INSTRUCTIONS

GEI-90892

FIELD TESTING OF GENERAL ELECTRIC TYPE OVERCURRENT TRIP DEVICES

SWITCHGEAR PRODUCTS DEPARTMENT

GENERAL ELECTRIC

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GENERAL

Increased interest in breaker maintenance is evident by the increase in field inquiries concerning maintenance procedures. Since the majority of these inquiries concern checking the operation of overcurrent trip devices, the following factory advice is offered as an aid to those involved in that activity.

Before attempting any checks or adjustments, the assigned tester should consult the maintenance manual to familiarize himself with the operating details of the specific breaker involved and the specific overcurrent trip device. He should be certain the power voltage has been removed. Prior to checking the overcurrent trip device, the breaker contacts, mechanism and trip latch should be checked to assure their proper functioning so that the breaker can carry the required current and that the trip shaft is free of high friction loads. The trip latch should be checked for proper trip latch engagement.

Overcurrent Trip Device Checks:

An adequate check to prove the overcurrent trip device functions properly consists of a mechanical check followed by an overcurrent operation.

Mechanical Check:

A careful mechanical check should be made of any magnetic overcurrent trip device to assure a successful tripping operation just before the armature reaches the fully closed air gap condition. This can be done by manually pushing the armature toward the closed air gap position, and determining how much further the armature moves after the breaker has tripped. This check to assure "positive trip" is within the tolerance specified in the breaker maintenance manual is important and can affect the apparent degree of time delay during a subsequent overcurrent timing test. If there is insufficient "positive trip" the armature may "bottom" on the magnet pole face without sufficiently displacing the trip latch. Slightly excessive "positive trip" may cause fast tripping while extremely excessive "positive trip" will allow the trip device armature to be loaded by the latch when the air gap is excessive. When the air gap is excessive, tripping force is at a low level compared to the force at short air gaps and the device may tend to stall or "ride the latch".

The armature of the EC-2, EC-2A, EC-1A and EC-1B of the AK breakers and the oil film (sticky disk) and Grade "B" time of AL-2 type breakers can be manipulated directly while observing the tripping. On the EC-1 device the trip arm is not fastened to the armature. To accurately determine the degree of positive trip on the EC-1, it is necessary to "probe" the armature through the holes provided in the case. A drill rod or short length of stiff wire will serve as a probe. Maintenance manuals for the specific breaker shows the procedure in detail.

While checking positive trip, the armature should be held in the tripped position sufficiently long to assure the time delay escapement is operative as follows:

a. As the armature is pushed to the closed air gap position, devices with instantaneous trip features will allow the instantaneous trip spring to stretch and allow temporary separation of the armature from the time delay dashpot. Maintaining the armature in the closed air gap condition will cause the instantaneous spring to pull the dash pot through its timing stroke. Devices with long delay characteristics will require considerable time to "time out." Failure of the dashpot

to move at all warrants further investigation to see if a bind exists in the dashpot or connecting linkage.. Similarly, lack of any time delay (when the device is so equipped) or a very fast "time out" will generally indicate lack of oil and again further investigation is warranted.

b. When releasing the armature after the device has "timed out" check the armature to be sure it returns to the fully open gap position and rests on the armature open air gap stop. An armature hanging half-way closed indicates a possible bind in the armature pivot or dashpot or possibly the pick-up setting has been reduced so far below the minimum setting that the calibration spring no longer provides resetting torque. Binds in the armature pivot of devices employing oil displacement type dashpots are generally detected by the armature failing to fully reset following a partial "timing out" operation (such as may occur from a motor starting operation). On the next overload the partially closed air gap causes premature tripping. (Generally considered a fail safe condition.)

c. Visually check for missing hardware, clamping devices, evidence of leaking oil, broken cases, cracked breaker trip paddles. On oil film (sticky disc) devices and Grade B timers, the condition of the oil should be observed and changed if necessary. Se maintenance manual for acceptable cleaning methods and type of oil.

Overcurrent Check:

If desired, an overcurrent test can be made to assure the breaker will trip on overcurrent. The purpose of overcurrent testing of trip devices in the field should be to determine if the breaker will perform as required for that circuit to which it is applied. Since the trip device exhibits its lowest trip force levels when encountering low levels of overcurrent, an indication of adequate trip device performance can generally be assured by making an overcurrent check at approximately 150 to 300 percent of coil rating as shown in Table I. On dual magnetic trip devices, the armature and pivot pin is common to both the long time delay feature and the instantaneous trip. If the force generated across the air gap is sufficient to attract the armature for slight overcurrents in the long time region, tripping on short circuit by the same armature is assured. As the armature times toward the closed air gap position, the force across the air gap increases high enough to stretch the instantaneous spring and exercise the instantaneous trip parts. Similarly, the short time armature on selective trip devices is on the same pivot as the long time armature and the iron structure is comparable. Therefore, checking the long time delay feature affords reasonable assurance of all features successfully performing their trip functions. The long time delay pick-up should be set at 100% current.

Overcurrent Test Equipment:

In addition to being capable of producing current levels approximately 300% of trip coil rating, the current must be reasonably sinusoidal. Since overcurrent trip devices are designed to saturate slightly above continuous rating to avoid destructive forces at short circuit levels of overcurrent, the devices represent a non-linear impedance at current levels recommended for time delay testing. If the trip device represents the predominant impedance in the test circuit, a non-sinusoidal current wave shape results. To maintain a reasonably sinusoidal wave shape of current, air core reactance should be inserted in the series circuit. The air core reactance must represent the predominant reactive (and linear) impedance to minimize the effect of the trip device impedance. Insertion of this additional impedance in turn requires an increase in test voltage. The minimum external impedance requirement varies for each coil size. The smaller the rating of the trip coil, the higher becomes its impedance, the more external impedance is required, hence the higher the required source voltage. Rather than specify the external impedance required for each coil rating, it is more convenient to indicate the open circuit voltage required for various coil ratings. The

external impedance can then be inserted as required to control the test current. Figure 1 shows these open circuit voltage requirements for various coils. This voltage can be quickly checked after the current has been set by measuring the voltage with the breaker open and the test set "on" at the level required to produce 300% continuous current.

Test Procedure:

1. With a test set meeting the minimum requirements outlined above and connected securely to the upper and lower studs of one pole of the breaker, set the long time pick-up setting on the trip device to 100%. The relative position of the adjustable time setting of EC-2 type devices should be noted. It is important that time adjusting screw is not forced to the limit of its travel; otherwise binding of the time delay linkage may result.

2. Close the breaker and adjust the current to the degree of over-current listed in Table I for the particular O. C. trip device.

3. Shut off the test set to allow the device to re-set.

4. Re-apply the power and record the trip time in the appropriate test log book.

If repeat tests are attempted, it will be necessary to allow a sufficient cooling time between tests so as not to exceed the thermal capacity of the circuit breaker.

The magnets of some overcurrent trip devices are oriented in such a direction that the flux across the air gap of the device of one pole effects the pick-up of the devices on adjacent poles. Generally, these breakers have correction factors applied to their single phase calibration currents to assure adequate performance when applied on 3 phase circuits. These correction factors should be similarly applied when field checking. Notes on Table I indicate the correction factors to be applied. Test data should be compared with acceptable or specified limits so that discrepancies can be verified immediately.

On completion of the overcurrent trip device test, it is important to carefully reassemble any accessories that were removed to facilitate the overcurrent trip device test or adjustments. Any adjustments to those accessories should be made as directed by the maintenance manual. Careless reassembly of accessories may result in subsequent serious damage to the breakers and the circuits they protect.

Test Results:

The trip time measured for the trip device at the recommended overcurrent condition should be compared with the factory trip curve for new devices. In view of the wide variation in the parameters responsible for the apparent degree of time delay from a trip device, tripping times will often exceed the band width shown on the characteristic curves. These variations can be caused by variations in the current wave produced by test equipment, wide deviations in ambient temperature or high oil temperature caused by repetitive testing. Field adjustments, if necessary, should be confined within the adjustable range designed into the device for field adjustments. Replacement parts (other than cases or clamping hardware) are not generally available for overcurrent devices. When replacement devices are required, complete nameplate information extracted from the overcurrent trip device and the involved breaker should accompany the order.

TABLE I

Breaker Type	Type Overcurrent Trip Device	Test Current in Percent of L.T.D. Pick-up *
AL-2	Oil film (sticky disc)	150
	Grade B	150
AK-15/25/50	EC-1	150
AK-15/25/50	EC-2, EC-2A (inst. 4X)	150
AK-15/25/50	EC-2, EC-2A (inst. 6X or higher)	300
AK-1-75-100	EC-1	150 **
AK-2-75-100	EC-1A, EC-1B	150 ***

* Pick-up set at 100% of trip device rating.

** Characteristics having XX suffixes should have 147% correction factored into current. Correction factors for YY characteristics are 160% on left and right poles and 187% on center poles.

*** Correction factors of 93 and 107% for left and right poles respective must be factored into test currents.

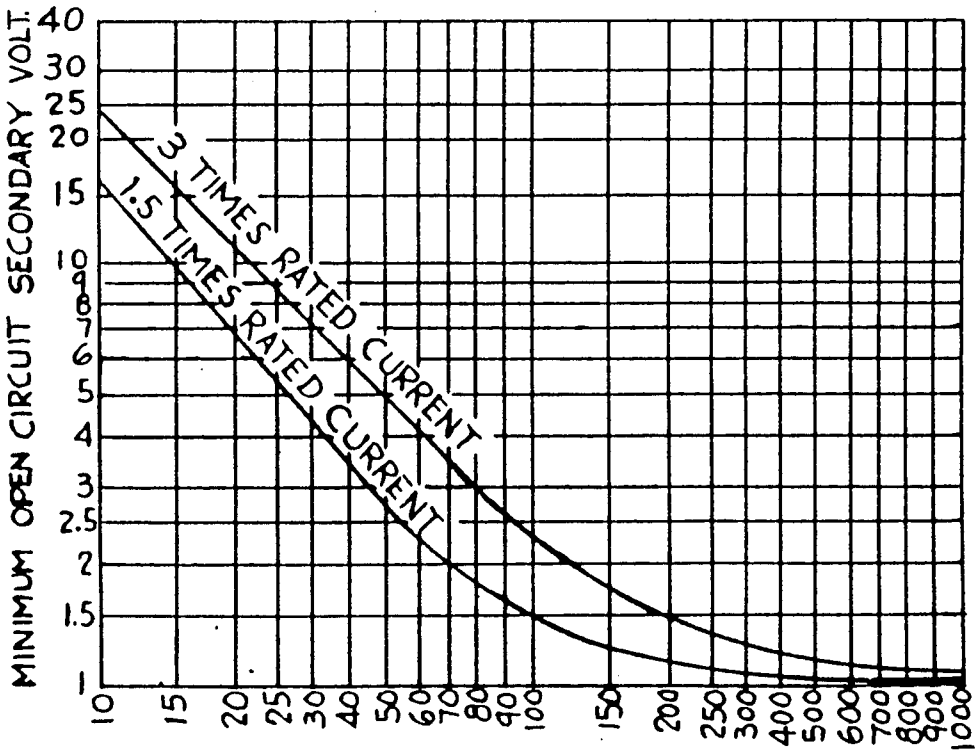

FIG-1