New Sulzer Diesel

Diesel After-Sales Service

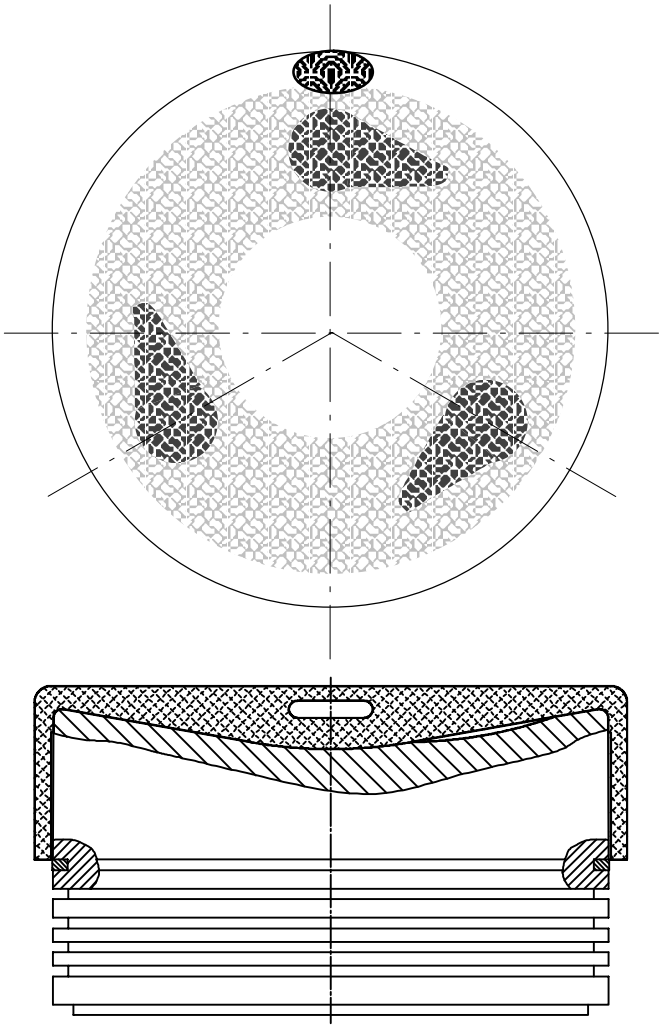
Service Bulletin

RTA–26

03.01.96

Technical Information to all the Owners of Sulzer RTA 58, 68, 76 and 84 Type Engines with *WATERCOOLED PISTONS*

Loss of Material on Piston Crowns due to High Temperature Corrosion and Erosion



Contents: **Page**

28.81.07.40 – Printed in Switzerland

New Sulzer Diesel Ltd
Phone: (052) 262 80 10 (24hours)

Diesel After-Sales Service
Telex: 896 659 NSDL CH

PO Box 414
Telefax: (052) 213 94 83

CH-8401 Winterthur, Switzerland

New Sulzer Diesel

INTRODUCTION

The loss of material on piston crowns which has more generally been known as piston crown ”burn-off” will be discussed in this Service Bulletin.

The up to now falsely called piston crown ”burn-off” is in principal a loss of material on piston crowns which is caused by a correlation between high temperature corrosion and erosion.

Corrosion: The elements Sulphur (S), Vanadium (V) and Sodium (Na) contained in the heavy fuel oil burned in large two-stroke engines deserve a special consideration in relation to corrosive deposits causing the loss of material on piston crowns.
High temperature corrosion deposits, contained in the light ash layer the piston crown is covered with after a relatively short running period, will cause practically no harm to the material of the piston crown as long as this layer remains undisturbed.

Erosion: Some areas of the piston crown are exposed to erosion caused by high gas and flame speeds which are evident in the combustion chamber. They are primarily responsible for the local removal of the corrosion products, thus starting a correlation between corrosion and erosion which enhances the loss of material in the affected areas.

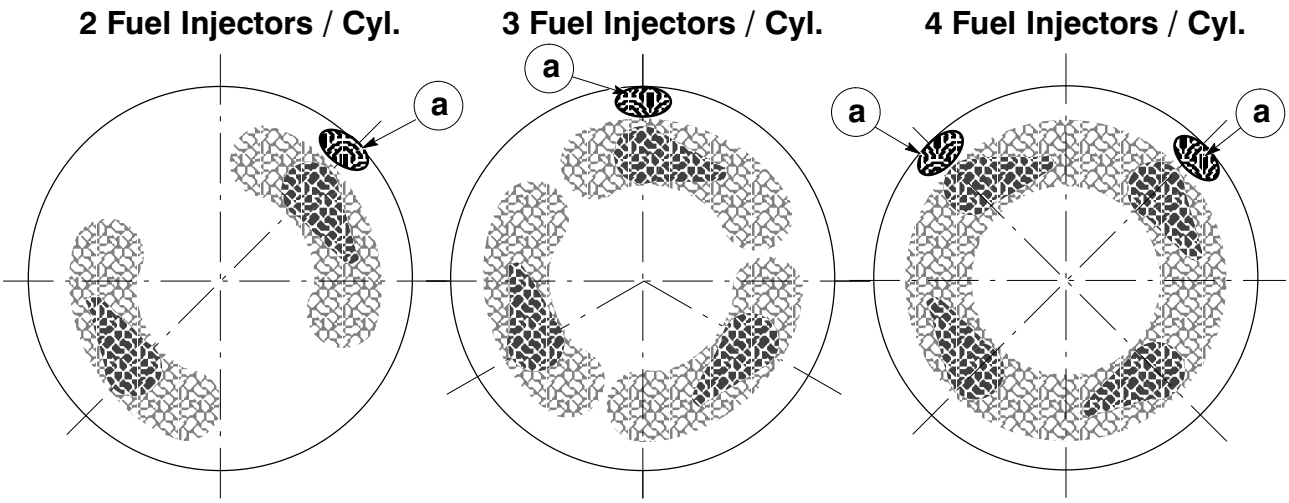
The mechanism of material loss is highly influenced by temperature, thus higher surface temperatures will indeed accelerate the loss of material in affected areas.

This Service Bulletin deals with engines equipped with water-cooled pistons. It informs you about the recognition of trouble spots, which can lead to material loss in an excessive manner if not detected and counteracted on in an early stage. It also suggests necessary countermeasures on how to minimize the loss of material on piston crowns.

1. LOSS OF MATERIAL ON PISTON CROWNS

There are two distinct patterns indicating the loss of material on piston crowns:

A. Local Material Loss in the Area of the Injection Spray



Pattern on piston crown if both fuel injectors are in poor condition or equipped with nozzle tips with incorrect specification.

Pattern on piston crown if all three fuel injectors are in poor condition or equipped with nozzle tips with incorrect specification.

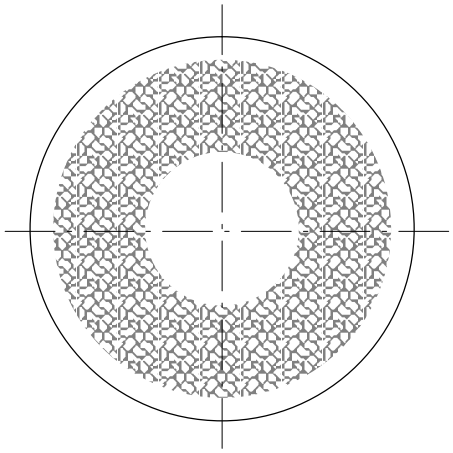
Pattern on piston crown if all four fuel injectors are in poor condition or equipped with nozzle tips with incorrect specification.

(a) Deep spots of material loss caused by dribbling fuel injection nozzles.

New Sulzer Diesel

B. Loss of Material on Top of Piston Crown

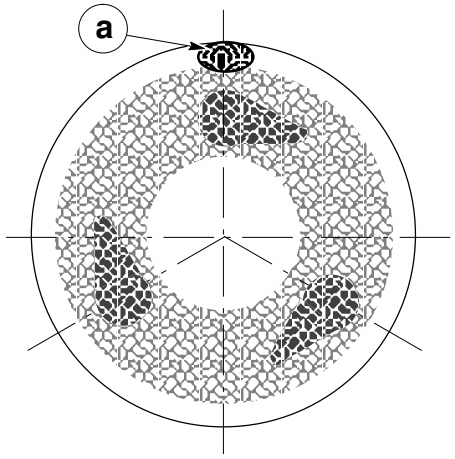
Pattern: **So called ”paving stone structure” / ”elephant skin” over a large part / or smaller parts of the combustion surface of the piston crown has been observed. Such a morphology is typical for the described loss of material.**



Reason for the loss of material:

1. **Piston cooling bores are covered either with scale and/or oily sludge due to insufficient piston cooling water condition.**
   (1mm deposit on the inside of the cooling water bores can cause a temperature increase of up to 200˚C on the combustion space surface of the piston crown.)
2. **Lack of scavenge air, due to dirty air filter, compressor wheel and diffuser of the turbocharger, contaminated aircooler, or a dirty exhaust gas boiler or silencer.**

Loss of material due to a combination of factors shown on A. and B.



Drawn for engines with 3 fuel injectors / cyl.

Pattern on piston crown if all three fuel injectors are in poor condition or fitted with a nozzle tip with an incorrect specification with one of them dribbling (a).
In addition there are some signs of impaired piston cooling originating from a source mentioned in paragraph B.1. and B.2. or a combination thereof influencing the temperature of the combustion space surface of the piston crown.

During regular piston ring inspections through the scavenge ports the piston crown should be inspected also to recognize early signs of loss of material on the piston crown.

If a template is made which has the same contour as the template 94366, but only half its diameter, then the approximate loss of material can be checked with the piston in situ (please refer to sketch on page 3) by inserting the template through the scavenge ports.

The above sketches may help you to pin-point the source of a problem in its early stage.

New Sulzer Diesel

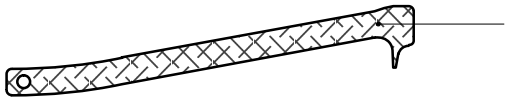
We would, however, like to point out that a small amount of material loss of < 0,2 mm/1000h is normal as long as it is evenly distributed. It also has to be born in mind, that a grey sooty layer has certain protection qualities against erosion as long as it remains undisturbed.

During piston overhauls the combustion space side of the piston crown has to be inspected and the contour must be checked each time, with the template 94366 and feeler gauge 94122 contained in the tool set, to establish the total loss of material (for your information on the matter please refer to the sketch below or to page 340−4 or 3403−4 of the Maintenance Manual).

Checking the Piston Crown for Loss of Material

(when the piston is fitted to the engine)

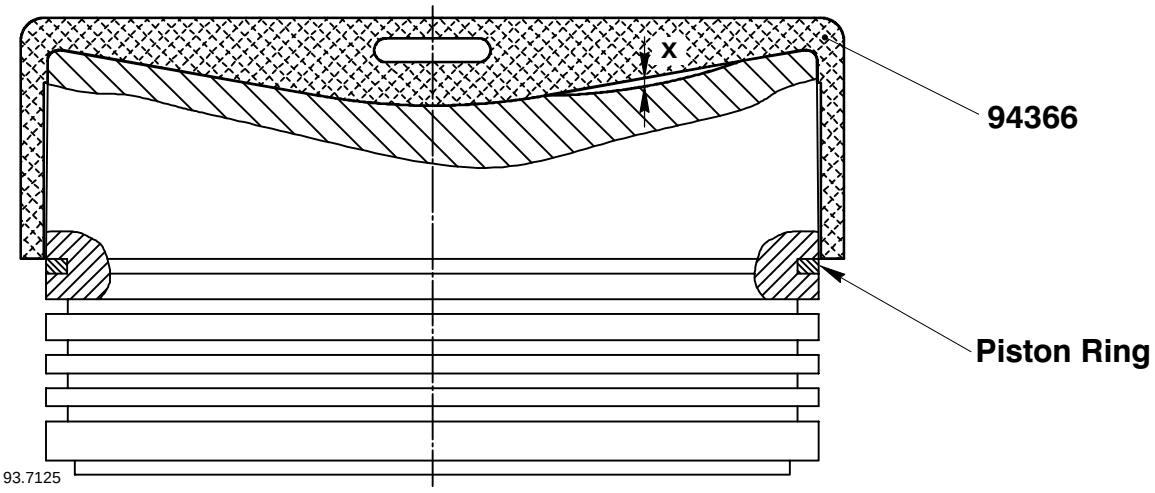
D A N G E R ! !
Whilst using the template the engine must under no circumstances be turned with the turning gear!



½ Template to check the loss of material if the piston is still fitted in the engine.

Checking the Piston Crown for Loss of Material

(when the piston is withdrawn)



ENGINE TYPE	RTA 58	RTA 68	RTA 76	RTA 84
Wear Limit **"x"**	8 mm	8 mm	9 mm	10 mm

If any abnormal amount of loss of material is discovered the piston crown must be removed and the cooling space must be inspected carefully and if there is any scale and/or oily sludge discovered then the origin of same must be investigated and the necessary steps taken to avoid any further chance for contamination of the piston cooling system.
However, should the loss of material be caused by overheating due to lack of scavenging air it is strongly recommended to investigate the matter until the true origin of the problem which has lead to this situation is found and taken care off (hints on possible trouble spots can be found in para B. 2.).

Piston crowns with wastage exceeding the above limits "x" can be sent to specialized firms for reconditioning.

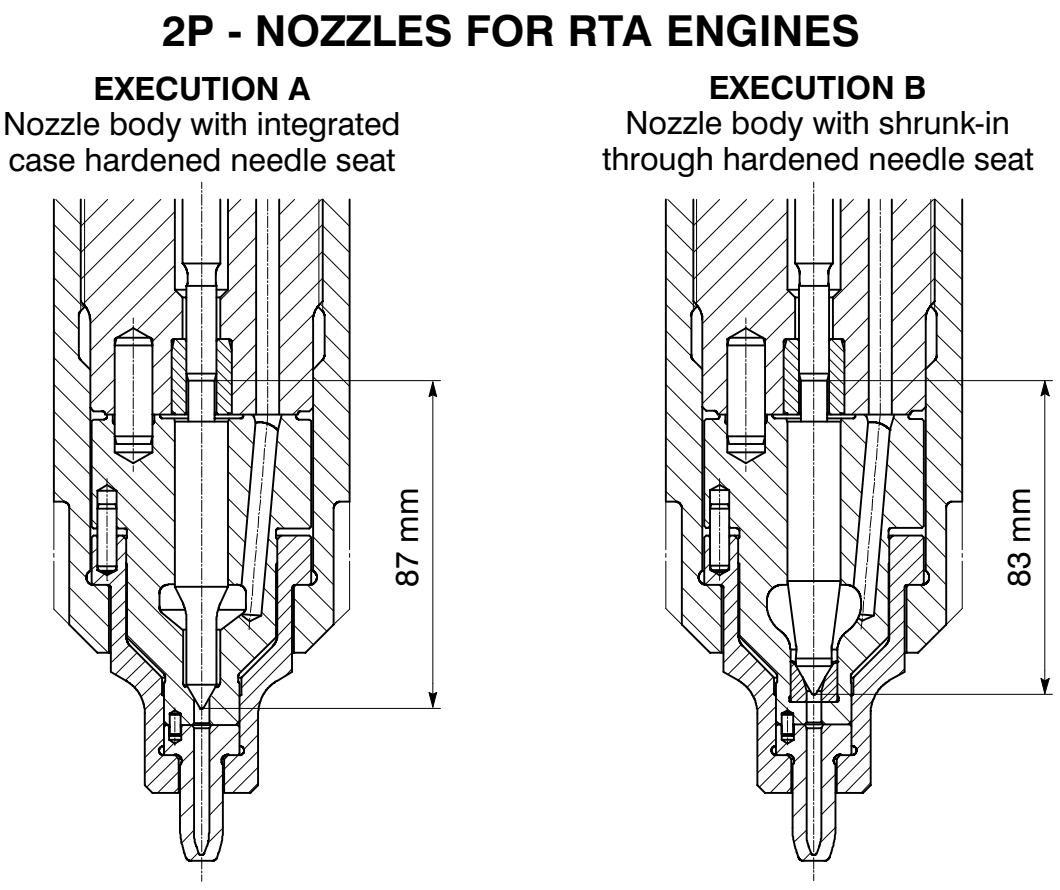
New Sulzer Diesel

2. COUNTERMEASURES TO MINIMIZE THE LOSS OF MATERIAL

2.1. Fuel Injector Valves

As we pointed out in paragraph 1.A. it is of major importance that the fuel injector valves are kept in a good state of repair to avoid excessive loss of material on piston crowns.
Also fuel nozzle tips with the wrong specification (unsuitable spraying angles, wrong size of hole diameters etc.) can cause loss of material, even if the fuel valve itself is in good condition.

The deep spots (a) which are caused by dribbling fuel injectors may shorten the useful life of a piston crown considerably and may call for an early reconditioning which may otherwise not be necessary.



To minimize the loss of material on the piston crown it is essential to use **only fuel nozzle tips with the correct specification** and we also recommend to use **only nozzle bodies with the through hardened seat** (please refer to "Execution B" on sketch above) to prolong the time between overhaul and increase the components serviceability.

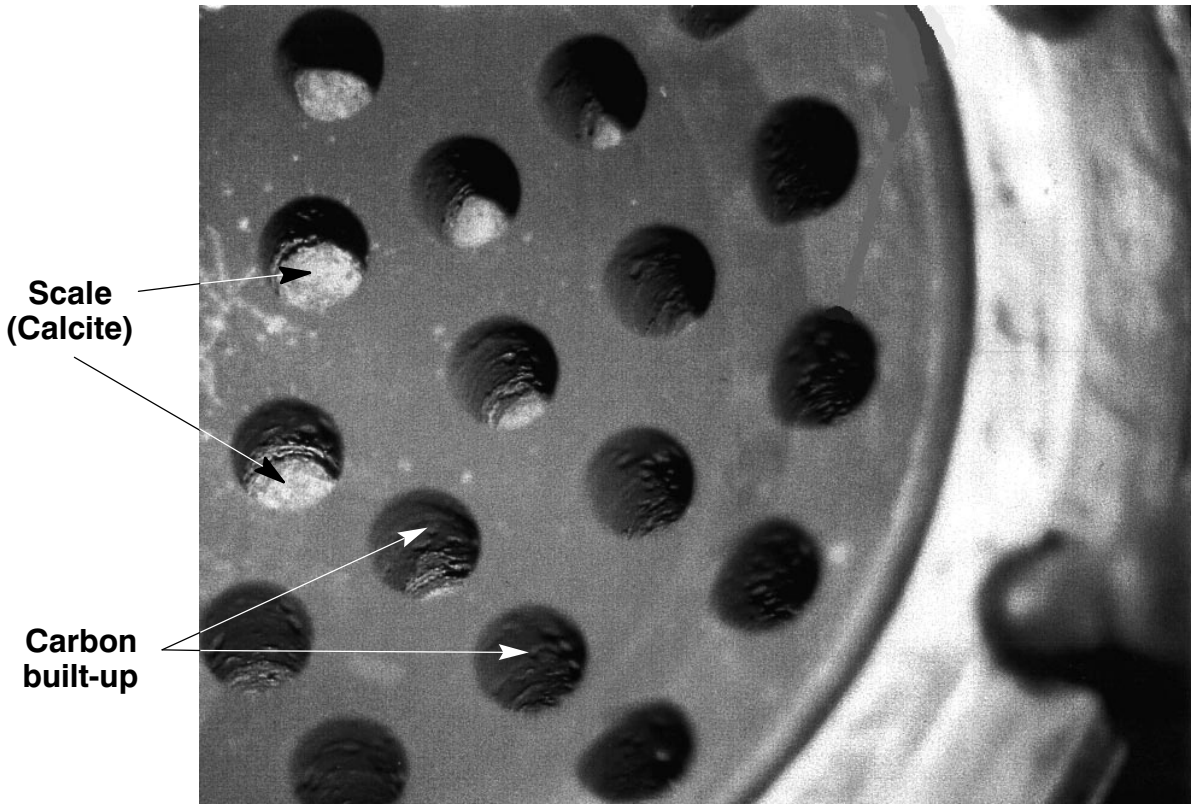
Fuel nozzles with a needle length of 87 mm have a body which has only a case hardened integrated needle seat, whereas the correct nozzle body to be used with the shrunk-in through hardened needle seat has a needle with a length of 83 mm only. The correct fuel injection parts suitable for your engine can be obtained from:
New Sulzer Diesel After Sales Service or their Representatives.

New Sulzer Diesel

2.2. Impaired Piston Cooling

If a pattern according to paragraph 1.B. or a combination of 1.A. and 1.B. is recognized then it is necessary to investigate the piston cooling system for its efficiency. The piston cooling water treatment plant may not work properly thus some of the sediments are causing either calcite and/or carbon deposits in the cooling bores of the piston crown (please refer to the picture of contaminated cooling bores below).

Contamination of Cooling Bores in Piston Crown



To clean the scale off the cooling bores it is necessary **to sandblast the internal of the piston crown.** A good efficient medium for the sandblasting is fine corund grit. Chemical removal of the scale is **not sufficient** enough, gives **unsatisfactory results** and in addition may also be an **environmental hazard.**

3. PISTON COOLING WATER SYSTEM

The layout of the piston cooling water system is often not according to the best specification and can therefore cause problems, which can in turn lead to contamination of the piston cooling water.

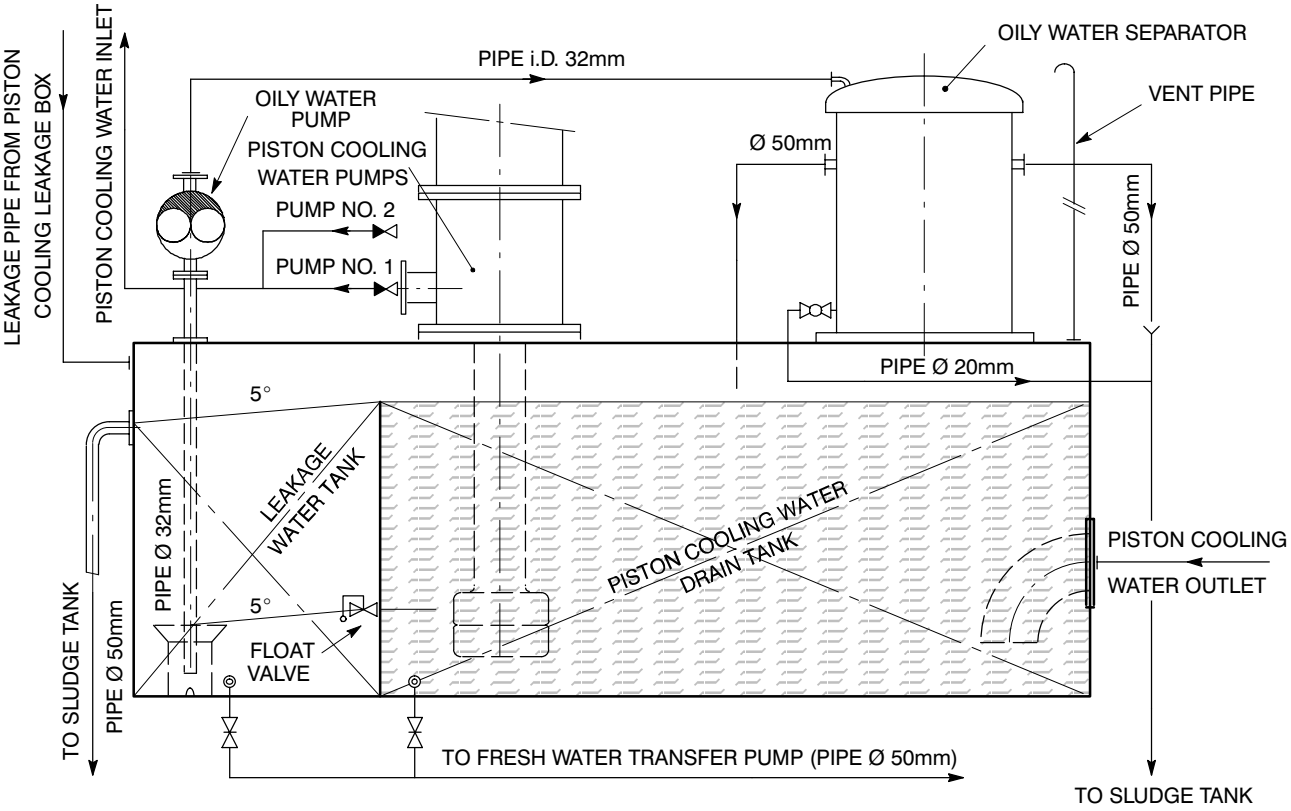
Contamination of the piston cooling system is mainly caused by oil and combustion residues which enter the cooling system and, if the layout of the system does not allow to separate them properly from the piston cooling water, they will eventually lead to contamination and forming of scale as can be seen on the picture above.

To improve the separation of oily residues we suggest to introduce a simple modification to the piston cooling water system as shown on the next page.

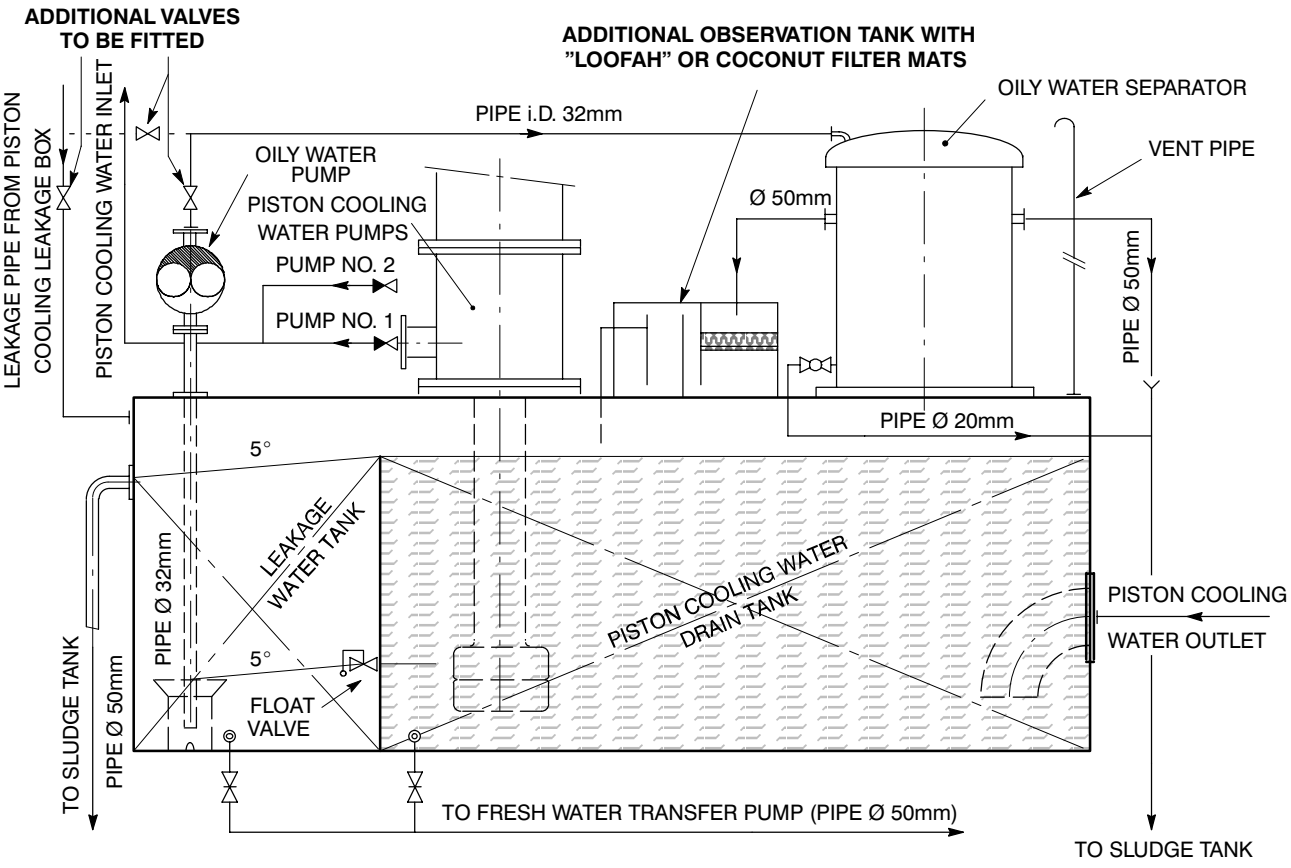
The oily water separator may be a static or centrifugal type. In case the actual arrangement of the leakage water tank section is different, the indicated proposal may serve as a guideline for the improvements.

New Sulzer Diesel

Existing Piston Cooling Water System (as Example)

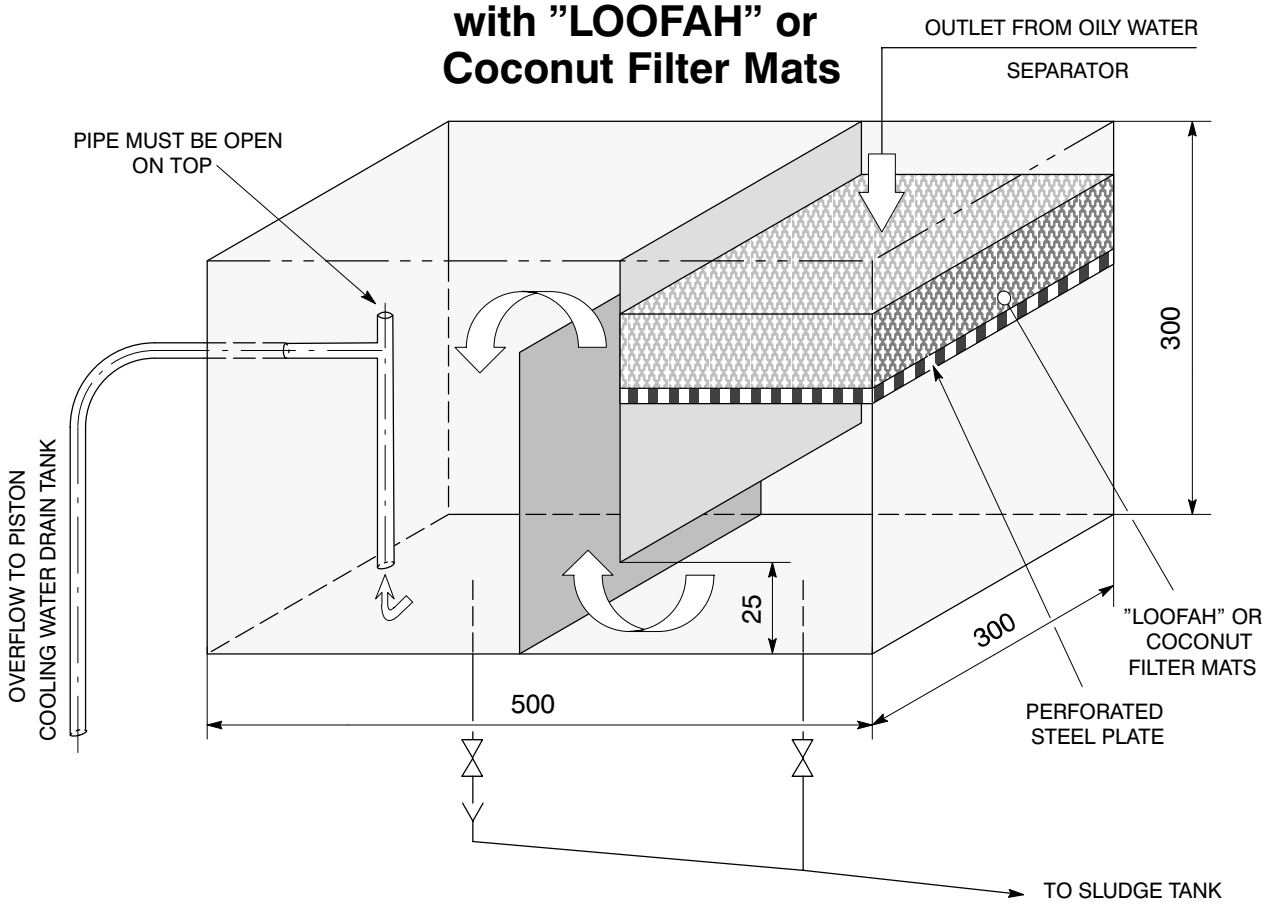


Modified Piston Cooling Water System



New Sulzer Diesel

Additional Observation Tank with ”LOOFAH” or Coconut Filter Mats



THE AIM AND WORKING PRINCIPAL OF THE MODIFIED PISTON COOLING WATER SYSTEM IS:

- Better control of the separator efficiency in service with the addition of an observation / filter tank between the ”clean water outlet” of the oily water separator and the piston cooling water drain tank.
- The observation tank will help you to recognize any contamination taking place at an early stage. It acts as an indicating instrument which will enable you to clearly recognize when the oily water separator must be cleaned, thus to avoid contamination of the water space before loss of material on the piston crown can take place.
- The ”LOOFAH” filter mats or other oil absorbent filter material can be washed in water and are fit for further use after cleaning. This makes them an economical proposition and in addition also friendly for the environment.
- The leakage water from the piston cooling leakage box is lead directly to the oily water separator, **the valves to the leakage water tank and oily water pump discharge remain closed during normal operation.**
- The existing oily water pump is only used manually if necessary, for skimming / overflowing any collected oil off the surface of the cooling water drain tank.

New Sulzer Diesel

3.1. Cascade System to Clean the Piston Cooling Water

A number of plants are equipped with a so called ”Cascade” cleaning arrangement for the piston cooling water.

The cascade system does keep the cooling water relatively clean as long as it is properly maintained. The piston cooling drain tank must be cleaned frequently to ensure that the steel plates which retain the oily residues are free from same to avoid that they are carried into the piston crowns where they can form the deposits mentioned in Paragraph 2.2., which enhances the risk of loss of material on the piston crowns.

It may be possible to install a tank as shown above, in series with the leakage line of the cascade system, to have an indication on the cleanliness of the piston cooling system at all times.

3.2. Piston Cooling Water

The Service Instruction Manual section 076 provides the necessary information in regards to the treatment of the piston cooling water particularly to avoid corrosion in the system. In service the quality of the cooling water is regularly checked with means and instructions provided by the supplier of the corrosion inhibitor.

In addition to the regular tests of the cooling water we strongly recommend as from now to **test the oil content in the piston cooling water**.

As a guide the **oil content** in the piston cooling water should be **less than 30 ppm.**

In case this value is regularly exceeded then investigations into the reason (s) and appropriate actions and countermeasures have to be carried out.

4. CONCLUSION

As can be seen from the above, it is not only necessary to ensure that components with the correct specification are fitted to the engine, but also that they are properly maintained and that the treatment and cleanliness of the piston cooling water system is monitored to avoid unreasonable loss of material on the piston crowns.

5. SERVICE BULLETINS PUBLISHED FOR LARGE BORE RTA–TYPE ENGINES

We have so far published the following Service Bulletins which are valid for Large Bore RTA–Type Engines (RTA 52 to RTA 84):

RTA–2	dated 05.10.88 /	Water Drain from Charge Air Receiver and Charge Air Temperature
RTA–3.3	dated 25.04.94 /	Fuel Injection Nozzles
RTA–4	dated 20.11.89 /	Oil Damping for Short Tie Rods
RTA–8	dated 15.06.92 /	RTA–Cylinder Liners and Reinforced Water Guide Jackets
RTA–9	dated 20.07.92 /	Cylinder Cover with Erosion / Corrosion Resistant Cladding
RTA–10	dated 28.10.92 /	RTA ”–8 Series” Engines / Piston Skirt in Two Parts

New Sulzer Diesel

RTA–11 dated 31.03.93 / Fuel Injection Pump Regulating Linkage

RTA–14 dated 30.11.93 / System Oil Care and Maintenance

RTA–15 dated 10.02.94 / Elastic Studs on RTA-Type Engines

RTA–16 dated 15.03.94 / Piston Rod Gland for RTA "-8 Series" Engines

RTA–17.1 dated 28.02.95 / Circulation Valve to Fuel Injection Valve

RTA–18 dated 15.09.94 / Running-in of Piston Rings and Cylinder Liners

RTA–19 dated 28.10.94 / Oil Supply Monitoring for Geislinger Torsional Vibration Damper

RTA–20 dated 30.11.94 / Rotational Safety Studs for Roller Guide of Fuel Pump and Exhaust Valve Actuator

RTA–21 dated 10.04.95 / Improvement of Starting Behaviour (For engines with DENIS–1 and DENIS–5 Control Systems only!)

RTA–22 dated 10.07.95 / Waisted Bolts for Piston Crown Spraying Plate of RTA 84C, 84CU, 84M and 84T Type Engines

RTA–24 dated 03.11.95 / ABB-Turbochargers Type VTR ..4 Introduction of Advanced Types of Bearing and Centrifuges

Should you not be in possession of the above mentioned documentation suitable for your plant, kindly contact your local New Sulzer Diesel representative for your copy.