



INSTRUMENT TRANSFORMERS MOLDED AND OTHER DRY TYPES

INTRODUCTION

These instructions apply to indoor and outdoor instrument transformers of molded and other dry-type constructions. For information on the installation and care of transformers with unusual ratings of frequency, voltage or current, or on installations where unusual conditions exist (refer to requirements for Instrument Transformers, ANSI/IEEE C57.13-1978, Section 4), consult the nearest sales office of the General Electric Company. When special information is requested, give the complete nameplate data 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 molded types may be shipped from the factory supported by insulation surfaces. Transformers should be dry and the surface of the bushings should be clean. All insulation surfaces should be considered the same as the surface of a porcelain bushing in regard to cleanliness and dryness.

DRYING OUT

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 molded transformer, refer to the nearest GE Sales Office for detailed information on proper procedure.

Wet asphalt-impregnated or varnish-impregnated transformers may be dried by self-heating. Refer to the nearest GE Sales Office for detailed information on proper procedure.

TESTING

General

Tests should be made in accordance with C57.13-1978, Section 8. Note that 8.8.2 states, in part:

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. The equipment covered by these operating instructions should be operated and serviced only by competent technicians familiar with good safety practices, and these instructions are written for such personnel and are not intended as a substitute for adequate training and experience in safe procedures for this type of equipment. 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.

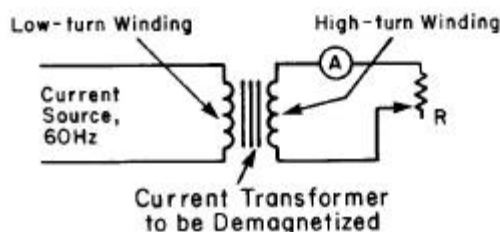
"It is recommended that field tests of insulation should not be in excess of 75 percent of the factory test voltage; that for old apparatus rebuilt in the field, tests should not be in excess of 75 percent of the factory test voltage; and that periodic insulation tests in the field should not be in excess of 65 percent of the factory test voltage. Tests made by the user for design approval may be made at 100 percent. These recommendations relate to dielectric tests applied between windings and ground and to induced voltage tests."

All other test methods are described in ANSI C57.13 and the Electrical Metermen's Handbook.

Demagnetizing

Current transformer cores may become magnetized as a result of the application of direct current to a winding (for example, while measuring winding resistance or checking continuity) or in other ways. If a current transformer becomes magnetized, it should be demagnetized before being used for precision work. Current transformers should always be demagnetized before accuracy test.

One method of demagnetizing is shown in Fig. 1. Connect the transformer in the test circuit as shown, with a low resistance across the high-turn winding. Pass rated current through the low-turn winding (usually H1 - I12). Increase the resistance (R) in the high-turn winding (usually X1 - X2) circuit until the transformer core is saturated; then, slowly reduce resistance to zero and disconnect the current source. Saturation of the core is indicated by a reduction of current in the high-turn winding circuit.



NOTE: The high-turn winding of a CT is the winding with the lower rated current.

Fig. 1. Circuit for demagnetizing current transformers

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WARNING: A CONTINUOUSLY VARIABLE RESISTANCE MUST BE USED TO AVOID OPENING THE HIGH-TURN WINDING CIRCUIT WHEN RESISTANCE VALUES ARE CHANGED. AS THE RESISTANCE IS INCREASED, THE VOLTAGE ACROSS THE RESISTANCE WILL APPROACH OPEN-CIRCUIT VALUE.

Demagnetizing JAR-0 Auxiliary Transformers

Due to the wide range of current ratios available in the Type JAR-0 current transformer, the following method is necessary to prevent voltages which are damaging to the transformer. See Fig. 2.

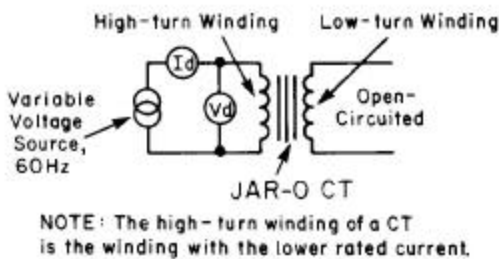


Fig. 2. Schematic diagram for demagnetizing JAR-0 transformers

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 by energizing any 5-ampere JAR-0 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 percent of the maximum value shown in the applicable formula (see above), and then gradually reduced to zero.

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

Insulated-neutral and Grounded-neutral Terminal-type Voltage Transformers

Certain voltage transformers are designed with one fully insulated primary terminal, with the neutral end of the primary winding insulated for a lower level or connected to the case, frame, or base. In some designs, this connection to the case, etc., can be removed for primary-applied potential testing. In such General Electric designs, the customer should consider the required factory primary applied potential test level to be 19 kV on outdoor types and 10 kV on indoor types. These levels correspond to C57.13-1978 requirements for insulated-neutral terminal types.

INSTALLATION

SAFETY PRECAUTIONS

1. 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.

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

3. Always ground the metallic cases, frames, bases, etc., of instrument transformers. The secondaries should be grounded close to the transformers. However, when secondaries of transformers are interconnected, there should be only be one grounded point in this circuit to prevent accidental paralleling with system grounding wires.

4. Do not open the secondary circuit of a current Transformer while the transformer is energized and do not energize while the secondary circuit is open. Current transformers may develop open-circuit secondary voltages which may be hazardous to personnel or damaging to the transformer or equipment connected in the secondary circuit.

5. The application of power fuses in the primary circuits of voltage transformers is recognized and recommended operating practice of power systems. To provide the Maximum protection practical against damage to other equipment or injury to personnel in the event of a voltage transformer failure, it is usually necessary to use the smallest fuse ampere rating which will not result in nuisance blowing. Increasing the fuse ampere rating to reduce nuisance blowing is usually accompanied by slower clearing and increased possibility of damage to other equipment or injury to personnel.

SAFETY PRECAUTIONS (CONT'D)

6. *Never short-circuit the secondary terminals of a voltage transformer. A secondary short circuit will cause the unit to overheat and fail in a very short period of time.*

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 terminals, and to prevent an increase in the secondary burden.

The resistance of the secondary leads should be included in calculating the secondary burden carried by current transformers. The total burden should be kept within limits suited to the transformers used. The voltage drop in the primary and secondary leads of voltage transformers will reduce the voltage at the measuring device.

Short-circuiting of Current Transformers

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 the short-circuiting position. Check the position of the shorting device. The secondary terminals should be short-circuited by the shorting device, or equivalent, until a suitable burden (such as an ammeter, wattmeter, watt-hour meter, relay, etc.) has been connected to the secondary terminals.

Tapped-secondary current transformers, including multi-ratio current transformers with more than one secondary tap, are adequately short-circuited when the short is across at least 50 percent of the secondary turns. When a suitable secondary burden has been connected to two terminals of a tapped-secondary current transformer, and normal operation is desired, all unused terminals must be left open to avoid short-circuiting a portion of the secondary winding and producing large errors. Only one ratio can be used at a time.

On double-secondary or multiple-secondary current transformers, that is, transformers with two or more separate secondary windings (each having an independent core), all secondary windings not connected to a suitable burden must be shorted.

Before a burden is disconnected from a current transformer, the secondary terminals should be short-circuited.

PRIMARY BY-PASS PROTECTION

Thyrite[®] primary by-pass protectors are recommended for the proper protection of current 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 surges occur, an appreciable part of the surge current is by-passed through the protector, reducing the voltage built up across the winding. Under normal operating conditions, the current bypassed has a negligible effect on accuracy.

On SUPER/BUTE[®] current transformers (Types JKW-150 through JKW-350), internal gaps are provided on low current ratings. If high voltages occur across the primary coil, these gaps fire and bypass the current around most of the primary impedance. The gaps fire at voltages well below the internal turn-to-turn dielectric strength of the primary winding.

SECONDARY PROTECTORS

Thyrite secondary protectors are designed for connection across the secondary windings of current transformers to reduce high open-secondary voltages, which might be dangerous to personnel or cause an insulation breakdown. If the secondary circuit to the intended burden is interrupted, the secondary current will flow through the Thyrite

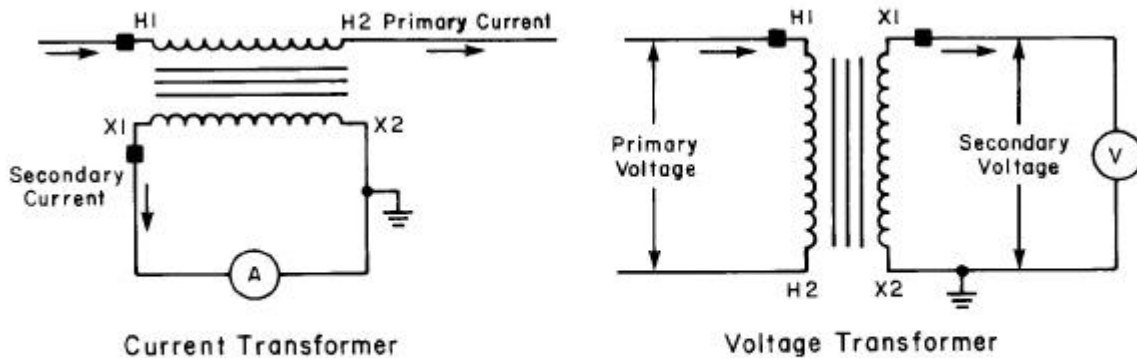


Fig. 3. Elementary connections of instrument transformers

disks and an adjacent heater coil. The resultant heating causes a thermostatic switch to short-circuit the current transformer secondary, allowing the disks and heater coil to cool, thus permitting the switch to open. This cycling is repeated until normal secondary connections are restored. Under normal operating conditions, the current that is bypassed has a negligible effect on accuracy.

POLARITY

When wiring instrument transformer circuits, it is necessary to maintain the correct polarity relationship between the line and the devices connected to the secondaries. For this reason, the relative instantaneous polarity of each winding of a transformer is indicated by a marker H1 (or a white spot) on or near one primary terminal, and a marker X1 (or a white spot) near one secondary terminal. See Fig. 3.

Where taps are present, all terminals are marked in order. The primary terminals are H1, H2, H3, etc.; the secondary terminals X1, X2, X3, etc. (and Y1, Y2, Y3, etc., if another secondary is used). The marker H1 always indicates the same instantaneous polarity as X1 and Y1.

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 flow away from the transformer in the secondary lead of similar polarity during most of each half cycle.

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

When the secondary of an instrument transformer is connected to an instrument (such as a voltmeter or ammeter) which measures only the magnitude of the primary voltage or current, polarity is not significant.

PRIMARY FUSES FOR VT'S

The function of voltage transformer primary fuses is to protect the power system by de-energizing failed voltage transformers. (Although the function of the fuses is not to protect the voltage transformer, the fuses selected will often protect the voltage transformer promptly in the event of a short in the external secondary circuitry, if the short is electrically close to the secondary terminals.)

To provide the maximum protection practical against damage to other equipment or injury to personnel in event of a voltage transformer failure, it is usually necessary to use the smallest fuse current rating which will not result in nuisance blowing. Fuses are rarely available which will fully protect the voltage transformer from overloads, or immediately clear the system of a failed voltage transformer. Increasing the fuse ampere rating to reduce nuisance blowing is usually accompanied by slower clearing and increased possibility of other damage.

The use of a fuse in the connection of a voltage transformer terminal to ground is not recommended. For grounded wye connections, it is preferred practice to connect one primary lead from each voltage transformer directly to the grounded neutral, using a fuse only in the line side of the primary. With this connection, a transformer can never be "alive" from the line side with a blown fuse on the grounded side.

The fuses on certain molded transformers for system voltages of 2400 volts or less are provided with molded fuse holders. The fuses and holders

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are secured to the transformer by the spring action of the fuse clips. When replacing the fuse and holder, be sure that the plastic insulating piece, which is fastened under the transformer fuse clip, is inserted between the end of the fuse and the open end of the fuse holder. Then press the holder firmly onto the transformer to seat the fuse in both clips.

WARNING: THE HOLDERS SHOULD NOT BE USED TO CONNECT OR DISCONNECT FUSES WHILE THE PRIMARY CIRCUIT IS ENERGIZED.

The fuses of some older dry-type transformers for system voltages of 2400 volts or less, are supported by a hinged ceramic 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 of sufficient length to prevent the operator from being injured in case an abnormality exists in the transformer or the connected circuits.

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

APPLICATION OF GE TYPE EJ FUSES

System maximum operating line-to-line voltage should be in the range of 70 to 100 percent of the rated voltage of the fuse. This range of application voltage is recommended because the current-limiting action of the fuse is characterized by the generation of transient recovery voltages above normal circuit voltage values. The magnitude of these over-voltages increases nonlinearly as available short-circuit current increases. The maximum voltage permitted at rated interrupting current is specified in ANSI C37.46-1969.

Therefore, it is important that the voltage rating of high-voltage fuses be coordinated with the voltage

levels of the associated system equipment to avoid inducing destructive voltages during fuse operation.

One permissible exception to the general rules above is the use of the 2400-volt, Size A, Type EJ-1 fuse, on 2400/4160-volt solidly grounded wye systems.

In selecting primary-fuse ampere ratings for use with voltage transformers, the objective is to use the smallest ampere rating that will not result in nuisance blowing during normal energization of the voltage transformer.

When delayed clearing of a failed voltage transformer may result in damage to other equipment or injury to personnel, "Class II" connection (where a fuse must pass the magnetizing inrush current of two transformers) should be avoided if this connection requires a higher fuse ampere rating than the "Class I" connection (where a fuse passes the inrush current of one transformer).

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

Molded transformers may be cleaned by scrubbing the insulation 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 to the surface if restoration of original surface appearance is desired.