

MACHINERY OIL OF GRADE I-8A (И-8А)

SPECIFICATIONS

GOST 20799-88

(Abstract)

The standard refers to machinery oil of grade I-8A (И-8А) of sub-group A, which is treated distilled and residual oils or their mixtures without additives used in industrial machines and mechanisms, the operating conditions of which do not require special antioxidation and anticorrosion properties of oils, and as hydraulic fluids as well.

1 Technical Requirements

1.1 The machinery oil shall be produced as per the present standard based on the process regulations approved in accordance with the established procedure.

1.2 As regards physical and chemical parameters, oil I-8A (И-8А) shall comply with the requirements and standard values given in Table 1.

Table 1

Parameter	Standard value	Test method
Viscosity-to-density ratio at 40 °C, mm ² /s	9–11	as per item 3.2
Acid value, KOH mg per 1 g of oil, maximum	0.02	as per item 3.3
Weight ratio of ash, %, maximum	0.005	as per item 3.4
Weight ratio of sulfur in oils of sour crude, %, maximum	1.0	as per item 3.5
Weight ratio of mechanical impurities	none	as per item 3.6
Weight ratio of water	traces	as per item 3.7
Density at 20 °C, kg/m ³ , maximum	880	as per item 3.8
Setting point, °C, maximum	-15	as per item 3.9

Table 1, continued

Parameter	Standard value	
Color per CNT (ЦНТ) colorimeter, CNT (ЦНТ) color units, maximum	1.5	as per item 3.10
Flash point in the open cup, °C, minimum	150	as per item 3.11
Resistance to oxidation: increment of acid value of oxydized oil, KOH mg per 1 g of oil, maximum increment of resins, %, maximum	0.20 1.5	as per item 3.12

2 Acceptance

2.1 The machinery oil shall be accepted in batches. A batch is any amount of oil manufactured during continuous process, homogeneous in quality data, and accompanied by a single quality document.

2.2 Acceptance tests are performed to check the oil quality.

2.3 If unacceptable test results were obtained even for a single parameter, repeated tests of the parameter for a new specimen taken from the same sampling shall be carried out. The results of the repeated tests apply to the whole batch.

2.4 Periodic test of parameter "Resistance to oxidation" may be performed once per quarter as agreed upon with the consumer.

In case unacceptable results are obtained during periodic tests, the manufacturer shall classify the tests of a certain parameter as acceptance tests for not less than three batches in a row till positive results are obtained.

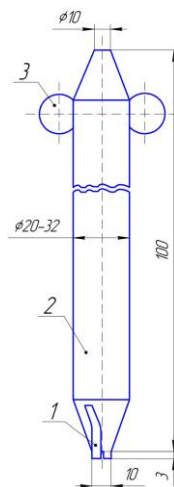
3 Test Methods

3.1 Sampling

One point sample shall be selected from one unit of transportation container. An integrated sample shall be made by mixing point samples.

Sampling shall be performed in a place protected from dust and atmospheric precipitations. Before sampling, the oil shall be stirred in the container. Contents of a canister, a jar, a bottle shall be mixed for 5 min by intensive shaking or with the help of a special agitator. Surface around plugs, lids and bottom shall be cleaned before opening.

A sampling tube (Figure 1) for point sampling of oil shall be dipped to the container bottom, then the upper hole shall be closed with your finger and the tube shall be taken out of the container. The sample shall be drained by opening the closed tube end.



1 – foot; 2 – tube; 3 – eyelet

Figure 1 – Sampling tube

3.2 Viscosity-to-Density Ratio Determination

The method consists in calculating the flow time of a certain volume of the tested fluid by gravity at the constant temperature in seconds with the help of a calibrated glass viscometer. Viscosity-to-density ratio is a product of calculated flow time by the viscometer constant.

3.2.1 Equipment and Reagents Applied

Cleaning solution for glass cleaning: potassium bichromate, sulphuric acid or chrome-free strong acid.

WARNING! Chromic acid is dangerous to health. It is toxic, considered cancer-causing, extremely corrosive and potentially dangerous when in contact with organic substances.

When using it, always protect your whole face and wear protective clothing. Do not inhale acid vapors. After use, decompose the wastes in accordance with standard techniques as they still stay dangerous.

Cleaning solutions of chrome-free strong acids are also corrosive and potentially dangerous when in contact with organic substances.

Solvent completely mixing with the specimen, for example petroleum-ether, shall be filtered before use.

Note – For majority of specimens, volatile white spirit (nefras S4-155/200 (C4-155/200)) or benzene for the rubber-processing industry (nefras S2-80/120 (C2-80/120)) are applicable.

Volatile desiccant solvent which can mix both with the specimen solvent and water. Before use, it shall be filtered. Analytically pure acetone may be used also.

Deionized and distilled water, filtered before use. Distilled water, pH 5.4–6.6.

Certified viscosity reference standards used for laboratory tests.

Laboratory filter paper.

Coarse-grain sodium chloride or anhydrous sodium sulphite, or incinerated calcium chloride, or any other desiccant.

Technical grade ethyl alcohol, synthetic ethyl alcohol, technical grade rectified ethyl alcohol.

Hydrochloric acid (HCl), analytically pure

Calibrated capillary glass viscometers ensuring measurement of viscosity-to-density ratio.

A set of viscometers shall be available for each viscosity range. It is allowed to use automatic viscometers.

Holder ensuring viscometer fixation in the accurately vertical position, with the upper mark located directly above the lower one, with the maximum error of 1 °C in any direction.

In case the upper mark of the viscometer is deflected against the lower one, the vertical deflection error shall not exceed 0.3 °C in any direction.

Viscometer verticality is determined by the upper half of the large knee.

Note – The required alignment of vertical parts may be checked with the use of a plumb line, however this method is not applicable for rectangular baths with lightproof edges.

Controlled temperature bath with necessary depth to ensure distances from the specimen in the viscometer to the upper liquid level in the bath and from the specimen to the bath bottom are not less than 20 mm during measurements. To fill the bath, it is necessary to use a transparent liquid remaining in the liquid state at the test temperature.

3.2.2 Bath temperature shall be adjusted so that it does not change by more than ± 0.02 °C along the entire height of the viscometers or within the space between the viscometers and the thermometer location point within the interval of plus 15 to plus 100 °C (for each series of flow time measurements). For

temperatures beyond the specified interval, temperature changes shall not exceed $\pm 0,05$ °C.

Depending on the temperature required to fill the thermostatic oven, the following reagents are used:

from minus 60 to plus 15 °C – technical grade ethyl alcohol or rectified ethyl alcohol, or technical grade isooctane;

from plus 15 to plus 60 °C – distilled water;

from plus 60 to plus 90 °C – glycerin dissolved with water in the proportion of 1:1, or light petroleum oil;

above plus 90 °C – 25% solution of ammonium nitrate.

To cool down the liquids in the thermostatic oven, use is made of ice, carbon-dioxide ice (dry ice) or liquid nitrogen.

In case no thermostatic oven is available to determine viscosity at temperatures below 15 °C, transparent Dewar vessels may be used.

Temperature measuring device

For the measurement range of 0 to plus 100 °C, use shall be made of calibrated liquid glass thermometers correctable to the minimum accuracy of ± 0.02 °C or above, or other thermometric devices with equal or higher accuracy. If two thermometers are used in the same bath, their readings shall not differ by more than 0.04 °C.

Note – When using calibrated liquid glass thermometers, it is recommended to use two thermometers.

For measurement of temperatures beyond the range of 0 to plus 100 °C, use shall be made of calibrated liquid glass thermometers correctable to the accuracy of ± 0.05 °C and above, and when two thermometers are used in the same bath their readings shall not differ by more than ± 0.1 °C.

When measuring temperatures with the use of a thermostatic oven (bath) by partial dipping of the control thermometer, graduated for complete immersion,

correction (Δt) shall be added to the readings of the control thermometer for the liquid column in the thermometer, outstanding from the thermostatic oven (over the liquid surface in the bath)

$$\Delta t = Kh(t_1 - t_2),$$

where K – correction factor, which is equal to 0.00016 for a mercury thermometer and to 0.001 for a spirit thermometer;

h – height of the outstanding column of mercury or spirit expressed in degree divisions of the thermometer scale;

t_1 – specified temperature in the thermostatic oven, °C;

t_2 – ambient temperature near the middle of the outstanding column of mercury or spirit, °C (determined with the help of an auxiliary thermometer whose bulb is positioned at the middle of the outstanding column height). To determine the actual temperature of liquid in the thermostatic oven, the correction shall be algebraically added to the thermometer readings.

Time measuring device enable to count time to 0.1 s (or with a lesser division value) with the error of ± 0.07 % for the interval of 200 to 900 s. Stopwatches with the division value of 0.2 s are allowed. Timer accuracy shall be checked regularly.

Note – Electrical time measuring devices may be used if the current frequency is checked with an accuracy not below 0.05 %. Alternating current (in some public networks) is controlled periodically rather than constantly, which may cause significant errors during viscosity measurements.

For measurements with the use of a timer, a standard frequency signal of the broadcasting or telephone network is applicable.

Such signals are applicable for time measurements if they have the accuracy of 0.1 s.

Drying oven, providing heating temperature from 100 to 200 °C.

Sieve with 75 μm holes.

Funnels or filtering crucibles.

3.2.3 Calibration and Adjustment

3.2.3.1 Adjustment of calibrated viscometers shall be performed in the laboratory conditions as per the technique specified in the standard with the use of certified viscosity reference standards. In case difference between the viscosity-to-density ratio measured on the reference standard and the value given in the certificate for it exceeds $\pm 0.35\%$ each testing stage, including adjustment of thermometer and viscometer, shall be checked to detect any reasons for errors.

Note – The most typical reasons for errors are dust particles in the capillary tube hole and error in temperature measurements. A proper result obtained for the certified reference standard does not exclude probable error sources.

3.2.3.2 Viscometer constant C depends on the gravity acceleration in the adjustment place and therefore is specified by the standardization laboratory together with the viscometer constant. In case gravity acceleration g differs by more than 0.1 %, adjustment constant C_2 shall be corrected using the formula below

3.2.3.3 General Requirements to Testing Procedure

3.2.3.3.1 The test temperature in the bath for viscometers shall be adjusted and kept at the required level, specified in item 3.2.2.

Note – To obtain the most reliable data during temperature measurements, it is recommended to use two thermometers provided with adjustment certificates.

The readings shall be observed with the use of object lenses with approximately 5x magnification, installed so that errors of angular deflection are avoided between visible and actual directions of image.

3.2.3.4 The use is made of two clean dry calibrated viscometers with measurement limits corresponding to the expected viscosity (for a viscous liquid – with a larger capillary tube, for a low-viscous liquid – with a small capillary tube). Time of liquid flow shall not be less than 200 s.

Note – Certain operations on viscosity determination may be changed depending on the viscometer type.

3.2.3.5 If the test temperature is below the dew point, in order to avoid water condensation it is necessary to connect drying tubes with a filler to open ends of the viscometer. The drying tubes shall match the viscometer design and shall not limit flow of the reference standard under the pressure created in the viscometer.

Before placing the viscometer into the bath, the operating capillary tube and the extension part of the viscometer shall be filled with the reference standard, after which it shall be drained again for extra protection against water condensation or freezing on the walls.

3.2.3.6 Viscometer Washing

3.2.3.6.1 Between serial measurements, the viscometer shall be thoroughly washed with a solvent several times, then with a completely evaporable solvent. The viscometer shall be dried by passing a weak jet of dry filtered air for 2 min or till there are no traces of solvent left.

3.2.3.6.2 The viscometer shall be regularly washed with a cleaning solvent for several hours in order to remove residual traces of organic deposits, then thoroughly rinsed with water and drying solvent, and dried with dry filtered air or in vacuo. If deposits of inorganic substances are present, before washing with chromic acid mixture they shall be removed using hydrochloric acid (HCl), especially when presence of barium salts is suspected.

3.2.3.6.3 Never use alkaline cleaning solutions as changes in viscometer calibration may occur.

Use of special devices for viscometer washing is allowed.

3.2.3.7 Processing of Results

3.2.3.7.1 Viscosity-to-density ratio v , mm^2/s , is calculated by the formula below

$$v=Ct,$$

where C – viscometer calibration constant, mm^2/s^2 ;

t – arithmetic average of flow time, s.

Test results for the viscosity-to-density ratio shall be recorded to four significant digits with the indication of test temperature. The results of viscosity-to-density ratio determination are rounded to 0.01 % of the measured or calculated value respectively.

3.3 Acid Value Determination

The method consists in titration of acid formations of the tested product with alcoholic solution of potassium hydroxide (KOH) with addition of color indicator, and in determination of acid value expressed in KOH mg/g.

3.3.1 Equipment, Materials and Reagents Applied

Cone flask with the rated capacity of 100 cm^3 with an interchangeable 29/32 cone, made of heat-resistant glass.

Cone flask with the rated capacity of 100 cm^3 without an interchangeable cone, with the neck diameter of 34 mm, made of thermally and chemically resistant glass.

Cone flask with the rated capacity of 100 cm^3 without an interchangeable cone, with the neck diameter of 22 mm, made of thermally and chemically resistant glass.

Cone flask with the rated capacity of 250 cm³ with an interchangeable 29/32 cone, made of heat-resistant glass.

Cone flask with the rated capacity of 250 cm³ without an interchangeable cone, with the neck diameter of 34 mm, made of thermally and chemically resistant glass.

Round-bottomed flask with two necks located at an angle with the rated capacity of 1 000 cm³, with an interchangeable cone and a central neck cone of 29/32, made of heat-resistant glass.

Round-bottomed flask with two necks located at an angle with the rated capacity of 1 000 cm³, without an interchangeable cone, with the central neck diameter of 34 mm, made of thermally and chemically resistant glass.

Chevron distillation tube with the length of 400 mm, minimum.

Condenser with a straight tube, casing length of 400 cm³, interchangeable 14/23 center punch cone, made of chemically resistant glass.

Ball condenser with the casing length of 400 mm, interchangeable 29/32 center punch cone, made of chemically resistant glass.

Ball condenser with the casing length of 400 mm made of thermally and chemically resistant glass, or air condenser, or glass tubes with the length of 700–750 mm and inside diameter of 10–12 mm.

Lipped cylinders with capacity of 50, 100, 1 000, 2 000 cm³.

Drop-meter with a one-way cock, accuracy class 2, capacity of 25 cm³.

Drop-meter without a cock, accuracy class 2, capacity of 25 cm³.

Drop-meters with an emergency vessel, accuracy class 2, capacity of 2 and 5 cm³.

Drop-meters with automatic zero and glass tube, accuracy class 2, capacity of 3 and 10 cm³.

Flask with one mark or with one mark and a ground plug, capacity of 100 cm³, accuracy class 2.

Flask with one mark or with one mark and a ground plug, capacity of 1 000 cm³, accuracy class 2.

Pipettes without divisions with expansion in the shape of a barrel or a ball, accuracy class 1 and 3, capacity of 50 cm³.

Evaporation bowl with the rated capacity of 100 cm³.

Hot plate with a closed spiral of any type.

Small weighing cup with an interchangeable 45/13 cone.

Heating funnel.

Stopwatch.

Glass tube of dark glass or painted black.

Spatula.

Exiccator filled with calcium chloride or silica gel.

Dropping bottle with a cap with the rated capacity of 50 cm³, made of chemically resistant glass.

Drying oven or muffle furnace.

General-purpose laboratory balance with the weighing limit of 200 g and accuracy class 2 minimum.

Counter balance.

Calcium chloride tube.

Rectified ethyl or propyl, isopropyl alcohol.

Chemically or analytically pure potassium hydroxide, titrated alcoholic solution of 0.05 mol/dm³.

Calcium chloride dehydrate or calcium chloride.

Soda lime or soda asbestos.

Potassium diphtalate (potassium biphthalate).

Chemically pure or analytically pure amber acid.

Analytically pure benzol.

Analytically pure xylene.

Analytically pure toluene.

Alkali blue 6B (6B), shall be prepared as follows: 0.8 g of alkali blue 6B (6B) shall be dissolved in 1 000 cm³ of 96% ethyl alcohol, then 1 500 cm³ of benzol shall be added till the indicator is dissolved completely. After benzol has been added, the mixture shall be kept for 12 h, then the transparent solution shall be filtered.

Hydrochloric acid HCl 0.1 mol/dm³.

Nitrasin yellow, 0.5% aqua solution.

Phenolphthalein, 0.1% alcoholic solution.

Distilled water, pH = 5.4–6.6.

3.3.2 Test Preparation

3.3.2.1 To prepare titrated solutions, freshly distilled alcohol is used. Alcohol distillation shall be performed in a 1 000 cm³ flask with a distillation tube.

Preparation of 85% ethyl alcohol: 89 cm³ of ethyl alcohol shall be mixed with 11 cm³ of distilled water.

To prepare 0.5% aqua solution of nitrasin yellow, 0.5 g of the indicator shall be dissolved in 100 cm³ of distilled water.

To prepare 1% solution of phenolphthalein, 1 g of the indicator shall be dissolved in 100 cm³ of ethyl alcohol.

3.3.2.2 For titration of alcoholic solution of potassium hydroxide, crystallized potassium diphthalate (potassium biphthalate) or amber acid is used. 70 g of potassium biphthalate shall be dissolved in 200 cm³ of hot distilled water. Crystallization shall be performed at a temperature not lower than 25 °C as a lower temperature causes formation of potassium triphthalate – a more acid salt. The formed crystals shall be dried to the constant weight at (105 ± 5) °C. 100 g of amber acid shall be dissolved in 165 cm³ of distilled water by boiling, the solution shall be filtered through the funnel with heating. After the solution is cooled down, the crystals shall be filtered on the exhaust funnel and crystallized again. The crystals

shall be dried at $(105 \pm 5) ^\circ\text{C}$ to the constant weight. The crystallized potassium biphthalate and amber acid shall be placed into weighing bottles and stored in the exiccator. Before each titration, potassium biphthalate and amber acid shall be dried for 1 h at $(105 \pm 5) ^\circ\text{C}$.

3.3.2.3 Preparation of 0.05 mol/dm^3 of alcoholic solution of potassium hydroxide.

3 g of crystal potassium hydroxide shall be weighed with the maximum error of 0.1 g, and dissolved in $1\,000 \text{ cm}^3$ of ethyl alcohol. The obtained solution shall be stirred and kept in a dark place for minimum 24 h.

The settled transparent solution shall be separated from residues by decantation into a drop-meter glass bottle or into a dark glass bottle with a plug or into those painted black. The drop-meter shall be protected with a tube with soda lime or soda asbestos.

Titration of potassium hydroxide solution shall be performed on potassium biphthalate.

In case potassium biphthalate is not available, titration may be performed on amber acid.

0.05–0.07 g of potassium biphthalate or amber acid, weighed with the maximum error of 0.0002 g, shall be put in a 100 cm^3 conical flask and dissolved in 50 cm^3 of freshly boiled distilled water, after which 3-4 drops of phenolphthalein shall be added, and titration with 0.05 mol/dm^3 solution of potassium hydroxide shall be performed while continuously stirring till pink coloring appears.

The coloring shall be stable for 30 s without stirring.

Potassium hydroxide titrant T , mg/cm^3 shall be calculated using the formula

$$T = \frac{56,11 \cdot m}{\Xi \cdot V_1} \cdot 1000,$$

where 56.11 – equivalent weight of potassium hydroxide, g;

m – weight of potassium biphthalate or amber acid, g;

E – equivalent weight of potassium biphthalate or amber acid equaling to 204.23 and 59.04 g respectively;

V_1 – volume of 0.05 mol/dm³ solution of potassium hydroxide consumed for titration of the weight of potassium biphthalate or amber acid, cm³.

An arithmetic average value of minimum three parallel determinations with the difference between them not exceeding 0.03 mg shall be assumed as a titration result. The solution titrant shall be checked not less frequently than once in two weeks.

3.3.2.4 Sample Preparation

A machinery oil sample shall be thoroughly mixed by shaking for 5 min in a glass bottle filled to $\frac{3}{4}$ of its volume, maximum.

3.3.3 Test Procedure

20 g of the tested product, weighed with the maximum error of 0.01 g, shall be placed into a 250 cm³ conical flask. Not less than 40 cm³ of alkali blue 6B (6B) shall be added while shaking till the sample dissolves completely. Then, the contents of the flask shall be titrated with the alcoholic solution of potassium hydroxide while slightly shaking till the blue coloring changes into the red one, or till the blue toning changes into the red one.

The control test without the tested sample shall be performed simultaneously with the same amount of blue alkali 6B (6B).

In case the sample dissolves incompletely, the contents of the flask shall be boiled with the backflow condenser for 5 min while continuously stirring.

The acid value may be determined in the following way: neutralized hot alcohol (50 cm³ of 85% ethyl alcohol shall be poured into the conical flask and boiled with the backflow water or air condenser for 5 min.) 8 to 10 drops (0.25 cm³) of nitrasin yellow shall be added into the boiled alcohol and neutralized in the hot state with 0.05N alcoholic solution of potassium hydroxide while continuously stirring till the yellow coloring first changes into the green one), shall be added into the flask with the tested product. The contents of the flask shall be boiled with the backflow condenser for 5 min while continuously stirring. The

mixture shall be titrated in the hot state with the alcoholic solution of potassium hydroxide while continuously and rapidly stirring till the yellow coloring (or yellow coloring with various tonings) of the alcohol layer or mixture changes into the green one (or the green one with tonings). The coloring shall be stable for 30 s without stirring.

Titration shall be performed in the hot state rapidly in order to avoid any influence from carbon dioxide containing in the air.

3.3.4 Processing of Results

Acid value of the tested sample K , KOH mg/g, when used as alkali blue, shall be calculated using the formula

$$K = \frac{(V_1 - V_2) \cdot T}{m},$$

where V_1 – volume of 0.05 mol/dm³ of potassium hydroxide alcoholic solution consumed for titration, cm³;

V_2 – volume of 0.05 mol/dm³ of potassium hydroxide alcoholic solution consumed for the control test, cm³;

T – titrant of 0.05 mol/dm³ of potassium hydroxide alcoholic solution, mg/cm³;

m_3 – weight of the sample, g.

Acid value of the tested sample K_1 , KOH mg/g, when used as nitrasin yellow, shall be calculated using the formula

$$K_1 = \frac{V_1 \cdot T}{m},$$

where V_1 – volume of 0.05 mol/dm³ of potassium hydroxide alcoholic solution consumed for titration, cm³;

T – titrant of 0.05 mol/dm³ of potassium hydroxide alcoholic solution, mg/cm³;

m – weight of the sample, g.

An arithmetic average of two parallel measurements shall be assumed as a test result.

Two test results obtained by the same assistant chemist are considered reliable at the confidence factor of 0.95 %.

3.4 Determination of Weight Ratio of Ash

The method consists in burning of a weight of a tested product and incinerating of fixed residue to the constant weight.

3.4.1 Equipment, Materials and Reagents Applied

Tall crucibles made of transparent quartz glass with the capacity of 50, 80, 100 cm³.

Small crucibles made of transparent quartz glass with the capacity of 50, 80, 100 cm³.

Cups made of transparent quartz glass with the capacity of 50, 80, 100, 160 cm³.

Platinum cups.

Low porcelain crucibles with the maximum outside diameter of 55 and 75 mm.

Evaporation bowls with the rated capacity of 50 or 100 cm³.

Porcelain crucibles and cups are used till the glazing on the inner surface is damaged.

Hot plate or sand bath.

Electric muffle or crucible furnace ensuring heating and the temperature of (600 ± 50) °C. The front and rear walls of the muffle and the furnace shall have holes,

Millivoltmeter with the calibration of scale to 1 000 °C with thermocouple KhA (XA) in a set.

Exiccator filled with calcium chloride or silica gel.

Crucible tongs.

Triangular stands made of a nickel-chromium wire or porcelain tubes on a steel framework.

Mercury thermometer.

Ash-free paper filters with the diameter of 9–11 cm, with the known weight of ash of one filter.

3–5 mm thick asbestos sheets.

Hydrochloric acid (HCl) dissolved with water in the proportion of 1:4.

10% aqua solution of ammonium nitrate.

Distilled water.

Granulous calcium chloride or molten calcium chloride.

3.4.2 Test Preparation

Crucibles (cups) shall be put into the glass and filled with dissolved hydrochloric acid, boiled for several minutes, after which the crucibles shall be rinsed with distilled water and incinerated in the muffle or crucible furnace at the temperature of (600 ± 50) °C (red heat) for 10 min, then they shall be cooled for 5 min in the air and taken to the exiccator.

After cooing in the exiccator for 30 min, the crucible shall be weighed with the error of 0.0002 g maximum. Incineration, cooling and weighing shall be repeated till the difference between two successive weighing cycles (bringing to the constant weight) is 0.0004 g maximum.

The tested product shall be thoroughly stirred for 5 min in a vessel filled to $\frac{3}{4}$ of its volume maximum.

3.4.3 Test Procedure

The ash-free filter shall be placed into the crucible (cup), prepared as per item 3.4.2, so that it tightly adjoins the crucible bottom and walls.

The crucible with the filter shall be weighed with the maximum error of 0.01 g and 25 g of the tested product shall be put into it.

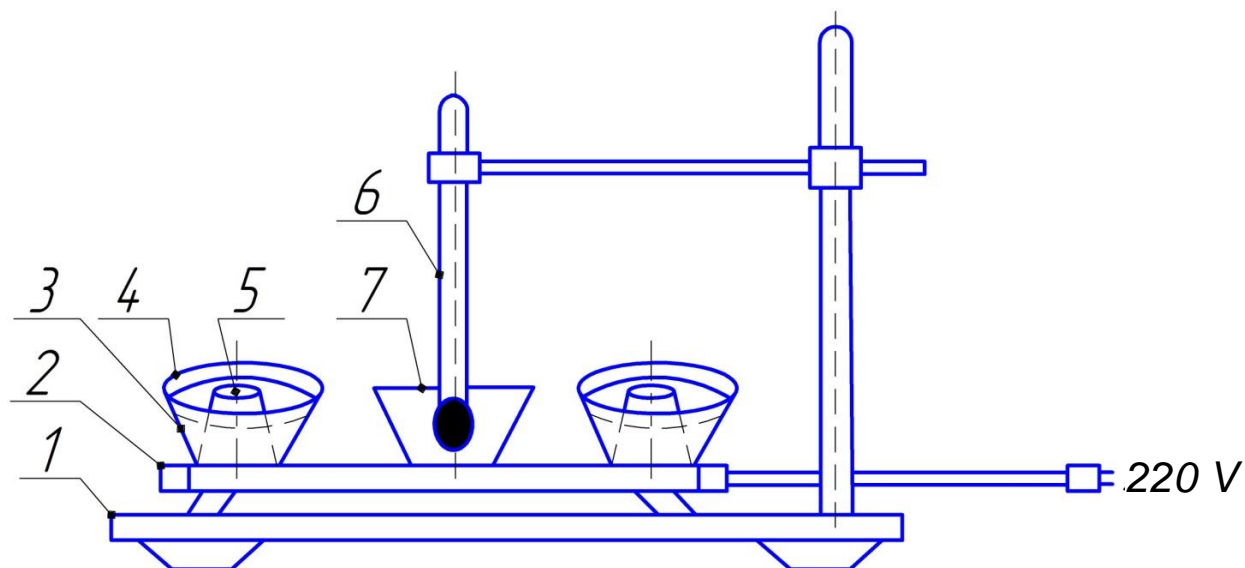
The other ash-free filter shall be folded in two and rolled in the shape of a cone. The upper part of the cone shall be cut with scissors at the distance of 5–10 mm from the top and placed into the crucible. The cone-like folded filter (core) shall be put into the crucible with the product with the base facing downwards so that it is steady covering the major part of the product surface.

When testing machinery oil containing water, the crucible with the tested product and core shall be installed onto the hot plate and heated for 10–30 min at a temperature not above 120 °C till slight foaming ceases to emerge on the surface of the tested product and the core is impregnated with the product to the degree ensuring its flammability. Dehydration temperature shall be measured with a thermometer put into the crucible with the product (Figure 2), which does not contain water and has the maximum flash point of 250 °C.

After the core is impregnated with the tested product, it shall be set afire.

The crucible with the tested product, in which evaporation can be performed, shall be placed onto the electrical heater and heated.

Product evaporation or burning shall be performed till dry carbon residue is obtained. During evaporation and in the beginning of burning, heating shall be adjusted in a way which prevents product spillage and flowing out of the crucible. During burning, the flame shall be tranquil.



1 – laboratory support; 2 – hot plate; 3 – porcelain crucible;
 4 – paper filter tightly adjoining crucible walls; 5 – paper filter cone (core);
 6 – mercury thermometer; 7 – oil

Figure 2 – General view of electric dehydrator for petroleum products

After product burning or evaporation, the crucible with carbon residue shall be taken to the muffle (or crucible furnace), heated to $(600 \pm 50) ^\circ\text{C}$ or to the temperature, specified by the technical requirements for the tested product, and kept at this temperature for 1.5–2 h till the residue is completely ashed.

In case the crucible is placed into a cold muffle, the muffle shall be heated to the above mentioned temperature for 1.5–2.0 and the crucible shall be kept in it at this temperature for 1.5–2.0 h till the residue is completely ashed.

If the carbon residue is ashed slowly or if there is free carbon visible after ashing, the residue in the crucible shall be cooled and treated with several drops of ammonium nitrate solution, then it shall be carefully evaporated and incineration shall be continued.

After ashing, the crucible shall be taken out of the muffle (or crucible furnace), placed onto asbestos or a triangular plate of nickel-chromium wire or porcelain tubes on a steel framework, and cooled for 5 min in the air, then it shall

be kept in the exiccator for 30 min, weighed and again taken to the muffle or crucible furnace for 15 min.

Incineration, cooling and weighing shall be repeated as per item 3.4.2 till the constant weight is obtained.

3.4.4 Processing of Results

Ash weight ratio in machinery oil X, %, shall be calculated using the following formula:

$$X = \frac{m_1 - m_2}{m} \cdot 100,$$

where m – weight of the tested product, g;

m_1 – weight of ash, g;

m_2 – weight of ash in two paper filters (weight of ash in a filter is indicated on the filter packing), g.

Note – m_2 shall be ignored during evaporation.

Permissible differences between the results of two parallel measurements of ash weight ratio shall not exceed the values given in Table 2

Table 2

Weight ratio of ash, %	Permissible difference, %
Up to 0.005	0.002
Over 0.005 to 0.01	0.003
Over 0.01 to 0.1	0.005
Over 0.1 to 1.0	0.01
Over 1.0 to 5.0	0.05
Over 5.0	4 % of the least value

Note – Ash weight ratio up to 0.002 % inclusive is considered as absence of ash.

3.5 Measurement of Sulfur Weight Ratio

The method consists in burning of weight quantity of a tested product in the air jet, collecting of forming sulfur trioxides and sulfur dioxides with the help of the hydrogen dioxide and sulfuric acid solution, and titration with the sodium hydroxide solution.

3.5.1 Equipment, Materials and Reagents Applied

Horizontal electric pipe heater with the length of 130 to 140 mm, inside diameter of 20 to 22 mm, with nickel-chromium winding ensuring the heating temperature of plus 900 to plus 1 000 °C;

laboratory autotransformer;

millivoltmeter with the measurement range of 0 to plus 1 100 °C;

thermocouple of type TKhA (TXA) (chromel-alumel) or of type TPP (ТПП) (platinum-platinum rhodium);

laboratory water-jet glass pump;

air blower, or laboratory compressor, or general air injection line;

laboratory glass flow meters;

quartz tube with a quartz knee (Figure 3);

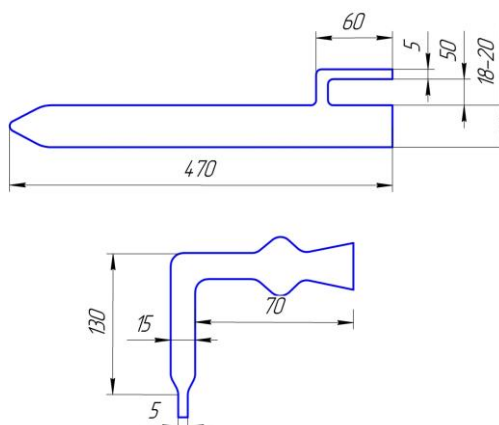


Figure 3 – Quartz tube with knee

glass bottles for air cleaning with the minimum capacity of 250 cm³;
laboratory graduated glassware;
measuring cylinders or measuring-glasses with the capacity of 250 cm³;
laboratory glass measuring equipment;
measuring pipettes with the capacity of 5 and 10 cm³,
drop-metes with the capacity of 10 cm³ with the division scale of 0.02 cm³,
drop-metes with the capacity of 25 cm³ with the division scale of 0.1 cm³, of
any type;
laboratory conical glass flasks with the capacity of 250 cm³;
calcium chloride tubes of any type;
porcelain laboratory dishes: combustion trays;
mortar and pestle;
laboratory glass dropping bottles;
rubber bulb;
small-sized metal spatula;
metal sieve with 0.25 mm holes;
medical or technical grade hydrogen dioxide (perhydrol) H₂O₂
methyl red (indicator), 0.2% alcoholic solution, and methylene blue, 0.1%
alcoholic solution, and 1:1 mixture of indicators;
phenolphthalein (indicator), 1% alcoholic solution;
chemically pure or analytically pure potassium permanganate, 0.1 M
solution;
chemically pure or analytically pure potassium iodate or chemically pure or
analytically pure potassium diphtalate;
molten calcium chloride, pure;
pure soda asbestos or soda lime;
industrial rectified ethyl alcohol;
medicated cotton wool;
chamotte with particles over 0.25 mm, incinerated at 900–950 °C;
distilled water;
chemically pure or analytically pure sulfuric acid, 0.02N solution;

chemically pure or analytically pure sodium hydrate (sodium hydroxide), 40% solution and 0.02N solution;

medical paraffin or any low-viscosity mineral oil checked for sulfur.

3.5.1.2 Preparation for Analysis

3.5.1.2.1 Preparation of 0.02N solution of sodium hydroxide solution

3.5.1.2.2 3 g of sodium hydroxide shall be weighed with the maximum error of 0.01 g, dissolved in 3 dm³ of distilled water. The obtained solution shall be thoroughly stirred and kept in a dark place for 24 hours, after which it shall be decanted, with the upper transparent layer taken for the analysis.

3.5.1.2.3 Potassium iodate shall be crystallized twice, to do which saturated aqua solution shall be prepared at 60 °C. The solution shall be filtered in the hot state, then cooled down in a bath filled with water with ice. Formed crystals shall be separated and dried at the temperature of plus 95 to plus 100 °C to the constant weight. Crystallized potassium iodate shall be stored in dark glassware in a dark place.

In case no potassium iodate is available, potassium diphthalate may be used for the test. The reagent shall be preliminarily crystallized at the minimum temperature of 25 °C in order to avoid formation of crystals of potassium triphthalate. Obtained crystals shall be dried to the constant weight at the temperature of plus 110 to plus 115 °C.

3.5.1.2.4 Normality of sodium hydroxide solution shall be determined by titration of certain weights taken from the small-sized drop-meter with the use of potassium iodate and from the 25 cm³ drop-meter with the use of potassium diphthalate.

During titration, the upper end of the drop-meter shall be protected with a calcium chloride tube filled with soda asbestos or soda lime and calcium chloride.

Three conical flasks shall be filled with 0.06 g of potassium iodate each (0.08 g of potassium diphtalate each), weighed with the maximum error of 0.0002 g, which shall be dissolved with 35 ml of freshly boiled distilled water and rapidly titrated with the sodium hydroxide solution.

When using potassium iodate, titration shall be performed with 8 drops of the indicators mixture till the purple coloring of the solution changes into the bright-green one, and when using potassium diphtalate, titration shall be performed with 3-4 drops of phenolphthalein till light-pink coloring, steady for 30 s (without stirring) appears.

Normality of sodium hydroxide solution N is calculated by the following formula:

$$N = \frac{m \cdot 1000}{V \cdot \epsilon},$$

where m – weight of potassium iodate or potassium diphtalate, g;

V – volume of sodium hydroxide solution consumed for titration, cm^3 ;

E – gram-equivalent of the substance, equal to 389.91 for potassium iodate, and to 204.23 g for potassium diphtalate.

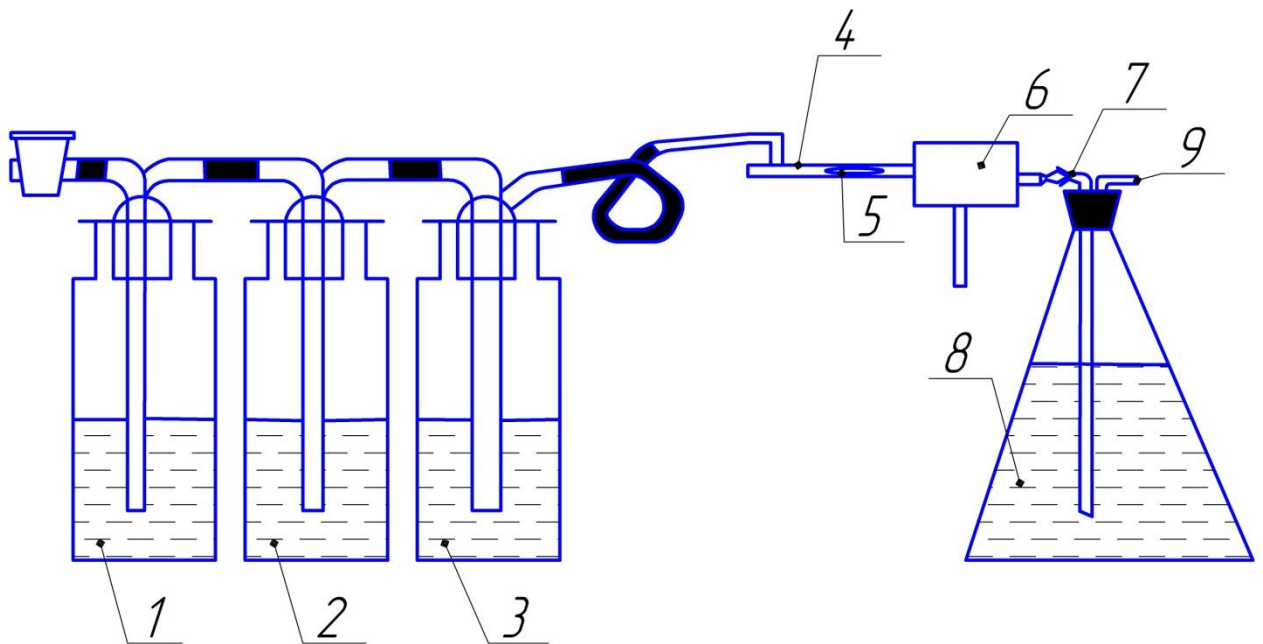
Normality of the sodium hydroxide solution shall be checked not less frequently than once in two weeks.

3.5.1.2 Equipment Preparation

3.5.1.2.1 Assemble the air cleaning system (Figure 4). To do this, the first glass bottle shall be filled with 0.1 M solution of potassium permanganate approximately to half of its volume, the second glass bottle with 40 % sodium hydroxide solution, and the third one – with cotton wool, and the three glass bottles shall be connected in series with a rubber tube. The receiving device shall be filled with 150 cm^3 of water, 5 cm^3 of perhydrol and 7 cm^3 of 0.02N solution of sulfuric acid. The receiving device shall be covered with a rubber plug fitted with a quartz knee and a discharge tube. With a polished section, the knee shall be connected to

a quartz tube, which shall be installed horizontally in a furnace. The other end of the tube shall be covered with a rubber plug and through an offshoot connected to the cleaning system, which is connected with an air injection appliance. An air flow rate meter shall be installed upstream of the cleaning system.

3.5.1.2.2 Before the analysis, the assembled apparatus shall be tested for leakage. To do this, the receiving device discharge tube shall be connected to the water-jet pump, filling the entire system with air, after which the cock on the discharge tube of the cleaning system shall be closed. No air bubbles shall emerge in the receiving device and cleaning system at that. In case the system is not tight, soapy water shall be applied onto all the joints, leaking points shall be detected and eliminated.



- 1 – glass bottle with potassium permanganate; 2 – glass bottle with 40% sodium hydroxide solution; 3 – glass bottle with medicated cotton wool; 4 – quartz tube;
 5 – tray; 6 – electric furnace; 7 – quartz knee; 8 – receiving device;
 9 – discharge tube

Figure 4 – Air Cleaning System

3.5.1.2.3 At the same time, the furnace shall be switched on and gradually heated to a temperature from plus 900 to plus 950 °C. To adjust and measure the furnace heating temperature, the autotransformer shall be switched on, and the furnace shall be installed into the thermocouple so that its junction point is in the middle of the furnace, the thermocouple ends shall be connected to the measuring device.

3.5.1.3 Analysis Procedure

3.5.1.3.1 The tested machinery oil shall be weighed with the maximum error of 0.0002 g in a porcelain tray, evenly distributing it over the entire tray. The weight quantity shall correspond to Table 3.

Table 3

Expected weight ratio of sulfur, %	Weight quantity, g
0–2	0.2–0.1
2–5	0.1–0.05

In case the tested machinery oil contains over 5 % of sulfur, it shall be preliminarily dissolved with medical paraffin or any low-viscosity mineral oil, checked for absence of sulfur, so that the sulfur content does not exceed 5 %.

Note – When analyzing high-sulfuric products (with weight ratio of sulfur over 5 %), weight quantities below 0.03 g, weighed with the micro-balance with the maximum error of 0.00003 g, are allowed instead of dissolution.

3.5.1.3.2 Before putting into the furnace, the weight quantity in the tray shall be preliminarily covered with sieved or incinerated chamotte and then placed into the quartz tube. The tube shall be quickly covered with a plug, and the air shall be passed through the system at the rate of 0.5 dm³/min; herewith the air flow rate shall be measured with a flow meter or another metering device.

Burning of the tested machinery oil shall be performed at the temperature of plus 900 to plus 950 °C for 30–40 min, and for products containing over 50 % of aromatic compounds – for 50–60 min, moving the tube with the tray along the

furnace avoiding product inflammation. The tube with the tray shall be afterwards put into the central, most heated part of the furnace, where it shall be incinerated once again for 15 min.

3.5.1.3.3 Upon completion of burning, the tube with the tray shall be gradually moved backwards, the receiving device shall be disconnected from the tube, and the quartz ring shall be washed with 25 cm³ of distilled water, draining it into the receiving device. The contents of the receiving device shall be titrated with 0.02N sodium hydroxide solution with 8 drops of mixed indicator till the purple coloring of the solution changes into the bright-green one. In case the product contains over 2 % of sulfur, the 25 cm³ drop-meter shall be used for titration.

3.5.1.3.4 Before the analysis of the machinery oil sample, the control test shall be performed in the same conditions.

3.5.1.4 Processing of Results

3.5.1.4.1 Weight ratio of sulfur S, % is calculated using the following formula:

$$S = \frac{0,00032 \cdot (V_1 - V_0) \cdot 100}{m_1},$$

where 0.00032 – weight of sulfur accurately corresponding to 1 cm³ of 0.02N solution of sodium hydroxide, g.

V_0 – accurate volume of 0.02N solution of sodium hydroxide used for control test titration, cm³;

V_1 – accurate volume of 0.02N solution of sodium hydroxide used for titration, cm³;

m – weight of machinery oil, g.

3.5.1.4.2 When dissolving the tested machinery oil with medical paraffin, weight ratio of sulfur S_1 , %, is calculated using the following formula:

$$S_1 = \frac{0,00032 \cdot (V_1 - V_0) \cdot m_2 \cdot 100}{m_3 \cdot m_4}$$

where m_2 – total sum of medical paraffin and product, taken for dissolution, g;

m_3 – weight of high-sulfuric product, taken for dissolution, g;

m_4 – weight of mixture, taken for the analysis, g.

3.5.1.4.3 An arithmetic average of two parallel measurements with the maximum permissible difference between them not exceeding the values given in Table 4 shall be assumed as a test result.

Table 4

Weight ratio of sulfur, %	Permissible difference, rel. %
Up to 1.0	± 5
Over 1.0	± 3

3.6 Determination of Weight Ratio of Mechanical Impurities

The method consists in filtration of tested products, with preliminary dissolution of slowly filtrating products in benzene or toluene, washing of a residue on a filter with solvent, with its subsequent drying and weighing.

3.6.1 Equipment, Materials and Reagents Applied

Water-jet pump ensuring the limit pressure over $1.33 \cdot 10^3$ Pa (10 mm Hg).

Drying oven or thermostatic oven ensuring the heating temperature of (105 ± 2) °C.

Water bath or hot plate with closed spiral.

Laboratory balance with the weighing error of 0.0002 g maximum.

Tall lipped glasses with the rated capacity of 200, 400, 500, 1 000 cm³, made of heat-resistant glass.

Conical flasks with the rated capacity of 500, 750, 1 000 cm³ without an interchangeable cone, with the central neck diameter of 34, 42, 50 mm, made of thermally and chemically resistant glass.

Tall weighing glasses with interchangeable 14/8, 19/9, 24/10, 34/12 cone.

Laboratory funnels with the diameter of 56 and 75 mm, height of 80 and 110 mm, made of chemically resistant glass.

Flasks with one mark, rated capacity of 500 and 1 000 cm³.

Exiccator with cock and without cock with the case diameter of 190 and 250 mm.

Buchner funnel with the rated capacity of 65, 80, 100, 130, 175 cm³.

Hot filtration funnel.

Glass rod of 150–200 mm long with a melt end.

Wash bottle with a rubber squeeze bulb.

Ash-free paper filter of “white ribbon” or “red ribbon” grade.

Nefras–S 50/170 (C 50/170) or straight-run gasoline with the initial boiling point of 80 °C minimum.

Industrial rectified ethyl alcohol.

Industrial ethyl alcohol.

Petroleum toluene.

The mixture of ethyl alcohol and toluene in the ratio of 1:4 (by volume).

The mixture of ethyl alcohol and ethyl ether in the ratio of 4:1 (by volume).

Caustic silver, 0.1 mol/dm³ solution

Distilled water.

Filter paper.

Vacuum meter ensuring recording of the residual pressure of $1.33 \cdot 10^3$ Pa (10 mm Hg).

3.6.2 Test Preparation

The sample shall be thoroughly stirred manually by shaking for 5 min in a vessel filled to not more than $\frac{3}{4}$ of its capacity.

The paper or glass filter shall be washed with the same solvent that is used during the test.

The paper filter shall be put inside a clean dry weighing glass.

The opened weighing glass and the filter shall be dried inside the drying oven at the temperature of (105 ± 2) °C for 45 min, then the glass shall be closed with the cover. The glass with the filter shall be cooled down for 30 min in the exiccator and weighed with the error of 0.0002 g maximum.

The glass with the filter shall be dried and weighed till the difference between two successive weighing cycles is 0.0004 g maximum. The filter shall be dried again for 30 min.

If the alcohol-toluene or alcohol-ether mixture is used as a solvent for the test, before drying and bringing the filters to the constant weight they shall be additionally treated by filtering of 50 cm³ of hot alcohol with the temperature from plus 50 to plus 60 °C.

If necessary, the filter shall be washed in 50 cm³ of distilled water heated up to the temperature of 80 °C.

All solvents shall be filtered through the filter of the same type as used for sample testing.

3.6.3 Test Procedure

100 g of the tested product shall be put into the glass and dissolved with heated solvent (benzol, toluene) in the ratio of 1:2. Before testing determine minimum volume of the sample and solvent necessary for dissolving the sample.

Benzol and toluene used for dissolving of samples of the tested products shall be heated in the water bath to the temperature of plus 40 and plus 80 °C.

Solvent boiling during heating is prohibited.

The contents of the glass shall be filtered through the paper filter, prepared as per item 3.6.2, placed into a glass funnel, which are fixed in the support.

The solution shall be poured onto the filter surface along the glass rod, the funnel with the filter shall be filled with solution by 3/4 of the filter height maximum. The residue on the glass shall be washed off to the filter with clean benzol (toluene) till a drop of filtrate put on the filter paper makes no grease spots on the paper after evaporation.

The remaining oil or solid impurities on the glass walls shall be removed with a glass rod and washed off onto the filter with hot clean benzol (toluene) heated up to 40 °C (80 °C).

If the tested product contains water, preventing filtration, the solution sample shall be settled for 10 to 20 min, after which the benzol (toluene) solution shall be filtered first, carefully draining it from the residual, then the residual shall be dissolved with 5–15 times amount (by volume) of alcohol-ether mixture and taken onto the filter. The residue on the flask shall be washed off onto the filter with alcohol-ether mixture and heated benzol (toluene).

After filtration the filter with the residue shall be washed with benzol heated up to 40 °C with the use of a wash bottle with a rubber bulb till no traces of the product are left on the filter, and perfectly transparent and colorless solvent runs off.

In case the residue on the filter cannot be dissolved with benzol and toluene, the filter may be additionally washed with alcohol-toluene mixture heated up to 60 °C.

The filter may be additionally washed with hot distilled water, the filter with the residue after washing with organic solvents shall be dried in the air for 10–15 min and then washed with 200–300 cm³ of hot distilled water.

Upon completion of washing, the filter with the residue shall be taken into the opened weighing glass in which the clean filter was dried. The opened weighing glass shall be dried in the drying oven at the temperature of (105 ± 2) °C for not less than 45 min. Then the glass shall be closed with the cover, the glass with the filter shall be cooled down inside the exiccator for 30 min and weighed with the error of 0.0002 g maximum.

The glass with the filter shall be dried and weighed till the difference between two successive weighing cycles is 0.0004 g maximum. The filter shall be dried and cooled down again for 30 min.

If weight ratio of mechanical impurities does not exceed the standard value after the first weighing cycle, the filter shall not be brought to the constant weight.

3.6.4 Processing of Results

Weight ratio of mechanical impurities X_1 , %, is calculated using the following formula:

$$X_1 = \frac{m_1 - m_2}{m_3} \cdot 100,$$

where, m_1 – weight of the weighing glass with the paper filter and mechanical impurities, g;

m_2 – weight of the weighing glass with clean prepared paper filter, g;

m_3 – weight of the sample, g.

An arithmetic average of two parallel measurements shall be assumed as a test result.

Weight ratio of mechanical impurities of up to 0.005 % inclusive shall be regarded as zero content of mechanical impurities.

3.7 Determination of Water Weight Ratio

3.7.1 Equipment, Materials and Reagents Applied

apparatus for quantitative determination of water weight ratio in petroleum, food and other products;

porcelain cup with the capacity of 150 or 250 cm³, diameter of 107 or 123 mm;
measuring cylinder with the rated capacity of 100 cm³;
electric heating mantle or hot plate with closed spiral;
glass rod of about 500 mm long with a rubber tip or metal wire of the same length with a thickening end;

solvent – straight-run gasoline with the boiling point of plus 80 to plus 120 °C, which contains maximum 3 % of aromatic hydrocarbons; before use the solvent shall be dehydrated and filtered;

pumice or unglazed pottery and porcelain, or glass capillaries soldered from one end, or red oil, or silicone fluid.

3.7.2 Test Preparation

3.7.2.1 A sample of the tested machinery oil shall be thoroughly stirred by shaking for 5 minutes in a glass bottle, filled to $\frac{3}{4}$ of its volume maximum.

3.7.2.2 Using a spatula, not less than 10 mm of the upper layer shall be removed from the surface of the sample of the tested grease and discarded, after which samples, approximately equal in the amount, shall be taken in several points (minimum, three) far from the vessel walls. The samples shall be put together in a porcelain cup and thoroughly mixed.

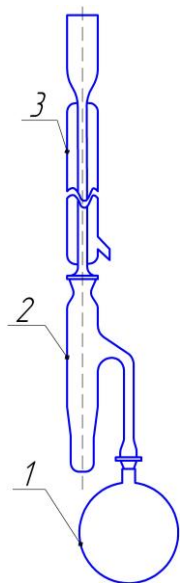
3.7.2.3 Weight quantity of the machinery oil per Table 5 shall be put into a well-dried (glass or metal) flask.

Table 5

Expected weight ratio of water, %	Weight quantity, g	Accuracy of weighing, g
Up to 10	100 ± 1	0.10
From 10 to 20	50 ± 0.5	0.05
From 20 and above	25 ± 0.25	0.02

Then, using a cylinder, 100 cm³ of solvent shall be added into the flask, the contents of the flask shall be thoroughly stirred till the machinery oil is dissolved completely, and several pieces of unglazed pottery or porcelain, or several capillaries, or 1-2 g of red oil, or several drops of silicone fluid shall be added into the flask.

A narrow-mouth flask (Figure 5) shall be connected to the discharge tube of clean and dry receiving collector 2 directly with the help of a polished section, while a wide-mouth flask shall be connected to it with the help of an adapter and polished sections. Condenser 3, cleaned with wool, shall be connected to the receiving collector with the help of a polished section.



1 – flask; 2 –receiving collector; 3 – condenser

Figure 5 – Installation for determination of water weight ratio in the machinery oil

3.7.2.4 In case the room temperature differs vastly from the temperature of the water coming into the condenser, the upper end of the condenser tube shall be closed with wool in order to avoid condensation of atmospheric moisture inside the condenser tube.

3.7.2.5 Test Procedure

3.7.2.5.1 The apparatus flask shall be installed into the heating mantle or onto the hot plate. The contents of the flask shall be heated to boiling, after which distillation shall be performed in such a way that 2–4 drops per 1 s drop into the receiving collector from the skewed end of the condenser tube.

3.7.2.5.2 If by the end of distillation there are water drops left in the condenser tube, they shall be washed off into the receiving collector with the condensed solvent to do which boiling intensity shall be increased for a short period of time.

3.7.2.5.3 Distillation shall be stopped as the volume of water in the receiving collector ceases to increase and the upper layer of the solvent gets perfectly transparent. The distillation time shall be within the interval of 30 to 60 min.

Remaining water drops on the condenser tube walls shall be pushed into the receiving collector with a glass rod or metal wire.

3.7.2.5.3 As the flask is cooled down and the solvent and water in the receiving collector are of the room temperature, the apparatus shall be disassembled and water drops shall be pushed off the receiving collector walls with a glass rod or metal wire.

In case there is some amount of water (up to 0.3 cm³) in the receiving collector and the solvent is cloudy, the receiving collector shall be put in the hot bath for 20–30 min for lightening, and then again cooled down to the room temperature.

Then the volume of water, accumulated on the receiving collector, shall be recorded with the accuracy to one upper division on the receiving collector part taken by the water.

3.7.2.6 Processing of Results

3.7.2.6.1 Water weight ratio X_2 , %, shall be calculated using the following formula:

where V – volume of water accumulated in the receiving collector, cm^3 ;

ρ_w – water density at the room temperature expressed in g/cm^3 (for simplicity of calculation, water density at the room temperature is considered to be $1 \text{ g}/\text{cm}^3$);

m – machinery oil weight quantity taken for the test, g;

3.7.2.6.3 Water volume in the receiving collector of 0.03 cm^3 and less is considered as traces.

Absence of water in the tested product is determined by a state at which there are no water drops visible in the lower part of the receiving collector.

In questionable cases, absence of water is checked by heating of the tested sample of machinery oil in a test tube, placed in the oil bath, to the temperature of $150 \text{ }^\circ\text{C}$. Herewith, absence of water is characterized by absence of a crack sound.

3.7.2.6.4 Difference between two parallel measurements of water weight ratio shall not exceed one upper division of the receiving collector part taken by water.

3.8 Density Determination

The method consists in immersing an oleometer into the product being tested, reading out indications by the oleometer scale at the measurement temperature and recalculation of results in terms of density at the temperature of $20 \text{ }^\circ\text{C}$.

3.8.1 Equipment Used

Oleometers. It is allowed to use similar oleometers graduated with reference to the lower meniscus.

Cylinders for oleometers, glass or metal with respective dimensions.

Mercury glass thermometers. The thermometer shall be calibrated for full-immersion.

Thermostatic oven or water bath for maintaining the temperature with the error of 0.2 °C, maximum.

3.8.2 Test Preparation

The sample of the tested product shall be heated to the temperature of 20 °C.

3.8.3 Test Procedure

The cylinder for the oleometers shall be mounted on the even surface. The sample of the product being tested shall be poured into the cylinder with the same temperature as the sample, preventing formation of bubbles and losses due to evaporation. Air bubbles formed on the surface shall be removed with filter paper.

Temperature of the sample being tested shall be measured before and after density measurement by the oleometer thermometer or with an additional thermometer. The temperature shall be maintained constant with the error of 0.2 °C, maximum.

The clean and dry oleometer shall be slowly and carefully put into the cylinder filled with the product being tested, holding the oleometer by the top end preventing wetting of a rod part above the oleometer immersion level.

When oleometer readings become stable and its oscillations cease, readout shall be done with reference to the upper edge of meniscus; herewith the eye shall be at the level corresponding to the meniscus level (Figure 6). Oleometer scale reading corresponds to density of the product being tested.

When using oleometers graduated with reference to the lower meniscus, readings shall be taken according to Figure 7, and meniscus correction shall be introduced as per Table 6.

Table 6

Parameter	Range of measured density	Oleometer division value	Permissible measurement error	Meniscus correction
Density at 20 °C, g/cm ³	From 0.60 to 1.0	0.0005	±0.0003	+0.0007
	From 0.60 to 1.10	0.001	±0.0006	+0.0014

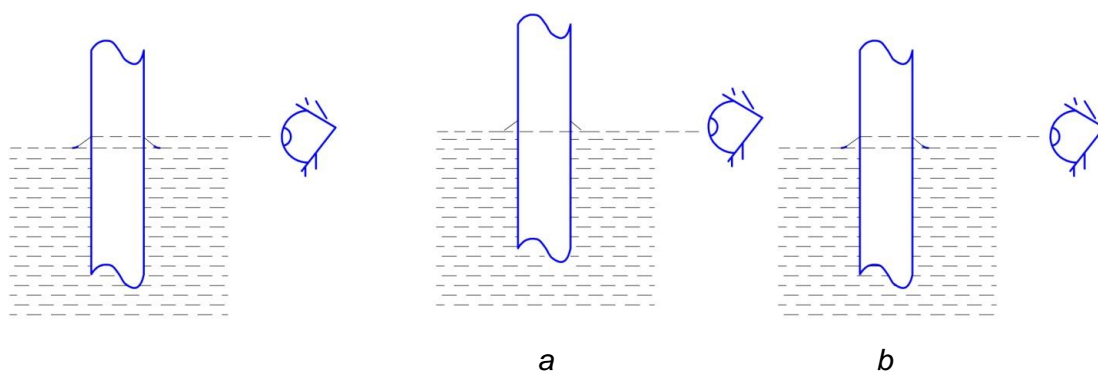


Figure 6

Figure 7

Two measurement results obtained by one person shall be regarded as reliable (with 95% confidence factor), if the difference between them does not exceed 0.0005 g/cm³.

3.9 Setting Point Determination

The methods consist in preheating a sample of the tested petroleum product and its subsequent cooling down at a specified rate to a temperature at which the sample remains immovable.

3.9.1 Method A

3.9.1.1 Equipment, Materials and Reagents Applied

flat-bottomed test tube made of transparent glass with the inside diameter of 30.0–33.5 mm and height of 115–125 mm.

The outer surface of the test tube shall have three indelible marks:

middle – corresponding to 45 cm³ of sample volume, upper, and lower, indicating permissible deviations of the sample volume, which make ± 3 cm³;

flat-bottomed glass or metal ferrule, with the height from 113 to 115 mm, with the inside diameter by 9.5–12.5 mm larger than the outside diameter of the flat-bottomed test tube;

cork or felt disk, 6 mm thick and with the diameter corresponding to the inside diameter of the ferrule;

ring-shaped gasket, about 5 mm thick, tightly adjacent to the test tube outer surface and freely entering the ferrule. The gasket can be made of natural cork or felt. Its purpose is to prevent the test tube from touching ferrule;

natural-cork or rubber plug matching the test tube inside diameter, with a hole for thermometer in the middle;

mercury thermometer with the measurement limit from minus 30 to plus 60 °C;

thermometer of any type for measuring coolant temperature, with calibration of scale corresponding to 1 °C;

bath of arbitrary shape and size, with the required bath temperature maintained with the help of a condenser or cooling mixture;

molten calcium chloride;

The cooling mixtures applied are as follows:

water and ice – for temperatures above 0 °C;

sodium chloride (NaCl) and ice — for temperatures down to minus 20 °C:

denaturated alcohol;

reclaimed ethyl alcohol and carbon-dioxide ice or other cooling mixtures – for temperatures below minus 20 °C.

3.9.1.2 Test Preparation

3.9.1.2.1 In the presence of water, the product shall be dehydrated. In case of considerable amount of water, it shall be removed through presedimentation followed by product draining.

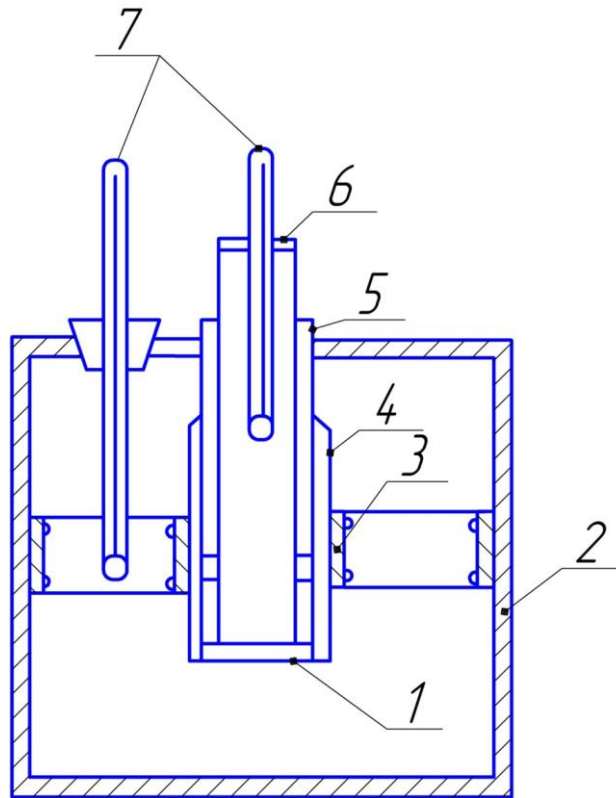
After that, the product shall be agitated periodically for 10–15 min with freshly incinerated and ground sodium sulfate or calcium chloride, then settled and filtrated through a dry filter.

3.9.1.2.2 The dehydrated product shall be poured into a dry clean test tube up to one of the volume marks, so that the product does not spread over test tube walls. If necessary, heat up the product (but not above 45 °C) on a water bath to the liquid state and transfer it to the test tube.

3.9.1.2.3 If it is known that over the preceding 24 hours the sample was subjected to heating above 45 °C or if its previous storage temperature conditions are not known, the sample shall be kept at the ambient temperature for 24 hours.

3.9.1.2.4 The test tube with machinery oil shall be tightly closed with a plug with an appropriate thermometer inserted into it for setting point determination.

The plug shall be tightly fitted to the test tube, so that the thermometer axis aligns with that of the test tube. The upper part of the thermometer bulb shall be immersed to 3 mm below the machinery oil surface (Figure 8).



1 – disk; 2 – bath; 3 – backing; 4 – test tube; 5 – ferrule; 6 – cork plug;
7 – thermometer.

Figure 8 – Instrument for determination of setting point

3.9.1.2.5 The tested machinery oil filled into the test tube shall be subjected to pre-treatment, proceeding as follows: heat it on a water bath without stirring up to 45 °C.

3.9.1.2.6 Place a disk on the ferrule bottom and put on a sealing ring on the flat-bottomed test tube at the height of 25 mm from the bottom.

The disk, the sealing ring, and the walls of the ferrule and test tube shall be clean and dry. Insert the test tube into the ferrule.

3.9.1.2.7 Test Procedure

3.9.1.2.7.1 Prepare a bath with the temperature from minus 1 to plus 2 °C and maintain this temperature throughout the test.

Install the test tube with the ferrule in the bath in the upright position, so that the ferrule top is 25 mm above the cooling mixture level.

During the test, do not allow thermometer shifting, so as to avoid violation of paraffine crystals structure. It is not allowed to place the test tube into the cooling medium without the ferrule.

3.9.1.2.7.2 The process of test tube taking out of and placing back in the ferrule shall take 3 s maximum.

If the tested sample of machinery oil has not lost fluidity during cooling down to 9 °C, transfer the test tube to the ferrule of another bath, whose temperature shall be maintained within minus 18 to minus 15 °C.

If the product retains fluidity when its temperature reaches minus 6 °C, transfer the test tube to the ferrule of a bath where the temperature is maintained within minus (33 ± 1) °C.

When determining very low setting points, it is necessary to have the temperature of each next bath by 17 °C lower than that of the previous one. In each case, transfer the test tube with the product being tested to the next bath after the machinery oil specimen being tested has cooled down to a temperature which is by 27 °C higher than the temperature of the next bath.

Once it is noticed that, with the test tube tilted, the tested product remains immovable, set the test tube to the horizontal position and observe the product surface.

If within 5 s (determined with a stopwatch or another precision instrument) any shifting of the surface is noticed, immediately place the test tube with the tested product into the ferrule and repeat fluidity test after additional cooling-down by 3 °C.

3.9.1.2.7.3 The temperature at which the product remains immovable for 5 s, with the test tube set to the horizontal position, shall be assumed as a setting point of the tested machinery oil.

3.9.1.2.7.4 A permissible difference between parallel measurements shall not exceed 3 °C.

3.9.2 Method B

3.9.2.1 Equipment, Materials and Reagents Applied

3.9.2.1.1 To determine the setting point, the following is used: glass test tube with a spherical bottom, height of (160 ± 10) mm, inside diameter of (20 ± 1) mm, with an indelible circumferential mark made on the outer side surface of the test tube at a distance of 30 mm from its bottom;

test tube–ferrule with a concave or spherical bottom, with the test tube height of (130 ± 10) mm, inside diameter of (40 ± 2) mm;

natural-cork or rubber plug matching the test tube inside diameter, with a hole for thermometer in the middle;

mercury thermometer with the measurement limit from minus 30 to plus 60 °C;

thermometer of any type for measuring coolant temperature, with calibration of scale corresponding to 1 °C;

bath of arbitrary shape and size, with the required bath temperature maintained with the help of the condenser or cooling mixture.

Industrial rectified ethyl alcohol with carbon dioxide ice is used as a cooling mixture. It is allowed to apply other reagents providing specified cooling temperature.

3.9.2.1.2 Test Preparation

3.9.2.1.2.1 If there is water in the machinery oil, the latter shall be dehydrated before the test as per item 3.9.1.2.

3.9.2.1.3 Prior to the test pour $0.5\text{--}1.0\text{ cm}^3$ of sulfuric acid or fuming sulfuric acid into test tube–ferrule.

3.9.2.1.4 Pour the dehydrated product into a dry clean glass test tube up to the mark, so that the product does not spread over test tube walls. Using a cork plug, tightly insert an appropriate thermometer into the test tube, securing it in such a way that it is on the test tube axis and its bulb is at a distance of 8–10 mm from the test tube bottom. For better thermometer steadiness in the test tube when in the

working position, put a cork plug on the thermometer lower part (approximately at its mid-length), fitted in such a way that it enters the test tube with a little friction.

3.9.2.1.5 Put the test tube with the product and thermometer in a water bath preheated to the temperature of $(50 \pm 1) ^\circ\text{C}$ and hold it there until the product has the temperature of the bath.

3.9.2.2 Test Procedure

3.9.2.2.1 Take the test tube with the product and thermometer out of the water bath, wipe dry on the outside, and secure it with the help of a cork plug in the test tube-ferrule in such a way that walls of the latter are approximately equidistant from ferrule walls. Secure the assembled device in the support holder in the upright position and leave at the room temperature for the machinery oil to cool down to $(35 \pm 5) ^\circ\text{C}$, then place it into a vessel with the cooling mixture whose temperature shall be preset to a value which is by $5 ^\circ\text{C}$ below the setting point to be determined.

During product cooling down, the preset cooling mixture temperature shall be maintained within the error of $\pm 1 ^\circ\text{C}$.

When the product in the test tube has the temperature of expected setting point determination, tilt the device to an angle of 45° and, without taking it out of the cooling mixture, hold in this position for one minute.

After that, carefully take the device out of the cooling mixture, quickly wipe the test tube-ferrule and check if the tested product meniscus has shifted.

3.9.2.2.2 If the meniscus has shifted, take the test tube out of the ferrule, heat it again up to $(50 \pm 1) ^\circ\text{C}$, and carry out a new setting point determination at a temperature which is by $4 ^\circ\text{C}$ lower than the previous one, until the meniscus stops shifting at a certain temperature.

Note. In case the test temperature is below minus 20 °C, before a new determination, in order to protect the device from damage caused by strong thermal effects, leave the test tube with the product and thermometer at the room temperature until the product has the temperature of minus 20 °C, and only thereafter place the test tube in a water bath.

3.9.2.2.3 If the meniscus has not shifted, take the test tube out of the ferrule, heat it again up to (50 ± 1) °C, and carry out a new setting point determination at a temperature which is by 4 °C higher than the previous one, until the meniscus stops shifting at a certain temperature.

3.9.2.2.4 After finding the setting limit (transition from fluidity to immovability or vice versa), repeat determination, increasing or decreasing the test temperature by 2 °C until such a temperature is established at which product meniscus remains immovable, whereas during a repeated test at a temperature by 2 °C higher, it shifts. This temperature shall be recorded as the one determined for a given test.

3.9.2.2.5 To determine the product setting point, two parallel tests shall be carried out, with the second test started from a temperature which is by 2 °C higher than the temperature determined during the first test.

3.9.2.3 Processing of Results

3.9.2.3.1 An arithmetic average value of two parallel measurements shall be assumed as a setting point of the tested machinery oil. The difference between the results of parallel measurements shall not exceed 2 °C.

3.10 Color Determination

The method consists in visual comparison of the color of machinery oil or its solution with glass color filters.

3.10.1 Equipment, Reagents and Materials Applied

3.10.1.1 To determine the color of machinery oil, the following is used: colorimeter consisting of a light source, 16 glass color filters, a test tube device, a lens system and an object glass, a test tube with a mark (Figure 9);

measuring cylinders with a snout, capacity of 50 and 100 cm³;

conical flasks with capacity of 250 cm³;

naphtha for the rubber-processing industry, or kerosene, the color of which is lighter than that of the potassium bichromate solution, obtained by dissolving 4.8 g of clean anhydrous potassium bichromate with 1 l of distilled water;

distilled water.

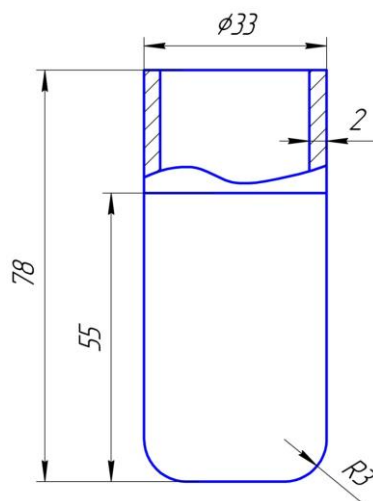


Figure 9 – Test tube for color determination using colorimeter

3.10.2 Test Preparation

3.10.2.1 Before the test, thoroughly agitate machinery oil, take the sample at the room temperature and determine the color.

3.10.2.2 If the tested sample of machinery oil is cloudy (non-transparent), it shall be heated to a temperature which is 6 °C higher than the temperature at which turbidness disappears, and this is the temperature at which color determination shall be performed.

3.10.3 Test Procedure

3.10.3.1 Two cells shall be filled to the mark with the following materials: one – with distilled water, the other – with the machinery oil sample prepared as per item 3.10.2. Open the colorimeter cover and put the cell with distilled water into the right chamber compartment, and the machinery oil sample – into the left chamber compartment, then close the instrument cover.

3.10.3.2 When determining the color of machinery oil prepared as per item 3.10.2.2, it shall be poured into the test tube, preliminarily heated in the drying oven to the temperature of machinery oil heating.

3.10.3.3 Switch on the light source and compare the color of the machinery oil sample with that of glass color filters. Select the light filter, the color of which corresponds to that of the machinery oil sample as much as possible.

3.10.3.4 Make two parallel determinations.

3.10.4 Processing of Results

3.10.4.1 The color of machinery oil shall be expressed in CNT (ЦНТ) units, corresponding to the number of the glass color filter.

3.10.4.2 In case the machinery oil has an interjacent color of two color filters, the color of the color filter with a more intensive toning shall be taken as the test result.

An arithmetic average value of two parallel measurements with the permissible difference between them not exceeding 0.5 CNT (ЦНТ) units shall be assumed as a test result.

3.11 Determination of Flash Point in Open Cup

The method consists in heating a sample of the tested product in an open cup at a specified rate until ignition (flash point) of product vapors occurs over the product surface, caused by an incendiary device, and until ignition (fire point) of the product occurs in the course of continued heating, with burning duration of at least 5 s.

3.11.1 Equipment, Materials and Reagents Applied

Apparatus for determining flash point and fire point in an open cup of type TVO (TBO) (TV-2 (TB-2)), or semi-automatic and automatic apparatuses of types ATVO (ATBO) (ATV-2 (ATB-2)), yielding results within the limits of tolerable differences as per the Cleveland method.

Three-leaf screen painted black on the inside, with sections of (46 ± 1) cm in width and (60 ± 5) cm in height, or a shield 55–65 cm high made from steel roofing sheet and painted black on the inside.

Thermometer.

Stopwatch of any type.

Mercury barometer or aneroid barometer with the maximum measurement error of 0.1 kPa.

Laboratory filter paper.

Pipette.

Wire brush.

Naphta with boiling range from 50 to 170 °C, or nefras S50/170 (C50/170).

Drying agents (dehydrated): anhydrous sodium sulfate or industrial sodium sulfate, or industrial calcium chloride, or sodium chloride.

Distilled water.

Additionally for Method B:

Apparatus for determining flash point and fire point in an open cup as per the Brenken method (of type LTVO (JITBO)).

3.11.2 Method A

3.11.2.1 Test Preparation

Mix a sample thoroughly and carefully.

A test product containing water shall be dried at the room temperature by shaking, with addition of one of the drying agents.

Install the apparatus on a flat desk in such a place where there is no noticeable air movement and a flash can be clearly visible. To protect the apparatus from air movement, surround it from three sides with a screen or a shield. Cool the apparatus before each test.

Wash the cup with solvent before each test. Remove carbonaceous deposits with a wire brush. Then wash the cup with cold distilled water and dry it on an open flame or a hot plate. Cool the cup down to a temperature which is lower than the expected flash point by at least 56 °C and place it into the apparatus.

Place a thermometer into the cup in the upright position, so that the lower end of the thermometer is at the distance of 6 mm from the cup bottom and equidistant from the cup center and walls.

3.11.2.2 Test Procedure

Fill the cup with the product so that the upper meniscus aligns precisely with the mark. If the cup is filled above the mark, remove excessive product with

a pipette or another suitable appliance. Remove air bubbles from the sample surface. Wetting of the cup walls above the fluid level is not allowed.

If the tested product gets onto the outer walls of the cup, remove the tested product from the cup and treat the latter according to item 3.7.2.1.

Heat the cup with the sample with the flame of a gas burner or by means of electric heating at a rate of 14 to 17 °C per minute at first. When the sample temperature becomes lower than the expected flash point by approximately 56 °C, adjust the heating rate, so that during the final 28 °C before the flash point the tested product is heated at a rate of 5 to 6 °C per minute.

Light up the incendiary device flame and adjust it in such a way that the flame diameter is about 4 mm. Compare the flame size against a template (gauge ball) integrated in the apparatus.

Starting from a temperature which is lower than the flash point by at least 28 °C, use the incendiary device each time the sample temperature increases by 2 °C. Move the incendiary device flame in the horizontal direction, without stopping above the cup edge and tracing the flame over the cup center in one direction for 1 s.

In the course of further temperature rising, move the igniting flame in the opposite direction.

Assumed as the flash point is the temperature indicated by the thermometer at the moment of the first blue flame appearing on a part of the surface or on the entire surface of the tested product.

In case of an uncertain flash appearing, it shall be confirmed by the following flash after 2 °C.

A blue circle (halo) which is sometimes formed around the ignition flame shall be ignored.

To determine the fire point, continue sample heating at a rate of 5 to 6 °C per minute and repeat testing with the incendiary device flame after each 2 °C of tested product temperature increase.

Assumed as the fire point is the temperature indicated by the thermometer at the moment the tested product ignites from the incendiary device flame set to it and keeps on burning for at least 5 s.

3.11.2.3 Processing of Results

If during the test the barometric pressure is below 95.3 kPa (715 mm Hg), introduce corresponding corrections as per Table 7 into the obtained flash point and fire point values.

Table 7

Barometric pressure, kPa (mm Hg)	Correction, °C
From 95.3 to 88.7 (from 715 to 665)	+2
From 88.6 to 81.3 (from 664 to 610)	+4
From 81.2 to 73.3 (from 609 to 550)	+6

An arithmetic average value of the results of two measurements rounded to an integer number and expressed in Celsius degrees shall be assumed as a test result.

3.11.3 Method B

3.11.3.1 Test Preparation

Test preparation shall be as per item 3.11.2.1.

3.11.3.2 Test Procedure

Cool the cup down to a temperature within plus 15 to plus 25 °C and place it into the apparatus's outer cup with annealed sand, so that the sand is at the height of 12 mm from the inner cup edge and there is sand between this cup bottom and the outer cup, with sand layer thickness being within 5 to 8 mm, which shall be checked with a template.

Place a thermometer in the upright position into the cup with the tested product, so that the mercury bulb is in the cup center, approximately equidistant from the cup bottom and from the product level, and secure the thermometer in this position in the support clamp.

Pour the tested product into the inner cup, so that the fluid level is 12 mm away from the cup edge.

Check correct pouring of the tested product with a template; pour the product until the product surface comes into contact with the nib point of the fluid level height indicator.

During pouring, do not allow sputtering of the tested product and wetting of the cup walls above the fluid level.

Heat the outer cup of the apparatus with the flame of a gas burner or Barthel lamp, or by electric heating, so that the tested product is heated by 10 °C per 1 min.

With 40 °C remaining to the expected flash point, reduce heating to 4 °C per 1 min.

With 10 °C remaining to the expected flash point, slowly trace the incendiary device flame along the cup edge at a distance of 10–14 mm from the tested product surface and parallel to it. Flame length shall be within 3–4 mm. The time of flame movement from one side of the cup to the other shall be 2–3 s.

Such test shall be repeated every 2 °C of temperature increase.

Assumed as the flash point is the temperature indicated by the thermometer at the moment of the first blue flame appearing on a part of the surface or on the entire surface of the tested product.

In case of an uncertain flash appearing, it shall be confirmed by the following flash after 2 °C.

Reflection from the incendiary device flame should not be mistaken for a true flash.

To determine the fire point, continue heating of the outer cup in such a way that the product is heated at a rate of 4 °C per minute and repeat testing with the incendiary device flame after each 2 °C of tested product temperature increase.

Assumed as the fire point is the temperature indicated by the thermometer at the moment the tested product ignites from the incendiary device flame set to it and keeps on burning for at least 5 s.

3.11.3.3 Processing of Results

Processing of the results shall be done as per item 3.11.2.3.

3.12 Determination of Resistance to Oxidation

The method consists in passing the air or oxygen through the tested oil with the addition of a catalyst or without it at high temperatures and in determination of physical and chemical properties of the oil before and after oxidation.

Oil stability during oxidation is characterized by change in the acid value, saponification value, viscosity, resin contents (for oils without additives), coking property, insoluble residues (sludge) forming during oxidation, as well as by change in catalyst color and weight and condensate amount.

3.12.1 Equipment, Materials and Reagents Applied

3.12.1.1 To determine machinery oil resistance to oxidation, the following is used:

apparatus of type TSM (TCM) or its equivalent (Figure 10). The apparatus set includes: heating bath representing an all-metal aluminum unit. The bath has six slots-pockets located circumferentially and intended for arrangement of reaction vessels in them. The bath is heated with the help of five heating spirals (Figure 11), 360 W each, combined in two groups I and II. The bath outer wall has three spirals, the inner wall and the bottom have one spiral each;

reaction vessels (Figure 12). The vessel includes a cylindrical test tube, a borosilicate or neutral glass with a polished section, a cartridge with polished sections, a condensate collector, a Liebig condenser with a tube of about (200 ± 2) mm and casing diameter of (20 ± 2) mm, and a tube for gas supply. In-between two necks of the cartridge, there is an appliance for suspension of plates used as catalysts;

gas divider of a star shaped type. To ensure even gas supply through all six reaction vessels, calibration capillaries 80 mm in length and with the inside diameter of up to 0.5 mm are used;

gas dehydration column filled with soda lime;

safety bottles (traps) located between wash bottles and the dehydration column;

contact thermometers;

laboratory glass mercury thermometers, with the scale division value of $0.5 \text{ }^\circ\text{C}$;

rying oven or thermostatic oven ensuring heating up to $(105 \pm 1) \text{ }^\circ\text{C}$;

exiccator filled with calcium chloride or silica gel;

analytically pure or chemically pure sulfuric acid for filling of the wash bottle;

chemically pure potassium hydrate (caustic potash), 20% aqua solution for filling of the wash bottle;

rectified ethyl alcohol (cellulosic or sulphite spirit);

analytically pure or chemically pure benzol;

chloroform (trichlormethane) or 1:4 alcohol-benzol mixture;

standard heptane;

analytically pure acetone;
distilled water;
gaseous industrial and medical oxygen;
soda lime;
cleaning solution;
plates or wire of electrolytic copper used as catalysts;
laboratory balance of any type with the weighing error of 0.0002 g maximum;
polishing paper on the paper or fabric base, or 6–8 grain polishing powder;
laboratory filter paper.

3.12.1.2 Test Preparation

Wash the reaction vessels successively with chloroform or alcohol-toluene mixture, ethyl alcohol, water and cleaning solution, then again with water, rinse with distilled water while checking for absence of acid, and dry them in the drying oven at $(105 \pm 1) ^\circ\text{C}$.

Grind the copper plate (Figure 13) with polishing paper and wipe it with filter paper till the paper stays clean.

Wash the copper plates with acetone and place them into the exiccator for storage. When working with the ground plate, use a pair of forceps or clean filter paper.

Switch on the apparatus of type TSM (TCM). Heating of the aluminum unit and temperature adjustment shall be performed in accordance with the apparatus instruction.

When passing gas through the oil, the specified bath temperature shall be maintained constant with the accuracy of up to $\pm 0.5 ^\circ\text{C}$.

3.12.1.3 Test Procedure

Put (75.0 ± 0.1) g of the tested oil into a clean and dry reaction vessel.

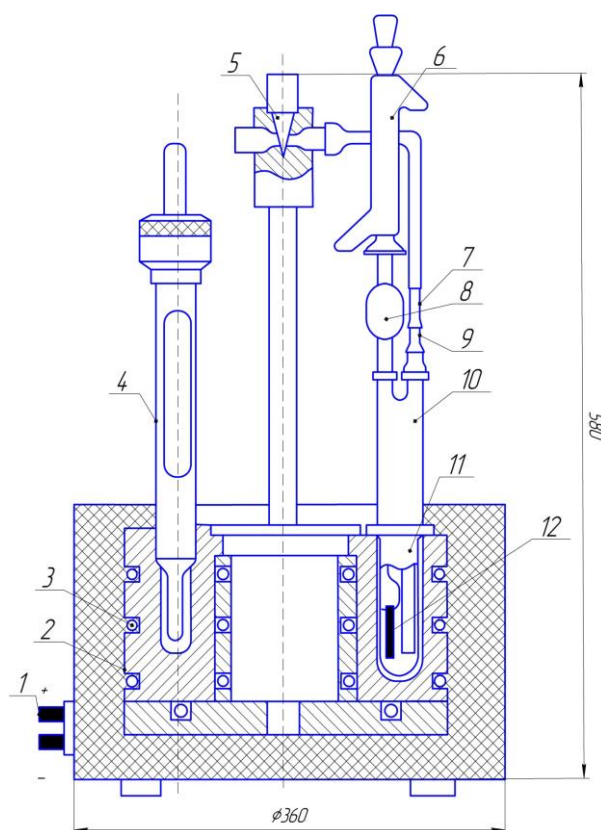
To detect corrosion, weigh the copper plate or wire with the maximum error of 0.0002 g and attach it to the cartridge hook. Condensate collector shall be

weighed with the maximum error of 0.001 g.

Assemble the reaction vessel and place it into the bath as specified in Figure 10. Fill the condenser with water.

As the tested oil reaches the specified temperature, connect gas tubes of reaction vessels to a float-type flow meter or rheometer through the gas cleaning and dehydration system and set the specified gas flow. When using oxygen for oxidation, the gas cleaning and dehydration system is not used. Oil resistance to oxidation shall be determined at the following conditions: temperature of $(100.0 \pm 0.5) ^\circ\text{C}$; air supply rate of $5 \text{ dm}^3/\text{h}$; catalyst – copper

The process of oil oxidation shall not be interrupted.



1 – heating bath; 2 – heat insulation; 3 – heating spirals; 4 – contact thermometer; 5 – gas divider; 6 – Liebig condenser; 7 – capillary; 8 – condensate collector; 9 – gas supply tube; 10 – cartridge with polished section; 11 – test tube; 12 – catalyst

Figure 10 – Oxidation device

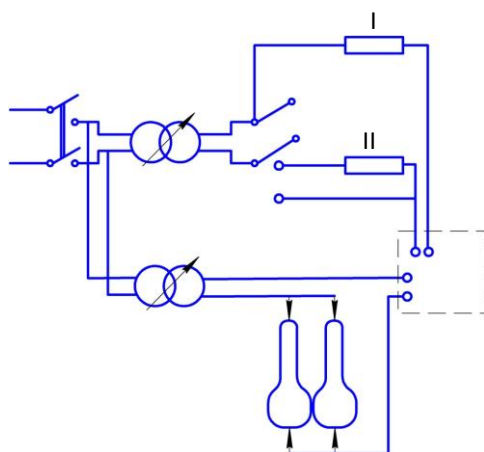
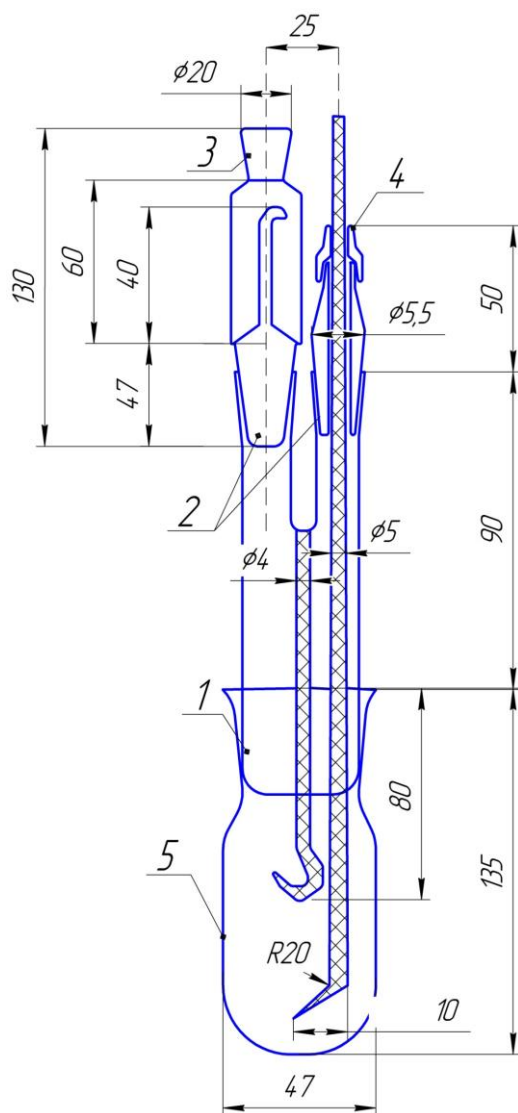


Figure 11 – Heating device connection diagram



1 – standard 45/40 polished section; 2, 3 – standard 14.5/23 polished section;
 4 – rubber tube; 5 – capillary with the inside diameter of 1.5 mm

Figure 12 – Reaction vessel

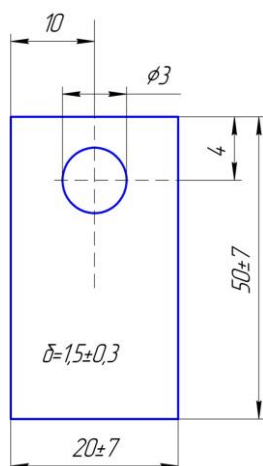


Figure 13 – Copper plate

Upon expiration of the specified time (40 h), take the reaction vessel out of the bath and cool it down to 50 °C, observe the color of the copper plate, wash it with the standard heptane, dry and weigh it with the error up to 0.0002 g and weigh the collector with condensate with the error up to 0.001 g.

3.12.1.4 Processing of Results

Oil shall be tested simultaneously in two reaction vessels.

An arithmetic average of physical and chemical properties of the oxidized oil in two reaction vessels shall be assumed as a test result.

4 Safety Requirements

In terms of action on human body, the machinery oil is referred to class of hazard 4 with the maximum permissible concentration of hydrocarbon vapors in the working air of 300 mg/m³, and to class of hazard 3 with the maximum permissible concentration of oil mist of 5 mg/m³.

The oil is a flammable product with the flash point of 140 °C minimum.

In case of spillage, collect the oil into a separate container, wipe the spill area with cleaning rags. In case of spillage on an open site, the spill area shall be strewed with sand with its further removal.

In case of oil burning, any fire fighting means may be used, excluding water.

When working with the oil, individual protective equipment shall be used in accordance with the established standards.

5 Packing, Transportation and Storage

5.1 Packing and Marking

5.1.1 Packing

The machinery oil is packed in metal canisters with the capacity of 100 dm³, 200 dm³. The container shall be fitted with internal oil-and-petrol resistant and vapor-resistant protective coating, which corresponds to the requirements of electrostatic sparking safety. As agreed upon between the manufacturer and the consumer, the oil may be packed in a disposable container without the internal protective coating.

Before filling, inspect the container. In case of any dirt, wash the container with hot water and petroleum solvent or steam it till deposits of petroleum products and mechanical impurities are completely removed, then dry it.

The container shall be filled to not more than 95 % of its volume.

After filling, close the container tightly with means of sealing, grease its entire surface with preservation lubricants or oils. The container shall be sealed.

5.1.2 Marking

5.1.2.1 A paper label shall be applied onto the consumer container, or an inscription shall be made on it indicating the following:

- product description and grade;
- designation of the standard;
- manufacturer's trademark
- net weight or volume;
- product manufacture date, month and year;
- batch number;
- inscription: “No fire”

5.2 Transportation

The machinery oil shall be transported by any means of transport inside closed transport vehicles as per the shipping rules applicable for the given means of transport.

5.3 Storage

The machinery oil shall be stored in closed warehouses, under a shed or on a design site protected against direct sunlight and atmospheric precipitations.

6 Manufacturer's Warranty

6.1 The manufacturer guarantees machinery oil quality compliance with the present standard provided that the transportation and storage conditions are observed.

6.2 Shelf life of the oil is 5 years from the manufacture date.