INSTRUCTIONS

INSTRUMENT TRANSFORMERS

BUTYL-MOLDED AND COMPOUND-FILLED, 600-V THROUGH 15-KV

INTRODUCTION

These instructions apply to indoor and outdoor instrument transformers of butyl-molded and other dry-type constructions. For information on the installation and care of transformers with unusual ratings of frequency, secondary voltage, current, or on installations where unusual conditions exist (refer to American Standards for Instrument Transformers, ASA C57.13–1954, section 13-00), consult the nearest sales office of the General Electric Company. When special information is requested, give the complete nameplate data in order to identify the transformer.

BEFORE INSTALLATION

INSPECTION

Before installation, transformers should be inspected for physical damage that may have occurred during shipment or handling. During shipping, transformers usually are supported only by the base or mounting supports, except that certain butyl-molded types may be shipped from the factory supported by butyl surfaces. Transformers should be dry and the surface of the bushings should be clean. All butyl surfaces should be considered the same as the surface of a porcelain bushing in regard to cleanliness and dryness.

DRYING OUT

Transformers that have been submerged in water should be dried out before installation. Wet asphalt-impregnated or varnish-impregnated transformers may be dried by self-heating. To do this, allow the transformer to stand not less than twelve hours in a room of constant temperature. Measure and record the room temperature and resistance of the secondary winding. Short-circuit the primary winding and apply a controllable voltage to the secondary winding. Adjust the voltage so that sufficient current will flow in the winding to raise its temperature to approximately 80 C. The rate of temperature rise should not exceed 6 C per half hour. The winding temperature should be held at approximately 80 C until the transformer is dry. It will usually require 24 to 48 hours to dry a transformer.

The amount of current necessary to obtain a winding temperature of 80 C varies because of the differences in heat dissipation and current densities in the different types of transformers. It is advisable to start with a current not greater than two amperes in the secondary of a potential transformer, or not greater than five amperes in the secondary of a current transformer. Gradually increase this current until the proper heating is obtained. Increases of current should be made cautiously with frequent checking of the rise in temperature of the winding.

The temperature of the winding may be determined conveniently by the "resistance change" method. Since the resistance of a copper winding increases approximately 1 percent for each 2 1/2 C, the temperature rise may be calculated by measuring the "before" and "after" resistances and finding the percentage increase in resistance. For example, if the "after" resistance is 0.244 ohm and the resistance at the start (room) temperature is 0.200 ohm, the percentage increase is

$$\frac{0.244-0.200}{0.200} = 0.22 = 22\%$$

which corresponds to a temperature rise of 22 x 2 1/2 = 55 C (approximately). The approximate winding temperature at any time is the temperature rise at that time added to the ambient (room) temperature.

Butyl-Molded Transformers

Butyl-molded transformers, particularly designs for outdoor use, are relatively impervious to moisture. If, due to unusual circumstances, insulation tests indicate the possibility of the entrance of moisture into a butyl-molded transformer, refer to the nearest General Electric Apparatus Sales Office for detailed information on proper procedure.

TESTING

If it is desired to make insulation tests after the drying out period, or at any other time, these tests

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

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may be made in accordance with American Standards for Instrument Transformers, ASA C57.13–1954. (Note: Periodic field tests of insulation should not exceed 65 percent of the ASA test voltage. Incoming tests of new equipment should not exceed 75 percent of the ASA test voltage.)

Convenient methods for testing polarity are given in American Standards C-57.13, the Electrical Metermen's Handbook published by Edison Electric Institute, and General Electric publication GET-97.

For ratio and phase angle tests, refer to Electrical Metermen's Handbook and General Electric publications GET-97 and GET-1725.

Certificates

A certificate of test is supplied with many types of butyl-molded potential and current transformers. The certificate is in the form of a tag attached to each transformer. The tag shows the ASA accuracy classification of the transformer, the burden at which it has been tested, and the actual test results of ratio correction factor and phase angle. The tag is perforated and can be detached as a 3- by 5-in. card for filing.

INSTALLATION

SAFETY PRECAUTIONS

Always consider an instrument transformer as a part of the circuit to which it is connected, and do not touch the leads and terminals or other parts of the transformer unless they are known to be adequately grounded.

The butyl surface of transformers should be considered the same as the surface of a porcelain bushing, since a voltage stress exists across the entire butyl surface from terminals to grounded metal parts.

Do not open the secondary circuit of a current transformer while the transformer is energized. This precaution is advisable since current transformers may develop open-circuit secondary voltages which may be hazardous to personnel or injurious to the transformer or equipment connected in the secondary circuit.

Always ground the metallic cases and frames of instrument transformers. The secondaries should be grounded close to the transformers. However, when secondaries of transformers are interconnected, there should be only one grounded point in this circuit.

MOUNTING

Instrument transformers should be mounted so that connections can be made to the power or distribution lines in such a manner as to avoid placing appreciable strains upon the terminals of the transformers. For high-current transformer ratings, 2000 amperes and above, there may be some interference from the electric field of the return bus unless the bus centers are kept at a minimum distance of 15 inches apart; for ratings above 5000 amperes this distance should be not less than 24 inches. If this type transformer is used with more than one primary turn, the loop should be at least 24 inches in diameter. Make sure that the secondary leads are twisted closely together and carried out without passing through the field of the primary conductors. It is not necessary that the bus exactly fill the window, but the bus or buses should be centralized. For ratings of 1000 amperes or less these precautions are generally unnecessary.

CONNECTIONS

SECONDARY CONNECTIONS

The resistance of all primary and secondary connections should be kept as low as possible to prevent overheating at the contacts, and to prevent an increase in the secondary burden.

The resistance voltage drop of the secondary leads should be included in calculating the secondary volt-ampere burden carried by instrument transformers. The total burden should be kept within limits suited to the transformers used.

Short-circuiting Device

Many current transformers are provided with a device for short-circuiting the secondary terminals, and are normally shipped from the factory with this device in short-circuiting position. Check the position of the shorting device. It should be opened prior to energizing the primary circuit, but only if a suitable burden, such as an ammeter, wattmeter, watthour meter, relay, etc., is connected to the transformer secondary terminals. If no burden is available, leave the shorting device closed.

On some designs the secondary cover is interlocked with the secondary hardware, so that the lead openings in the cover will be 180 degrees from the usable position unless the short-circuiting device is open. The short-circuiting device should be replaced for safety before the burden is removed from the transformer secondary.

Multi-ratio current transformers with tapped secondary windings are partially or completely inoperative when any portion of the secondary winding is short-circuited. All short-circuiting devices must be in the open position for normal operation, so that no portion of the winding is short-circuited.

In contrast, on double-secondary or multiple-secondary current transformers the shorting device must be left closed on all unused windings. (Unused windings are those to which no suitable burden is attached.)

PRIMARY BY-PASS PROTECTION

Thyrite® primary by-pass protectors are recommended for the proper protection of current

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transformers which are so located as to be exposed to the effect of surge currents. They are especially recommended for low primary-current ratings, as these ratings have a relatively high winding impedance.

Thyrite primary by-pass protectors consist of one or more Thyrite disks which are connected in parallel with the primary winding of the transformer. When high-frequency or steep-front voltage surges occur, the characteristic of the Thyrite is such that an appreciable part of the surge current is by-passed through the protector. A high-surge voltage, which might result in failure within the primary winding, is thus prevented from building up across the winding.

GROUNDING

Grounding of instrument transformers should be made in accordance with AIEE Standard No. 52, March, 1951, Application Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.

POLARITY

In wiring instrument transformer circuits, it is necessary to maintain the correct polarity relation between the line and the devices connected to the secondaries. For this reason, the relative polarity of each winding of a transformer is indicated by a marker H_1 (or a white spot) on or near one primary terminal, and a marker X_1 (or a white spot) near one secondary terminal; and in some cases by white bushings. See Figure 1. Where taps are present, all terminals will be marked in order. The primary terminals will be H_1, H_2, H_3, etc.; the secondary terminals X_1, X_2, X_3, etc.; and the tertiary terminals, if present, Y_1, Y_2, Y_3, etc. H_1 always indicates the same instantaneous polarity as X_1 and Y_1.

When connection is made to a secondary terminal having a polarity marking similar to a given primary terminal, the polarity will be the same as if the primary service conductor itself were detached from the transformer and connected directly to the secondary conductor. In other words, at the instant when the current is flowing toward the transformer in a primary lead of a certain polarity, current will tend to flow away from the transformer in the secondary lead of similar polarity.

When connecting instrument transformers with meters or instruments, refer to the Instructions furnished with the meters or instruments involved.

AMBIENT TEMPERATURE

All General Electric transformers are designed to operate at either or both the ambient temperatures, as indicated by the Company, at the standard rating or ratings for the corresponding ambient temperatures, provided the altitude does not exceed 3300 feet. Refer to American Standards for Instrument Transformers, ASA C57.13-1954, section 13-00. Generally, the allowable ambient temperatures and ratings are marked on the transformer nameplate.

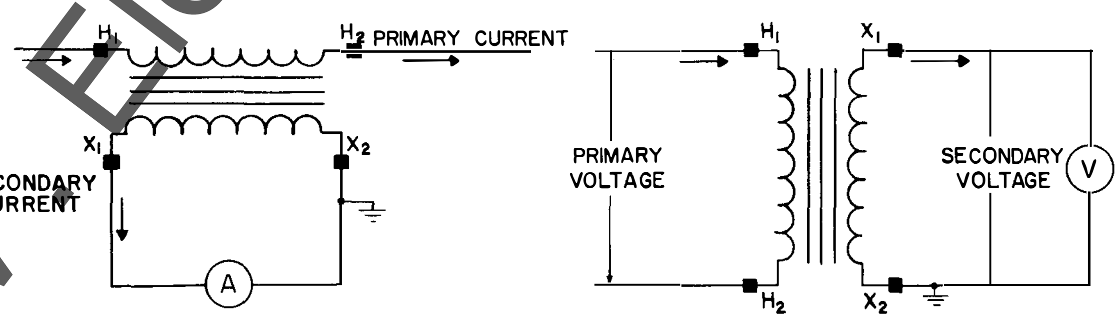
FUSES

Potential-transformer primary fuses are intended to protect the supply system rather than the transformer, although proper fuses will afford partial protection to the transformer in a large number of cases.

The fuses on butyl-type transformers, rated at 0.6-kv through 2.5-kv insulation class, are provided with molded fuse enclosures which are secured to the transformer by the spring action of the fuse clips.

Each fuse and its enclosure may be removed as a unit from the transformer. The fuse is then removed through an opening in one end of the enclosure. A fiber fuse puller must be used, or other suitable protective measures taken, if the fuses are to be removed while the unit is energized.

When replacing the fuse and enclosure, be sure that the plastic insulating piece, fastened under the transformer fuse clip, is inserted between the end



CURRENT TRANSFORMER POTENTIAL TRANSFORMER

Fig. 1. Elementary Connections of Instrument Transformers

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of the fuse and the open end of the fuse enclosure. Then press the enclosure firmly onto the transformer to seat the fuse into both clips.

The fuses of some dry-type transformers, 2400 volts and below, are supported by a hinged cover. If it is necessary to replace a fuse while the transformer is connected to an operating circuit, the cover should be opened by use of an insulating hook, which should be of sufficient length to prevent the operator from being burned in case a short circuit exists in the transformer.

In testing fuses for continuity of circuit, not more than 0.25 ampere should be used.

In replacing fuses, be certain that the voltage rating of the fuse is the one nearest above the line-to-line voltage of the circuit, regardless of the rated voltage of the transformer. Do not use fuses of higher voltage ratings, as undesirable overvoltages may result should the fuse blow. One permissible exception to this general rule is the use of Size A, Type EJ-1 fuse in the Types JE-2 and JVM-2 transformers. In this case the Size A fuse can be used on either 2400-volt, delta circuits or 2400/4160-volt, solidly grounded Y circuits.

MAINTENANCE

After instrument transformers for indoor use have been installed, they should need no care other than keeping them clean and dry. Transformers for outdoor installations should receive the same care in operation as power transformers of similar design and of similar voltage rating.

CLEANING BUSHINGS

Porcelain bushings may be cleaned by means of a wet cloth or by use of carbon tetrachloride* or ammonia. After cleaning a bushing, wash thoroughly with clean water to remove foreign material from the surface.

Butyl-molded transformers may be cleaned by scrubbing the butyl surface with detergent and a stiff brush to remove accumulated dirt or oil film. Remove the detergent by washing with clean water. Then apply a light grade of silicone oil (G-E Silicone Liquid, SF-92 or equal) to the butyl surface.

DEMAGNETIZING

If by accident a current transformer becomes magnetized, it should be demagnetized before being used for precision work. Connect at least 50 ohms resistance in series with the meters or instruments in the secondary circuit. Bring the primary current up to as near full load as possible and gradually reduce the series resistance until it reaches zero, being careful not to open the secondary circuit in the process. For best results, gradually reduce the primary current to zero before disconnecting the resistance circuit. The variable series resistor must have reliable contacts and be suitable for the thermal duty required.

* Precautions against toxic vapors should be taken when using carbon tetrachloride.

Demagnetizing JAR-O Auxiliary Transformers

Due to the wide range of current ratios available in the Type JAR-O current transformer and the lack of standards for demagnetizing the odd ratios available, the following method is necessary to prevent voltages which are damaging to the transformer. See Fig. 2.

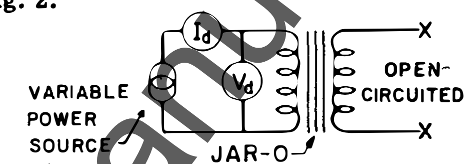

Fig. 2. Schematic diagram for demagnetizing JAR-O transformers

Key to Fig. 2.

I_d = ammeter for reading demagnetizing current.

V_d = voltmeter for reading demagnetizing voltage.

The I_d reading shall not exceed:

$$\frac{\text{Rated current of the winding energized}}{50}$$

The V_d reading shall not exceed:

$$\frac{160}{\text{Rated current of the winding energized}}$$

For example, for demagnetizing any 5-ampere JAR-O winding, do not exceed 32 volts and 0.1 ampere. The core will be adequately demagnetized when either the voltage or the current is increased to over 80% of the maximum value shown in the applicable formula (see above), and then gradually reduced to zero.

CAUTION: ONE OR MORE WINDINGS ARE OPEN-CIRCUITED DURING THIS OPERATION. THESE WINDINGS MAY DEVELOP VOLTAGES WHICH ARE HAZARDOUS TO PERSONNEL. OBSERVE SAFETY PRECAUTIONS.

DIFFERENTIAL PROTECTION

Standard General Electric current transformers may be used for differential protection through a considerable range of burden and overcurrent. The range is limited by the difference in burden, the maximum overcurrent, and the mechanical and thermal short-time rating. Information regarding these points may be obtained from the G-E publication GET-97 or from the nearest sales office of the company.

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