaces is of outmost importance for a proper application of corrosion protection, as the adhesion of all applicants will be as good as cleaning and drying work was performed!

To accelerate the drying time, heaters with dry air fans for heating up the engine interior can be considered.

A heat venting system is probably even more useful in connection with drying of all water pipes and/or water cooling spaces.

Connection flanges at the transition between the venting system and the piping/ cooling spaces might be especially useful, as flange connections are easily adaptable to different engine sizes by the mere use of additional adaptors.

All parts which have been affected by carbon deposits during engine running have to be cleaned carefully, otherwise the carbon deposits will harm the parts, as there remains sulphuric acid which corrodes the material very much, especially during long period of stand still conditions.

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## 7.1 General preparations

- Heaters with dry air fans for heating up the engine internal can be considered due to the amounts of solvents as well as of the corrosion protectors used during a production year, and also to accelerate the drying time, in order to obtain a beneficial economical and environmental effect (one work carried out once) for the engine preservation work.
- A heat venting system is probably even more useful in connection with drying of all water pipes and/or water cooling spaces (see also 7.6).
- Connection flanges at the transition between the venting system and the piping/ cooling spaces might be especially useful, as flange connections are easily adaptable to different engine sizes by the mere use of additional adaptors.

The engine maker and probably also the shipyard(\*) should take the following into account:

(\*)= It might be interesting for shipyards by reason of unpredictable anchoring of ships after seatrials due to re-arranged final ship-delivery or other force majeure reasons.

As the cleaning-, and much more, the drying work after a shop test can be of a dangerously annoying stimulus due to the fact that especially the oil will flow repeatedly over already cleaned surfaces, or, as in our case, over machined/blank surfaces, a fast heating and drying-up of the crankcase as well as of the piston underside by a heating fan system should be considered just after shop test.

A thickened oil film is much easier and faster cleaned with much less solvent. Likewise the thickened oil will not flow quickly again over the surfaces cleaned/prepared for corrosion protection.



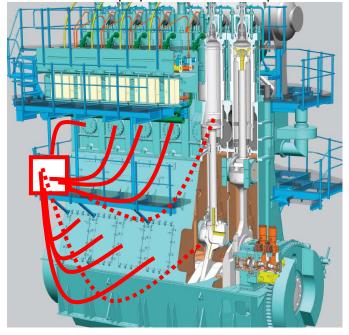
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Sample of hose connection of dehumidifier system.



Heating fan with multi-connectable hose system & adaptable flange connectors.

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## 7.2 Tools & materials to be used for cleaning

The following tools and products are to be used for cleaning work in general:

- Acid-free cotton cloth
- Paper towels
- Wooden or plastic spatula/scraper
- Airgun or airless spray unit (see chapter 15.3.3)
- White spirit (e.g. Shellsol : see chapter 16.1)
- Petroleum
- Kerosene

#### NOT to be used under any circumstances:

- Metallic scraper

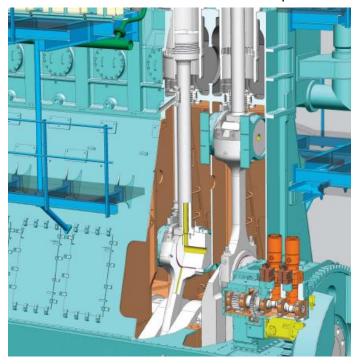
## 7.3 Crankcase – drying & cleaning

The crankcase can be cleaned and dried in usually three different engine stages:

- 7.3.1 Engine fully assembled
- 7.3.2 Engine dismantled in 3 major parts (bedplate with crankshaft)
- **7.3.3 Engine dismantled in 3 major parts** (bedplate without crankshaft)

## 7.3.1 Engine fully assembled

The engine will not be dismantled for transport and installation at shipyard. All engine internal parts have to be dried and cleaned after shop test.



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The cylinder covers and the pistons have been removed for their cleaning and corrosion protection work!

All engine internal parts have to be dried and cleaned after shop test.

Either of system oil, like

- piston cooling oil
- crosshead lubrication
- main bearing lubrication
- servo oil rail

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- servo oil pumps (Supply Unit)
- Turbocharger lubrication
- all pipe circuits belonging either to the ingoing or outgoing of fluid flow,

or of water residues/deposits of the cooling water system, like

- cylinder liner cooling space
- cylinder cover & exhaust valve cage
- scavenge air receiver/cooler spaces
- all pipe circuits belonging either to the ingoing or outgoing of fluid flow,

or of air of the starting air- or control air system, like

- starting air shut-off valve
- starting air distributor
- starting air valve at cylinder cover
- all pipe circuits belonging either to the ingoing or outgoing of fluid flow,

or of fuel, like

- Injection Control Unit (ICU) RT-flex engines
- fuel rail
- fuel pumps
- all pipe circuits belonging either to the ingoing or outgoing of fluid flow.

All engine external machined surfaces and/or parts have to be cleaned and dried.

For all machined surfaces a cleaning solvent/white spirit should be used. See 16.1.2.

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# 7.3.2 Engine dismantled in 3 major parts (bedplate with crankshaft)



Column at cleaning stage. Cleaning solvent (white spirit) is used.



Cylinder jacket at cleaning stage.
Cleaning solvent (white spirit) is used.

# 7.3.3 Engine dismantled in 3 major parts (bedplate without crankshaft)



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Bedplate delivered as single part



Crankshaft delivered as single part. Already cleaned of corrosion protector by solvent and ready for bedplate assembling. Crank-throw journals protected with rubber and steel plates (8mm thick).



Crankshaft under cleaning / removing work of corrosion protection.

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## 7.4 Main bearings & thrust bearing pads dismantled

If the crankshaft is delivered as single part, also the main bearing shells and bearing covers as well as the thrust bearing pads are to be removed from the bedplate.

Carefully clean them with Shellsol / white spirit.

## 7.5 Crankshaft delivered as single part

This chapter describes the handling of the separately delivered crankshaft.



## 7.5.1 Crankshaft cleaning

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- Thorough manual cleaning of the entire crankshaft surface with acid-free cotton cloth (no rags), paper towels and clean solvent, e.g. white spirit, Shellsol or a similar product.
- Flushing of all bores with clean solvent.
- **Important**: From this moment the crankshaft must not be touched with bare hands anymore!
- Allow the crankshaft to dry completely.
- Check whether clean and free of rust. Do not touch the cleaned surfaces with bare hands.
- If there are signs of rust, the quality assurance department will decide whether additional work is necessary. If the traces of rust are only slight, they can be removed with emery cloth No. 220 (or finer) and petroleum. Repeat cleaning!

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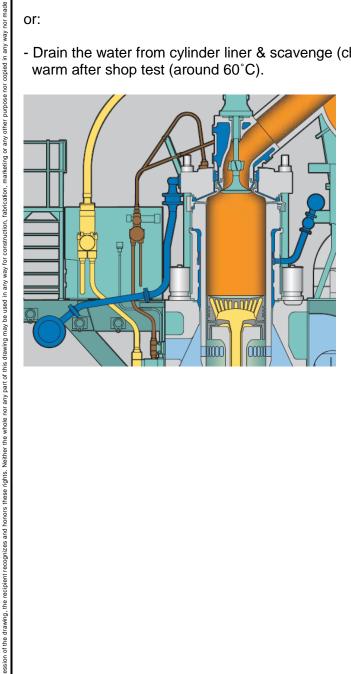
#### 7.6 Cylinder liner & scavenge air cooler: cooling water system (Cylinder liner – scavenge air cooler – piping for water circulation on engine)

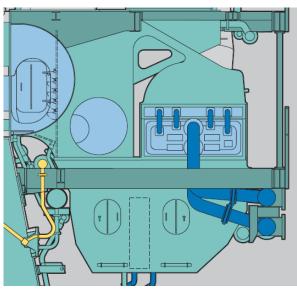
- Make sure that the cooling water circuits have been treated properly by adding a water inhibitor during engine running. (water inhibitors see chapter 16.2)
- The cooling water must be drained and dried. It is recommended to blow warm, pre-dried air through the pipes. The cooler has to be sufficiently vented.

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- Drain the water from cylinder liner & scavenge (charge) air cooler when the engine is still warm after shop test (around 60°C).

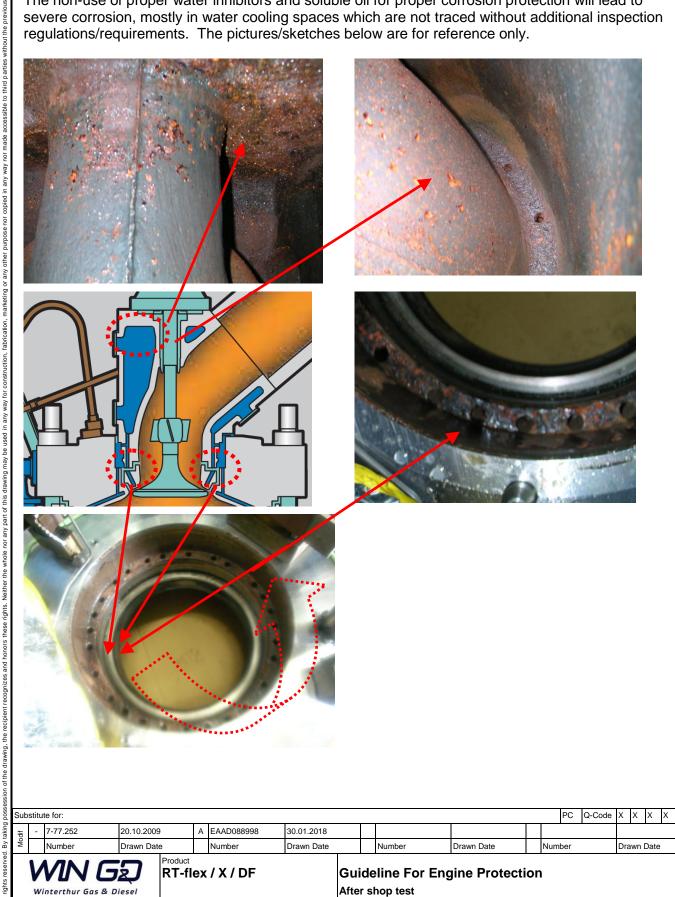




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#### 7.7 Consequences

The non-use of proper water inhibitors and soluble oil for proper corrosion protection will lead to severe corrosion, mostly in water cooling spaces which are not traced without additional inspection regulations/requirements. The pictures/sketches below are for reference only.



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# 7.8 Cylinder liner & piston

If the engine is not dismantled, make sure that also the piston inner parts, like spraying plate with nozzles, as well as the piston inside itself are protected in a practicable way.

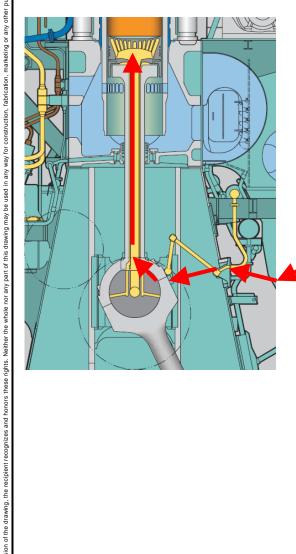
This could be achieved by using either the piston cooling pipe system or the flange connections for lever.

- Piston dismantling after shop test:

After shop test, mainly the piston crowns, the piston rings and probably the piston ring grooves are to be cleaned of combustion residues.

- Gland box piston rod: To be opened and properly cleaned of carbon and dirt oil deposits.
- Cylinder liner dismantling after shop test:

It has to be determined whether the cylinder liners will be dismantled after shop test. The cylinder liners can be cleaned still assembled to the cylinder jacket, as also the pistons will have to be dismantled.



If the engine is not dismantled, make sure that also the piston inner parts, like spraying plate with nozzles, as well as the piston inside itself are protected in a practicable way.

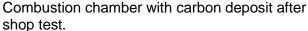
This could be achieved by using either the piston cooling pipe system or the flange connections for lever.

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## 7.9 Cylinder cover

After shop test, the cylinder covers will have to be dismantled, injectors have to be removed to clean the combustion residues in the combustion chamber as well as the exhaust cage. Drain the cooling water carefully (check exhaust cooling water space) and use warm/heated-up air if necessary.







Combustion chamber after cleaning.

# 7.10 Starting- & control air system

- ☐ Drain the complete starting air system including air spring.
- Remove all starting air valves, open them, clean all parts, oil the parts slightly with rust protection oil and reassemble them.

#### Option 1

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The starting air valves can be refitted in the engine after overhaul.

#### **Option 2 (recommended)**

The starting air valves can also be kept separate from the engine. In this case the starting air valves should be stored in a dry place, well preserved and packed in VCI paper. Note that the openings in the cylinder covers need to be closed air-tight with steel flange covers (draft prevention).



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Dismantle the shut-off valve for starting air, clean all parts and oil them with rust
protection oil. Afterwards the valve can be refitted in closed position.

Remove the end cover of the main starting air pipe and place silica gel desiccant bags inside. Afterwards refit the cover (as a precaution a marking must be applied outside to indicate that a silica gel desiccant bag has been stored inside).

## 7.11 Fuel injection system

To achieve the highest level of corrosion protection for the RT-flex and X fuel injection components it is recommended to drain the MDO from the fuel system and to remove the needed parts from the engine as described below. Afterwards the fuel rail and the intermediate accumulator including the fuel pumps need to be filled with system oil or special rust-preventing engine oil.

## 7.11.1 Fuel Injector

#### 7.11.1.1 Conventional

All fuel injection valves are to be overhauled according to the instructions given in the Maintenance Manual. It is recommended to flush the overhauled fuel injection valves on a test bench using a special calibration fluid (for corrosion protection reasons no MDO should be used). After flushing the injection valves the tension of the springs should be released.

The openings at the cylinder cover are to be sealed air-tight.

## 7.11.1.2 Directly controlled (l'Orange) including pilot-fuel Injectors

Same Instruction as for conventional Injectors under 7.11.1.1, except for releasing the tension of the spring which is needless. All open ports need to be preserved against corrosion and sealed in order to prevent ingress of foreign particles. Handle cables of the Injector with care.

#### 7.11.1.3 Pilot fuel injector + pre-chamber

Same Instruction as for conventional Injectors under 7.11.1.1, except for releasing the tension of the spring which is needless. All open ports need to be preserved against corrosion and sealed in order to prevent ingress of foreign particles. Handle cables of the Injector with care

#### 7.11.2 Rail Unit

#### 7.11.2.1 ICU

All ICUs need to be removed from the rail / engine; depending on the number of running hours it should be considered to send them to a Wärtsilä reconditioning workshop for overhaul. ICUs must not be recon. Since the shop test can have few hundreds of rhr but an ICU lives more than 30000 rhrs If the ICUs are not due they must be stored in an oil bath during the lay-up period. The openings on the fuel rail need to be sealed with blind flanges so that the fuel system can be completely filled with system oil or special rust-preventing engine oil.

1. After the engine has been shut down on MDO, make sure that the whole fuel system including low pressure circuit, intermediate fuel accumulator and fuel rail is completely drained. The rails have venting and drain valves. In any case, the rail can be emptied by pressurised air and filled in with system oil.

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- 2. Clean all ICUs as well as possible from outside and coat with protection oil against corrosion.
- 3. Remove all rail valves and fuel quantity sensors from the ICUs. Preserve the fuel quantity sensors and rail valves and store them in a dry place.
- 4. Remove all ICUs from the engine and store them in an oil bath for corrosion protection. As soon as the ICU is in the oil bath, it is recommended to move the fuel quantity piston by manually carrying out a few strokes.
- 5. Check if the fuel pumps are filled with oil. Drain them if necessary.

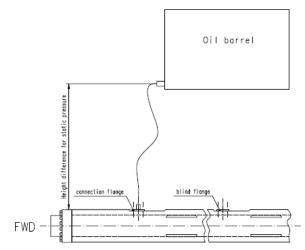
#### 7.11.2.2 Fuel Rail

- 6. Blank off all openings on the fuel rail with blind flanges, except the one on the forward side. There a flange with a connection needs to be installed to supply oil into the fuel rail.
- 7. Blank off the control oil supply to the ICU to allow operating the control oil pumps.
- 8. Fill the fuel rail including rising pipes, intermediate accumulator and fuel pumps with system oil or special rust-preventing engine oil. As soon as the fuel system is completely air-free filled with oil, a small tank (oil barrel) can be connected to compensate slight leakages during the storage. There is a connection in the rails to fill with system oil. In case of X-Engines the connection is in the valve block and in case of Flex Engines in the cover. The job can be done with service pump.



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Additional lubrication oil tank connected to the fuel rail to keep it under constant static pressure.



Flange for oil supply to fuel rail and blind flange.

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#### 7.11.2.3 FLV

Clean all FLVs as well as possible from outside. Remove all FLV from the engine and store them in an oil bath for corrosion protection. Then follow Instruction in 7.11.2.2.

#### 7.11.2.4 PCV + safety valve

Clean the mentioned components as well as possible from outside. Clean and then spray coat.

#### 7.11.2.5 Servo-oil rail

Servo-oil rail with hydraulic oil. Clean and then spry external surfaces with rust- preventing oil.

#### 7.11.2.6 VCU

Clean and then spry external surfaces with rust- preventing engine oil.

#### 7.11.2.7 Hydraulic valves

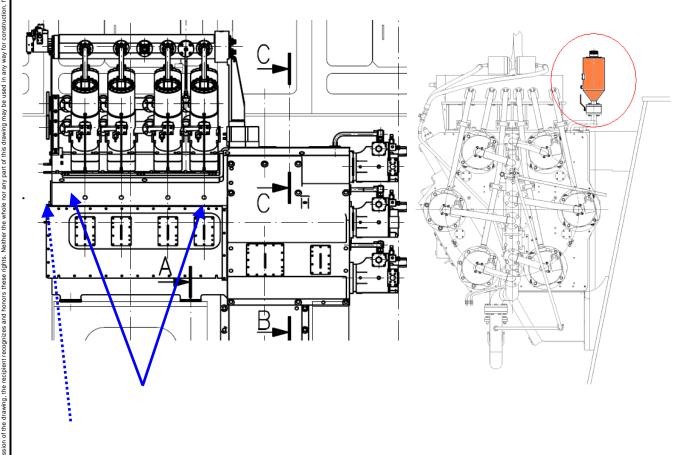
Remove all hydraulic. Preserve rail valves and store them in a dry place.

## 7.11.2.8 Cylinder lubrication components

Clean and then spray coat cylinder lubrication pumps, pipes and the outstanding parts of the lubricating quills with rust-preventing engine oil. In best case; inject minimum 10 times oil manually, so the injection holes are cleaned.

## 7.11.3 Supply Unit

Clean and then spray coat the camshaft, bearing covers rollers, roller guides, etc. with rust-preventing engine oil.



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#### 7.11.3.1 Fuel pump

See Chap. 7.11.2.2 for preservation of internal surfaces. Clean and then spray external surfaces with rust-preventing engine oil. In order fill up the high-pressure pipes and fuel pumps with oil, oil pipe, i.e. with 10 bar pressure can be connected to the check points at fuel inlet pipes can be filled up the high-pressure line till rail.

### 7.11.3.2 IFA (PCV)

See Chap. 7.11.2.2 for preservation of internal surfaces. Clean and then spray external surfaces with rust-preventing engine oil.

#### 7.11.3.3 Servo-oil pump

Clean and then spray esternal surfaces with rust-preventing engine oil

#### 7.11.3.4 Pilot-fuel supply unit

To achieve the highest level of corrosion protection for the Pilot-fuel supply components it is recommended to drain the MDO from the pilot fuel system and to remove the needed parts from the engine as described below. Afterwards the high pressure pipes including the fuel pump need to be filled with system oil or special rust-preventing engine oil.

## 7.11.4 High pressure pipes

It is recommended to flush high pressure pipes using either a special calibration fluid or rust-preventing engine oil (for corrosion protection reasons no MDO should be used). Clean and then spray external surfaces with rust-preventing engine oil. After flushing, openings at their ends are to be sealed air-tight.

## 7.12 Gas supply

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No activities required for prevention as main pipes (gas distribution pipe) are made of stainless steel.

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# 8 Corrosion protection of machined surfaces / engine parts

The application of corrosion protection has to be checked and renewed on all machined/blank surfaces, as the corrosion protection may be flushed due to the temperatures reached during engine running for shop test, or has melted away during the shop test itself or scraped away during assembly.

## 8.1 Overview of the general application range

For exposed parts (engine external), the following description of layer application might be used as "general guidance" regarding corrosion protection application. (e.g. starting air distributor, manoeuvring linkage, etc.)

Apply a first layer of "Tectyl 506" to all surfaces using an airless spray unit. Allow to dry for at least 5 hours at 10°-20°C (3 hrs at 20°-25°C; 2 hrs at >25°C).

A second coating of "Tectyl 506" must be applied to all surfaces, with the exception of the webs, using an airgun . Do not touch this coating. Allow to dry for at least 36 hours at 10°-20°C (24 hrs at >20°C).

A coating of "Tectyl 132" must be applied to all crankshaft surfaces by means of an airless spray unit. Allow to dry for at least 36 hours at 10°-20°C (24 hrs at >20°C).

## 8.2 Application of the corrosion protectors / coating

The climatic properties have been described under in 6.1 & 6.2.

To avoid the accretion of moisture on blank surfaces, the components must show room temperature during the work.

The coating must be applied straight after cleaning to the dried surfaces.

For the recommended coating materials with details of their application see pages 13 to 15. The supplementary product specifications for the coating materials must be strictly observed.

## 8.3 Checking the quality of the coating

The inspection of the dry coating is made non destructively according to the magnetic-induction method, e.g. with the measuring device "Minitest".

The adhesion of the coating is to be checked with a cross-cut test according to DIN 53 151 (Code GT 1). The damaged coating resulting from this inspection is to be ground over and applied anew. In case of non-fulfilment of the quality standard, the manufacturer's quality assurance department will decide whether further inspections are necessary and if the coating should be renewed.

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## 8.4 Coating & corrosion protection of the components – General information

The different surface protection measures are listed in the table "Coatings and corrosion protection general". The components and surfaces are shown in groups, thus allowing to be treated by the manufacturers in a corresponding manner.

## 8.5 Crankshaft corrosion protection at engine shop

#### 8.5.1 Preservation for indoor and temporary storage

- The crankshaft must be free of rust, cleaned thoroughly as instructed in para.
   7.1-7.5, and not have been touched since. If this is not fulfilled, repeat cleaning according to 7.5.
- Flush oil bores, threaded holes etc. with "Dewatering Fluid WA" or "Anticorit DFW" and allow to dry completely (min. 5 hrs at 10° to 20°C; min. 3 hrs at 20° to 25°C; 2 hrs at >25°C).
- Close the bores, threaded holes, etc. with plastic protective plugs (do not use wooden pegs). These protective plugs are not to be removed until just before the crankshaft is fitted in the engine.
- Using an airgun, dewater and neutralize all surfaces with "Dewatering Fluid WA" or
  "Anticorit DFW". Do not touch the surface. Allow the waxy protective film to dry for at least
  5 hours at 10°-20°C (3 hrs at 20°-25°C; 2 hrs at >25°C) prior to further treatment. It is
  mandatory to keep to the drying time! The protective film must be touch proof (however, not
  to be touched with bare hands!). In case of insufficient drying, the adhesion of the
  subsequent coatings is not assured.
- Apply a first layer of "Tectyl 506" to all surfaces with an airless spray unit.
   Allow to dry for at least 5 hours at 10°-20°C (3 hrs at 20°-25°C; 2 hrs at >25°C).
- A second coating of "Tectyl 506" must be applied to all surfaces, with the exception of the webs, using an airgun. Do not touch this coating. Allow to dry for at least 36 hours at 10°-20°C (24 hrs at >20°C).

Duration of protection: indoor storage max. **12** months. Insulation protection must be guaranteed. Before the storage time expires, the preservation must be removed and the crankshaft checked for signs of rust. Afterwards the preservation is to be applied again.

## 8.5.2 Preservation of crankshafts for land and sea transport

After corrosion treatment, the crankshaft is to be preserved further prior to shipment. Any dust or layers of dirt are to be removed with dry compressed air or with clean cloths.

- Apply a first layer of "Tectyl 506" to all surfaces with an airless spray unit.
   Allow to dry for at least 5 hours at 10°-20°C (3 hrs at 20°-25°C; 2 hrs at >25°C).
- A second coating of "Tectyl 506" must be applied to all surfaces, with the exception of the webs, using an airgun. Do not touch this coating. Allow to dry for at least 36 hours at 10°-20°C (24 hrs at >20°C).

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• A coating of "Tectyl 132" must be applied to all crankshaft surfaces by means of an airless spray unit. Allow to dry for at least 36 hours at 10°-20°C (24 hrs at >20°C).

Duration of protection: indoor storage max. **12** months, outdoor storage max. **6** months Insulation protection must be guaranteed.

## 8.5.3 Additional mechanical protection of the crankshaft pins for open transport

The journals and pins must be wrapped with the following materials:

- one layer of VCI paper (Volatile Corrosion Inhibitor)
- two layers of polyethylene foil

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- one layer of Ethafoam foil, 5 mm thick (must not absorb water)
- three layers of Lamiflex laminae

All layers are to be fixed with chlorine-free adhesive tape.

To avoid damage to the mechanical protection and the preservation material during lifting, the journals are to be protected as follows:

steel shells with a thickness of at least 8 mm are to be fitted.

Instructions to the effect "Do not lift here" are to be posted on all other pins and journals.

Supplier information :
 Lamiflex lamellae
 Lamiflex AB
 Gasverksvägen 4-6
 611 35 Nyköping - Sweden
 www.lamiflex.se

## 8.5.4 Additional mechanical protection of the axial surfaces of the thrust bearing flange

- one layer of VCI paper
- two layers of polyethylene foil
- one layer of Ethafoam foil, 5 mm thick
- plywood, 20 mm thick

#### 8.5.5 Mechanical protection of crankshafts for transport in boxes

The crankshaft is to rest on the webs. To avoid damage to the preservation material during lifting, the corresponding journals are to be protected with thick and reinforced rubber.

## 8.5.6 Packaging

The engine maker is responsible for proper packaging.

The crankshaft must rest on the webs, whatever the kind of transport.

The surfaces of wooden supports must be treated in advance with a **neutralising preservation product**.

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## 8.5.7 Removal of the preservation material prior to fitting and for inspection purposes

The corrosion protective products can be removed manually with acid-free cotton cloth soaked with petroleum or aromatic-free white spirit. A proven method is to wrap the bearing journals concerned in acid-free cotton cloths, which are then dowsed with a solvent, such as white spirit or Shellsol (for lack of solvents use diesel oil). After a sufficient application time (min. 1 hour), the cloths may be removed. The preservation layers can now been scraped off by means of a wooden spatula.

Attention: metallic scrapers or other means, such as steam- or hot water cleaners, must not be used!

The preservation must be checked before the expiration of the duration of protection and, if necessary, renewed.

## 8.6 Corrosion protection of cooling water circuits

(Cylinder liner – scavenge air cooler – piping for water circulation at engine)

As the cooling water will be drained off after shop test, further treatment against corrosive attack is absolutely essential, i.e. the admixture of a so-called 'soluble oil' to the cooling water in order to protect the engine cooling water system. The concentration must be maintained at levels between 0.5 and 0.8 per cent by volume. Prior to the complete shut-down of the system, the circulating cooling water through the engine cooling water system is to be maintained at a pH value between 7 and 9 and the soluble oil inhibitor level increased to 1 per cent by volume. The cylinder temperature is not to exceed 90°C and circulation is to continue for at least three hours, allowing time for the soluble oil inhibitor to coat the internal surfaces.

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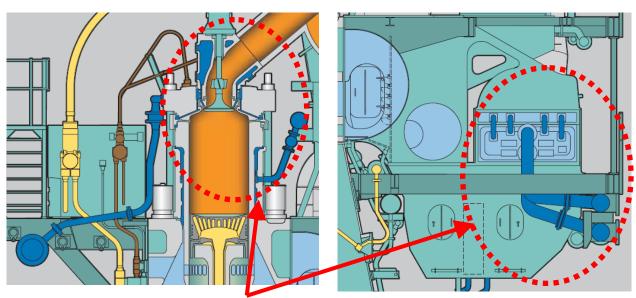
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The application of soluble oil might be just of helpful use, if the storage period is predicted as being very long (over 12 months). The reason is that the water circuits would have to be flushed at shipside after installation, before being finally connected to board circuit.

If the water circuits - especially the one for cylinder liners and cylinder cover cooling spaces with the cooling bores in the cylinder liner as well as the one in the cylinder cover - and exhaust valve cooling circuit are not flushed, the soluble oil foam, in connection with dust, will lead to clogging of the beforehand described cooling bores.

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To carry out corrosion protection of water cooling pipes and spaces properly, ...

... the application of soluble oil has to be done right after shop test with still connected water circuit.

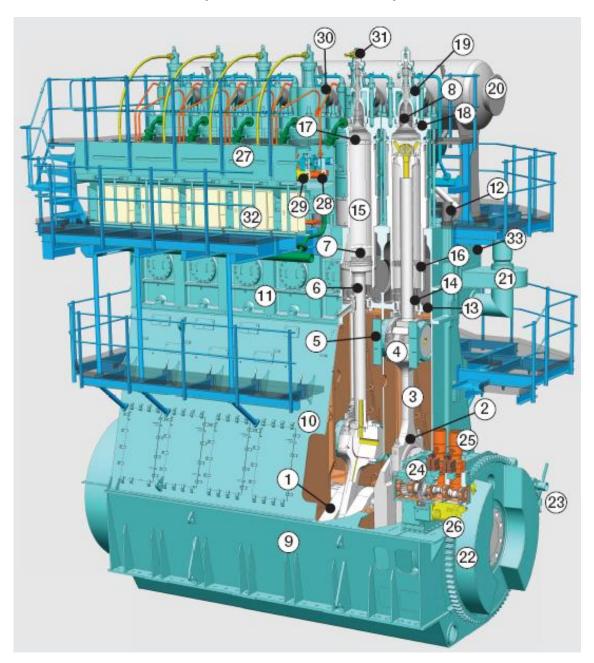
## 8.6.1 Electrical equipment

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- Place desiccant bags in all electrical boxes fitted on the engine (e.g. E25, E10, E120 etc...)
- ☐ Make sure that all cable glands are tight. Open holes should be sealed.
- ☐ If applied, place desiccant bags in Boll & Kirch automatic oil filter control box.
- Make sure that the power supply for the heating of the electric motors is assured (if applicable).

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# 8.7 Overview of the components to be corrosion protected



The next page provides a preliminary overview of corrosion protection liquids which can be used. For a proper evaluation of the correct corrosion protection application and the liquids used, refer to the components given in the chapters overview on page 35-41. (Attention: valid only for fully assembled engines in storage condition with fully operational dehumidifier.)

- Tectyl 506 & 132:
- Engine external:
- Engine internal:
- Engine internal:
- Generally all surfaces not painted with Tectyl 506 & Tectyl 132.
- Generally all machined (movable) parts with Tectyl 930.

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## Quick overview of engine parts and the corresponding corrosion protection 8.7.1 liquids - Refer (please compare) to chapter 16

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Pos	a. Part		Engine location	Protector type
1.	Crankshaft		Internal	B or F
	Crank web		Internal	B or F
	Crankpin: web journal &	& main journal		B or F
	Gear wheels		Internal	B or F
	Thrust bearing pads		Internal	B or F
2.	Bottom end bearing		Internal	B or F
3.	Connecting rod		Internal	B or F
4.	Crosshead bearing		Internal	B or F
5.	Crosshead guide shoes		Internal	B or F
6.	Piston rod		Internal	B or F
7.	Piston		Internal	B or F
8.	Exhaust valve		Internal	B or F
9.	Bedplate		Internal	B or F
10.	Column (Guide rails)		Internal	B or F
11.	Cylinder block		External	С
12.	Tie rods		External	С
13.	Diaphragm		Internal	B or F
14.	Piston rod gland		Internal	B or F
15.	Cylinder liner		Internal	B or F
16.	Scavenge ports		Internal	B or F
17.	Anti-Polishing ring		Internal	B or F
18.	Cylinder cover		External	С
	Combustion space		Internal	B or F
19.	Exhaust valve cage		Internal	B or F
20.	Exhaust manifold		External	
21.	Auxiliary scavenge air blow	er er	External	Turn elect. motor
22.	Flywheel		External	C & D
23.	Turning gear			
	Electric motor		External	
	Wheel pin		External	C & D
24.	RT-flex Supply Unit			
	all flanged units		External	С
25.	High-pressure fuel pumps		External	С
26.	Servo oil pumps		External	С
27.	Rail Unit		External	С
28.	Fuel oil rail with injection ur	nits	External	С
29.	Servo oil rail with exhaust v			
	exhaust valve control u	nits	External	С
30.	High-pressure pipes to fuel	injectors	External	С
31.	Exhaust valve drive		Internal	B or F
32.	Electronic cabinets		External	Silica Gel
33.	Scavenge air receiver			
	all relief valves		External	С
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## 8.8 Detailed overview of parts & spaces to be corrosion protected

Group 1: bedplate and tie rod

• Group 2: cylinder liner and cylinder cover

Group 3: crankshaft, connecting rod and piston
 Group 4: engine control system and control elements

Group 5: supply unit, servo oil pump, fuel oil pump and exhaust valve actuator

Group 6: scavenge air & turbocharger systemGroup 7: platforms (not mentioned in particular)

• Group 8: exhaust manifold; piping systems (see chapter 7.6)

• Group 9: engine monitoring

- Refer (please compare) to chapter 16!

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- All corrosion protectors given under "C" are to be removed from engine internal spaces parts before starting the engine.

Group	Component	Comments	Preserving actions
1	Bedplate arrangement	All exposed machined surfaces to be coated	C; 2 layers
1	Bedplate oil drain	Seal drains with a suitably sized steel flange and airtight gasket	C; 1 layer
1	Bedplate free end	Where applicable seal the crankcase vent	<b>C</b> ; 2 layers
1	Bedplate driving end	Coat all machined surfaces, in particular the thrust area; remove the thrust bearing saddle drain to prevent any potential clogging and moisture accretion, refit before engine use	C; 2 layers
1	Main bearing shell	All exposed surfaces to be coated	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
1	Main bearing cover	Coat all machined surfaces, pay attention to the stud threads where applicable	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
1	Thrust bearing arrangement	Coat all exposed machined surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
1	Thrust bearing pads	Coat all machined surfaces, prevent excessive dry turning	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
2	Engine frame assembly parts		C; 2 layers
2	Column doors	Seal all crankcase relief valves, ensure that the valves are corrosion-free	C; 1 layer
2	Casing free end	Coat all machined surfaces	C; 2 layers
2	End casing driving end	Coat all machined surfaces	C; 2 layers

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Group	Component			Cor	nments				Pres	erving action	ns	
2	Oil baffle two-parts driving end				fle, be mi ential dam				C	; 2 layers		
2	Tie rod				oores are					volineTectyl 93 (Shell Valvata 1000)		
2	Cylinder jacket grouping				trial to roustion by				С	; 2 layers		
2	Supporting ring				s drained ea of the					(external) or ater inhibitor (internal)		
2	Cylinder liner	ar	nd macl If er - Layer ismantle on unde	nined ru ngine is applica ed starti rside or	is draine nning sur fully asse tion throung air valus scaveng tom dead	face mblo gh b ve a e po	e coate ed: oore of and fro orts (pi	ed : m		volineTectyl 93 (Shell Valvata 1000)		
2	Cylinder liner holder	En	sure th	at water	is draine	d cc	mplet	ely	С	; 2 layers		
2	Water guide jacke	: En	sure tha	at water	is draine	d cc	mplet	ely		2 layers and ater inhibitor (internal)		
2	Lubricating quill with accumulator for cylinder lubrication		spection layer of penings	or remore of " <b>C</b> ", part at wate	er oil and oval, and ocked in V r supporti anged air-	stor 'CI p	e by contained by	ne		<b>C</b> ; 1 layer VCI paper		
2	Lubricating quill fo Pulse		Fill with spection layer of benings	n cylinde n or rem f " <b>C</b> ", pa at wate	er oil and oval and cked in V r supporti anged air-	top stor 'CI p	up for e by o paper. ring to	ne		<b>C</b> ; 1 layer VCl paper		
2	Gland box piston rod				achined s					ValvolineTecty r <b>F</b> (Shell Valv 1000)		
2	Compression space		If er - Layer dism	ngine is application	II machine fully asse tion throu starting ai	mbl gh b r va	ed: oore of live	:		ValvolineTecty r <b>F</b> (Shell Valv 1000)		
2	Cylinder cover	Al	I fuel in dismant sea d. cover	jection a led for s aled by externa	er spaces and startir torage. A flange air al surface internal:	ng a II op -tigh : C ;	ir valve pening nt. ; 2 laye	es s	B (Val	; 2 layers volineTectyl 93 (Shell Valvata 1000)		
2	Fuel valve complete (Fuel injectors)		l injecto aned on	rs remo test be	ved from nch with ' ection ap	cyl. <b>A</b> ";	cover packe			A; volineTectyl 93 (Shell Valvata 1000)		
2	Starting air valve		e, pack	ed in V	d apply p Cl paper; cover air-t	flan	ge bor			ValvolineTecty r <b>F</b> (Shell Valv 1000)		
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Group	Component	Comments	Preserving actions
2	Relief valve	Remove, clean, and apply protector, then store, packed in VCI paper; flange bore in cylinder cover air-tight	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
2	Indicator valve	Remove and store, close the bore in cyl. cover air-tight by flange.  Apply "B" or "F" and store packed in VCI paper.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
2	Exhaust valve complete	Remove the valve and ensure that cooling spaces are completely drained.  Seal off all openings (exhaust chamber to funnel) air-tight.  Apply protection to valve seat.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
2	Valve spindle for exhaust valve	Nymonic valve spindles should not corrode; ensure no damage occurs during transportation.  Apply protection.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
3	Complete crankshaft assembly	Coat all exposed machined surfaces. Grease the flywheel teeth.	See chapter <b>8.5.1</b>
3	Vibration damper crankshaft	Viscous fluid dampers are sealed and no access is possible. Spring type dampers can be flushed with system oil; carry out when inspecting the engine at regular intervals.	<b>C</b> ; 2 layers
3	Axial detuner	Flush when inspecting periodically	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Turning gear	Ensure that the gearbox is filled and all components are coated	<b>C</b> ; 2 layers Grease gear pinion
3	Connecting rod assembly	All machined and uncoated surfaces to be coated as well as the central oil bore	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
3	Bearing shell crankpin	Coat all exposed surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Upper bearing half of connecting rod top end bearing	Coat all exposed surfaces	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
3	Bearing shell for top end bearing	Coat all exposed surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Screwed connection piston rod - crosshead	Ensure that the threads are coated, see notes on screw threads	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
3	Crosshead and guide shoe	Coat all machined and other uncoated surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)

Group	Component	Comments	Preserving actions
2	Relief valve	Remove, clean, and apply protector, then store, packed in VCI paper; flange bore in cylinder cover air-tight	
2	Indicator valve	Remove and store, close the bore in cyl. cover air-tight by flange.  Apply "B" or "F" and store packed in VCI paper.	or <b>E</b> (Shell Valvata
2	Exhaust valve complete	Remove the valve and ensure that cooling spaces are completely drained.  Seal off all openings (exhaust chamber to funnel) air-tight.  Apply protection to valve seat.	<b>B</b> (ValvolineTectyl 930)
2	Valve spindle for exhaust valve	Nymonic valve spindles should not corrode; ensure no damage occurs during transportation.  Apply protection.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Complete crankshaft assembly	Coat all exposed machined surfaces. Grease the flywheel teeth.	See chapter <b>8.5.1</b>
3	Vibration damper crankshaft	Viscous fluid dampers are sealed and no access is possible. Spring type dampers can be flushed with system oil; carry out when inspecting the engine at regular intervals.	
3	Axial detuner	Flush when inspecting periodically	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Turning gear	Ensure that the gearbox is filled and all components are coated	<b>C</b> ; 2 layers Grease gear pinion
3	Connecting rod assembly	All machined and uncoated surfaces to be coated as well as the central oil bore	R (ValvolineTectyl 930)
3	Bearing shell crankpin	Coat all exposed surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Upper bearing half of connecting rod top end bearing	Coat all exposed surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Bearing shell for top end bearing	Coat all exposed surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
3	Screwed connection piston rod - crosshead	Ensure that the threads are coated, see notes on screw threads	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
3	Crosshead and guide shoe	Coat all machined and other uncoated surfaces	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
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3	Piston assembly parts	Internal parts to be coated; system oil is used but may not adhere as specific products would	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
Group	Component	Comments	Preserving actions
3	Piston cooling and crosshead lubrication	All pipes to be coated. Operate pump with 3-4bar pressure force and connect to flange at column-exhaust entering.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
4	Pneumatic manoeuvring units	Remove all control valves and store them separately; apply protector and then pack in VCI paper	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
4	Camshaft drive	See specific instructions on the following list	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
4	Drive supply unit	See specific instructions on the following list	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
4	Gear wheel on crankshaft	Coat all teeth and other machined surfaces; coat all uncoated surfaces. Fill bearings when rotating. This item is sensitive to corrosion.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
4	Intermediate wheel for camshaft drive	Coat all teeth and other machined surfaces; coat all uncoated surfaces. Fill bearings when rotating. This item is sensitive to corrosion.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
4	Gear wheel on camshaft	Coat all teeth and other machined surfaces; coat all uncoated surfaces. Fill bearings when rotating. This item is sensitive to corrosion.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
4	Intermediate wheel supply unit	Coat all teeth and other machined surfaces; coat all uncoated surfaces. Fill bearings when rotating. This item is sensitive to corrosion.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
4	Camshaft/reversing servomotor	Coat all uncoated surfaces, internal components to be filled with system oil; this will not be as effective as a dedicated preserving oil	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
4	Fuel cam	Coat all surfaces, this item is sensitive to corrosion.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
4	Actuator cam	Coat all surfaces, this item is sensitive to corrosion.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
4	Vibration damper camshaft	Only viscous fluid dampers are used, no internal access; coat all external surfaces	C; 2 layers
4	Damper casing camshaft	Remove for damper access, coat all surfaces	
4	Bearing housing(s)	Apply protector " <b>C</b> " to all external machined surfaces. All internal parts & surfaces: apply " <b>B</b> "/"F"	C ; 2 layers B (ValvolineTectyl 930) or F (Shell Valvata 1000)
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T-777.252   20.10.2009   A EAAD088998   30.01.2018	4	Bearing housing ancillary parts	m	achin	r " <b>C</b> " to all external ed surfaces surfaces: apply " <b>B</b> "/"F"	<b>B</b> (V 930) or	; 2 layers alvolineTectyl F (Shell Valvata 000)				
4 Starting air distributor   External surface: "C": 2 layers   1000)   C: 3 layers   1000)   C: 4 layers   1000)   C: 4 layers   1000)   C: 5 layers   100	Group	Component		Con	nments	Prese	rving actions				
A   Starting air distributor   Internal pitor valves to be coated, sensitive to corrosion   Remove pneumatic valves and blank all ports/holes air-tight. Apply "B" /"F". Store separately, packed in VCI.   Shut-off valve starting air distributor   Shut-off valve starting air   Coat all internal parts, removal is required for access. Apply silica gel, but mark outside.   Internal parts coated with system oil, not effective in the long term. To be packed in VCI paper and then stored.   Apply "B" /"F" beforehand. Blank openings air-tight.   Internal parts coated with system oil, not effective in the long term. To be packed in VCI paper and then stored.   Apply "B" /"F" beforehand. Blank openings air-tight.   Internal parts coated with system oil, not effective in the long term. To be packed in VCI paper and then stored.   Apply "B" /"F" pack in VCI paper and then stored.   Apply "B" /"F" pack in VCI paper and then stored.   Apply "B" /"F" pack in VCI paper and store separately.   B (ValvolineTectyl 930) or F (Shell Valvata 1000)   B (ValvolineTectyl 930) or F (Shell Valvata 1000)   Shell Valvata 1000)   B (ValvolineTectyl 930) or F (Shell Valvata	4		Coat all ge	ars, s	ensitive to corrosion	or <b>F</b> (	Shell Valvata				
4 starting air distributor separately, packed in VCI.  4 Shut-off valve starting air or coess. Apply silica gel, but mark outside.  4 Reversing valve Internal parts coated with system oil, not effective in the long term. To be packed in VCI paper and then stored. Apply "B" /" F" beforehand. Blank openings air-tight.  4 Rotation direction safeguard VCI paper and then stored. Apply "B" /" F" beforehand. Blank openings air-tight.  5 Disconnect supply and seal pipes. Control air supply "B" /" Pbeforehand. Blank openings air-tight.  6 Control air supply "B" /" Pbeforehand. Blank openings air-tight.  7 Disconnect supply and seal pipes. Control air susually contains humidity, ensure that all pipes are dry after shop trial. All control valves to be removed. Apply "B" /" F", pack in VCI paper and store. Blank all openings.  8 PolavolineTectyl 930) or F (Shell Valvata 1000)  9 PolavolineTectyl 930 or F (Shell Valvata 1000)  1 Valve unit reversing interlock paper and store. Blank all ports/holes. Apply "B" /" F", pack in VCI paper and store. Blank all ports/holes. Apply "B" /" F", pack in VCI paper. Blank all ports/holes. Apply "B" /" F", pack in VCI paper. Blank all ports/holes. Apply "B" /" F" pack in VCI paper. Blank all ports/holes. Apply "B" /" F" pack in VCI paper. Blank all ports/holes. Apply "B" /" F" pack in VCI paper. Blank all ports/holes. Apply "B" /" F" and pack in VCI paper. Blank all ports/holes. Apply "B" /" F" or pack in VCI paper. Blank all ports/holes. Apply "B" /" F" f" and pack in VCI paper. Blank all ports/holes. Apply "B" /" F" f" pack in VCI paper. Blank all ports/holes. Apply "B" /" F" f" pack in VCI paper. Blank all ports/holes. Apply "B" /" F" f" f" pack in VCI paper. Blank all ports/holes. Apply "B" /" F"	4		Intern	ıal sur ⁄alves	faces: "B" / "F" to be coated, sensitive	<b>B</b> (V 930) or	alvolineTectyl <b>F</b> (Shell Valvata				
A   Situt-Oil Valve starting air   for access. Apply silica gel, but mark outside.	4	starting air	ports/holes a separ	ir-tigh ately,	t. Apply " <b>B</b> " <b>/</b> " <b>F</b> ". Store packed in VCI.	930) or 10	F (Shell Valvata 000)				
## Reversing valve   effective in the long term. To be packed in VCI paper and then stored. Apply "B" /" F" beforehand. Blank openings air-tight.  ## Rotation direction safeguard   Internal parts coated with system oil, not effective in the long term. To be packed in VCI paper and then stored. Apply "B" /" F" beforehand. Blank openings air-tight.  ## Rotation direction safeguard   Disconnect supply and seal pipes. Control air usually contains humidity, ensure that all pipes are dry after shop trial. All control valves to be removed. Apply "B" /" F", pack in VCI paper and store. Blank all ports/holes. Apply "B" /" F", pack in VCI paper and store. Blank all ports/holes. Apply "B" /" F", pack in VCI paper and store separately.  ## Valve unit reversing interlock   Remove pneumatic valves and blank all ports/holes. Apply "B" /" F", pack in VCI paper. Blank all ports/honecting points.   ## Valve group B by gearing for auxiliary drive   Remove all valves and store them. Apply gearing for auxiliary drive   Pick-up engine stand   Pick-up engine speed/TDC   Sensitive to corrosion, seal or remove; if removed, pack in VCI paper and seal the cable ends   Pick-up engine speed/TDC   Sensitive to corrosion, seal or remove; if removed, pack in VCI paper and seal the cable ends   Pick-up engine speed/TDC   Remove all valves and store them, packed in VCI paper and seal the cable ends   Pick-up engine speed/TDC   Remove all valves and store them; blank all ports/connecting points   Pick-up engine speed/TDC   Remove all valves and store them; blank all ports/connecting points   Pick-up engine speed/TDC   Remove all valves and store them; blank all ports/connecting points   Pick-up engine speed/TDC   Remove all valves and store them; blank all ports/connecting points   Pick-up engine speed/TDC   Pick-up engine speed/TDC	4		for access.	Appl ou	y silica gel, but mark utside.	or <b>F</b> (	Shell Valvata				
Rotation direction safeguard   Internal parts coated with system oil, not effective in the long term. To be packed in VCI paper and then stored. Apply "B" /"F" beforehand. Blank openings air-tight.	4	Reversing valve	effective in the VCI pa Apply " <b>B</b> "	e long aper a ' <b>/</b> " <b>F</b> "	g term. To be packed in and then stored. beforehand. Blank	or <b>F</b> (Shell Valvata					
4 Control air supply  air usually contains humidity, ensure that all pipes are dry after shop trial. All control valves to be removed. Apply "B" / F", pack in VCI paper and store. Blank all openings.  4 Valve unit reversing interlock Paper and store use and blank all openings.  8 (ValvolineTectyl poor F (Shell Valvata 1000)  4 Valve group B by gearing for auxiliary drive  Control box local manoeuvring. Stand Pick-up engine stand  Pick-up engine speed/TDC  4 Control elements unit all ports/connecting points.  Control elements unit all ports/connecting points.  Control elements unit all ports/connecting points.  Remove all valves and store them, packed in VCI paper. Blank all ports/connecting points. Apply "B" / "F".  Control elements unit all ports/connecting points.  Control elements unit all ports/connections.  Control elements unit all ports/connecting points.  Control elements unit all	4		Internal parts effective in th VCI pa Apply " <b>B</b> " o	s coat e long aper a ' / "F" pening	ed with system oil, not great term. To be packed in and then stored. beforehand. Blank gs air-tight.	930) or	F (Shell Valvata				
4	4	Control air supply	air usually co all pipes are o valves to be	ntains dry aft e reme pape	s humidity, ensure that er shop trial. All control oved. Apply "B" / "F", er and store. Blank all	930) or	F (Shell Valvata				
4 gearing for auxiliary drive "B" / "F" and pack in VCI paper. Blank all ports/connecting points.  Control box local manoeuvring. stand points. Apply "B" / "F".  Pick-up engine speed/TDC Sensitive to corrosion, seal or remove; if removed, pack in VCI paper and seal the cable ends  Control elements unit all ports/connecting points.  Remove all valves and store them, packed in VCI paper. Blank all ports/connecting points. Apply "B" / "F".  Control elements unit all ports/connecting points all ports/connecting points all ports/connecting points.  Remove all valves and store them; blank all ports/connecting points all ports/connecting points all ports/connections. Store separately.  Control elements unit all ports/connections. Store separately.  Remove and seal pipe/ports/connections. Store separately.  Control elements unit all ports/connections. Store separately.  Remove and seal pipe/ports/connections. Store separately.  Control elements unit all ports/connections. Store separately.  Control elements unit al	4		ports/holes.	Apply	" <b>B</b> " <b>/</b> " <b>F</b> ", pack in VCI	930) or	F (Shell Valvata				
4 manoeuvring. stand in VCI paper. Blank all ports/connecting points. Apply "B" / "F".  4 Pick-up engine speed/TDC  5 Sensitive to corrosion, seal or remove; if removed, pack in VCI paper and seal the cable ends  4 Control elements unit  4 Pick-up engine speed/TDC  Remove all valves and store them; blank all ports/connecting points  Remove all valves and store them; blank all ports/connecting points  B (ValvolineTectyl 930) or F (Shell Valvata 1000)  B (ValvolineTectyl 930) or F (Shell Valvata 1000)  B (ValvolineTectyl 930) or F (Shell Valvata 1000)  Substitute for:  PC Q-Code X X X X X X X X X X X X X X X X X X X	4	gearing for	" <b>B</b> " <b>/</b> " <b>F</b> " and	pack	in VCI paper. Blank all	930) or	F (Shell Valvata				
4 Control elements unit Remove all valves and store them; blank all ports/connecting points B (ValvolineTectyl 930) or F (Shell Valvata 1000)  4 Fuel interlock override device Remove and seal pipe/ports/connections. Store separately.  Substitute for:    PC   Q-Code   X   X   X   X   X   X   X   X   X	4	manoeuvring.	in VCI paper	nk all ports/connecting	or <b>F</b> (Shell Valvata						
4 Control elements unit all ports/connecting points or F (Shell Valvata 1000)  4 Fuel interlock override device Remove and seal pipe/ports/connections. Store separately.  B (ValvolineTectyl 930) or F (Shell Valvata 1000)  Substitute for:  PC Q-Code X X X X X X X X X X X X X X X X X X X	4	. •	removed, pack in V		/CI paper and seal the	or <b>F</b> (	Shell Valvata 00)				
4 Fuel Interlock override device Store separately.  Substitute for:    PC   Q-Code   X   X   X   X   X   X   X   X   X	4				The state of the s	or <b>F</b> (Shell Valvata 1000)					
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4	Local manoeuvring stand	All surfaces to be coated	C; 2 layers			
4	Reversing interlock	Remove and seal pipe/ports/connections. Store separately.				
Group	Component	Comments	Preserving actions			
4	Rod for local manoeuvring stand and pneumatic logic unit	Coat and seal to exclude moisture. All surfaces must be adequately protected.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
4	Speed indication	Remove and store in VCI paper				
4	Speed indication drive	Ensure that all surfaces are coated	B (ValvolineTectyl 930) or F (Shell Valvata 1000)			
4	Rotation counter	Remove and store separately in VCI paper. Blank off bore air-tight.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Governor and booster arrangement	For mechanical and electrical governors remove and store as per makers' instructions				
5	Safety cut-out device	Critical component sensitive to corrosion, ensure that no moisture remains	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Fuel pump block	Flush with calibrating fluid and seal; top up when inspecting	External surface <b>C</b> ; 2 layers			
5	Eccentric shaft injection pump	Sensitive to corrosion, to be lubricated with system oil, but ineffective in the length of time	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Plunger with bush	Seal lower area to prevent air entry. Ensure that fuel pump is cut out. No touching of roller and cam.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Valves injection pump	See above actions for fuel pump	B (ValvolineTectyl 930) or F (Shell Valvata 1000)			
5	Roller guide fuel pump	Assembly to be coated with system oil, not effective in the length of time	B (ValvolineTectyl 930) or F (Shell Valvata 1000)			
5	Gear wheel supply unit		<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Pump servo oil	Remove and store separately; seal all ports/pipes and access points	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Supply unit	All internal parts to be coated with system oil, not effective in the length of time.  Coat all external surfaces.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)			
5	Fuel pump	All internal parts to be coated with system oil. Coat all external surfaces.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)			
5	Fuel pump plunger	Seal lower area to prevent air entry. Ensure that fuel pump is cut out. No	B (ValvolineTectyl 930) or F (Shell Valvata			
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		touching of roller and cam.	1000)
5	Rail unit	Coat all surfaces. Cabling and sensors are sensitive to corrosion.	B (ValvolineTectyl 930) or F (Shell Valvata 1000)
5	Fuel rail	Coat all surfaces. Cabling and sensors are sensitive to corrosion (as for rail unit).	C; 2 layers
Group	Component	Comments	Preserving actions
5	Injection control unit	See Instructions 107.378.493. To be dismantled and stored in wooden box.	
5	Actuator (RTA only)	Internal parts to be coated with system oil; coat all external surfaces.	C; 2 layers
5	Roller guide actuator pump	To be cut off. No contact of roller & cam. Assembly to be coated with system oil, not effective over longer periods.	<b>B</b> (ValvolineTectyl 930) or <b>F</b> (Shell Valvata 1000)
5	Servo oil rail	Coat all surfaces. Cabling and sensors are sensitive to corrosion.	C; 2 layers
5	Exhaust Valve Drive / Partition Device / Assembly	Coat all parts and inspect regularly. Or: to be dismantled and stored in wooden box.	<b>C</b> ; 2 layers
5	Regulating linkage arrangement	Coat all parts and inspect regularly	C; 2 layers
5	Regulating linkage air cylinder	Sensitive to internal corrosion	C; 2 layers
5	Positioning unit VIT/FQS	Coat all surfaces. Cabling and sensors are sensitive to corrosion (as for rail unit).	C; 2 layers
6	Scavenge air receiver	The internal and external surfaces should be coated; this is a large area which should be kept dry, use a dehumidifier	is painted
6	Underslung separator	Ensure that water is drained completely	
6	Turbocharger	Store as per manufacturers' instructions.	
6	Auxiliary blower	The motor and bearings are sensitive to corrosion. Electric motors should be covered and heated where possible.  Check winding resistance when inspecting.	
6	Auxiliary blower switch box	Keep sealed and internal spaces warm, use silica gel	
6	Scavenge air cooler	Ensure that the water side is completely drained. This component is less sensitive to corrosion, but care should be taken when transporting.	Inhibitor has been used.
6	Water separator scavenge air	Ensure that the water side is completely drained	

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	5	Rail unit	Coat	all surfaces. ( sensitive			nsors	are			hell	Tectyl 9 Valva		
	5	Fuel rail		all surfaces. ( nsitive to corro					<b>C</b> ;	; 2	laye	ers		
G	roup	Component		Cor	nmen	ts			Prese	erv	/ing	actio	ons	
	5	Injection control unit	Tol	See Instructi be dismantled				en						
	5	Actuator (RTA only)	Inter	nal parts to be coat all ex				oil;	<b>C</b> ;	2	laye	ers		
	5	Roller guide actuator pump		ne cut off. No ombly to be coa	ated wit	th syste	m oil,		930) or		(Sh	neTectiell Val		
	5	Servo oil rail	Coat	all surfaces. ( sensitive			nsors	are	<b>C</b> ;	2	laye	ers		
	5	Exhaust Valve Drive / Partition Device / Assembly		oat all parts a be dismantle					<b>C</b> ;	2 I	laye	rs		
	5	Regulating linkage arrangement	C	Coat all parts a	nd insp	ect reg	ularly		<b>C</b> ;	2 I	laye	rs		
	5	Regulating linkage air cylinder		Sensitive to	interna	corros	ion		<b>C</b> ;	2 I	laye	rs		
	5	Positioning unit VIT/FQS		all surfaces. (					<b>C</b> ;	2 I	laye	rs		
	6	Scavenge air receiver	The be	internal and e coated; this i ould be kept d	xternal s a larg	surface ge area	es sho which	ould 1	į	is ţ	oain	ted		
	6	Underslung separator	Ens	sure that water	is drai	ned co	mplete	ely		_				
	6	Turbocharger		e as per manı								-		
	6	Auxiliary blower	cc	motor and be prrosion. Elect overed and he Check windin ins	ric mot ated wh	ors sho nere po ance w	uld be ssible	)				-		
	6	Auxiliary blower switch box	Kee	p sealed and		l space	s war	m,		-				
	6	Scavenge air cooler	drair	ure that the wned. This comportsion, but when t	ater sic ponent care sh	le is co is less nould b	sensit	ive	Inhil		or h	as bee	n	
	6	Water separator scavenge air	Ens	ure that the w di	ater sic	le is co	mplet	ely						
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6	Scavenge air waste gate	The internal components should be free of corrosive combustion residue. Coat all parts.	<b>C</b> ; 2 layers	
8	Exhaust gas manifold	Clean and seal		
8	Automatic oil filter	See manufacturer's Operation Manual. Drain the system and place silica gel bags to each candle tube.		

#### 8.9 Corrosion protection of piping

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See chapter 7.6 and 107.296.755 (specification for cleaning).

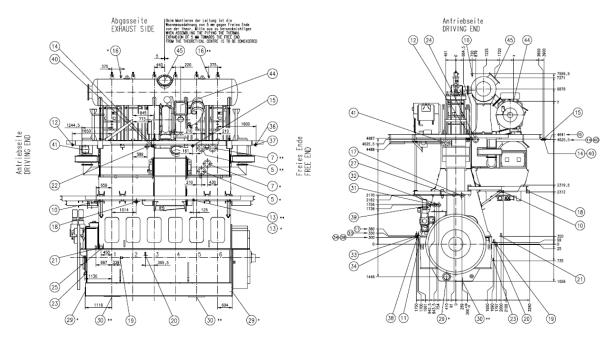
### 8.10 Overview of flange connections to be sealed air-tight

To provide an overview of the flange connection options, some sketches of the Pipe Connection Plan are given below for your reference. The drawings of each corresponding engine type are available at the Licensees.

The flange geometry can be used to produce proper steel flanges for air-tight sealing after the application of final corrosion preservation.

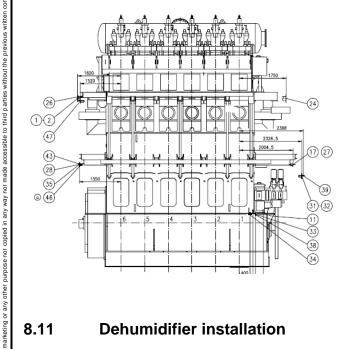
For checking the positions, see the parts list.

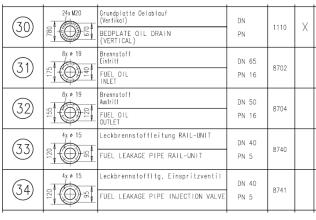
This Pipe Connection Plan differs with every engine type; therefore check carefully and also consider the gas relevant piping in case of DF systems;



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#### 8.11 **Dehumidifier installation**

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Install a real-humidity monitoring system to crankcase and piston underside to record real humidity and temperature during the lay-up period.

The dehumidifier needs to be connected with flexible hoses to the engine as described below. A real humidity of 40% - 50% inside the engine needs to be reached to keep the risk of corrosion low. The execution of the connection may vary depending on the dehumidifier system used and engine type. It is recommended to use a booster fan within the dehumidifier circuit to obtain a constant slight overpressure inside the engine.

- 1. Connect the dehumidifier to the piston underside, inlet on the AFT side and outlet on the FWD side of the engine (opposite direction is also possible).
- 2. Connect the dehumidifier to the crankcase, inlet on the AFT side and outlet on the FWD side of the engine (opposite direction is also possible). The flexible hoses can either be connected to the crankcase door openings with a dummy plate, or two relief valves can be removed for the connection.
- 3. Record humidity values daily of each engine space given on the "Inspection List for Dehumidifier" - see chapter 17.2.

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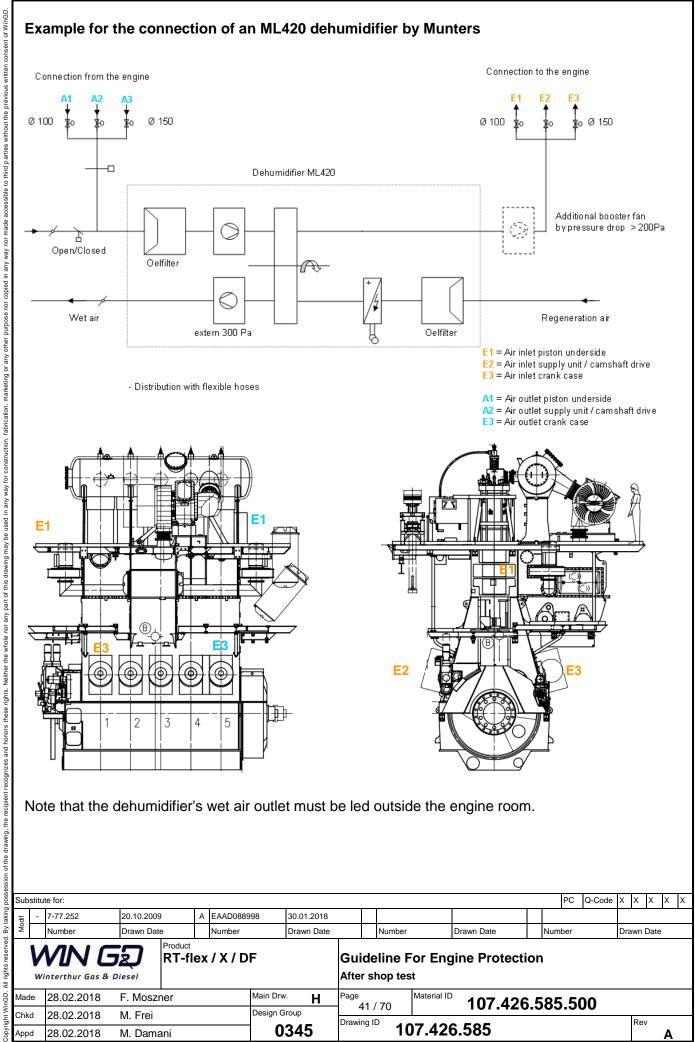


Sample picture of the installation of a Munters M120 dehumidifier



Dehumidifier outlet air taken from the crankcase

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### 8.12 Turbocharger

Generally the turbocharger manufacturer operation manual has to be consulted to carry out any kind of work. It has to be assumed that all cast- or flange-contact surfaces have been corrosion protected properly with Tectyl 506 as first layer and Tectyl 132 as second layer.

- It is of outmost importance that the turbochargers be sealed against moisture penetration, and also the sealing of the exhaust silencer by proper application of so-called VCI (Volatile Corrosion Inhibitor) foil has to be assured.
- It is strongly recommended that reliable re-commissioning of the turbocharger needs to be carried out by an authorised service branch the manufacturers. This is mostly by reason of detecting the proper condition (e.g. VTR 4: concentricity of rotor, condition of bearing space and bearing, as also the proper measuring of the clearances thereof), if necessary carrying out further action and finally, assuring readiness for operation.



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## Final Delivery Inspection (at engine maker)

Sample of a cover sheet of the Final Delivery Inspection

The cover sheet is accompanied by the checking list given in chapter 17.4.

#### 9.1 Final Delivery Inspection (at engine maker)

Detailed information as follows:

#### **Engine Type:**

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#### Corrosion-protective products applied

#### Conditions for storage

Indoors in dry conditions, protected against dirt and damage.

#### **Duration of protection**

After a period of X months, calculated from the date of shipment, the corrosion protection material is to be removed and the engine/engine parts inspected for signs of rust. After this, the preservation is to be renewed in accordance with the enclosed specification no. 107.426.585.

#### Inspection and removal of the preservation material

#### Final delivery inspection at engine maker

Inspection carried out on (Date YYYY-MM-DD:) - -:

 Engine / engine parts are checked according to the detailed parts list as attached. See inspection parts list in chapter 17.4.

The complete preservation is to be inspected for damage.

#### Removal of the preservation material prior to fitting and for inspection purposes after the period of protection has expired

The corrosion-protective products can be removed manually with acid-free cotton cloth soaked with petroleum or aromatic-free white spirit. Mechanical means, steam or hot water cleaners are not to be used.

The following products are recommended: white spirit, Shellsol If necessary, the preservation must be renewed.

#### **Engine manufacturer's information**

Date of preservation:

Date of shipment:

Name of manufacturer:

Stamp of quality department and name of inspector:

Documentation:

Hand over the Guideline for Engine Protection 107.426.585

together with the signed Final Delivery Inspection sheet (chapter 9)

to shipyard inspector

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# 10 Protection condition during transport to shipyard

As the engine and/or its parts have been checked at engine maker, see 9.0, and therefore the engine and/or its parts and the packaging are assumed to be in proper condition, the engine with connected dehumidifiers has to be checked on a daily basis for proper operation. As transportation can take even several weeks and/or the discharge at arrival port may be postponed due to unexpected occurrences, the further inspection procedure has to be guaranteed.

## 11 Inspection upon arrival (at shipyard)

The inspection is to be carried out within **two weeks** after the engine/engine parts have arrived to the final destination. Any shortcomings because of an improper preservation are to be reported in writing to WinGD Switzerland Ltd within this time limit. **After this time limit, no claims about corrosion damage of the engine and the engine parts respectively shall be taken into account.** See also chapter 9.

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Sample of a cover sheet of the Final Delivery Inspection.

The cover sheet is accompanied by the checking list given in chapter 17.4.

To be provided by the shipyard

## **Engine Type:**

way nor

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#### 11.1 Sample sheet: Inspection of engine upon arrival at the destination

Inspection carried out on (Date YYYY-MM-DD:)\_\_\_-\_:

• Engine / engine parts are checked according to the detailed parts list as attached.

See inspection parts list in chapter 17.4.

The complete preservation is to be inspected for damage.

Copy of the Final Delivery Inspection with the filled-out recording sheets is available. Yes / No

# Removal of the preservation material prior to fitting and for inspection purposes after the period of protection has expired

The corrosion-protective products can be removed manually with acid-free cotton cloth soaked with petroleum or aromatic-free white spirit. Mechanical means, steam or hot water cleaners are not to be used.

The following products are recommended: white spirit, Shellsol

If necessary, the preservation must be renewed.

#### **Manufacturer's information**

Date of preservation:

Date of shipment:

Name of manufacturer:

Stamp of quality department and name of inspector:

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# 12 Storage conditions at shipyard

The stored engine and/or engine parts will be checked.

#### 12.1 Installation and/or maintaining of dehumidifier operation

The dehumidifier should have been installed already since final corrosion protector application has been carried out, if the climatic conditions (humidity) required this.

If not done so, install according to chapter 8.11. Check the dehumidifier and record the humidity values daily.

#### 12.2 Installation of turning gear power supply

The main power source required for generally all turning gear types is AC 440V – 60Hz. Please check beforehand on type plate of turning gear or verify with engine maker.

If the engine has been delivered fully assembled or part-wise (bedplate with crankshaft installed), it is necessary to turn the crankshaft once a week by minimum of 3-4 turns. If so, check if the

- main bearings,
- connecting rod bottom end bearing,
- crosshead bearing,
- guide rails; the 4 guide shoes respectively of each cylinder,
- cylinder liners,
- pistons (either through the starting air valve bores at the cylinder covers, or through the scavenge ports),
- gear wheel drive,
- RT-flex engines: camshaft bearings

have been greased with Tectyl 930 or Valvata 1000.

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# 13 Regular Re-inspection & re-coating of machined surfaces / engine parts at yard condition

#### 13.1 Once a week

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#### (if possible at yard stage!)

Operate the main engine system oil pump for 20 minutes while turning the engine. During this
time the cylinder lubrication should be operated manually. The engine should be stopped each
time in another position. Note that the dehumidifying system needs to be turned off prior to
starting the lube oil pumps. Two hours after stopping the lube oil pumps the dehumidifier may be
turned on again.

**Important!** The number of pulses / turns required to keep the cylinder liner surface properly lubricated must be verified by visual inspections of the liner surface and piston ring package from the piston underside space.

CLU-4 type lubricating system/flex-lub-lubrication system (if possible at yard stage!) Operate the manual/emergency cylinder lubrication for 10 – 15 minutes. During this time, keep the engine turning with the turning gear.

# Retrofit Pulse and Pulse Lubricating System (RPLS & PLS) (if possible at yard stage!)

Start the main lube oil pump and rotate the engine with the turning gear. Start the oil supply pump and set the delivery pressure to 12-14 bar by means of the oil supply unit's pressure regulating valve. Actuate manual cylinder lubrication. At such low pressure (normally 50 bar), the cylinder oil will not be injected but will flow along the liner wall. Give each cylinder approx. 100 pulses. During this time, keep the engine turning with the turning gear.

#### Pulse Feed Lubricating System (if possible at yard stage!)

Start the main lube oil pump and rotate the engine with the turning gear. Start the control oil pump, or the Servo Oil Service pump on engines without control oil pumps, in order to provide hydraulic pressure for driving the dosage pumps. The lubricating system servo oil pressure has to be adjusted to 12 to 14 bar by means of the pressure regulating valves which are, depending on the execution, either located inside or just outside the rail unit. Start manual lubrication to individual cylinders. At such low pressure (normally 50 bar), the cylinder oil will not be injected but will flow along the liner wall. Give each cylinder approx. 100 pulses. During this time keep the engine turning with the turning gear.

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#### Pulse Jet Lubrication System (if possible at yard stage!)

Start the main lube oil pump and rotate the engine with the turning gear. Start the control oil pump, or the so-called service pump on engines without control oil pumps, in order to provide hydraulic pressure for driving the dosage pumps. The servo oil pressure needs not be reduced. Start manual lubrication to individual cylinders. Give each cylinder approx. 100 pulses.

- In case the cooling water system has not been drained, the cooling water pumps need to be operated for around 20 minutes to get some circulation in the cooling system.
- Check the level of the corrosion-protective oil which has been filled into the fuel system (if required refill).
- The fuel linkage needs to be moved by hand; re-lubricate it if required.
- Check the recorded relative humidity and temperature inside the engine on the data logger.
- Open the drain cock of the turbocharger gas outlet casing for one minute (water check).
- Re-spray rust-preventive coating on piston rods if required.

**Please note:** Always use pumps alternately, a long standstill could lead to detriments (if there is no power supply to some pumps, they should be turned by hand on a weekly basis):

LO pumps

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- X head pumps
- o booster pumps
- water pumps

#### 13.2 Every two weeks

- Open the crankcase (on one side) and piston underside doors and check for condensation and rust traces, particularly on:
  - thrust bearings
  - gear wheels
  - quide rails
  - camshaft
  - cams and rollers
  - pistons
  - piston rods
  - cylinder liners
  - fuel rail- & servo oil rail units

If necessary re-spray coating on blank parts in the crankcase that are not covered with system oil when the engine is turned over.

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- Open and close the main starting shut-off valve from time to time. Make sure that the supply from the starting air bottles is depressurised.
- Check the dehumidifying system and clean/replace the filter(s).
- Inspect the exhaust manifold for any moisture deposits or corrosion.
- Turn the rotor of the turbocharger(s) at an angle of 90° to avoid bending of the shaft.
- Turn the auxiliary scavenge air blower(s) by hand a few revolutions to avoid detriments.

### 13.3 Every month

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- Lift a crosshead pin and check for signs of corrosion. Spray-coat again all mentioned parts with rust-preventing engine oil. For re-assembling use steam engine cylinder oil.
- Remove a main bearing cover and check the journal pin for signs of corrosion. Spray-coat again all mentioned parts with rust-preventing engine oil. For re-assembling use steam engine cylinder oil.
- Replace the silica gel desiccant bags inside the control boxes.
- Replace the silica gel desiccant bags inside the main starting air pipe.
- Replace the silica gel desiccant in the automatic filter candles.
- If the fuel injectors, the starting air valves, the indicator cocks, the injection control units

(ICU) have not been removed after shop test for single part storage, they must be removed and checked

- Check by analysis the following liquid media (if possible at yard stage!):
  - cooling water
  - system oil
  - MDO in the fuel system of the engine

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# 13.4 Overview parts inspection time-frame

			Period	of Inspection	on		
Main inspection parts	Daily	Every week	Every two week	Monthly	Every 3 month	Every 4 - 6 month	Remark
De-Humidifier	•						
Bedplate				•	(3)	(4)	
Column				•	(3)	(4)	
Guide Rails Column		•			(3)	(4)	
Crankshaft		•			(3)	(4)	
Main Bearings				(5)	(3)	(4)	
Connecting Rod		•			(3)	(4)	
Bottom End Bearing				(5)	(3)	(4)	
Cross-Head Bearing				(5)	(3)	(4)	
Piston Head		•		` '	(3)	(4)	
Piston Rod		•			(3)	(4)	
Gland Box Springs		•			(3)	(4)	
Cams & Camshaft		•			(3)	(4)	
Cyl. Liner Inside		•			(3)	(4)	
Cyl. Liner Outside		•			(3)	(4)	
Fuel rail pipe		•			(3)	(4)	
Servo rail pipe		•			(3)	(4)	
Exhaust Valve drive		•			(3)	(4)	
Injection Control Unit		•			(3)	(4)	
Starting Air Distributor		•			(3)	(4)	
Rotation Direction Safeguard		•			(3)	(4)	
Engine turning			•				
Ancillary Parts (*) installed at engine				(1)	(2)		
Ancillary Parts (*) stored in VCI paper & closed woodenbox					(1)	(2)	
(*) = Fuel Injection valves; Starting Air valves; Indicator cock valve; Injection Control Unit (ICU)							
(1) = Max. humidity 75% (2) = Max. humidity 50%				•			•

(3) = Max. humidity 75% - dry condition - single part

(4) = Max. humidity 50% - dry condition - single part

(5) = To be opened for inspection

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## 14 Recovery of corroded parts

If there are signs of rust, the quality assurance department will decide whether additional work is necessary. If the traces of rust are only slight, they can be removed with emery cloth No. 220 (or finer) and petroleum. Repeat cleaning!

If the parts are too heavily corroded, contact your next WinGD Ltd. Service Branch for further decision.

## 15 Tools needed for storage

#### 15.1 Dehumidifier

It is up to the engine maker or shipyard to decide which tools are used, as long as the technical properties/specifications are complying with the samples attached.

#### 15.1.1 Introduction

The requirements on a dehumidifier system always depend on the engine type/size (volume to be dried) and the storage location (temperature and real humidity). On the following pages three recommended dehumidifier products are shown which are able to cover the WinGD 2-stroke engine portfolio, even in subtropical areas. The main task of a dehumidifier system is to maintain the real humidity inside the engine between 40% and 50%, in order to keep the level of corrosion as low as possible.

#### 15.1.2 Engine volume overview

The list below can be used as a rough reference for the volume (crankcase, piston underside and camshaft housing) which needs to be dried in the engine.

~ Volume per cylinder in m³ (crankcase & scavenge air space & camshaft housings)

W-X35B	4 m³	
W-X40B	6 m³	
W-X46	11 m³	Example for the definition of the air volume to be
W-X52	15m³	dried in a 6X72 engine
W-x62	24 m³	
W-X62-B	24 m³	6 x 60 m <sup>3</sup> = <u>360 m<sup>3</sup> total air volume</u> inside the engine
W-X72	$37 \text{ m}^3$	onge
W-X72-B	$37 \text{ m}^3$	
W-X82-B	56 m³	
W-X92	65 m³	

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Depending on the lay-up location, temperature, humidity and engine type, the capacity of the dehumidifier system needs to be defined case by case.

# 15.2 Tools for dehumidification & corrosion protector application

Below is a recommendation for three types of absorption dehumidifiers made by the Munters company. The marine industry has already had positive experience with these dehumidifiers.

#### 15.2.1 Munters M120



#### 0,8 0,6 0,4 0,2 0,10 0,0 0,10

Dehumidification capacity, kg/h

1,0

#### **Process air**

#### Rated airflow (m³/h) 120 Available static pressure 50Hz (Pa) 200 Available static pressure 60Hz (Pa) 360

#### **Miscellaneous**

➤ Operating temperature (°C) -40/+40

Process Air Temperature, °C

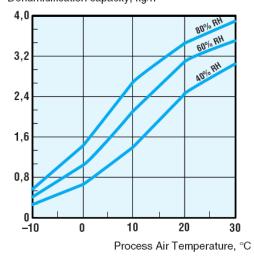
Available for different voltage supplies from 115V to 240V

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#### 15.2.2 Munters ML420



Dehumidification capacity, kg/h



#### **Process air**

Rated airflow (m³/h) Available static pressure (Pa)

#### **Miscellaneous**

420

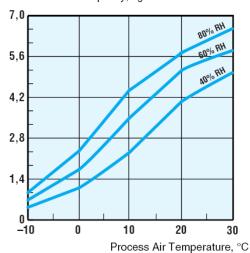
200

- ➤ Operating temperature (°C) -20/+40
- Available for different voltage supplies from 220V to 500V

#### 15.2.3 Munters ML690



#### Dehumidification capacity, kg/h



#### **Process air**

Rated airflow (m³/h) Available static pressure (Pa) 690

300

#### **Miscellaneous**

- ➤ Operating temperature (°C) -20/+40
- Available for different voltage supplies from 220V to 500V

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#### 15.3 Accessories

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- Booster fan
- Oil filter elements (to assure the efficiency of the dehumidifier)
- Controller
- Pipe distributor with flaps
- Flexible hose Ø 80 mm
- Flexible hose Ø 125 mm
- Flexible hose Ø 160 mm
- Flexible hose Ø 200 mm
- Connecting T-pieces
- Transport frame

#### 15.3.1 Humidity and temperature control

During the lay-up a humidity and temperature data logger must be fitted to the crankcase, piston underside and camshaft housing/supply unit, in order to monitor the conditions inside the engine and check proper working of the dehumidifier system. Below is a recommendation for a tool which can be used for this purpose.

## 15.3.2 HygroLog NT3



- Relative humidity, temperature, dew point or other calculated parameter
- Multi-probe capability, wide selection of probes to satisfy every application
- Measurements from 0 to 100%RH and -50..200°C /-58..392°F (with external probe)
- Optional internal humidity-temperature probe, protected against unauthorized removal
- Monitoring of up to two external contacts (door, relay contact, etc.)
- Optional LC display and multi-function keypad
- Large recording capacity with removable flash memory card
- Operates with a 9 VDC standard or rechargeable battery
- Data download without interrupting the measurements

#### 15.3.3 Equipment for preservation oil spraying

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To spray coat engine components and blank metal parts, a portable oil sprayer may be used. There are different types and executions of oil sprayers. Below two examples are shown for reference only.



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Airless spray unit, made e.g. by Wagner (www.wagner-group.com)



Airgun, e.g. type 405T, made by Gloria (www.gloriagarten.de)

# 16 Overview of liquids & application properties

Below a sample list has been compiled of fluids to be used for various applications, which have been summarized. Note that the fluids have been divided in various categories; they are referred to in the subsequent component tables. Where applicable the application method is referred to. The list is not complete: where the products referred to are not available locally, a suitable replacement can be used; however, the basic properties should remain the same. In all cases where cabling and sensors are concerned the compatibility of the preserving agent with the relevant cabling should be confirmed.

Please contact WinGD Switzerland Ltd.

Product*	Description	Class	Application method
Shell calibration fluid S9365	Calibrating fluid for testing fuel injectors and pumps	Α	Used in conjunction with a test pump/bench
Shell Ensis Engine Oil 30	Mineral oils with excellent rust		Spray coating or
Valvoline Tectyl 930	prevention properties	В	brush. Where spraying is used, a
Mobilarma 524	Used for coating engine parts	В	manual pump is
Total Osyris DWY 3500/5500	including cylinder liners, piston rods, gears, etc. Only used for		preferred. Any air pumps must use

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	engine storage.		moisture-free air.
Tectyl 502 EH			
Tectyl 506 H	Solvent cutback, soft-wax based,		
Tectyl 132	corrosion-preventive compound.		
Chevron Rustproof Compound L	Can be used to protect external blank metal parts, for example	С	Brush.
Shell Ensis DW2462	fuel pump blocks, rails, cylinder		
Mobilarma 798	covers, etc.		
Castrol Safecoat DW33			
Pyroshield LE 5182	High-pressure grease which can	<b>D</b>	Davish
Klüberfluid CF Ultra	be used for lubricating flywheel teeth.	D	Brush.
Mobilcut 200	Soluble oil inhibitors which are		A date date a continue
Shell Dromus B / BX	used to protect emptied cooling	E	Added to cooling water.
Total Lactuca MS 5000	water spaces.		
Castrol Cresta SHS			
Chevron Cylinder oil 1000	High-viscosity steam engine		
Shell Valvata Oil 1000	cylinder oils with excellent corrosion protection and	F	Brush.
Mobil 600 W Super Cylinder Oil	resistance to wiping.		Diusii.
Total Cyl 1000	Used for bearing shells		

#### Cleaning and degreasing agents 16.1

- Shellsol T

Properties	Shellsol TD	Shellsol T	Solvent FP68
Boiling range, at 760 mm Hg			
beginning at °C	172	185	194
ending at °C	195	212	251
Density at 20°C in kg/m <sup>3</sup>	735	760	790
Colour SAYBOLT	+ 30	+ 30	+ 30
Aromatic content vol. %	≤ 0,2	≤ 0,2	≤ 0,5
Sulphur content weight %	≤ 0,005	≤ 0,005	≤ 0,005
Copper corrosion	1	1	1

ļ		•	engine storage.			moisture-f	iee aii.
	Tectyl 502 EH						
ļ	Tectyl 506 H						
ļ	Tectyl 132		utback, soft-wax b -preventive comp				
ļ	Chevron Rustproof Compound L		used to protect ext		С	Brusl	
	·		etal parts, for exar		C	Diusi	1.
	Shell Ensis DW2462	Tuel pum	p blocks, rails, cyll covers, etc.	inaer			
	Mobilarma 798						
ļ	Castrol Safecoat DW33						
	Pyroshield LE 5182		ssure grease whic		_	D	ı
	Klüberfluid CF Ultra	be used	for lubricating flyw teeth.	meei	D	Brusl	n.
ļ	Mobilcut 200						
			oil inhibitors which		E	Added to d	cooling
	Shell Dromus B / BX		protect emptied co water spaces.	oling	_	wate	r.
	Total Lactuca MS 5000						
	Castrol Cresta SHS						
ļ	Chevron Cylinder oil 1000		scosity steam eng				
	Shell Valvata Oil 1000		er oils with excelle sion protection an		F	Brusl	_
ļ	Mobil 600 W Super Cylinder Oil		istance to wiping.		•	Diusi	1.
	Total Cyl 1000	Use	d for bearing shells	6			
16	6.1 Cleaning and degre	asing age	ents	1			
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( V	inodorous aliphatic hydrocarbon  White spirit is the generic term fo  - Shellsol TD	s, free of a	romatics)	ts:	ol T	Solvent FF	<b>1</b> 68
() V	inodorous aliphatic hydrocarbon White spirit is the generic term for a Shellsol TD and a Shellsol T  - Shellsol T  Valvoline product: Solvent FP68  Properties	s, free of a	romatics) ring Shell produc		ol T	Solvent FP	268
() V	inodorous aliphatic hydrocarbon White spirit is the generic term for Shellsol TD Shellsol T Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg	s, free of a	romatics) ring Shell produc	Shells	ol T		268
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(( V	inodorous aliphatic hydrocarbon White spirit is the generic term for shellsol TD - Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C  Density at 20°C in kg/m³  Colour SAYBOLT	s, free of a	romatics) ring Shell productions  Shellsol TD  172 195 735 + 30	185 212 760 + 30	ol T	194 251 790 + 30	268
( V	inodorous aliphatic hydrocarbon White spirit is the generic term for a Shellsol TD and a Shellsol TD.  Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %	s, free of a	romatics) ring Shell product  Shellsol TD  172 195 735 + 30 ≤ 0,2	185 212 760 + 30 ≤ 0,2		194 251 790 + 30 ≤ 0,5	268
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	inodorous aliphatic hydrocarbon White spirit is the generic term for a Shellsol TD and a Shellsol TD.  Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C ending at °C  Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %  Sulphur content weight %	s, free of a	romatics) ring Shell production  Shellsol TD  172 195 735 + 30 ≤ 0,2 ≤ 0,005	185 212 760 + 30 ≤ 0,2 ≤ 0,005		194 251 790 + 30 ≤ 0,5 ≤ 0,005	268
\(\frac{1}{2}\)	inodorous aliphatic hydrocarbon White spirit is the generic term for a Shellsol TD and a Shellsol TD.  Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %	s, free of a	romatics) ring Shell product  Shellsol TD  172 195 735 + 30 ≤ 0,2	185 212 760 + 30 ≤ 0,2		194 251 790 + 30 ≤ 0,5	268
() V	inodorous aliphatic hydrocarbon White spirit is the generic term for a Shellsol TD and a Shellsol TD.  Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C ending at °C  Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %  Sulphur content weight %	s, free of a	romatics) ring Shell production  Shellsol TD  172 195 735 + 30 ≤ 0,2 ≤ 0,005	185 212 760 + 30 ≤ 0,2 ≤ 0,005		194 251 790 + 30 ≤ 0,5 ≤ 0,005	P68
( V	inodorous aliphatic hydrocarbon White spirit is the generic term for Shellsol TD - Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C ending at °C  Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %  Sulphur content weight %  Copper corrosion	s, free of a r the follow	romatics) ring Shell product  Shellsol TD  172 195 735 + 30 ≤ 0,2 ≤ 0,005 1	185 212 760 + 30 ≤ 0,2 ≤ 0,005 1	5	194 251 790 + 30 ≤ 0,5 ≤ 0,005 1	de X X X X
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Substit	inodorous aliphatic hydrocarbon  White spirit is the generic term for Shellsol TD - Shellsol TD - Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C ending at °C  Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %  Sulphur content weight %  Copper corrosion  tute for:  7-77.252 20.10.2009 A EAAD088 Number Drawn Date Number  Product RT-flex / X / D	s, free of a r the follow	romatics) ring Shell product  Shellsol TD  172 195 735 + 30 ≤ 0,2 ≤ 0,005 1  Guideline For After shop test	Shells  185 212 760 + 30 ≤ 0,2 ≤ 0,005 1  □ Draw	n Date Protect	194 251 790 + 30 ≤ 0,5 ≤ 0,005 1	de X X X X
Substit	inodorous aliphatic hydrocarbon  White spirit is the generic term for Shellsol TD - Shellsol TD - Shellsol T  Valvoline product: Solvent FP68  Properties  Boiling range, at 760 mm Hg beginning at °C ending at °C ending at °C  Density at 20°C in kg/m³  Colour SAYBOLT  Aromatic content vol. %  Sulphur content weight %  Copper corrosion  Lute for:  7-77.252   20.10.2009   A EAAD088   Number   Number   Number   Number   Number   RT-flex / X / D	s, free of a r the follow  998 30.01.20 Drawn D	Shellsol TD  172 195 735 + 30 ≤ 0,2 ≤ 0,005 1  Guideline For After shop test  Page 56 / 70  Page 56 / 70	Shells  185 212 760 + 30 ≤ 0,2 ≤ 0,005 1  □ Draw	n Date Protect	194 251 790 + 30 ≤ 0,5 ≤ 0,005 1	de X X X X

Aniline point °C	84	84.5	75
Viscosity at 20°C in cst.	1.62	1.85	1.84
Relative evaporation time			
(ether = 1)	110	130	800
Flash point Abel °C	46	56	72
Drop ignition temperature°C	-	330	-
Danger class BVD	Fe-II/B	F-III/B	B-III
Transport danger class RID/ADR	IIIa2301/a	IIIa2301/a	Cl. 3 Pt. 32c
Poison class	5	5	free
Max. permissible concentration ppm	500	500	500
mg/m <sup>3</sup>	3200	3400	2000

<u>Toxicology:</u> Only at very high vapour concentrations: will have narcotic effects and may

cause dizziness.

<u>Application</u>: Solvents, thinning, cleaning and degreasing agents for lacquers and paints.

Non-fluorescent dielectric material for non-destructive testing.

Manufacturers: Royal Dutch Shell plc Shellsol TD and T

Carel van Bylandtlaan 30 NL – 2596 HR DEN HAAG

www.shell.com

Valvoline Europe, Solvent FP68

Pesetastraat 5

NL – 2991 XT, Barendrecht www.valvolineeurope.com

## 16.2 Corrosion inhibitors for WinGD 2-stroke diesel engines

For closed cooling water circuits

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Approved and recommended for use in WinGD 2-stroke diesel engines

Product brand name	Supplier	Main reagent
Liquidewt	Ashland Drew Marine	Nitrite/borate
Maxigard	Ashland Drew Marine	Nitrite/borate/organic
CorrShield OR4411	GE Betz	Organic compounds
Q8 Corrosion Inhibitor Long-Life	Kuwait Petroleum	Organic compounds
D.C.W.T. Non Chromate	Marichem Marigases	Nitrite/borate
Marisol CW	Maritech	Nitrite/borate
Nalfleet EWT 9-108	Nalco / Nalfleet	Nitrite
L	L	

Sul	ostitu	te for:													PC	Q-Code	Х	Х	X	Х	Χ
Modif	-	7-77.252	20.10.2009	9	Α	EAAD0889	998	30.01.2018													
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0		VIN G	لغ	Product RT-fI	ex	/ X / D	F	Guideline For Engine Protect					tior	1							
Ма	de	28.02.2018	F. Moszr	ner			Main Drw	Н	Page	7 / 70	Material	<sup>□</sup> 107.42	6 5	585	50	nn					
Ch	kd	28.02.2018	M. Frei				Design G		Drawing				0.0	,00		00		Rev			
App	od	28.02.2018	M. Dama	ani			0	345	Drawing	טון	107.42	26.585						1160		Α	

RD 25 Complex	Rohm and Haas	Molybdate/phosphate
Havoline XLI	Texaco	Organic compounds
WT Supra	Total	Organic compounds
Colorcooling	Uniservice	Nitrite
Anticorr	Uniservice	Phosphonate
NCLT	Uniservice	Nitrite
Cooltreat AL	Unitor Chemicals	Organic compounds
Dieselguard NB	Unitor Chemicals	Nitrite/borate
Rocor NB Liquid	Unitor Chemicals	Nitrite/borate
	1	1

The condition of the cooling water before treatment should be as follows:

min. pH 6.5

max. 10 °dH (corresponds to 180 mg/l CaCO3)

max. 80 mg/l chloride max. 150 mg/l sulphate

The dosage of the corrosion inhibitor and the maintenance of its concentration in service should be carried out according to the supplier's instructions. The supplier company undertakes all responsibility for the performance of the water treatment in service to the exclusion of any liability of WinGD Switzerland Ltd.

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taking	dif		7-77.252	20.10.2009	)	Α	EAAD0889	198	30.01.201	18												
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All rights reserve	WIN GE RT-flex / X / DF									Guideli After sho		_	ne Protec	tion	1							
inGD.	Mad	е	28.02.2018	F. Moszr	ner			Main Drw.	Н	F	Page 58 / 7		Material ID	107.42	6 5	85	500	)				
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5	Арро	t	28.02.2018	M. Dama	ani			0	345		2.ag .2	10	7.426.	.585							Α	

#### Overview of some corrosion protection product specifications 16.3

Time of commercian analysis and dust. Day		.:41					
	ratering way, dry pro			rotection			
Name of product: <b>Dewatering Fluid WA</b>				No: ication No: tute for Spec.	No:		
General and physical properties:	Protection	against:		<u> </u>			
Oil-based corrosion preventive	Humidity	, persp	oiration, s	hower-proo	of		
Application Temperature: 15°C to 35°C	Applica meth		Thinner %	Viscosity	Spraying pressure	Nozzle mm	k / Oh
Humidity:	Brush	Yes					
Colour: like Vaseline	Roller	Yes					
Degree of gloss: mat	Dipping	Yes					
Covering power:	Spraying: low press.	Yes					
Density: 810 kg/m <sup>3</sup> at 15°C	high press.	Yes					
Content of solids: 15.5 %	Airless	Yes					
Viscosity:	Electro- static	Yes					
Danger class: A-II	Drying: Air	dust- free	set to touch	completely dry	Reco spraying	atable after:	<u> </u>
Poison class: free BAG T Nr. 611 500	20°	ii CC	1 h	1	no		no
Flash point: 40°C in closed pot	Oven	Time r	10	Temperature	of componer	nt:	
Identification duty: ADR/SDR CI. 3 Pt. 31 c	Forced	Time r	10	Temperature	of componer	nt:	
Shelf life: 12 months cool/dry	Technical d	ata:					
Mixing ratio: 1) 2)	Cross-cut te	est					
With hardener:	Hardness a	cc. to:					
Pot life:	Steel ball je DIN 53154	t:					
Coverage: 180 m <sup>2</sup> /l	Mandrel ber DIN 53152	nd test:					
with dry film thickness of 0.8 microns 3)	Ericcson cu DIN 53156	pping ind	ex IE:				
Temperature range: - 20°C to + 60°C	Salt-spray to DIN 50021	est:	I	DIN 50'907	150 hrs		
Dry film melting-point:	Kesternich t DIN 50018	est:					
1) Weight 2) Volume 3) On smooth surface	Condensed ASTM-D-14			DIN 51'359	150 hrs		
Surface preparation: Grease-free surface. May I	be applied	to mo	ist surface	э.			
Features: Highly water displacing, liq films on metal surfaces, dis			nd moistu	re out of po	ocket holes		
Duration of protection: Indoor storage 9 - 12 mont	hs / shed	storag	e 4 - 8 mc	onths			
Removal, cleaning: Normally not necessary. Conside Removal with white spirit or petro	red as coat s						
Supplier: Valvoline Oil Co. Ltd., Hardturmst Tel. +41 (0) 1/446 50 50	tr. 175, P.O.	Box, Ch	l-8005 Zuric	h, Switzerland	i		
The data given are mean values based on practical experie with regard to climatic and specific conditions.	ence. Applic	ation acc	cording to th	e supplier's sp	pecification a	nd at user's	risk
ostitute for:					PC	Q-Code X X	( x x
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16.4 Dewatering Fluid WA  Type of corrosion-protective product De	watering	with co	rrosion	orotection							
	xy, dry pi										
Name of product: <b>Dewatering Fluid WA</b>			Subst	No: fication No: fitute for Spec.	No:						
General and physical properties: Oil-based corrosion preventive	Protection Humidit			hower-prod	of						
Application Temperature: 15°C to 35°C	Applic		Thinner %	Viscosity	Spraying pressure	Nozzle mm	k /				
Humidity: Colour: like Vaseline	Brush Roller	Yes Yes									
Degree of gloss: mat	Dipping	Yes									
Covering power:	Spraying: low press.	Yes									
Density: 810 kg/m <sup>3</sup> at 15°C	high press.	Yes									
Content of solids: 15.5 %	Airless	Yes									
Viscosity:	Electro- static	Yes									
Danger class: A-II	Drying: Air	dust- free	set to touch	completely dry	Red sprayir	coatable after ng	:				
Poison class: free BAG T Nr. 611 500	20°		1 h		no	)	no				
Flash point: 40°C in closed pot	Oven	Time I	10	Temperature	of compone	ent:					
Identification duty: ADR/SDR CI. 3 Pt. 31 c	Forced	Time No Temperature of component.									
Shelf life: 12 months cool/dry	Technical of	data:									
Mixing ratio: 1) 2)	Cross-cut t DIN 53151	est									
With hardener:	Hardness acc. to:										
Pot life:	Steel ball je DIN 53154										
Coverage: 180 m <sup>2</sup> /l	Mandrel be DIN 53152										
with dry film thickness of 0.8 microns 3)	Ericcson co		ex IE:								
Temperature range: - 20°C to + 60°C	Salt-spray DIN 50021	test:		DIN 50'907	150 hrs						
Dry film melting-point:	Kesternich DIN 50018										
1) Weight 2) Volume 3) On smooth surface	Condensed ASTM-D-1		nate: 359	DIN 51'359	150 hrs						
Surface preparation: Grease-free surface. May				e.							
Features: Highly water displacing, li films on metal surfaces, d			nd moistu	ire out of po	ocket hole	es					
<b>Duration of protection:</b> Indoor storage 9 - 12 mor <b>Removal, cleaning:</b> Normally not necessary. Consider											
Removal with white spirit or petr	roleum.		,								
<b>Supplier:</b> Valvoline Oil Co. Ltd., Hardturm Tel. +41 (0) 1/446 50 50	str. 175, P.O	. Box, Cl	1-8005 Zurio	ch, Switzerland	d						
The data given are mean values based on practical expe with regard to climatic and specific conditions.	rience. Applio	cation ac	cording to th	ne supplier's s	pecification	and at user'	s risk				
ostitute for:					PC	Q-Code X	x x				
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Product RT-flex / X / DF		1 1			1 1	рга	Dale				
	Gu	ıaeline	For Ena	ine Protec	tion						

#### 16.5 Tectyl 506

Type of corrosion-protective product W	axv. drv	/. grin-d	lrv n	rotecti	ve film for	lona-term			
					rotection				
Name of product: <b>TECTYL 506</b>					e No: fication No: itute for Spec.	No:			
General and physical properties:	Protec	ction agair	nst:	Subsi	itute for Spec.	INO.			
Oil-based corrosion preventive	Atmo	ospheric	: influ		incl. rain, sr			e	
	indus	industrial atmosphere and gases such as SO <sub>2</sub>							
Application Temperature: 10°C to 35°C		plication- method		Thinner %	Viscosity	Spraying pressure	Nozzle mm	k / Oh	
Humidity:	Brush		s	/0		pieceure	111111	Oii	
Colour: brown	Roller	No	)						
Degree of gloss: wax-like, consistent	Dippir	ng No	,						
Covering power:	Sprayii	~ 110	s						
Density: 870 kg/m <sup>3</sup> at 20°C	high pr		s						
Content of solids: 54 %	Airles	s Ye	s						
Viscosity:	Electro	· Ye	s						
Danger class: A-II	Drying			et to toucl			atable after:		
Poison class: free BAG T Nr. 16889	Air 20°C	free 2hi		3 hrs	4 hrs	spraying			
Flash point: 41°C in closed pot	Oven	Tim			Temperature	of componer	t:		
Identification duty: ADR/SDR CI. 3 Pt. 31 c	Force	ed Tim	ne		Temperature	of componer	t:		
Shelf life: 12 months cool/dry	Techni	ical data:							
Mixing ratio: 1) 2)	Cross- DIN 53	cut test							
With hardener:		ess acc. to:							
Pot life:	Steel b								
Coverage: 16 m <sup>2</sup> /l	Mandre	Mandrel bend test: DIN 53152							
with dry film thickness of 35 microns 3)		on cupping 3156	index	IE:					
Temperature range: - 40°C to + 120°C	Salt-sp	DIN 53156  Salt-spray test: 5 % DIN 50021			5 % 80 day	S			
Dry film melting-point:		nich test:							
1) Weight 2) Volume 3) On smooth surface		nsed water -D-148, DIN			> 100 days				
Surface preparation: Dry, dust-free, oil- and g					treated with	Dewaterin	g Fluid V	VA	
Features: Non water displacing									
Duration of protection: Indoor storage up to 4 years	ears / ou	tdoor st	orag	e up to	2 years				
Removal, cleaning: With petroleum, aromatic	-free wh	nite eniri	t alk	alina s	oaker.				
steam or hot-water clear		•							
Supplier: Valvoline Oil Co. Ltd., Ha	ardturms	str. 175.	P.O.	Box, C	CH-8005 Zu	rich, Switze	erland		
Tel. +41 (0) 1/446 50 50		,		•					
The data given are mean values based on prespecification and at user's risk with regard to						ng to the si	upplier's		
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	0.01.2018							<u> </u>	
<u> </u>	rawn Date	Nu	umber		Drawn Date	Number	Drav	vn Date	
WIN GO Product RT-flex / X / DF		Guideli	ne F	or Eng	ine Protect	tion			
Winterthur Gas & Diesel		After sho	p tes	t					
de 28.02.2018 F. Moszner Main Drw.	- 11	Page 60 / 7	0	Material ID	107.42	6.585.50	0		
kd 28.02.2018 M. Frei  Design Gro		Drawing ID		7.426	3.585		F	Rev	
od 28.02.2018 M. Damani U3	TJ			,, . <del>,</del> (	,. <del></del>				

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#### 16.6 Tectyl 5006W

	ky, dry, gr servation			ve film for I rotection	ong-	term				
Name of product: <b>TECTYL 5006W</b>			-	No: fication No: itute for Spec.	No:					
General and physical properties:	Protection		t:	•			_	_		
Oil-based corrosion preventive				atmospheric						
emulsifiable with water	as SO <sub>2</sub>		ressive ind	dustrial atmo	osphe	ere and g	ases	such		
Application Temperature: 10°C to 35°C	Applica metho		Thinner %	Viscosity	Sprayi pressu	-	lozzle mm	k / Oh		
Humidity:	Brush	Yes								
Colour: milky white	Roller	Yes								
Degree of gloss: wax-like, consistent	Dipping	Yes								
Covering power:	Spraying: low press.	Yes								
Density: 1090 kg/m <sup>3</sup> at 20°C	high press.	Yes								
Content of solids: 40 %	Airless	Yes								
Viscosity: DIN 4 - 20°C - 30 sec.	Electro- static	Yes					1			
Danger class: none	Drying: Air	dust- free	set to touch	completely dry	S	Recoatable praying	e after:			
Poison class: none	20°	1,5h	2 hrs	3 hrs		no	' '	าด		
Flash point: none (emulsion)	Oven	Time	1 ½ h	Temperature	of com	ponent:	max.	60°C		
Identification duty: NO	Forced Time 1 ½ h Temperature of component: max. 60									
Shelf life: cool/dry + 5°C to + 35°C	Technical data:									
Mixing ratio: 1) 2)	Cross-cut te DIN 53151	st								
With hardener:	Hardness acc. to:									
Pot life:	Steel ball jet DIN 53154	t:								
Coverage: 10 m <sup>2</sup> /l	Mandrel ber DIN 53152	nd test:								
with dry film thickness of 40 microns 3)	Ericcson cup DIN 53156	pping in	dex IE:							
Temperature range: - 30°C to + 120 °C	Salt-spray to DIN 50021	est:		5 % > 240 h	nrs					
Dry film melting-point:	Kesternich to DIN 50018	est:								
1) Weight 2) Volume 3) On smooth surface	Condensed ASTM-D-14			> 240 hrs						
Surface preparation: Dust-free, oil- and grease- Surface treated with Dewa				ied to moist	surfa	ce.				
Features: Storage: protect against from Treated parts should only		utside	e when co	mpletely dry	·.					
Duration of protection: Indoor storage up to 4 year										
hot-water cleaner with corrosion	Removal, cleaning: With petroleum, aromatic-free white spirit, alkaline soaker, steam or hot-water cleaner with corrosion protection additive									
Supplier: Valvoline Oil Co. Ltd., Hardturms Tel. +41 (0) 1/446 50 50										
The data given are mean values based on practical experi with regard to climatic and specific conditions.	ence. Applica	ation a	ccording to the	ne supplier's sp	ecifica	ition and a	user's	risk		
bstitute for:						PC Q-Co	de X X	x x		
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	vn Date	Num	ber	Drawn Date	Nu	mber	Draw	n Date		

	osion-protective prod		y, dry, greervation			ve film for otection	long-term		
Name of product:	:TECTYL 5006W					No: ication No: tute for Spec.	No:		
General and phys Oil-based corr emulsifiable w	rosion preventive			ate res	istant to a		c influences osphere ar		
Application Tem	nperature: 10°C to 35	°C	Applica		Thinner	Viscosity	Spraying pressure	Nozzle	k/
Hun	nidity:		meth Brush	Yes	%		pressure	mm	Oh
Colour:	milky white		Roller	Yes					
Degree of gloss:	wax-like, consistent		Dipping	Yes					
Covering power:			Spraying:	Yes					
Density:	1090 kg/m <sup>3</sup> at 20°C		low press.	Yes					
Content of solids	: 40 %		Airless	Yes					
Viscosity:	DIN 4 - 20°C - 30 se	C.	Electro-	Yes					
Danger class:	none		Static  Drying:	dust-	set to touch	completely		patable after:	
Poison class:	none		Air 20°	free 1,5h	2 hrs	dry 3 hrs	spraying <b>no</b>	- 1	าด
Flash point:	none (emulsion)		Oven	Time 1	l □½ h	Temperature	of componen	nt: max.	60°C
Identification duty	, ,		Forced	Time '	l ½ h		of componen		60°C
Shelf life:	cool/dry + 5°C to + 3	5°C	Technical d	ata:		<u> </u>	·		
Mixing ratio: 1)	2)		Cross-cut to	est					
With hardener:	, , , , , , , , , , , , , , , , , , ,		DIN 53151 Hardness a	cc. to:					
Pot life:			Steel ball je	t:					
	40 - 2"	DIN 53154  Mandrel bend test: DIN 53152							
Coverage:	10 <b>m</b> ⁻/l			na test:					
Coverage:	10 m <sup>2</sup> /l	ns 3)	DIN 53152 Ericcson cu		ex IE:				
with dry film thick	xness of 40 micro	ns 3)	DIN 53152 Ericcson cu DIN 53156 Salt-spray t	pping ind		5 % > 240	hrs		
with dry film thick Temperature range	cness of 40 micro	ns 3)	DIN 53152 Ericcson cu DIN 53156	pping ind		5 % > 240	hrs		
with dry film thick	cness of 40 micro ge: - 30°C to + 120 °C point:	ns 3)	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021	pping indestance of the second	:		hrs		
with dry film thick Temperature range Dry film melting-p	ge: - 30°C to + 120 °C point:  2) Volume  3) On sm	ooth surface	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kesternich DIN 50018 Condensed ASTM-D-14	pping indest: test: water clir 18, DIN 51	nate: 359	> 240 hrs			
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara Features:	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protec Treated parts sl	ooth surface nd grease-f with Dewar t against fro	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kesternich DIN 50018 Condensed ASTM-D-12 Tree surfactering Flu DSt. De taken o	est: test: water clir 18, DIN 51 ce. Ma id WA.	nate: 359 y be appli when cor	> 240 hrs ed to moist	surface.		
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara Features: Duration of prote Removal, cleani	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protec Treated parts sl  tection: Indoor storage to hot-water cleaner w	nd grease-f with Dewar t against fro nould only b up to 4 year matic-free whith corrosion p	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50211 Kesternich DIN 50018 Condensed ASTM-D-14 free surfactering Flu Detaken cors / outdoor ite spirit, alk protection according to the core of the c	water clir water clir 18, DIN 51 ce. Ma id WA. butside or stora aline soadditive	when corage up to	> 240 hrs ed to moist mpletely dr 2 years or	s surface.		
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara Features: Duration of prot	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protec Treated parts sl  tection: Indoor storage ing: With petroleum, arc	nd grease-f with Dewar t against fro nould only t up to 4 year matic-free wh ith corrosion p	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50211 Kesternich DIN 50018 Condensed ASTM-D-14 free surfactering Flu Detaken cors / outdoor ite spirit, alk protection according to the core of the c	water clir water clir 18, DIN 51 ce. Ma id WA. butside or stora aline soadditive	when corage up to	> 240 hrs ed to moist mpletely dr 2 years or	s surface.		
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara Features: Duration of prot Removal, cleani Supplier: The data given a	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protec Treated parts sl  tection: Indoor storage of the storage: with petroleum, arc hot-water cleaner with valvoline Oil Co. Lt	nd grease-f with Deward t against from ould only be up to 4 years matic-free whith corrosion pends, Hardturmst 10 50 ractical experies	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kestemich DIN 50018 Condensed ASTM-D-14 Tree surfactering Flu Dost. De taken cors / outdood itte spirit, alk protection according from 175, P.O.	pping indestructions and indestructions and water climates, DIN 51 ce. Maid WA.  Dutside or stora aline so additive  Box, Ch	when corage up to aker, steam	> 240 hrs ed to moist  mpletely dr 2 years or h, Switzerland	surface.	nd at user's	risk
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara Features: Duration of prote Removal, cleani Supplier: The data given a with regard to clire	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protec Treated parts sleetion: Indoor storage ing: With petroleum, archot-water cleaner wow Valvoline Oil Co. Lt Tel. +41 (0) 1/446 5 are mean values based on prematic and specific conditions	ooth surface  nd grease-f with Deward  t against from the could only be up to 4 year matic-free where the corrosion periods, Hardturmst to 50 factical experiess.	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kesternich DIN 50018 Condensed ASTM-D-12 Tree surfactering Flu Detaken Cors / outdoor itte spirit, alk protection actr. 175, P.O.	pping indestructions and indestructions and water climates, DIN 51 ce. Maid WA.  Dutside or stora aline so additive  Box, Ch	when corage up to aker, steam	> 240 hrs ed to moist  mpletely dr 2 years or h, Switzerland	t surface.  V.  d  pecification ar	nd at user's	
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara Features: Duration of prot Removal, cleani Supplier: The data given a with regard to clire	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation:  Dust-free, oil- a Surface treated  Storage: protec Treated parts sl  section: Indoor storage of the storage of	nd grease-f with Deward t against from ould only burn to 4 years matic-free whith corrosion public, Hardturmst 10 50 reactical experies.	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kestemich DIN 50018 Condensed ASTM-D-14 Tree surfactering Flu Dost. De taken cors / outdood itte spirit, alk protection according from 175, P.O.	pping indestructions and indestructions and water climates, DIN 51 ce. Maid WA.  Dutside or stora aline so additive  Box, Ch	when corage up to aker, steam	> 240 hrs ed to moist  mpletely dr 2 years or h, Switzerland	t surface.  V.  d  pecification ar	Q-Code X X	
with dry film thick Temperature range Dry film melting-p 1) Weight Surface prepara  Features: Duration of prote Removal, cleani Supplier: The data given a with regard to clire bestitute for: - 7-77.252	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protect Treated parts sleetion: Indoor storage:  With petroleum, arc hot-water cleaner w  Valvoline Oil Co. Lt Tel. +41 (0) 1/446 store mean values based on protect matic and specific conditions  20.10.2009  Drawn Date  Product  RT-flex / X /	nd grease-f with Deward t against from the against from t	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kesternich DIN 50018 Condensed ASTM-D-14 free surfar tering Flu Dost. De taken cors / outdoor ite spirit, alk protection according to the cordinate of the	water clir water clir 18, DIN 51 Ce. Ma id WA. butside or stora aline so dditive Box, Chation acc	when corage up to aker, steam cording to the cordinal	> 240 hrs ed to moist mpletely dr 2 years or h, Switzerland e supplier's s	d pecification ar	Q-Code X X	X >
with dry film thick Temperature range Dry film melting-p  1) Weight Surface prepara  Features:  Duration of prote Removal, cleani Supplier:  The data given a with regard to clir  bistitute for:  - 7-77.252   Number	ge: - 30°C to + 120 °C  point:  2) Volume  3) On sm  ation: Dust-free, oil- a Surface treated  Storage: protect Treated parts sleetion: Indoor storage:  With petroleum, arc hot-water cleaner w  Valvoline Oil Co. Lt Tel. +41 (0) 1/446 store mean values based on protect matic and specific conditions  20.10.2009  Drawn Date  Product  RT-flex / X /	nd grease-f with Deward t against from the against from t	DIN 53152 Ericcson cu DIN 53156 Salt-spray t DIN 50021 Kestemich DIN 50018 Condensed ASTM-D-14 Free surfar tering Flu Dist. De taken cors / outdoor ite spirit, alk protection according to the spirit, alk pr	water clir water clir 18, DIN 51 ce. Ma id WA. butside or stora caline so ditive Box, Chation accommodation	when corage up to aker, steam cording to the cordinal	> 240 hrs ed to moist mpletely dry 2 years or th, Switzerland e supplier's s  Drawn Date	d pecification ar	Q-Code X X	X >

#### 16.7 Tectyl 5805W

Type of corrosion-protective product Dry p	protective	coat	for short-	term pres	ervation		
Name of product: <b>TECTYL 5805 W</b>				No: cation No: tute for Spec.	No:		
General and physical properties:	Protection	against	I				
Oil-based corrosion preventive				case of inc			
emulsifiable with water				heric influe			
Application Temperature: 10°C to 35°C	Applica meth		Thinner %	Viscosity	Spraying pressure	Nozzle mm	k/ Oh
Humidity:	Brush	No	70				1011
Colour: yellowish	Roller	No					
Degree of gloss: Oily	Dipping	Yes					
Covering power:	Spraying: low press.	Yes					
Density: 900 kg/m³ at 20°C	high press.	Yes					
Content of solids: none	Airless	Yes					
Viscosity: 17 mm <sup>2</sup> /s at 40°C	Electro- static	No					
Danger class: none	Drying: Air	dust- free	set to touch	completely dry	Reco	patable after:	
Poison class: none	20°C	1100		2 hrs			
Flash point: 140°C	Oven	Time 1	⁄₂ h	Temperature	of componer	nt: max.	60°C
Identification duty: none	Forced	Time 1	⁄₂ h	Temperature	of componer	nt: max.	60°C
Shelf life: 12 months cool/dry	Technical da	ata:					
Mixing ratio: 1) 1:4 2) 1:10	Cross-cut te DIN 53151	est					
With hardener:	Hardness ad	cc. to:					
Pot life:	Steel ball jet DIN 53154	t:					
Coverage: 150 - 400 m <sup>2</sup> /l	Mandrel ber DIN 53152	nd test:					
with dry film thickness of 1 - 2 microns 3)	Ericcson cu DIN 53156	pping ind	ex IE:				
Temperature range: - 10°C to + 50°C	Salt-spray to DIN 50021	est:					
Dry film melting-point:	Kesternich t DIN 50018	est:					
1) Weight 2) Volume 3) On smooth surface	Condensed ASTM-D-14			Mixture 1:3	> 10 days		
Surface preparation: Dust-free, oil- and grease-f	ree surfac	ce. Ma	y be appli	ed to moist	surfaces.		
Features: Storage: protect against from results in milky emulsion	ost. Mixab	le in ev	ery ratio	with water,			
Duration of protection: Indoor storage up to 6 mon	nths, depe	nding	on mixture	e ratio			
Removal, cleaning: If required, with petroleum, steam or hot-water cleaner					oaker,		
Supplier:         Valvoline Oil Co. Ltd. Hard           Tel. +41 (0) 1/446 50 50	turmstr. 1	75, P.(	D. Box, Cl	H-8005 Zur	ich, Switze	erland	
The data given are mean values based on prac specification and at user's risk with regard to cl					ng to the s	upplier's	
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#### 16.8 Tectyl 910 / Tectyl 930

Type of corrosion-protective product Rus	t-prevent	ing oil	for prese	ervation ar	nd lubrica	tion	
Name of product: TECTYL 910 / TECTYL 930				No: ication No: tute for Spec.	No:		
General and physical properties: Oil-based corrosion preventive. Stays oil, does not become gummy. MIL-L-21260 B+C, API SF/CD		neric in	fluences	such as agg cal loads a			
Application Temperature: 0°C to 50°C	Applica meth		Thinner %	Viscosity	Spraying pressure	Nozzle mm	k / Oh
Humidity:	Brush	Yes					
Colour: yellow-brown	Roller	Yes					
Degree of gloss: wet gloss	Dipping	Yes					
Covering power:	Spraying: low press.	Yes					
Density: 880 - 890 kg/m <sup>3</sup> at 15°C	high press.	Yes					
Content of solids: none	Airless	Yes					
Viscosity: 910: VG46 930: VG100	Electro- static	Yes					
Danger class: none	Drying: Air	dust- free	set to touch	completely dry	Reco spraying	patable after:	I.
Poison class: free BAG T No. 611 500		1100				i i	
Flash point: 218-230°C in closed pot	Oven	Time		Temperature	of componer	nt:	
Identification duty:	Forced	Time		Temperature	of componer	nt:	
Shelf life: 24 months cool/dry	Technical da	ata:					
Mixing ratio: 1) 2)	Cross-cut to DIN 53151	est					
With hardener:	Hardness a	cc. to:					
Pot life:	Steel ball je DIN 53154	t:					
Coverage: 910:140 930:110 m <sup>2</sup> /l	Mandrel ber DIN 53152	nd test:					
with dry film thickness of 5 - 7 microns 3)	Ericcson cu DIN 53156	pping ind	ex IE:				
Temperature range: - 20°C to + 50°C	Salt-spray to DIN 50021	est:	1	passed 20	hrs		
Dry film melting-point:	Kesternich t	est:					
1) Weight 2) Volume 3) On smooth surface	Condensed ASTM-D-14			Jan-791 7	20 hrs with	out findin	gs
Surface preparation: Dry, dust- and grease-free	surface	<u> </u>	· · · · · · · · · · · · · · · · · · ·				
Features:							
Duration of protection: Indoor storage 6 - 24 mont	hs, depen	iding o	n climatic	conditions			
Removal, cleaning: Normally not necessary. If	required,	with w	hite spirit.				
Supplier: Valvoline Oil Co. Ltd. Hard Tel. +41 (0) 1/446 50 50	turmstr. 1	75, P.C	D. Box, Cl	H-8005 Zur	ich, Switze	erland	
The data given are mean values based on prac specification and at user's risk with regard to cli					ng to the s	upplier's	

Type of corr	osion-prot	ective pro	duct Ru	st-prev	enting oi	I for	pres	ervation ar	nd I	ubricat	ion		
Name of produc	t: TECTYL 9	910 / TEC	TYL 930					e No: fication No: itute for Spec.	No:				
General and phy Oil-based co Stays oil, doe MIL-L-21260	rrosion preves not beco	rentive. me gumm	y.	Atmo		nflue		such as agg ical loads a					
Application Ter	mperature:	0°C to 50	°C		olication- nethod	Т	hinner %	Viscosity		raying ssure	Noz	zzle m	k / Oh
Hu	midity:			Brush	Yes		70				- 111		<u> </u>
Colour:	yellow-br	own		Roller	Yes								
Degree of gloss	wet gloss	;		Dippin	g Yes								
Covering power				Sprayir low pre									
Density:	880 - 890	) kg/m³ at	15°C	high pro									
Content of solids	s: none			Airless	Yes								
Viscosity:	910: VG4	16 930: V	G100	Electro	Yes								
Danger class:	none			static Drying:	dust-	set	to touch				atable	ifter:	
Poison class:	free BAG	T No. 61	1 500	Air	free			dry		spraying			
Flash point:	218-230°	C in close	d pot	Oven	Time			 Temperature	of c	omponen	t:		
Identification du				Force	d Time			Temperature					
Shelf life:	<u> </u>							. ,					
Mixing ratio: 1)	<u> </u>												
With hardener:				DIN 53 Hardne	ss acc. to:								
Pot life:				Steel b	Steel ball jet:								
Coverage:	910-140	930:110 r	n <sup>2</sup> /l	DIN 53 Mandre	154 el bend test:								
with dry film thic		5 - 7 mic			DIN 53152  Ericcson cupping index IE:								
Temperature rai			0113 0)	DIN 53	DIN 53156			nassed 20	hrs				
Dry film melting-		0 1 30 0		DIN 50				passed 20 hrs					
1) Weight	2) Volume	3) On s	mooth surface	DIN 50	018 nsed water cli	mate:		Jan-791 7	20.1	hre with	out fi	ndings	
			grease-fre	ASTM-	D-148, DIN 5			Jan-731 7	201	III3 WILII	out III	- Idii iga	, —
Surface prepar	ation: Dry,	dust- and	grease-ire	Suriac	.e								
Features:													
Duration of pro		Ŭ											
Removal, clear		-	ecessary. I				-						
Supplier:	Tel.	+41 (0) 1/	446 50 50					H-8005 Zur					
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#### 16.9 Tectyl 175GW; Tectyl 185 GW; Tectyl 132

Type of corrosion-protective product Waxy and resinous, dry, grip-dry protective film for longpreservation and external protection Article No: Name of product: TECTYL 175GW; 185 GW; 132 Specification No: Substitute for Spec. No: General and physical properties: Protection against: Extreme atmospheric influences, aggressive industrial Oil-based corrosion preventive atmosphere and gases such as SO<sub>2</sub> and acid vapours. Absolutely resistant in water. 10°C to 35°C Application-Thinner Viscosity Spraving Nozzle k/ Application Temperature: pressure Oh method mm Brush Humidity: yes Roller yellow Colour: nο Dipping Degree of gloss: waxy no Spraying: Covering power: no low press 950 kg/m<sup>3</sup> at 20°C high press Density: no Airless Content of solids:  $65 \pm 3 \%$ yes Electro-Viscosity: yes static Drying: set to touch after A-II dustcompletely Re-coatable Danger class: dry spraying free free BAGT No. 611 500 20°C Poison class: 2 h 5 h 10 h 43°C in closed pot Oven Flash point: Time Temperature of component: Identification duty: ADR/SDR cl. 3 zif. 31c Forced Time Temperature of component: 12 months cool/dry storage Technical data: Shelf life: Mixing ratio: 1) 2) Cross-cut test DIN 53151 Hardness acc. to: With hardener: Steel ball jet: DIN 53154 Pot life: Mandrel bend test:  $5 \text{ m}^2/\text{l}$ Coverage: DIN 53152 Ericcson cupping index IE: DIN 53156 with dry film thickness of 100 3) microns Salt-spray test: Temperature range: - 23°C to + 175°C 5 % at 75 microns, 1500 h DIN 50021 Kesternich test: Dry film melting-point: Condensed water climate: ASTM-D-148, DIN 51359 1) Weight 2) Volume 3) On smooth surface Dry, dust-free, oil- and grease-free surface; surface treated with Dewatering Fluid WA Surface preparation: and TECTYL 506 or 5006W Features: Non water displacing. Duration of protection: Indoor storage up to 5 years / outdoor storage up to 3 years. Immersion-resistant in water. With petroleum, aromatic-free white spirit, alkaline soaker; steam or Removal, cleaning: hot-water cleaner with corrosion protection additive Supplier: Valvoline Oil Co. Ltd., Hardturmstr. 175, P.O. Box, 8005 Zurich, Switzerland Tel. +41 (0) 1/446 50 50 The data given are mean values based on practical experience. Application according to the supplier's specification and at user's risk with regard to climatic and specific conditions. PC Q-Code X X X X X Substitute for: A EAAD088998 20.10.2009 30.01.2018 7-77.252 Drawn Date Drawn Date Number Number Drawn Date Number Drawn Date RT-flex / X / DF Guideline For Engine Protection Winterthur Gas & Diesel After shop test Main Drw. Made 28.02.2018 F. Moszner Page Н 107.426.585.500 64 / 70 Design Group Chkd 28.02.2018 M. Frei Drawing ID 107.426.585 0345

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# 17 Overview of regular inspection lists during engine storage

Mainly four lists have to be used during engine storage:

- 17.1 Inspection List for general parts purpose
- 17.2 Inspection List for dehumidifier

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sion of the drawing, the recipient recognizes and honors these rights. Neither the whole nor any part of this drawing may be used in any way for construction, fabrication,

- 17.3 Inspection List for time-dependant inspections or moving of parts
- 17.4 Inspection List for final delivery inspection

(carried out at engine maker / see chapter 9) Same list to be used for "Inspection upon arrival" (carried out at shipyard / see chapter 11)

## 17.1 Inspection List for general parts purpose

The below-mentioned inspection record list for the inspection of engine and/or parts is for reference only, as every person responsible for storage may create his/her own list, as long as the 7 items given in the list below are mentioned in a way or other and clearly identified respectively.

If possible	e the temperatu	re and hur	nidity should b	e recorded in th	ne same dayti	me period
Part inspected	Re-coated Yes/No	Temp. °C	Humidity %	Signature	Date	Remark (e.g. rust visible)

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#### Inspection List for daily dehumidifier inspection 17.2

# **Humidity record sheet**

Date	Total hour	Temp (°C)	Humidity (%rh) Crankcase	Humidity (%rh) Piston underside	Humidity (%rh) Camshaft housing
	L			1	

Date	Total hour	Temp (°C)	Humidity (%rh) Crankcase	Humidity (%rh) Piston underside	Humidity (%rh) Camshaft housir
tute for:	Tan 40 0000 T.A	EAAD088998 30.0	01.2018		PC Q-Code X X X
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# 17.3 Inspection List for time-dependant inspections or moving of parts

# Repeated treatment record sheet

Date	Treatment	Comments
Once a week	Engine turned with main lube oil pump running Lubrication of the cylinder liners Check oil level in the fuel system Operation of the cooling water pumps Move the fuel regulating linkage Temperature and humidity recording Inspection/re-coating of blank metal parts	
Once a month	Inspection of the crankcase Inspection of the piston underside Inspection of the exhaust manifold Open/close main starting shut-off valve Check dehumidifying system (filter, hoses, etc.) Turn the rotor of the turbocharger(s) by 90° Turn the auxiliary blower(s) by hand	
After three months	Inspection of a cross head bearing pin Inspection of a main bearing journal pin Replacement of the silica gel desiccant bags Analysis of the cooling water Analysis of the system oil	

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# Inspection List for final delivery inspection / inspection upon arrival

- Final delivery inspection (carried out at engine maker / see chapter 9)
- Inspection upon arrival (carried out at shipyard / see chapter 11)

# This parts list can/should be used for: Final delivery inspection (at engine maker) &

	Final deliver	y inspecti	on (at	d be used for engine mak (at shipyaro	er) &		
No.	Part - Designation	Inspec	ted	Re-coated Yes/No	Signature	Date	Remar k (e.g. rust visible)
1	Crankshaft						VISIDIC)
2	Main bearing shell						
3	Main bearing cover						
4	Jacking bolt main bearing (For RTA52U; RTA62U-B; RTA72U-B; RTA84T-D only)						
5	Crank web						
6	Crankpin : web journal & main journal						
7	Gear wheels						
8	Thrust bearing						
9	Thrust bearing pads						
10	Bottom end bearing						
11	Connecting rod						
12	Crosshead bearing						
13	Crosshead guide shoes						
14	Piston rod						
15	Piston						
16	Exhaust valve						
17	Bedplate: machined surfaces						1
18	Column: machined surfaces						
19	Column (guide rails)						
20	Cylinder block						
21	Tie rods						<u> </u>
23	At cyl. block top  At bedplate bottom						-
24	Diaphragm						
25	Piston rod gland						
26	Cylinder liner						
27	Scavenge ports						
28	Anti-Polishing ring						
	1				<u> </u>	I	<u> </u>
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			_		
29	SAC cooler				
30	Cylinder cover				
31	Fuel injectors				
32	Combustion space				
33	Starting air valve				
34	Starting air shut-off valve				
35	Exhaust valve cage				
36	Exhaust manifold				
37	Scavenge air receiver				
38	Auxiliary scavenge air blower				
39	Flywheel				
40	Turning gear				
41	Electric motor				
42	RTA fuel pump block				
43	Starting air distributor				
44	Camshaft/reversing servomotor				
45	Linkage local manoeuvring stand				
46	RT-flex Supply Unit				
47	All flanged SU parts				
48	High-pressure fuel pumps				
49	Servo oil pumps				
50	Rail unit box				
51	Fuel oil rail				
52	Injection Control Unit (ICU)				
53	Servo oil rail				
54	Exhaust valve drive				
55	High-pressure pipes to fuel				
	injectors				
56 57	Electronic cabinets  All relief valves				
58					
59	<u> </u>				
60	Pilot injection valve				
61	Gas distributor pipe				
62	• •				
		-			

# 18 Engine tools

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The engine tools should be stored in a clean, well ventilated and dry place; in addition, they need to be protected against corrosion. It is advisable to check the condition and completeness of the engine tools to avoid any problems during commissioning and engine hand over.

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### 19 Spare parts

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All spare parts must be firmly secured to prevent any movement. Metal-to-metal contact is to be avoided during storage of any components. All open ports, adapters, pipes, etc. are to be sealed in order to prevent ingress of foreign particles.

All spare parts have to be protected against corrosion. Large components should be treated with 'Valvoline' Tectyl 506 or a suitable equivalent. Smaller components, with the exception of electronic equipment, may be wrapped in a corrosion-protective VCI paper.

## 20 Health protection and safety at work

The official statutes and regulations for occupational hygiene and technical equipment measures are to be stringently observed, and the working conditions with cleaning agents and corrosion protective products have to be allowed for.

#### Samples of safety mask & safety goggle which are to be used:





Safety mask with exchangeable filter system.

Must be used during corrosion protection application or use of cleaning solvent inside closed spaces (inside the engine)

Safety goggle with closed side frame.

Must be used during corrosion protection application or use of cleaning solvent inside closed spaces (inside the engine)

# 21 Disposal

The generation of waste should be avoided or minimized wherever possible. Avoid dispersal of spilled material, their contact with soil and further runoff, waterways, drains and sewers. Disposal of these products, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional or local

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