
**Ships and marine technology —
Hydraulic oil systems — Guidance for
grades of cleanliness and flushing**

*Navires et technologie maritime — Circuits d'huile hydrauliques —
Guide relatif aux degrés de propreté et de rinçage*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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Ships and marine technology — Hydraulic oil systems — Guidance for grades of cleanliness and flushing

1 Scope

This International Standard specifies pipe cleaning and cleaning levels of hydraulic oil pipe systems. The cleaning of pipes and components in hydraulic oil pipe systems is essential for the trouble-free operation of hydraulic systems.

It indicates methods and equipment for the practical execution of the cleaning of specific parts of hydraulic systems with appurtenant components.

The purpose of the cleaning process is to remove installation dirt and to check that the piping and hydraulic system have been adequately cleaned.

The cleaning process of a system is considered a “washing through” process when the Reynolds number, R_e , $\leq 3\,000$, and a flushing process when $R_e > 3\,000$. The Reynolds number is an indicator of whether a fluid flow is considered laminar or turbulent.

This International Standard presupposes that the pipe sections of the hydraulic system have been cleaned partly by pickling and partly by mechanical cleaning. It is furthermore assumed that both dynamic and static components from system suppliers are adequately clean when delivered (see Clause 5).

The specifications given in this International Standard are supplementary to, and not a replacement for, the guidelines specified by the various manufacturers. The manufacturer's guidelines, where available, take precedence.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification*

ISO 4406, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

ISO 28523, *Ships and marine technology — Lubricating and hydraulic oil systems — Guidance for sampling to determine cleanliness and particle contamination*

3 Symbols

The following symbols are used throughout this International Standard.

A (mm ²)	pipe cross-sectional area
β_x (—)	particle filtration ratio
d (mm)	pipe diameter
Δp (bar)	pressure drop
K_1 (—)	flushing-filter factor
R_e (—)	Reynolds number
Q_1 (l/min)	flow rate of filter
Q_2 (l/min)	flow rate of system
ν (cSt)	viscosity
W (m/s)	flow velocity

4 Recommended pipe cleaning levels

4.1 Pipe cleaning levels during/after prefabrication

4.1.1 Black-steel pipes and pipes of other material qualities showing oxide scale as a result of heating or welding

These should be cleaned internally after welding together of prefabricated pipes and fittings using either chemical cleaning (alkaline cleaning and pickling) or mechanical blow cleaning to achieve a cleanliness corresponding to Sa 2½ as specified in ISO 8501-1.

Steel shot should not be used because of the risk of adhesion by magnetism and subsequent rust seizure; copper (Cu) slag should be used instead. Sealing faces should be protected during the blow cleaning.

4.1.2 Precision-steel pipes and pipes of other material qualities, which are delivered, and remain, free of oxide scale (no heating or welding)

After cutting and careful deburring, pipes and fittings that are joined without being subjected to prior heating or welding processes, for example by means of clamping rings, should be cleaned by one of the following methods:

- chemically (using an alkaline cleaning process);
- blown through with pressurized air;
- by pulling through lint-free cloths.

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