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

Navires et technologie maritime — Les systèmes lubrifiant et hydraulique de pétrole — Directives pour essais pour déterminer la contamination de propreté et particule

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 28523 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

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

1 Scope

This International Standard specifies methods for dynamic and static extraction of fluid samples from lubricating and hydraulic oil systems.

A correct execution of the sampling is essential when analysing fluids from lubricating and hydraulic oil systems.

In order to achieve reliable and comparable analysis results, the sampling must be performed under defined conditions and operating environment.

When the system has reached its operating temperature, a representative sample is extracted from where the fluid is in a turbulent flow condition. This method is called dynamic sampling. If this is not possible, the sample can be extracted from the system tank. This method is called static sampling.

NOTE Particles > 20 µm settle quickly during static sampling.

This International Standard specifies methods for both dynamic and static sampling in connection with collection in bottles.

For extraction of samples through a filtration kit for comparison with “master slides”, reference is made to the manuals from the suppliers of such equipment.

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 3722, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods*

ISO 4021, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system*

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

3 Dynamic sampling

3.1 Rigging the sampling device

If it is possible to mount the sampling device on a section of the system pipe with a turbulent flow, a sampling device as specified in Figure 1 is used.

If this is not possible, a turbulent flow can be achieved by inserting a T-piece in the pipe and mounting the equipment on the T-piece (as shown in Figures 1 and 2).

The sampling equipment includes a flexible capillary tube. The internal diameter and total length of the tubing is chosen with the object of achieving an appropriate flow velocity during the sampling. However, in accordance with ISO 4021, the internal diameter shall be $\geqslant$ 1,25 mm.

3.2 Sampling

Observe the following procedures for sampling.

a) Extract the sample from a warm system.

b) Thoroughly wipe off the capillary tubing with a lint-free cloth.

c) Activate the ball valve and/or measuring coupling to full flow.

d) A minimum of 0,5 l of fluid must pass through before the actual sample is extracted.

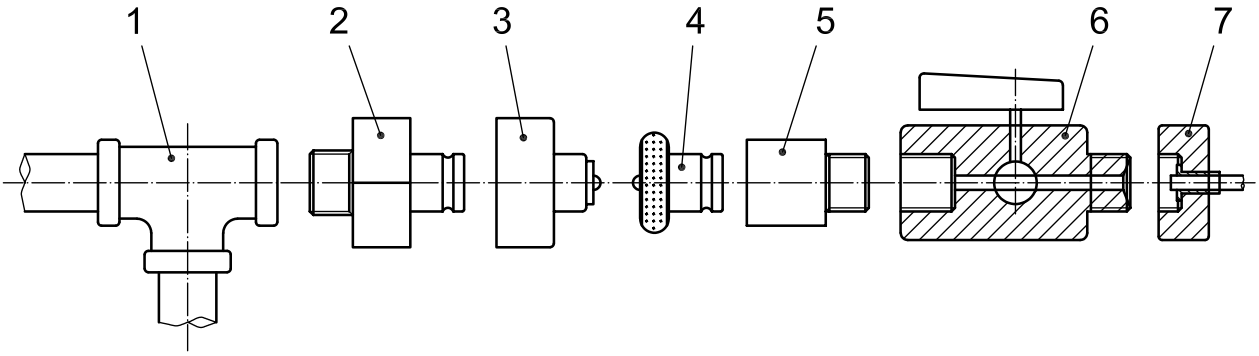
e) Collect the desired sample without adjusting the ball valve/measuring coupling. The sample volume should make up a minimum 50 % and maximum 80 % of the volume of the sample container. If an automatic particle counter is used, a minimum of 0,4 l should be extracted.

f) Remove the sample bottle while the fluid is still flowing.

g) Close the sample bottle immediately after filling.

h) Close the ball valve and/or measuring coupling.

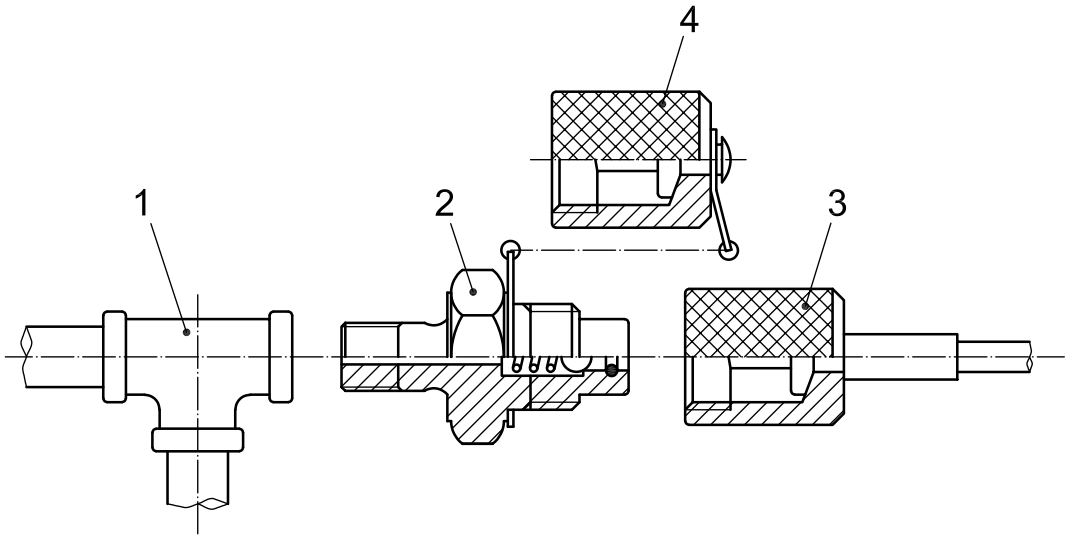
To avoid contamination of the sample, do not immerse the flexible capillary tube into the sample bottle.



Key

1 tee fitting
2 coupling with check valve
3 cap
4 cap
5 coupling without check valve
6 ball plug valve
7 fitting with capillary hose

Figure 1 — Dynamic sampling device in accordance with ISO 4021



Key

1 tee fitting
2 reducing nipple
3 fitting with capillary hose
4 cap

Figure 2 — Dynamic sampling device in connection with measuring coupling

The choice between Figure 1 and Figure 2 configurations depends on the needs of the user. See Table 1 below for advantages and disadvantages.

Table 1 — Comparison of dynamic sampling devices

Figure number	Advantages	Disadvantages
1	Meets the requirement for minimum internal diameter (1,25 mm) in accordance with ISO 4021	Cannot be mounted with pressure on the plant
2	a) Widely used b) Can be mounted with pressure on the plant	Does not meet the requirement for minimum internal diameter (1,25 mm) in accordance with ISO 4021

4 Static sampling

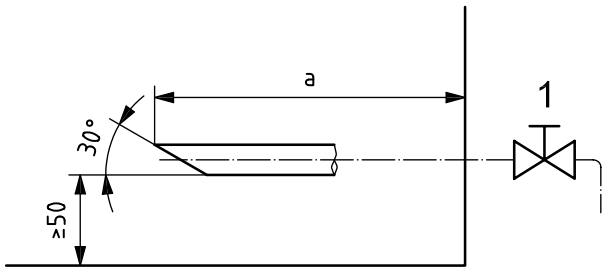
4.1 Rigging up the sampling device

The sampling device and its fitting are shown in Figures 3 and 4.

4.2 Extraction of the sample

The extraction procedure is as specified in 3.2 a) to h).

Dimensions in millimetres



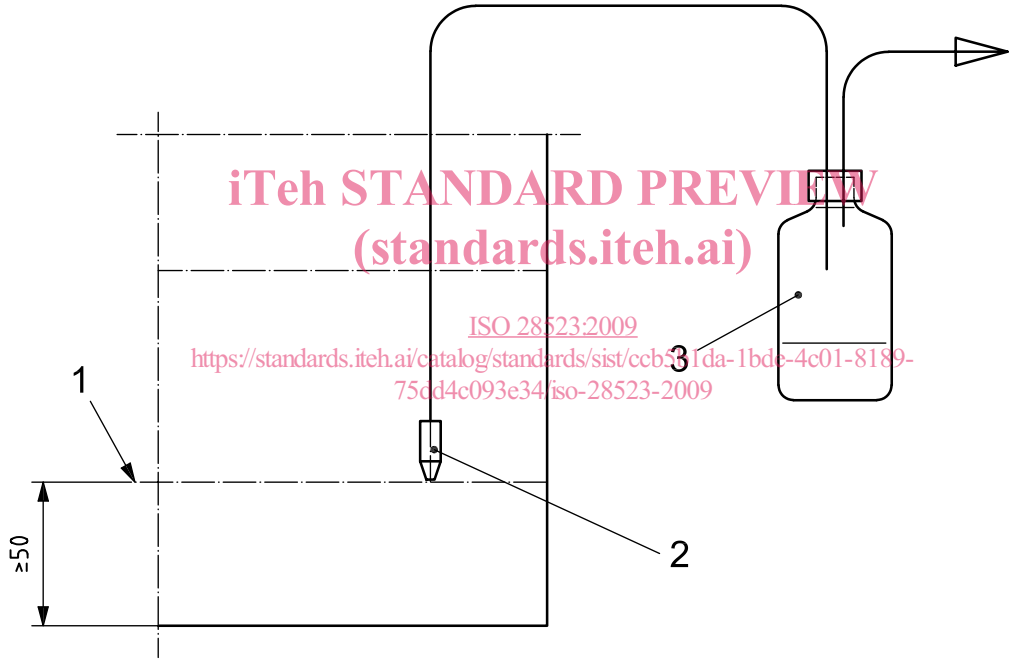
Key

1 ball valve

[a] Length is from 50 mm to 200 mm.

Figure 3 — Static sampling device

Dimensions in millimetres



Key

1 pump inlet
2 weight (if necessary)
3 sample bottle (compliant with ISO 3722)

Figure 4 — Static sampling device by means of vacuum

5 Sample bottles

5.1 Cleanliness

The sample bottles shall comply with the requirements specified in ISO 3722.

Clean sample bottles delivered from the supplier must be encapsulated or sealed off. This will prevent contamination during transport and handling.

5.2 Visual inspection

The sample bottles should be transparent and resistant to the extracted sample.

5.3 Labelling

The sample bottles shall be labelled with adequate identification (as shown in Figure 5).

Writing on the label should be made with a water-resistant pen.

Name of company	Date: Newbuilding/Project No.: Plant (type): Sampling device (location): Sample No.: Operating time: hours Working pressure: bar Oil pressure:

Figure 5 — Example label

6 Automatic particle counting

6.1 Example of a procedure for automatic particle counting

a) The water content is determined by means of the "Karl Fisher reagent" method. If the result shows water content of < 0,05 % mass fraction, then continue to item b). If the water content is > 0,05 % mass fraction, then automatic particle counting cannot be used.

b) Heat the sample to approx. 65 °C (i.e. using a water bath).

c) Shake the sample for 5 min using a shaking device.

d) Perform ultrasonic processing of the sample for 15 s. This is done partly to split any lumps, partly to eliminate air.

e) Exhaust remaining air from the sample. This should be performed in a vacuum chamber. Maximum pressure shall be 50 kPa to 80 kPa (i.e. 5 000 mm to 8 000 mm water column).

f) Perform the particle counting in accordance with the relevant instructions.

g) Convert the results to ISO-code (Contaminant Code) in accordance with ISO 4406, or another specified standard. See ISO 28521 for guidance.

It is important that items a) to g) are performed in a continuous sequence; a few seconds of unnecessary hesitation increases the settling of the particles and, thereby, the risk of achieving an incorrect analysis result.

6.2 Evaluation of cleanliness using a microscope

With regard to flushing, evaluation of cleanliness by means of microscopy is a widely used and very informative method which, at the same time, allows careful monitoring of the flushing in order not to flush longer than necessary to achieve the appropriate cleanliness.