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**INTERNATIONAL STANDARD****3734**

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## **Crude petroleum and fuel oils — Determination of water and sediment — Centrifuge method**

*Pétrole brut et fuel-oils — Détermination de la teneur en eau et en sédiments — Méthode par centrifugation*

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## FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3734 was drawn up by Technical Committee ISO/TC 28, *Petroleum products*, and circulated to the Member Bodies in October 1974.

It has been approved by the Member Bodies of the following countries :

Australia	Ghana	South Africa, Rep. of
Austria	Hungary	Spain
Belgium	India	Sweden
Brazil	Iran	Turkey
Bulgaria	Israel	United Kingdom
Canada	Japan	U.S.A.
Chile	Netherlands	U.S.S.R.
Czechoslovakia	Poland	Yugoslavia
France	Portugal	
Germany	Romania	

No Member Body expressed disapproval of the document.

# Crude petroleum and fuel oils – Determination of water and sediment – Centrifuge method

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the determination of water and sediment in crude petroleum and fuel oils by means of a centrifuging procedure.

NOTE – Experience has shown that with some types of oils it is difficult to obtain complete separation of the water and sediment with this method. When this situation is encountered ISO 3733 and ISO 3735 may be used.

The criterion for the abandonment of this method shall be failure to obtain either a clear interface or the repeatability or reproducibility given in clause 8.

## 2 REFERENCES

ISO 3733, *Petroleum products and bituminous materials – Determination of water – Distillation method.*

ISO 3735, *Crude petroleum and fuel oils – Determination of sediment – Extraction method.*

ISO 5272, *Toluene – Specifications.*<sup>1)</sup>

## 3 SOLVENT

**3.1 Toluene**, conforming to ISO 5272, grade 2, shall be used as the solvent, except as provided in 3.2. The solvent shall be water saturated at ambient temperature, but shall be free of suspended water. This may be accomplished by the addition of 2 ml of water to 1 000 ml of solvent. Shaking will aid saturation, but adequate settling time is necessary to ensure that the solvent is free from suspended water before use.

**CAUTION** – Toluene is toxic. In particular, take precautions to avoid breathing the vapour, and protect the eyes.

**3.2** It is recognized that some oils may require the use of solvents other than toluene. Solvents agreed upon between the purchaser and seller may be used provided these do not contribute to the water and sediment.

**3.3 Demulsifiers.** A demulsifier may only be used in transactions where tests have demonstrated a need. If a demulsifier is required, the type and amount to be used shall be agreed between the purchaser and seller.

## 4 APPARATUS

**4.1 Centrifuge**, capable of whirling two or more filled centrifuge tubes at a speed which can be controlled to give a relative centrifugal force (rcf) of between 500 and 800 at the tips of the tubes. The revolving head, trunnion rings, and trunnion cups, including the cushions, shall be soundly constructed to withstand the maximum centrifugal force capable of being delivered by the power source. The trunnion cups and cushions shall firmly support the tubes when the centrifuge is in motion. The centrifuge shall be enclosed by a metal shield or case strong enough to prevent danger if any breakage occurs.

The centrifuge drive shall not be capable of causing ignitions of solvent vapour during the operation of the test.

Calculate the speed of the rotating head as follows :

$$\text{rev/min} = 1\,336 \sqrt{\frac{\text{rcf}}{d}}$$

where

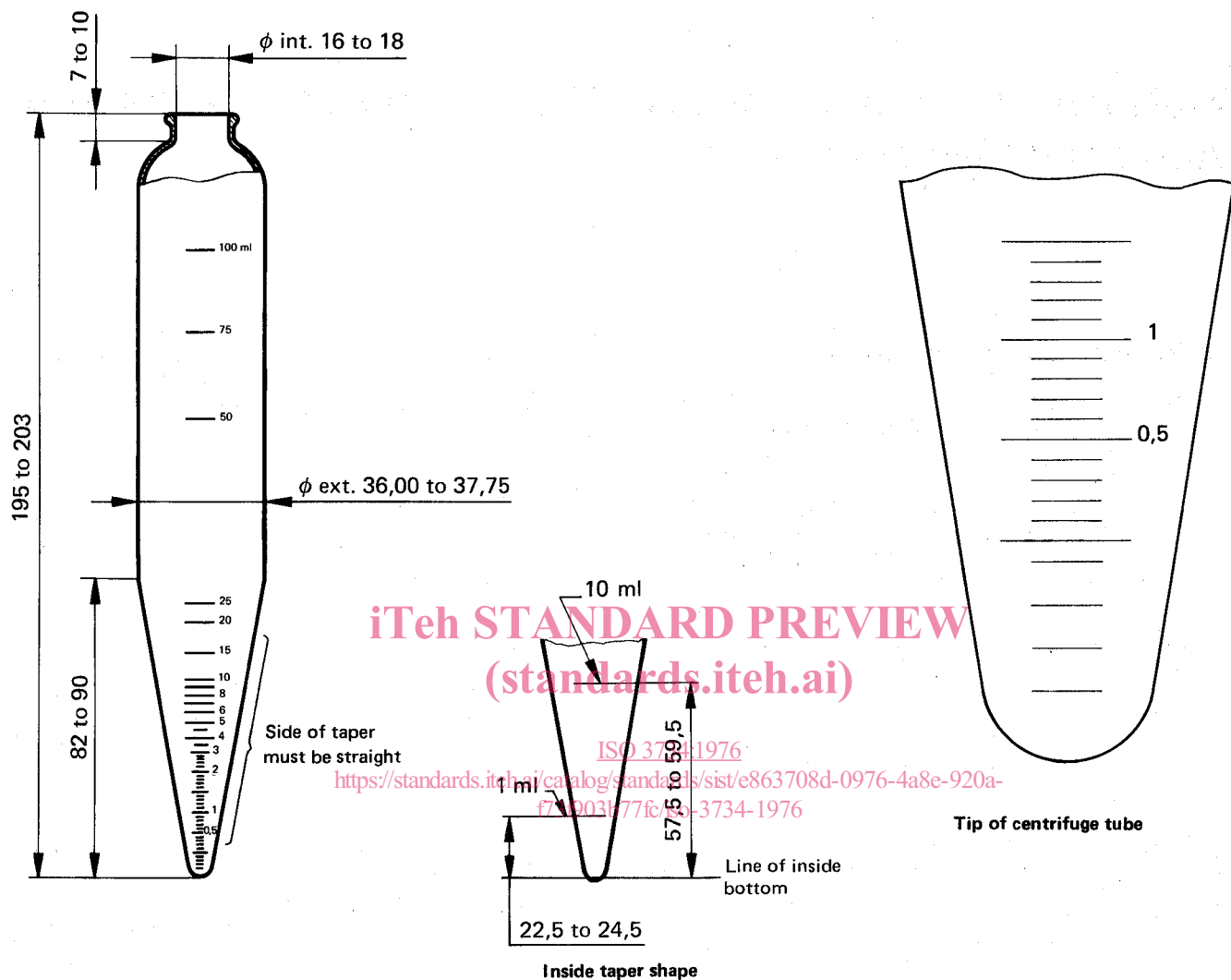
rcf is the relative centrifugal force;

*d* is the diameter of swing, i.e. twice the radius of swing, in millimetres, measured between axis of rotation and tip of tube when in rotating position.

The centrifuge may require a heating device to ensure that the temperature does not fall below 46 °C during centrifuging.

1) In preparation.

Dimensions in millimetres unless otherwise specified



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NOTE – For volumetric tolerances see table 1.

FIGURE 1 – Centrifuge tube

**4.2 Centrifuge tube**, cone-shaped, conforming to the dimensions given in figure 1 and made of thoroughly annealed glass. The graduations, numbered as shown in figure 1, shall be clear and distinct, and the mouth constricted in shape for closure with a cork. Scale error tolerances and smallest graduations between various calibration marks are given in table 1, and apply to calibrations made with freshly boiled water at 20 °C, reading the bottom of a shaded meniscus.

**4.3 Bath** : either a solid metal block bath or a liquid bath of sufficient depth for immersing the centrifuge tube, in a vertical position, to the 100 ml mark. Means shall be provided for maintaining temperatures of 50 ± 1 °C and 60 ± 1 °C.

TABLE 1 – Centrifuge tube calibration tolerances

Range ml	Sub-division ml	Volume tolerance ml
0 to 0,1	0,05	± 0,02
Above 0,1 to 0,3	0,05	± 0,03
Above 0,3 to 0,5	0,05	± 0,05
Above 0,5 to 1,0	0,10	± 0,05
Above 1,0 to 2,0	0,10	± 0,10
Above 2,0 to 3,0	0,20	± 0,10
Above 3,0 to 5,0	0,5	± 0,20
Above 5,0 to 10	1,0	± 0,50
Above 10 to 25	5,0	± 1,00
Above 25 to 100	25	± 1,00

**5 SAMPLING**

The sample shall be thoroughly representative of the material to be tested and the test portion shall be thoroughly representative of the whole sample. Vigorously agitate the sample immediately before transferring the test portion to the tube. Cold samples of oils should be warmed to facilitate mixing. The difficulties in obtaining representative samples for this determination are unusually great; hence, the importance of sampling cannot be too strongly emphasized.

**6 PROCEDURE**

**6.1** Fill each of two centrifuge tubes (4.2) to the 50 ml mark with water-saturated solvent; then immediately pour the well-shaken sample directly from the sample container into the centrifuge tubes until the total volume in each tube is 100 ml (see note). If a demulsifier is required, add the appropriate amount at this point. The centrifuge tubes and contents shall be weighed and balanced to within 0,5 g by attaching masses, for example copper wire, to the outside of the lighter tube; balancing by addition of solvent to the lighter tube shall not be used. Stopper the tubes tightly and shake vigorously until the contents are thoroughly mixed. Immerse the tubes to the 100 ml mark for 10 min in the bath maintained at the appropriate temperature specified in 6.2.

**NOTE** — The volume of both the test portion of oil and the solvent shall be read at the top of the meniscus.

**6.2** The bath temperature shall be regulated so as to give the condition as appropriate in a) or b) below :

- a) in the case of wax-free oils, the temperature of the sample at the commencement of each centrifuging shall be  $50 \pm 1^\circ\text{C}$ ;
- b) in the case of waxy oils and oils having a pour point above  $10^\circ\text{C}$ , the temperature of the sample at the commencement of each centrifuging shall be  $60 \pm 1^\circ\text{C}$ .

The temperature of the test portion during centrifuging shall not be allowed to fall below  $46^\circ\text{C}$  in either case a) or case b).

**6.3** Remove the tubes from the bath and invert them to ensure that the contents are uniformly mixed.

**CAUTION** — A large increase in pressure may develop in the tube due to the increase of vapour pressure of the solvent with rise in temperature.

**6.4** Place the tubes in trunnion cups on opposite sides of the centrifuge to establish a balance condition and whirl for 10 min at a rate, calculated from the equation given in 4.1, sufficient to produce a relative centrifugal force (rcf) of between 500 and 800 at the tip of the whirling tubes (see table 2 for the relationship between diameter of swing, rcf and rev/min). Read and record the combined volume of water and sediment at the bottom of each tube to the

nearest 0,05 ml from 0,1 to 1 ml graduation lines and to the nearest 0,1 above 1 ml graduation line. Below 0,1 ml, estimate to the nearest 0,025 ml (see figure 1). Return the tubes without agitation to the centrifuge and whirl for 10 min at the same rate. Repeat this operation until the combined volume of water and sediment remains constant for two consecutive readings. In general, not more than two whirlings are required.

**NOTE** — In order to avoid the danger of tubes breaking in the cups, care must be taken that the tubes are bedded onto the bottom cushion so that no part of the tube is in contact with the rim of the cup.

**TABLE 2 — Rotation speeds applicable for centrifuges of various diameters of swing**

Diameter of swing mm	rev/min at 500 rcf	rev/min at 800 rcf
450	1 410	1 780
500	1 340	1 690
550	1 280	1 610
600	1 235	1 542

**7 EXPRESSION OF RESULTS**

**7.1** Record the final volume of water and sediment in each tube. If the difference between the two readings is greater than one sub-division on the centrifuge tube (see table 1), or 0,025 ml for readings of 0,10 ml and below, the readings are inadmissible and the determination shall be repeated.

**7.2** Express the sum of the two admissible readings (see 7.1) as the percentage by volume of water and sediment; report the results as shown in table 3.

**TABLE 3 — Expression of results**

Reading in ml			Percentage by volume of water and sediment
Tube 1	Tube 2	Total	
No visible water and sediment	No visible water and sediment	—	0 (Zero)
No visible water and sediment	0,025	0,025	0,05
0,025	0,025	0,05	0,05
0,025	0,05	0,075	0,10
0,05	0,05	0,10	0,10
0,05	0,075	0,125	0,15
0,075	0,075	0,15	0,15
0,075	0,10	0,175	0,20
0,10	0,10	0,20	0,20
0,10	0,15	0,25	0,25
etc.			

**8 PRECISION**

The precision of the method, as obtained by statistical examination of inter-laboratory test results, is as follows :

**8.1 Repeatability**

The difference between successive test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material, would in the long run, in the normal and correct operation of the test method, exceed the values for repeatability shown in figure 2 only in one case in twenty.

**8.2 Reproducibility**

The difference between two single and independent test results, obtained by different operators working in different laboratories on identical test material, would in the long run in the normal and correct operation of the test method, exceed the values for reproducibility shown in figure 2 only in one case in twenty.

**9 TEST REPORT**

The test report shall include the following information :

- a) reference to this International Standard;
- b) results of test, in accordance with clause 7;

- c) solvent used, if other than toluene;
- d) name and amount of demulsifier, if used;
- e) bath temperature.

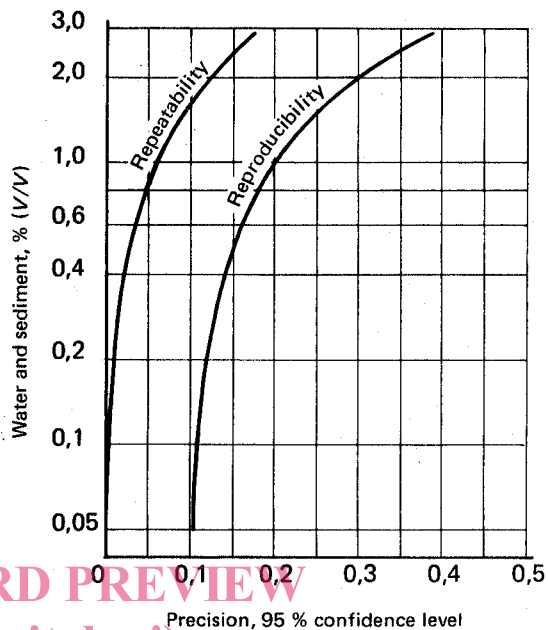


FIGURE 2 — Precision curves

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