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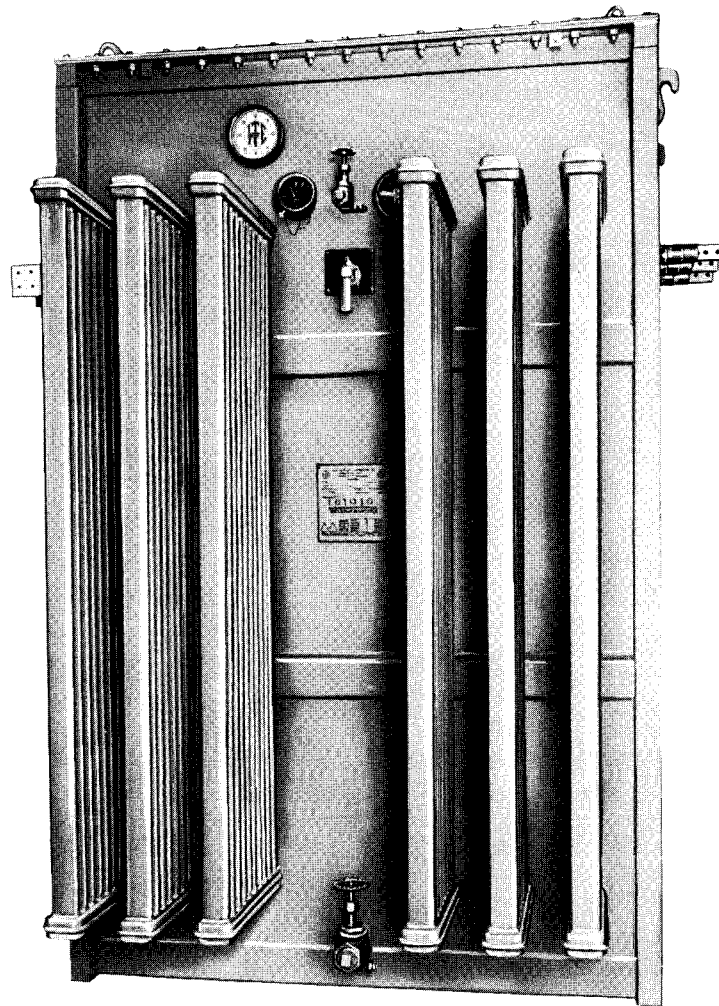
ISSUE A

## UNIT SUBSTATION TRANSFORMERS

# INSTRUCTIONS

INSTALLATION • MAINTENANCE

## ASKAREL-IMMERSED TRANSFORMERS



***ITE Imperial Corporation***



## INSTRUCTIONS FOR THE INSTALLATION AND MAINTENANCE OF ASKAREL-IMMERSED TRANSFORMERS

### INTRODUCTION

The proper installation and maintenance of I-T-E askarel filled transformers is as essential to successful operation as the design and manufacturing methods. Since askarel is chemically different from transformer oil, improper use may result in damage or loss of the transformer. It is with this in mind that these instructions are published.

Askarel (1470) is a cooling and insulating liquid which is noninflammable, chemically stable, non-sludging, and straw-yellow in color. It has a Saybolt Viscosity of 54 seconds at 37.8° C (100° F), which is approximately the same as transformer oil.

Caution must be exercised when handling askarel to prevent contamination with foreign materials. In particular, it must not contact petroleum oils. These are miscible in all proportions with askarel and will adversely affect the noninflammable characteristic of askarel. Separation of the two liquids is very difficult and cannot be effected by ordinary processes.

Some materials, common to oil filled transformers, are soluble in askarel. These have been carefully excluded. No materials should be used in contact with the liquid unless approved by the I-T-E Imperial Corporation.

### INSTALLATION

#### INSPECTION

All transformers are thoroughly tested and inspected before leaving the I-T-E Imperial Corporation.

The transformer must be examined for damage in transit immediately upon receipt at its destination. If any damage is evident, claims should be filed at once with the transit company, and the I-T-E Imperial Corporation notified. Tighten any parts which may have worked loose, such as nuts and leads.

Transformers are shipped filled with askarel. Askarel used for filling the transformer should have a dielectric strength of 30 KV or higher. Under certain temperature conditions askarel may condense on the under side of the pressure relief diaphragm. These drops are not to be mistaken for water.

Before attempting to remove any covers or parts, the internal pressure should first be relieved either by opening the filling plug on the cover or the top sampling valve.

#### HANDLING

Lugs and eye nuts or eye bolts are provided for lifting the transformer. Additional eye nuts or eye

bolts are supplied for lifting heavy sections of the transformer. The transformer cover must be securely bolted in place when lifting to prevent buckling of tank walls.

The transformer can be moved on skids or rollers if care is taken to prevent damaging its base or tipping it over. In no case should the transformer be moved or lifted by placing jacks or tackle under drain valves, radiators or other attachments.

### LOCATION

Consideration should be given to inspection, ventilation, and accessibility. Self cooled transformers depend entirely upon air to carry away their heat and adequate ventilation must be provided. When located indoors the room air inlets should be located at floor level and the air outlets as high as the room will permit. The number and size of the air inlets depends upon the rating of the transformer. In general, about 20 square feet each of inlet and outlet area should be provided for each 1000 KVA of transformer capacity. If the transformer is to operate long periods at full load, inlet and outlet area should be increased to about 40 square feet per 1000 KVA of transformer capacity.

When transformers are to be located adjacent to walls or each other there should be a separation of not less than 24 to 36 inches depending on the transformer size.

The transformer should be located on a level floor strong enough to support its weight.

On those transformers with a pressure relief valve mounted on the tank side, the transformer should be installed in a position such that the valve does not face an aisle or passage way.

### CONNECTIONS

**WARNING: DO NOT CHANGE CONNECTIONS ON A TRANSFORMER THAT IS UNDER EXCITATION, NOR MAKE ANY CONNECTIONS EXCEPT AS AUTHORIZED BY THE NAMEPLATE OR CONNECTION DIAGRAM.**

Leads not in use should be insulated from ground and all other leads.

The transformer must be grounded permanently by connecting an effective ground to the grounding pad located at the bottom of the tank. **WARNING:** A poor ground may result in loss of life or damage to the equipment.

If the transformer is specifically designed to operate on a system having a grounded neutral, it is necessary that the neutral of the transformer be solidly grounded without resistance.



A single phase transformer suitable for wye connection on primary or secondary sides must not be connected in a wye bank on both sides simultaneously.

Lightning protection should be provided for every transformer. Lightning arresters, solidly grounded, should be located as near to the transformer as possible.

Line connections must be made without placing a strain on the transformer terminals, which would result in an undue stress on the bushings.

### TAP CHANGER OPERATION

I-T-E transformers are supplied with a no load tap changer. Taps must never be changed while the transformer is energized. To operate the tap changer, depress the latch and rotate handle to desired position as indicated on the nameplate.

### GASKETS

Gaskets used on I-T-E askarel transformers are made of cork or a cork and rubber compound. Extra gaskets and cementing compounds may be obtained from the I-T-E Imperial Corporation.

To install a gasket (other than a bushing gasket) the metal surfaces should be completely cleaned with denatured alcohol. Brush one side of the gasket and its mating metal surface with Benolite 6-610. After 15 to 30 minutes place the gasket flatly on the metal surface. Brush the opposite

gasket side and metal surface with Benolite 6-610 and after 15 to 30 minutes tighten into position. After four hours, retighten all joints to remove any slack that may have accumulated.

If a bushing gasket is to be replaced, first clean all parts thoroughly. Brush Benolite 6-610 on all sides of the gasket and allow to dry for 15 to 30 minutes, then tighten into position. Again, after four hours retighten the bushing to remove any slack.

Before assembling pipe fittings, clean the threads with petroleum spirits. Then apply a coating of Benolite 6-610 to the male threads only and screw the mating parts together by hand. Take fittings apart and apply a second coating. Then tighten securely for a permanent joint.

### PRESSURE TEST

Before operation but after installation of the transformer, a pressure test should be made. With all covers tightly bolted subject the tank to a pressure of four pounds per square inch. Use either dry compressed air or dry nitrogen applied through the rotating type sampler valve. Close the supply and allow the transformer to stand under pressure for at least twelve hours. If the pressure remains constant, the tank is satisfactory. Leaks above the askarel level can be located by applying a solution of glycerine and soap to all joints, pipe fittings, and cable connections.

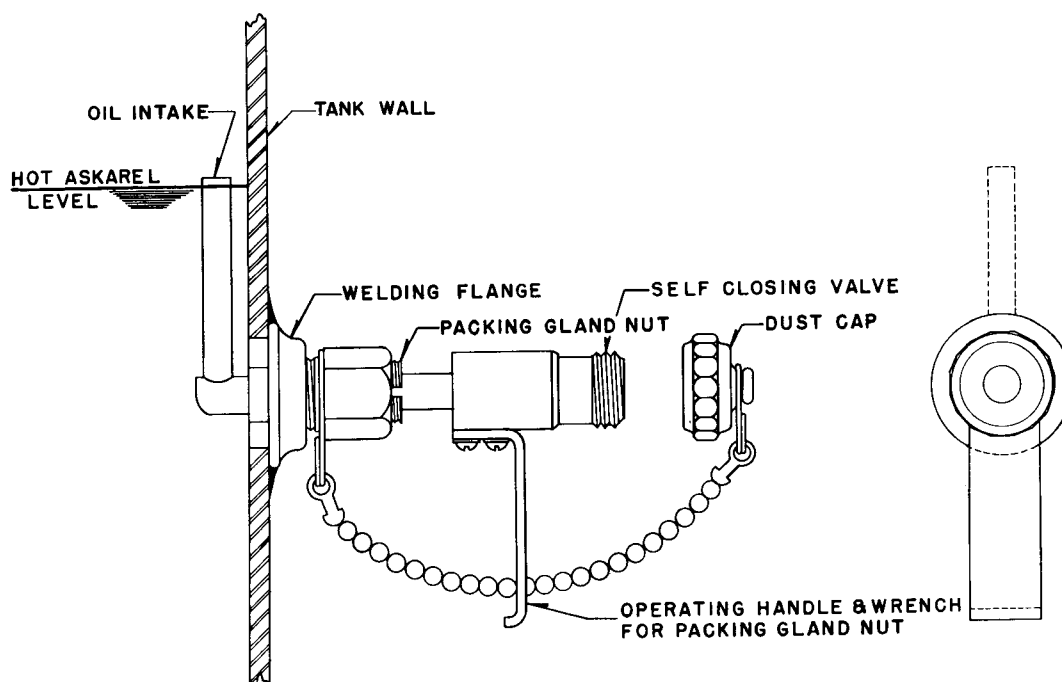


Fig. 1—Rotating Type Sampler Valve



Following the pressure test and at any time that the transformer is opened, the tank should be closed at the proper pressure in accordance with the liquid temperature. At 25° C reseal at zero pounds per square inch gage. For each 5° C above 25° C, increase the resealing pressure 0.5 pounds per square inch. If the initial temperature is less than 25° C, reseal at atmospheric pressure but vent the transformer when 25° C is reached.

### STORAGE

Askarel transformers that are not in use should be stored in a dry location that is not subject to extreme temperature variation. The askarel level should be normal and the tank must be sealed. Replacement coils must be kept under askarel and protected from moisture. Before placing the transformer in service, a complete inspection should be made.

### MAINTENANCE

While a transformer requires less care than most other types of electrical apparatus, neglect of certain requirements may lead to serious trouble.

The maintenance, operation, overvoltage protection, and overcurrent protection is generally the same as that of oil filled transformers. However, the use of askarel presents certain problems that are covered in the following sections.

### HANDLING OF ASKAREL

Askarel must be handled carefully since continued exposure may produce local skin irritation. This irritation can be eliminated by washing the skin with a mild soap. Application of cold cream to the skin will also neutralize the effect. Ordinary medicinal washes will remove any irritation caused by Askarel's coming in contact with an open cut or skin abrasion. A drop of castor oil will neutralize any irritation caused by contact of liquid Askarel with the eye. Exposure to the vapors of the volatile Askarel should be avoided by ventilating the room while the tank is open to air.

To maintain the noninflammable qualities of Askarel, all containers, hose, or pipes must be free of oil, grease, pitch, or other foreign matter. Any equipment for handling Askarel should be reserved for use with Askarel only, as it is very difficult to remove traces of contaminants that will affect the Askarel. Since rubber is affected by Askarel it is necessary to use an all-metal hose in handling this liquid.

### FILLING TRANSFORMERS

If it is necessary to refill a transformer in the field, first make certain that all joints are tight, and then open an air vent above the normal liquid level.

It is preferable to pump the Askarel into the transformer tank through the drain valve by means

of a filter press. If it is necessary to pour the Askarel into the tank, it will necessitate letting the Askarel set until all the air has come to the surface. The transformer should be filled to the 25° C mark while the temperature of the liquid is approximately 25° C.

If Askarel is accidentally spilled on the outside of the transformer tank, the Askarel must be carefully removed because it will dissolve the paint and ruin the finish.

A "milky substance" that separates from Askarel (this action will take place only at low temperatures) is a scavenger content which will go back into solution when the unit is warm. For this reason Askarel should never be filtered when the temperature is below 25° C.

### PERIODIC INSPECTIONS

After the transformer has been in operation about two weeks, it is advisable to test the dielectric strength of the Askarel.

A definite schedule should be set up for periodic testing of the Askarel. The frequency of inspection depends upon climatic conditions and the importance of minimizing interruptions in service. Under normal conditions annual tests are sufficient. If, at any time, the dielectric strength of the Askarel drops below 22 KV, the Askarel should be filtered until a test of 30 KV or higher is attained.

Impurities tending to affect the dielectric strength of Askarel will, in general, be at the top of the liquid. A sample of the Askarel should be taken through the sampling valve. As the level of Askarel will change relative to its temperature, a Rotating Type Sampler Valve is provided such that a top sample may be taken irrespective of the liquid level.

If no oil test set is available for use, samples of the Askarel may be sent to the I-T-E Imperial Corporation in Philadelphia, Pa. for testing. The sample should be tagged and identified by transformer serial number or drum marking, and date of sample taken.

At the same time that liquid samples are taken, the maximum oil temperature should be recorded.

Approximately once a year a tank pressure test should be made and an examination of the tank made for signs of corrosion.

### SAMPLING OF ASKAREL

Containers used for sampling Askarel should be used for Askarel only and the greatest care should be used in drying and cleaning the receptacles.

First rinse the sample bottles with oil-free gasoline or carbon tetrachloride. Then wash the bottles with strong soap suds. Rinse thoroughly with water and dry in an oven at 105° C to 110° C for at least eight hours. After drying, the bottles must be tightly plugged with a glass stopper.

It is preferable that samples be taken when the temperature of the transformer is near 25° C. If the sample is taken when the transformer is cooler or warmer than 25° C, the transformer tank should be



vented when the transformer is next at 25° C. Thus excessive tank pressure or vacuum due to large changes in temperature will be avoided.

A small amount of liquid should be allowed to flow through the sampling valve to clean the valve of any dirt or water that may have collected before drawing the sample.

If the samples of Askarel are taken from drums, the liquid should be allowed to settle for approximately eight hours beforehand. The samples should be taken from the top of the drum by means of a chemically clean thief.

### TESTING OF ASKAREL

For testing the dielectric strength of Askarel, follow the technique as specified by the AMERICAN SOCIETY FOR TESTING MATERIALS in the method entitled "The Standard Method of Testing Electrical Insulating Oils".

1. Set the spacing of the electrodes at 0.100 inch.

2. The test cup and electrodes should be wiped clean with dry, calendered tissue or a clean, dry chamois and thoroughly rinsed with oil-free, non-leaded gasoline or carbon tetrachloride.

3. Fill the test cup with gasoline and make a breakdown test under standard conditions of voltage application (3 KV per second rise). If the dielectric strength is not less than 25 KV, the cup is considered suitable for testing purposes. Precaution should be observed when handling the gasoline.

4. Immediately after the final rinsing with gasoline, rinse the test cup with a portion of the askarel sample and proceed with the test at once.

5. The temperature of the liquid to be tested should be at room temperature; that is, 68° F to 86° F. Misleading and variable results will be obtained at lower or higher temperatures.

6. After filling the test cups, the liquid must be allowed to stand for three minutes to allow air bubbles to escape.

7. When making tests, take only one test per filling. Fill at least five times and average the results.

If, at any time, the dielectric strength of the Askarel drops below 22 KV, the Askarel should be filtered. (See following section, "Filtering Askarel".)

### FILTERING ASKAREL

Askarel transformer liquid can be filtered by means of a filter press similar to the one used in cleaning transformer oil. The filter press used for Askarel should be used only for Askarel.

The purifier consists of a driving motor, a 7-inch filter press, positive volume gear pump, combined mixing tank and drip pan, necessary piping, valves, strainer, gauges, and a drying oven.

To be assured of obtaining the correct filtration of the liquid, the fuller's earth and filter paper

should be stored in an oven or hot room where the temperature is 35° C or 40° C. At no time should the temperature exceed 50° C for a long period of time. If an oven is not available, the fuller's earth can be dried in the standard oven furnished with the purifier for a period of 6 to 10 hours at 85° C, and the filter paper hung on rods in the same oven and dried from two to four hours at the same temperature. To insure uniformity of drying, the individual sheets of filter paper should be separated when hanging them in the oven.

When charging the filter, face the pump or head-end of the equipment. The frames and plates should be assembled alternately with all the small projections at the right-hand side. Three sheets of dry filter paper should be placed between each plate and the adjacent frame, being careful that the holes in the paper correspond to those in the plate. Clamp the press securely by means of the compression screw at the back of the assembly.

Nine pounds of 80/300 mesh, dry fuller's earth constitute one standard charge for the filter. Mix one-third of this charge in five to six gallons of clean Askarel. When this is thoroughly mixed, open the valve leading from the mixing tank to the pump, and the valve between the outlet of the press and the drip pan, and close all other valves. Start the motor and circulate the mixture through the press. A cake of fuller's earth should now be deposited on the surface of the paper.

Let the pump run for about 10 minutes, slowly add the rest of the nine-pound charge of fuller's earth and mix thoroughly in order to prevent any dry lumps from being drawn into the pump. The purifier should be run an additional five minutes after the last of the fuller's earth has been added. The purifier is now ready for use.

The filtering procedure that will insure the best results is to draw the impure askarel from one container through the filter press and into a clean tank. Where this method is impractical, a circulation method is recommended where the Askarel is circulated from the transformer tank through the filter press and back to the transformer. The inlet of the purifier should be connected to the top of the transformer and the return fluid to the bottom. Allow enough time after filtering for the air to escape before putting the transformer into service. Continue filtering until the dielectric test on the Askarel is 30 KV or better.

After the filtering operation, a considerable amount of Askarel can be salvaged from the press by passing compressed air through it. This will also simplify disassembly and cleaning of the press.

To perform this operation, close all valves except the one leading from the filter-press outlet to the drip pan. Connect a supply of dry, oil-free air to the valve adjacent to the press inlet. Pass the air, at pressures of 40 to 100 pounds per square inch, through the press until all the askarel is discharged.

After the above procedure is completed, the individual frames with filter paper intact may be removed and cleaned.



## DRYING A TRANSFORMER

The short-circuit method should be used for drying Askarel transformers. This consists of heating the windings while under Askarel, with the top of the tank open to the air to prevent condensation.

The desired load is obtained by short-circuiting one winding and applying a suitable voltage to the other. The per cent full-load impedance of the transformer will aid in determining the value of this voltage ( $\%$  impedance  $\times$  full load volts).

By heating the liquid and winding under short-circuit with a partial load on the windings, moisture will be driven off. To obtain suitable top liquid temperature, the tank should be blanketed. Lag the cover to prevent condensation. If the transformer is at room temperature at the start of drying, 125% load will help to accelerate the heating until the top liquid reaches 65° C. When this is reached, the load should be reduced to obtain constant temperature in accordance with the following tabulation. Never exceed the specified temperature for any given load. To do so will endanger the transformer.

Short-Circuit Amp. % Rated Load	Max. Top Liquid Temp.
50	85° C
75	80° C
85	75° C

The drying can be considerably hastened by filtering the liquid during the run. However, this may keep the temperature of the liquid too low if done continuously. Hence it may be preferable to filter periodically. If, during the run, moisture condenses on the underside of the cover, the temperature should be reduced until condensation stops. After about eight hours the temperature may again be raised.

The drying should be continued until the liquid from the top tests 30 KV or more for 4 consecutive tests taken 4 hours apart. The liquid should be maintained at a maximum temperature and unfiltered between tests.

## TAP CHANGER LEAK

The procedure for correcting a leak around the seal of an external tap changer assembly is as follows:

1. Set tap changer at position "C". (Vertical.)
2. Remove the tap changer handle from the shaft by taking out the set screw.
3. Loosen set screw holding the gland nut.
4. Turn the gland nut clockwise until the leak is stopped. In the majority of cases any leak around the gland can be corrected by turning the gland nut clockwise. However, if the seal still leaks continue procedure at step 5.
5. Lower the liquid level in the transformer tank below the tap changer shaft.
6. Remove the gland nut (turn counter-clockwise).
7. Remove the old packings.

8. Install new packings (I-T-E N510173-A1).
9. Turn the gland nut clockwise until the packing is tight.

NOTE: It may be impossible to start the gland nut with four gaskets. If this is the case, remove one of the gaskets and tighten the gland nut using three gaskets, then remove the gland nut and insert the fourth gasket and tighten the gland nut.

10. Tighten the set screw holding the gland nut from turning.

11. Bring the liquid level back to normal and check the seal for leaks.

12. Replace the tap changer handle. The tap changer handle must be installed in the "C" position.

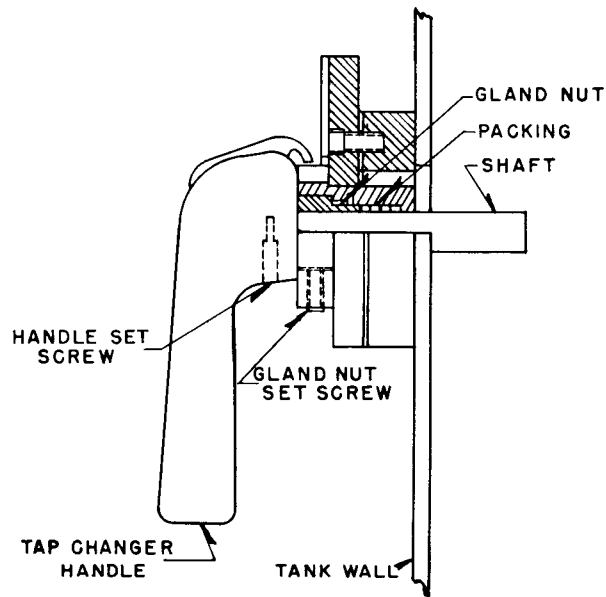


Fig. 2—Tap Changer

## OPERATION AT HIGH ALTITUDES

When a transformer is moved to high altitudes it must first be vented and resealed at atmospheric pressure and 25° C.

Other effects to be considered carefully are due to the decreased air density. First, the transformer may overheat if self cooled; and second, the spark-over voltage of the bushings will be lower.

Standard bushings may be used up to 3300 feet. Before operation at greater elevations, contact the I-T-E Imperial Corporation relative to suitability of the bushings.

## IMPURE AIR

If transformers are to be installed where abnormal conditions prevail, special care is required to prevent breakdown.



If formation of conducting deposits is possible, the bushings must be kept clean at all times to prevent sparkover.

Transformers installed near the seacoast must be cleaned often and kept well painted to prevent corrosion.

Conduit leading from the station to the terminal chamber of the transformer should be sealed to prevent the entrance of warm air which may cause condensation.

### TRANSFORMER FAILURE

If a transformer should fail, no work should be done except to determine the extent of the damage. If parts are removed from the Askarel, they should be replaced. Notify the I-T-E Imperial Corporation, giving the rating and serial number of the transformer. A sample of the Askarel should also be submitted for analysis.

Time and expense will be saved if spare units are kept in readiness. In the storage of spare units the following items should be inspected periodically in addition to pressure tests: Askarel level, liquid dielectric strength, relief diaphragms, and fan control and conduit.

### ACCESSORIES

#### THERMAL AND LIQUID LEVEL INDICATOR

Thermometers of the submersible type are furnished on most transformers and are equipped with or without contacts for use in external alarm circuits. Each thermometer is provided with a knurled projection for resetting the maximum temperature indicator.

Liquid level indicators are provided to aid in the systematic inspection of the transformer during

operation. The gauge indicates the proper Askarel level at 25° C.

#### PRESSURE/VACUUM GAUGE

Pressure/Vacuum gauges are provided on some transformers. During extreme changes in ambient temperature or loading requirements, the transformer may be vented prior to the blowing of the pressure relief disk. If persistent high pressures prevail after venting, investigation for the generation of gas is in order.

#### PRESSURE RELIEF DIAPHRAGM

Both outdoor and indoor type transformers are provided with a pressure relief diaphragm. The diaphragm is usually on top of the transformer. The disk consists of a flange welded to the cover of the transformer provided with fine wire screening, suitable gaskets, clamping ring, and glass disk. The glass diaphragm will rupture when excessive internal negative or positive pressure is reached. If the diaphragm must be replaced: First, remove the cover and then remove the screws that hold the diaphragm and flange together. Replace the diaphragm only after the cause for failure has been determined and remedied.

#### RENEWAL PARTS

When ordering renewal parts, or when requesting information regarding a particular transformer, always state the serial and specification number. This information will be found on the nameplate of the transformer.

Any additional information regarding a particular transformer may be obtained by contacting the nearest sales office of the I-T-E Imperial Corporation.



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