

MATERIAL SPECIFICATIONS CELL

TECHNICAL SPECIFICATION

INSULATING LIQUIDS : NATURAL ESTERS FOR
DISTRIBUTION SYSTEM IN MSEDCL



TECHNICAL SPECIFICATION NO.

CE/QC-T/MSC-II/NATURAL ESTERS,
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1.00 SCOPE

- 1.01** The specification covers manufacturing, sampling, testing, packing, marking and delivery of Natural Esters for Sealed Transformers and Sealed Capacitors.
- 1.02** Use of Natural Esters is not recommended for electrical equipment that is open to the atmosphere
- 1.03** 'Natural esters' applies to insulating fluids for transformers and similar electrical equipment with suitable bio-degradability and environmental compatibility.
- 1.04** This specification prescribes the requirements of Natural Esters suitable for use as an insulating, heat transfer medium and arc quenching medium.
- 1.05** These Natural Esters are vegetable oils obtained from seeds and oils obtained from other suitable biological materials. These oils are comprised of triglycerides
- 1.06** Natural esters with additives are within the scope of the IS 16659:2017. Because of their different chemical composition, natural esters differs from insulating minerals oils and other insulating fluids that have high fire points, such as Synthetic esters or Silicone fluids.

2.00 HEALTH, SAFETY AND ENVIRONMENT (HSE) PROPERTIES.

- 2.01** Natural esters with additives are within the scope of the IS 16659:2017. Because of their different chemical composition, natural esters differs from insulating minerals oils and other insulating fluids that have high fire points, such as Synthetic esters or Silicone fluids.
- 2.02 Flash point and fire point :** The safe operation of electrical equipment requires an adequately high fire point that is measure in accordance with ISO 2592. Flash point is measured with ISO 2719 (PMCC) or ISO 2592.
- 2.03 Polychlorinated biphenyls (PCBs):** Unused natural esters shall be free from PCBs. Concentrations of these chemicals can be measured according to IEC 61619/ ASTM D 4059; total concentration shall be less than 2mg.
- 2.04** Unused natural esters shall be free from PCBs. Concentrations of these chemicals can be measured according to IEC 61619/ ASTM D 4059; total concentration shall be less than 2mg.
- 2.05 Biodegradation:** Natural esters exhibit better environmental compatibility relative to petroleum derived insulating minerals oils. Specific tests need to be undertaken to demonstrate ready

biodegradability of these fluids. Tests include OECD 301B; C or F; or US EPA –OPPTS 835.311

2.06 Toxicity : Unused Natural Esters are considered non- toxic and suppliers shall supply assays that define the product as non toxic.

3.00 REFERENCE STANDARDS

Unless otherwise specified, the Natural Esters to be supplied shall be conformed to Standards amended up to date as follows

No.	Standards No.	Title
1	IEC 60076-14	Power transformers – part 14: Liquid immersed power transformers using high temperature insulation materials.
2	IS 16659	Fluids for Electrotechnical Applications-Unused Natural Esters for Transformers and Similar Electrical Equipment
3	IEC 60156	Insulating Liquids - Determination of the breakdown voltage at power frequency – Test method.
4	IEC 60247	Insulating liquids – Measurement of relative permittivity, dielectric dissipation factor ($\tan \delta$) and d.c. resistivity of insulating liquids,
5	IEC 60475	Method of sampling liquid dielectrics.
6	IEC 60814	Insulating liquids – Oil-impregnated paper and pressboard – Determination of water by automatic coulometric Karl Fischer titration.
7	IEC 60666	Detection and determination of specific additives in mineral insulating oils.
8	IEC 61125:1992	Unused hydrocarbon-based insulating liquids – Test methods for evaluating the oxidation stability.
9	IEC 61620	Insulating liquids – Determination of the

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		dielectric dissipation factor by measurement of the conductance and capacitance – Test method
10	IEC 62021-3	Insulating liquids – Determination of acidity – Part 3: Test methods for non mineral oils.
11	IEC 61039:2008 and IS 13503:2013	Classification of insulating liquids according to fire-point and net calorific value.
12	IEC 61198	Mineral insulating oils – Methods for the determination of 2-furfural and related compounds.
13	IEC 61619	Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method of determination by capillary column gas chromatography.
14	ASTM D 4059	Standard test method for analysis of polychlorinated biphenyls in insulating liquid by gas chromatography
15	ISO 2592	Determination of flash and fire-points – Cleveland open cup method.
16	ISO 2719	Determination of flash-point – Pensky Martens closed cup method.
17	ISO 3016	Petroleum products – Determination of pour-point.
18	ISO 3104	Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity.
19	ISO 3675	Crude petroleum and liquid petroleum products – Laboratory determination of density – Hydrometer method.
20	ISO 12185	Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method.

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21	OECD 301	Guideline for testing of chemicals adopted by European council on July 17 th 1992.
22	IEC 62535:2008	Insulating liquids – Test method for detection of potentially corrosive sulfur in used and unused insulating oils.
23	IEC 62697-1	Test method for quantitative determination of corrosive sulfur compounds in unused and used insulating liquids – Part 1: Test method for quantitative determination of dibenzyl disulfide (DBDS)
24	ASTM D 1275	Standard Test Method for Corrosive Sulfur in Electrical Insulating Oil.
25	OECD 201-203	Test Guidelines for ecotoxicity.
26	US EPA	Office of Prevention, Pesticides and Toxic Substances (OPPTS)
27	835.311	Fate, Transport and Transformation Test Guidelines.

4.00 TERMS AND DEFINITIONS:

4.01 Additives: Suitable chemical substances which are deliberately added to natural ester insulating fluids in order to improve certain characteristics e.g. pour point, viscosity, foaming and oxidation stability

4.02 Corrosive Sulfur : Free sulfur and corrosive sulfur compounds detected by subjecting metals such as copper to contact with an insulating liquid under standardized conditions

4.03 Natural Esters: Vegetable oils obtained from seeds and oils obtained from other suitable biological materials and comprised of triglycerides.

4.04 Potentially corrosive sulfur : Organo-sulfur compounds present in transformer oil that may cause copper sulfide formation.

4.05 Unused natural esters as delivered by the supplier .

Note1: Such a liquid has not been used in, nor been in contact with electrical equipment not required for its manufacture, storage or transport.

Note2: The manufacturer and supplier of unused natural esters will have taken all reasonable precautions to ensure that the natural esters are not contaminated with polychlorinated biphenyls, polychlorinated terphenyls or polycyclic aromatics (PCB, PCT, PCAs) or corrosive sulfur compounds; used, reclaimed, or dechlorinated oils or other contaminants.

5.00 PHYSICAL PROPERTIES

5.01 Appearance: A visual inspection of unused natural esters (with light transmitted through approximately 10 cm thickness of natural esters at ambient temperature) indicates the presence of visible contaminants, free water and suspended matter.

5.02 Viscosity: Viscosity influences heat transfer and therefore affects the increase of temperature in the transformer and other equipment. The lower the viscosity, the easier the oil circulates leading to better heat transfer. Viscosities at lower temperatures is a critical factor for cold start of transformers with ON cooling (absence of circulation can lead to possible overheating at hot spots). It can have negative impact on the speed of moving parts such as on load tap changer mechanism, pumps and regulators. Due consideration should be given to viscosity at the lowest cold start energizing temperature (LCSET). Viscosity at 40 deg C and 100 deg C shall be measured according to ISO 3104

5.03 Pour point: Pour point of unused natural esters is the lowest temperature at which the natural esters will just flow. Pour point shall be measured in accordance with ISO 3016. Crystallization behavior of natural esters depends on time and temperature. Crystals should not be present in liquid at application temperature; precautions shall be taken if oil temperature inside the electrical device is lower than 0 deg C. Below this temperature thermal and dielectric behavior of the device with natural esters can be adversely affected. A well defined method to measure crystallization behavior is not available at present.

5.04 Water content: Water content of natural esters affect their dielectric properties. Water content shall be measured in accordance with IEC 60814

5.05 Density: Density of natural esters shall be measured in accordance with ISO 3675 (reference method) but ISO 12185 is also acceptable.

6.00 ELECTRICAL PROPERTIES:

6.01 Breakdown voltage: Breakdown voltage of unused natural esters shall be in accordance with IEC 60156. Because of the difference in properties of natural esters, an initial set-up time is required; it may range between 15 min and 30 min, when there are no visible bubbles in the liquid before measurements are made.

6.02 Dielectric Dissipation factor (DDF): DDF is a measure for dielectric losses caused by liquid. High DDF can indicate contamination of the liquid with moisture, particles or soluble polar contaminants or poor refining quality. DDF shall be measured in accordance with IEC 60247 or IEC 61620 at 90° C. In case of dispute, IEC 60247 at 90°C should be used.

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

6.03 Relative permittivity (dielectric constant): It is the ratio of the amount of electrical energy stored in the liquid at an applied voltage, relative to that stored in a vacuum. It shall be measured in accordance with IEC 60247 or IEC 61620 at 90°C. In case of dispute at 90° should be used.

7.00 CHEMICAL PROPERTIES:

7.01 Acidity: Unused natural esters should be near neutral; acidity shall be measured in accordance with IEC 62021-3.

7.02 Corrosive Sulfur: Free corrosive sulfur and potentially corrosive compounds are detected by contacting copper with insulating liquid under standardized conditions (IEC 62535 or ASTM D1275B). Known corrosive sulfur compounds such as dibenzyl disulphide (DBDS) shall not be present above detection limit (IEC 62697-1).

7.03 Additive content: Additives include antioxidants, metal deactivators, pour point depressants, etc. Antioxidant additive slows down the oxidation of esters and, in turn, the formation of gels and acidity. One such antioxidant is 2, 6-di-tert-butyl-p-cresol (DBPC), also known as BHT, but others are also used. Detection and measurement of defined anti-oxidant additives shall be in accordance with IEC 60666 or other suitable methods. Total concentration of additives shall be less than a weight fraction of 5%.

The supplier with mutual consent should declare the generic types of all additives, and their concentrations in the case of antioxidants and passivators. Information on initial type and concentrations of

additives is useful for supervision and maintenance guidance during the life of natural esters in transformers and similar electric equipment.

7.04 Furfural content: Furanic compounds, including 2-furfural, are degradation products of kraft insulating paper; such compounds are not typically present in unused Natural esters. 2-furfural and related compounds shall be determined in accordance with IEC 61198.

8.00 PERFORMANCE

8.01 Unused natural esters are recommended for application only in equipment that is not open to atmosphere because these fluids are prone to rapid oxidation. Oxidation stability of these fluids can be assessed with modifications to the procedure as described in Method C of IEC 61125: 1992.

8.02 Total acidity: Acidity of natural esters subjected to oxidation stability test. Acidity should be measured in accordance with 1.9.4 of IEC 61125: 1992

8.03 Viscosity: Viscosity of natural esters subjected to oxidation stability test shall be measured at 40°C

8.04 Dielectric Dissipation factor (DDF): DDF measurements after oxidation stability test provides a measure for dielectric losses resulting from the water and soluble polar compounds formed in a dielectric liquid as a result of oxidation. DDF shall be measured in accordance with IEC 60247 or IEC 61620

8.05 Health, safety and environment (HSE) properties: NOTE: These are the properties that are related to safe handling of natural esters and minimization of their adverse impact. Examples can include flash and fire points, polycyclic aromatics (PCAs) and polychlorinated biphenyls/polychlorinated terphenyls (PCBs/PCTs).

8.06 Fire point and flash point: The safe operation of electric equipment requires an adequately high fire point that is measured in accordance with ISO 2592. Flash point is measured according to ISO 2719.

8.07 Polychlorinated biphenyls (PCBs):Unused natural esters shall be free from PCBs. Concentrations of these chemicals can be measured according to IEC 61619; total concentration shall be less than 2 mg/kg

8.08 Biodegradation: Natural esters exhibit better environmental Compatibility relative to petroleum-derived insulating mineral oils. Specific tests need to be undertaken to demonstrate ready

biodegradability of these fluids. Tests include OECD 301B; C or F; or US EPA-OPPTS 835.311

8.09 Toxicity: Unused natural esters are considered non-toxic and suppliers shall supply assays that define the product as non-toxic

9.00 Specifications for Natural Esters used in Sealed Transformer

9.01 General Technical Requirements (Natural esters used in Sealed Transformer): The characteristics of the Natural Esters when it is sampled a manufacturer's work ad /or at the point of delivery and tested in accordance with the methods referred to in Specification sheet 1, Transformer ester- Type T1 and Specification sheet 2 , Capacitor ester – Type C 1of IS: 16081: 2013 amended upto date.

9.01.1 Physical Properties:

- a) The appearance of the Natural Esters shall be clear, free from water, free from suspended matter and sediments (impurities). Colour of Natural Esters shall be **maximum 200 Hazen as per ISO 2211**
- b) The Density of Natural Esters shall be **maximum 1000 kg/ dm³ at 20 ° C** as per ISO 3675 or ISO 12185.
- c) The Kinematic Viscosity of Natural Esters shall be **maximum 35 mm²/s** at 40 ° C and **maximum 3000 mm²/s** at -20 ° C as per ISO 3104.
- d) Flash point of the Natural Esters shall be **minimum 250 ° C** as per ISO: 2719(Pensky- Martens closed cup procedure).
- e) Fire point of the Natural Esters shall be **minimum 300 ° C** as per ISO: 2592(Cleveland open cup)
- f) Pour Point of the Natural Esters shall be **maximum - 10 ° C** as per ISO: 3016

9.01.2 Chemical Properties:

- a) Total water content in the Natural Esters shall be **maximum 200 mg / kg** as per IEC: 60814
- b) Total Acidity. in the Natural Esters shall be maximum **0.6 mg KOH/gm** as per IEC: 62021-1 or IEC: 62021-2
- c) The Natural Esters Oxidation stability test as per IEC: 61125, Method C

Test duration 48 hour.

- i. Total Acidity in the Natural Esters shall be maximum **0.6 mg KOH/gm**

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- ii. Total Sludge in the Natural Esters shall be maximum **57 in % of mass**

9.01.3 Electrical Properties:

- a) As per IEC 60156 the Electric Strength (Breakdown voltage) of Natural Esters shall be : The Breakdown voltage of Esters should be minimum **35 KV (rms) at.2.5 mm gap**
- b) The Dielectric dissipation factor, $\tan \delta$ at 90°C and 50 Hz of Esters shall be **maximum 0.05 ac as per IEC 60247 or IEC 61620**

9.01.4 ISI Certification mark for Natural Esters: The Natural Esters is to be supplied confirming to IS 16659:2017 & IEC 62770:2013 as amended upto date should bear ISI certification mark, without ISI mark insulating oil will rejected

When tested in accordance with the methods specified in this specification, the properties of the Unused liquid shall comply with the requirements given in specification sheet 1.

10.00 PACKING:

10.01 The Natural Esters shall be delivered in perfectly clean steel drums of 210 liters nominal capacity conforming to Grade "A" type 2 conforming IS: 1783 (Part 1) : 1993 amended upto date. The drum shall be coated from inside with epoxy lacquer of phosphate coating or better. The inside coating of the drum shall be resistant to insulating oil. The outside surface of the drum may be coated with anticorrosive primer and finish paint, for protection against atmospheric corrosion. The colour of the finishing paint shall be Navy Blue (Shade No. 106) conforming to IS:5:1994 (Colours of ready mixed paints). The drum shall be effectively sealed immediately after filling the Natural Esters to avoid ingress of moisture.

10.02 Steel barrel: The Natural Esters of above specification shall be supplied in standard packing of 200 liters nominal capacity, non-returnable Brand New Steel Barrels (Drums) 'A' grade type-2 conforming to IS-1783 (Part-I) 1993 as amended upto date.

10.03 The Type-2 drums shall be as per Fig-2 with triple / Spiral seam (Drawings No. MSEDCL/MM-II/OIL/01 and MSEDCL/MM-II/OIL/02) with ISI marking.

11.00 SAMPLING

Representative sampling shall be carried out in accordance with the procedure described in IEC 60475.

12.00 Tests :

The tenderer shall submit Test reports of the offered Natural Esters with the offer in electronic format (i.e. Compact Disc) and in physical format. The tests shall be carried out at laboratories accredited by National Accreditation Board for testing and Calibration Laboratories (NABL) such as CPRI/ERDA to prove the requirements specified in this specification & as per relevant standards 16659:2017 & IEC 62770:2013 amended up-to-date. The tests should be carried out within 5 years prior to the date of opening of this tender. The offer without test reports from NABL laboratories is considered as non-responsive and likely to be rejected.

The successful tenderer shall get approved the test reports of Natural Esters and drum from Chief Engineer (Testing & Quality Control), MSEDCL, Prakashgad, Bandra, Mumbai prior commencement of the supply. The Drum drawings shall be submitted to the Chief Engineer (Testing & Quality Control) and get approved before commencement of the supply

13.00 PRE-DISPATCH INSPECTION

The tenderers should arrange for sample testing of Natural Esters twice during the contractual period, at their cost. Tenderers should note that no separate testing charges will be payable by the MSEDCL. Sample testing will have to be arranged as and when directed by the MSEDCL at CPRI, Bangalore/ERDA, Vadodara Laboratories

14.00 TESTING FACILITY

14.01 The tenderer should have adequate testing facility for all routine and acceptance tests on Natural Esters and should provide the testing arrangements and testing equipments to testing Engineer of MSEDCL. The tenderer should submit the list of testing equipments available with them with the offer.

14.02 The bidder should also supply along with his offer the pamphlets/literatures in respect of Natural Esters available with them.

14.03 The bidder should not change GTP parameters of Natural Esters once it offered in A/T and Type Test Reports.

15.00 REJECTION

Apart from rejection due to failure in testing of Natural Esters to meet the specified test requirements the Natural Esters shall be liable for rejection on any one of the following reasons.

- i. If tests are not carried out as per clause no. 13.0 of this specification

- ii. If Drawings are not submitted with offer
- iii. If GTP parameters are not submitted as per Schedule A of this specification
- iv. The bidder should fill up all the details in GTP parameter list, the statement such as "as per drawings enclosed", "as per MSEDCL's requirement" "as per IS" etc. shall be considered as details are not furnished and such offers shall liable for rejection

16.00 QUALITY ASSURANCE

- 16.01** Names of the supplier for the raw material, list of standards accordingly to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representatives, copies of test certificates.
- 16.02** Information and copies of test certificate as in (i) above respect of bought out accessories.
- 16.03** 3List of manufacturing facilities available
- 16.04** Level of automation achieved and list of areas where manual processing still exists
- 16.05** List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections
- 16.06** List of testing equipment available with the bidder for final testing of Natural Esters and test plant limitation, if any, vis-à-vis the special acceptance and routine tests specified in the relevant standards and the present specification
- 16.07** The successful bidder shall submit the Routine Test Certificate along with documentary evidence having paid for the excise duty for the raw materials at the time of Testing.

17.00 QUALITY ASSURANCE

- 17.01** The Tenderer must be a manufacturer of Natural Esters.
- 17.02** The tenderer having ISO certificate for their manufacturing unit for Natural Esters shall be given preference
- 17.03** The bidder should have proven experience of not less than 5 years in Manufacture, supply and testing at works for offered Natural Esters.
- 17.04** The bidder should have adequate in house testing facilities for conducting acceptance tests in accordance with relevant IS.
- 17.05** Bidder should have a minimum turnover of 60% of the value of the material offered in any one financial year during the previous 3 years

- 17.06** The Bidder should furnish all the relevant documentary evidence to establish the fulfillment of the above requirement
- 17.07** The bidders not meeting the requirement at clause No. 13.1 can also participate, provided they have valid ongoing collaboration with a manufacturer who has at least 10 years experience in the manufacturing and testing of offered Natural Esters, which have been in satisfactory service for a period of at least three years. In such an event the bidder shall furnish along with the bid the documentary evidence for the same and undertaking from the bidder and collaboration accepting joint and several liability for all obligations under the contract.
- 17.08** The bidder who does not meet the above Qualifying requirement of experience (Clause No. 13.3) may be considered for a Trial Order subject to fulfilling the following requirements along with Clause Nos. 13.1 to 13.7.
- 17.09** The bidder shall have the basic infrastructure for the manufacture and supply of the Natural Esters offered, like machinery, technical knowledge, capacity etc.
- 17.10** The purchaser should be satisfied with the manufacturing, supplying and financial capacity of the bidder after inspecting the bidder's works.
- 17.11** Notwithstanding anything stated above, the purchaser's decision in this regard will be final.

Specification Sheet 1

Transformer ester- Type T1

This type of ester is prepared from a polyhydric alcohol (pilyol) and a mixture of monocarboxylic acid with suitable stabilizing additives as required to meet the properties specified below.

Property	Test Method	Permissible Values
Physical		
Appearance	Visual	Clear, free from sediment and suspended matter.
Density at 20°C (Kg/dm ³)	ISO 3675 or ISO 12185	Max. 1000
Kinematic viscosity At 40°C (mm ² /s) At 100°C (mm ² /s)	ISO 3104	Max.50 Max. 15
Flash - Point(°C)	ISO 2719	Min.250
Fire - Point (°C)	ISO 2592	Min.300
Pour - Point (°C)	ISO 3016	Max. - 10
Chemical		
Water content (mg./kg)	IEC 60814	Max.200 ^a
Acidity (mg KOH/g)	IEC 62021-1 or IEC 62021-2	Max.0.6
Oxidation stability ^b	IEC 61125, Method C	
Test duration 48 h		

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Total acidity (mg KOH/g)		Max. 0.6
Total sludge (%mass)		Max 0.57
Electrical		
Breakdown voltage (Kv)	IEC 60156	Min 35 ^a (See Clause 8)
Dielectric dissipation factor, tan δ at 90°C and 50 Hz	IEC 60247 or IEC 61620	Max.0.05 ^{a,c}
^a For untreated liquid, as received.		
^b Oxidation stability (IEC 61125, Method C) at 500 h is an optional extra test. No requirement in this standard.		
^c For frequencies (f (Hz)) in the range of 48 Hz to 62 Hz, convert values as follows: $\tan \delta[f(50\text{Hz})]= f(\text{Hz})/50 \times \tan \delta [f(\text{Hz})]$		

SPECIFICATION FOR DRUMS, LARGE, FIXED ENDS

Grade "A" DRUMS

1. Scope:

This specification covers design, manufacturing, testing, supply Non-Returnable, New Steel Barrels (Drums) of Grade-A , Type 1 & Type 2, confirming as per IS: 1783-(Part-1) 1993 of 200 liters nominal capacity with fixed ends with the following types of construction.

- a) Type-1 – Drums of steel sheets of nominal thickness 1.25 mm for body and ends, with end seam resistance welded and double seam construction.
- b) Type – 2 – Drums of sheets of nominal thickness 1.25 mm for body and ends, with end seam of spiral/triple seam construction

2. References:

The following Indian standards are necessary adjuncts to this standard.

IS No.	Title
513 : 1994	Cold rolled low carbon steel sheets and sheets (Fourth revision).
1394 : 1984	Glossary of terms relating to metal containers (Third revision).
1784 : 1984	Screwed closures for drums (Second revision).
3258 : 1966	Methods of sampling of metal containers

- 3. Terminology:** For the purpose of this standard, the definitions given in IS:1394:1984 shall apply

4. **Capacity:** The minimum gross capacity of the drums measured with water at ambient temperature shall be 210 litres
5. **Dimensions:** The drums of type 1 & type 2 construction shall have dimensions as given in Fig. 1 & Fig.2. The drum drawings are attached with the specification. Drawings No. MSEDCL/MM-II/OIL/01 & MSEDCL/MM-II/OIL/02

6. Material:

- 6.1 The material for type 1 & Type 2 drums shall be as follows:
 - a) Type 1- Body and ends of the drums shall be Cold Rolled Carbon Steel sheets conforming to Grade "O" or "D" or "DD" of IS: 513:1994
 - b) Type 2 – Body and ends of the drums shall be Cold Rolled Carbon Steel sheets conforming to Grade "O" or "D" of IS: 513:1994
- 6.2 The nominal thickness of steel sheets for body and ends of both types of drums shall be 1.25 mm
- 6.3 The sheets and blanks shall be phosphatized by any of the recognized processes
7. Construction.
 - 7.1 The sheets shall be blanked and formed to shape. The blanks shall be free from cracks, dents, pitting, rust other defects.
 - 7.2 The body shall be continuously resistance welded so as to provide air-tight joint.
 - 7.3 Triple/Spiral seam construction for type 2 drums. The top and bottom ends shall be seamed to the body as shown in Fig.2. The seam shall have rolled 5 layers of sheet with the sealing compound forming a core at the joint of body and end sheets. The sealing compound forming the core shall be flexible and chemically resistant to the product to be packed.
 - 7.4 The Drums shall be provided with two rolling bends or he as expanded or rolled in the drum body, located as shown in Fig 1 & Fig. 2.
 - 7.5 Closures :-

The drums shall be fitted with two screwed closures one of 50 mm and the other of 20 mm as desired by the purchaser. The position of the screwed closure shall be as shown in Fig 1 & Fig.2. Screwed closures shall be conforming to IS:1784:1984

8. Finish

- a) The drums shall be in clean condition, the inside being free from all traces of rust and foreign matter
- b) The inside and outside surfaces of each drums shall be treated as per Specification CI.No.7.1 of Unused Synthetic Organic Esters

9. Tests

a) Leakage tests:

Each drum shall be tested for leakage by either of the methods: At air pressure of 50 Kpa (0.5 Kgf/ cm²) with the seams under water or covered with soap solution. The drums shall not show any sign of leakage or drop in the test pressure when observed for at least 10 seconds.

OR

Using special equipment fill the drum with helium, thereafter putting the drum in an air-tight chamber, creating a high vacuum in the annular space between the inner wall of the chamber and outer surface of the drum and thereafter testing for leakage in the drum by checking for presence of helium in annular space using Mass Spectrometer.

OR

Using special equipment put drum in air -tight chamber creating a high vacuum in the annular space between the inner walls of the chamber and outer surface of drum and thereafter testing for leakage in the drum by observing for any drop in the differential pressure between inside of the drum and outside of the drum

b) Drop Test.

- i. Fill the drum to 98 percent of its gross capacity with water at ambient temperature and close it properly, suspend the drum with the diagonal in the vertical position and raise it to a height so that the lowest point on the drum is 1.80 mm clear off the horizontal striking test surface. The striking surface shall be horizontally plain concrete floor or a steel plate at least 40 mm thick. The drum shall be dropped in such a way that it strikes the floor at the bottom rim at its junction with the side seam. The same drum shall again be dropped so that it strikes the floor at the top rim at its junction with the side seam.
- ii. The drum shall be examined for any leakage of water after the test. Any leakage of water shall indicate failure of the drum in the test.
- iii. The drum after the test shall be subjected to air leakage test as per 8.1. The drum shall not show any sign of leakage.

c) Hydraulic pressure test:

The drum shall be subjected to a gradually applied hydraulic pressure of 200 Kpa (2.0 kgf/cm.sq.). This pressure shall be maintained for at

least 5 minutes and any leakage of water or drop in the pressure shall indicate failure of the drum in the test

10. Sampling

- a) Representative samples of the drums for tests regarding dimensions, capacity, construction, finish, air leakage shall be drawn as prescribed in IS:3259-1988.
- b) One sample from each lot of 2000 drums shall be subjected to drop test as detailed in Cl.No. 9.2.1 to 9.2.3 of this specification
- c) One fresh sample from each lot of 2000 drums shall be selected and subjected to hydraulic pressure test as detailed in Cl. No. 9.3 of this specification
- d) If the sample tested above fails two more drums from the same lot shall be subjected to the same test and if any of the two samples fails again, the lot shall be deemed to have failed in the test

11. Marking

Each drum shall be marked with the following particulars by embossing on the head with raised markings.

- i. Name of the manufacturer with trademark.
- ii. Grade and type of the drum
- iii. Unused Synthetic Organic Esters
- iv. Identification code
- v. The date of manufacture
- vi. Quantity in litres.
- vii. MSEDCL

12. Schedules

- a) The bidder shall fill in the following schedules which form part of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be rejected.

Schedule `A' -Guaranteed Technical Particulars

Schedule `B' -Schedule of Tenderer's Experience

- b) The discrepancies between the specification and the catalogs, Literatures and indicative drawings which are subject to change, submitted as part of the offer, shall not be considered and representation in this regard will not be entertained.
- c) The Bidder shall submit the list of orders for similar type of equipments, executed or under execution during the last three years, with full details in the schedule of Tenderer's experience (Schedule `B') to enable the purchaser to evaluate the tender

Schedule "A"

GUARANTEED TECHNICAL PARTICULARS

Natural Esters in Drums for Transformers

Sr.No	GTP Parameters	
1.	Firm's Name	
2.	Applicable Standards for Natural Esters	
3.	Specify the type of New Insulating Oil	
4.	Specify the maximum Density of natural ester in kg/dm ³ at 20 degree Celsius as per ISO 3675 or ISO 12185	
5.	Maximum Kinetic viscosity of natural ester in mm ² /s at 40 deg. Centigrade as per ISO 3104	
6.	Maximum Kinetic viscosity of natural ester in mm ² /s at 100 deg. Centigrade as per ISO 3104	
7.	Specify the maximum Pour Point of natural ester in deg. centigrade as per as per ISO 3106	
8.	Specify maximum Water content in natural ester (mg./kg) as per IEC 60814	
9.	Specify the minimum Breakdown value of un - filtered natural ester in kV (rms) at 2.5 mm gap	
10.	Specify the minimum Breakdown voltage of filtered natural ester in kV (rms) after laboratory treatment at 2.5 mm gap.	
11.	Specify the maximum Dielectric Dissipation Factor (DDF)(tan delta) at 90 °C and 50 Hz as per IEC 60247.	
12.	Specify minimum DC resistivity at 90 deg. Centigrade as per IEC 60247 or IEC 61620	
13.	Specify minimum Flash point as per in deg. Centigrade as per ISO 2719	

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14.	Specify minimum Fire point as per in deg. Centigrade as per ISO 2719	
15.	Specify the maximum acidity in mg KOH/g as per IEC 62021-1 or 62021-2	
16.	Oxidation stability carried out as per IEC 61125, Method C at 500 hrs	
17.	Specify appearance of the unused Natural Ester	
18.	Specify the Neutralization Value of Natural ester as per IEC:62021-1 Maximum acidity in (mg/KOH/gm)	
19.	Specify the total sulphur content in % as per ISO 14596 or ASTM D4294	
20.	Specify condition of Corrosive sulphur of natural ester	
21.	Specify condition of potential Corrosive sulphur of unused natural ester	
22.	Specify maximum Dielectric dissipation factor (tan delta) of natural ester at 90 deg. C	
23.	Maximum Total sludge after oxidation in percent by weight	
24.	Specify the maximum value of Polychlorinated Biphenyls(PCB) Content in mg/kg of the unused natural ester should not be detectable as per IS 16082	
25.	Test Reports of Natural Ester submitted on soft copy with the offer(Yes/No)	
26.	STEEL DRUM ('A ' Grade type 2)	
27.	Type and Grade of the steel Drum	
28.	Applicable Standards for Natural Ester	
29.	Nominal capacity of oil drum in liters	
30.	New steel barrels confirms to IS-1783 as amended up to date (Yes/No)	
31.	Dimensions of oil barrel as per drawings enclosed	

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32.	Material for oil drum	
33.	The appearance of the Natural Ester	
34.	Sampling shall be done as per IS 6885: 1973(Yes/No)	
35.	Give construction details of drum	
36.	Insulating oil bears ISI certification mark(Yes/No)	
37.	Tenderer have adequate testing facility to carry out tests specified in the specification (Yes/No)	
38.	List of equipments for testing submitted with the offer(Yes/No)	
39.	List of supplier for raw material, list of standards applied, routine tests for raw material, List of tests carried out are enclosed with offer(Yes/No) material, list of test certificates submitted on soft copy (Yes/No)	
40.	Leakage Tests shall be carried out on each oil drums at pressure of 50 K Pa as per specification. (Yes/N)	
41.	Duration of Leakage Tests in minutes	
42.	Method used for carrying out Leakage Tests shall on each oil drums as per specification.	
43.	Drop Tests shall be carried out on oil drum as per specification (Yes/No)	
44.	Hydraulic pressure test shall be carried out on oil drum as per specification (Yes/No)	
45.	Hydraulic pressure (in Kpa) used in the test for oil drum	
46.	Marking shall be carried out on each oil drum as per of specification (Yes/No)	

SCHEDULE - "B"

TENDERER'S EXPERIENCE

Tenderer shall furnish here a list of similar orders executed/under execution by them to whom a reference may be made by company in case it is necessary

Sr. No.	Name of client	Order No. & date	Qty. ordered	Qty. supplied
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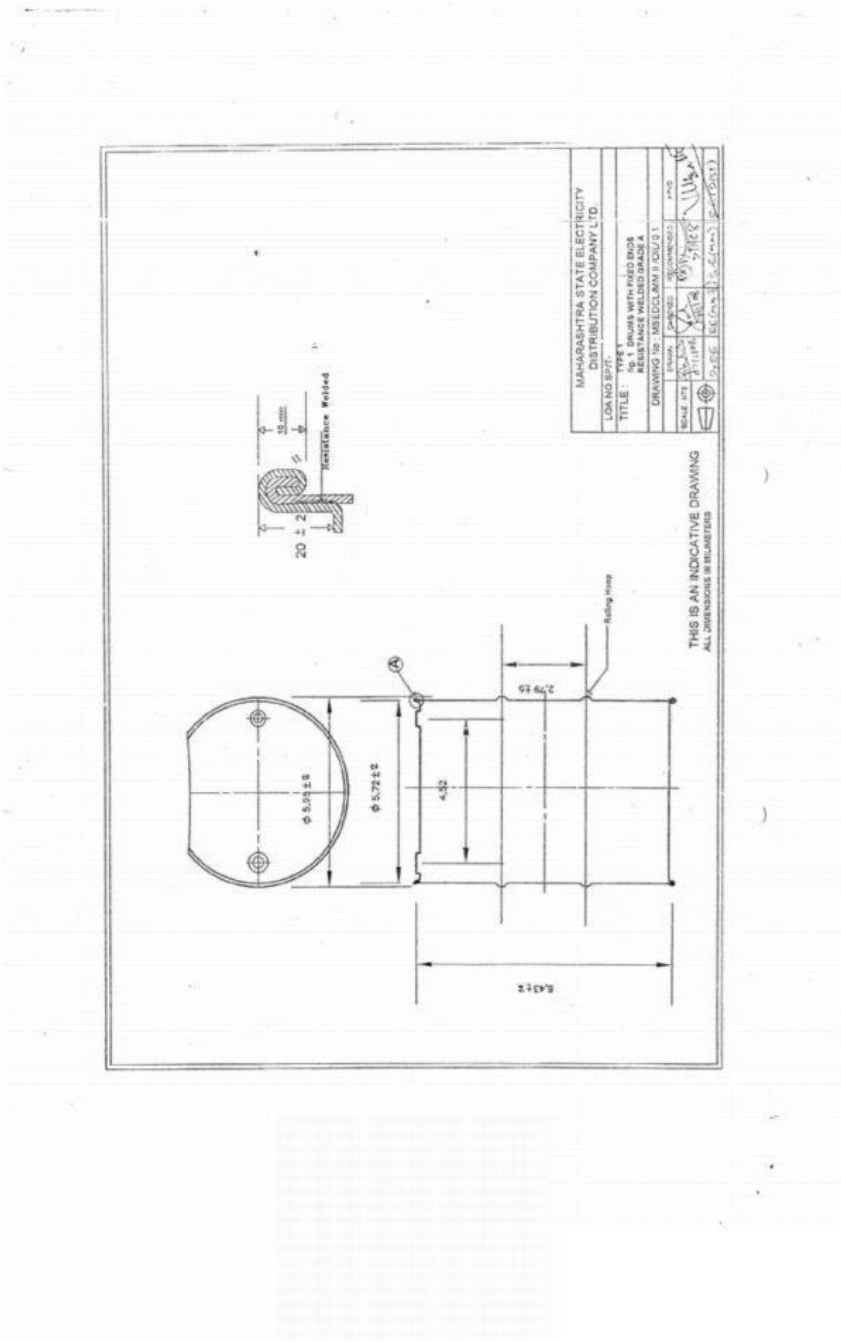
NAME OF FIRM _____

NAME & SIGNATURE _____

DESIGNATION _____

DATE _____

**TECHNICAL SPECIFICATIONS OF INSULATING LIQUIDS: NATURAL ESTER FOR DISTRIBUTION
IN MS&DCL**



MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD.	
FORM NO. 1	TYPE 1
TITLE: Fig. 1 BRUSH WITH POLE SHOULDER	
DRAWING NO. MS&DCL/MT/01/1	
SCALE: 1:1	DATE: 20.02.2017
DESIGNER: [Signature]	CHECKER: [Signature]
APPROVED: [Signature]	DATE: 20.02.2017

THIS IS AN INDICATIVE DRAWING
ALL DIMENSIONS IN MILLIMETERS

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