YOUR "ASKAREL" TRANSFORMER SHOULD BE



care and grooming of ASKAREL TRANSFORMER fluid

Monsanto

. . . to help you be sure your Askarel liquid insulation is tip-top and to keep it in the best of operating health

your



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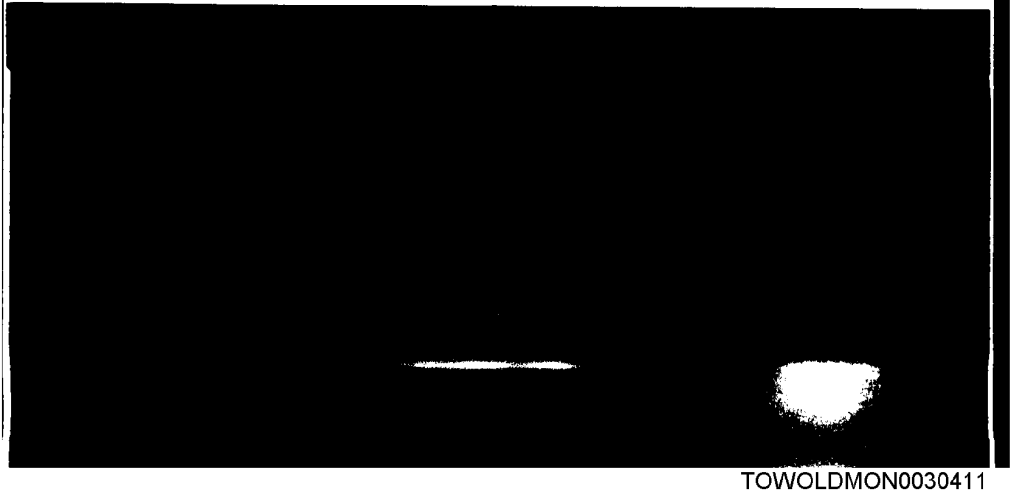

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FAR AS EQUIPMENT CAN BE!)

)est friend!

Since "askarel" type transformers were first made in 1930, few pieces of electrical equipment have equalled these "juice controllers" in trouble-free service. The name "askarel" applies to the liquid insulation that fills askarel type transformers. And "askarel" is a general name for a unique kind of chemical classified as a halogenated hydrocarbon. But, don't let this chemical jargon bother you one bit. After you read this little pamphlet, you'll be an EXPERT on operating askarel transformers; you'll know all about this wonderful liquid askarel insulation because it's all very simple.

however!

Since many engineers and maintenance operators work with BOTH askarel and transformer "oils," you will want to remember that askarel is *different* from mineral oil . . . and you'll want to know the simple ways to "check up" on the health of your askarel transformer.

That's the reason for this pamphlet. First, to tell you that your askarel transformer, in addition to being FIRESAFE, can be the most trouble-free piece of equipment you operate. Second, to give you the few simple facts that will make you an expert on the "whys" and "wherefores" of the easy maintenance. Knowing the facts given on the following pages, you will keep your askarel (and transformer) operating at trouble-free, top performance, year, after year, after year.*

***We own one that has been operating as faithfully as a heart beat for 28 years!**

Monsanto also supplies:

Pydraul AC	All synthetic fire-resistant compressor lubricant.
Pydraul	All synthetic fire-resistant hydraulic fluids.
Thermal Fluid	Fire resistant, non-vaporizing heat transfer fluid.
Coolanol	Dielectric coolants for high power electronic circuits.
Fluid OS-59	Dielectric for high frequency power transformers.

Monsanto

MONSANTO CHEMICAL COMPANY
Aviation and Special Fluids Department
Organic Chemicals Division
St. Louis 66, Missouri

Askarel transformer fluids can be ordered directly from any one of these Monsanto sales service centers

Atlanta
Boston
Chicago
Cincinnati
Cleveland
Detroit
Houston
Los Angeles
Minneapolis
New York
Pittsburgh
St. Louis
San Francisco
Seattle
Syracuse
Wilmington

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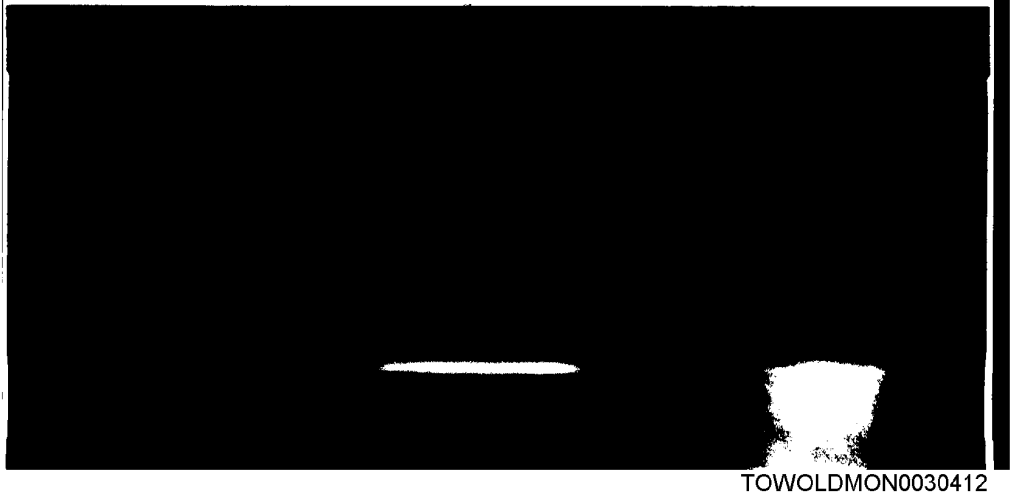

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LET'S TALK ABOUT THE "liquid insulation" IN TRANSFORMERS

OILS — *that can burn*

There are quite a number of these. They are sold by oil companies; and these mineral oils are used in transformers where, if they catch fire, no great harm (besides the transformer itself) comes from the burning oil. If water gets into an oil-filled transformer, it tends to settle through the oil to the bottom. There are certain ways to check on the health of mineral oil insulation, too, but the "Check-points" are somewhat different than for askarel.

ASKARELS — *that cannot burn*

Although there are TWO *types* of askarel fluids (supplied under a number of brand names), actually they all have just one and the same basic ingredient: Monsanto's Aroclor* 1260. (If you want to know, Aroclor 1260 is hexachlorobiphenyl). And THIS is one of the world's best liquid insulations!

don't worry about "different kinds"

So, what are the two types? What's the difference? Simply this: they have different pour points — and — the tiny amount of "scavenger" chemical added to each is different. The Pyranol 1470 (General Electric) type has the lower pour point; it will still pour at 47° below (F.) zero. The Inerteen PPO (Westinghouse) type will pour down to 26° below (F.) zero. These two types each contain a tiny amount of a different additive; both additives are good and do their job. However, the additive in Pyranol type askarel can crystallize out a bit at 14° above (F.) zero. It does no harm; the crystals disappear after a while when the transformer warms up.

Other brand names, like Chlorextol (Allis Chalmers); Nattamol (Wagner Electric); Asbestol (American Corp.); Saf-T-Kuhl (Kuhlman Electric) — are either one type or the other. Some manufacturers simply call their fluid by the common descriptive name: askarel. But, transformer manufacturers who supply askarel fluids have sound reasons for favoring their own type. So, it's best to stay with your particular brand.

However, since basically askarel is askarel, there will be no difference in the operation of your transformer if IN EMERGENCY you would interchange or even mix the two types!

But askarel is NOT oil — cannot, should not, must not be mixed with ordinary transformer oil. For one reason: the inside core materials used with mineral oil filled units get gooey with askarel. For another reason — over 2% of mineral oil mixed into askarel "cribbers" its fire resistance. For another reason — never mind! Don't *mix* or *interchange askarel* and *oil*.

"Askarel" liquid insulation is a very carefully-manufactured, highly pure, chemically made fluid. It does not vary in composition like the range of oils. AND . . . askarel is *heavier* than water. If water gets into askarel insulation, only a smidgeon (125 ppm) dissolves the rest *floats on top*.

Askarel is one of the most fire-resistant, chemically-inert, heat-stable liquids ever developed! You can be sure of this: askarel does not deteriorate when exposed to air, heat, hot metal; it does not break down over long use to form conducting or corrosive chemicals; it does not sludge or oxidize. Askarel will remain perfectly stable year after year after year unless broken down by exposure to severe arcing — the kind that could set an oil transformer afire. The only real "enemy" of askarel is: contamination by water.

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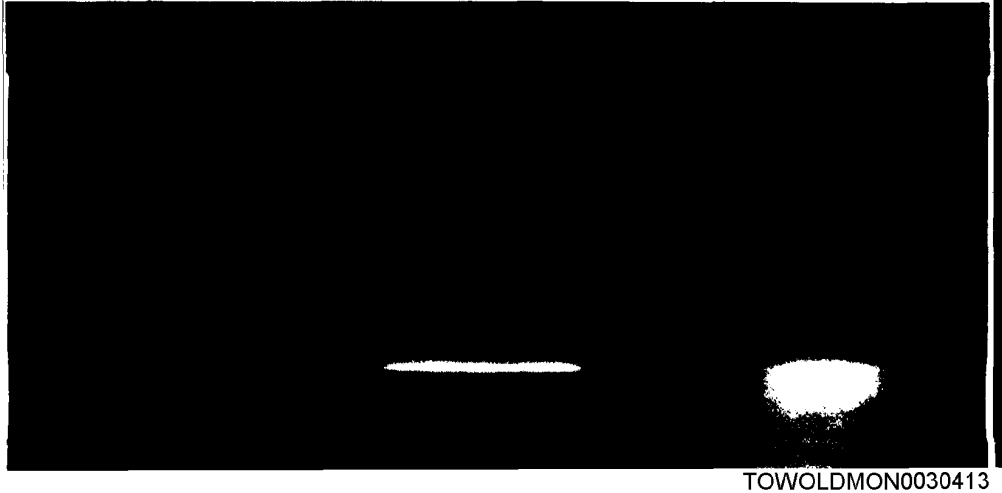

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NOW LET'S TALK

year to year operation!

One of the most brain-y electrical engineers in the business once said: "The best 'maintenance' for askarel transformers is KEEP 'EM DRY, and leave them alone!"

This business of "keep 'em dry," however, whether your transformer is EITHER an oil-type or an askarel type, is the watchword! It takes some care. In fact, anything MECHANICALLY you can do to stop moist air breathing and condensation will be the best health insurance for your liquid filled transformer. Here are some of the questions that come up when you want to "keep 'em dry."

Is your transformer a **welded shell** or a gasket top?
(even the tightest gaskets can "breathe!")

Does your transformer run, stop; run, stop; run, stop?
(This hot-to-cold temperature cycling makes the breathing faster and harder!)

Is air around it mostly cold and dry or hot and moist?
(Wouldn't it be great for automobiles and transformers if there wasn't any such thing as condensation!)

When you have "breathing" and high humidity — you can cut back on check-ups if you fit the transformer with a drying device (all transformer makers offer these) or you can bleed dry nitrogen into the shell. Any mechanical steps you take to stop inside condensation will be double insurance on trouble-free operation.

Of course, if you are ordering a brand new transformer — either oil or askarel type — you can "design out" most of the moisture-entry points. Basically, you call for all-welded construction, including fins, pipes, and instrument connections AND a recessed gasket for the hand holes.

(If you or your electrical equipment supplier would like more complete details on tips to keep innards dry, we can send you a copy of: "Design Details For Moisture Protection of Liquid Insulation Transformers.")

So — you'll be happy to learn that preventing moisture contamination is the only major health insurance you need provide for your askarel insulation.

CHECKING THE CHECKPOINTS

Now you are well on your way to being an "expert." Since you know that keeping tabs on MOISTURE is the *major* checkpoint on your askarel transformer, let's ask:

How do you keep tabs on moisture?

You do this by a periodic test of the askarel's **dielectric strength.**

Do not bother to check — or if you do — do not be misled or disturbed by relatively high power factor . . . or even a drop in volume resistivity.

(If you want to know why, you can read the fine print on the following page.)

The DIELECTRIC STRENGTH of the askarel is your major clue to the "health" (i.e. dryness) of your askarel transformer. Besides taking a good look at a sample of your askarel — dielectric strength is the only "test" you need actually run!

Here's why: the dielectric strength of askarel is sensitive to moisture; *not sensitive* to other ordinary contaminants (like metal dust, salts, dirt, etc.). The dielectric strength is also hurt by severe arcing, but you'll know that arcing is the culprit if the askarel has gotten noticeably black or has particles of sooty carbon floating in it. Unless you've had severe arcing (lightning, accidental overload, back surge, etc.), the dielectric strength is your "moisture indicator."

New askarel has a minimum dielectric strength of 35 KV at 25°C.; a maximum moisture content of 30 ppm. If you check the dielectric strength periodically, find that it is rapidly decreasing — this is your "clue" to moisture pick-up, arcing, or both. When the moisture content rises to 100-120 ppm (or over) — the dielectric strength will drop to 20 KV or less. That's your clue!

INSPECT FOR WATER CONDENSATION IN THE SHELL, AND "REFINE" THE ASKAREL.

As the operator, *you* will have to judge *how often* you want to check up on your askarel insulation. Steadily running, well-sealed askarel transformers have run as long as 25 years on the initial charge of askarel — and the dielectric strength still checked out at above 30 KV. HOWEVER, if the dielectric strength drifts downward to 25-20 KV at 25°C. — then it is time to "clean-up" the liquid insulation and to get rid of any water accumulation in the shell, too.

This askarel clean up is relatively simple; the askarel need NOT be discarded. BUT MOST IMPORTANT . . . if the dielectric strength drops *rapidly* over a *short period* of time, this shows rapid pick-up of water (or arcing).

When you take your sample for check-up — *be sure* to take it carefully (so it represents the *surface*) and handle the sample properly (so it doesn't *pick up* moisture in the sampling).

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How to check test* your a



You'll be able to "take the pulse" of your askarel insulation with the following five simple rapid tests. (Three are simply "inspection-by-eye"!) You can do these check-ups yourself or have the tests run by a local transformer service shop.

1 **COLOR** (by inspection) New askarel is a clear, faint-yellow liquid. After long-term use, the color will gradually intensify to brown. Any color change, such as taking on a green, red or blue cast, indicates extraction. If you find a distinct *change in color*, the complete range of electrical characteristics should be checked to learn if the extracted color is the tell-tale for contamination.

2 **CLARITY** (by inspection) New askarel is clear and should remain clear in service. Development of turbidity or cloudiness indicates contamination from water, insulation particles, metallic dust or dirt. Cloudiness or turbidity calls for a complete analysis. The exception to this would be cloudiness in a cold sample of *PYRANOL 1476*. This type askarel contains a scavenger additive which will "come out" of solution when cold (around 15°F.) and cause white turbidity and perhaps show salt-like deposits on the transformer shell. If this is noticed, heat the askarel sample to 150-200°F. for several hours and agitate. Upon heating, the Pyranol's additive will redissolve, as it will in a warm transformer.

3 **BLACK COLOR AND SMALL CARBON PARTICLES** (by inspection) If the color of the sample is black, and especially if suspended carbon particles can be seen, this shows that the askarel has arced and should be discarded. You can also detect exposure to strong arcing *chemically*, with indicator paper. Simply dip a piece of moist blue litmus paper into the askarel. If the blue litmus turns red, there is excess acidity from arcing beyond the limit absorbed by the "scavenger" additive.

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arel insulation!

4 **DIELECTRIC STRENGTH** (by ASTM D901, D877)* The dielectric strength is the most important; and it is a simple test to make. The dielectric strength of new askarel is 35 KV at 25°C. minimum. This value should not be allowed to fall below 25-20 KV. Contaminants (which may have pronounced effect on the power factor and volume resistivity) *usually do not lower askarel's dielectric strength.* Reduced dielectric strength almost always shows exposure to strong arcing or moisture contamination.

5 **MOISTURE** The moisture content of new askarel is 30 parts per million maximum. The moisture *saturation* level is about 125 ppm at ordinary temperatures. When the moisture content approaches 125 ppm (saturation level), the dielectric strength goes down. The moisture content of askarel should not be allowed to rise over 70 ppm; it should be held as near as possible to 30 ppm.

NOTE: If your sample shows 30-35 KV dielectric strength, you need not check for moisture. However, if you do check moisture, use the Karl Fisher Method, ASTM D-1533.

IF ANY OF THESE FIVE CHECK-UPS APPEAR ABNORMAL, CONTACT YOUR TRANSFORMER MANUFACTURER FOR COMPLETE ANALYSIS.

These simple tests will show you the condition of your askarel insulation, but only *indirectly* the condition of your transformer. They can be relied upon when the sample is carefully taken (so as not to "miss" water globules floating on the surface or adhering to the shell in the air space over the insulation). So, if you have taken mechanical precautions against moisture entry into your askarel transformers and can "Keep 'em dry!" — these tests will be your assurance that, between checks, you can "Forget 'em."

*The American Institute of Electrical Engineers has published a comprehensive and informative guide titled "Proposed Guide for Maintenance of Transformer Askarel," A.I.E.E. No. 76, December 1958. This guide describes properties to be inspected and the ASTM method to be used.

Monsanto completely analyzes each production lot of transformer askarel by these methods prior to shipment. However, these official tests are **NOT ESSENTIAL** to the user of askarel transformers. When a complete analysis is required in a special case, the user should request it from the transformer maker, who in turn can call on Monsanto if needed.

GROOMING ASKAREL FOR RE-USE

If strong arcing has blackened askarel, throw it away; it costs less to replace arced insulation than to reclaim it. If there's been no arcing, but a low dielectric test shows moisture contamination, you'll find it is quite easy to refine the askarel back to good operating dielectric strength. Simply run the insulation through a dry, absorbent filter.

Most operators prefer a portable refining apparatus, such as a plate press, fitted with a dolly, (available from Sparkler, Mundelein, Ill.); or the earthen cartridge filter type, (available from Industrial Filter Corp., Lebanon, Ind.). Filter paper liners for the plate press are available from Carl Schleicher & Schuell Co., Keane, N.H.

Any flexible hoses and gaskets on the refining equipment should be lined with or made of materials that will not be softened by contact with askarel fluid. (Silicone or Teflon materials are suitable).

If you use a filter press, before refining it is advisable to oven dry the filter paper at 100°C. for a half hour to remove all moisture. If the askarel to be refined contains excessive moisture, circulate it hot (55-60°C.) through the filter fitted with the paper liners only first. Then, refit press with dry paper and load it with the absorbent earth.

The earth refining process is simple:

1. SPREAD DRY EARTH EVENLY OVER THE FILTER SURFACE.

Fine-mesh Attapulgus clay or Fullers earth, dried and activated by heating for 12 hours at 250°C. immediately prior to use, is highly efficient. The amount of earth used should be 0.1 to 0.2 per cent by weight of the askarel (askarel weighs about 13 pounds per gallon).

To deposit the earth evenly, stir one-third of the earth with a small portion of askarel in a clean container. Pump the mixture through the filter and follow with two more one-third portions.

2. PUMP THE HEATED ASKAREL FROM TRANSFORMER THROUGH FILTER.

Circulate askarel taken from near the top of the transformer, pass it hot (55-60°C.) through the filter and feed back through the bottom transformer outlet.

3. CONTINUE CIRCULATING THROUGH THE FILTER UNTIL ASKAREL IS CLEAR.

When the askarel is clear use the simple tests described earlier to check for restored dielectric strength.

4. CHECK THE TRANSFORMER AFTER REFINING.

After refining the askarel, the overall power factor and insulation resistance should closely approximate the values it would show with new askarel fluid.

If the overall power factor is more than 30-35 per cent (at 20°C. and 60 cycles) it is considered POOR and it is advisable to run a complete analysis of the entire insulation system.

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POWER FACTOR & VOLUME RESISTIVITY

High power factor and low volume resistivity in transformer mineral oils are commonly regarded as "danger signals" that the oil has deteriorated and broken down chemically.

This is NOT true of askarel liquid insulation.

New, unused askarel shows these electrical values:

Power Factor: 0.05-0.2% @ 60 cycles 20°C.
about 1-2.0% @ 60 cycles 100°C.)

Volume Resistivity: 100-1000 x 10^9 ohm-cm (@ 100°C., 500V., DC., 0.1" gap)

Used askarel from SATISFACTORILY OPERATING TRANSFORMERS normally and frequently shows

Power Factor: 20 to 80% @ 60 cycles, 100°C.

Volume Resistivity: about 25 x 10^9 ohm-cm (@ 100°C., 500 V., DC., 0.1" gap)

This relatively *high* power factor and relatively low volume resistivity of used askarel ARE TO BE EXPECTED. Even at these levels, the askarel's dielectric strength is STILL in the 30-35 KV range.

The reason is simple: askarel, unlike "oil," is a relatively polar liquid. The volume resistivity is sensitive to traces of conductive contaminants. However, even in the presence of large amounts of contaminants, the volume resistivity does not seem to fall below 10 x 10^9 ohm-cm. Yet the dielectric strength remains high, because intrinsically askarel remains a non-conductor.

To quote from Insulation Magazine, December 1961

DIELECTRIC LOSS YARDSTICKS

by John C. Botts, Manager Insulation Development Section, and Graham Lee Moses, Manager Services *Engineering, Westinghouse Electric Corp., East* Pittsburgh, Pa.

"Dielectric loss is a good comparative evaluation for some characteristics of insulation. It may be used for comparing similar samples of the same materials. It may not be used as an overall evaluation for comparing different materials." (i.e. "oils" and askarels)

Power factor is not an important criteria of askarel insulation efficiency IN A PROPERLY CONSTRUCTED TRANSFORMER.

However if improper construction materials or unpredictable foreign contaminants enter the system high power factor (in the absence of moisture in the shell) can indicate improper construction.

sampling your ask

NOW . . . since you know that the DIELECTRIC STRENGTH is the most important checkpoint, and that (except for arcing) MOISTURE is the villain that saps dielectric strength . . . you want to make sure that your SAMPLE truly represents your askarel insulation.

TAKE YOUR SAMPLE AS CLOSE TO THE TOP OF THE LIQUID SURFACE AS POSSIBLE!

(Many large askarel transformers have a built-in sampling tube near the surface for convenient sampling. If additional sampling tube connections are contrived on to valves for easier sampling, make the tubes of clean glass, stainless steel, aluminum or tin for rigid types; and silicone or Teflon tubing for flexible types.)

Water *floats* on askarel. If there is any water in your transformer, it may collect in little puddles ON TOP of the askarel. AND, therefore, more water will probably be dissolved in the askarel near the top, where it contacts any collected condensation.

If you find low dielectric strength and high moisture in the askarel, you will probably want to thoroughly dry out the shell and take some mechanical steps to keep it dry.

When you take your askarel sample for testing, take the same precautions (but no more) that you take when sampling mineral oil:

1 Select a dry day. Do not sample insulator on a warm, moist day when humidity exceeds 75%, and

2 Make sure that the askarel is at least as warm as the surrounding air. (Cold liquids can condense moisture from humid air.)

3 *NEW containers for fluid sample*
Your sample container should be a **new** and **previously unused** small mouth pint glass bottle fitted with a Bakelite screw cap fitted with an aluminum or tin bottle cap liner. Make sure that the new bottle does not stand around open to collect dust or moisture. Rinse the sample bottle and cap lining two or three times with askarel from the transformer, then fill it. When sample will be tested promptly, a clear glass bottle can be used. If sample is to be stored indefinitely, use an amber glass bottle or wrap clear glass with aluminum foil.

Whenever a sample is to be shippec to the transformer manufacturer (or to Monsanto) for complete analysis, the container must be a 5-pint amber glass bottle. For your convenience, various transformer manufacturers and Monsanto will send you the sample bottle filled with new askarel. You simply empty out the new askarel and re-fill bottle with your sample.

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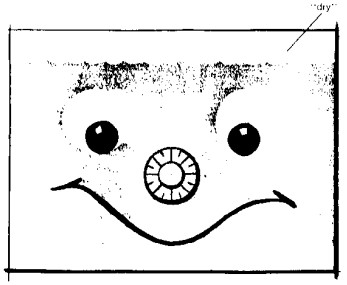
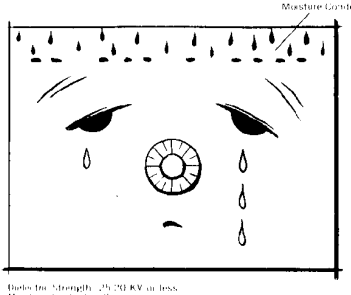


Dielectric Strength: 40-45 KV
Moisture Content: 40-50 ppm



Dielectric Strength: 25-30 KV or less
Moisture Content: 75 ppm

THAT'S THE STORY:

keep 'em dry... let 'em alone!

But you might want these storage and handling "tips" to make you a complete transformer askarel expert.

STORE NEW ASKAREL IN A CLEAN DRY PLACE

Keep the 5, 30, or 55 gallon drums dry; turn them over on their sides to keep water off the drum head. (It can be sucked in by the drum "breathing.")

CLEAN UP SPILLAGE

Askarel can, if left standing, attack paint, rubber, or plastics. Absorb it from floors with sawdust, sweep, and then wipe dry. Use a rag wet with mineral spirits if you want to make sure it's all cleaned away.

TAKE ORDINARY PERSONAL CARE

Transformer askarel has been made, handled and used for over 30 years without causing toxic or other ill effects. Askarel can be handled in the same manner as insulating mineral oil. As with mineral oil, there may be some people allergic to askarel, so prolonged skin contact should be avoided where possible.

When accidentally spilled or splashed on the skin, askarel does not present an acute hazard nor will it cause serious skin irritation. Simply wash it off with soap and water. If work clothes become impregnated with askarel, they should be removed and washed.

Eye contact may cause temporarily painful irritation but NO PERMANENT DAMAGE to the tissues or sight. Flush the eye with large amounts of water. A drop of castor oil may be put in the eye. As with all eye first-aid, refer to a physician who will treat the eye with an ointment.

Ordinary, infrequent exposure to askarel vapors will not cause any ill effects. However, prolonged exposure to strong vapors should be avoided. If hot fluid is to be handled in a closed or confined area, provide ordinary exhaust ventilation. Harmful concentrations of askarel vapors are easily detectable by the smarting of the nose or eyes.

Should hot askarel (above 100°C.) have to be handled in the open in a confined, unventilated area it is advisable to wear organic canister-type masks as supplied by Mine Safety Co., Pittsburgh, Pa.

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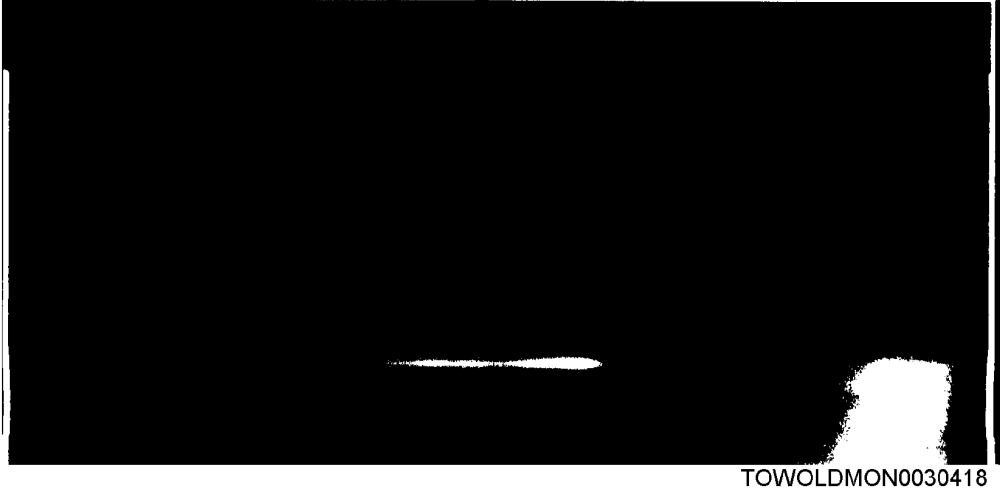

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