

WÄRTSILÄ		Document title: Cleaning specification for piping				
All rights reserved. Nothing from this publication may be reproduced, or disclosed without prior written approval of Wärtsilä Netherlands B.V.						
System code	Info code	System variant	Issue Date	Page	Doc. no.	Rev.
950	230		2002-01-10	1 / 4	T003002114	H

Rev 05 2009-09-09 ISO-class changed
 Rev 06 2010-03-02 ISO-class changed
 Rev 07 2010-03-25 Chapter 2.1 updated
 Rev H 2012-08-08 Chapter 2.5 Cleanliness class modified [AK]

1 General

This specification concerns hydraulic, lubrication oil and non-hydraulic piping.

Piping classes		
01.	<ul style="list-style-type: none"> • Hydraulic piping 	high pressure hydraulic oil for hydraulic steering
		high pressure hydraulic oil for pitch actuation
02.	<ul style="list-style-type: none"> • Lubrication oil piping 	lubrication oil system
03.	<ul style="list-style-type: none"> • Non-hydraulic piping 	bilge (seawater removal) systems
		compressed air systems (actuation of valves, inflatable seal, brake actuators, clutch actuators)

Piping systems that are not clean can cause a failure of any of the applied components and subsequently a complete system failure. Therefore, all piping must be properly cleaned before operating any of the systems, to ensure that the valves and other sensitive components are not contaminated.

Non-hydraulic systems and lubrication systems are less sensitive to contamination, but are nevertheless required to be as clean as possible. Especially the bearing-, gear- and seal-lubrication circuits and circuits for installations with a controllable pitch propeller should be as clean as possible.

The components delivered by Wärtsilä Netherlands can be assumed to have been cleaned at the shop.

When installing piping always be sure to work with flushed pipes and couplings to avoid the inclusion of dirt as much as possible.

WÄRTSILÄ	Document title:				
	Cleaning specification for piping				
Doc. no.	T003002114	Rev.	H	Page	2 / 4

2 Flushing of hydraulic and lubrication oil piping

2.1 Setup

The piping connecting the hydraulic components must be de-mounted and be interconnected with temporary piping to make several loops of the piping. During flushing the piping loops must be in horizontal position to give the heavier particles the chance to come out along with the flushing fluid. If the piping cannot be de-mounted after fitting, another manner of temporary pipe interconnecting must be selected. In this case the flushing unit must be positioned in the lowest position of the piping loop. Components that may present a restriction to the required flow, or that may be damaged, may be by-passed during flushing.

2.2 Flushing tools

Flushing is to be performed with a special flushing unit, capable of providing a flushing velocity of at least 7 m/s. The required flow for the several pipe diameters is to be selected by the piping supplier.

Please note that the pumps of the different subsystems are not suitable for use in the flushing process, as their flow is not sufficient.

2.3 Fluid

A special flushing fluid with a low viscosity is to be used in the flushing process. If the use of a special flushing fluid is not possible, one of the appropriate fluids in the applicable oil list can be selected. Always use clean fluid for the flushing process. The flushing fluid must be heated up to at least 60°C.

2.4 Duration

Minimum flushing duration per flushing loop is 2.5 hours, but the flushing has to be continued until the required cleanliness level has been reached. Check filter(s) of the flushing unit regularly. If necessary, replace filter cartridge(s).

Each hour is to be interrupted by a 5 minute break. During each break the flow direction of the flushing process is to be inverted.

WÄRTSILÄ	Document title:				
	Cleaning specification for piping				
Doc. no.	T003002114	Rev.	H	Page	3 / 4

2.5 Cleanliness

The cleanliness of the flushing fluid to be according the class defined in the table below and to be determined on basis of a fluid sample.

Cleanliness classes		
01.	• Hydraulic piping	ISO 4406 class 18/16/13 (NAS 1638 class 7)
02.	• Lubrication oil piping	ISO 4406 class 21/19/16 (NAS 1638 class 10)

(The above mentioned NAS cleanliness codes roughly correspond to the ISO cleanliness codes)

2.6 Completion

When the piping is flushed properly, drain all piping and blow out the remaining flushing fluid with dry air, remove the temporary piping, apply conservation oil and re-install all piping to its original place or cap, mark and store the pipe segments for later use.

2.7 Detailed instructions

For more detailed instructions see 3004137, which is an extract from CETOP RT 117 H

WÄRTSILÄ	Document title:				
	Cleaning specification for piping				
Doc. no.	T003002114	Rev.	H	Page	4 / 4

3 Cleaning of lubrication and non-hydraulic piping

Prescribed cleaning method by flushing can be very time consuming and expensive. Moreover lubrication and non-hydraulic piping may not need to be as thoroughly cleaned as hydraulic piping (although it should be ensured that the piping is clean). In some cases cleaning may be executed using an alternative process using special foam plugs.

3.1 Prerequisites for alternative cleaning

Cleaning of pipes may be executed by blowing special foam plugs through the pipes if following prerequisites are taken into account:

1. Alternative (non flushing) cleaning may never be used as primary cleaning method on hydraulic piping. Piping for closed loop steering systems, piping for pitch actuation always must be flushed (because of the sensitive hydraulic components in these circuits).
2. Alternative cleaning method is not recommended for systems with a controllable pitch propeller as actuation of the pitch is executed with the same oil as the lubrication system.
3. Alternative cleaning method may only be used if piping is made from seamless precision pipe (acc. DIN 2445 or DIN 2462).
4. Piping that has been welded or heat treated (for bending or other purposes) always must be cleaned by flushing.
5. Alternative cleaning method may only be used on piping that was manufactured and stored in a clean environment.

3.2 Foam plug cleaning procedure

1. The pipes should at least be visually clean and free of all loose parts.
2. Pipes must be blown with clean air first.
3. Blow a foam plug through the pipe and repeat this until plug does not pick up debris any more.
4. Finally blow a new, clean plug through the pipe and check if this plug comes out clean. Repeat cleaning sequence until this final check is positive.

3.3 Completion

When the piping is cleaned apply conservation oil. Re-install all piping to its original place or cap, mark and store the pipe segments for later use.