

Dielectric Fluids

Service Information

Envirotemp® FR3™ Fluid Storage and Handling

S900-20-1

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CAUTION: This guide neither claims to cover all variations in use, nor provides for every possible contingency in connection with storage, handling, application, or maintenance. It is the responsibility of the user to ensure that specific components, processes or treatments are suitable for Envirotemp FR3 fluid. Contact Cooper Power Systems for further information.

GENERAL

Envirotemp® FR3™ fluid is a biodegradable, fire resistant, natural ester (vegetable oil) dielectric coolant. It was developed to deliver high margins of fire and environmental safety. It is miscible and compatible with conventional transformer oil. Envirotemp FR3 fluid can be used in many applications where its unique performance, environmental, and safety properties are an advantage.

PRECAUTIONS

Fire Point

Mineral oil content greater than 7% in Envirotemp FR3 fluid can reduce the fire point of the mixture to below 300°C (572°F). Note that for retrofill transformers, the mineral oil impregnated in the insulation will leach out over time and add to the total mineral oil content.

Static Charge

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.

Air Exposure

To maintain the optimal fluid properties for its intended use as an electrical insulating fluid, exposure to oxygen, moisture, and other contaminants must be minimized. Except for short storage periods, material that has been immersed in Envirotemp FR3 fluid should not be



Figure 1. Prior to shipment, Envirotemp FR3 Fluid undergoes extensive quality assurance testing. The facility where Envirotemp FR3 Fluid is produced is ISO 9001 Certified.

exposed to air. Thin films of natural esters tend to polymerize much faster than conventional transformer oil. For equipment drained of Envirotemp FR3 fluid, it is recommended that the equipment be placed in an inert gas environment or be re-immersed as soon as is practical.

Processing Assemblies Impregnated with FR3 Fluid

Unlike assemblies impregnated with mineral oil, hot air drying is an unacceptable process for assemblies already impregnated with a natural ester fluid. For impregnated assemblies that require additional drying, 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.

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 Cooper Power Systems sales engineer.



SAFETY FOR LIFE



Cooper Power Systems 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 Cooper Power Systems employees involved in product design, manufacture, marketing and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high-voltage lines and equipment and support our “Safety For Life” mission.

SAFETY INFORMATION


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.

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.


Caution: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.


Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

 **DANGER:** Hazardous voltage. Contact with high voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.

 **WARNING:** Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.

 **WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply may result in death, severe personal injury and equipment damage.

 **WARNING:** Power distribution equipment must be selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain this equipment can result in death, severe personal injury, and equipment damage.

Low Temperature Storage

Prolonged storage at $\leq -15^{\circ}\text{C}$ (5°F) will cause the FR3 fluid to gel. Warm to temperature required for efficient transfer by pump.

Material Compatibility

Envirotemp FR3 fluid is compatible with most materials used in conjunction with conventional electrical grade mineral oil. Compatibility should be verified for each new application.

Component Functionality

Although Envirotemp FR3 fluid is functional with most operational components used in conjunction with transformers and other equipment using conventional electrical grade mineral oil, component functionality should be verified for each application. For example, some internal loadbreak switches may not necessarily match the ratings published for the device tested in mineral oil, particularly at low temperatures.

Mineral Oil Contamination

Equipment used for both mineral oil and Envirotemp FR3 fluid should be drained of mineral oil and flushed with Envirotemp FR3 fluid prior to filling with Envirotemp FR3 fluid. The equipment should be drained and flushed with mineral oil afterwards.

Cold Temperature Handling

For cold weather pumping outdoors, pipes should be heated with either steam coils or electric resistance tracing. A means for keeping the FR3 fluid above 10°C is needed for ease of handling.

Laboratory Testing

Although testing of Envirotemp FR3 fluid is done in much the same way as mineral oil, a few minor modifications to several 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 Cooper Power Systems for detailed test recommendations.

RECEIVING

Inspection

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

Receiving Tests

Samples should be taken from containers per ASTM D-923, as follows:

- The number of shipping containers sampled should equal at least ten percent of the number of containers received.
- The sampled containers should be chosen randomly.
- If the shipment contains drums from more than one lot, the sample should represent different lots of Envirotemp FR3 fluid. (See the drum label for the lot number of the fluid).

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.

CONTAINER HANDLING

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.

When storing drums and totes of Envirotemp FR3 fluid for long periods, it is good practice to store them in a dry, heated building. If long-term outside storage cannot be avoided, drums should be stored horizontally with the bungs of the drum below the fluid level. Drums and totes should be placed in protected areas to avoid exposure to sun and rain.

Drip pans or basins are always recommended for drum and tote storage, unless the containers are located in area that provides containment

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. For drums, electric drum heaters may be used when time permits.

TABLE 1
Envirotemp® FR3™ Fluid Recommended Acceptance Limits

| Property | ASTM Method | New Fluid as Received | Continued Use of Service Aged Fluid | | |
|--------------------------------------|---------------|-----------------------|-------------------------------------|-----------------|---------------|
| | | | ≤ 69 kV | $>69 - <230$ kV | ≥ 230 kV |
| Dielectric Strength, 2 mm gap (kV) | D1816 | ≥ 40 | 40 | 47 | 50 |
| Dissipation Factor (%) | D924 | ≤ 0.20 | — | — | — |
| | | ≤ 4.0 | — | — | — |
| Neutralization (Acid) No. (mg KOH/g) | D974 | ≤ 0.06 | — | — | — |
| Flash Point ($^{\circ}\text{C}$) | D92 | ≥ 300 | — | — | — |
| Fire Point ($^{\circ}\text{C}$) | D92 | ≥ 340 | 300 | 300 | 300 |
| Viscosity (cSt) | D445 | ≤ 10 | — | — | — |
| | | ≤ 40 | — | — | — |
| Pour Point ($^{\circ}\text{C}$) | D97 D5950* | ≤ -18 | — | — | — |
| | | ≤ -18 | — | — | — |
| Water Content (mg/kg) | D1533B | ≤ 200 | 300 | 150 | 100 |

* Method not yet approved in ASTM D6871 Standard Specification for Natural Ester Fluid



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 ways, and may be raised to a suitable height with a fork truck. 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. In lieu of testing, the product should be visually examined. Draw a sample in a clean, clear, dry glass jar. Check the sample for clarity, color, odor, and viscosity relative to a clean sample known to be Envirotemp FR3 fluid.

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 FR3 fluid. The minimum recommended hose size is 3" ID. Hose fittings should be aluminum or brass, and firmly attached to the hose. Dry-break 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

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

Location

The location and type of storage tank will depend on the user's physical plant arrangement.

A tank located indoors is ideal. Vertical tanks offer the largest volume per square foot of floor space and the greatest ease of draining and cleaning. An indoor location reduces 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 heaters to warm the fluid. Tanks placed underground should be below the frost line to minimize the effect of winter temperatures. For new 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 or less.
- A circulating pump and in-line heater having a watt-density of 12 W/in² or less can be attached to a storage tank to maintain temperatures of 38° C (100° F) or higher. (A 20 GPM pump with a 10 kW heater will maintain a temperature of 43° C (110° F) in a 5,000 gallon storage tank if heat losses to the environment are not excessive).
- Do not use immersion heaters.

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 vegetable 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.

Headspace

Use a dry nitrogen headspace in the storage tank. Do not vent to atmosphere.

Pumps

CAPACITY

The viscosity of Envirotemp FR3 fluid is higher than conventional transformer oil. Select the proper pump size based on the required flow rate, head pressure, and fluid temperature (viscosity). 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 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 inch 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 140-180° F (60-82° C). 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 oils and process temperatures.

Gaskets and packing compatible with vegetable oils should be used. Buna-N and nitrile seals will be satisfactory to about 100° C (212° F). For extended service at higher temperatures, Viton or fluorocarbon-based 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, but, depending on process temperatures, additives may be removed. 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 2 to determine the temperature needed to obtain the desired viscosity.

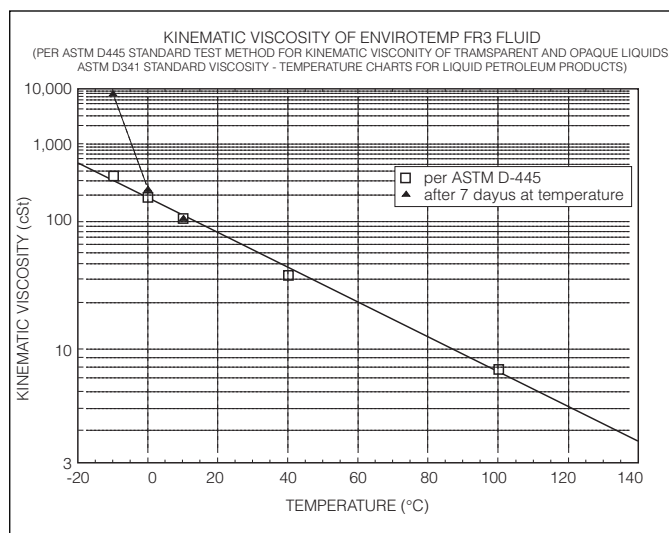


Figure 2.
Kinematic viscosity of Envirotemp FR3 Fluid as measured using ASTM D-445.

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.

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 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

A common practice is to fill new equipment from the bottom and in-service equipment from the top of the tank.

VACUUM FILLING

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

Degassing should be carried out at a temperature higher than that required for conventional transformer oil. The processing temperature should be at least 80° C (175° F) at as low a pressure as practical. This promotes complete degassing and dehydration of Envirotemp FR3 fluid 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 exhibit excessive foaming during filling, depending on the amount of air and moisture dissolved in the fluid.

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 in the range of 80-95° C (175-200° F).

Fill the tank from the bottom at a rate slow enough to prevent trapped pockets of air. The filling rate should be limited to a few inches per minute.

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 about 100° C to promote more complete impregnation. For example, a 25 kW in-line heater will allow a fill rate of about 1 1/2 GPM at about 100° C. A relatively long period of time should be allowed for the transformer insulation to impregnate and cool. The impregnation rate is slower than mineral oil and similar to the rate of impregnation for R-Temp fluid. Higher voltage rated units will require longer impregnation times. The thicker the pressboard, the longer the impregnation time.

When retrofitting transformers under atmospheric conditions, Envirotemp FR3 fluid should be filtered and heated to at least 65° C (150°F). For example, a 12 kW in-line heater will allow a fill rate of about 1 1/2 GPM at 65° C. Setting times of one hour per kV rating of the high voltage winding have been used successfully.

The external surfaces be cleaned of any films of Envirotemp FR3 fluid as it occurs to facilitate the process.

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

Power factor measurements on transformers using Envirotemp FR3 fluid typically is 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.

Reprocessing 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 levels 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 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 provided that Envirotemp FR3 fluid is acceptable for use in the vapor phase system. Remove the residual Envirotemp FR3 fluid from the vapor condensation chamber. The user is responsible for developing a procedure compatible with their manufacturing or repair process.



Caution: Processing methods subjecting insulation impregnated with Envirotemp FR3 fluid to hot air are not acceptable.

TRANSFORMER MAINTENANCE

Periodic maintenance tests should be performed on the same schedule as would be used for conventional mineral oil transformers in a similar application. The same type of sampling techniques should be used, and liquid samples should be collected from the sampling valve located on the main drain valve near the bottom of the transformer. Basic recommended tests for

Envirotemp FR3 fluid-filled transformers are dielectric breakdown strength, water content, and fire point.

Avoid leaving the tank expansion space open to the atmosphere for longer than necessary while doing maintenance. If possible, fill the tank expansion space with dry nitrogen when the maintenance is completed.

Dielectric Strength

An Envirotemp FR3 fluid dielectric strength below 30 kV (ASTM D1816, 2 mm gap) is an indication of excessive contamination. In this case, the Envirotemp FR3 fluid should be processed to restore it to good electrical condition or replaced.

Flash and Fire Points

Small percentages of conventional transformer oil or other low fire point contaminants will reduce the flash point and may reduce the fire point of Envirotemp FR3 fluid. The fire point can fall below 300° C if the content of conventional transformer oil goes above 7 percent. If contamination is suspected, the fire point should be measured in accordance with ASTM D92. A fire point below 300° C indicates substantial contamination by a lower fire point material.

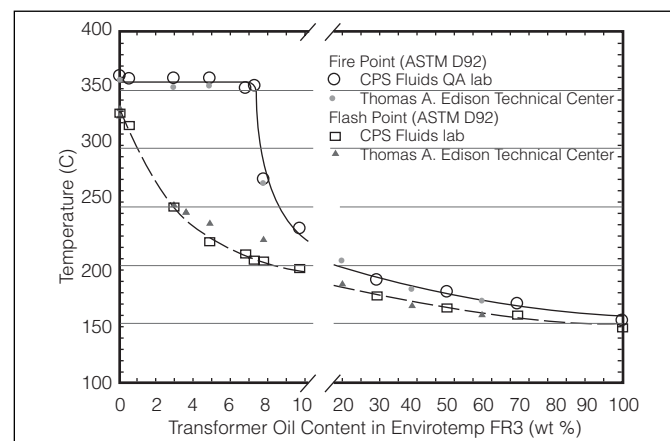


Figure 3
Flash and fire points of mixtures of Envirotemp FR3 fluid and conventional mineral oil as a function of mineral oil content.

Drain and Refill

If it is necessary to drain and refill the transformer, take special care to avoid trapping gas bubbles in the system. Someone skilled in completing this process using the proper equipment should do the work. Allow sufficient time between refilling and energizing the transformer to dissipate gas bubbles created during the process. See recommendations in Transformer Filling section above, or refer to CPS Bulletin S900-20-2, "Recommended Retrofill Procedures for the Replacement of Oil with Envirotemp FR3 fluid".

Cleaning Procedures

Cleanup of Envirotemp FR3 fluid on surfaces is most effective when the Envirotemp FR3 fluid spills and drips are fresh. S-34™ aqueous cleaner [1] 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 information on the chemical content, safety, environmental and health hazards.

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 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 200°F in air for 5 days would result in polymerization to a dry state.

For partially polymerized 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 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. User should consult with their company's policy regarding the use of personal protective equipment.

[1] Ecolink, Inc., 1481 Rock Mtn. Blvd., Stone Mountain, GA 30083, 800-886-8240, www.ecolink.com

