

Dielectric Fluids

Envirotemp™ FR3™ Fluid Storage and Handling Guide

Contents

General.....	1
Precautions.....	1
Safety Information.....	2
Receiving.....	3
Container Handling.....	3
Tank Truck Unloading.....	4
Bulk Storage Systems.....	4
Electrical Equipment Filling.....	7
Power Factor Measurements.....	7
Transformer Maintenance.....	8

IMPORTANT: This Storage and Handling Service Information Guide is limited to apply only to Envirotemp FR3 fluid. This bulletin does not claim to cover all possible variables that might be encountered while receiving, handling, and storing Envirotemp FR3 fluid. It is the sole responsibility of the user to ensure that specific storage and handling equipment, materials, and processes are suitable.

GENERAL

Envirotemp™ FR3™ fluid is a natural ester-based dielectric coolant formulated for use in distribution and power transformers. Envirotemp FR3 fluid is primarily used in new transformer applications. It has also been applied in transformer retrofill, new switchgear, specialty power supplies, and other applications. This Guide does not address the suitability of Envirotemp FR3 fluid for any given application. The suitability is the responsibility of users and their equipment suppliers.

Key drivers for the growing demand for Envirotemp FR3 fluid are the increased asset insulation life and performance while providing environmental benefits including renewable, carbon neutral*, non-toxic and ultimately biodegradable. While Envirotemp FR3 fluid is miscible and compatible with conventional transformer mineral oil, it is important that the fluid be maintained in as pure a state as when new, to avoid decreasing the performance and environmental benefits.

The chemistry of natural esters are significantly different from petroleum oils. Therefore, certain practices used for mineral oil may not necessarily be proper for the storage and handling of Envirotemp FR3 fluid. Adhering to the information provided by this Guide helps assure that the quality of the fluid properties remain at its highest state, helps avoid damage to equipment, and increases personnel safety.

*According to Building Environmental Economic Sustainability [BEES] lifecycle analysis



Figure 1. Prior to shipment, Envirotemp™ FR3™ Fluid undergoes extensive quality assurance testing. The facilities producing Envirotemp FR3 Fluid are ISO 9001 Certified.

ENVIRONMENTAL

Envirotemp FR3 fluid is formulated from vegetable oils and performance enhancing additives. It passed the very sensitive acute aquatic toxicity (OECD Method 203), and meets the highest EPA biogradation rate classification. Contamination by mineral oil may result in additional remediation requirements in the event of a spill.

FIRE SAFETY

Envirotemp FR3 fluid is UL Classified and FM Approved as a NEC less-flammable dielectric coolant with a flash point of approximately 330° C and a fire point of 360° C. Mineral oil concentrations in excess of 7% can reduce the fire point below the 300° C, the threshold required for NEC and IEC fire resistant classifications for certain installations where increased fire safety is required. Typically, with proper retrofilling techniques, the level of residual mineral oil that will eventually leach out of the cellulose insulation over time should not exceed 4-5% in power transformers and 5-6% in distribution transformers.

These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide directions for meeting every contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your Cargill sales engineer.

SAFETY INFORMATION

Cargill products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cargill employees involved in product design, manufacture, marketing and service.

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians, who are familiar with this equipment should install, operate and service it. A competent technician has these qualifications:




- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Safety Instructions


Hazard Statement Definitions

This manual may contain four types of hazard statements:


-  **DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
-  **WARNING:** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
-  **CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.


Special Attention Statement Definitions


This manual contains important statements:


-  **IMPORTANT:** Indicates information to help avoid unnecessary degradation of the product, equipment damage or application misuse, particularly if the practice differs from common practices in the storage and handling of convention transformer mineral oil.

Throughout this Guide, hazard and key precautions appear. It is important to carefully read and understand all such statements.

 **WARNING:** Before receiving, inspecting, testing, handling, storing, applying and processing this material, carefully read, understand and follow the contents of this guide. Failure to do so can result in death, severe personal injury and equipment damage. Failure to do so can also cause a significant reduction in the electrical, physical and chemical qualities of this material.

 **WARNING:** This material is to be received, inspected, tested, handled, stored, processed and applied following all locally approved procedures and safety practices. Failure to comply may result in death, severe personal injury, and material and equipment damage.

 **WARNING:** Receiving, inspecting, testing, handling, storing, applying and processing this material must be performed by competent personnel who have been trained and understand proper safety procedures. This guide is written for use by such personnel and is not a substitute for adequate training and experience in safety procedures. Failure to use competent personnel can result in death, severe personal injury, and equipment damage. Failure to do so can also cause a significant reduction in the electrical, physical and chemical qualities of this material.

 **IMPORTANT:** This Storage and Handling Service Information Guide is limited to apply only for Envirotemp FR3 fluid. This bulletin does not claim to cover all possible variables that might be encountered while receiving, handling, and storing FR3 fluid. It is the sole responsibility of the user to ensure that specific storage and handling equipment, materials, and processes are suitable.

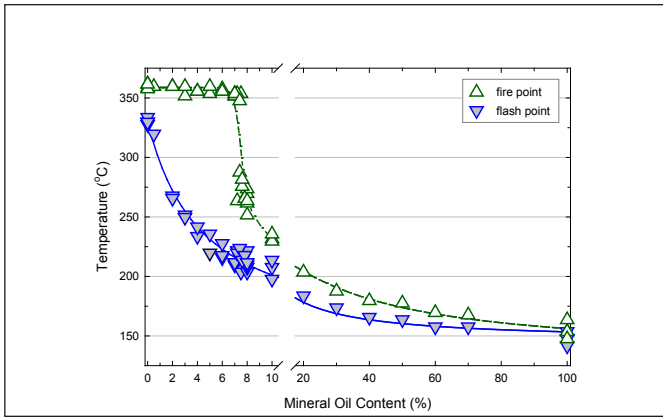


Figure 2.
Flash and fire points of mixtures of Envirotemp™ FR3™ fluid and conventional mineral oil as a function of mineral oil content.

Compatibility of Dielectric Fluids

Envirotemp FR3 fluid is miscible with conventional transformer oil, high molecular weight hydrocarbons, PCB (Askarel) and most PCB substitutes except silicone oil. Envirotemp FR3 fluid is not miscible with silicone oil and should not be applied in transformers previously containing silicone oil.

! IMPORTANT: To prevent moisture ingress, and maintain the optimal fluid properties for its intended use as an electrical insulating fluid, exposure to oxygen, moisture, and other contaminants must be minimized.

RECEIVING Inspection

Each lot received should be inspected for container integrity. Verify that tamper seals are intact.

Receiving Tests

A Certificate of Analysis is included with every shipment of fluid. If independent receiving tests are required, samples should be taken from containers per ASTM D-923 Standard Test Method.

When material is to be combined for production, samples may be mixed together to create a composite sample for testing. The minimum tests recommended are dielectric strength and visual inspection. Dissipation factor and water content tests are recommended, although not essential.

Recommended acceptance values are given in Table 1.

! IMPORTANT: Although laboratory testing of Envirotemp FR3 fluid is done in much the same way as mineral oil, minor modifications to certain ASTM test procedures are needed in order to obtain repeatable and reliable results. If your laboratory does not have experience testing Envirotemp FR3 fluid, have them contact Cargill for detailed test recommendations.

TABLE 1
Envirotemp™ FR3™ Fluid Recommended Specification Limits

Property	Specification Limits		Test Method
	IEEE C57.147	ASTM D6871	
Electrical			
Dielectric Breakdown, 2mm [kV]	-	-	ASTM D1816
Sampled from Bulk	≥35	≥35	ASTM D1816
Sampled from Totes/Drums	≥60	≥60	ASTM D1816
Dissipation Factor [%]			ASTM D924
25° C	≤ 0.20	≤ 0.20	
100° C	≤ 4	≤ 4	
Gassing Tendency [μl/min]	-	≤ 0	ASTM D2300
Physical			
Color [ASTM units]	≤1.0	≤ 1.0	ASTM D1500
Appearance	-	bright & clear	ASTM D1524
Kinematic Viscosity [mm ² /s]			ASTM D445
40° C	≤50	≤ 50	
100° C	≤15	≤ 15	
Pour Point [°C]	≤-10	≤ -10	ASTM D97
Fire Point [°C]	≥300	≥ 300	ASTM D92
Flash Point (open cup) [°C]	≥275	≥ 275	ASTM D92
Relative Density [15° C/15° C]	≤0.96	≤ 0.96	ASTM D1298
Chemical			
Water Content [mg/kg]			
Sampled from Bulk	≤200	≤200	ASTM D1533
Sampled from Totes/Drums	≤100	≤200	ASTM D1533
Acid Number [mg KOH/g]	≤ 0.06	≤ 0.06	ASTM D974
Corrosive Sulfur	not corrosive	not corrosive	ASTM D1275B
PCB Content [ppm]	not detectable	not detectable	ASTM D4059

CONTAINER HANDLING

IMPORTANT: Dedicated equipment is recommended for storing, handling, and processing Envirotemp FR3 fluid. However, if existing equipment is used for both mineral oil and Envirotemp FR3 fluid, it should be drained of mineral oil and flushed with Envirotemp FR3 fluid to minimize mineral oil content. After use, the equipment should be drained of Envirotemp FR3 fluid and flushed with mineral oil.

IMPORTANT: Avoid extremes of temperature in storage. Store Envirotemp FR3 fluid in labeled, tightly closed containers at 10-40° C (50-104° F) in dry, isolated and well-ventilated areas, away from sources of ignition or heat.

Storage

Drums and totes of Envirotemp FR3 fluid are sealed at the factory to protect against foreign material and moisture contamination during shipping. Tamper-resistant seals verify that the container has not been opened. Cargill recommends storing drum and totes indoors, in a dry location, out of direct sunlight, and with ambient temperature above 10° C. If long-term outside storage cannot be avoided, drums stored horizontally with the bungs of the drum below fluid level is acceptable. Containers must be placed in protected areas to avoid exposure to sun and rain.

Totes are designed to be stacked during storage. However, totes are not designed to, and should not be stacked during transportation.

For drum and tote storage, drip pans or basins are always recommended, and may be required by local codes. Please refer to your local authority having jurisdiction for definitive rulings.

IMPORTANT: Prolonged low temperature storage will cause the viscosity of Envirotemp FR3 fluid to significantly increase. Warm fluid to >10° C for efficient transfer by pump.

Heating

In the event the drums and totes have been stored in a very cold environment, or it is necessary to use cold Envirotemp FR3 fluid as soon as it is received, heating the containers may be necessary to reduce viscosity. If heating in a short period of time is necessary, heating ovens can be used. Cargill recommends opening the vent to provide pressure relief during heating cycle. For drums, electric drum heaters may be used.

CAUTION: A drum bung or tote cap must be loosened prior to heating to relieve internal drum and tote pressures. Immersion heaters or open flame heaters are not recommended.

Fluid Removal from Containers

Pumps with a positive suction capability are recommended to remove Envirotemp FR3 fluid from drums and totes. Positive displacement pumps, diaphragm, or air-operated drum pumps are satisfactory. Centrifugal pumps will prove satisfactory if the fluid is heated to obtain a suitable viscosity. This temperature will vary with the size and brand of pump. Contact your pump supplier to make sure that a centrifugal pump is correctly sized for a given viscosity (temperature) of fluid.

Totes have drain valves that permit gravity feed. The totes accept forklifts from 4 sides, and may be raised to a desired height with suitable forklifts. Gravity feed from drums can be done when properly rigged.

TANK TRUCK UNLOADING

Inspection

The receiving inspection of Envirotemp FR3 fluid is done similarly to inspection of conventional transformer oil. Inspection and testing should be completed prior to unloading. Refer to the Receiving Tests section and Table 1 for recommended tests and acceptance values.

If the as-received Envirotemp FR3 fluid does not meet the acceptance specifications, contact your supplier immediately.

Unloading Envirotemp™ FR3™ fluid

When received in bulk, Envirotemp FR3 fluid can be unloaded using a pump or gravity feed. Particle filtration is recommended during the process of unloading into bulk storage.

Hoses and Fittings

The unloading hose should be a quality oil resistant hose designed for suction service. The hose length should be kept to a minimum. Dedicated hoses are recommended for use with Envirotemp FR3 fluid to minimize the possibility of contamination. Hoses previously used for electrical grade mineral oil can be used for Envirotemp FR3 fluid if first flushed with Envirotemp FR3 fluid. The minimum recommended hose size is 3 inch (7.62 cm) in internal diameter. Hose fittings should be aluminum or brass, and firmly attached to the hose. Drybreak type quick connector fittings are recommended to reduce spillage and contamination of Envirotemp FR3 fluid. Dust caps and plugs should be used whenever the hoses are not being used.

If the viscosity of cold fluid hampers unloading, hoses and transfer lines should be heat traced.

BULK STORAGE SYSTEMS

Location

The location and type of storage tanks will depend on the user's physical plant arrangement. Tanks located indoors are ideal. An indoor location may reduce the need for heating the fluid to maintain proper pumping and filtering temperatures. Tanks located outdoors where ambient temperatures fall below 10° C may require insulation and heaters to warm the fluid. Tanks placed underground should be below the frost line to minimize the effect of winter temperatures. For new underground installations, a thermal insulating backfill should be considered to reduce heat loss.

Storage Temperatures

Envirotemp FR3 fluid can be pumped directly from either indoor or outdoor storage tanks. If suction line lengths or suction lifts are excessive, heating fluid will reduce the viscosity and ease pumping. The temperature of Envirotemp FR3 fluid shall be above 10° C for pumping.

Recommended types of heating systems are:

- Indirect heating, such as a steam-jacketed storage tank, is preferred. The watt-density of the heating systems should be 12 W/in² (1.86 joules/cm²) or less.
- A circulating pump and in-line heater having a watt density of 12 W/in² (1.86 joules/cm²) or less can be attached to a storage tank to maintain temperatures of 38° C (100° F) or higher. (A 20 GPM [76 liters] pump with a 10 kW heater will maintain a temperature of 43° C (110° F) in a 5,000 gallon (approx. 19,000 liters) storage tank if heat losses to the environment are not excessive).
- Do not use immersion heaters.

For cold weather pumping outdoors, pipes should be heated with either steam coils or electric resistance tracing. A means for keeping the Envirotemp FR3 fluid above 10° C is needed for ease of handling. In addition, the tank and piping should be insulated for low ambient temperatures in order to minimize heating costs.

Storage Tanks

Standard steel storage tanks such as those used for conventional transformer oil are satisfactory. All tanks should conform to local codes and standards. New tanks are preferred, and should have at least one manhole. Before use, the inside of the tanks should be sandblasted and primed with a coating that is compatible with seed oils.

Existing storage tanks used for conventional transformer oil can be used for Envirotemp FR3 fluid if the following conditions are met:

- The tank is of proper capacity and the lines for filling and suction are adequate.
- The tank is thoroughly cleaned and inspected closely to insure suitable condition.

Do not use free breathing tanks. Use a dry nitrogen headspace in the storage tank. Do not vent to atmosphere.

Pumps



CAUTION: As with other dielectric fluids, flowing Envirotemp FR3 fluid can produce a significant high voltage static charge during pumping operations. We recommend that all equipment, winding leads, containers, and piping be grounded both during pumping and for one hour after fluid flow has stopped.

Capacity

Envirotemp FR3 fluid is more viscous than conventional mineral oil. Select the proper pump size based on the required flow rate, head pressure, and fluid temperature (viscosity). (See Figure 2.) Determine the maximum flow rate required. Select a pump and motor for use at the lowest temperature (highest viscosity) that will be encountered.

Type

Positive-displacement pumps are commonly used to pump Envirotemp FR3 fluid. A standard iron pump with either a mechanical seal or stuffing box is satisfactory. When specifying the correct size pump and motor, the pump supplier should be made aware of the viscosity, pumping rate required, suction lift, and discharge head. For capacities up to 76 LPM (20 GPM), direct driven pumps have proved to be satisfactory. For higher pumping rates, a reduction gear or belt driven pump may be required. Other pump types used successfully are the air-operated diaphragm pump, progressive cavity pump, and flexible impeller pump.

Horsepower

If pumps used for conventional transformer oil are used in an Envirotemp FR3 fluid system, it is necessary to check the motor horsepower to make sure it has sufficient capacity. Many times, the existing pump will be entirely satisfactory, or may be made satisfactory by a change in the motor horsepower or using a slower pump speed.

NOTE: If a larger motor is used, ensure that the pump and drive coupling will withstand the increased horsepower. If a change to a lower RPM is made, ensure that the required pumping rate will be obtained at the lower RPM.

PIPE, VALVES, AND FITTINGS

Pipe

All piping, valves, and fittings should be properly labeled to avoid cross-contamination and to comply with applicable OSHA guidelines. As a general rule, all piping, two inches and larger, should be welded with flanged connections.

Piping with screw-type fittings should be standard schedule 40 black iron with forged fittings. Teflon tape should be used to seal fittings.

All new piping should be flushed with either hot Envirotemp FR3 fluid or hot standard conventional transformer oil before use in order to remove any dirt or mill scale in the pipe.

Valves

Valves suitable for use with conventional transformer oil have been successfully used with Envirotemp FR3 fluid.

NOTE: A vacuum degassing and dehydration system requires temperatures of 60-82° C (140-180° F). Be sure to select components compatible with the fluid and process temperatures. Consult with the component manufacturer for the proper selection.

ACCESSORIES

Accessories such as pressure gauges, thermometers, and flow switches should be compatible with vegetable (soy) oil and process temperatures.

Gaskets and packing compatible with vegetable (soy) oil should be used. Buna-N and nitrile seals will be satisfactory to about 100° C (212° F). For extended service at higher temperatures, fluorocarbon-based seals such as Viton® seals are recommended.

FILTERS

Types

Most types of filters used for conventional transformer oil service can be used with Envirotemp FR3 fluid. The cartridge-type filter is best suited for this service. It is offered in various micron ranges and sizes for either low or high flow rates.

Adsorption filters such as activated clay (Fuller's earth) can be used, up to process temperatures of 75-80 C. Higher process temperatures may remove the additives. Contact Cooper Power Systems for advice on reclaiming aged Envirotemp FR3 fluid.

Flow Rate

If filters sized for conventional transformer oil are used, flow rates may decrease due to the higher viscosity of Envirotemp FR3 fluid. Heating the fluid decreases its viscosity. Consult Figure 3 to determine the temperature

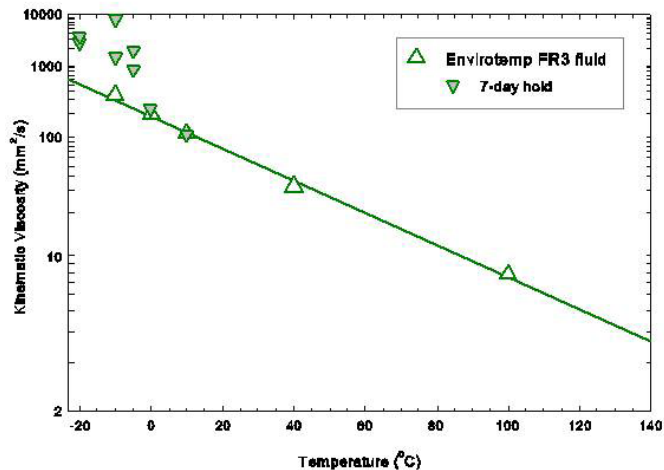


Figure 3. Kinematic viscosity of Envirotemp™ FR3™ Fluid as measured using ASTM D-445.

Degree of Filtration

For maximum dielectric strength, filter Envirotemp FR3 fluid just prior to introduction into the electrical apparatus. A particulate filter with a nominal pore size of 0.5 microns is recommended.

Moisture Removal Filters

Envirotemp FR3 fluid can tolerate much more water than conventional mineral oil before compromising its electrical characteristics.

If moisture content of Envirotemp FR3 fluid increases above acceptable limits, additional treatment is required. Moisture can present itself in two forms in the oil: free water and dissolved moisture.

Free Water Removal

- If the moisture is in the form of free water, filter units such as the AMF CUNO Zeta-Plus® and HILCO® blotter paper cartridge filters can be used effectively. Desiccant packaged filter cartridges should be specified to ensure dryness of the filter media
- Free water can also be removed by raising the temperature of the bulk fluid to 105° C (220° F). Agitation of the fluid will speed this process. A dry nitrogen gas atmosphere is recommended for this process. See dissolved moisture reduction for additional requirements.

Dissolved Moisture Reduction

- If the dissolved moisture content must be lowered, a high vacuum dehydration system may be required. An advantage of vacuum dehydration is that dissolved gases are also removed. (See the Vacuum Filling in the Electrical Equipment Filling section).
- Molecular sieve filters are also satisfactory if the quantity of moisture to be removed is not excessive. Activated grade 3A or 4A molecular sieves are recommended for moisture removal from Envirotemp FR3 fluid, and are effective over a broad temperature range, provided adequate care is taken in filter selection to ensure sufficient residence time in the filter.

Moisture removal filters should be located upstream of the final particulate filter in the fluid handling system.

HEATERS

Types

Indirect heaters such as steam jackets are recommended. Electric in-line heaters may be used for heating Envirotemp FR3 fluid, provided sufficient fluid flow is present.

Use a heater with a watt density rating of 12 watts (1.86 joules) per square inch or less. Immersion heaters are not recommended.

Controls

All heating systems should have a reliable temperature controller. When multiple heaters are used in parallel, a stepping type controller is recommended.

Each heater should also have a high temperature shut-off thermostat set at a maximum of 115° C (240° F). In systems where a heater is fed by a pump, a flow interlock must be installed in the heater outlet piping. The heaters must be de-energized when fluid flow is inadequate to prevent potential localized overheating of the fluid.

A time delay on the pump shut-off is recommended to de-energize the heaters prior to stopping the circulating pump.

ELECTRICAL EQUIPMENT FILLING

Vacuum Filling

When possible, fill the tank with hot degassed fluid at a rate that maintains the required (partial) vacuum. If foaming occurs when filling under vacuum conditions, degas the Envirotemp FR3 fluid.

Degassing should be carried out at 80° C (175° F), and at as low a pressure as practical, typically less than 100 Pa prior to introduction into the equipment. Degassing and dehydration units are available for processing oils to acceptable levels of dissolved moisture and dissolved air.

After Envirotemp FR3 fluid is degassed, it should be introduced directly into the tank under vacuum. If this is not possible, a storage tank that can be maintained under a vacuum at least equal to, or greater than, the vacuum maintained in the transformer, is recommended. Otherwise, the Envirotemp FR3 fluid may absorb gases and foam during filling.

Dedicated equipment is recommended for processing Envirotemp FR3 fluid. However, if existing equipment is used for both mineral oil and Envirotemp FR3 fluid, it should be drained of mineral oil and flushed with Envirotemp FR3 fluid to minimize mineral oil content. After processing Envirotemp FR3 fluid, the equipment should be drained and flushed with mineral oil.

Atmospheric Filling

Vacuum filling, even with only a partial vacuum, is preferable to atmospheric filling. When filling units with Envirotemp FR3 fluid at atmospheric pressure, heating and filtering the fluid are strongly recommended to maximize performance. Fluid temperatures during tank filling operations at atmospheric pressure should be 75°-80° C (165°-175° F).

Use a dry nitrogen blanket during tank draining and filling operations.

If a new transformer must be filled under atmospheric conditions, heat both the transformer and the Envirotemp FR3 fluid to 100° C to promote more complete impregnation. The impregnation rate is much slower than mineral oil. Higher voltage rated units will require longer impregnation times. The thicker the pressboard, the longer the impregnation time required.

When retrofitting transformers under atmospheric conditions, Envirotemp FR3 fluid should be filtered and heated to 75°-80° C (165°-175° F).

NOTE: Insure no residual Envirotemp FR3 fluid is on the surface of insulators after filling the equipment. Wipe the insulators with a suitable cleaner.

POWER FACTOR MEASUREMENTS

Transformer power factor measurements using Envirotemp FR3 fluid typically are higher than the same insulation assembly using mineral oil. The change depends on the percentage of fluid in the insulation space being measured and the condition of the insulating fluids. For power transformers, a mineral oil-impregnated insulation assembly retrofilled with Envirotemp FR3 fluid will typically have a power factor of about twice the percentage power factor measured with mineral oil if the fluid occupies a high percentage of the insulation clearance spacing being measured.

Maximum power factor limits used for mineral oil units should typically be doubled for transformers containing Envirotemp FR3 fluid.

DRYING IMPREGNATED INSULATION

Drying impregnated insulation by exposure to hot Envirotemp FR3 fluid, kerosene vapors, or nitrogen is acceptable.

Hot Envirotemp FR3 fluid dryout of insulation impregnated with Envirotemp FR3 fluid:

- Lower the fluid level well below the radiator inlet, but above all current carrying parts, to disable radiator cooling.
- Seal the tank with a nitrogen atmosphere over the fluid. Use a pressure relief device to protect against over-pressure.
- Heat the transformer until the top fluid temperature is about 110° C by means of a fluid heater or by using the heat run power supply.
- Using a nitrogen backfill, drain the fluid from the tank. Place the tank under vacuum to dry the insulation. Do not exceed the vacuum rating of the tank. Cold traps (water vapor condenser) will make the system more effective.
- Vacuum fill with dry Envirotemp FR3 fluid or break vacuum with dry nitrogen if the unit must be stored prior to vacuum filling.

Repeat as needed to obtain the required insulation dryness. Vapor phase drying of Envirotemp FR3 fluid impregnated assemblies can be used. Remove the residual Envirotemp FR3 fluid from the vapor condensation



IMPORTANT: Unlike assemblies impregnated with mineral oil, hot air drying is an unacceptable process for reducing power factor of assemblies already impregnated with a natural ester fluid. For additional drying of natural ester impregnated assemblies, a method of drying that does not expose the impregnated insulation to air is required to avoid polymerization of the dielectric fluid. See page 7, Reprocessing Impregnated Insulation section in Power Factor Measurements for recommended procedures.

chamber. The user is responsible for developing a procedure compatible with their manufacturing or repair process.

TRANSFORMER RETROFILL

If it is necessary to drain and refill the transformer, take special care to store Envirotemp FR3 fluid in appropriate sealed containers, with a nitrogen headspace to minimize moisture ingress or other contamination. Except for short storage periods, material that has been immersed in Envirotemp FR3 fluid should not be exposed to air. Thin films of natural esters tend to polymerize much faster than conventional transformer oil. See recommendations in Transformer Filling section above, or refer to Cargill Bulletin R2040, "Power Class Transformer Retrofill Guide > 7500KVA" and R2010, "Distribution Transformer Retrofill Guide ≤ 7500KVA".

CLEANING PROCEDURES

A thin film of Envirotemp FR3 fluid will polymerize over time making it increasingly more difficult to clean. The extent of polymerization depends on air exposure time, temperature and UV or sunlight. For example, the extent of polymerization of a thin film of Envirotemp FR3 fluid after 1 day at 38.8° C (100° F) in air is minimal, while after 7 days it would be partially polymerized and tacky to the touch. Exposure of a thin film of Envirotemp FR3 fluid to 93.3° C (200° F) in air for 5 days would result in polymerization to a dry state.

Cleanup of Envirotemp FR3 fluid on surfaces is most effective when the Envirotemp FR3 fluid spills and drips are fresh. S-34™ aqueous cleaner has been found to be effective. Apply cleaner with a pump spray or cloth, followed by hand wiping with a clean cloth and/or spray washing. Refer to the S-34 cleaner Material Safety Data Sheet.

For more information on S-34 cleaner, contact Ecolink, Inc.
1481 Rock Mtn Blvd., Stone Mountain, GA 30083,
800-886-8240, www.ecolink.com



CAUTION: Unlike assemblies impregnated with mineral oil, hot air drying is an unacceptable process for reducing power factor of assemblies already impregnated with a natural ester fluid. For impregnated assemblies that require additional drying to reduce power factor, a method of drying that does not expose the impregnated insulation to air is required to avoid polymerization of the dielectric fluid. See the Impregnated Insulation section in Electrical Equipment Filling for recommended procedures.

For partially polymerized (sticky) Envirotemp FR3 fluid, apply S-34 cleaner with a pump spray and allow a 15 minute soak time at 70° F, followed by hand wiping with a clean cloth using moderate rubbing. Multiple applications may be necessary depending upon the extent of polymerization of the Envirotemp FR3 fluid. Use shorter soak time at higher temperatures and longer soak time at lower temperatures.

For larger spills on impervious surfaces, wet down the area, apply powder based #15 Economy Floor Cleaner™. Let sit for 15 minutes, wash down using hot water.

For Envirotemp FR3 fluid polymerized to semi-hard or hard consistency, scraping, light sanding or paint touch-up may be required in addition to vigorous scrubbing. Users should consult with their company's policy regarding the use of personal protective equipment.