Material Specification

Electrical Equipment—Insulating Oil

Substation & Civil Engineering

Date: 16 Oct 12

Project Issue Date: _____

Company Project Info

Attachment to Exhibit _____, Section _____, Attachment no. _____

Project name: _____

Edited by: _____

Contents

Electrical Equipment—Insulating Oil

1 Scope

This material specification states the requirements for insulating oil to be used by the company in energized electrical equipment.

2 Applicable Documents

The following publications shall be used in conjunction with this material specification, and form a part of this material specification to the extent specified herein. When a referenced publication is superseded by an approved revision, the revision shall apply.

2.1 Industry Publications

Referenced industry publications are:

OSHA 29 CFR 1910, 1200, *Hazard Communication Standard*

ASTM D 117, *Standard Guide to Tests Methods and Specifications for Electrical Insulating Oils of Petroleum Origin*

ASTM D 877, *Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes*

ASTM D 923, *Standard Test Method for Sampling Electrical Insulating Liquids*

IEC WG–35, *Covered Conductor Deposition Test*

ASTM D3487, *Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus*

3 General

3.1 Application Information

This material specification states the general requirements for insulating oil for energized electrical equipment. The insulating-oil-specific requirements that vary depending on the project shall be stated in the purchase order.

3.2 Authorized Material Specification

This material specification is not considered valid until each page contains the approval signature (or initials) of the persons named in the title blocks.

4 Manufacturing Requirements

4.1 Codes and Standards

Except as required otherwise by this material specification, electrical equipment insulating oil requirements shall be in complete accordance with the latest applicable industry codes, ANSI, IEEE, NEMA, and ASTM standards, and company construction standards and material specifications in effect on the date of invitation to bid. When these standards do not agree, the more stringent standards shall apply.

4.2 Type

The insulating oil supplied under this specification shall be non-corrosive, light mineral insulating oil for use as a dielectric medium in an energized electrical apparatus. The oil shall also be naphthenic and inhibited, as specified in Sections 4.3 and 4.5.

4.3 Raw Material and Processing

The insulating oil shall be manufactured from predominantly naphthenate-base crudes. Distillates from these crudes may be acid-refined, hydrogen-treated, solvent-extracted, or processed by other industry-accepted methods that will yield mineral insulating oil that meets the testing requirements in Section 5 of this specification at the point of delivery to the company. No changes in the approved crude used or the approved refining methods shall be made without prior written acceptance by the company.

4.4 Impurities

Insulating oil shall be clear and free from all injurious impurities, such as metallic or nonmetallic particles or other foreign substances.

4.5 Additives

Insulating oil shall contain no additives other than the oxidation inhibitor. Certification shall be provided stating that the additive Dibenzyl Disulfide (DBDS) is not contained in the insulating oil.

4.6 Oil Sampling

Oil samples shall be taken in accordance with ASTM D 923 and shall be taken such that they represent the oil at the point of delivery to the company.

5 Testing and Certification

The supplier shall provide a certificate or a Material Safety Data Sheet (MSDS) stating that the insulating oil provided is not required to carry a cancer warning label in accordance with OSHA 29 CFR 1910, 1200. The supplier shall guarantee conformity to this specification at the point of delivery. Each individual container shall be accompanied by a certificate showing that the insulating oil in that container conforms to this specification at the point of loading, and giving all results of tests made on the oil. A copy of all documentation shall be submitted to the company as specified in Section 6 of this document. The certificates shall include the results of the following tests, made on bottom samples taken after filling of each container of oil prior to shipment to the company:

1. PCB analysis
2. Dielectric breakdown voltage (ASTM D 877)
3. Flash point
4. Dissipation (power) factor
5. Color
6. Visual examination
7. Neutralization number
8. Water content
9. Corrosive sulfur

The certificate shall also include the results of the tests specified in Table 1, made on samples from the manufacturing batch from which the shipment is drawn, and the following shipment identification information:

1. Company purchase order number
2. Supplier's order number
3. Consignee
4. Date of shipment
5. Destination
6. Refinery lot number
7. Trailer or equipment serial number
8. Filling date
9. Volume of oil shipped

All insulating oil that does not conform to this specification at the point of delivery will be returned to the supplier collect. The company shall be kept fully informed by the supplier as to the method and frequency of quality control employed for certification of these properties.

Table 1 specifies the properties to be tested, the test methods to be employed, and the test criteria for acceptance. The ASTM test methods listed in Table 1 may be found in abbreviated form in ASTM D 117.

Table 1—Test Requirements

Properties	Test Method	Test Criteria
Electrical		
Dielectric breakdown at 60 Hz:		
Disc electrodes 0.100-inch gap	ASTM D 877	30 kV min.
VDE electrodes 0.040-inch gap	ASTM D 1816	28 kV min.
Dielectric breakdown voltage impulse at 25 °C needle-to-sphere ground 1-inch gap	ASTM D 3300	145 kV min.
Dissipation (power) factor		
at 25 °C	ASTM D 924	0.05% max.
at 100 °C	ASTM D 924	0.30% max.
Gassing tendency		
Procedure A	ASTM D 2300	+15 µl/minute max.
Procedure B (use either procedure A or B)	ASTM D 2300	+30 µl/minute max.
Physical		
Aniline point	ASTM D 611	63–80 °C
Color	ASTM D 1500	0.5 max.
Flash point	ASTM D 92	145 C
Interfacial tension at 25 °C	ASTM D 971	40 dynes/cm min
Pour point	ASTM D 97	–40 °C max.
Specific gravity at 15/15 °C	ASTM D 1298	0.865–0.910
Viscosity		
at 100 °C	ASTM D 445	3.0/36 cST/SUS max.
at 40 °C	ASTM D 445	12.0/66 cST/SUS max.
at 0 °C	ASTM D 445	76.0/350 cST/SUS max
Visual examination	ASTM D 1524	Clear and bright
Chemical		
Corrosive Sulfur	ASTM D 1275B ASTM D 2668 IEC WG–35	Noncorrosive
Inorganic chloride ion	ASTM D 878	0.10 ppm
Inorganic sulfate ion	ASTM D 878	None
Neutralization number	ASTM D 974	0.03 mg KOH/g max.

Properties	Test Method	Test Criteria
Chemical		
Oxidation inhibitor content % by weight	ASTM D 1473 ASTM D 2668	0.3% max.
Oxidation stability testing		
72 hour test: Sludge weight % Neutralization number	ASTM D 2440	0.10% max. 0.30 mg KOH/g max.
164 hour test: Sludge weight % Neutralization number	ASTM D 2440	0.20% max. 0.40 mg KOH/g max.
Rotating bomb test, minutes	ASTM D 2112	195 min.
Polychlorinated biphenyl (PCB)	ASTM D 4059	Not detectable
Total sulfur, weight %	ASTM D 989	0.15 % max.
Water Content, ppm	ASTM D 1315 ASTM D 1533	30 ppm max. before processing

6 Technical Documentation

All values in documentation shall be shown in US customary units only, or in both US customary and SI units.

A certified oil test report is required with delivery of the oil, or with the delivery of the oil-filled equipment.

7 Shipping Requirements

All insulating oil shall be shipped via common-carrier truck or factory-filled electrical apparatus purchased by the company or as specified in the purchase order. All insulating oil shipped by any other means will be returned to the supplier collect. The supplier shall carefully inspect each container to assure that it is free of injurious foreign matter. The inspection shall include, but shall not be limited to, a visual internal inspection of the container, valves, and piping. Inspection shall occur immediately prior to loading of the insulating oil.

7.1 Notification of Shipment

The supplier shall notify the company two weeks prior to the expected arrival of the insulating oil. Additionally, the company contact named below shall be notified 48 hours prior to delivery and on the day of shipment to ensure provisions for unloading.

PacifiCorp . . . . . ❑

PacifiCorp Project Services Department – Attn. Senior Materials Analyst
Lloyd Center Tower
825 NE Multnomah St., Ste. 1500
Portland, OR 97232
(503) 813–7061; fax (503) 813–6596

MidAmerican Energy . . . . . ❑

Notification instructions will be on the purchase order.

8 Supplier Approval

All suppliers must be approved by the company prior to receiving an order. Approval is issued to a supplier for a given crude source, refining process, conformity to the requirements of this specification, and performance deemed essential by the company. Suppliers may be required to submit a one-gallon sample, for independent testing, and test certificates representing the quality of insulating oil to be delivered. The test certificates shall include the test requirements found in Section 5. The test sample submitted to the company shall be clearly marked with the refinery name, refinery location, crude source, and refining process.

9 Issuing Department

The engineering standards and technical services department of PacifiCorp published this material specification. Questions regarding editing, revision history and document output may be directed to the lead editor at (503) 813–5293. Technical questions and comments may be submitted to Steve Haacke, MidAmerican Energy Company substation engineering, (563) 333–8388 or Daniel Scott, PacifiCorp substation standards engineering, (503) 813–6924.

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