व्यापक परिचाला में मसौदा

प्रलेख प्रेषण संज्ञापन

संदर्भ	दिनाँक
ईटी ०३ /टी - १	०१-०६-२०१०

तकनीकी समिति: ईटी ०३

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प्रेषती:

१ । ईटी ०३ के सभी सदस्य

२ । विद्युत तकनीकी विभाग परिषद, तथा

३ । रूचि रखने वाले अन्य सभी निकाय

महोदय,

कृप्या निम्नलिखित मसौदे संलग्न हैं::

प्रलेख: ईटी ०३ (६२५१)

शीर्षक: विद्युततकनीकी अनुप्रयोग के लिए फ्ल्युइड — ट्रांसफार्मर और स्विचगेयर के लिए अनुपयोगी खनिज रोधक तेल [आई एस ३३५ का *पाँचवां पुनरीक्षण*]

कृप्या इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजें कि अंतत: यदि ये भारतीय मानक के रूप में प्रकाशित हो जाएँ तो इन पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयाँ आ सकती हैं ।

सम्मतियाँ भेजने की अंतिम तारीख **३०-०७-२०१०** ।

सम्मतियाँ यदि कोई हों तो कृप्या अगले पृष्ठ पर दिए पत्र में अधोहस्ताक्षरी को उपरिलिखित पते पर भेज दें ।

धन्यवाद,

भवदीय,

(आर् के त्रेहन)

वैज्ञानिक 'एफ' एवं प्रमुख (विद्युततकनीकी)

संलग्न : उपरिलिखित

DRAFTS IN WIDE CIRCULATION

Document Despatch Advice

REFERENCE	DATE
ETD 03/ T- 1	01-06-2010

TECHNICAL COMMITTEE: ET 03

ADDRESSED TO:

1. All Members of Fluids for Electrotechnical Applications Sectional Committee, ET 03;
2. All Members of Electrotechnical Division Council; and
3. All other Interested.

Dear Sir(s),

Please find enclosed a copy each of the following draft Indian Standards:

Doc No. ETD 03(6251)

Title: Fluids for Electrotechnical Applications – Unused Mineral Insulating Oils for Transformers and Switchgear (*Fifth Revision* of IS 335)

Kindly examine the draft standard and forward your views stating any difficulties which you are likely to experience in your business or profession, if these are finally adopted as Indian Standard.

Comments, if any, may please be made in the format given overleaf and mailed to the undersigned.

Last date for comments: **30-07-2010.**

Thanking you,

Yours faithfully

(R.K. Trehan)
Sc 'F' & Head (Electrotechnical)

Encl: As above

Date	Document No.
01-06-2010	Doc: ET 03(6251)

Sl. No.	Name of the Organization	Clause/ Sub-clause	Paragraph/ Figure/Table	Type of Comment (General/ Technical/ Editorial	Comments	Proposed Change

Fluids for Electrotechnical Applications Sectional Committee, ET 03

FOREWORD

This draft Indian Standard (*Fifth Revision*) is proposed to be adopted by the Bureau of Indian Standards, after the draft finalized by the Fluids for Electrotechnical Applications Sectional Committee has been approved by the Electrotechnical Division Council.

This standard, first published in 1953, was based on BS 148 : 1951 'Insulating oil for transformers and switchgear', issued by the British Standards Institution. It was revised in 1963 to bring the test methods in line with the practices in vogue. The second revision was undertaken in 1972 mainly to include oxidation test as given in IEC Pub 296 (1982) 'Specification for unused mineral insulating oils for transformers and switchgear'. The third revision was undertaken in 1983 to include an ageing test based on ASTMD 1934 : 1968 'Standard method of test for oxidative ageing of electrical insulating petroleum oils by open beaker method', issued by the American Society for Testing and Materials. Subsequently, the fourth revision was undertaken in 1993 to include amendments issued since the adoption of third revision and also a new method of test adopted for detection of oxidation inhibitor.

This fifth revision has been undertaken to align the standard with the third edition of IEC 60296(2003) . Main changes with regard to the fourth revision include: only one class of oil has been replaced by two classes namely transformer oil and low temperature switchgear oil, but a new concept, the lowest cold start energizing temperature, has been included; new properties have been added (i.e. sulphur content, gassing, PCA, PCB, & furan); values for properties have been revised, & test methods have been revised (that is acidity, corrosive sulfur & oxidation stability).
For the maintenance and supervision of insulating oils conforming to this specification and used in transformers, switchgear and certain other similar oil immersed equipment, reference shall be made to IS 1866 : 1988 'Code of practice for maintenance and supervision of mineral insulating oil in equipment (*second revision*)'.

IS 12463:1988,Inhibited Mineral Insulating Oils, shall be withdrawn subsequent to publication of this standard.

The technical committee has reviewed the provisions of the following International Standards referred in this standard and has decided that they are acceptable for use in conjunction with this standard:

IEC 60666 Detection and determination of specified anti-oxidant additives in insulating oils
IEC 61125 Unused hydrocarbon based insulating liquids – Test methods for evaluating the oxidation stability IEC 61125, Unused hydrocarbon based insulating liquids – Test methods for evaluating the oxidation stability

IEC 61619 Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method of determination by capillary column gas chromatography

ISO 12185**,** Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method

ISO 14596, Petroleum products – Determination of sulfur content – Wavelength-dispersive X-ray fluorescence spectrometry

DIN 51353: Detection of corrosive sulfur – Silver strip

BS 2000, Part 346: Determination of polycyclic aromatics in lubricant base oil and asphaltene free petroleum fractions – Dimethylsulfoxide refractive method

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Doc: ET 03(6251)

BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

(Not to be reproduced without the permission of BIS or used as a **STANDARD**)

Draft *Indian Standard*
FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED MINERAL INSULATING OILS FOR TRANSFORMERS AND SWITCHGEAR (*Fifth Revision* of IS 335)

Last date for receipt of comments is **30-07-2010**

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1 SCOPE

This Indian Standard covers specifications and test methods for unused mineral insulating oils. It applies to oil delivered to the agreed point and time of delivery, intended for use in transformers, switchgear and similar electrical equipment in which oil is required as an insulant and for heat transfer. These oils are obtained by distillation and refining of crude petroleum.

Oils with and without additives are both within the scope of this standard.

This standard is applicable only to unused mineral insulating oils.

Reclaimed oils are beyond the scope of this standard.

This standard does not apply to mineral oils used as impregnants in cables or capacitors.

NOTE − Mineral insulating oils complying with the requirements of this standard, of the same class and containing no additives (*see* **3.4**), are considered to be compatible with one another and can be mixed in any proportion. This does not apply to oils containing additives. Where the user wishes to mix such oils, a check is recommended to be made to ensure that the mixture meets the requirements of this standard.

1 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

2 TERMINOLOGY

For the purposes of this document, the following definitions shall apply:

3.1 Transformer oil

Mineral insulating oil for transformers and similar electrical equipment where normal oxidation resistance is required

3.2 Low Temperature Switchgear Oil

Mineral insulating oil for oil-filled switchgear for outdoor application in very cold climatic conditions

3.3 Additive

Suitable chemical substance which is deliberately added to a mineral insulating oil in order to improve certain characteristics

NOTE - Examples include antioxidants, pour point depressants, electrostatic charging tendency depressants such as benzotriazole (BTA), anti-foam agents, refining process improvers, etc.

3.4 Antioxidant Additive

Additive incorporated in an insulating oil to improve oxidation stability

NOTE - A large number of antioxidant additives are available. For this standard, these are limited to those identified in IEC 60666.

3.5 Uninhibited Oil

Mineral insulating oil, containing no antioxidant additives, but which may contain other additives

3.6 Trace Inhibited Oil

Mineral insulating oil containing up to 0.08 percent antioxidant additive together with other additives as mentioned in 3.4

3.7 Inhibited Oil

Mineral insulating oil containing a minimum of 0.08 percent and a maximum of 0.40 percent antioxidant additive together with other additives as mentioned in 3.3.

3.8 Unused Mineral Insulating Oil

Mineral insulating oil as delivered by the supplier

NOTE - Such an oil has not been used in, nor been in contact with electrical equipment or other equipment not required for manufacture, storage or transport. The manufacturer and supplier of unused oil will have taken all reasonable precautions to ensure that there is no contamination with polychlorinated biphenyls (PCB), used, reclaimed or dechlorinated oil or other contaminants.

3.9 Reclaimed Oil

Mineral insulating oil used in electrical equipment which has been subjected to chemical and/or physical processing to eliminate soluble and insoluble contaminants

NOTE -A blend of unused and reclaimed oil in any proportion is regarded as being reclaimed.

4 PROPERTIES OF OIL

Characteristics are listed in Tables 1 and 2 and in Clause 7.

4.1 Functional properties

Properties of oil which have impact on its function as an insulating and cooling liquid.

NOTE -Functional properties include viscosity, density, pour point, water content, breakdown voltage, dielectric dissipation factor and specific resistance.

4.2 Refining and Stability

Properties of oil that are influenced by quality and type of refining and additives.

NOTE -This can include appearance, interfacial tension, sulfur content, acidity, corrosive sulfur, 2-furfural content.

4.3 Performance

Properties that are related to the long-term behaviour of oil in service and/or its reaction to high electric stress and temperature.

NOTE -Examples include oxidation stability and gassing tendency.

4.4 Health, Safety and Environment (HSE) Properties

Oil properties related to safe handling and environment protection.

NOTE - Examples can include flash point, density, PCA (polycyclic aromatics), PCB (polychlorinated biphenyls).

5 CLASSIFICATION, IDENTIFICATION, GENERAL DELIVERY REQUIREMENTS AND SAMPLING

5.1 Classification

5.1.1 *Classes*

For the purpose of this standard, mineral insulating oils are classified into two classes:
– transformer oils;
– low temperature switchgear oil.

5.1.2 *Antioxidant Additive (inhibitor) Content*

Transformer oils are classified into three groups, according to their content of antioxidant additive:

– uninhibited transformer oils: marked with U;
– trace inhibited transformer oils: marked with T;
– inhibited transformer oils: marked with I.

5.1.3 Lowest Cold Start Energizing Temperature (LCSET)

After the inhibitor marking, the LCSET shall be indicated.

Standard LCSET in this standard is –30 °C; optionally other LCSET can be selected according to Table 1.

Example: Transformer oil I –40 °C, transformer oil T –30 °C, transformer oil U 0 °C.

5.2 Requirements

General requirements of this standard are given in Table 2.

Specific requirements are defined under Clause 7.

5.3 Mixability

Unused insulating oils of the same class, the same group and the same LCSET are considered to be mixable and compatible with each other (see as well IS 1866).

5.4 Marking and General Delivery Requirements

5.4.1 Oil is normally delivered in bulk, rail tank cars, tank containers or packed in drums or IBC (intermediate bulk containers). These shall be clean and suitable for this purpose to avoid any contamination.

5.4.2 Oil drums and sample containers shall carry at least the following markings:

– supplier's designation;
– classification;
– oil quantity.

5.4.3 Each oil delivery shall be accompanied by a document from the supplier specifying at least: suppliers designation, oil classification and compliance certificate. At purchaser’s request, the supplier has to indicate the presence (type, concentration) of any additive.

5.4.4 *BIS Certification Marking*

The product may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers maybe obtained from the Bureau of Indian Standards.

5.5 Sampling

Sampling shall be carried out in accordance with the procedure described in IS 6855.

6 PROPERTIES, THEIR SIGNIFICANCE AND TEST METHODS

6.1 Viscosity

Viscosity influences heat transfer and therefore the temperature rise of the equipment. The lower the viscosity, the easier the oil circulates leading to improved heat transfer. At low temperatures the resulting higher viscosity of oil is a critical factor for the cold start of transformers with ON cooling (no circulation and therefore possible overheating at the hot spots) and negatively influences the speed of moving parts, such as in power circuit breakers, switchgear, on-load tap changer mechanisms, pumps and regulators. The viscosity at the lowest cold start energizing temperature (LCSET) shall not exceed 1 800 mm^2/s (resp. 2 500 mm^2/s at –40 °C, *see* Table 1). This lowest cold start energizing temperature (LCSET) for transformer oils is defined in this standard as being –30 °C (this is 5 K lower than indicated in IS 2026-Part 2). Other LCSET (*see* Table 1) can be agreed between supplier and purchaser.

Low temperature switchgear oil should have a lower viscosity at LCSET: max. 400 mm^2/s. Standard LCSET of low temperature switchgear oil is defined with –40 °C but other LCSET may be agreed between supplier and purchaser.

NOTE - For more details concerning ON cooling (natural oil circulation without pump), refer to IS 2026 – Part 2.

Table 1 – Maximum Viscosity and Pour Point of Transformer Oil at Lowest Cold Start Energizing Temperature (LCSET)

Sl No.	LCSET °C	Maximum Viscosity mm^2/s	Maximum Pour Point °C
(1)	(2)	(3)	(4)
1	0	1 800	–10*
2	–20	1 800	–30*
3	**–30**	**1 800**	**–40**
4	–40	2 500	–50*

* Optional.

NOTE - There is no lower viscosity limit set in this standard, but under certain conditions oils with a viscosity less than 7 mm^2/s /40 °C can be considered to be a potential aspiration hazard.

Viscosity shall be measured according to IS 1448-Part 25, viscosity at very low temperatures according to IEC 61868.

6.2 Pour Point

Pour point of mineral insulating oil is the lowest temperature at which the oil will just flow. It is recommended that the pour point should be minimum 10 K below the lowest cold start energizing temperature (LCSET). If a pour point depressant additive is used, this should be mentioned by the supplier to the user. Pour point shall be measured in accordance with IS 1448-Part 10.

6.3 Water Content

A low water content of mineral insulating oil is necessary to achieve adequate electrical strength and low dissipation losses. To avoid separation of free water, unused insulating oil should have a limited water content. Before filling the electrical equipment, the oil should be treated to meet the requirements of IS 1866. Where requested by the purchaser, the supplier of oil shall demonstrate that after treatment to remove solid particles, humidity and dissolved air by a vacuum procedure (*see* note), the oil shall have a high dielectric strength of minimum 70 kV breakdown voltage. Water content shall be measured in accordance with IS 13567.

NOTE -This laboratory treatment referred to consists of filtration of the oil at 60 °C by vacuum (pressure below 2,5 kPa) through a sintered glass filter (porosity 4).

6.4 Breakdown Voltage

Breakdown voltage of transformer oil indicates its ability to resist electrical stress in electrical equipment. Breakdown voltage shall be measured in accordance with IS 6792.

6.5 Dielectric Dissipation Factor (DDF)

DDF is a measure for dielectric losses caused by the oil. Increased DDF can indicate contamination of the oil by moisture, particles or soluble polar contaminants or poor refining quality. DDF shall be measured in accordance with IS 6262 at 90 °C.

NOTE - By agreement between parties, DDF may be measured at temperatures other than 90 °C. In such cases the temperature of measurement should be stated in the report.

6.6 Specific Resistance (Resistivity)

It is the ratio of the dc potential gradient in volts per centimetre paralleling the current flow within the specimen, to the current density in amperes per square centimetre at a given instant of time and under prescribed conditions. This is numerically equal to the resistance between opposite faces of a centimetre cube of the liquid. It is expressed in ohm-centimetre. Resistivity should be measured following IS 6103.

6.7 Appearance

A visual inspection of insulating oil (oil sample in transmitted light under a thickness of approximately 10 cm and at ambient temperature) indicates the presence of visible contaminants, free water or suspended matter.

6.8 Acidity

Unused mineral insulating oil should be neutral and free from any acidic compound. Acidity should be measured following IS 1448-Part 1.

6.9 Interfacial Tension (IFT)

Low IFT sometimes indicates the presence of undesirable contaminants. IFT shall be measured in accordance with IS 6104.

6.10 Sulfur Content

Different organo-sulfur compounds are present in transformer oils, dependent on the crude oil origin and the degree and type of refining. Refining treats sulfur and aromatic hydrocarbons. As some sulfur compounds have an affinity to metals, they may act as copper passivators or they may promote corrosion.
Sulfur content should be measured following ISO 14596.

6.11 Corrosive Sulfur

Some sulfur compounds, e.g. mercaptans, are very corrosive to metal surfaces, i.e. steel, copper and silver (switchgear contacts) and shall not be present in new oil. Corrosive sulfur should be measured following DIN 51353.

6.12 Antioxidant Additive Content

Antioxidant additive (inhibitor) slows down the oxidation of oil and therefore the formation of oil sludge and acidity. It is important to know whether and in what proportion antioxidant additive has been added in order to monitor additive depletion during service. 2,6-di-tert-butyl-p-cresol (DBPC) is the most commonly used antioxidant, but others are also used. Detection and measurement of defined antioxidant additives shall be determined in accordance with IEC 60666. The type and quantity of each antioxidant additive present in the oil shall be stated in the quality certificate. If co-stabilizers are used during the refining process, their presence shall be agreed between the supplier and the purchaser.

6.13 Oxidation Stability

Oxidation of oil gives rise to acidity and sludge formation and can be minimized as a result of high oxidation stability leading to longer service life time by minimizing sludge deposition, electrical losses, metal corrosion, electrical faults and maximizing insulation life. Oxidation stability is measured in accordance with method C of IEC 61125. There is an option for stricter limits for special applications. In some countries more stringent limits and/or additional requirements and tests may be requested.

6.14 Gassing

Gassing tendency of mineral insulating oil, that is the gas absorbing property of oil under electrical stress, is only necessary and important for special transformers like HV (high voltage) transformers and is a measure of the rate of absorption or evolution of hydrogen into oil under prescribed laboratory conditions. Gas absorption properties are related to oil aromaticity which is subject to indirect control by the oil's oxidation requirements. Gassing tendency is measured in accordance with IS 12475-Part 1. Gassing tendency is a specific requirement.

6.15 Flash Point

The safe operation of electrical equipment requires an adequately high flash point that is measured in accordance with IS 1448 – Part 21 (Pensky-Martens closed cup procedure).

6.16 Density

Density of oil shall be low enough to avoid, in cold climates, that ice resulting from the freezing of free water is floating on the oil surface and possibly leading to fault conditions developing in flashover of conductors. Density shall be measured in accordance with IS 1448 – Part 16.

6.17 Polycyclic Aromatics (PCA)

Some PCAs are classified to be carcinogens and therefore need to be controlled to an acceptable level in mineral insulating oil. PCAs are defined so as to be detectable by extraction with DMSO (Dimethylsulfoxide) under the conditions of BS 2000 Part 346.

6.18 Polychlorinated Biphenyls (PCB)

Unused mineral insulating oil shall be free from PCB. The reference method is IEC 61619. The detection limit for a single peak is 0,1 mg/kg.

NOTE - The total limits are given by national regulations.

6.19 2-Furfural and Related Compounds (2-FAL)

2-FAL and related compounds in unused mineral insulating oils can result either from improper redistillation after solvent extraction during refining or from contamination with used oil.

Unused insulating oils should have a low level of 2-FAL and related compounds; measurement should be done according to IEC 61198.

Table 2 – General Specifications
(*Clause* 5.2)

Property	Test method	Limits	
		Transformer oil	Low temperature switchgear oil
1 – Function			
Viscosity at 40 °C	IS 1448 – Part 25	Max. 12 mm^2/s	Max. 3.5 mm^2/s
Viscosity at –30 °C [a]	IS 1448 – Part 25	Max. 1 800 mm^2/s	--
Viscosity at –40 °C [b]	IEC 61868	--	Max. 400 mm^2/s
Pour point [a]	IS 1448 – Part 10	Max. –40 °C	Max. –60 °C
Water content	IS 13567	Max. 30 mg/kg [c] / 40 mg/kg [d]	
Breakdown voltage	IS 6792	Min. 30 kV / 70 kV [e]	
Density at 20 °C	IS 1448 – Part 16	Max. 0.895 g/ml	
DDF at 90°C	IS 6262	Max. 0.005	
Resistivity at 90°C	IS 6103	Min. 35 x 10^{12} ohm-cm	
Resistivity at 27°C	IS 6103	Min. 1 500 x 10^{12} ohm-cm	
2 – Refining/stability			
Appearance	--	Clear, free from sediment and suspended matter	
Acidity	IS 1448 – Part 1	Max. 0.01 mg KOH/g	
Interfacial tension	IS 6104	No general requirement [f]	
Total sulfur content	ISO 14596	No general requirement	
Corrosive sulfur	DIN 51353	Not corrosive	
Antioxidant additive	IEC 60666	(U) uninhibited oil: not detectable (T) trace inhibited oil: max. 0.08 percent (I) inhibited oils: 0.08 – 0.40 percent	
2-Furfural content	IEC 61198	Max. 0.1 mg/kg	
3 – Performance			
Oxidation stability [1]	IEC 61125 (method C) Test duration: (U) Uninhibited oil: 164 h (T) Trace inhibited oil:332 h (I) Inhibited oil: 500 h		
- Total acidity		Max. 1.2 mg KOH/g [1]	
- Sludge		Max. 0.8 percent [1]	
DDF at 90 °C	IS 6262	Max. 0.500 [1]	
Gassing	IS 12475-Part 1	No general requirement	
4 – Health, safety and environment (HSE)			
Flash point	IS 1448-Part 21	Min. 135 °C	Min. 100 °C

[1] More stringent limits and/or additional requirements may be considered.

PCA content	BS 2000 Part 346	max. 3 percent
PCB content	IEC 61619	Not detectable

a This is the standard LCSET for an transformer oil (*see* **5.1**) and can be modified depending on the climatic condition of each country. Pour point should be minimum 10 K below LCSET.

b Standard LCSET for low temperature switch gear oil.

c For bulk supply.

d For delivery in drums and IBC.

e After laboratory treatment (*see* **6.4**).

f Where it is used as a general requirement, a limit of minimum 40 mN/m is recommended.

7 SPECIFIC REQUIREMENTS FOR SPECIAL APPLICATIONS

7.1 Higher Oxidation Stability and Low Sulfur Content

For transformers with higher operating temperatures or designed for extended service life, there may exist restricted limits after oxidation test (*see* IEC 61125, method C). Mostly, such oil is inhibited (I) [2], [3].

– Total acidity: max. 0.3 mg KOH/g;
– Sludge: max. 0.05 percent;
– DDF at 90 °C: max. 0.050;
– Total sulfur content: max. 0.15 percent.

7.2 Gassing

For equipment with high electrical field stress or special design, gas which may be formed under special stress conditions must be absorbed by the oil. Therefore the gassing tendency according to IS 12475-Part 1 must be agreed between the oil manufacturer and the user of the oil.

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2 More stringent limits and/or additional requirements may be considered.

3 DDF of max. 0.020 after 2 h of oxidation (*see* IEC 61125, method C) may be considered for application in EHV instrument transformers and bushings.

ANNEX A

IS 2026-Part 2, Power transformers – Part 2: Temperature rise

IS 6792, Method for determination of electric strength of insulating oils

IS 6262, Method of test for power factor and dielectric constant of electrical insulating liquids

IS 6103, Method of test for specific resistance (resistivity) of electrical insulating liquids

IS 1866, Code of Practice for Electrical Maintenance and Supervision of Mineral Insulating Oil in Equipment

IS 6855, Method of sampling liquid dielectrics

IS 12475-Part 1, Gassing of insulating liquids under electrical stress and ionization: Part 1 Method of determination of gassing rate under hydrogen atmosphere

IEC 60666, Detection and determination of specified anti-oxidant additivies in insulating oils

IS 13567, Determination of water in insulating liquids and in oil-impregnated paper and pressboard by automatic coulometric karl fischer titration – method of test

IEC 61125, Unused hydrocarbon based insulating liquids – Test methods for evaluating the oxidation stability

IS 15668, Mineral insulating oils – Methods for the determination of 2-furfural and related compounds

IEC 61619, Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method of determination by capillary column gas chromatography

IEC 61868, Mineral insulating oils – Determination of kinematic viscosity at very low temperatures

IS 1448-Part 1, Neutralization number by potentiometric titration

IS 1448-Part 21, Petroleum and its products – methods of test- Flash point (closed) by Pensky Martens apparatus

IS 1448-Part 10, Methods of test for petroleum and its products - Cloud point and pour point

IS 1448-Part 25, Methods of Test for Petroleum and its Products - Determination of Kinematic and Dynamic Viscosity

IS 1448-Part 16, Methods of test for petroleum and its products - Density, relative density or API gravity of crude petroleum and liquid petroleum products by hydrometer method

IS 6104, Method of test for interfacial tension of oil against water by the ring method

ISO 12185, Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method

ISO 14596, Petroleum products – Determination of sulfur content – Wavelength-dispersive X-ray fluorescence spectrometry

DIN 51353: Detection of corrosive sulfur – Silver strip

BS 2000, Part 346: Determination of polycyclic aromatics in lubricant base oil and asphaltene free petroleum fractions – Dimethylsulfoxide refractive method

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