

Cleanliness

General





Cleanliness - Flushing procedure

1. In our documents you can find recommendations covering the preparation, manufacturing and installing of all lubricating and fuel oil piping for MAN B&W Diesel 2-stroke diesel engines and applies to engine builders, shipyards etc.
2. We recommend to follow our instructions to ensure that the whole system is absolutely clean before filling with oil and starting up!

In order to avoid problems stemming from rust, scales, welding and impurities in lubricating and fuel oil systems it is essential that the system pipes are manufacturing, cleaning and treating accordingly.

The detailed procedures have been prepared on basis of many years experience. Large particles, e.g. slag, sand and steel particles can damage pumps, valves and bearings.

Clean pipes will reduce the flushing period considerably. First it is necessary to understand that flushing is **not able to remove completely particles if the system is very dirty**. Flushing removes particles, which is not possible to avoid at earlier stages and also to check the condition of the system.

If some impurities will remain in the system then, after flushing may cause damage later: due to vibrations of the ship in service.

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General



Scratches of crosshead pin – open up inspection after sea trial

All engine crankshaft bearings were heavily damaged as well as the crossheads pins had got many scratches. Of course, all damaged parts required to be dismount and send to workshop and rectify.

Afterwards, inspection of lubricating oil and system pipes carried out. Many of hard particles found inside. The welds were checked and found not satisfactory – splatters, not full penetration, some pockets, etc. Other bearings (main) found to be damage, also.



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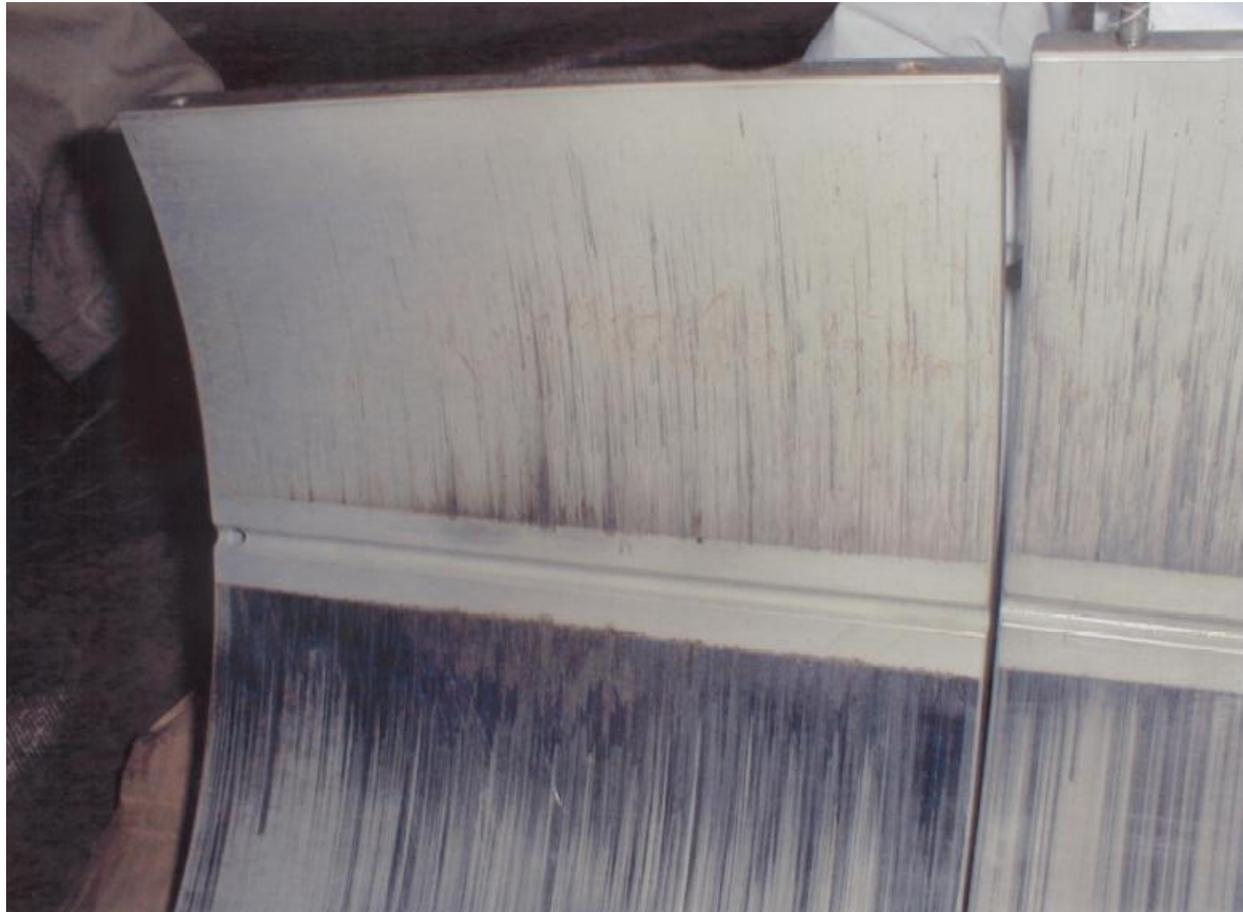
General



Scratches of crosshead pin – open up inspection after sea trial

These examples show how important is the proper **manufacturing of pipes, clean assembly process and flushing procedure.**

Please imagine yourself the necessary work to be done to rectify all these damages.



OBJECTIVES of flushing.

- **Remove those particles from the system which cannot be avoided at earlier stages**
- **Improve condition of new lubricating oil**

1.1. To protect the engine components it is very important that the main lube oil system, the camshaft lube oil system and the fuel oil system are carefully flushed.

1.2. While-erecting engine it is often very difficult, due to sand blasting of the ship's hull, welding in the engine casing etc. to prevent entering of particles from these jobs inside of the engine, into the oil tanks and inside the piping.

1.3. Particles can also be present from manufacture of pipes and from the production and assembly. Some particles may still remain in the internal systems on the engine.

1.4. Particles / water can also be present in new oil.

Always by-passing the bearings

Cleanliness

Flushing



As particles cannot be completely removed by manual cleaning, a special flushing procedure must be used before filling the systems with oil to save components in the fuel oil system and bearings and journals against the ingress of dirt.

First it is necessary to understand that flushing is not able to remove completely particles if the system is very dirty. Flushing removes little particles, which is not possible to avoid and also to check the condition of the system.

Flushing of the lube oil systems **can be affected with the lube oil normally recommended** by MAN B&W Diesel for service.

PRECONDITIONS

- Clean engine inside
- Clean pipes inside
- Clean tanks inside

The initial conditions before flushing are **clean engine inside** and the **pipes** already **properly welded and clean**. All pockets inside engine should be cleaned very carefully.

Then the **lubricating tank is also clean**. When filling the tank let the oil pass through a filter / separator.

Cleanliness

Flushing



Stages of flushing

1 STEP – flushing of external piping with engine pipes by-passed, what means, only engine room pipes (Shipyard's pipes)

2 STEP – flushing of both external and internal piping, what means engine room pipes and engine pipes together,

but not the bearings and crossheads.

The purpose of flushing is to remove particles during circulation of the oil but **by-passing the bearings**. During the first 8 hours it essential **to washed down engine inside** for instance using flexible hose connected to the main lube oil pipe.

Flushing conditions

Obligatory conditions:

- Heating the oil to 60-65 deg C
- Running purifier (centrifuge)
- Full flow rate from both oil pumps running simultaneously
- Portable vibrators (instead of manual hammering)

After the first 24 hours of flushing, the 50 micron filter basket should be either exchanged with a 10-25 micron filter basket or additional 10-25 micron filter material should be inserted inside the filter basket.

Optional conditions:

- Temporary full flow flushing filter of 10-25 μ m fineness,
- Temporary by-pass fine filter of 6 μ m fineness (tank to tank)

Cleanliness

Flushing



Some comments in respect of the mentioned above conditions:

The min. Reynolds number is 3000 in order to have sufficient turbulence in the piping; normally both pumps to be kept running with it's max. capacity.

Sometimes there is a problem for shipyard that **separators are not commissioned** before flushing. And they start it without purifiers. In such case **experience shows** that the period of flushing is the lost period, lost time. The **shipyard management** should arrange to commission purifiers in such way that to be ready for flushing, too.

To attend mentioned temperature some **heating system** to be arranged. Quite often without separators obtaining the temperature is very difficult may be the boiler or other method will be needed. Anyhow, until not possible to provide heating and obtaining required temperature to start purifiers there is **useless to start flushing process**.

We insist to use vibrators: **portable vibrators should be used** on the outside of the lube oil pipes during flushing in order to loosen any impurities in the piping system. These vibrators should to be moved for at least every 6 hours.

Hammering is not sufficient method. Also we do not thrust in it: to achieve similar effect as for vibrator we need many workers at the same time, let me say 50 persons for one shift. What about the second and third shift? You may need another 50 and 50 peoples!

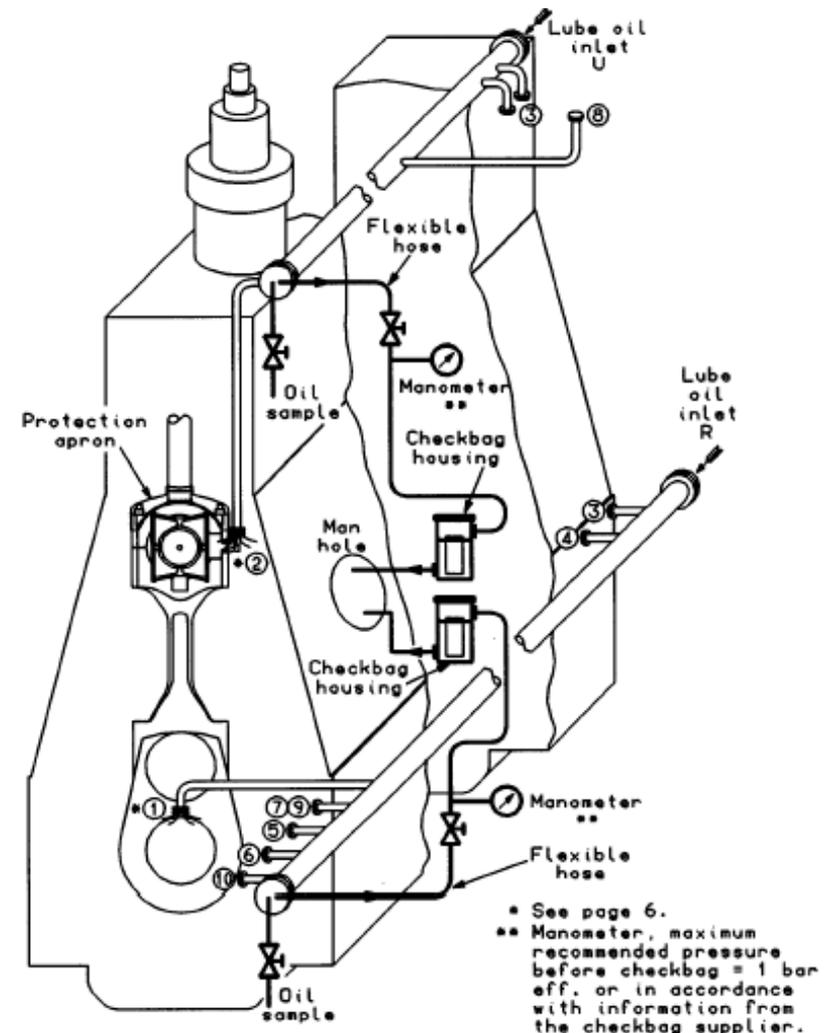
Cleanliness Flushing



Verification of flushing results

- **Check bag**
- Particle counting

Normally the check-bag is **not used during flashing**, it is **not filter**. It is to verify conditions of flashing. So, after some period of flashing we have to install check-bags for about 2 hours, then take it and wash in diesel oil. Then it is easy to see any particles, so we can examine them. **No one hard particle to be found after 2 hours.**



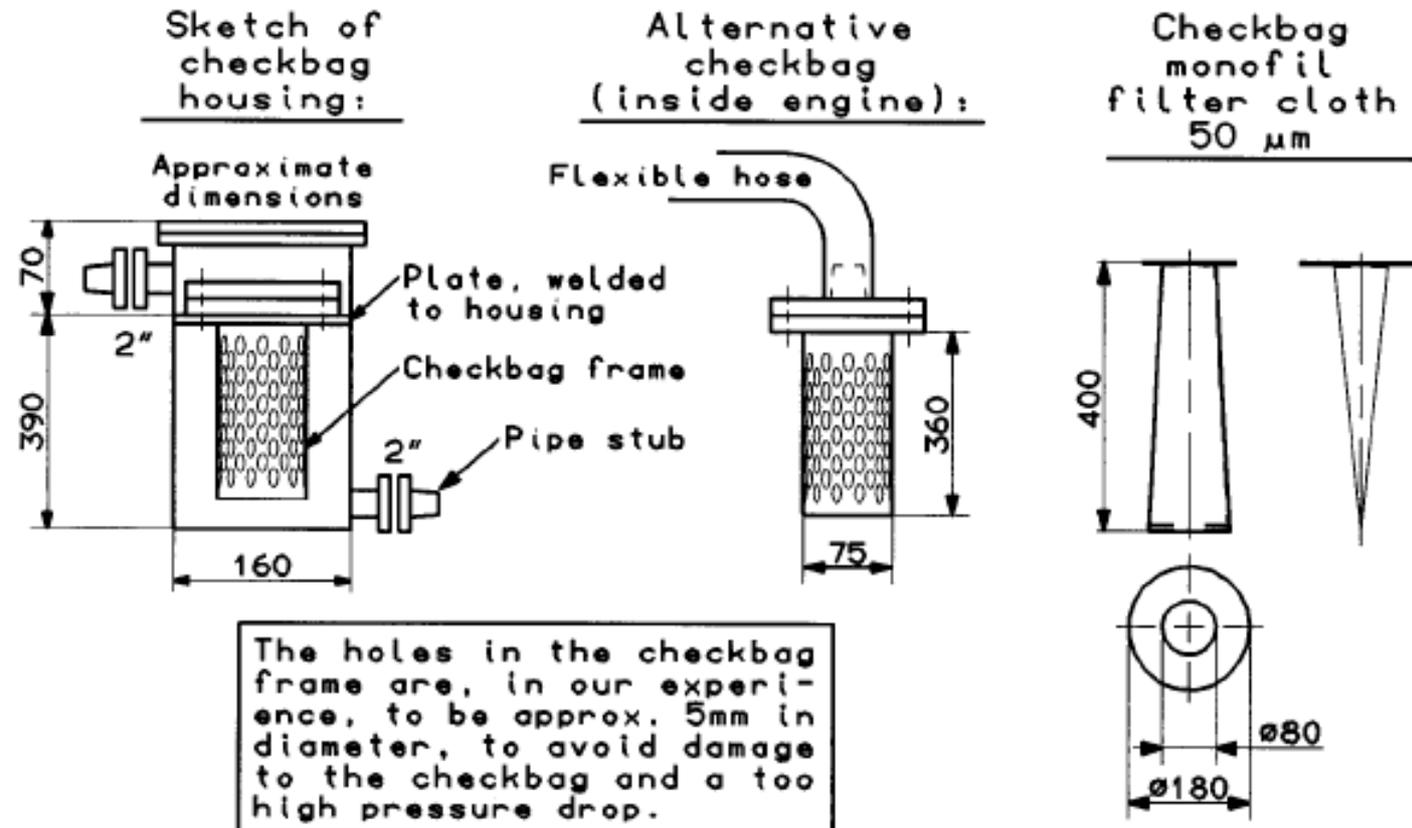
Cleanliness Flushing



Verification of flushing results

- **Check bag**

To be installed inside check bag housing



Cleanliness Flushing



Verification of flushing results

• Particle counting

If the first step of flashing is satisfied then we can attend for **second stage** of flashing. Again we use **check-bags** for control of cleanness. But at this stage we **count the numbers of particles**, also, parallel to using the check-bag. So, when we have satisfactory check with the bag then oil sample to be sent for laboratory with possibilities of particle accounting.

When using particle counting, flushing should not be acceptable as being complete until the cleanliness is found to be within the range in ISO standard 4406 levels less 19/15.

In case of ME type engines, the cleanliness is found to be within the range in ISO standard 4406 levels less 16/13.

MBD Info. No. 3 76 661		A 4	ISO 4406 Fluids Contamination Coding	MAN B&W Diesel A/S -- Identification No. -- 78 65 24 3
Suppl. Dwg.:			Page No.: 8 (8)	
Tabular presentation of the code number				
Code number	Number of particles per millilitre larger than			
	5 µm		15 µm	
	More than	Up to and including	More than	Up to and including
20/17	5 000	10 000	640	1 300
20/16	5 000	10 000	320	640
20/15	5 000	10 000	160	320
20/14	5 000	10 000	80	160
19/16	2 500	5 000	320	640
19/15	2 500	5 000	160	320
19/14	2 500	5 000	80	160
19/13	2 500	5 000	40	80
18/15	1 300	2 500	160	320
18/14	1 300	2 500	80	160
18/13	1 300	2 500	40	80
18/12	1 300	2 500	20	40
17/14	640	1 300	80	160
17/13	640	1 300	40	80
17/12	640	1 300	20	40
17/11	640	1 300	10	20
16/13	320	640	40	80
16/12	320	640	20	40
16/11	320	640	10	20
16/10	320	640	5	10
15/12	160	320	20	40
15/11	160	320	10	20
15/10	160	320	5	10
15/9	160	320	2.5	5
14/11	80	160	10	20
14/10	80	160	5	10
14/9	80	160	2.5	5
14/8	80	160	1.3	2.5
13/10	40	80	5	10
13/9	40	80	2.5	5
13/8	40	80	1.3	2.5
12/9	20	40	2.5	5
12/8	20	40	1.3	2.5
11/8	10	20	1.3	2.5

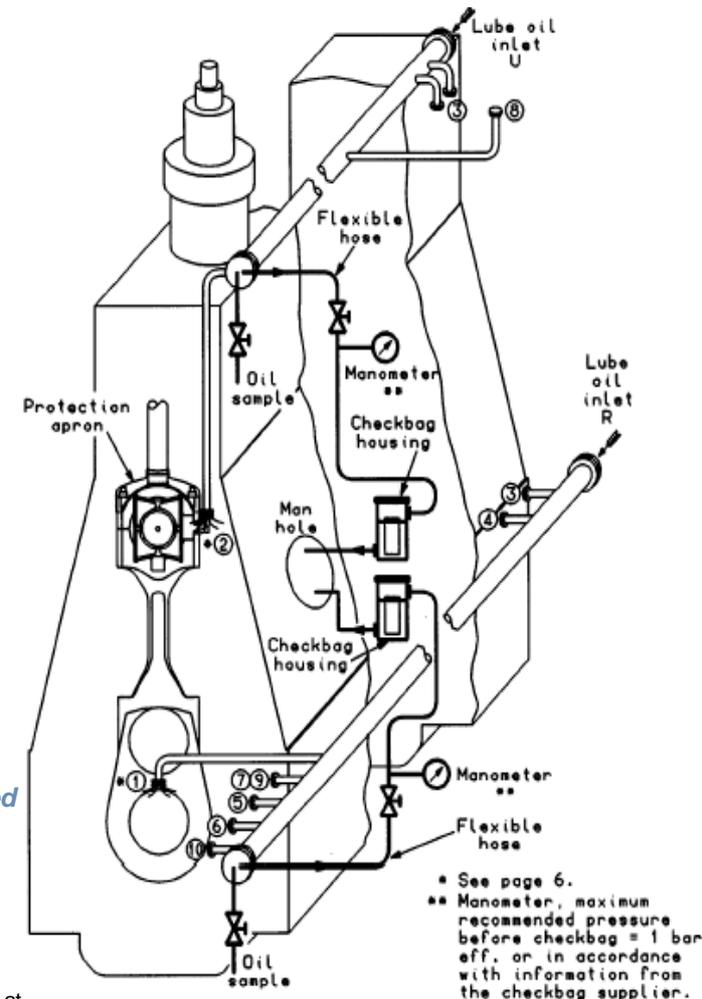
NOTE - The table above covers the most usual series of codes between scale numbers 8 and 20. Other codes which are not given above can be used also.

Cleanliness Flushing



Preparation for first stage - Flushing engine room pipes, only

1. Inspect condition of engine room pipes inside. If any dirt, dust, corrosion etc is found - dismantle them, clean carefully and repeat chemical cleaning
2. Disconnect engine room pipes from engine pipes
3. Seal (blank off) the engine pipes
4. Connect (arrange) by-pass from engine room pipes to sump tank
5. Install check bag housing at that by-pass
6. Clean carefully oil sump tank inside
7. Fill the oil sump tank with the oil through a filter
In fact, you can start flushing, now. However, the engine is already using in this step – due to connection of engine room pipes via the engine crankcase to sump tank. So, for convenience we recommend to carry out further preparation - needed in second step - as follows:
8. Inspect condition of engine pipes inside.
9. Inspect and clean carefully engine space inside
10. Check condition of crossheads
11. Install special by-pass pieces at the connections to main bearings and telescope pipes as well as the blanks at the inlets to other bearings and lubricating points:
12. Loosen screws for stuffing boxes of telescope pipes by 10-15 mm



Cleanliness Flushing

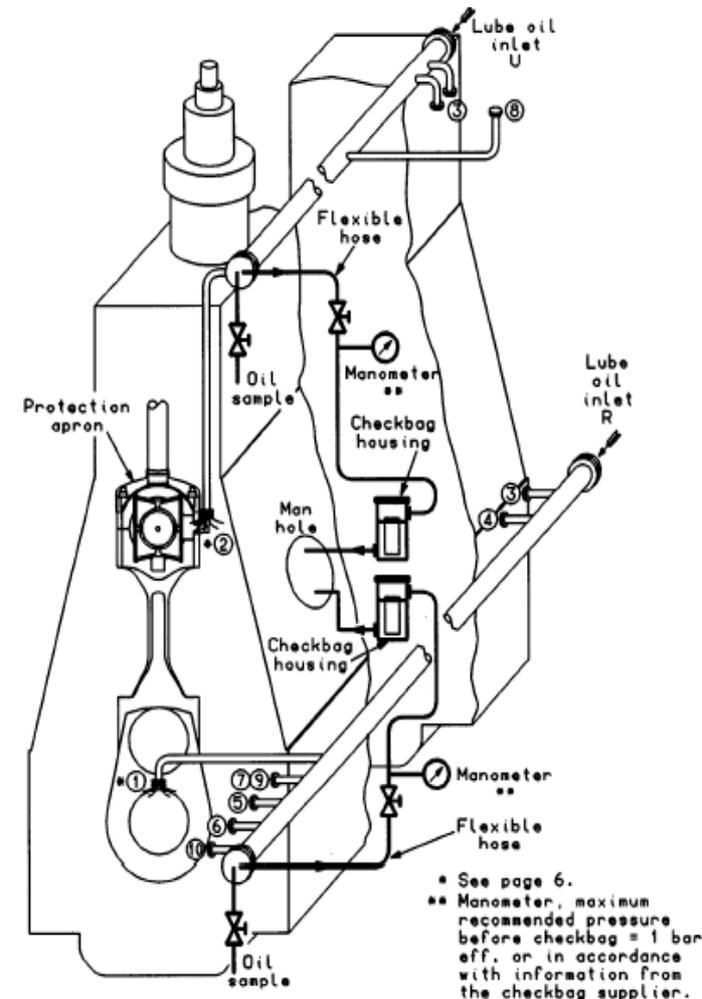


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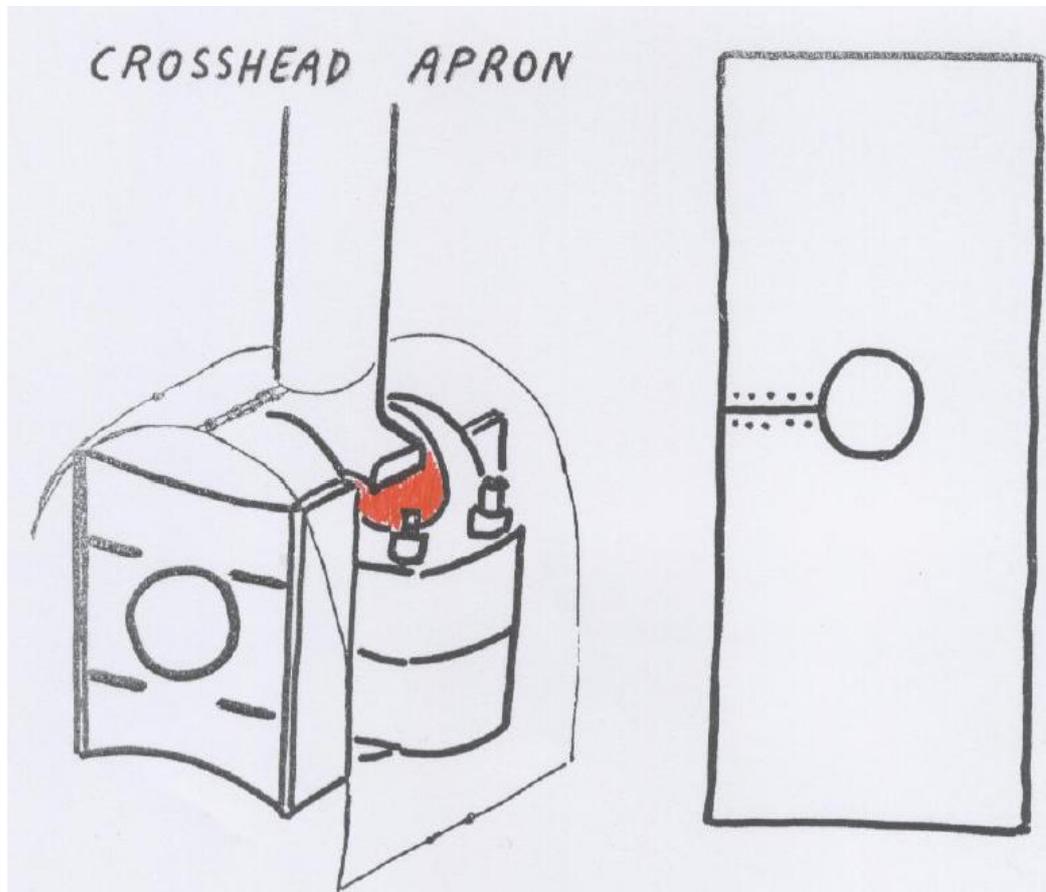
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Cleanliness Flushing



We recommend to check covering of crossheads; if such covers are missing then at this **stage special aprons** be installed; any way, we recommend to check if the pin / bearings are clean using **e.g. filer gauge**. If any dirt, dust, foreign particles etc are found – it is necessary to open the crosshead bearings, clean them and crossheads carefully, assembly again.

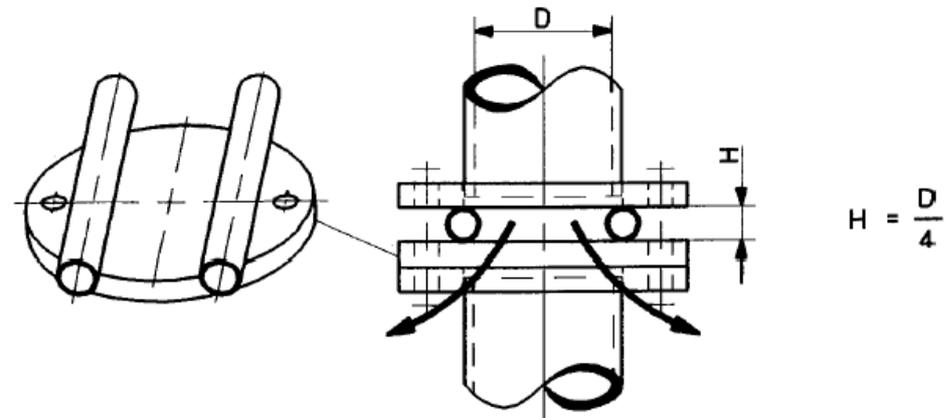


Cleanliness Flushing



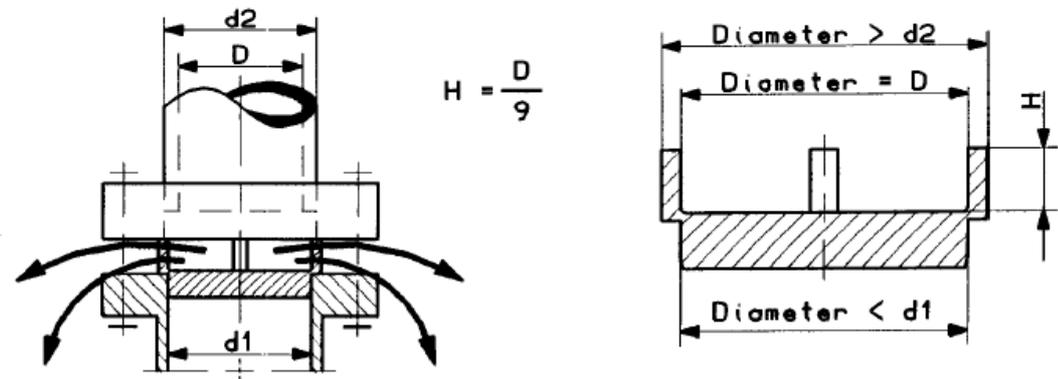
* Blank flanges for flushing:

A) Blank at main bearings.



Such set of blanks can
be use several times for
the same / similar engine
types

B) Blank between telescopic pipes and crossheads.



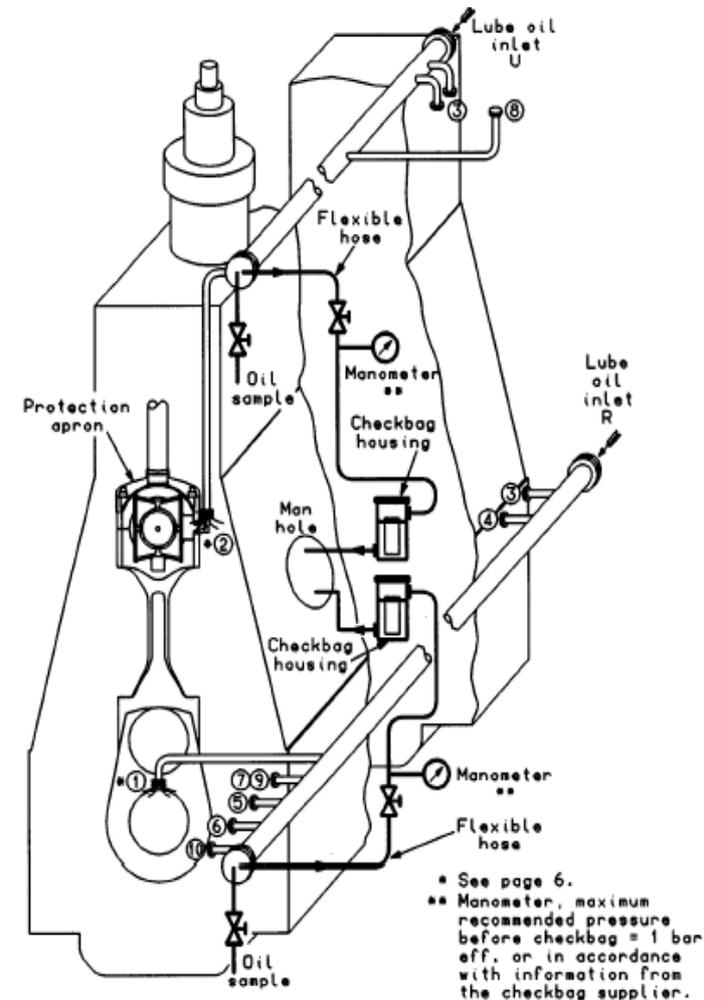
Cleanliness Flushing



Preparation for second stage - means, flushing engine room and engine pipes together

1. Reconnect engine room pipes to engine pipes
2. Install check bag housings at engine pipes using plastic hoses
3. Connect the flexible hose to main lub.oil pipe.
4. It is highly recommendable to note all above-mentioned works

FLUSHING LOG										MAN B&W Diesel A/S			
Shop/serial:				Lloyd's no.:						Yard:		Hall no.:	
System: M.E. <input type="checkbox"/> Combust. <input type="checkbox"/> Fuel <input type="checkbox"/>				M.E. No.:									
PUMPS		CENTRIFUGAL		ABSOLUTE FINENESS		CENTRIFUGAL		MAGNET FILTER		OTHER FILTERS			
Type:		Type:		Type:		Type:		Type:		Type:			
Capacity:		Capacity:		Capacity:		Capacity:		Capacity:		Capacity:			
LUBRICANT (used)		Type:		Type:		Type:		Type:		Type:			
Temp [C]		Pressure [bar]		Time start		Running hours		Fuel start		Filter No. & ISO code			
Inspection of Pipes & Tanks:		Checked by:		Date:		Pump A. M.E.		stop running hours		stop running hours			
Date:		Remarks:											
Sign:		Inspector:		Verifying luber:		Total flushing hrs.:		Final cleanliness:		Check bags: ISO 4406 code			
Recording of pump running hrs. within 7d hr.													
Cleaning and replacement of filters to be recorded under remarks.													
Accepted flushing cleanliness level: Clean check bags after 2 hrs. ISO 4406 code \leq 18/15.													
C		2		3		4		Info. No.:		P Ident. No.:			
Drawing: 75x222/2/2/2								3 78 61		4 A 78 62 25 - 6			
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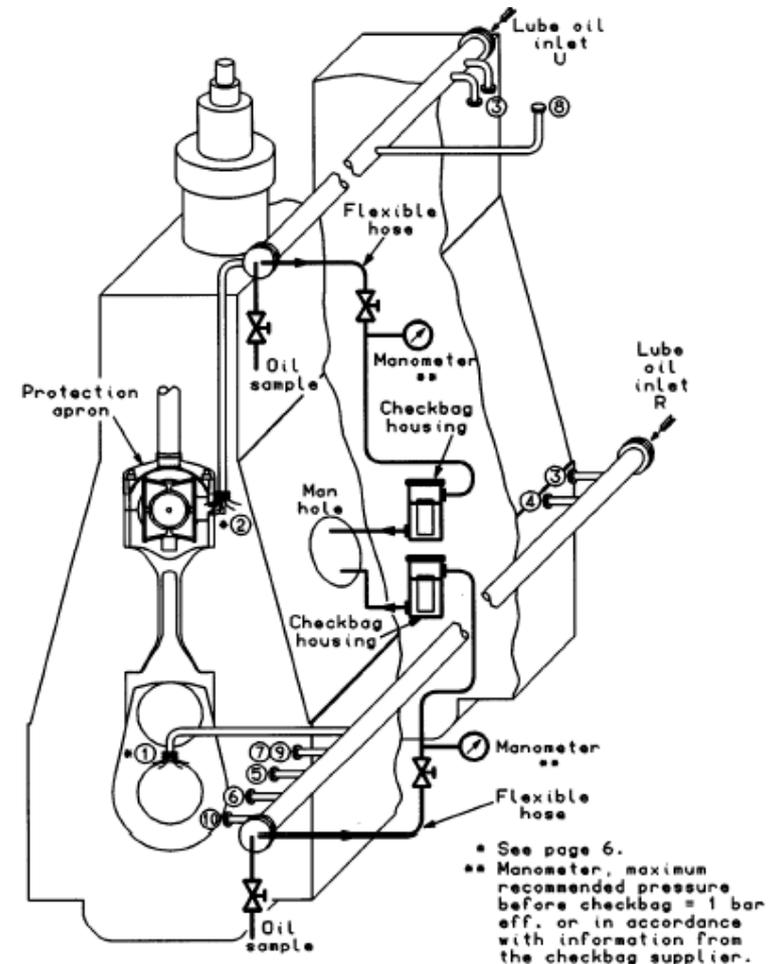


Cleanliness Flushing



After flushing

1. Transfer the oil from sump tank to other clean spare tank through a filter
2. Clean carefully the sump tank
3. Transfer the oil back to sump tank through the purifier
4. Clean filters and filter housings
5. Open flanges at the ends of main lub.oil pipes, inspect them, clean and close again;
6. Restore normal condition of lub.oil system
7. Disassemble, clean and assemble finally stuffing boxes of telescope pipes
8. Remove special aprons from the crossheads

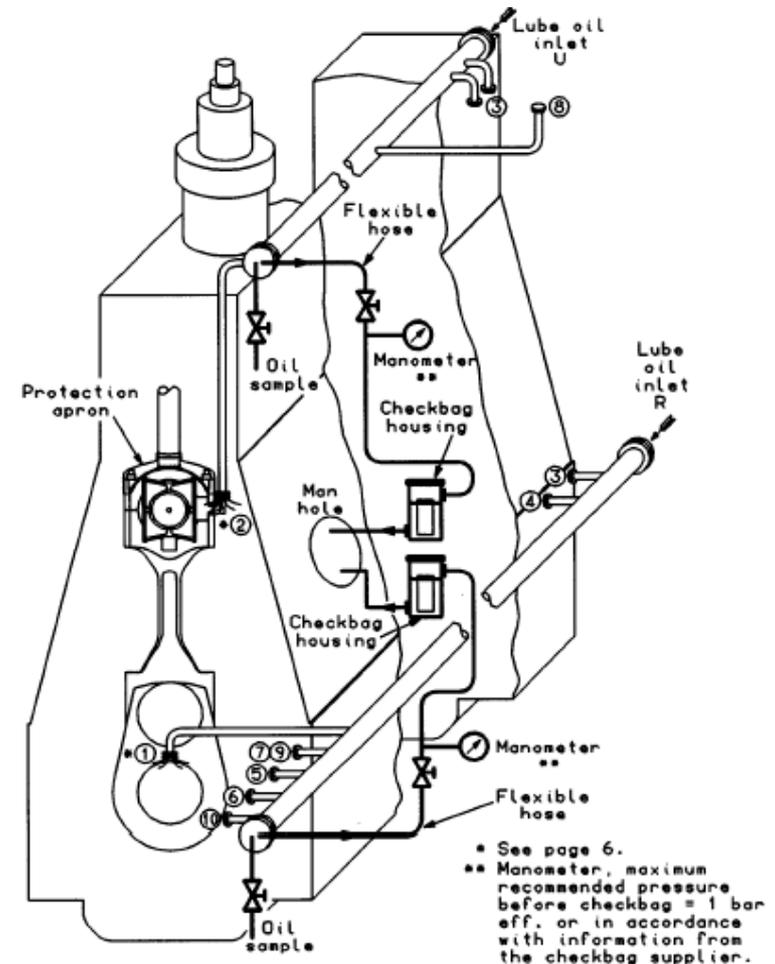


Cleanliness Flushing



After flushing

1. Transfer the oil from sump tank to other clean spare tank through a filter
2. Clean carefully the sump tank
3. Transfer the oil back to sump tank through the purifier
4. Clean filters and filter housings
5. **Open flanges at the ends of main lub.oil pipes, inspect them, clean and close again;**
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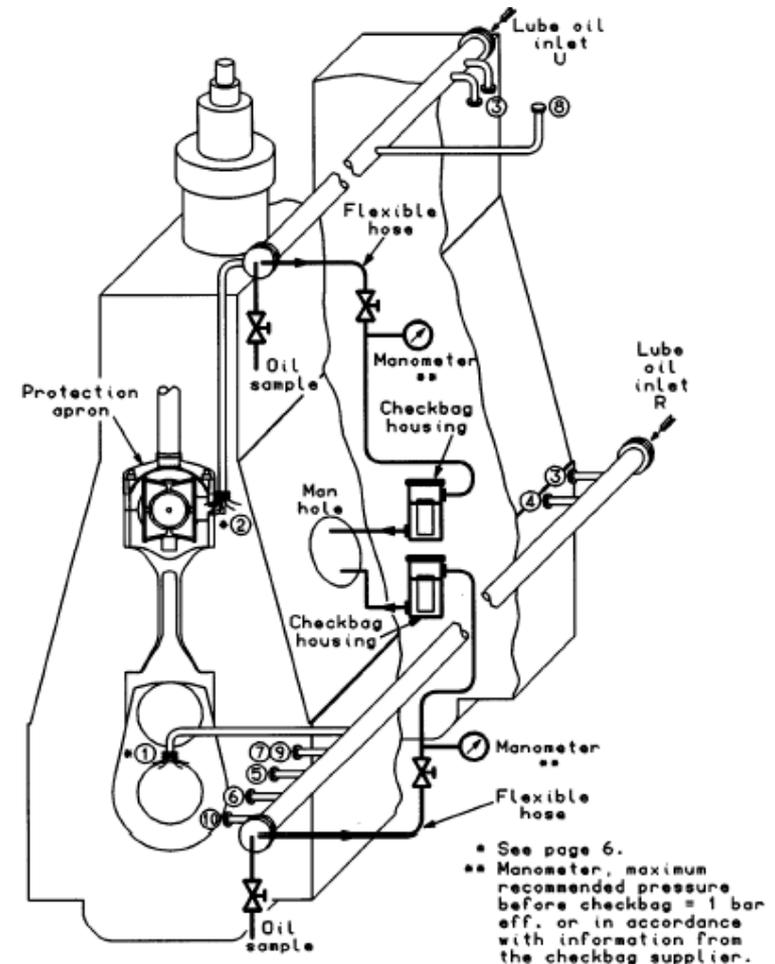


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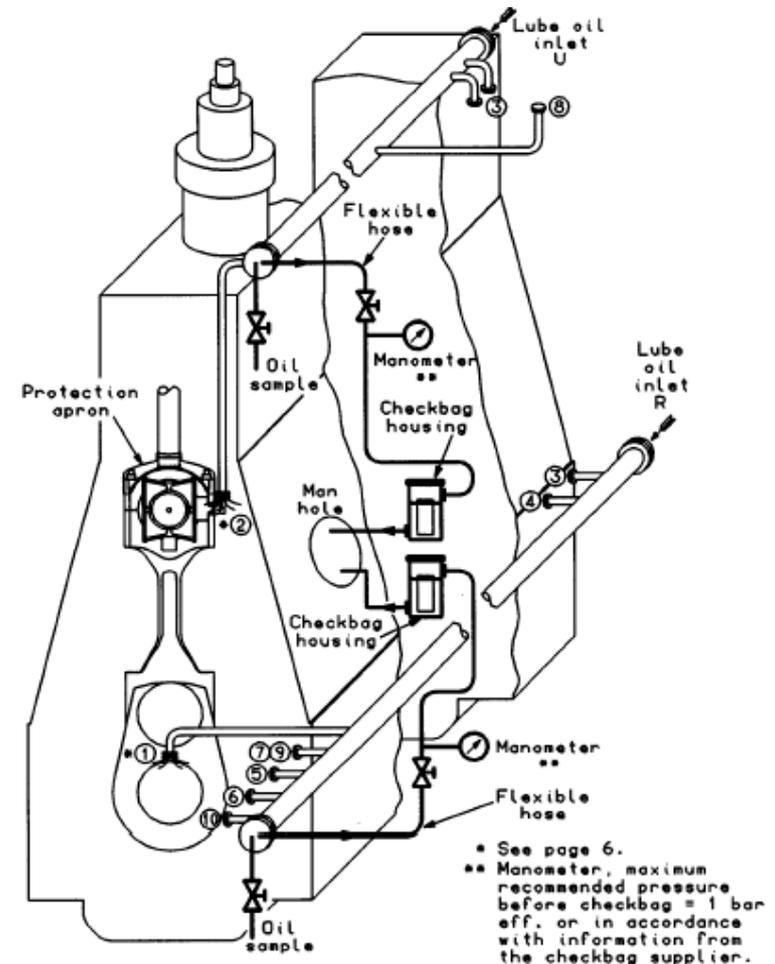


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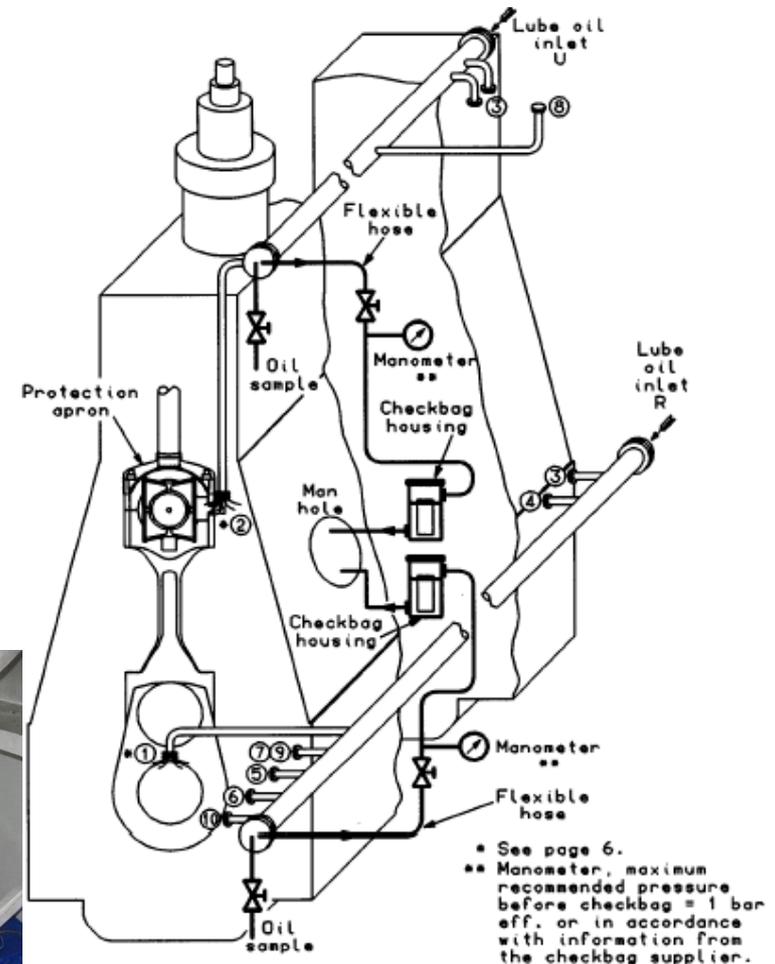


Cleanliness Flushing



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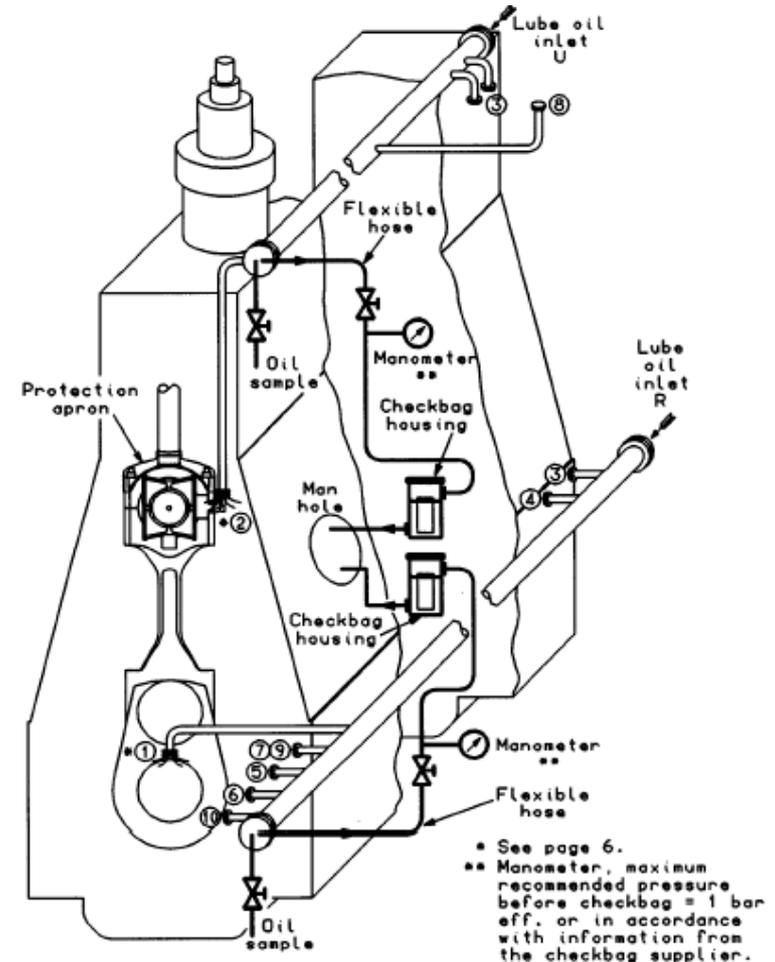


Cleanliness Flushing



After start of oil circulation

We need to start lube oil pump with reducing of oil pressure; at reduced oil pressure open crankcase and chain case doors (one by one) to see if oil is flowing properly – must be done by experience person / service engineer from maker.



During quay/sea trials

- Continue to run purifier
- Option: if temporary flushing filter of 10-25 μ m fineness was used during flushing, it would be an advantage continuing to use it during quay/sea trials provided that the lubeoil pressure at the engine inlet is sufficient
- Option: if temporary by-pass filter of 6 μ m fineness had been used during flushing, it would be an advantage to continue to use it during quay/sea trials.

Cleanliness Flushing



Crosshead cover?



Cleanliness Flushing



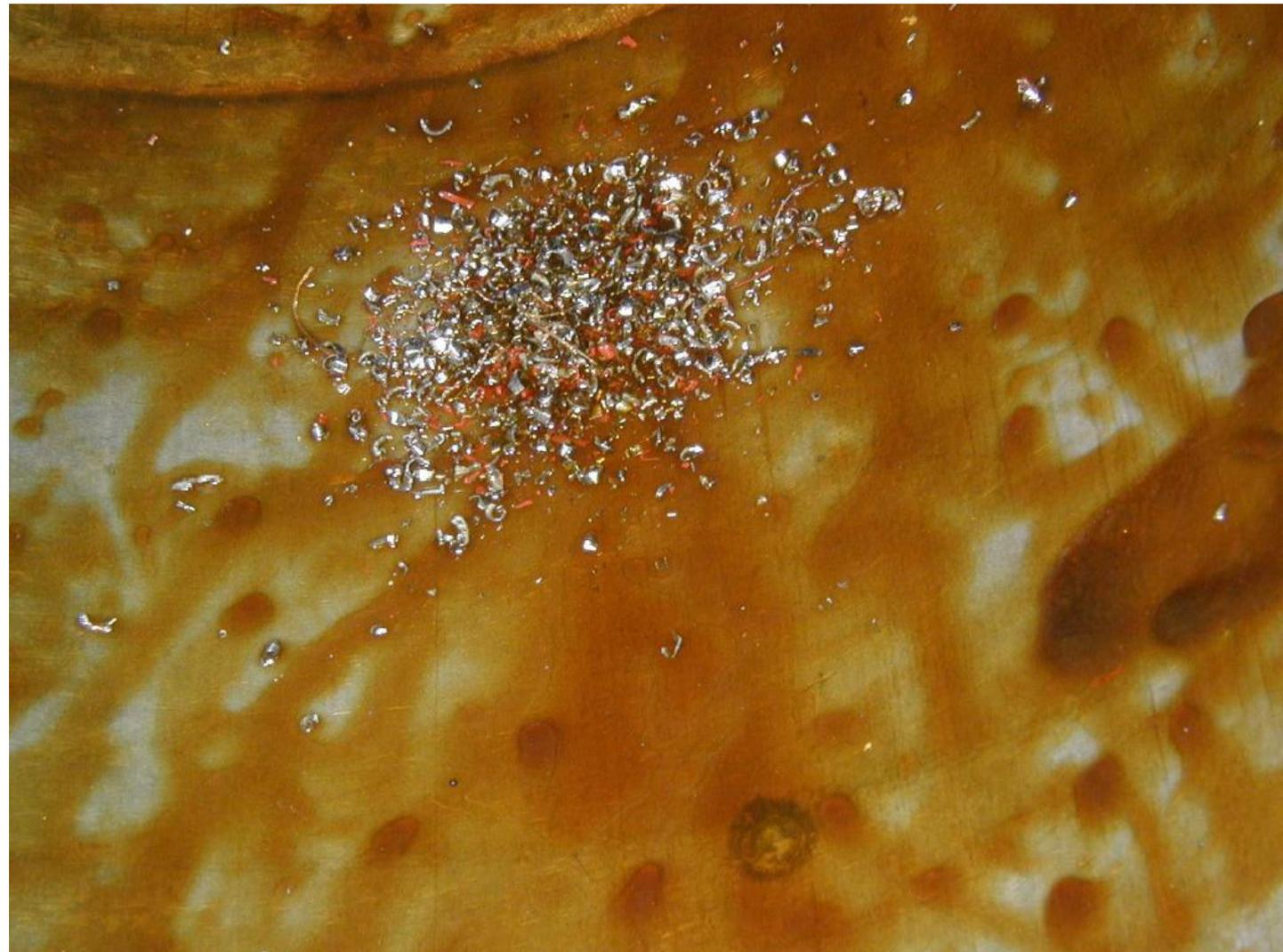
The engine crankcase



Cleanliness Flushing



Piping inspection before flushing



Cleanliness Flushing



Temporary filter for flushing



Cleanliness Flushing

